

# Principles of material selection and method of installation of textile diffusers

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Designer, deciding to leave the comfort of designing software and enforcing the use of textile diffuser, must carry-out some extra work. He/she should be acquainted himself/herself with terms, which he/she as air conditioning engineer does not need in any other cases; they are rather from the textile field. Most manuals involved in the ventilation still ignore textile diffusers, hence losing touch with the reality. Textile air distribution systems are becoming to be more and more spread and there are no signs of the change of this trend. The objective of this article is to explain several basic essential terms, which you can not find in any literature.

## Material selection

Designer is not responsible for the quality of used material; nevertheless he/she shall specify clear requirements to basic characteristics. Designer should define following 6 characteristic features or should recommend producer, complying with his/her requirements. Unless done so, the investor can be disappointed by product not providing the full service

**1/** As completely essential it is necessary to realize the **difference between non-woven textile and fabric**. Both of them can be used for the manufacturing of functional diffuser. Identically to the case that all mushrooms are edible, but some of them only once, non-woven textile can be washed, but , not more than once. In contrast, quality fabric shall endure 50 washing cycles as minimum.

**2/** Certain quantity of microorganisms shall be always found inside textile diffuser after certain period of the operation. They do not have any influence over the fabric in case it is **100% synthetic**, natural material shows significantly shorter durability.

**3/** Fabric can be produced either from silk or staple; foreign and more illustrative terms are **monofilament or multifilament**. Continuous filament (rayon yarn) is more suitable for the air distribution. It can guarantee zero fly of particles during the operation. Fibers twined from thousands of small pieces (staples) release small particles, which can be seen even by eye. Diffuser from staple material seems to be hairy after several weeks of the operation. Tests proved that silk materials can be even used in clean rooms up to the class no. 4 (EN ISO 14644-1).

**4/** Air-tightness of the material can be achieved by special treatment; untreated textile always leaks some air flow. This **permeability** can oscillate in large range, from 0 to aprox. 2500 m<sup>3</sup>/h/m<sup>2</sup> with overpressure 120 Pa. The more permeable material, the more instable and susceptible to damage. Achieving of required permeability by means of micro-perforation is very effective. Dependency between flow (permeability) and overpressure for fabrics is nearly linear in the technically most frequently used pressure intervals (50 250 Pa). By simple consideration we can deduce that long diffusers (with large surface) demands low permeability, short diffusers the high one. Higher overpressure decreases the demand to permeability, the lower then increases it. Use of completely airtight material is usually necessary for long diffusers so as to maintain needed static pressure for their formation. In such case the air is distributed via exact quantity of small holes. Already minimal permeability shall prevent the formation of the condensate on the surface of the diffuser.

**5/ Weight** of used fabrics ranges from 70 to 700 g / m<sup>2</sup>. At the same time, heavier material is usually stronger, more durable and more expensive. As optimum can be considered **approximately 300 g / m<sup>2</sup>**, but there are many satisfied users of the lightest materials or, on the contrary, the heaviest ones. Each installation sets another requirements also to strength of the fabric. **Strength** is specified in Newton acc. to EN ISO 13934-1, always in two directions warping / weft, which are two mutually vertical directions along and across the roll of the fabric. Safe against any stress are values exceeding 2000 / 1000. Quite frequently used materials with values around 500 / 500 incline to ripping.

**6/ Fire-resistance rating** of the diffuser represents very important question. Firstly, it is necessary to highlight that it is really a distribution element, not piping, as some fire-fighter might assume. In my view, classification into three groups can be used. Usually even the ordinary person can classify the sample into one of them. It is sufficient to set the sample into fire (in well vented place!) and monitor its burning.

**A/ Without fire-resistance rating.** The most commonly used materials can be classified into this group, such as polyester, polypropylene, polyester with PVC and polyethylene. The burning will not stop after the setting into fire, material can drop away. This particular group can be used in places with zero requirements to fire-resistance rating. There are many such premises (even most of them) as the diffusers usually represent secondary element in the whole equipment of the room.

**B/ With increased fire-resistance rating.** Various modified polyesters belong to this group (Trevira CS being the most famous), then airtight fabrics with various inflammable treatment f.e. polyester with PVC and admixture of antimony. After setting into fire, these materials shall flame out spontaneously; they do not drop away and do not develop any dangerous smoke. This corresponds with the classification acc. to EN 13501-1: 2002 B-s1, d0. Of course, they are more expensive; they should be used only in such cases when investor or any standard clearly specifies the requirement to increased fire-resistance rating of textile diffusers.

**C/ Completely inflammable materials** have brilliant properties and astronomic prices, the most re-known being Nomex and Aramid. The only alternative - more favorable from price point of view - is fiberglass with polyurethane or silicone coating. As results from the title of this group, it is not possible to set these fibers on fire. Their use is based on the strict requirement of the instruction, which allows only inflammable materials in the particular room.

