



Zenner

Test report

Lindab Oy

Mechanical durability of silencer lining
during brush cleaning

23.3.2021

Project 3470-1en



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1. General

1.1. Customer

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1.2. Examinations and report

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1.3. Date

Examinations: 10.3.2021
Examination report: 23.3.2021

1.4. Background

The ventilation systems in buildings (duct systems, silencers etc.) are generally cleaned every five years. The decree of the Ministry of the Interior 802/2001 regarding cleaning of ventilation ducts and ventilation equipment [1] requires that ventilation systems in spaces that are used for professional preparation of food, paint shops, launderettes etc. are cleaned once a year. The same decree sets the requirement that the ventilation systems in hospitals, elderly homes, schools, and similar spaces are cleaned once every five years.

The cleaning is typically done by a brushing procedure, where a nylon brush with an extendable shaft is rotated by means of an electric rotating device (such as a battery-powered drill). The nylon brush is pushed through the ventilation system to be cleaned and is then pulled back. The dust and other dirt particles that are released are collected in a separate filter through means of negative pressure in the duct. For the cleaning of grease ducts in kitchens and restaurants, a steel brush is used.

Additionally, a short instruction for the cleaning process is given in HVAC Instruction Sheet LVI 03-10429 [2] (in Finnish, published by Rakennustieto Publishing): "The cleaning of ventilation ducts is performed by means of a mechanical cleaning device consisting of an automatically rotating brush with a reel unit. The instrument shall also include a suction unit that can produce

a large volume flow rate, and that can be connected to a filter unit with a specified filtration ratio.

1.5. Assignment

The assignment was to examine the mechanical durability of the lining of two silencer models manufactured by Lindab Oy (KVDPX-2 and KVDPX-4) during brush cleaning. In the examination, two silencer models in two separate installation positions were cleaned by means of the brushing procedure described above, and the effect of the brushing on the lining of the silencers was examined.

The installation positions were as follows:

- Straight duct situation
 - 1 m of straight duct before the silencer
 - 2 m of straight duct after the silencer
- 90° elbow situation
 - 1 m of straight duct + 90° elbow right before the silencer
 - 2 m of straight duct after the silencer

Pictures of the installation positions are presented in figure 3.

The brushing was performed for each silencer in each installation situation for 1, 5, 10 and 20 times (one brush cycle = one brush back and forth through the silencer). In between each brushing series the silencer was opened, and its interior was examined and photographed. Additionally, a sample was taken from the surface of the lining through means of adhesive tape, in order to examine the amount of detached fibers/particles from the lining. The amount of brush cycles (assuming a cleaning interval of 5 years) corresponds to 5, 25, 50 and 100 years of use concerning cleaning.

As a surplus test, the durability of the lining was examined with the use of a steel brush. Steel brushes are not normally used in cleaning of normal ventilation systems, but rather in the cleaning of so-called grease ducts (e.g., in restaurants and kitchens).

Examined products, including installation and examination situations, are presented in table 1.

Table 1. Examined silencers and examination situations.

Product	Duct dimension [mm]	Length [mm]	Sound absorption material	Performed examination
KVDPX-200-1000-2 no 1	200	1000	Heavy polyester fiber + laminated fabric	Straight duct
KVDPX-200-1000-2 no 2	200	1000		90° elbow before silencer
KVDPX-200-1000-4 no 1	200	1000	Polyester fiber + laminated fabric	Straight duct
KVDPX-200-1000-4 no 2	200	1000		90° elbow before silencer

1.6. Examined silencers

The examined silencers were models KVDPX-200-1000-2 (2 pcs) and KVDPX-200-1000-4 (2 pcs), delivered from the stock of Lindab Oy. Both silencers are rectangular silencers with steel casing, with a detachable cover for cleaning and inspection. Both silencers are equipped with round Ø200 duct connections. In silencer model 2, the used sound absorption material is heavy polyester fiber with a laminated fabric lining. In silencer model 4, the used sound absorption material is ordinary polyester fiber with a laminated fabric lining.

Pictures of the silencers can be seen in figure 1.



Figure 1. Measured silencers. In the top left picture model KVDPX-200-1000-2 (grey sound absorption material). In the top right picture model KVDPX-200-1000-4 (white sound absorption material). In the bottom picture a silencer with the detachable cover attached.

1.7. Used instruments

The brushing was performed by an external company, IV-maailma Oy, that performs cleaning of ventilation systems. As a cleaning device, a brand-new nylon brush with an extendable shaft was used. The brush was rotated by means of a battery powered drill (Makita). The battery of the drill was changed regularly, so the rotating speed of the brush would remain constant.

Pictures of the used brushing apparatus can be seen in figure 2.

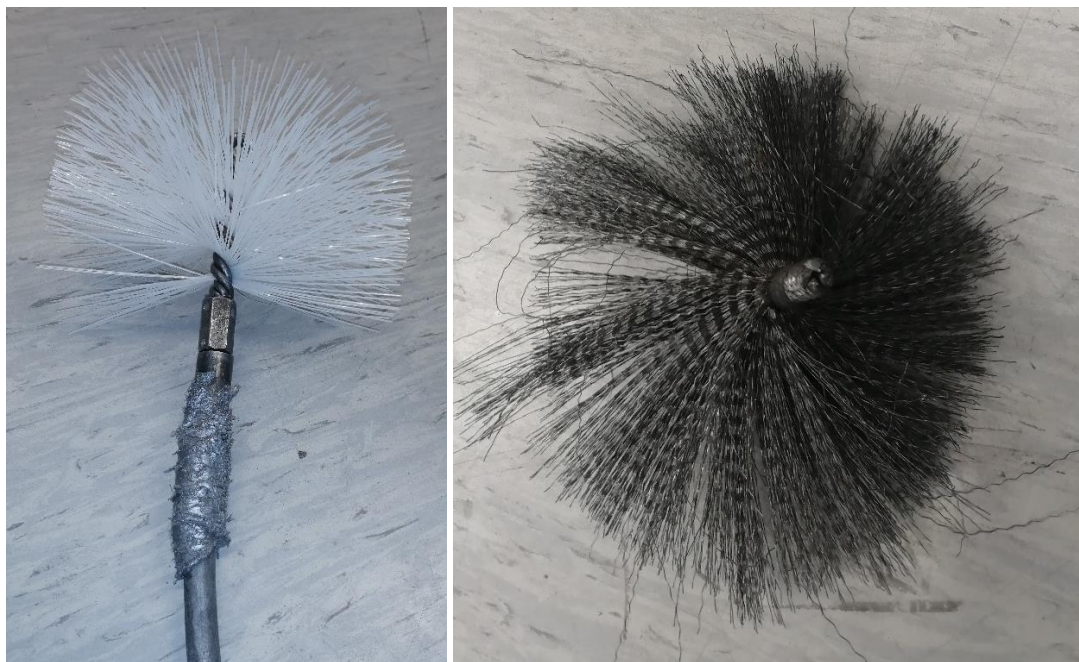


Figure 2. Brushing apparatus in the examinations. In the bottom left corner, the normally used nylon brush. In the bottom right corner, a steel brush.

2. Tests

2.1. Test procedures

Photographs of the installation situations can be seen in figure 3. All the tested situations are presented in table 2.

Table 2. Examination situations.

