AGENDA



Online Basic Seminar

VDA19.1/2026

Welcome and Introduction to Technical Cleanliness

Dr. Steffen Oßwald

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AGENDA

TIME	TOPIC	PRESENTER
8:30	Welcome & Introduction	Dr Steffen Oßwald, Head of Sales
9:15	Cleanliness inspection according to VDA 19 Part 1	Jörg Kotzian, Technical Cleanliness Laboratory Manager
10:00	Qualification and blank value	Lisa Riese, TecSa Lab Dresden
10:45	Break	-
11:00	Practical session – video (cleanliness inspection procedure)	-
11:15	Microscopic particle analysis	Dr. Nils Rotthowe, Application & Sales Engineer
12:10	Practical session – live (microscopy)	Patrick Vogel, Microscopy Laboratory Supervisor
12:40	End of Day 1	-

QUESTIONS

About any of the presentations

- At any time via the chat function
  - For more detailed questions, please contact us afterwards by email or ask at the end of Day 2
  - If a question remains unanswered, please send it to us by email

- Afterwards by email to seminar@cleancontrolling.de

CONTENTS

Introduction to CleanControlling GmbH

Characteristics and nature of technical cleanliness

The future of VDA 19.1

Further standards and guidelines on technical cleanliness

CleanControlling at a glance



CleanControlling at a glance



140 employees

CleanControlling at a glance



Active on four continents

CleanControlling at a glance



Industries

Automotive

MedTec

Environmental

CleanControlling at a glance



