

BUILDING SCIENCE GLOSSARY

Thermal Terms

Absorption: Refers to the taking up of water in bulk by matter (such as insulation); penetration of water into the insulation. Also see **Sorption**.

Adsorption: Refers to the surface retention or adhesion of a very thin layer of water molecules to the surfaces of a material (such as insulation) with which they are in contact. Also see **Sorption**.

Approved: Acceptable to the authority having jurisdiction.

Authority having jurisdiction: The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

ASJ (All Service Jacket): A reinforced white kraft paper and aluminum foil laminate with the white kraft facing outward.

Blanket (insulation): A relatively flat and flexible insulation in coherent sheet form furnished in units of substantial area.

Board (insulation): Semi-rigid or rigid insulation preformed into rectangular units having a degree of rigidity particularly related to their geometrical dimensions.

British thermal unit (Btu): The heat required to raise the temperature of a pound of water 1°F.

Celsius (formerly Centigrade): A thermometric scale in which the freezing point of water is 0°C and its boiling point 100°C at normal sea level atmospheric pressure (14.7 psi).
 $C = (\text{°F} - 32) / 1.8$.

Condensation: The changing of vapor to liquid by extracting heat.

Conductance, thermal (C): The time rate of steady state heat flow through a unit area of a material or construction induced by a unit temperature difference between the body surfaces.
 $C = \text{Btu} / \text{hr} \cdot \text{ft}^2 \cdot \text{°F}$
 $C = (\text{W} / \text{m}^2 \cdot \text{°C})$

Conductivity, thermal: The time rate of steady state heat flow through a unit area of homogeneous material induced by a unit temperature gradient perpendicular to that unit area.

$$k = \text{Btu} \cdot \text{in} / \text{hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}$$

$$\lambda = (\text{W} / \text{m} \cdot ^\circ\text{C})$$

Density: The mass per unit volume of in place thermal insulation.

Dew point temperature: The temperature at which condensation of vapor in a space begins for a given state of humidity and pressure as the vapor temperature is reduced; the temperature corresponding to saturation (100% relative humidity) for a given absolute humidity at constant pressure.

Economic thickness (of insulation): That thickness which provides the lowest possible annual cost of energy, insulation, and energy producing equipment.

Emittance: The ratio of the radiant flux emitted by an ideal, perfect emitter and absorber of thermal radiation at the same temperature and under the same conditions.

Facing: A protective and/or decorative surface applied as the outermost layers of an insulation system.

Fahrenheit: A thermometric scale in which 32°F denotes freezing and 212°F the boiling point of water under normal sea level atmospheric pressure of 14.7 psi.

Fire resistance rating: The time, in minutes or hours, that materials and assemblies have withstood a fire exposure as established in accordance with the test procedures of NFPA 251, ASTM E 119, or UL 723, Standard Methods of Tests of Fire Endurance of Building Construction and Materials.

Flame spread index: A number or classification of a material determined in accordance with NFPA 255, ASTM E 84, or UL 723, Standard Methods of Tests of Surface Burning Characteristics of Building Materials.

FSK (foil scrim kraft): A glass scrim reinforced vapor retarder laminate of aluminum foil and kraft paper bonded together with a fire retardant adhesive. The foil side faces outward to present a neat metallic surface finish.

Heat flow: The rate at which heat moves from an area of higher temperature to an area of lower temperatures.

$$\text{Btu/hr (W/hr)}$$

Heat flow is generally used to quantify the rate of total heat gain or heat loss of a system.

Homogenous material: A material in which relevant properties are not a function of the position within the material.

Humidity: The mass of water vapor per unit volume. Also see Relative humidity.

Jacket: A form of facing applied over insulation. It may be integral with the insulation, or field-applied using sheet materials.

Limited combustible material: A building construction material not complying with the definition of noncombustible material, which, in the form in which it is used, has a potential heat value not exceeding 3500Btu/lb (8141 kJ/kg) and complies with one of the following: (1) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of (0.32 cm), that has a flame spread index not greater than 50; (2) Materials, in the form and thickness used, other than as described in (1), having neither a flame spread index greater than 25 nor evidence of continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame spread index greater than 25 nor evidence of continued progressive combustion.

Listed: Equipment, materials, or services included in a list published by an organization acceptable to the authority having jurisdiction and concerned with evaluation of products or services and whose listing states either that the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

Loose fill (insulation): Insulation in granular, nodular, fibrous, powdery, or similar form designed to be installed by pouring, blowing, or hand placement.

Mean temperature: The arithmetic mean between hot and cold surface temperatures of an insulated pipe, duct, or vessel.
 $t_m = (t_1 + t_2) / 2$.

Noncombustible material: A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat when tested in accordance with ASTM E 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C.

PSK (poly scrim kraft): A vapor retarder laminate of polypropylene, scrim (reinforcement), and kraft construction. The white polypropylene surface faces outward to present a smooth, bright white finished appearance.

Perm: The mass rate of water vapor flow through one square foot of a material or construction of one grain per hour induced by a vapor pressure gradient between two surfaces of one inch of mercury or in units that equal that flow rate.