Test no.	Product	Installation situation	Brushings
1	KVDPX-2 no 1	Straight duct	1 x
2			5 x
3			10 x
4			20 x
5	KVDPX-2 no 2	90° elbow before silencer	1 x
6			5 x
7			10 x
8			20 x
9	KVDPX-4 no 1	Straight duct	1 x
10			5 x
11			10 x
12			10 x
13			1 x steel brush
14	KVDPX-4 no 2	90° elbow before silencer	1 x
15			5 x
16			10 x
17			20 x

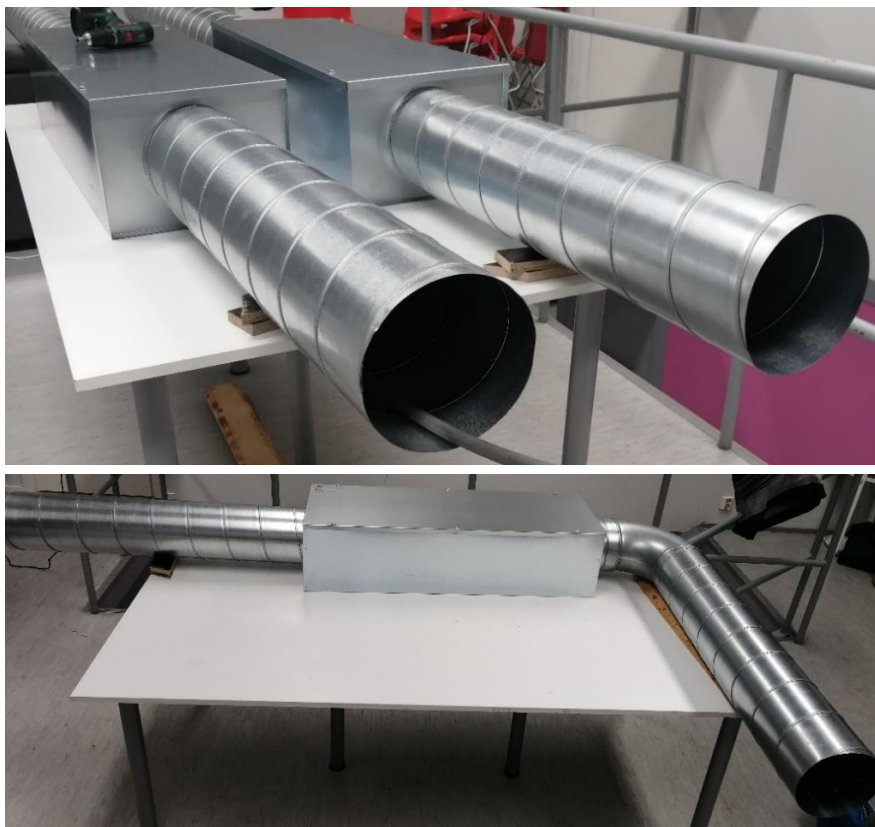


Figure 3. Installation situations in the examinations. In the top picture straight duct situation, in the bottom picture 90° elbow situation.

2.2. Results

Based on performed cleaning procedures and tests, it can be stated that no traces of the brushing could be perceived through sensory evaluation after 1 or 5 brushings. See figures 4–5 and 8–9. After 10 and 20 brushings, very light frizzing could be perceived on the lining of all the examined silencers, with the lining still being completely intact. See figures 6–7 and 10–11.

After the brushing performed with the steel brush, the lining of the silencer was damaged/teared at several positions. Additionally, abrasion of the lining was perceived throughout the silencer. See figure 12.

Based on samples taken by means of adhesive tape, the amount of detached particles/fibers caused by the brushing is very small and is slightly increased with increasing brush cycles. See figures 13–16.

Adhesive tape samples were also taken repeatedly from the same positions from two silencers to investigate whether the particles/fibers are continuously detaching. Based on the samples, it can be stated that particles/fibers will not detach continuously after brushing, meaning that the material has not started "leaking". The same result could also be perceived in the silencer cleaned with the steel brush, even though the lining was partially damaged. See figures 17 and 18.

3. Summary

Based on the performed examinations, it can be stated that the examined silencers endure the mechanical strain caused by the brushing at least 20 brush cycles. After 20 brush cycles the inner lining of each examined silencer was completely intact, although lightly frizzled.

The duct elbow was not found to have any impact on the wear of the silencer lining.

Based on adhesive tape samples, the amount of particles/fibers that are detached from the lining after the brushing procedure is not significant.

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References

- [1] The decree of the Ministry of the Interior regarding cleaning of ventilation ducts and ventilation equipment (Sisäasiainministeriön asetus ilmanvaihtokanavien ja -laitteistojen puhdistamisesta). 802/2001.
- [2] LVI 03-10429. Työselostuksen laatiminen, ilmanvaihtojärjestelmien puhdistus ja säätö. Helmikuu 2008.

