



Tube cleaning with ALKA Pro-Clean projectiles and contamination classification

Contamination analysis carried out with the particles counting method using an optical microscope

In order to obtain feedback on the grade of cleanliness achievable through the ALKA Pro-Clean system, a test was carried out on tube and hose samples, obtained from European world-class manufacturers.

1. 2x Steel tube I.D. 15mm, cut to a length of 1 meter. "Producer A / B"
2. 2x Rubber hose I.D. 19mm, cut to a length of 1 meter. "Manufacturer C"
3. 1x Rubber hose I.D. 19mm, cut to a length of 1 meter. "Manufacturer D"

Step 1: Cleaning

The tubes were cleaned by shooting ALKA Pro-Clean Complex type (abbreviated C) and Superhard type (abbreviated S) projectiles of the indicated diameter and number, alternating the shooting directions, and subsequently sealed.

1. Steel pipe I.D. 15mm. "Producer A" (Left), "Producer B" (Right)



Tube 1: 1x Projectile S020



Tube 2: 2x Projectile S020

It is possible to observe the removal, already with the first projectile, of all the cutting chips. The tube of "Manufacturer A" (Left) also has extruding lubricant oil contamination, however removed by the projectile, a residue that can, sometimes, be found despite the pickling operation.

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2. Rubber hose I.D. 19mm. "Manufacturer C"



Hose 1: 1x Projectile C026



Hose 2: 2x Projectile C026

3. Rubber hose I.D. 19mm. "Manufacturer D"



Hose 3: 3x Projectile C026

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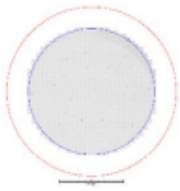
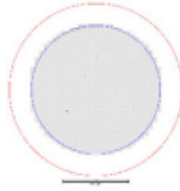
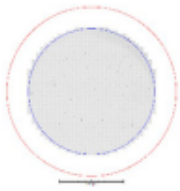
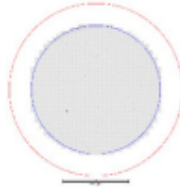
Step 2: Analysis

Laboratory filtration of the control hydraulic fluid through mixed cellulose esters membrane with a porosity of 0.8µm in order to guarantee a level of contamination by particulate matter according to NAS 1638 and SAE AS4059F ≤ 3. The oil reached a NAS / SAE class equal to 2 and ISO: _ / 9/7.

Each tube/hose was filled approximately ¾ of its total capacity with the previously filtered hydraulic fluid and then vigorously shaken for no less than 1 minute / each, along the three axes, simulating a flushing operation. At the end of the operation the tube/hose was emptied and the fluid collected in a bottle, previously rinsed with the same filtered fluid, and then subjected to analysis, in order to establish the grade of contamination according to NAS 1638 and SAE AS4059F, carrying out the counting and the dimensional distribution of the particulate material according to the UNI ISO 4407 analysis method.

Results:

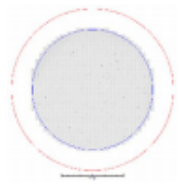
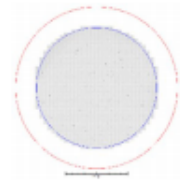
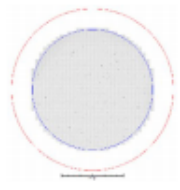
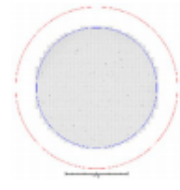
1. Steel pipe I.D. 15mm. "Producer A" (Left), "Producer B" (Right)

	NUMERO PARTICELLE EFFETTIVE/100 mL	IMMAGINE DEL FILTRO		NUMERO PARTICELLE EFFETTIVE/100 mL	IMMAGINE DEL FILTRO
≥ 5 µm	7198		≥ 5 µm	1429	
≥ 15 µm	1659		≥ 15 µm	373	
Da 5 µm a 15 µm	5539		Da 5 µm a 15 µm	1056	
Da 15 µm a 25 µm	970		Da 15 µm a 25 µm	223	
Da 25 µm a 50 µm	536		Da 25 µm a 50 µm	127	
Da 50 µm a 100 µm	130		Da 50 µm a 100 µm	20	
>100 µm	23		>100 µm	3	

