Understanding your ISO 16232 report: Reporting to A, V, or N

When you are first exposed to ISO 16232 it may be because a print or a cleanliness specification lists out a code such as CCC = A(C-E15/F-G10/H-I4/J-K00) or CCC = V(C-E15/F-G10/H-I4/J-K00) or CCC = N(C-E32000/F-G1000/H-I16/J-K0). Typically, that code is at least initially confusing and I've briefly covered how to decipher it in my article entitled **"Understanding your ISO 16232 report: CCC or cleanliness code"** – so today we are going to discuss reporting to A, V, or N. You likely recall that A = Area and specifically in ISO 16232 it means a Standard Area of 1,000cm^2 and V = Volume meaning a Standard Volume of 100cm^3 while N = number of particles per part. So let's look at each mode of reporting one by one.

Reporting to A or Standard Area is the most common so let's start there. Your test part likely doesn't have a surface area of exactly 1,000cm^2 and while you must report to the Standard Area of 1,000cm^2 it isn't critical to test exactly 1,000cm^2 of area to accomplish correct reporting. If you have a part which is larger than 1,000cm^2 then typically you test one part at a time and your report will show a Total Particle Count (all particles in that size range on the filter patch) and also a Standardized Count which means that the Total Particle count is mathematically extrapolated to show the Particle Count per 1,000cm^2. If on the other hand your parts are very small then best practice is to test a batch of parts with a combined total surface area of at least 250-500cm^2 – whether that means testing a batch of two parts or a batch of one hundred or more parts. You want accuracy and to get accuracy you need to test enough surface area so that any part to part cleanliness variation is covered within the batch. A distinct advantage of reporting to A is that the same code or Limits can be fairly applied to parts of vastly differing size which require the same level of cleanliness. Reporting to A also allows you to very directly compare cleanliness levels of parts which greatly vary in size. By way of example if a very small part which has a bright shiny finish is testing at CCC = A(C-E15/F-G10/H-I4/J-K00) and a larger part with a dull finish is testing at CCC = A(C-E10/F-G8/H-I4/J-K00) then despite that shiny small part possibly "looking cleaner" the larger dull finished part is actually much cleaner (in this example.) Having the means to directly compare cleanliness across parts of differing size helps you to assess your cleaning operations and find ways to improve cleanliness when test results indicate the need. When gravimetric results (Mass of contamination) are also given on a "reported to A" ISO 16232 report they should be reported to A as well so that milligrams per 1,000cm^2 are shown and clearly labelled as such. The Contamination Level code found in Table 2 of ISO 16232-10 is used when reporting to A or Standard Area.

If your ISO 16232 cleanliness limit code is CCC = V(C-E15/F-G10/H-I4/J-K00) then you are reporting to V or Standard Volume which means reporting to a wetted volume of 100cm^3. Typically, the best fit for Volume based testing is when you are actually testing a fluid since 100cm^3 is the same as 100 milliliters. You will however find some parts with limits requiring reporting to V or Standard Volume in which case it is generally talking about wetted part volume. Be mindful that our lab has seen rare instances where the limit called for reporting to V and the interior surfaces of the part were defined as the test surfaces but the volume being reported to was actually the cavity within the part through which fluid circulated. Yes it can be confusing. Due to seemingly more "custom variations" than other reporting modes our best advice when your part cleanliness limits require reporting to V is to seek out complete definition so that you are able to correctly report per the definition. The Contamination Level code found in Table 2 of ISO 16232-10 is used when reporting to V or Standard Volume. Total Particle Count in the various size ranges and also the mathematically determined Standardized Particle Count (per 100cm^3) should both be displayed on the report. When gravimetric results (Mass of contamination) are also given on a "reported to V" ISO 16232 report they should be reported by mathmetical extrapolaton to V as well so that milligrams per 100cm^3 are shown and clearly labelled as such.

When reporting to N or "number of particles per part" the Contamination Level Code is dispensed with entirely – which makes this mode of reporting uniquely different. After listing the Size Class code letter (or range of size code letters) it calls out the actual number of particles per part as in this example CCC = N(C-E23536/F-G997/H-I92/J-K0). When testing very small parts it remains wise to test a batch of parts and we still recommend testing at least 250-500cm^2 worth of combined surface area in the test batch as a rule of thumb to aid accuracy even though your Standardized particle counts will be reported "per part" via mathematical extrapolation. When gravimetric results are cited on a "reported to N" report they should also be reported "per part" via mathematical extrapolation and clearly labelled as such.

I hope that helps increase your understanding regarding "reporting to A, V, or N" per ISO 16232.

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Please feel free to give me a call – we do a lot of ISO 16232 based testing for a wide array of customers here at the Paul Hutchison Clean Technology Laboratory in Jackson, Michigan USA. Give me a call when you have a question about cleanliness testing or need cleanliness testing done. We offer Standard Turnaround for scheduled cyclical 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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Tables 1 & 2 from ISO 16232-10

Table 1 — Size classes for particle counting

Size class	Size X (µm)
B	$5 \leq x < 15$
C	$15 \leq x < 25$
D	$25 \leq x < 50$
E	$50 \leq x < 100$
F	$100 \leq x < 150$
G	$150 \leq x < 200$
H	$200 \leq x < 400$
I	$400 \leq x < 600$
J	$600 \leq x < 1000$
K	$1000 \leq x$

NOTE 1 The size of largest particle size (found or allowable) can be expressed individually, independent of the nominal size classes specified above.

NOTE 2 According to individual requirements, size ranges may be combined and left out.

Table 2 — Definition of the contamination level of a component

Number of particles per 1000 cm^2 or per 100 cm^3		Contamination level
More than	Up to and including	
0	0	00
0	1	0
1	2	1
2	4	2
4	8	3
8	16	4
16	32	5
32	64	6
64	130	7
130	250	8
250	500	9
500	1×10^3	10
1×10^3	2×10^3	11
2×10^3	4×10^3	12
4×10^3	8×10^3	13
8×10^3	16×10^3	14
16×10^3	32×10^3	15
32×10^3	64×10^3	16
64×10^3	130×10^3	17
130×10^3	250×10^3	18
250×10^3	500×10^3	19
500×10^3	1×10^6	20
1×10^6	2×10^6	21
2×10^6	4×10^6	22
4×10^6	8×10^6	23
8×10^6	16×10^6	24

NOTE n the test report, the raw number of particles should be noted.