



DEFINITION OF THE PROCEDURE FOR FUNCTIONAL APPROVAL

WP2

Date of document

29/08/2025

DELIVERABLE VERSION:

D2.4, V1.4

DISSEMINATION LEVEL:

PU¹

AUTHOR(S):

Stefan Schumacher, Franc Pricken, Heiko Böker, Christof Asbach

¹ PU = Public - fully open

SEN = Sensitive - limited under the conditions of the Grant Agreement

DOCUMENT HISTORY

PROJECT ACRONYM	AEROSOLFD
Project Title	Fast track to cleaner, healthier urban Aerosols by market ready Solutions of retrofit Filtration Devices for tailpipe, brake systems and closed environment
Grant Agreement N°	101056661
Project Coordinator	M+H
Project Duration	01/05/2022 – 31/08/2025 (40 months)
Deliverable No.	D2.4 - Definition of the procedure for functional approval
Diss. Level	Public (PU)
Deliverable Lead	IUTA
Status	Working Verified by other WPs/Partners x Final version
Due date	31/08/2025
Submission date	29/08/2025
Work Package	WP2 - Retrofit Brake Dust particle filter – Development and Demonstration
Work Package Lead	MANN+HUMMEL
Contributing beneficiary(ies)	TÜV Nord (IUTA subcontractor), M+H, ZF
DoA	Definition of the procedure for functional approval

DATE	VERSION	AUTHOR	COMMENT
02/05/2025	1.0	Schumacher	First draft of deliverable
06/05/2025	1.1	Asbach	Proofreading of V1.0
23/07/2025	1.2	Schumacher	Update on Parts Type Approval
21/08/2025	1.3	Larsen	Peer Review
25/08/2025	1.4	Schumacher	Final Version

©2022-2025 AeroSolfd Consortium Partners. All rights reserved.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.

AeroSolfd is a Horizon Europe project supported by the European Commission under grant agreement No 101056661. All information in this deliverable may not be copied or duplicated in whole or part by any means without express prior agreement in writing by the AeroSolfd partners. All contents are reserved by default and may not be disclosed to third parties without the written consent of the AeroSolfd partners, except as mandated by the Grant Agreement with the European Commission, for reviewing and dissemination purposes. All trademarks and other rights on third party products mentioned in this document are acknowledged and owned by the respective holders. The AeroSolfd consortium does not guarantee that any information contained herein is error-free, or up-to-date, nor makes warranties, express, implied, or statutory, by publishing this document. For more information on the project, its partners and contributors, please see the AeroSolfd website (www.aerosolfd-project.eu).

TABLE OF CONTENTS

1. INTRODUCTION	9
1.1. PURPOSE AND TARGET GROUP	9
1.2. CONTRIBUTIONS OF PARTNERS	9
2. OBJECTIVES AND EXPECTED IMPACT	10
2.1. OBJECTIVES	10
2.2. EXPECTED IMPACT	10
3. DESCRIPTION OF TECHNICAL/SCIENTIFIC ACTIVITIES	10
4. RESULTS AND DISCUSSION	10
4.1. PREREQUISITES FOR PARTS TYPE APPROVAL.....	10
4.2. DESCRIPTION OF THE COMPONENTS TO BE APPROVED	11
4.3. TEST CRITERIA AND PRINCIPLES.....	12
4.4. GENERAL REQUIREMENTS ON THE APPROVAL OBJECT	14
4.5. REQUIREMENTS FOR A TEST REPORT	14
4.6. RESPONSIBILITIES FOR THE APPLICANT	14
4.7. TRANSFERABILITY TO OTHER COUNTRIES	15
5. DEVIATIONS FROM THE PLAN	15
6. LINKS WITH OTHER WPS.....	15
7. CONCLUSIONS AND RECOMMENDATIONS.....	15
8. BIBLIOGRAPHY	16
9. ANNEX	17

LIST OF TABLES

Table 1 Contribution of partners.....	9
Table 2 Test matrix for the parts type approval	13

LIST OF FIGURES

Figure 1 Design concept with holder (1), filter element (2), carrier (3), brake system (4), and brake disk (5).....	11
Figure 2 Filter frame (green parts) and filter element (gray parts)	12

LIST OF ABBREVIATIONS

ACRONYM	DESCRIPTION
ABE	Allgemeine Betriebserlaubnis (general operating license)
FEM	Finite Element Method
KBA	Kraftfahrt-Bundesamt (German Federal Motor Transport Authority)
MAB	Merkblatt für Anfangsbewertung (Initial Assessment Fact Sheet)
StVZO	Straßenverkehrs-Zulassungs-Ordnung (German Road Traffic Licensing Regulations)
TTG	Teiletypgenehmigung (Parts Type Approval)