Appendices

- Appendix A Pictures of examined situations

Appendix A: Pictures of examined situations

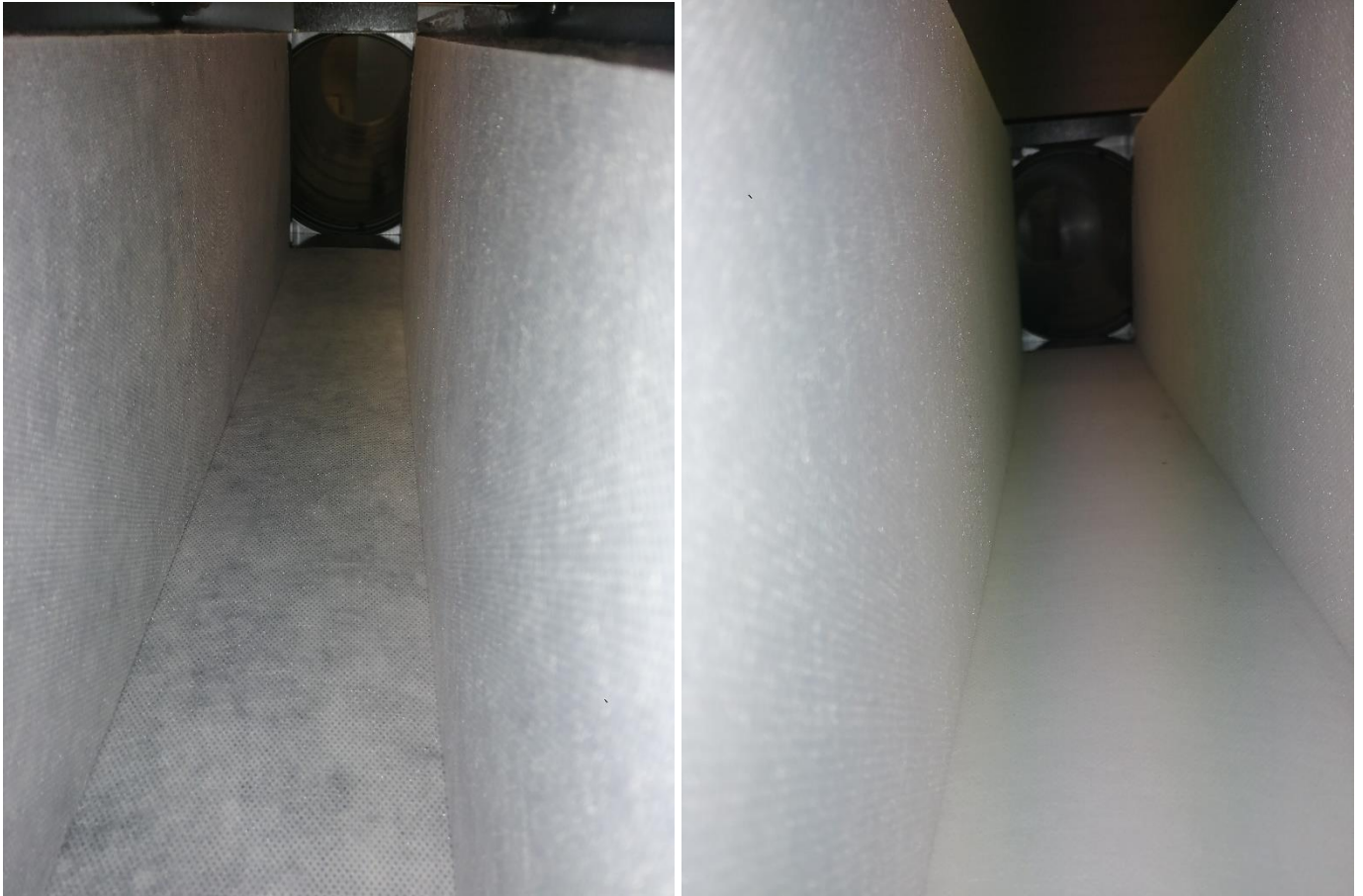


Figure 4. Straight installation: 1 brush cycle: KVDPX-2 no1 and KVDPX-4 no1.

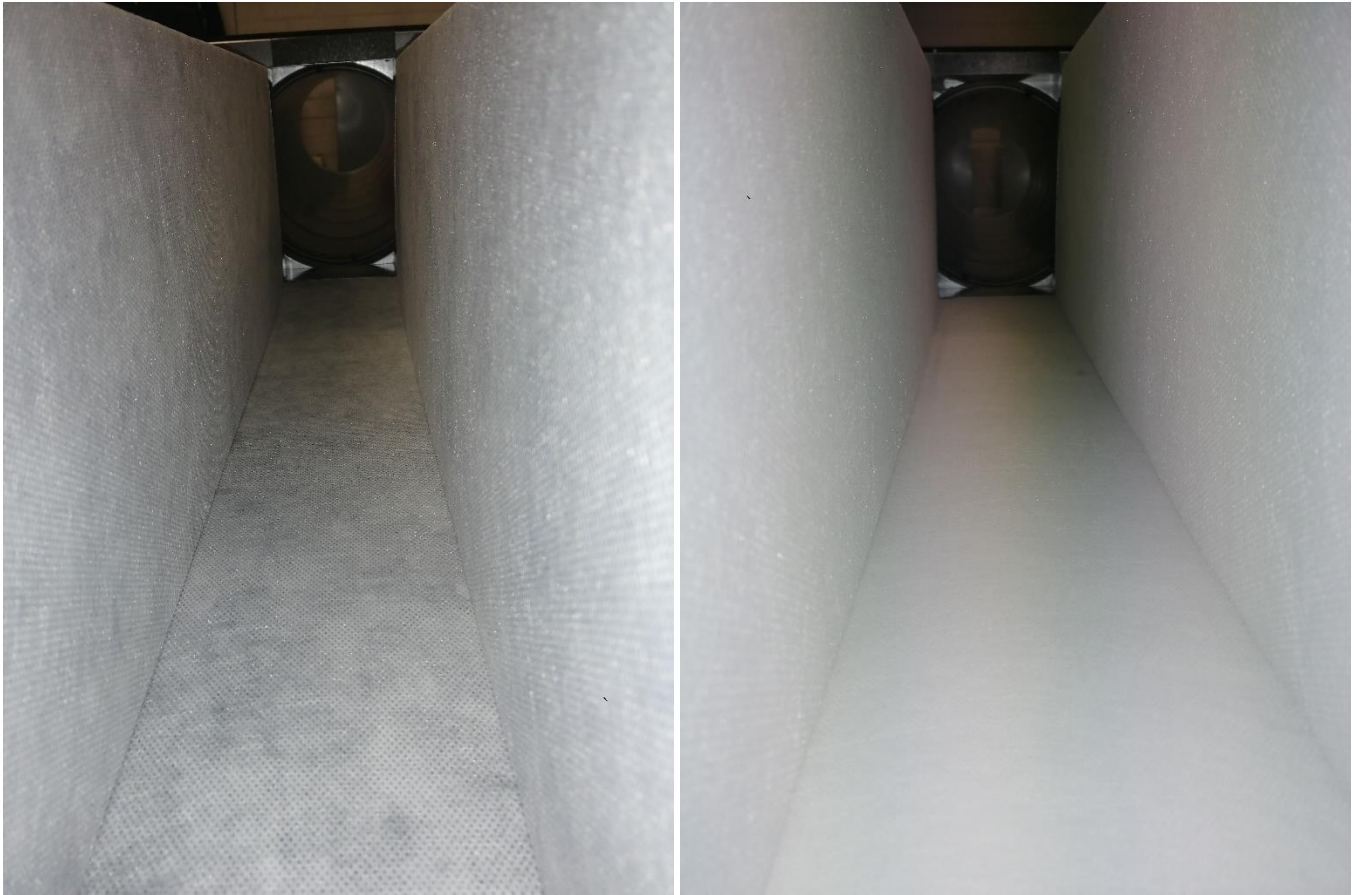


Figure 5. Straight installation: 5 brush cycles: KVDPX-2 no1 and KVDPX-4 no1.