four companies

CleanControlling at a glance



Unser KnowHow

20 years of experience

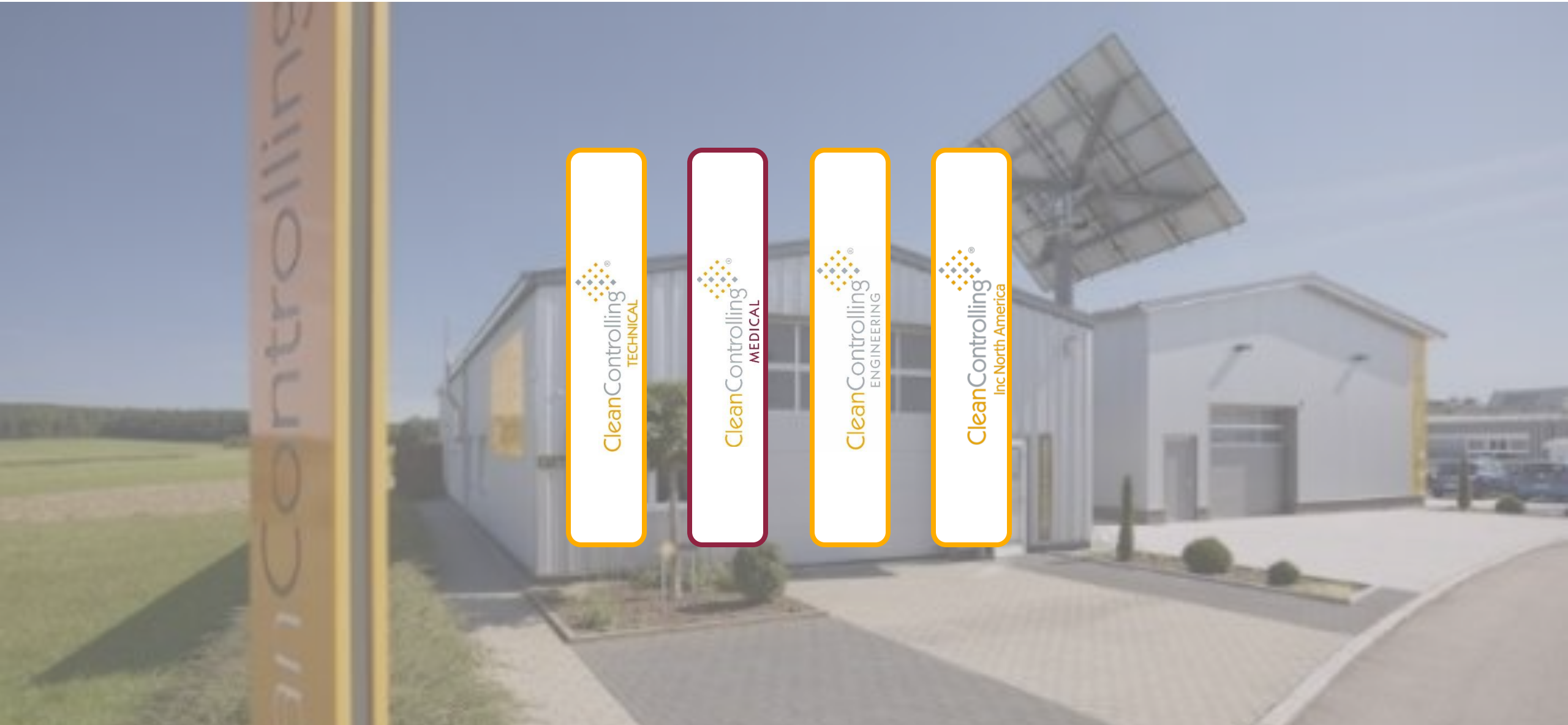
over **140.000** analyses

400 international consulting projects

ISO17025 accredited
ZLG recognised
GLP compliant

Over 25 in-house developed products

The CleanControlling Group



The CleanControlling Group

TECHNICAL

Technical Cleanliness Laboratory

Sales of technical cleanliness products



CleanControlling TECHNICAL

CleanControlling MEDICAL

CleanControlling ENGINEERING

CleanControlling Inc North America

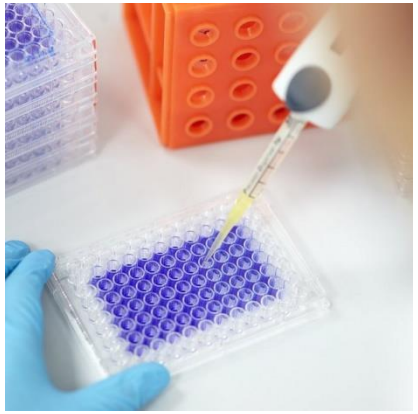
The CleanControlling Group

CleanControlling TECHNICAL

MEDICAL

Biology / Chemistry Laboratory

Environmental and special analyses



CleanControlling MEDICAL

CleanControlling ENGINEERING

CleanControlling Inc North America

The CleanControlling Group

CleanControlling TECHNICAL

CleanControlling MEDICAL

ENGINEERING

Training

Consulting

Product development



CleanControlling ENGINEERING

CleanControlling Inc North America

The CleanControlling Group

CleanControlling TECHNICAL

CleanControlling MEDICAL

CleanControlling ENGINEERING

NORTH AMERICA

Sales

Laboratory

Product development



CleanControlling Inc North America

CleanControlling worldwide



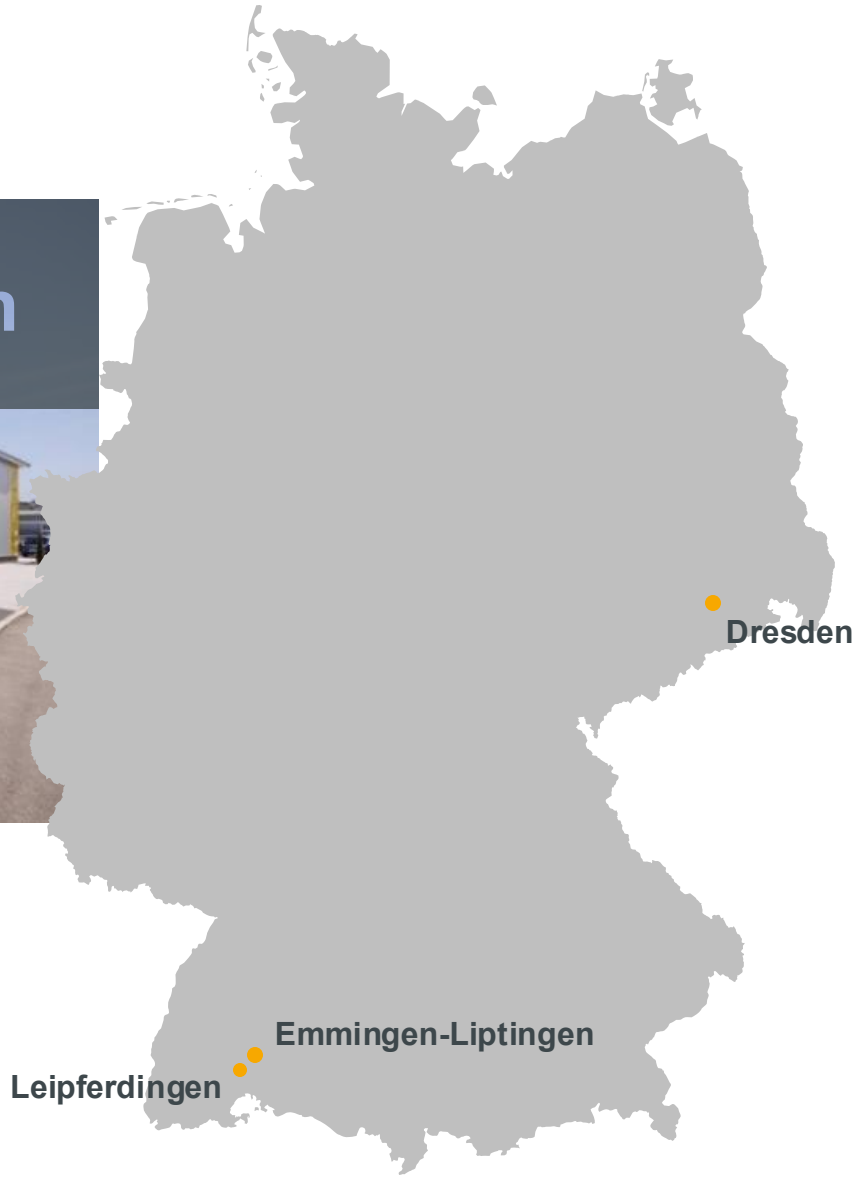
CleanControlling worldwide





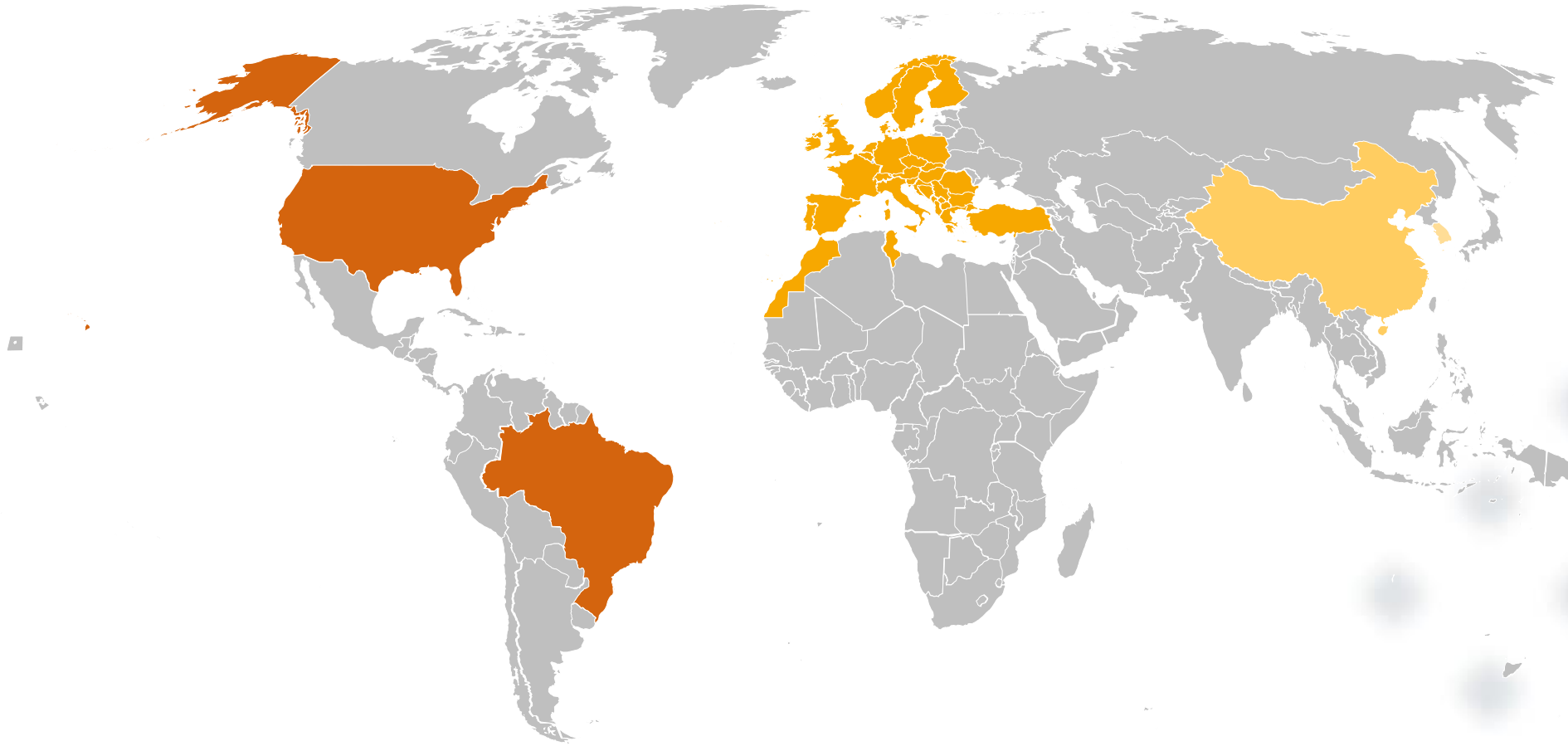
CleanControlling worldwide



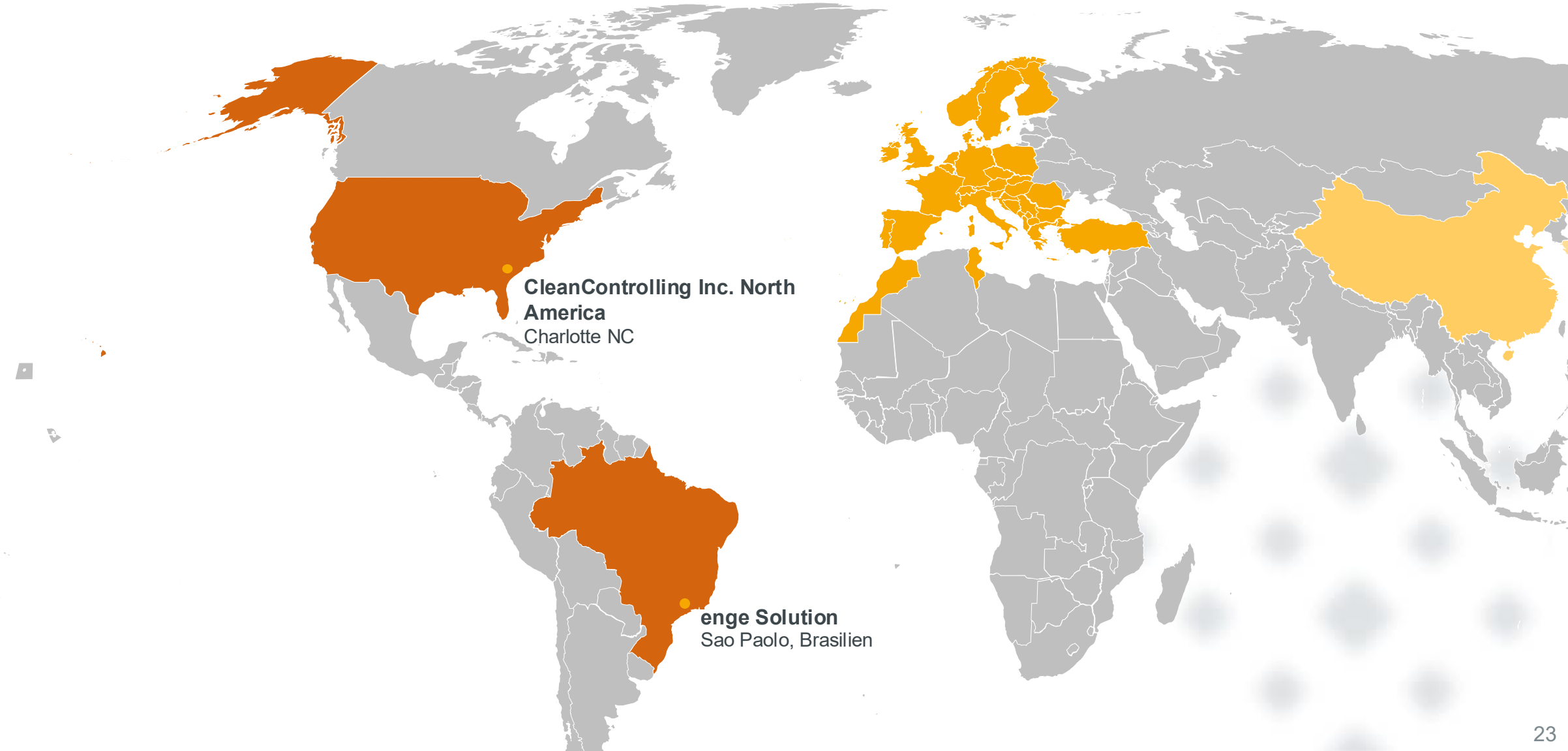