Tube 1: 1x S020 – Grade: NAS 7, ISO _/13/11

Tube 2: 2x S020 – Grade: NAS 5, ISO _/11/9

2. Rubber hose I.D. 19mm. "Manufacturer C"

	NUMERO PARTICELLE EFFETTIVE/100 mL	IMMAGINE DEL FILTRO		NUMERO PARTICELLE EFFETTIVE/100 mL	IMMAGINE DEL FILTRO
≥ 5 µm	36360		≥ 5 µm	10122	
≥ 15 µm	5092		≥ 15 µm	2207	
Da 5 µm a 15 µm	31268		Da 5 µm a 15 µm	7915	
Da 15 µm a 25 µm	3614		Da 15 µm a 25 µm	1396	
Da 25 µm a 50 µm	1260		Da 25 µm a 50 µm	662	
Da 50 µm a 100 µm	183		Da 50 µm a 100 µm	127	
>100 µm	35		>100 µm	22	

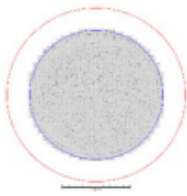
Hose 1: 1x C026 – Grade: NAS 8, ISO _/16/13

Hose 2: x2 C026 – Grade: NAS 7, ISO _/14/12

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3. Rubber hose I.D. 19mm. "Manufacturer D"

	NUMERO PARTICELLE EFFETTIVE/100 mL	IMMAGINE DEL FILTRO
≥ 5 µm	745355	
≥ 15 µm	247110	
Da 5 µm a 15 µm	498245	
Da 15 µm a 25 µm	121070	
Da 25 µm a 50 µm	86985	
Da 50 µm a 100 µm	32070	
>100 µm	6985	

Hose 3: 3x C026 – Grade: NAS N/C, ISO_/20/18

Conclusion:

As can be seen from the test results, cleaning with ALKA Pro-Clean projectiles allows to reach particularly stringent grades. The achievable level can be lower or higher depending on the procedure adopted. Different projectile models, different sizing of the projectile in relation to the internal diameter of the tube/hose and different number of shots made, are all factors that can allow to obtain more or less effective results, depending on the target to be achieved.

It should also be kept in mind that the particle count in a fluid used in relation to only $\frac{3}{4}$ of the capacity of the tube/hose is penalizing, as it finds a concentration greater than which, in fact, would occur with the same number of particles, but diluted in a major quantity of oil; for example in a system with a tank, completely filled.

One of the most determining factors, however, is, as can be seen from the results, the initial cleanliness degree, especially when it comes to flexible hoses. The build quality and the initial cleanliness of the tube/hose you purchase significantly affects the effort required for cleaning. **The same method applied to two tubes/hoses with extremely different starting conditions (Manufacturer C vs. Manufacturer D) leads to two completely different results:**

- Manufacturer C = **NAS/SAE: 7 – ISO: _/14/12. Only 2 projectiles used.**
- Manufacturer D = **NAS/SAE: N.C. – ISO: _/20/18. Despite the use of 3 projectiles.**

It is therefore essential, if it is necessary to achieve particularly high grades of cleanliness, to prefer those suppliers who are able to guarantee a tube/hose with a superior construction quality and a degree of attention to internal cleaning which, however, always needs to be verified in practice.

In particular, the quality of the compound in the flexible hose affects, more than anything else, the achievable grade. A hose with a compound that tends by its nature (type of ingredients used, quality of vulcanization, cleanliness of the core on which it is manufactured, etc ...) to disperse particles will never allow to meet the highest requirements as it isn't, in fact, definitively cleanable.

In the steel pipes, the quality of the pickling is very important, as the residue of the extruding oil is difficult to be removed completely, especially once dried. Cutting shavings and other types of metal or solid particles deposited inside are the most dangerous, but they are also the easiest to remove.

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