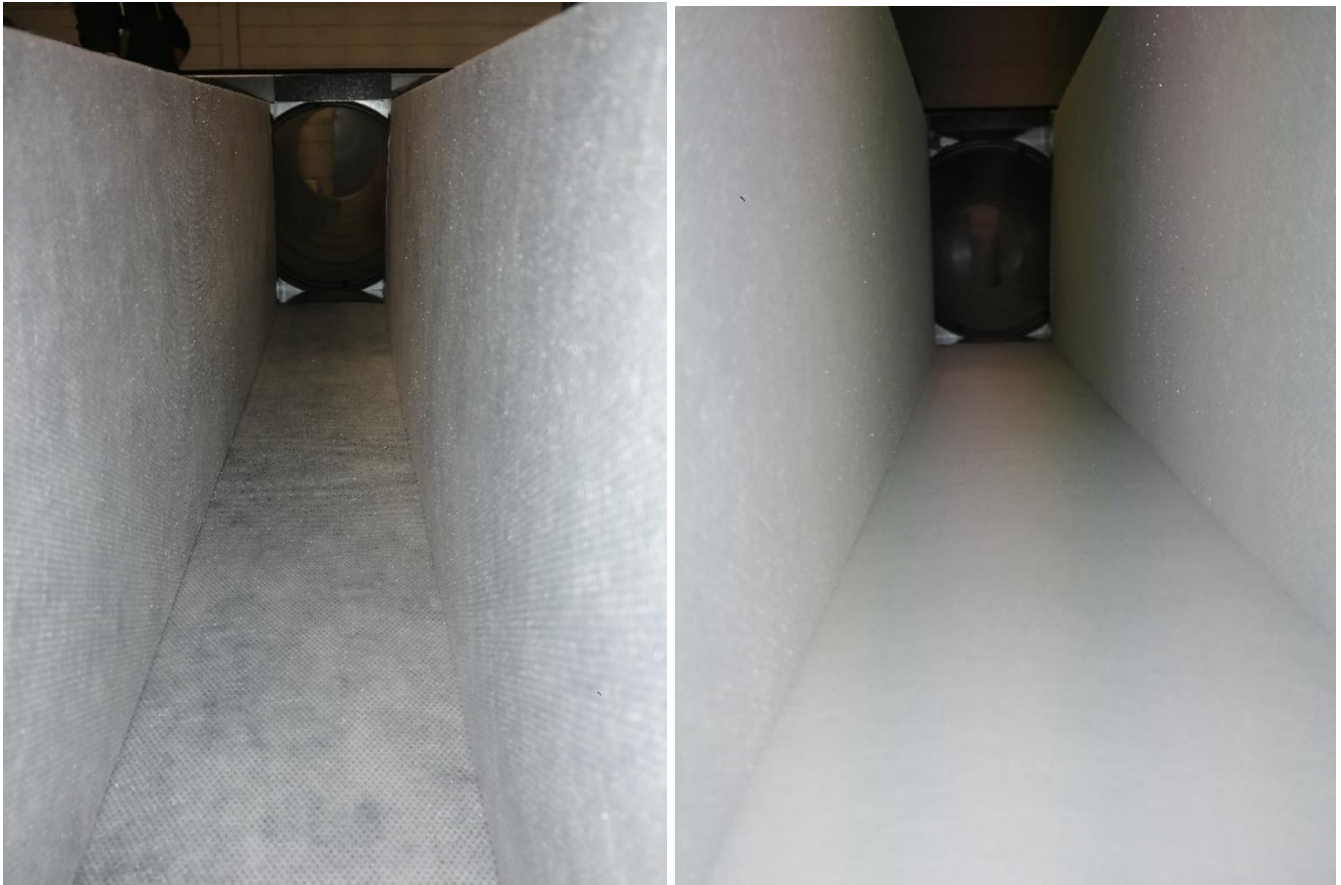


Figure 6. Straight installation: 10 brush cycles: KVDPX-2 no1 and KVDPX-4 no1.

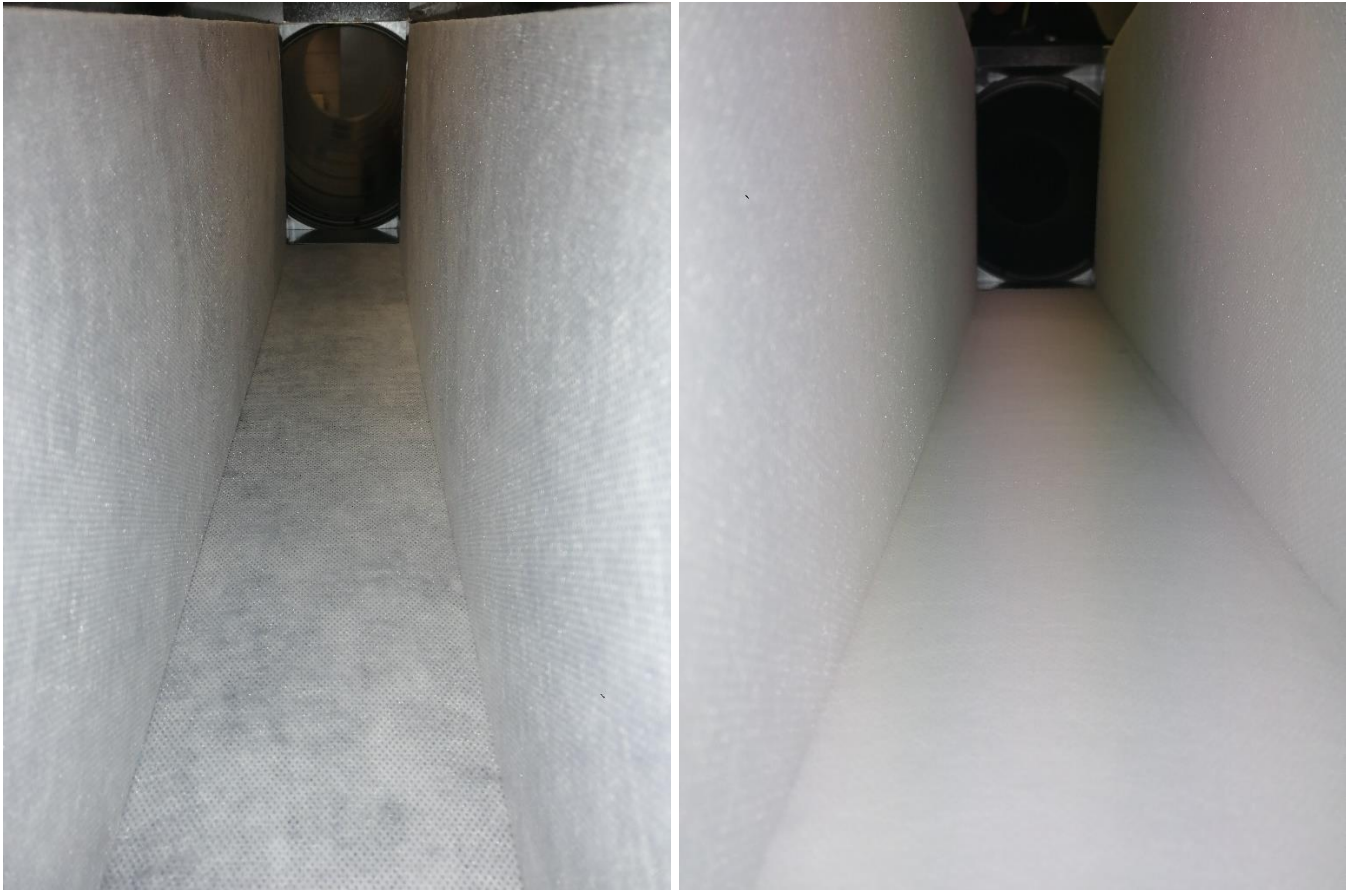


Figure 7. Straight installation: 20 brush cycles: KVDPX-2 no1 and KVDPX-4 no1.



Figure 8. 90° elbow: 1 brush cycle: KVDPX-2 no2 and KVDPX-4 no2.