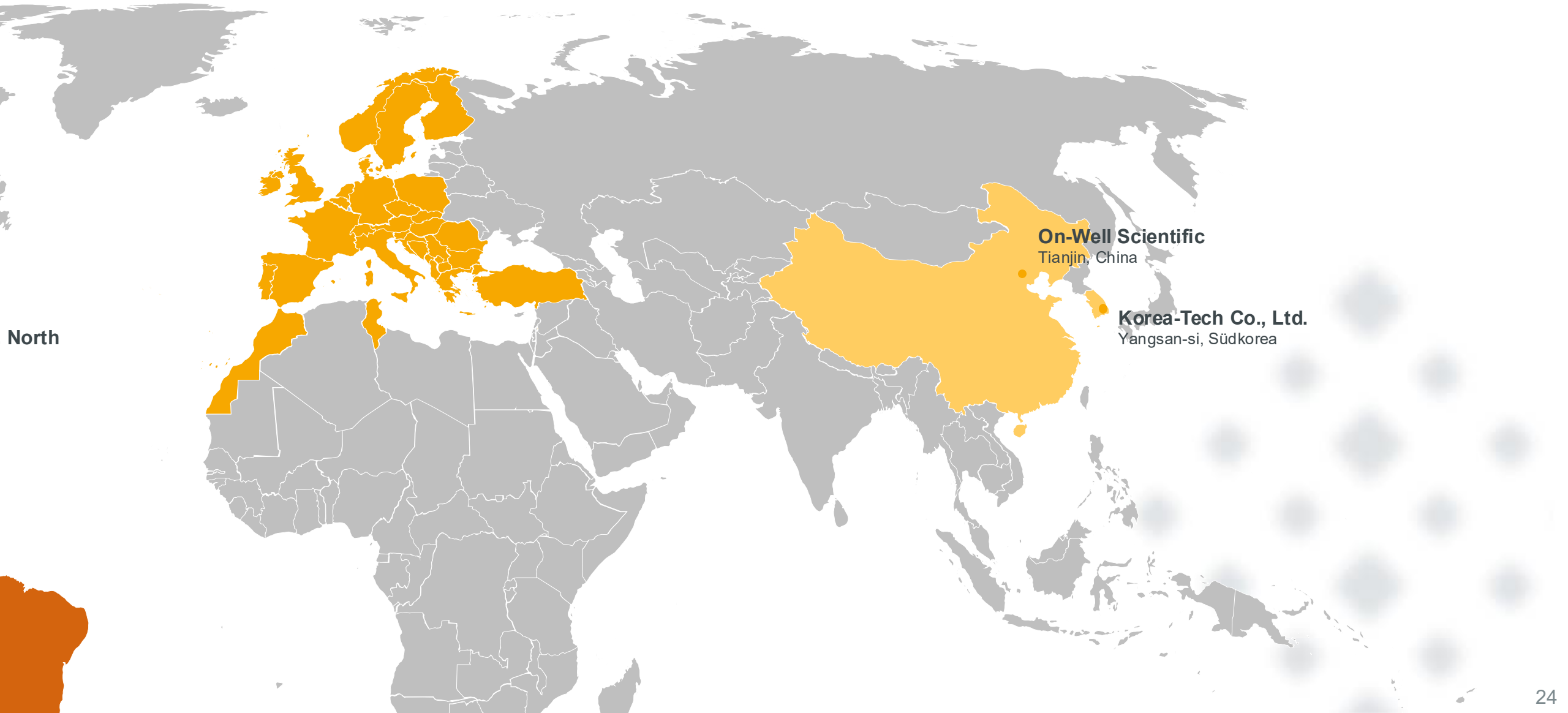
CleanControlling worldwide



CleanControlling worldwide



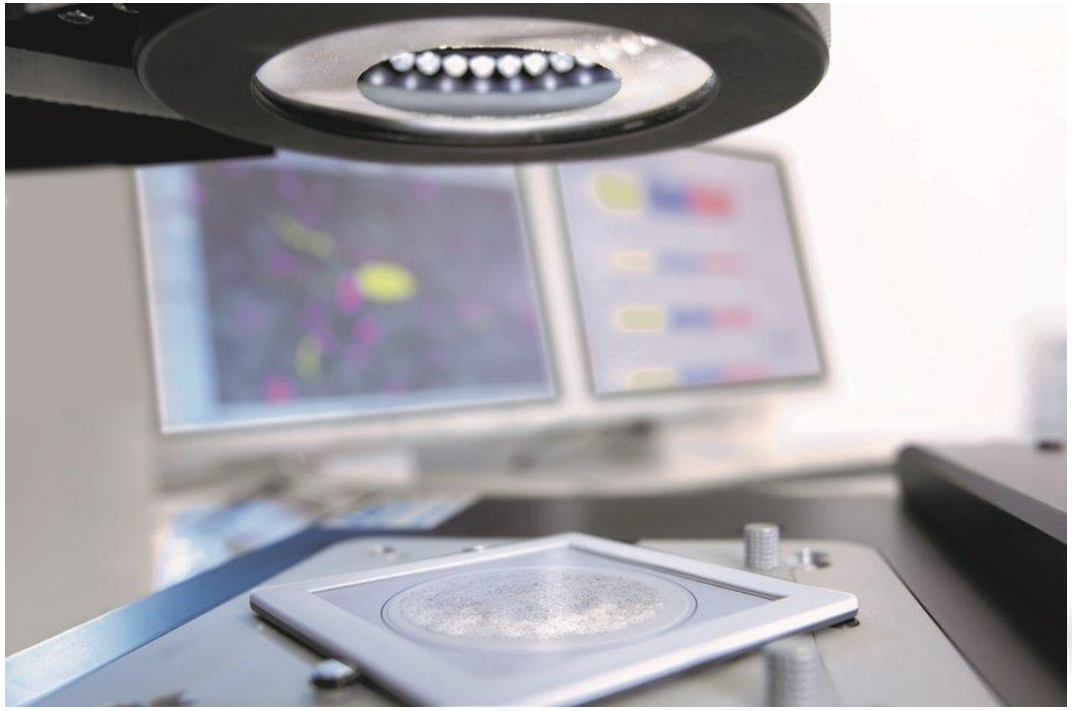
CleanControlling worldwide



Technical Cleanliness Laboratory

Particulate contamination

- Cleanliness inspections according to VDA 19.1, ISO 16232 and more than 1,000 customer standards
- Use of all extraction methods compliant with VDA 19.1
- Microscopy using stereo, materials and scanning electron microscopes
- Particle material identification using SEM/EDX and IR
- Particle determination in oils and greases



Technical Cleanliness Laboratory

Chemical and filmic contamination

- Determination of organic contamination using AGREE, gravimetry, surface tension, IR, TOC and GC-MS
- Determination of ionic contamination using IC and ROSE
- Detection and characterisation of chemical surface residues using GC-MS, TOC and THC



Technical cleanliness products

Particle vacuum extraction systems

- **C|PS³flex compact system:**
  Mobile on-site use in production environments.
  Continuous development since 2018.

- **C|PS³apex complete system:**
  A milestone featuring digital control.
  Full ESD protection



Technical cleanliness products

Particle monitoring (particle traps and stamps)

- Comprehensive monitoring equipment for technical cleanliness in production and logistics environments
- User-friendly products for use in in-house or external laboratories
- Customised solutions (design, QR codes, etc.)



