

NOMEX®
only by DuPont



CASE HISTORY

NOMEX® THERMAL TECHNOLOGY SERVING WIND GENERATORS BY FMV

The French designer and manufacturer of industrial ventilators FMV (Française de Motoventilateurs) replaced their 3-ply DMD insulation with a 2-ply NOMEX® paper/polyester (NM), to insulate the bottom of the slots found in their asynchronous engines, with which their entire ventilator product range is equipped.

In collaboration with the French company MICEL in Saint-Chemond, FMV developed an alternative technology, enabling them to achieve a reliability rate of more than 99% and to double the life span of their products, amongst other advantages.

Designed for use in particularly stringent operating environments, these 20 W and 5kW ventilator engines, manufactured by FMV, are used in hot air production, refrigeration, air treatment, cooling of industrial equipment and the ventilating of industrial and agricultural installations.

The operating conditions which this equipment undergoes, such as extreme temperature environments (-40°C to +90°C) and in particular the imposing operating cycles often consisting of up to 100 start-ups per hour, is directly responsible for the premature aging experienced. This occurs when the conventional insulation materials which are traditionally used in these electric engines, heat up. The possible mechanical weaknesses arising from these circumstances could prove extremely expensive, not to mention dramatic. For instance, a breakdown in a supermarket's refrigeration storage installation or that of vital hospital equipment, a ventilation systems shutdown in a greenhouse or poultry pen, or a breakdown of the cooling system of industrial laser-equipped machines. In all these applications, the reliability of the ventilator's engine depends to a large extent on the insulations performance capability. The latter also plays a significant role regarding the expected service life span of the engine, as

replacing these installations represents a considerable maintenance and investment expense.

A traditional 3-ply DMD (a 3-ply structure based on fibre and a mat of polyester) adept, FMV decided in 1998, following in-depth trial runs on dielectric performance and the aging of materials, to adopt the 2-ply NOMEX® paper/polyester film for utilization in the slot insulation of their engines, manufactured at their Villieu (Ain) facility. This decision was made with the aim of further improving the overall reliability, which was already of a high standard, of FMV's products. Christian Perrot, FMV's company quality manager, emphasized the fact that, "At FMV, quality standards and related procedures are not perceived as a constraint, but rather an opportunity for innovation and creativity". It is in direct response to this, that FMV took the step towards adopting the NOMEX® thermal technology.

PERFORM WHEN THE HEAT'S ON



Reliability test bed - loading predictions

The class "F" engines, manufactured by FMV for its ventilators, operate at internal temperatures of 150°C, peaking at 180°C. At these temperatures, DMD's 3-ply insulation structures are unable to provide a sufficient safety margin ensuring a requisite reliability, which is an essential factor owing to the often stringent and extreme operating environment of these industrial ventilators. By ensuring, up to 200°C and over, and unchanging dielectric performance and in particular its superior (anti-) aging stability, NOMEX® in the 2-ply NM structure guarantees this requisite reliability. The decision to use NOMEX® paper as an insulation was supported by laboratory tests, during which the material was subjected to a continuous oven temperature of 180°C for 96 hours at 3100 volts (CEI 626) without it showing the slightest dielectric or mechanical default. Subsequent testing over a period of 500 hours still gave no sign of a breakdown in the material. This performance data was confirmed during endurance tests which simulated aggravated operating conditions, such as when due to an obstructed rotor-blade, the engine's internal temperature rose up to 240°C, while operating at 300 start-ups per hour.

For FMV, with an operating failure rate of less than 0.04% and particularly with an average life span of 2,680 hours versus 1240 hours

previously, the direct consequences of switching to the 2-ply NOMEX®/polyester paper were extremely positive and considerably improved the overall image of FMV's products.

Now FMV's decision to adopt the 2-ply NOMEX®/polyester insulation proved to have other benefits – both industrial and economic. By reducing the thickness of the insulation



The new Compact range is highly temperature tolerant

thickness – from 0.25 mm (10 mils) for DMD to 0.18 mm (7 mils) with NOMEX®/polyester and thus the space used at the bottom of the slot, the material's flexibility and smoothness of NOMEX® contributed to improvements during the manufacturing process, by facilitating the



Asynchronous Motor Range X with metal panel diameter 120 - 160 - 200, 40 watts to 5 kW



Durability, the smart route to reliability

automatic threading of the machines, thus making the enamel less susceptible to damage. As a consequence, FMV reported a reduction of more than 50% in electrical failures during production as well as in end-of-the-line rejects.