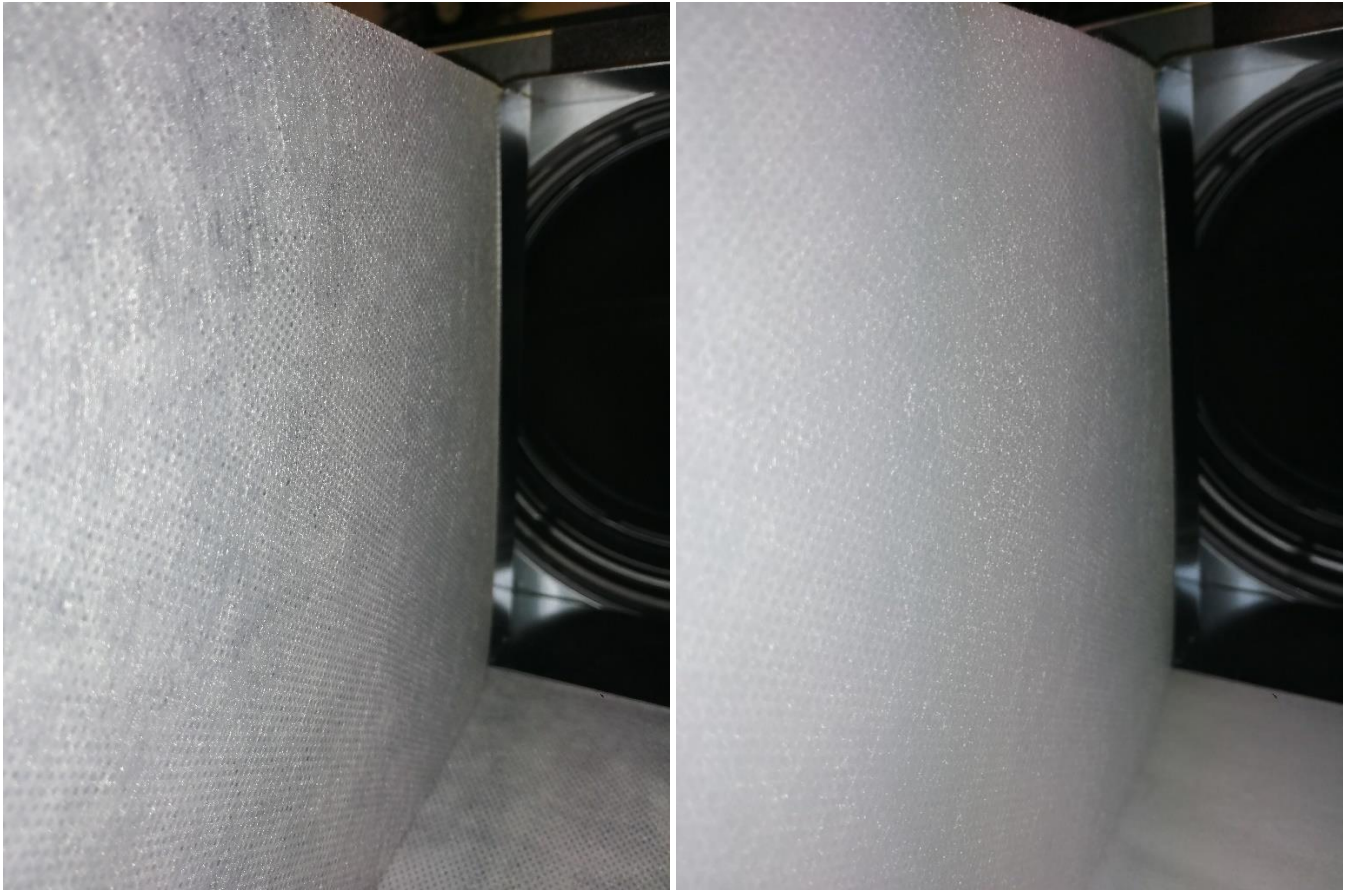


Figure 9. 90° elbow: 5 brush cycles: KVDPX-2 no2 and KVDPX-4 no2.



Figure 10. 90° elbow: 10 brush cycles: KVDPX-2 no2 and KVDPX-4 no2.

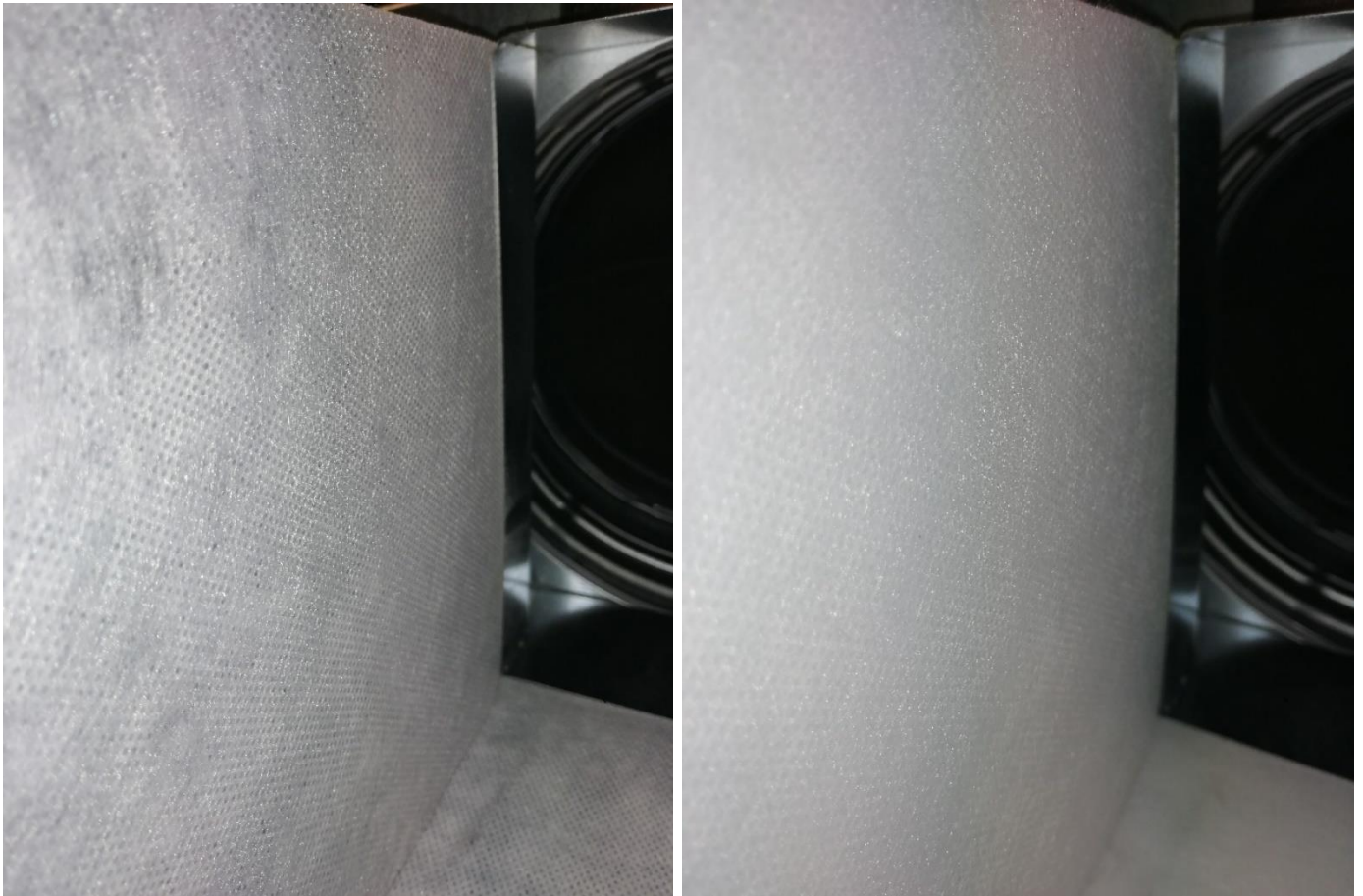


Figure 11. 90° elbow: 20 brush cycles: KVDPX-2 no2 and KVDPX-4 no2.