## Installation method

It is necessary to state again that designer is not responsible for materials and structures used by producer; nevertheless, he/she should know factual structural solution and know whether it shall guarantee desired function. I assume as essential that producer of fabric diffuser delivers complete installation material.

**7/** Textile diffuser can be installed by means of **wires or profiles**. Profiles shall keep the diffuser really horizontally without sagging; we can clearly recommend them. They must have sufficient rigidity, be sufficiently enough anchored to the roof, and be produced from quality material. For example plastic profiles with respect to their low rigidity can not be usually suspended at all, and they can be only directly anchored into the roof or wall. Stainless steel ledges are inadequately expensive and zinc-coated can not be used in the corrosion environment. **Aluminum** seems to be the ideal material. Profiles are usually delivered in maximal length 6 m and individual parts shall be accurately and firmly connected by means of proper couplings (see picture 1). Installation with wires is cheaper, but the wire especially with longer distance can not be sufficiently stretched (see photographs 1 and 2). I.e., it will be used for such cases where the sagging of the wire and as a consequence the waving does not matter. Wire can be twisted, from stainless steel or minimally zinc-coated with plastic coating. Wire without plastic keeps more dirt; on the contrary, zinc-coated wire can corrode, though covered with plastic. The ideal is then stainless steel with plastic surface; unfortunately, I do not know any such producer.

**8/** Diffuser shall be attached to supporting wire or profile by means of **hooks or longitudinal belt** stitched along its whole length. This is the way how to achieve the best image. Only tightening ring can surpass a.m. solution; if sewn into blinded end and tightened against strong structure it keeps its shape (see photograph 3). No other installation material except this stretching device is necessary for short diffusers.

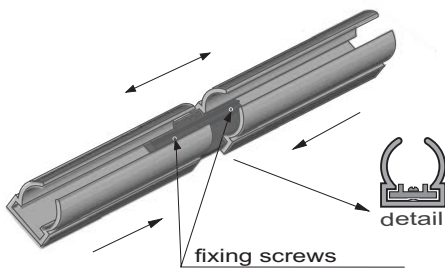
**9/** Either **single or doubled** suspension can be selected. Diffuser, suspended in a single suspension with the fan closed, hangs practically vertically as the laundry in the clothesline. Especially in case of higher diameters the bottom of the fabric falls significantly under the bottom edge in high-blown status. Doubled-suspension shall remove such problem; nevertheless, double-sided long hooks can disturb the design. For short diffusers (up to 10 m) is clearly the best solution (from price, image and technical point of view) the straining of rings in blinded end.

**10/ Reinforcement rings** represent special chapter (see photograph 4). On one hand, they prevent deflation of the diffuser in case of switching-off of the air supply; on the other hand, the whole diffuser is then far more expensive. Producer must attach the rings in such a way so as their easy dismantling is possible, as well as re-setting. This operation complicates necessary maintenance, and the rings can not be recommended for places with the necessity of frequent washing. For plastic rings, their material should have necessary rigidity and fire-resistance rating.

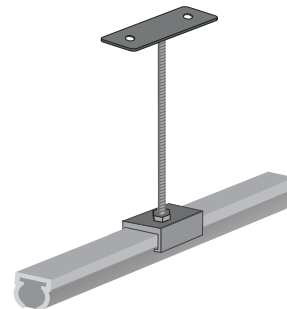
**11/** Person installing the equipment should follow exactly the **mounting instruction** as well as should use the common sense. Each installation is an original in its way. The fitter should pay enough attention to the fact whether strings or profiles are really straight and without sagging. Furthermore, installation usually does not take place in clean area and the fabric is very susceptible to dirt during the installation. Supervisor should take it into consideration. Technology of textile diffusers does not demand authorized erection and is very easy; however, it must not be underestimated. As valid for many other cases, one detail can deteriorate the whole result.

The objective of this article was to specify principles for defining of the fabric of textile diffuser and selection of the correct installation. By their use can be specified conditions for suppliers, and at the same time provided base for the investor for the checking of the delivery. Inspection of above-mentioned eleven points gives good pre-requisite for correct function of textile air distribution system. I believe that extra necessary work worth it, as project investor will be satisfied with saved financial means and good function of the equipment.

In Hlinsko, 31. 8. 2005, Zdeněk Příhoda



1. Connecting of parts of the profile by means of couplings



2. Suspension of aluminum profile by means of threaded rod



1. Installation with correctly tightened wire



2. Installation with insufficiently tightened wire



3. Strengthening ring



4. Internal part of diffuser with reinforcement rings