CROWN INDUSTRIAL SERVICES INC. **CLEANLINESS TESTING LABORATORY**

We test to ISO 16232

Component Cleanliness Testing: Blank Value

Blank Tests are crucial when it comes to component cleanliness testing. Often required in many Original Equipment Manufacturer (OEM) cleanliness specifications, a typical blank test should be identical to the validated cleanliness testing procedure conducted on a part or batch of parts with one variable: remove the component. (See Component Cleanliness Testing: Extraction Validation.) The point of a blank test is to ensure the equipment and solvent used to conduct the test, as well as the environment in which the test is conducted are not contributing excessive amounts of contamination that would in turn impact the cleanliness test results in a negative fashion. The contaminants recovered during the blank test can be defined as contamination that does not originate directly from the component under assessment. These contaminants are known as the blank value or blind value. Blank tests should be conducted regularly to ensure quality test results that accurately display the condition of various components in relation to their cleanliness requirements. In addition, many OEM cleanliness specifications even necessitate blank studies with far greater frequency than "regularly" citing specific times to conduct them i.e. prior to extraction validation, before and after every test, daily equipment checks.

An appropriate blank value typically depends upon pre-determined standards in relation to a component's OEM cleanliness specification. In regards to gravimetric analysis or judging the levels of contamination by mass, ISO 16232 states that the blind value should not exceed 10 percent of the presumed or specified cleanliness level. Suppose a certain component is still in the early development stages and an appropriate mass limit has yet to be determined by a qualified party. Upon completion of a blank test using the parameters validated during the extraction validation study, a total of 0.2mg contamination is recovered. Thus, when testing the component, no less than 2.0mg contamination should be recovered. After several tests on several samples of the same component, an average of 5mg contamination is recovered. The presumed mass of contamination would then be 5mg as with further testing the inspector would expect to remove somewhere within a close range of 5mg of contamination. Since 0.2mg is less than 10 percent of 5mg, it can be concluded the blind value is an appropriate level of environmental contamination that in turn is not going to have a negative effect on the component cleanliness test results. Further testing of the component reveals that upon installation any more than 5mg of contamination may result in equipment failure. The equipment manufacturer now has enough data to provide a cleanliness specification: The maximum amount of contamination on that particular component may not exceed 5mg. Thus, when conducting a blank study in relation to the component, any value less than 10 percent of 5mg or 0.5mg is an acceptable blank value.

Along with, or in place of mass limits, an increasing number of OEM cleanliness specifications have limits in relation to the size and count of particulate contamination on their components. When evaluating a blank value based on particle count ISO 16232 once again requires no more than 10 percent the presumed or specified number in a