Figure 12. Straight duct: 1 brush cycle with steel brush: KVDPX-4 no1.

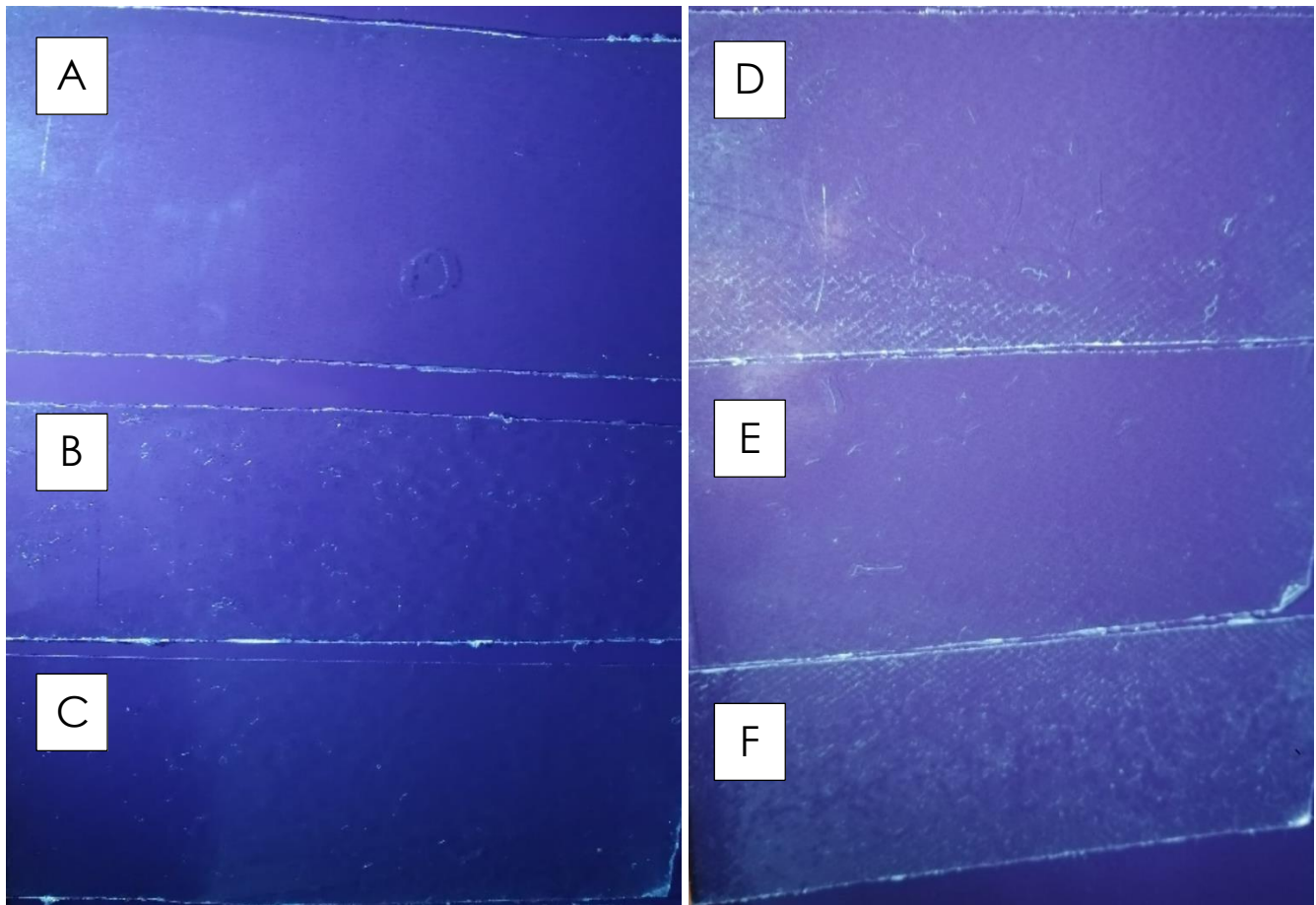


Figure 13. Silencer KVDPX-2 no 1 (straight duct): unused adhesive tape (A), 0 (B), 1 (C), 5 (D), 10 (E) and 20 (F) brush cycles.

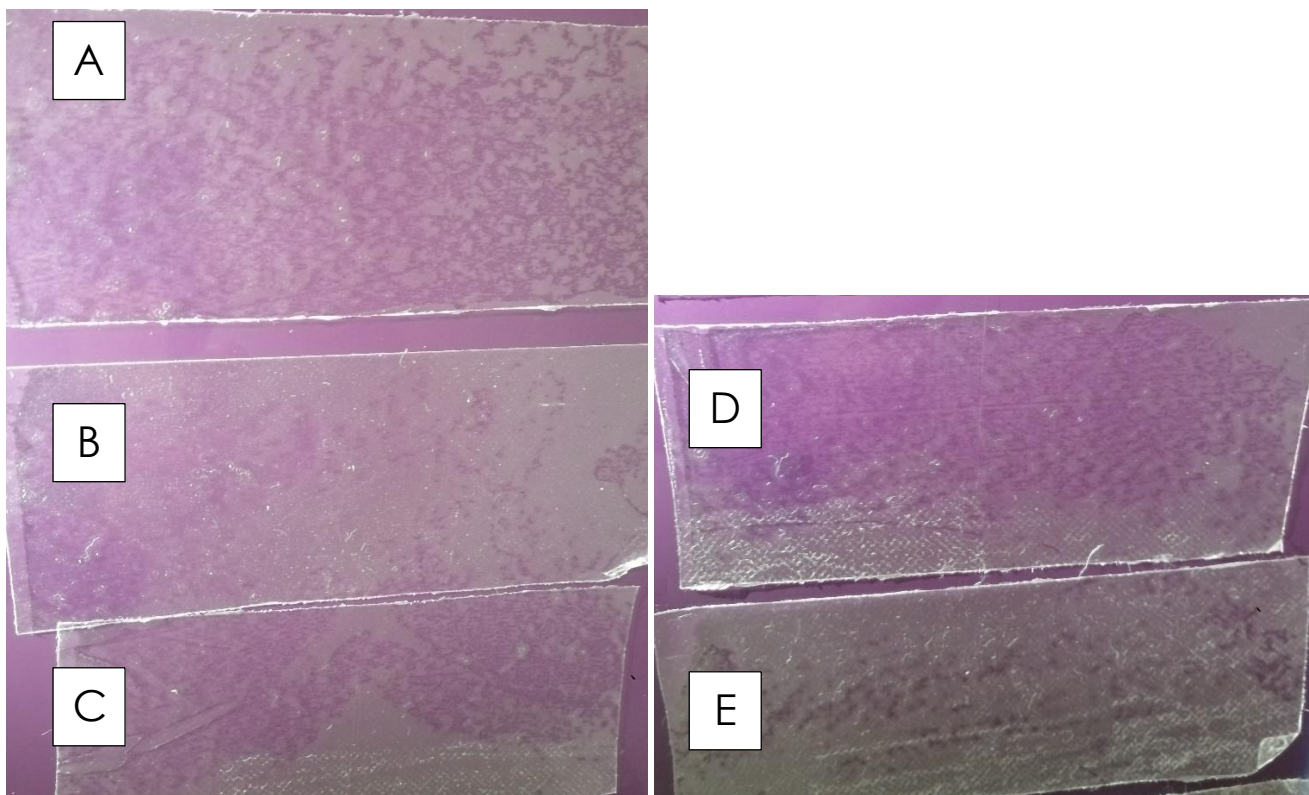


Figure 14. Silencer KVDPX-4 no 1 (straight duct): 0 (A), 1 (B), 5 (C), 10 (D) and 20 (E) brush cycles.

