Component Cleanliness Testing:
Methods of Extraction

The method by which a component is extracted when conducting a cleanliness test in accordance with its engineering standard should typically be the most effective and efficient procedure possible. The point of the extraction method is to remove the majority of contamination from a component and prepare the sample for analysis. In the case of many OEMs (Original Equipment Manufacturer) a 90+% reduction of contaminants must be proven to establish and validate the extraction parameters. (See Component Cleanliness Testing: Extraction Validation.) Many standards specifically call out what extraction method to use while others reference longer more detailed specifications like ISO 16232 and VDA 19. This leaves the decision of the most suitable method up to the inspector and manufacturer. Two of the most common methods of extraction are extraction by fluid and extraction by air. In order to determine the best method of extraction many factors must be taken into consideration such as composition of the component, batch size, surfaces of concern, accessibility to the surfaces of concern, type of contamination to be removed, adhesion of the contamination to the component, and the unintentional production of additional debris from the procedure. Examining various procedures by which the component requiring testing could be extracted will lead to prudent decisions in order to sufficiently remove contamination for further analysis.

When it comes to extraction of contaminants by fluid, there are four primary procedures to consider. The most widely used, pressure rinsing, is the extraction of a component's surfaces by washing them with solvent from a pressurized vessel. Extraction by agitation typically involves washing a component's internal cavities with a 30 to 40% solvent volume in relation to total internal volume. Agitation can also be used to extract larger batch sizes of small parts by swirling or stirring. Extraction by Ultrasonic is the use of ultrasonic techniques to remove contamination from the component or components. Extraction by internal rinsing (not to be confused with agitation) is also known as a functional test bench. This process involves passing fluid through a component to its full volume for a set time period at a set pressure similar to how the component would function upon assembly. Examples of components suitable for this method would be hoses, pumps, filters, etc. Along with choosing the best technique from the aforementioned which will be discussed individually with more detail in separate documents, it is also important to choose an appropriate solvent that is not only compatible with the material by which the component is manufactured so as to not cause unwanted degradation, but to ensure proper removal of contaminants from the component. It's always best to remember the old chemistry saying, "like dissolves like." Using a polar solvent to remove non-polar contamination like wax or oils is literally not going to cut it because the molecular configuration will not allow for the two to mix into a

solution. In cases where components are treated with grease, oils, and wax to act as preservation agents, the process of dissolving may need to take place prior to the actual extraction procedure. Typically, dissolving is necessary when the extraction fluid isn't an adequate solvent to remove certain substances.

Of course, extraction by fluid is not always necessary. Many components never come in contact with fluids during the manufacturing processes or field operations. Certain components could even be damaged by fluid contact making an extraction by such very inefficient. Extraction by air can be an effective alternate procedure in these cases. Air jet extraction and Air through flow extraction are examples of this methodology. Similar to fluid pressure rinsing, air jet extraction is passing over the surfaces of a component with clean compressed air to remove contamination. Air through flow extraction is similar to internal rinsing or a functional test bench in that compressed air is passed through the cavity of a component for duration of time to force out any contamination similar to how the component would normally function upon installation. It is important to note that a rinsing of collection equipment with an appropriate solvent may still be necessary to properly collect the sample and prepare it for analysis.

More often than not, extraction by fluid using a strong, compatible solvent tends to be the most effective and efficient process to ensure the removal of the majority of contamination from a component to prepare for analysis. The contaminants suspended in the solvent can easily be removed through vacuum filtration and dried on a filter membrane for examination. Conducting a thorough, validated extraction procedure will result in accurate, repeatable findings as to whether or not a component is in conformance with its cleanliness specification. This will in turn allow for the production of quality components and the prompt attention to problems and defects pre-assembly that can cause vehicle malfunction later on down the road.

Stay tuned for a more in depth look as well as the pros and cons of each individual method of extraction by fluid

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Jared Friedman | Laboratory Technician | Crown Cleanliness Testing Laboratory
Crown Industrial Services Inc. | 2070 Brooklyn Rd. | Jackson, MI 49203 | United States of America
jfriedman@crownindservices.com | (517) 905-5329 Lab