certain size class. Evaluation of a component requires the OEM to create particle count limits as follows: N(F-H100/I10/J-K1). Interpretation of this component cleanliness code limits the number of particulates in the 100 to 400 micron size range to 100, 10 particles in the 400 to 600 micron size range, and allows for 1 particle greater than 600 micron. (For more information on deciphering component cleanliness codes see Component Cleanliness Code and Reporting to A, V, or N in the "Understanding ISO 16232" series by Jack Griffes.) Applying the 10 percent rule to these limits indicates that when conducting a blank test no more than 10 particles in the 100 to 400 micron size range, 1 particle in the 400 to 600 micron range, and 0.1 or one tenth of a particle greater than 600 micron are appropriate blank values. Furthermore, ISO 16232 illustrates each calculated value must be rounded down to the nearest whole number. That being understood, 0.1 would have to be rounded down to 0 which allows for no particles greater than 600 micron recovered from the blank test. If the cleanliness limits include a maximum particle size, ISO 16232 states the maximum particle size for the blank value should be no particles in the next lowest size class to the size class of half the specified maximum particle size. In the case of another component it has been determined that any particle greater than 600 micron may result in equipment failure. Using 600 micron as the maximum particle size, divide that number in half. The quotient, 300 micron, is classified as size class H with ISO 16232 having a range from 200 to 400 micron. The next lowest size class is G having a range from 150 to 200 micron. A blank value in accordance with the 600 micron example maximum particle size would then be no particles greater than 150 micron to comply with ISO 16232. VDA 19, a specification very similar in structure to ISO 16232 with slightly differing verbiage says in the case of maximum particle size, no particles in the size class of half the specified maximum particle size are acceptable on the blank test. This would then allow for no particles greater than or equal to 200 micron. VDA 19 then goes on to elaborate that if a certain component has several specifications (mass limit and maximum particle size/counting) both blank values must be evaluated. In the event the cleanliness specification included both, maximum particle sizing and counting, using the given examples an appropriate blank value would be no particles greater than 200 micron for VDA 19 (or 150 micron per ISO 16232) even though the particle count would allow for 1 particle in the 400 to 600 micron range. As VDA 19 states, the more stringent limit must be applied to the blank value. It is also important to note that if the cleanliness level is neither presumed nor specified, then the blank value limits default to less than 4000 particles larger than 5 micron and less than 500 particles larger than 15 micron per 100ml of extraction fluid, as well as no particles larger than 50 micron per ISO 16232. VDA 19 only calls out the 50 micron maximum particle size. Another significant point to ascertain is that depending on the definition of what constitutes as a particle in any OEM standard as well as the cleanliness classification of the environment in which the test is conducted, the latter blank value limit may be highly impractical and very difficult to achieve.

Although many OEM specifications directly reference ISO 16232 and VDA 19 in relation to aspects like the blank test and extraction validation for cleanliness testing, not all completely abide. An example of this would be Ford's ESBC3P-7W092-BA. The blank test in this instance is to be conducted prior to the extraction validation. This in turn can be slightly complicated when the appropriate extraction parameters have yet to be determined and validated. Nevertheless, the specification states that a blank value should be no more than 0.2mg. Other Ford specifications that have deferred strictly to particle count such as ESHL1P-7W092-AA have a blank value of no more than 20

percent the specified maximum particle count in ISO 16232 size class ranges C-I. MTU Friedrichshafen's MTV5067 states simply for test cleaning the blind value must be considerably low so as not to be an influencing value to the cleanliness limit. If this is not achievable then an adjustment to the cleaning system must be made or any conclusions regarding the cleanliness of a component are invalid. The specification then goes on to explain the blind value for the test system (container for sample collection, extraction fluid, extraction fluid dispenser, air lines, filter housing, etc.) should be no more than 0.3mg. MTV5067 also requires a blank test after testing the component to ensure all removed contamination was included in the sample for analyzation.

Reviewing the various definitions of appropriate blank values in different cleanliness specifications alludes to two main concepts. Conducting blank studies are important to ensure the blind value is not an influencing factor in the component cleanliness testing results. This is vital so the equipment manufacturer knows for a fact that any component that complies or fails to comply with the predetermined cleanliness specification is solely responsible for conformance or non-conformance and it was not the result of excessive contamination introduced by the inspector and/ or testing environment or failure to analyze all contamination removed from the component. Blank studies also shed light on realistic levels of contamination which in turn give perspective as to whether or not complying with a certain cleanliness specification is even possible in a particular test environment. Any drastic changes to a typical blank value should be a red flag that something is amiss and whatever the issue may be it can be promptly addressed so the continuation of cleanliness testing can occur with the utmost confidence that it is being conducted appropriately and accurately. After all, how can cleanliness be properly evaluated if it cannot be exhibited with an exemplary blank value?

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Please feel free to give us a call – we do a lot of ISO 16232 based testing for a wide array of customers here at the Crown Cleanliness Testing Laboratory in Jackson, Michigan USA. Do not hesitate to contact us when you have a question about cleanliness testing or need cleanliness testing done. We offer Standard Turnaround for scheduled cyclical cleanliness testing and Expedited Turnaround when you need results ASAP. We also sell Lab kits and can train your personnel to do cleanliness testing if your customer insists you do the testing in-house.

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