Relative humidity: The ratio of the mole fraction of water vapor present in the air to the mole fraction of water vapor present in saturated air at the same temperature and barometric pressure.

Resistance, thermal, R (metric: RSI): The reciprocal of thermal conductance.

$$R = \text{hr} \cdot \text{ft}^2 \cdot \text{°F} / \text{Btu}$$

$$\text{RSI} = (\text{m}^2 \cdot \text{°C} / \text{W})$$

Smoke developed index: A number or classification of a material determined in accordance with ASTM E 84, Standard Test Method of Surface Burning Characteristics of Building Materials, that measures visible smoke.

Sorption: Refers to the taking up and holding of water by various processes such as absorption and adsorption.

Water vapor diffusion: The process by which water vapor spreads or moves through permeable materials caused by a difference in water vapor pressure.

Water vapor permeability: The time rate of water vapor transmission through unit area of flat material of unit thickness induced by unit vapor pressure difference between two specific surfaces, underspecified temperature and humidity conditions.

Water vapor permeance: The time rate of water vapor transmission through unit area of flat material or construction induced by unit vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions.

Water vapor pressure: The pressure of water vapor at a given temperature. Also, the component of atmospheric pressure contributed by the presence of water vapor.

Water vapor resistance: The steady vapor pressure difference that induces unit time rate of vapor flow through unit area of a flat material (or construction that acts like a homogeneous body) for specific conditions of temperature and relative humidity at each surface.

Water vapor transmission rate: The steady water vapor pressure difference that induces unit time rate of vapor flow through unit area and thickness of a flat material (or construction that acts like a homogeneous body) for specific conditions of temperature and relative humidity at each surface.

Water vapor retarder: A material or system that adequately impedes the transmission of water vapor underspecified conditions.

Acoustical Terms

Acoustical material: Any material considered in terms of its acoustical properties. Commonly and especially, a material designed to absorb sound.

Airborne sound: Sound which arrives at the point of concern, such as one side of a wall, by propagation through air.

A-weighted sound level (dB): The most common single number rating system for measuring the loudness of a noise. It may be read directly on most sound level meters by selecting the designated scale. It is obtained by applying the A-weighted frequency response curve to the measured sound. The response curve is indicative of the way humans respond to different frequencies.

Attenuation: The sound reduction process in which sound energy is absorbed or diminished in intensity as the result of energy conversion from sound to motion or heat.

Decibel (dB): The term used to identify ten times the common logarithm of the ratio of two like quantities proportional to power or energy. (See **Sound transmission loss**.) Thus, one decibel corresponds to a power ratio of (10 to the 0.1 power) to the n power. Note: Since the decibel expresses the ratio of two like quantities, it has no dimensions. It is, however, common practice to treat “decibel” as a unit, as for example in the sentence: “The average sound pressure level in the room is 45 decibels.”

Direct sound field: The sound that arrives directly from a source without reflection.

Field sound transmission class (FSTC): A single number rating derived from measured values of field transmission loss in accordance with ASTM Classification E413, Determination of Sound Transmission Class. It provides an estimate of the performance of the partition in certain common sound insulation problems.

Field transmission loss (FTL): Of a partition installed in a building, in a specified frequency band, the ratio, expressed on the decibel scale, of the airborne sound power incident on the partition to the sound power transmitted by the partition and radiated on the other side.

Flanking transmission: Transmission of sound from the source to a receiving location by a path other than that under consideration.

Frequency (Hz): The number of cycles per second measured in units of Hertz (Hz). A frequency of 1000 Hz means 1000 cycles per second.

Impact Insulation Class (IIC): A single number rating derived from measured values of normalized impact sound pressure levels in accordance with Annex 1 of ASTM Method E 492, Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine. It provides an estimate of the impact sound insulation performance of a floor-ceiling assembly.

Insertion loss: Of a silencer or other sound-reducing element, in a specified frequency band, the decrease in sound power level, measured at the location of the receiver, when a sound insulator or sound attenuator is inserted in the transmission path between the source and the receiver.

Noise: Unwanted sound.

Noise isolation class (NIC): A single number rating derived from measured values of noise reduction as though they were values of transmission loss, in accordance with ASTM Classification E 413, Determination of Sound Transmission Class. It provides an estimate of the sound isolation between two enclosed spaces that are acoustically connected.

Noise reduction (NR): In a specified frequency band, the difference between the space-time average sound pressure levels produced in two enclosed spaces or one of them. Note: It is implied that in each room individual observations are randomly distributed about the average value, with no systematic variation with the position within the permissible measurement region. Noise reduction becomes meaningless and should not be used in situations where this condition is not met.

Noise reduction coefficient (NRC): A single number rating derived from measured values of sound absorption coefficients in accordance with ASTM Test Method C 423, Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method. It provides an estimate of the sound absorptive property of an acoustical material. NRC values range from near 0 for hard, reflective materials such as flat glass and gypsum board to 1.2 for several inches of highly efficient fiberglass boards.

Outdoor/Indoor Transmission Loss (OITL): Of a building facade, in a specified frequency band, ten times the common logarithm of the airborne sound power incident on the exterior of the facade to the sound power transmitted by the facade and radiated to the interior. The quantity is expressed in decibels.