PUBLISHABLE SUMMARY

Within Task 2.6 of WP 2 a procedure for achieving a parts type approval for a retrofit brake dust particle filter was developed. To demonstrate that the retrofitted product does not negatively influence the functionality and safety of the car, the following central aspects must be considered: 1. The functionality of the brake must not be negatively influenced. 2. A visual inspection of the wear of the brake pad and disk must still be possible. 3. The surrounding space must not be blocked to ensure the free movement of other components. 4. The structural stability of the modified brake caliper holder must be guaranteed. However, the brake dust removal efficiency is not relevant for the approval process. Test procedures based on generally accepted test specifications were identified and put in a test matrix. All steps were conducted in close discussion with the German motor transport agency KBA. Furthermore, requirements for a test report, general responsibilities and the transferability between countries are discussed.

1. INTRODUCTION

Vehicles may only be put into operation on public roads if they are officially licensed for traffic. To achieve this, a general operating license (ABE) must be issued for all vehicles produced in series. The operating license issued for an individual vehicle based on the ABE is generally retained unless modifications are made to the vehicle, e.g. such as retrofitting a brake dust filter. In this case, the vehicle's operating license in principle expires. To avoid this, an additional type approval for the specific vehicle part can be achieved. If the fitting instructions are observed, the operating license of the whole vehicle does then not expire when the component is fitted.

Since 20 June 2025 the German Federal Motor Transport Authority (KBA) does not grant any new national type approvals according to § 22 StVZO, but parts type approvals (TTG). However, this does not affect the general processes for testing and achieving the approval so that all methods developed within the project before that date are still valid.

The aim of Task 2.6 of WP 2 is to develop a general procedure how such a parts type approval for the brake dust filter can be achieved. This shall be done in close discussion with the responsible authorities for approval. The results are described in this deliverable.

1.1. PURPOSE AND TARGET GROUP

The purpose of the deliverable is to define a procedure to achieve a parts type approval for a brake dust filter. One central target group are the manufacturers of brake dust filters and brakes, who need to know which procedures that need to be fulfilled when placing a new product on the market. Furthermore, technical surveillance associations typically conducting the actual approval process as well as the motor transport authorities eventually granting the approval are addressed.

1.2. CONTRIBUTIONS OF PARTNERS

Table 1 Contribution of partners

PARTNER SHORT NAME	CONTRIBUTIONS
IUTA	Lead the deliverable
TÜV Nord (IUTA subcontractor)	Contact with KBA, proposals for test procedures, description of the procedures in an internal report
M+H	Provision of technical drawings of the brake dust filter
ZF	Provision of technical drawings of the brake caliper holder, testing of effects of the brake dust filter on temperature and stability

2. OBJECTIVES AND EXPECTED IMPACT

2.1. OBJECTIVES

Vehicles may only be put into operation on public roads if they are licensed for traffic. For simplicity, we consider in the following exemplarily the case of Germany. There, for vehicles produced in series, a general operating license (in Germany *Allgemeine Betriebserlaubnis*, ABE) is issued to the manufacturer following an inspection carried out at the manufacturer's expense. The operating license issued for the individual vehicle based on the ABE is generally retained unless modifications are made to the vehicle. In this case, the vehicle's operating license expires. To avoid this, a parts type approval (in Germany *Teiletypgenehmigung*, TTG) for specific vehicle parts can be issued. The TTG in accordance with § 22 of the German Road Traffic Licensing Regulations (StVZO) can be issued for parts that form a technical unit and can therefore be treated separately in the approval procedure. If the fitting instructions are observed, the vehicle-operating license does not expire when the component is fitted to a vehicle.

2.2. EXPECTED IMPACT

The approval procedure will ensure that the vehicle is still safe to operate after installation of the brake dust filter. Early publication of the standardized method allows manufacturers to prepare all necessary information on time before requesting a general operating license. This will presumably facilitate the introduction of retrofit brake dust filters to the market.

3. DESCRIPTION OF TECHNICAL/SCIENTIFIC ACTIVITIES

None of the project partners have experience in developing parts type approval procedures in cooperation with motor transport agencies. Consequently, and in accordance with the DoA, IUTA first published a call for tender for a subcontractor. The most economically feasible offer was provided by TÜV Nord in Essen, who were thus subcontracted by IUTA.