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Technical cleanliness products

Particle monitoring (particle traps and stamps)

- Cooperation with PartikelART (start-up from TU Dortmund University)
- AI-based particle monitoring using a smartphone camera
- Customised product portfolio enabled by 3D printing
- Clever Stamps & PartikelLens
  - Fast, cost-effective, digital



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Consulting and training

Consulting

- Auditing and assessment of production according to VDA 19 Part 2
- Assessment of manufacturing processes
- Particle monitoring in production areas
- Particle investigations in manufacturing processes
- Support with troubleshooting related to residual contamination / technical cleanliness



Consulting and training

Training / qualification

- Basic technical cleanliness training
  - Online or on site
- Qualification programmes
  - Technical Cleanliness Professional
  - Technical Cleanliness Specialist
  - Technical Cleanliness Auditor



CONTENTS

Introduction to CleanControlling GmbH

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The future of VDA 19.1

Further standards and guidelines on technical cleanliness

TECHNICAL CLEANLINESS – DEFINITION

What does “technical cleanliness” mean?

From Wikipedia:

“Technical cleanliness means a sufficiently low level of contamination of cleanliness-sensitive technical components by harmful particles.”

Common definitions, standards and specifications for technical cleanliness are generally limited to particulate contamination.

Please note!

Filmic and chemical contamination can also be function-critical for components.

TECHNICAL CLEANLINESS – DEFINITION

What does “technical cleanliness” mean?

From Wikipedia:

“Technical cleanliness means a sufficiently low level of contamination of cleanliness-sensitive technical components by harmful particles.”

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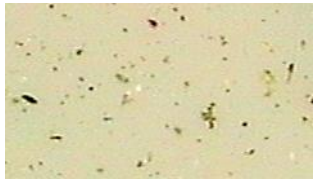
Please note!

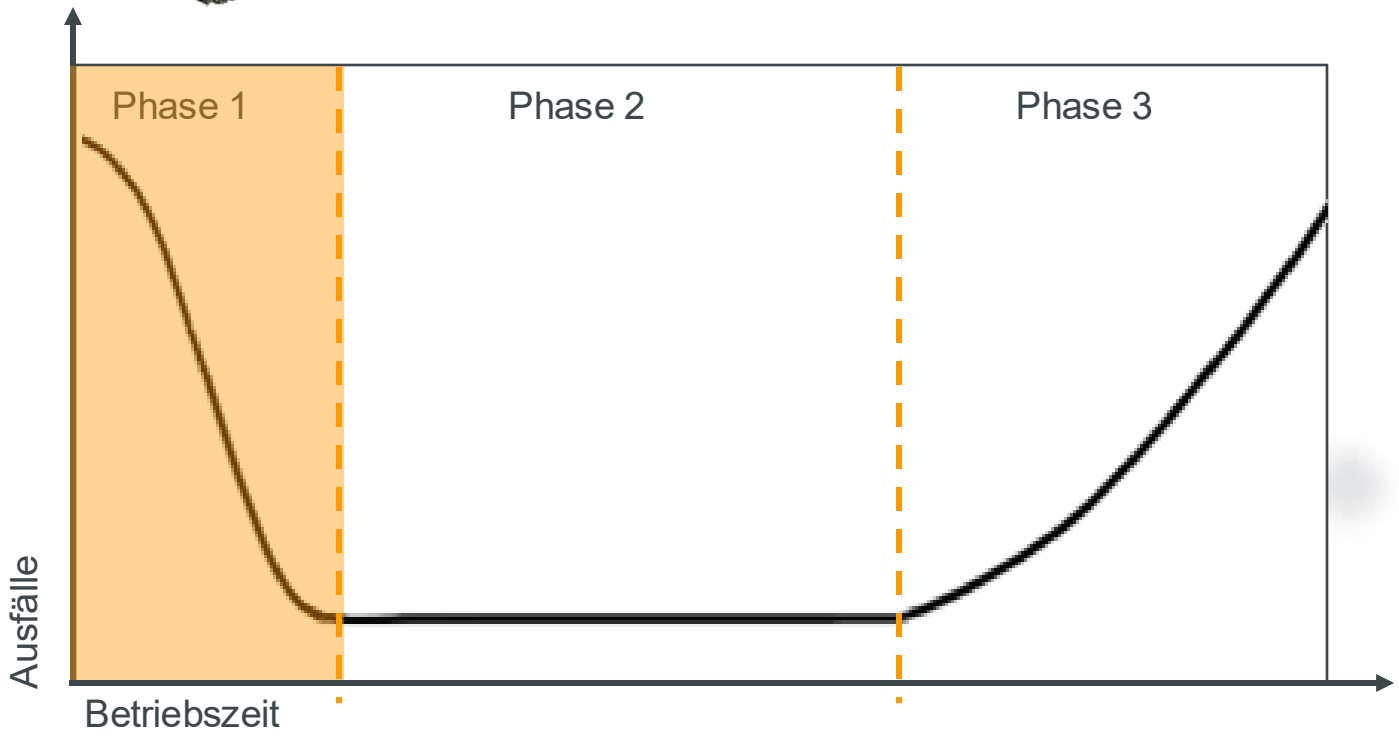
Filmic and chemical contamination can also be function-critical for components.

MOTIVATION
Growing importance of technical cleanliness

Residual contamination becomes technical cleanliness: permissible particle cleanliness limits are defined



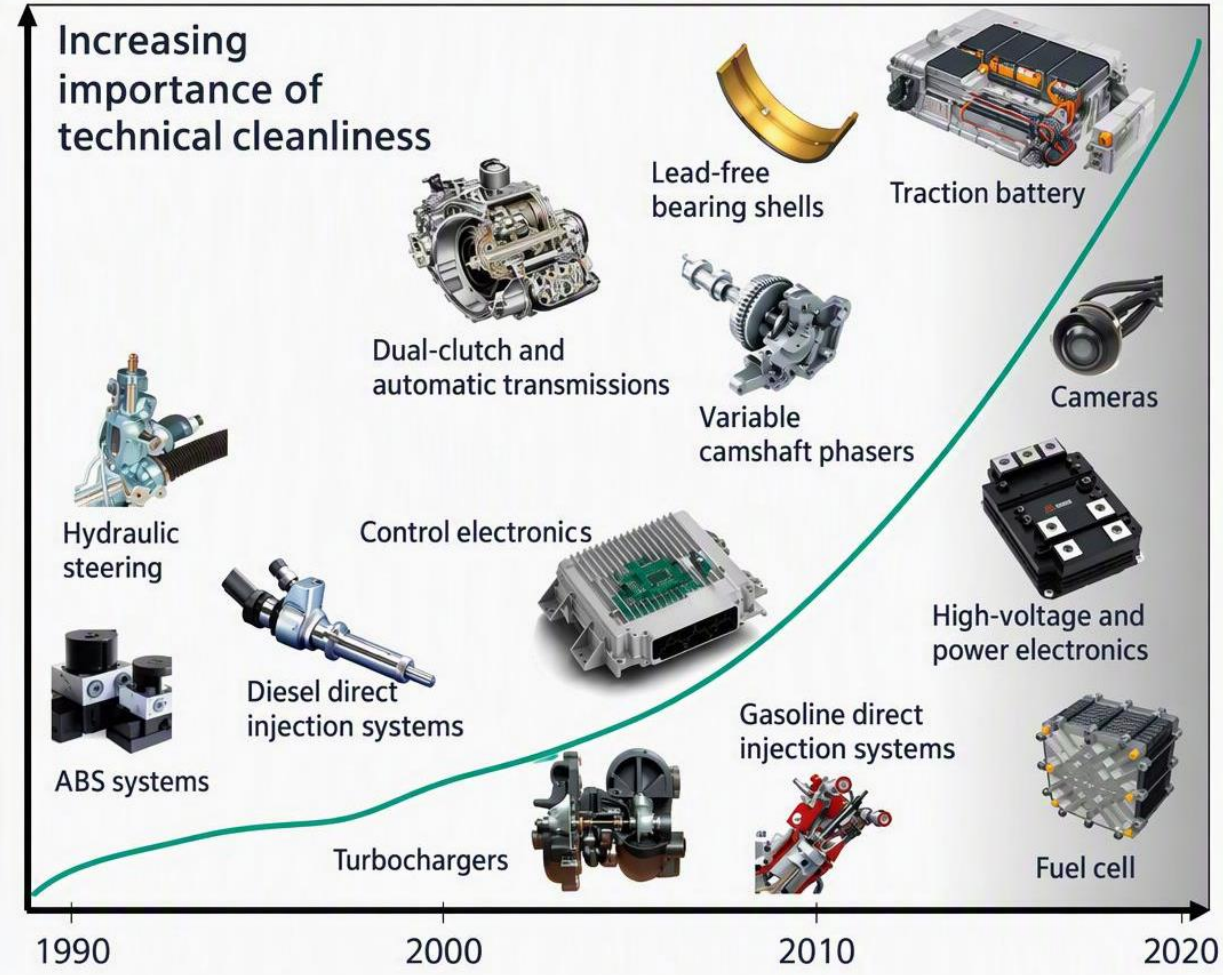




Source: VDA 19/1 industry consortium

MOTIVATION

Growing importance of technical cleanliness



Classical applications:

- (Engine) oil area
- Fuel system
- Brake system
- Cooling and air conditioning system
- Intake manifold
- Exhaust system
- Manual, automatic and axle transmissions
- Control electronics
- Steering systems

With the upcoming e-mobility:

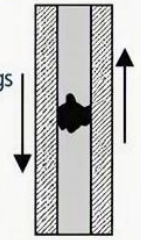
- High-voltage and power electronics
- Batteries
- Fuel cells

Source: VDA 19/1 industry consortium

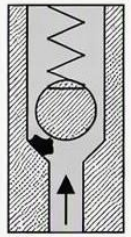
MOTIVATION
Examples of damage mechanisms

Particle-related failure mechanisms – Fluid systems, sealing and surfaces

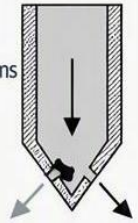
Jamming of bearings or sliding surfaces
- Turbochargers
- Crankshaft bearings
- Metering pumps
- Cylinder liners



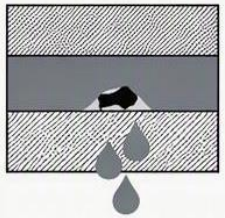
Blocking of valves
- Anti-lock braking system (ABS)
- Hydraulics
- Brake booster



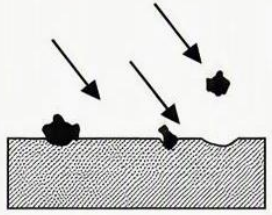
Clogging of nozzles or filters
- Injectors
- Fuel supply systems



Leakage at seals
- Lines
- Tanks
- Battery trays
- Electronic housings

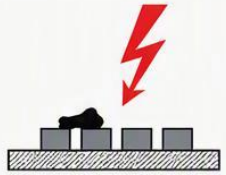


Surface damage
- Ball bearings
- Sensors
- Headlamp lenses

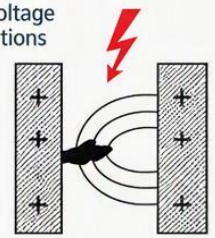


Particle-related failure mechanisms – Electrical, insulation and optical effects

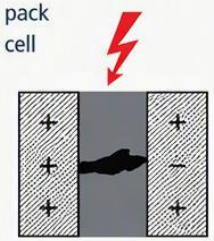
Short circuit of contacts
- Control electronics
- Power electronics



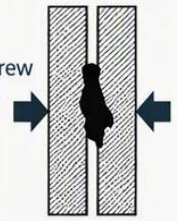
Reduction of air and creepage distances
- High-voltage applications



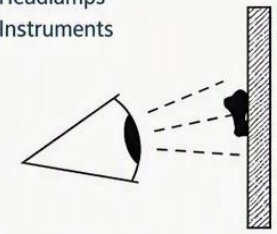
Impairment of insulation layers
- Battery pack
- Battery cell



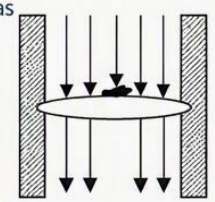
Influence on contact resistance
- Connectors
- Contacts
- Electrical screw connections



Optical soiling
- Headlamps
- Instruments



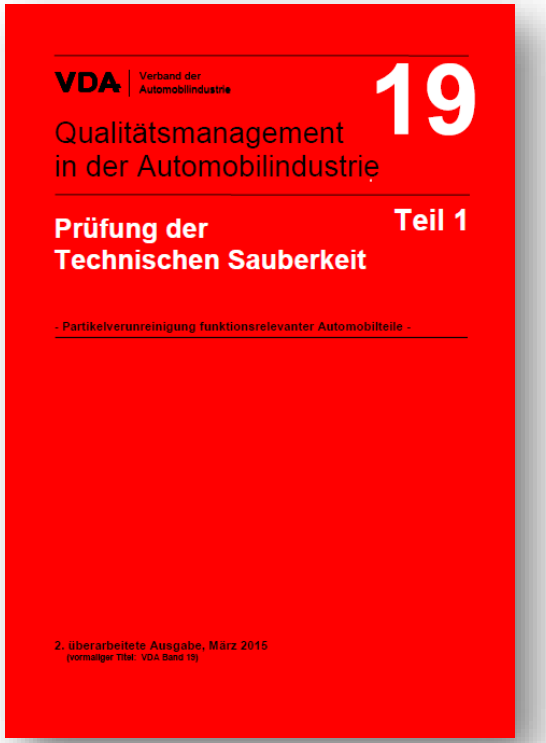
Optical blockage
- Sensors
- Cameras



Source: VDA 19.1 industry consortium 2025

CHARACTERISTICS AND NATURE OF TECHNICAL CLEANLINESS

Standards and specification documents


VDA | Verband der Automobilindustrie

19

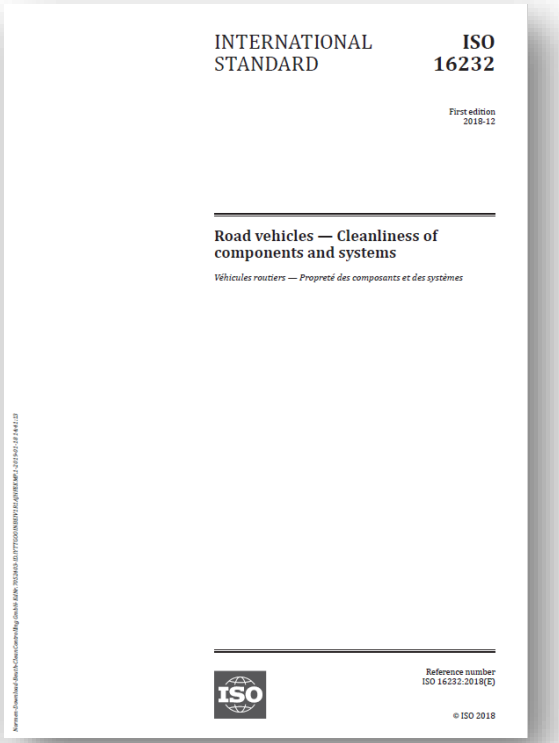
Qualitätsmanagement in der Automobilindustrie

Prüfung der Technischen Sauberkeit

Teil 1

- Partikelverunreinigung funktionsrelevanter Automobilteile -

2. überarbeitete Ausgabe, März 2015
(vormaliger Titel: VDA Band 19)


INTERNATIONAL STANDARD

ISO 16232

First edition
2018-12

Road vehicles — Cleanliness of components and systems

Véhicules routiers — Propreté des composants et des systèmes

Reference number
ISO 16232:2018(E)

© ISO 2018


BMW Qualitätsvorschrift
BMW Quality Specification

QV 11 111

Februar / *February* 2020

Erstverwendungs-Ko. Gr. *Initial use U.P.G.*	Erstverwendungs-Typ *Initial use on model*
06.95 – 7 584 130	E71 / N63

Anforderungsgerechte Technische Sauberkeit von Bauteilen und Fluiden in BMW Antrieben

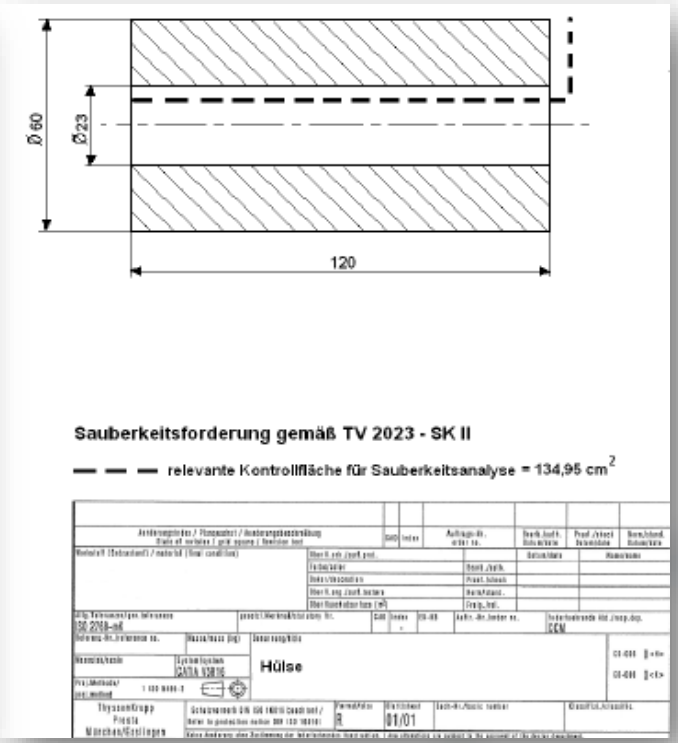
Appropriate Technical Cleanliness of Components and Fluids in BMW Power Train

Der Anwender dieses Dokumentes ist verpflichtet, sich über den gültigen Stand zu informieren.
Die deutsche Version ist verbindlich.
The user of this document is obligated to obtain information with regard to the validity of this specification.
The German wording is valid.