In addition to ultra-modern production equipment, the company's "total quality" policy is based on ISO 9000 standards, considerable R&D campaigns along with extensive performance controls of raw materials and finished products. In particular, FMV employed methodical endurance test procedures under real operating conditions and even unusual operating conditions: repetitive intermittent stopping and starting; high and low voltage; frequency fluctuations; excess speed; wear and tear; heavy rain; extreme temperatures (-40°C to +90°C); accelerated aging in salty mist; and prolonged UV exposure. Under these grueling conditions, even the best products have their limitations!

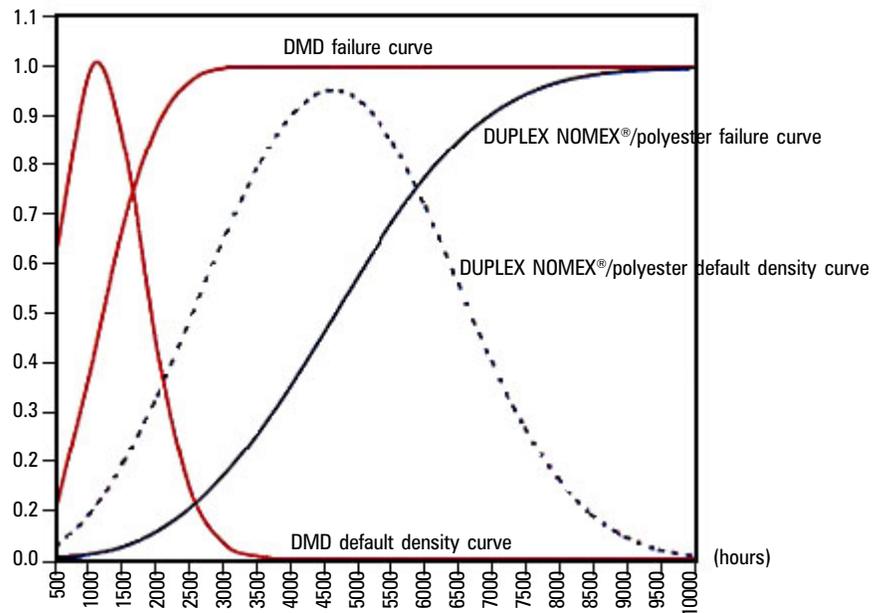
These test results are shown by means of a so-called "failure curve" (also known as a reliability curve) and a "default density curve". The failure curve shows the overall period of total reliability, then the appearance of failures, rare at first and then more frequently. The default density curve shows how the damages are distributed over the average expectation of a tested material.

Ventilators insulated with NOMEX®/polyester insulation are, of course, subjected to these rigorous endurance tests. The curves show the clear superiority of the NOMEX®/polyester product over that of the 3-ply DMD.

Christian Perrot, resumed the benefit of NOMEX®/polyester: "For FMV, this evolution in insulation technology of our engines, constitutes a major leap forward, not only in terms of reliability but also in terms of

competition. Thanks to these technological advantages, to the increased productivity and to cost reductions in the industry afforded by adopting 2-ply NOMEX®/polyester, we are now able to offer our customers, at lower prices, equipment with quasi total reliability and with a doubled service life span. We have also gained a certain innovative flexibility when it comes to the conception of new products, like more compact products, or products with variable speeds. A new opportunity to expand our product range further and to respond better to market needs."

Thanks to its unique combination of electrical, mechanical and chemical properties, NOMEX® paper is the ideal choice for demanding electrical insulation applications at both high and low voltages. NOMEX® contributes to improved reliability, increased operating life span and ease of maintenance of high performance equipment such as motors, transformers, as well as electrical production and distribution equipment. Thanks to its superior performance, NOMEX® enables improvements in product design so as to be able to meet the specific users needs better, particularly in extreme operating conditions.



Failure and Default Density curves for DMD and NM

NOMEX®

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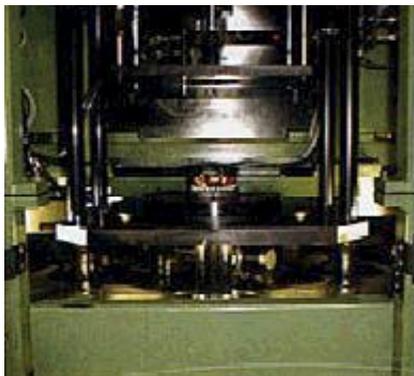
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Compact Range, Improved integration



Winding and insertion of electrical insulation



More flexibility, superior quality, higher speed

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