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THE SCIENCE BEHIND - COOLBLUE

In electronics, a choke is a specially designed inductor used to block high frequency alternating current in an electrical circuit, while passing designed frequency currents. The name "choke" comes from "choking" higher, unwanted, frequencies. In common mode noise situations, such as the noise generated from a VFD, noise is going out simultaneously from all outputs, but also coupling back to earth ground. The only solution is to capture the unwanted noise and keep it from being transmitted and coupling back to earth ground. To do this, high frequency currents should be captured through a magnetic core. **CoolBLUE** is used in this application to provide high impedance at the unwanted high frequency. Common mode currents will cause bearing damage in the motor, and electromagnetic interference which affects control signals, encoder feedback, communication links for programmable logic controllers, Remote I/O, metal detectors, pump monitors, and other types of sensors including, ultrasonic sensors, bar code/vision systems, weight and temperature sensors. Conducted ground current also leads to radiated emissions, with the drive cables acting as antennas.

For a real-world example, that will help you understand this question, and the word "random" used. We tested in a paper making facility in the southeast about 4-5 years ago. There were three X mile long lines, running nearly 24/7 a year. They were experiencing bearing failures (lubrication breakdown, and fluting/pitting /etc.), but more important to them, was what they termed "random" or "ghost" shutdowns of the lines. We could have used any of several terms such as arbitrary, chance, unsystematic, but we chose random, because that is what most field guys call it ... other than "ghost" and I don't believe in ghosts. These particular lines have from \$30k-100k of revenue per hour. Typical rebooting of the lines takes approximately 3 hours. Big dollars.

Also, within these facilities, if you are not familiar, 18" underground is water. Having sufficient earth ground is difficult at best. Our theory, was to try **CoolBLUE** on the VFD's, because of the possibilities of stray ground currents. That was over 4 years ago, and we have not heard of any more "random" line shutdowns. Also, we have an automotive manufacturer. They have six, 600HP motors, all connected to VFD's, controlled via Ethernet. They were getting, termed again by the engineer, "random" system errors. This particular engineer there told us he had used chokes on the VFD's before in Europe, and he wanted to try **CoolBLUE** on his lines here. That was in 2013. No more "random" system errors. We have many, many examples of food



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processing that have errors in their food metal detectors. Mars and Pet Smart in particular were having problems (information on our website (www.coolblue-mhw.com)). They would have to run the system at 75% speed, and still get errors. Since installing **CoolBLUE** chokes, in not one, but many of their plants, they are running full speed with no errors. One last example. We tested in a chemical plant in upstate NY. Two cement block pump houses, 15 meters apart, with exactly the same setup. 75HP motor, less than 10 meters of cabling, and a simple pump monitor. Each running 24 on, 24 off, supplying fresh water from the river to the plant. With just 2 years of operation (new construction), one system has worked flawlessly (no bearing failure, pump monitor working accurately, etc.), the other, 20 meters away, has had 3 bearing failures due to lubrication and fluting, AND, the pump monitor in this facility has never worked. We measured the common mode current with our Rogowski coil and scope and found that both had the same amount of common mode current. We put **Cool BLUE** on both facilities. The system that had the malfunctioning pump monitor, started up immediately, and has worked ever since (2 years ago). What we found, and discussed, was that the one block house with the failures, was built on a huge rock that went down into the ground close to 25 meters. We think, and I emphasize our thoughts only based on information, that this was poor earth grounding. Why one motor failed and the other not failed, even though both had the same amount of current... we don't know but continue to monitor.

All the above examples, and many more, were using shaft diverter rings at times of failures. As for the statement of wanting to know the root cause of shutdowns ... of course. Everyone wants to know this, but again, how many facilities have perfect building ground systems ... you can chase this for days, weeks, months, but my guess is, some are just not looking for grounding. Just think about in the US southeast coastline, Florida, Louisiana, etc., there is water underground ... sometimes inches from the surface. IF the design, and facilities management aren't completely diligent, grounding becomes a major problem.

These cores have been around for 25 years, but applications such as we are finding now have only been within the last 15 years ... mainly in Europe since late 1990's (ABB, Siemens, Danfoss, Grundfoss, Vestas). Quick note, Europe has tight/strict regulations on their power grid. Radiated and conducted emissions are not acceptable. I introduced here in North America in 2010, and only started with end users 3-4 years ago.

Now, on to your statement about "1) Lower end VFD manufacturers that haven't put a lot of output filtering into their products. 2) End-users that purchased lower end VFD's and are now experiencing motor bearing failures **CoolBLUE** choke retrofit, placed as close to the VFD as



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possible (maybe even inside). The chokes would be a cheaper solution than buying/installing a new VFD."

Low end VFD manufacturers? Not clear who would be considered low end. Most VFD manufacturers will not admit to putting out a product that creates noise/common mode currents, but nearly all admit it. If you read the information from ABB and Danfoss you will get a much better understanding of the issues. I've enclosed two documents for your reading.

ABB HVAC drives have cores in almost all their drives. And, the failures are happening more frequently due to (from my understanding speaking with Danfoss, and other drive manufacturers) faster silicon, speeding up the carrier frequency, IGBT design, etc.

I've seen drive motors on Trane air handlers in the field last 10-15 years, and the "same" drive motor combination only last 2 years with the "same" configuration. I tested in an office complex in Charlotte that had Trane the same exact part number air handler, in ten different, 8 story buildings. Some were 12 years old, and still working. Some that were 2 years old and completely gone. All the same Trane part number, but carrier frequency went from fixed 3Khz, to adjustable, and some running at above 8kHz.

We are in one of the largest manufacturers of chillers in the world ... with every new build since 2009 (and screw compressor types since 2014), and with field upgrades. They use, exclusively, Danfoss and Rockwell drives on their chillers. They have not had a failure since 2006 and went back from using ceramic to steel bearings.

Every Vestas wind turbine that has gone out of the factories in both Denmark (over 12 years), and US (in Colorado since 2010) have used **CoolBLUE**. Even in the newer 5-6 Megawatt versions with DC link, use the cores. With that said, we can go to just about any GE wind turbine and hear of problems.

We have two very large motor manufacturers completing testing with our cores and have sent out preliminary statements stating the fact they suggest usage of our cores. Not to mention ALL the VFD and motor manufacturers testing our cores with confidence.

Bill Wilson
MH&W International Corporation