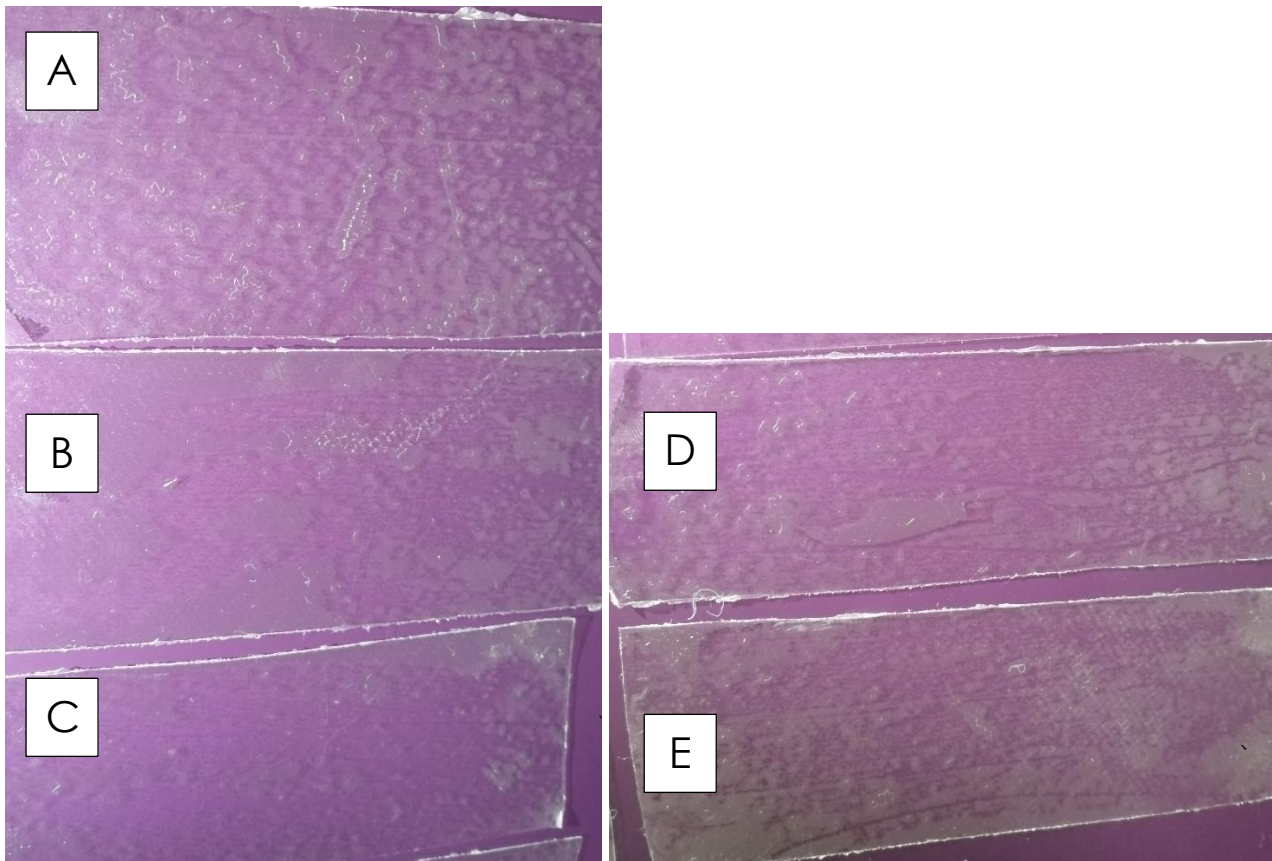


Figure 15. Silencer KVDPX-2 no 2 (90° elbow):
0 (A), 1 (B), 5 (C), 10 (D) and 20 (E) brush cycles.

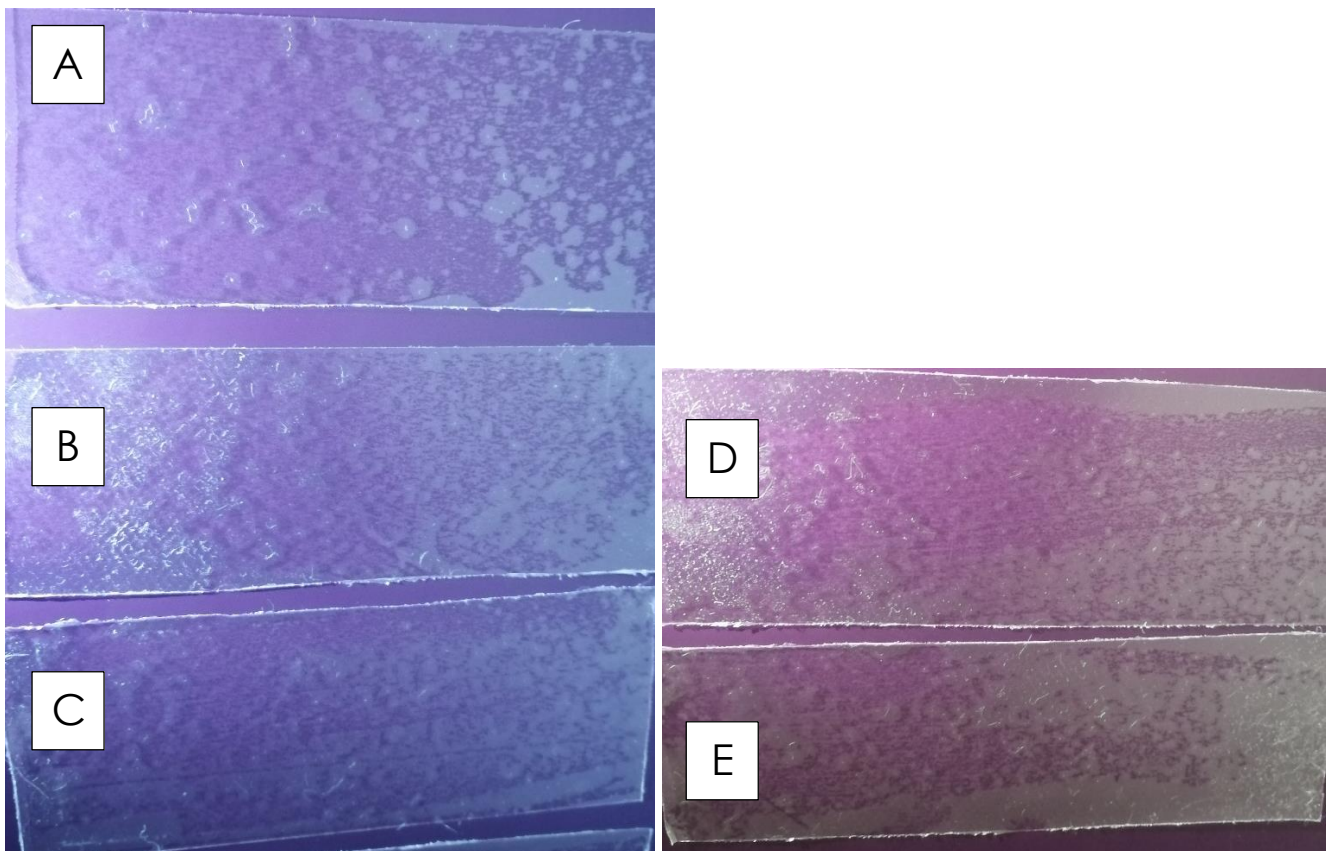


Figure 16. Silencer KVDPX-4 no 2 (90° elbow):
0 (A), 1 (B), 5 (C), 10 (D) and 20 (E) brush cycles.

