



## ***S2.4.2 - Technical Cleanliness Inspection for Automotive Filtration Industry***

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An important technical specification on a product's manufacturing quality control plan is technical cleanliness. Particulate that is generated during the manufacturing process can impact the performance, durability, and lifespan of the system that the product is placed in. A few or even a single particle can migrate throughout a system and be detrimental for a component such as a high-pressure fuel pump or injector. A technical cleanliness inspection will determine if a product is meeting the official cleanliness requirements. More end-users are requiring suppliers to meet specified cleanliness requirements. As emissions regulations have changed, the technology within the engine evolution has driven tighter tolerances and unique materials being used. These tighter tolerances and unique materials can be susceptible to initial particulate contamination. This has driven cleanliness specifications into markets that ten years ago did not have specifications. For this discussion, we will focus on the ISO 16232 pressure rinsing and internal rinsing via liquid methods. The pressure rinsing extraction method is carried out using a jet of test fluid through a nozzle to remove and collect particulate from the test

component. The internal rinsing extraction method is carried out by flowing liquid through the inner surfaces of a test component to release and capture particulate. Once particulate has been captured, it will be inspected via a gravimetric measurement, particle count, and distribution using light optical analysis, or both. In addition to industry standards, internal standards have been developed at the OEM level with deviations pertaining to fluid type, declining curve determination, and normalization of results, all of which can have an impact on the severity and portrayal of the data. When looking at a cleanliness requirement, there are many things to consider, for instance, hard vs. soft particles, reflective vs. non-reflective, test procedure differences, test fluid differences, etc. Hard particles such as metals, silica, and nylon can be detrimental based on the size of the contaminant, while a soft particle such as a fiber of clothing would not do as much damage. Determining whether particulate is hard or soft through light microscopy alone can be difficult due to the limitations of current equipment available today. For a given product type, the stringency of cleanliness requirements can vary even across similar applications. In a global manufacturing environment, the need to dual source products requires a global quality control plan, which needs to include measurement uncertainty analysis and correlation studies between testing sites. The difficulty of doing this is the availability of common equipment capabilities and facility/ environment differences. These studies need to be completed with a focus on controlling processes, environment and understanding the impact of differences in equipment. A technical cleanliness inspection will be needed to determine a product's ability to conform to a cleanliness requirement. The ability to carry out this type of inspection is increasing in importance as customers are requiring more specifications on products. Further information pertaining to methods and stringency of requirements, as well as measurement uncertainty analysis, will be presented at the spring AFS conference.

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Delonna Lyles is a Laboratory Operations Engineer at Cummins Filtration. In the 11 years, she has spent with Cummins, Technical Cleanliness Inspection has been a significant focus of her work. In addition to her cleanliness work, she assists and oversees laboratory-controlled test processes to evaluate product performance. She has been Six Sigma certified through the Cummins organization. Delonna graduated from Tennessee Technological University with a Bachelor of Science in Chemistry. She then continued her education at Bethel University where she earned her MBA. She enjoys spending time with family, traveling, and watching her children participate in multiple sports. Delonna resides in Cookeville, TN with her husband Lee and their four children.

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