4. RESULTS AND DISCUSSION

4.1. PREREQUISITES FOR PARTS TYPE APPROVAL

In Germany, the KBA is responsible for issuing a TTG. The KBA provides information on decisions already made with regards to the eligibility for approval or the test bases via a "red" and a "green" list. The "Red List" includes vehicle parts or separate technical units for which no permits have yet been issued. The causes can be both a lack of test criteria and contradictions with regards to the applicable legal provisions. Any vehicle part that has been registered, but has not yet been approved, initially appears on the Red List. The "Green List", on the other hand, contains all permit objects for which a national permit has already been granted. The test criteria and principles to be applied are described. A permit object can thus be transferred from the "Red List" to the "Green List" as eligible for approval by describing the basis for the test.

The latest versions of these lists are available under the following links:

https://www.kba.de/DE/Themen/Typgenehmigung/Zum_Herunterladen/ErteilungTypgenehmigung_n/rote_liste_xlsx_de.html

https://www.kba.de/DE/Themen/Typgenehmigung/Zum_Herunterladen/ErteilungTypgenehmigung_n/gruene_liste_xlsx_de.html

TÜV Nord checked both lists of the KBA. As expected, there was not yet an entry for brake dust filters on the green list, but there was one for brake dust particle filters for cars and trucks on the red list. However, it was not marked that granting of a TTG has been generally refused for legal reasons. After clarification with the KBA it was stated that there are no general objections for achieving a parts type approval, but only the criteria for testing are still missing at the moment. Based on this, criteria for testing were developed in the next step with the aim of defining a procedure, which generally allows to transfer the brake dust filter from the Red List to the Green List.

4.2.DESCRPTION OF THE COMPONENTS TO BE APPROVED

The brake dust filtering system contains overall the following main features

- Brake carrier
- Filter frame
- Filter element

The filter frame will be mounted on the brake carrier of the brake caliper as shown in Figure 1 and Figure 2. The filter frame contains the actual filter element for collecting the brake dust particles. Consequently, the filter element is designed as wear part and regulated in the maintenance requirements of the manufacturer.

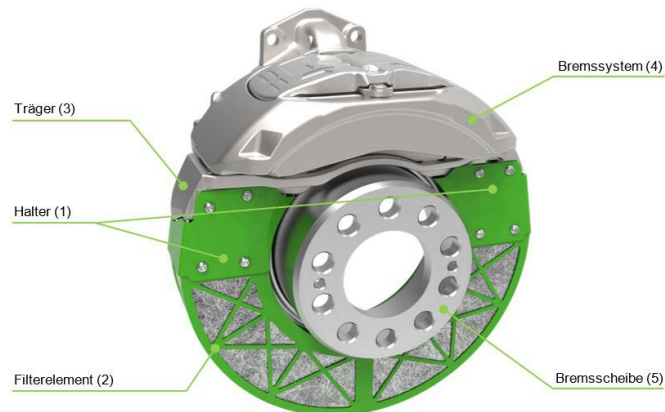


Figure 1 Design concept with holder (1), filter element (2), carrier (3), brake system (4), and brake disk (5).

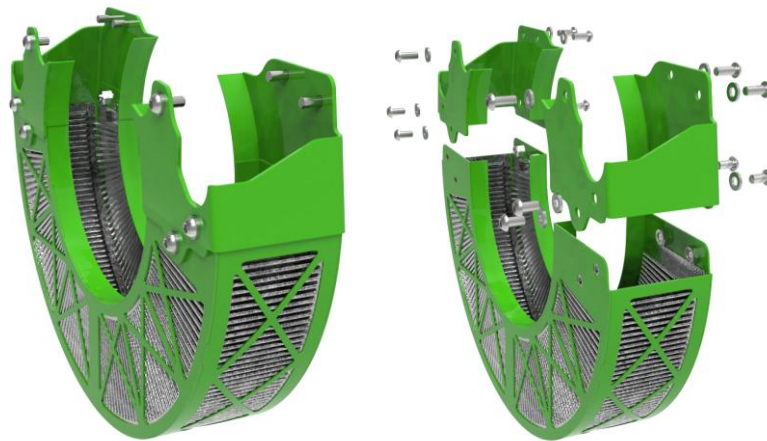


Figure 2 Filter frame (green parts) and filter element (gray parts)

4.3. TEST CRITERIA AND PRINCIPLES

In order to obtain a TTG for an independent technical unit that is still on the "Red List", it is necessary to develop general test principles. A particular problem here is that the filter element encloses the entire brake disc and the cooling situation is changed. Furthermore, the attachment of the technical unit changes the envelope of the wheel brake, which has an effect on the freedom of movement between the brake and the rim. From the point of view of the provision, an existing type-approval of a vehicle thus violates the legal acts of the wheel brake as well as the attachment of wheels and tires. Furthermore, there is also the difficulty that the brake carrier, i.e. an existing component of the brake caliper, has to be replaced, as mounting holes have to be made there.