Fortsetzung Seite 2 bis 24
Continued on pages 2 through 24

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	EX-T	Prof. Dr. Helmut Schramm	

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Sauberkeitsforderung gemäß TV 2023 - SK II

— — — relevante Kontrollfläche für Sauberkeitsanalyse = 134,95 cm²

Hülse

DRAWING SPECIFICATION

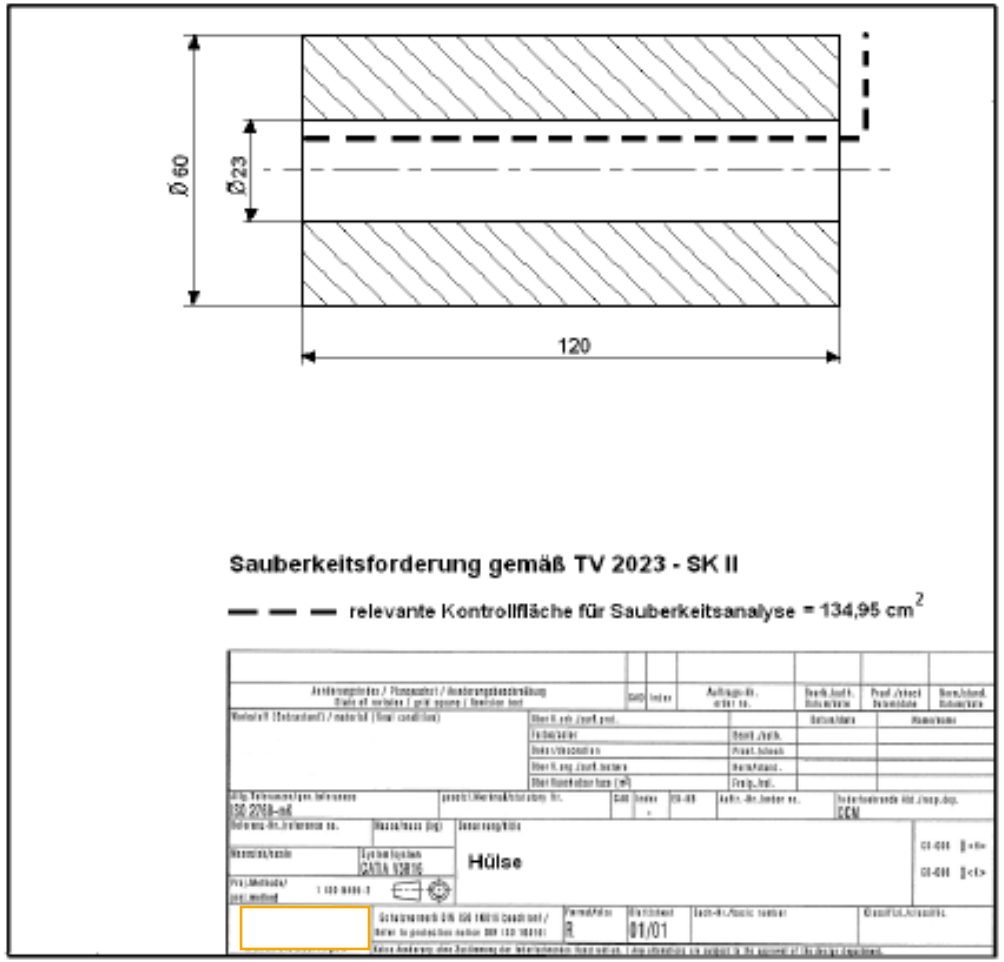
Technical cleanliness as a measurable and binding product characteristic

Current drawing specifications and manufacturer requirements

Tab 2 **Sauberkeitsklassen SK und max. zulässige Partikelanzahl pro 1000 cm ²**

Sauber-keitsklasse SK	Art der Partikel	K > 1000 µm	J 600 – 1000 µm	I 400 – 600 µm	H 200 – 400 µm	G 150 – 200 µm	F 100 - 150 µm	E 50 – 100 µm
I	gesamt*	1	8	8	64	130	250	1.000
	metallisch**	0	0	1	16	32	64	130
II	gesamt*	4	16	32	250	500	1.000	4.000
	metallisch**	0	0	2	64	130	250	500
III	gesamt*	16	32	130	1.000	2.000	4.000	16.000
	metallisch**	0	0	4	250	500	1.000	2.000
IV	gesamt*	16	32	500	4.000	8.000	16.000	64.000
	metallisch**	0	1	8	1.000	2.000	4.000	8.000
V	gesamt*	32	64	2.000	16.000	32.000	64.000	250.000
	metallisch**	1	2	16	2.000	4.000	8.000	16.000
VI	gesamt*	32	64	8.000	64.000	128.000	250.000	1.000.000
	metallisch**	1	4	32	4.000	8.000	16.000	32.000

*gesamt max. zulässige Anzahl aller Partikel je Größenklasse
**metallisch davon max. zulässige Anzahl der Partikel mit metallischem Glanz je Größenklasse



CHARACTERISTICS AND NATURE OF TECHNICAL CLEANLINESS

Standards and specification documents

Prüfvorschrift
Test specification

CleanControlling

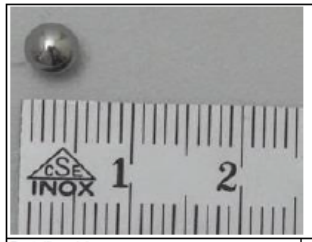
53xxx_PV_Kugel 5 mm_Musterkugel

CC-Artikel-Nr.:	53xxx	

Kunde *Customer*	Kunde / *Customer* Straße / *Street* Stadt / *City* Land / *Country*	Musterfirma Musterstraße 1 12345 Musterstadt Musterland

Kontakt Technik	Max Mustermann

Identifikation des Bauteils/
Identification of component



Bauteilbezeichnung *Component name*	Kugel 5 mm
Bauteilnummer *Component No.*	Musterkugel
Oberfläche pro Bauteil *Surface of component*	0,7854 cm²
Bemerkung *Comment*	Losgröße 500

Kundenanforderung
Customer requirement specification
VDA 19 / ISO 16232

	Sollwert *Rated value*
Gravimetrie *Gravimetric result*	≤ 2 mg / 1000 cm²
Größtes metallisch glänzendes Partikel *largest metallic shining particle*	≤ 300 µm
Größtes nicht glänzendes Partikel [1] *largest not shining particle* [1]	≤ 300 µm

1) Nicht glänzende Partikel ohne Fasern (Faserkriterium siehe Kapitel Mikroskopie)
Not shining particles w/o fibers (fiber definiton see chapter microscopy).

Fasern [2] *fibers* [2]	≤ 3000 µm

2) Faserkriterium siehe Kapitel Mikroskopie.
Fiber definiton see chapter microscopy.

Analyseprotokoll
Analysis report

Sauberkeitsprüfung
Cleanliness Inspection

DAkkS

CleanControlling

Analyse Nr. ***Analysis No.***	12346
Analyse-Datum ***Date of Analysis***	12.4.2014
Prüfberichtsdatum ***Date of Report***	12.4.2014
Kunden Nr. ***Customer No.***	123

Identifikation des Bauteils / *Identification of component*

Bauteilbezeichnung
Component name
Kugel 5 mm

Bauteilnummer
Component no.
12345

Datum Bauteileingang /Bestellnummer
Date part received/ Order number
10.4.2014

Entnahmeort
Sampling site
-

Cleancontrolling Artikel Nr.
Cleancontrolling article no.



