

Basics of Dynapore® Laminate Design for Spark, Flame & Detonation Arrest

Dynapore® diffusion-bonded multiple-layer woven wire mesh laminates have been successfully used in spark, flame and detonation arresters, as well as a wide variety of other gaseous applications where controlled permeability to flow, high surface area, or mass transfer capability are desired. In addition, Dynapore® is used in gas sparging, fluidizing, filtration and dedusting, transpiration cooling, acoustic attenuation, and many other applications.

For flame arrest and related applications, the most commonly employed laminates are those comprising two or more layers of plain square weave wire meshes. A plain weave is one in which uniformly spaced wires run in each of two perpendicular directions (warp and fill, or shute, wires) with wires passing alternately “over one and under one.” The weave is “square” if the number of wires in each direction is the same.

A plain square weave mesh is typically specified by two numbers: the mesh count in wires per inch, and the wire diameter. For example “16x.018” refers to a plain square weave mesh with 16 wires per inch in each direction, with a .018” wire diameter. For each standard mesh count, there are various possible wire diameters. However, there is a standard “market grade” in most cases. So for example, merely referring to “16 mesh” would imply the standard market grade, which employs a .018” diameter wire.

Typically, spark arrest laminates may contain two to five layers of market grade meshes, while flame or detonation arrest laminates typically contain anywhere from five to twenty or more layers, and may range up to 0.50” or greater thickness, and up to 36” seamless diameter. Larger area structures may be fabricated using joining techniques such as welding.

If two layers of identical mesh are superimposed, there is a possibility in one case that the holes of one layer would line up precisely over the holes of the second layer, while in another case the holes of the first layer might line up precisely over the wire intersections of the subsequent layer. These two cases would exhibit markedly different pore sizes and permeabilities. In order to eliminate this possibility, it is good practice to vary either the angular orientation of the layers, or the mesh count of each successive layer.

For example, it would not be recommended to stack ten layers of 20 mesh with the same wire orientation in each layer. Instead, one might rotate each successive layer by 22.5°, 30° or 45°. Note that a plain square weave mesh exhibits a rotational symmetry every 90°. Another approach might be to alternate layers of two or more meshes, e.g. 20/30/20/30, etc. It is ideal if the greatest common denominator is small, i.e. the mesh counts are nearly relatively prime, to prevent phasing issues.

One ideal approach might be to use both methods, alternating meshes and angles. For example two meshes might be alternated in a sequence of three angles, with the result that repetition only occurs every sixth layer, as follows:

	Layer	Mesh	Angle
→	1	20	0°
	2	30	30°
	3	20	60°
	4	30	0°
	5	20	30°
	6	30	60°
→	7	20	0°

In general, the alternating meshes method is somewhat less expensive, as cutting the layers at various angles requires more labor and also wastes a certain amount of the raw materials. Cutting at 45°, for example, sometimes results in a scrap loss of up to 50%.

The choice of meshes should depend on the desired effective hydraulic diameter, or straight-through pore size. In reality, most flow paths through Dynapore® will be tortuous in nature, and calculations of effective pore size are approximate in nature. In a separate paper, we discuss the calculation of effective pore size when two or more layers of plain square weave meshes are superimposed. This calculation assumes that one is using either alternating angles or meshes, to avoid the problem mentioned above.

Once the diameter is specified, and correlated to an approximate mesh size, it is reasonable to specify either an alternating angles laminate using a mesh with the correct pore size, or an alternating meshes laminate using a mesh finer than the specified pore size in combination with a mesh coarser than said pore size (to maximize permeability).

Thus for a particular effective hydraulic diameter, we might recommend various choices, such as 18 mesh at alternating angles, or a laminate with alternating 16 and 20 meshes. The number of layers, and thickness of the laminate, should depend on the desired mass and pressure drop. Note that a given laminate can be compressed to lower thickness by calendering, thus yielding increasing pressure drop. Therefore, each internal Dynapore® laminate specification includes thickness and flow information for absolute repeatability.

Our engineering staff is always available to help specify and recommend Dynapore® laminates for your flame, spark or detonation arrest applications.

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