- The brake dust filter must not negatively influence the function of the brake system.
- As a formal requirement, the inspection of the brake pad wear must still be possible.
- All relevant distances in the installation space must be maintained.
- The structural stability of the revised holder for the brake caliper must be guaranteed.

In consultation with the German Federal Motor Transport Authority (KBA), no requirements have been defined for the particle removal efficiency of the brake dust filter system. Efficiency is therefore not subject to testing and approval.

There are different standardized methods to address above-mentioned aspects in a test procedure. The functionality of the brake can be tested and approved in accordance with the requirements of UN Regulation No. 13. Here, the focus is particularly on fading, i.e. the reduction of braking power as the temperature rises, as well as the hot braking effect, but the requirements from the building regulations must also be checked here. The following aspects are of relevance:

- Point 5.1.1.1: The brake system must be designed, constructed and installed in such a way that the vehicle complies with the requirements of this Regulation under normal operating loads, despite the vibrations that occur.
- Annex 4 Point 1.4 : Type-0 test (ordinary performance test with brakes cold)
- Annex 4 Point 1.5 : Type-I test (fade test)

■ Annex 4 Point 1.7.2: Type-III test (hot performance)

The state of wear of the wearing components of the service brake, e.g. brake pads and drums/discs can be checked in accordance with UN R13 5.2.2.8.2. It shall be possible to easily assess the wear on service brake linings from the outside or underside of the vehicle, without the removal of the wheels, by the provision of appropriate inspection holes or by some other means. This may be achieved by utilizing simple standard workshop tools or common inspection equipment for vehicles.

The clearances between the brake and the rim can be checked in the style of UN R 142 Point 5.2.1.3. The space in which the wheel rotates must be large enough not to obstruct the movement of the wheel when using the largest permissible tires and rim widths, considering the largest and smallest offset within the limits of the vehicle manufacturer's maximum and minimum specifications for suspension and steering. This shall be verified using the largest and widest tires, taking into account the permissible dimensional tolerances (i.e. the maximum values) applicable to the respective designation of the tire size as specified in the relevant UN Regulation.

For checking the structural stability of the holder, there are no standardized regulations, but it can be demonstrated, for example by finite element method (FEM) calculations of a shaker test. Based on these specifications, the test matrix presented in Table 2 was created. The proposed test criteria and principles were discussed with the KBA and generally considered as suitable for achieving the parts type approval.

Table 2 Test matrix for the parts type approval

DESCRIPTION	TEST BASE	REMARK / GOAL
1 Functionality of the brake		
Tests without brake dust filter	UN R13 Annex 4	Comparison (Type 0-I-II-III) on an inertia dynamometer test bench, comparison of the hot braking performance
Tests with brake dust filter		
2 Verification of formal demands		
Inspection of the pad wear	UN R13 (5.2.2.8.2)	It must be possible to determine the state of wear of the wearing components of the service brake, e.g. brake pads and drums/discs.
3 Verification of the free rotation		
Inspection of the installation space	in style of UN R142 (5.2.1.3)	All clearances between the brake and the rim must be checked and comply with the requirements.

4 Structural stability of the holder

Testing of the attachment of the brake dust filter in the vehicle	FEM analysis or shaker test presented to technical service	If the technical service requires further evaluation, this must be provided by the customer
---	--	---

4.4. GENERAL REQUIREMENTS ON THE APPROVAL OBJECT

When granting a permit, the requirement applies that the object of approval must not pose a risk to individuals or the environment and also comply with all applicable legal provisions. With regards to the brake dust filter discussed here, the following tasks arise concerning product safety, which are presented in the project by the project partners M+H and ZF within the framework of a "Design Verification Plan (DVP)".

The holder of an approval shall deliver the independent technical unit fully packaged as a sales unit. The packaging must be sealed so that any tampering would be immediately apparent. In case of the German TTG, installation and assembly instructions in German must be included with each sales unit.