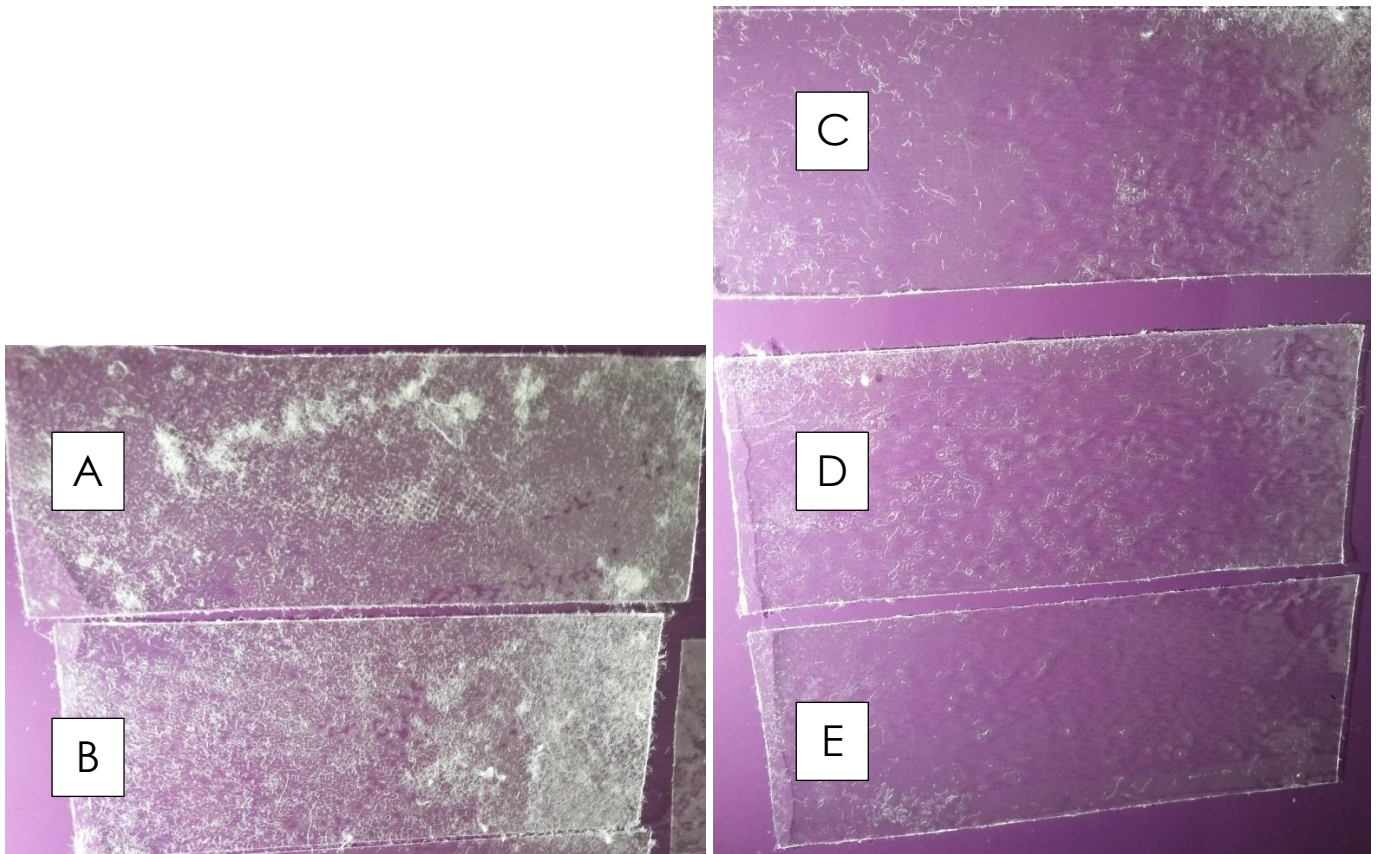


Figure 17. Silencer KVDPX-4 no 1 (straight duct – steel brush):
 1 brush cycle with steel brush (A), 4 consecutive adhesive tape samples from same position (B, C, D and E).

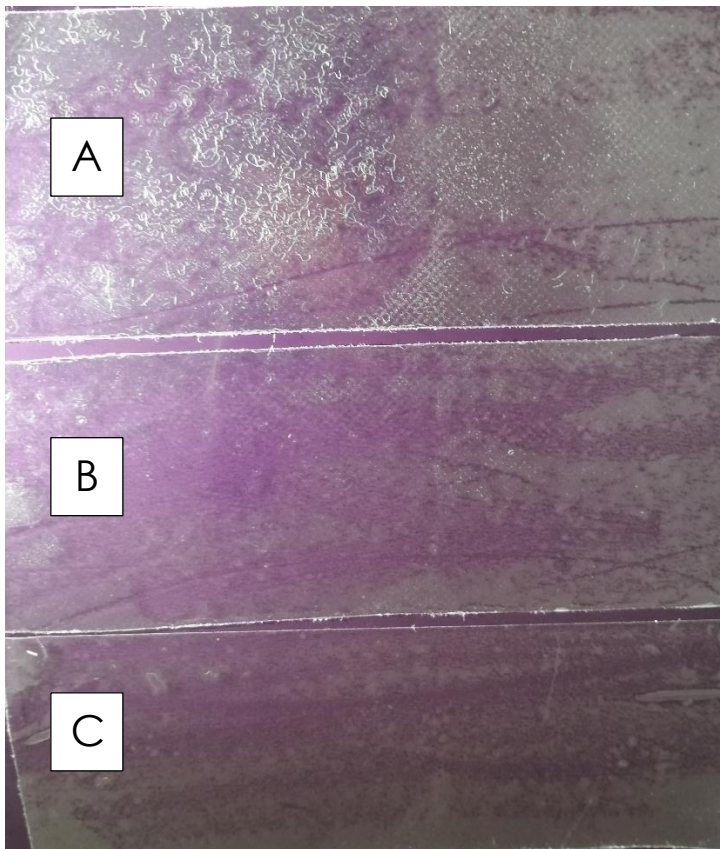


Figure 18. Silencer KVDPX-4 no 2 (90° elbow):
 3 consecutive adhesive tape samples after 20 brush cycles (A, B and C).