Analyseergebnis (Zusammenfassung) / *Analysis result (summary)*

Kundenanforderung *Customer requirement specification*
VDA 19 / ISO 16232

	Soll *rated value*	Ist *actual value*	Ergebnis *result*
Gravimetrie *Gravimetric result*	≤ 2 mg / 1000 cm²	0,03 mg / 1000 cm²	✓
Größtes metallisch glänzendes Partikel *Largest metallic shining particle*	≤ 300 µm	180 µm	✓
Größtes nicht glänzendes Partikel [1] *Largest not shining particle* [1]	≤ 300 µm	183 µm	✓
Größtes faseriges Partikel [2] *Largest fiber particle* [2]	≤ 3000 µm	536 µm	✓

1) Nichtglänzende Partikel ohne Fasern (Faserkriterium siehe im Kapitel Mikroskopie der Prüfvorschrift)
Not shining particles w/o fibers (fiber definiton see chapter microscopy in test specification)
2) Faserkriterium siehe im Kapitel Mikroskopie der Prüfvorschrift
fiber definiton see chapter microscopy in test specification

Quarz, Sand, Stein wurde über eine manuelle, visuelle Begutachtung des Prüfers über das Stereomikroskop durchgeführt: Es konnten keine auffallenden Partikel dieser Gruppe erkannt werden.
Quartz, sand, stone are manually and visually checked. We found no noticeable particle out of this category.

Restschmutzanforderungen **erfüllt/*passed***
Cleanliness specifications

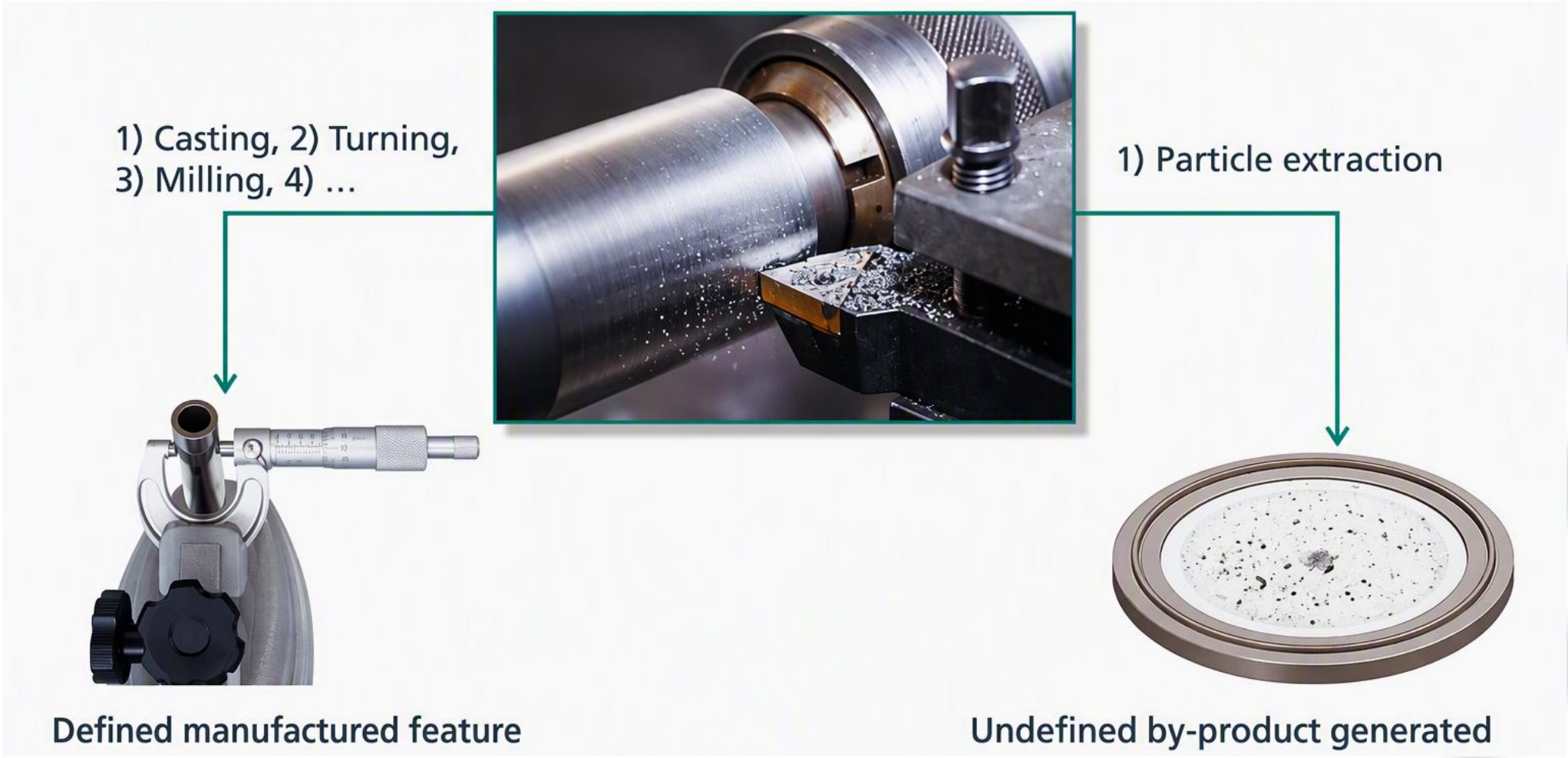
Die Analyse wurde erstellt von *Prepared by*	Prüfung und Freigabe des Prüfberichtes durch *Reviewed and authorized by*
Gez. Annamaria Borelli /Labor *Laboratory*	Gez. Dr. Oliver Podlech / Technische Leitung *Technical management*

PRÜFBERICHT

CHARACTERISTICS AND NATURE OF TECHNICAL CLEANLINESS

Interpretation of cleanliness requirements

Technical cleanliness is subject to greater variation than deliberately manufactured characteristics



Source: TecSa 2.0 industry consortium

CHARACTERISTICS AND NATURE OF TECHNICAL CLEANLINESS

Interpretation of cleanliness requirements

Process capability studies are not applicable to technical cleanliness!