Octave band: A range of frequency where the highest frequency of the band is double the lowest frequency of the band. The band is usually specified by the center frequency.

Reverberation: The persistence of sound in an enclosed or partially enclosed space after the source of the sound has stopped.

Sabin (L2): The unit of measure of sound absorption in the inch-pound system (i.e. 1 sabin = 1 dB/ft²).

Sound absorption: (1) The process of dissipating or removing sound energy; (2) The property possessed by materials, objects, and structures (such as rooms) of absorbing sound energy.
Note: Sound energy passing through a wall or opening may sometimes be regarded as being absorbed.

Sound absorption coefficient (α) (dimensionless): Metric sabin/m² of a surface, in a specified frequency band, the measure of the absorptive property of a material as approximated by ASTM Test Method C 423, Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method. Ideally, the fraction of the randomly incident sound power level absorbed or not otherwise reflected.

Sound Isolation: Lack of acoustical connection. There are basically two ways to achieve a degree of sound isolation:

- (1) By insulation, preventing the sound from reaching a receiving location;
- (2) By attenuation, reducing sound intensity as it travels toward a receiving location.

Sound pressure level (Lp): Of airborne sound, ten times the common logarithm of the ratio of the square of the sound pressure under consideration to the square of the standard reference pressure of 20 mPa. The quantity so obtained is expressed in decibels.

Sound transmission class (STC): A single number rating derived from measured values of transmission in accordance with ASTM Classification E 413, Determination of Sound Transmission Class. It provides an estimate of the performance of a partition in certain common sound insulation problems.

Sound Transmission Loss (TL): Of a partition, in a specified frequency band, ten times the common logarithm of the ratio of the airborne sound power incident on the partition to the sound power transmitted by the partition and radiated on the other side. The quantity so obtained is expressed in decibels.

Note: Unless qualified, the term denotes the sound transmission loss obtained when the specimen is exposed to a diffuse sound field as approximated in reverberation rooms meeting the requirements of ASTM Test Method E 90, Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

Structure borne sound: Sound that arrives at the point of concern by propagation through a solid structure.

Pre-engineered Metal Building Terms

Bay: The space between frame center lines or primary supporting members in the longitudinal direction of the building.

Beam: A primary member, usually horizontal, that is subjected to bending loads. There are three types: simple, continuous, and cantilever.

Beam and column: A primary structural system consisting of a series of rafter beams supported by columns. Often used as the end frame of a metal building system.

Butt plate: The end plate of a structural member usually used to rest against a like plate of another member in forming a connection.

Column: A primary member used in a vertical position on a building to transfer loads from main roof beams, trusses, or rafters to the foundation.

Curtain wall: Perimeter wall panels which carry their own weight and wind load.

Eaves: The line along the side wall formed by the intersection of the planes of the roof and wall.

Eaves strut: A structural member at the eaves to support roof panels and wall panels. It may also transmit wind load forced from roof bracing to wall bracing.

End wall frame: A frame at the end wall of a building to support the roof load from half the end bay.

End wall post: A secondary column at the end of a building to support the girts and, in a beam-and-column end wall frame, to additionally support the rafter.

Flange: The projecting edge of a structural member at either end of the web.

Framing: The primary and secondary structural members – columns, rafters, girts, purlins, brace rods, etc. – which go together to make up the skeleton of a structure to which the covering can be applied.

Girder: A main horizontal or near-horizontal structural member that supports vertical loads. It may consist of several pieces.

Girt: A secondary horizontal structural member attached to side wall or end wall columns to which wall covering is attached and supported horizontally.

Knee brace: A diagonal brace designed to resist horizontal loads usually from wind or moving equipment. The lower end is normally connected to a column and the upper end connected to an eaves strut.

Masonry: Any construction using materials such as bricks, concrete blocks, ceramic blocks, and poured concrete.

Pier: A concrete structure designed to transfer load from the base of a column to a footing.

Primary members: The main load carrying members of a structural system, including the columns, end wall posts, rafters, and other main support members.

Purlin: A secondary horizontal structural member attached to the primary frame which transfers the roof loads from the roof covering to the primary members.

Rafter: A primary beam supporting the roof system.

Rake: The intersection of the plane of the roof and the plane of the gable.

Rake angle: Angle fastened to purlins at rake for attachment of end wall panels.

Ridge: Highest point on the roof of the building which describes a horizontal line running the length of the building.

Sandwich panel: A panel assembly used as covering consisting of an insulating core material with inner and outer skins.

Secondary members: Members which carry loads to the primary members. In metal building systems, this term includes purlins, girts, struts, diagonal bracing, knee braces, and other miscellaneous framing.

Strut: A brace fitted into a frame work to resist forces parallel to its length.

Stud: A vertical wall member to which exterior or interior covering or collateral material may be attached. It maybe either load bearing or non-load bearing.

Thermal block: A spacer of low thermal conductance material (insulation) usually placed over purlins where metal building insulation will be compressed.



Truss: A structure made up of three or more members, with each member designed to carry a tension or compression load. The entire structure acts as a beam.

Web: That portion of a structural member between the flanges.

References

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