4.5. REQUIREMENTS FOR A TEST REPORT

The TTG is granted on the basis of a test report from a technical service. In addition to information on the applicant, the report contains documentation of the tests carried out and any conditions, acceptance instructions and a final certificate. The final certificate must contain statements on the following points: The result of an assessment in accordance with § 30 StVZO which ensures that it is to be expected that the normal operation of the vehicles, taking into account the installation instructions enclosed with the product and the use of the installation materials specified or enclosed by the manufacturer, will not harm anyone or endanger, hinder or inconvenience anyone more than is unavoidable. Furthermore, it must be confirmed that the condition of the vehicles is maintained, particularly with regard to handling and the structural safety of the vehicle. In connection with Article 55 of Regulation (EU) 2018/858, it must also be confirmed that the installation of the separate technical unit is not expected to pose a serious risk to the safe functioning of other systems that are essential for the safety of the vehicle or for its environmental compatibility.

4.6. RESPONSIBILITIES FOR THE APPLICANT

A special challenge for the parts type approval of the brake dust filter is that it is not solely manufactured by a single company, but in close cooperation of the manufacturer of the actual filter and the manufacturer of the revised holder of the brake system. Here, the KBA clearly stated that the responsibility for the TTG must not be shared between two parties. The holder of an approval is solely responsible for all matters relating to the type-approval procedure and for the conformity of production. According to the definition of the StVZO § 22 clause 1, the scope of the permit includes all required parts that are required for the attachment or conversion of the technical unit. In the case of the brake accumulation filter under review, these includes the brake carrier, the filter element, the filter holder and fittings.

According to Section 3 of the Initial Assessment Fact Sheet (MAB), obligations associated with type-approval cannot be passed on to third parties. Any agreement to the contrary is invalid vis-à-vis the KBA.

4.7. TRANSFERABILITY TO OTHER COUNTRIES

The procedure for type approval was exemplified using the case of Germany. The TTG issued by the KBA is also accepted in some other EU countries, allowing the product to be introduced directly in those markets.

Within the EU, the EC type approval system (EU Whole Vehicle Type Approval) is the only harmonized framework recognized by all Member States. If a component or vehicle holds EC type approval (identified by an E-mark, e.g., “E1” for Germany), recognition across the EU is legally required. However, since there are currently no specific ECE or EU regulations that exclusively govern brake dust filters, approval is often granted through individual national procedures or special approvals in cooperation with the relevant national authorities.

Another route to market in other EU Member States is provided by Regulation (EU) 2019/515 of the European Parliament and of the Council of 19 March 2019 on the mutual recognition of goods lawfully marketed in another Member State. This regulation facilitates the free movement of goods in the absence of harmonized EU legislation. Under this framework, a manufacturer can notify their product for sale in another Member State by submitting an application to a designated authority or notified body. This procedure also applies to Switzerland. It has, for example, been used successfully to introduce LED retrofit vehicle light bulbs into various EU markets.

5. DEVIATIONS FROM THE PLAN

There were no substantial deviations from the original planning.

6. LINKS WITH OTHER WPS

As the exhaust particle filter developed in WP 1 also requires a modification to the vehicle, WP 1 can benefit from the general procedure how to prepare a procedure for parts type approval. The results were provided to WP 5 and WP 6 for further dissemination and communication.

7. CONCLUSIONS AND RECOMMENDATIONS

Within Task 2.6 of WP 2 a procedure for achieving a parts type approval for a retrofit brake dust particle filter was developed. To demonstrate the retrofitted product does not negatively influence the functionality and safety of the car, the following central aspects were considered: 1. The functionality of the brake itself must not be negatively influenced. 2. A visual inspection of the wear of the brake pad and disk must still be possible. 3. The surrounding space must not be blocked to ensure the free movement of other components. 4. The structural stability of the modified brake caliper holder must be guaranteed. Test procedures based on generally accepted test specifications were identified.

8. BIBLIOGRAPHY

German Federal Ministry for Digital and Transport. (2021). Road Traffic Licensing Regulations (StVZO). Last amended on June 10, 2024.

United Nations Economic Commission for Europe (UNECE). (2025). UN Regulation No. 13 – Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking (Rev. 10, Amend. 2).

United Nations Economic Commission for Europe (UNECE). (2022). UN Regulation No. 142 – Uniform provisions concerning the approval of motor vehicles with regard to the installation of their tyres. Revision 1, Amendment 1.

https://www.kba.de/DE/Themen/Typgenehmigung/Zum_Herunterladen/ErteilungTypgenehmigung_n/rote_liste_xlsx_de.html

https://www.kba.de/DE/Themen/Typgenehmigung/Zum_Herunterladen/ErteilungTypgenehmigung_n/gruene_liste_xlsx_de.html

9. ANNEX

The PDF file containing this information is provided in the attachments.