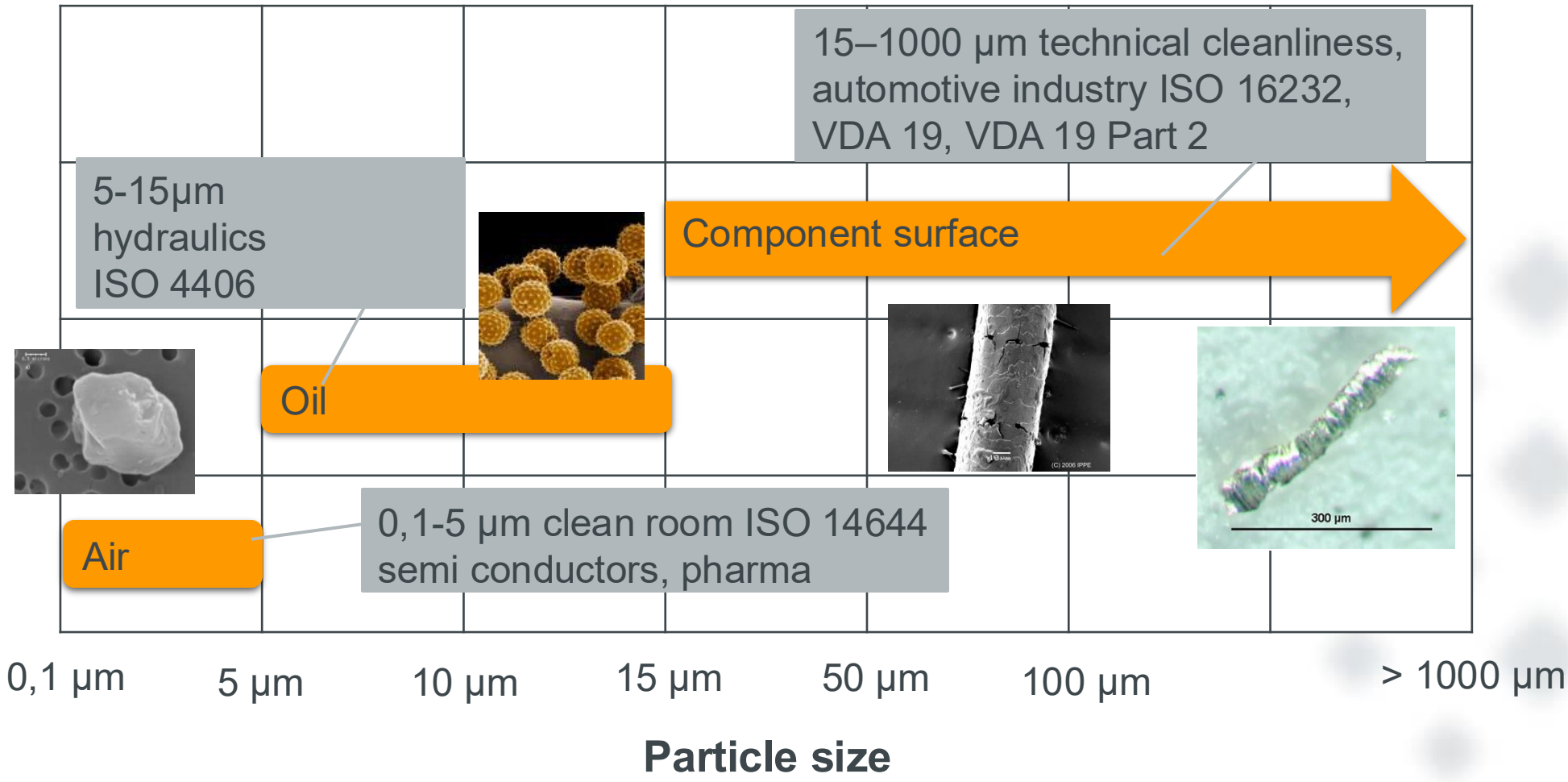


Source: TecSa 2.0 industry consortium

CHARACTERISTICS AND NATURE OF TECHNICAL CLEANLINESS

Relevant STANDARDS and REGULATIONS

Particle sizes and applicable standards



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Introduction to CleanControlling GmbH

Characteristics and nature of technical cleanliness

The future of VDA 19.1

Further standards and guidelines on technical cleanliness

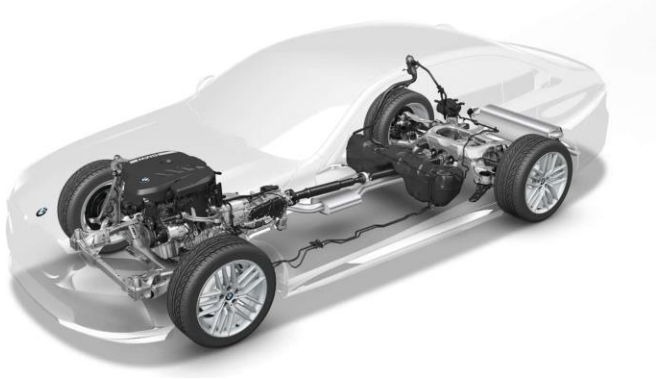
THE FUTURE OF VDA 19.1

Growing importance of technical cleanliness

From a simple quality characteristic on the drawing and sample-based inspection

to a

safety-critical drawing specification effectively requiring 100% inspection











Source: VDA 19.1 industry consortium 2025

THE FUTURE OF VDA 19.1

Motivation & objectives

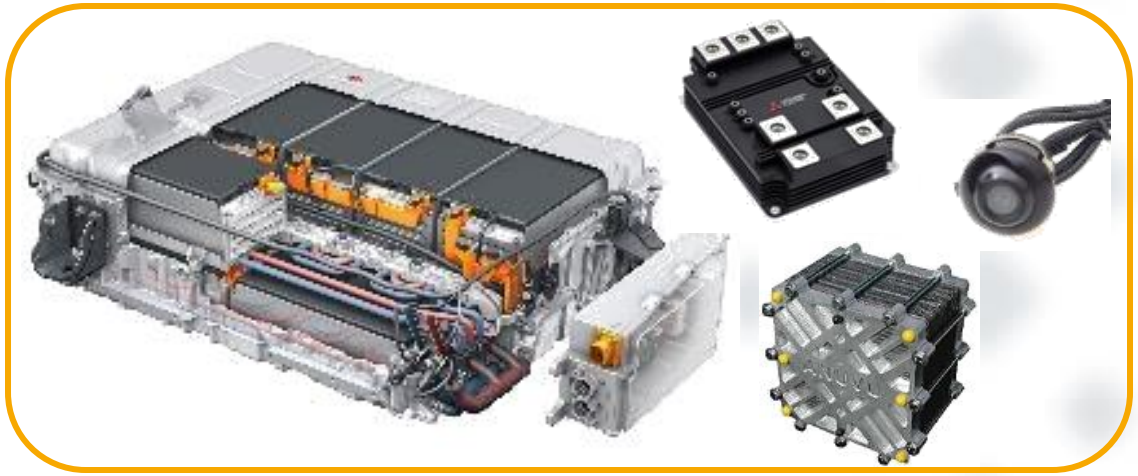
Motivation: transition to electromobility and autonomous driving

- Large / heavy components
- Energised components
- Dry process chains
- Different / additional materials (plastics, ceramics, etc.)



New requirements

- New damage mechanisms
- Small particles (< 50 µm, below the standard analysis range) are relevant



THE FUTURE OF VDA 19.1

Motivation & objectives

Objectives

- Integration of new dry extraction methods and new analytical techniques
- Retention of comparable standard analyses and creation of more flexible, problem-specific tests within defined requirements
- More precise description of testing for particles < 50 µm
- Development of a standard SEM/EDX analysis with uniform material classes
- Numerous optimisations and clarifications of test procedures and initial parameters based on many years of experience



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Vorstellu

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Die Zuku

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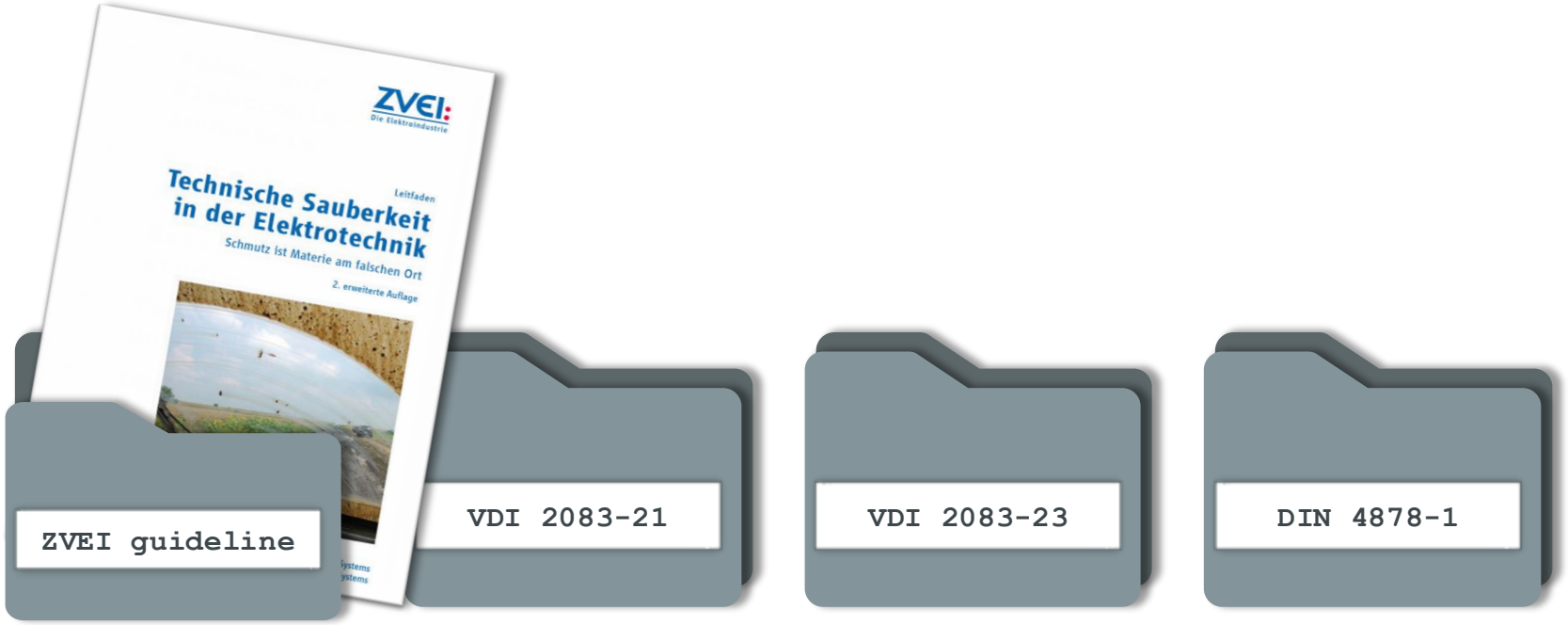
The future of VDA 19.1

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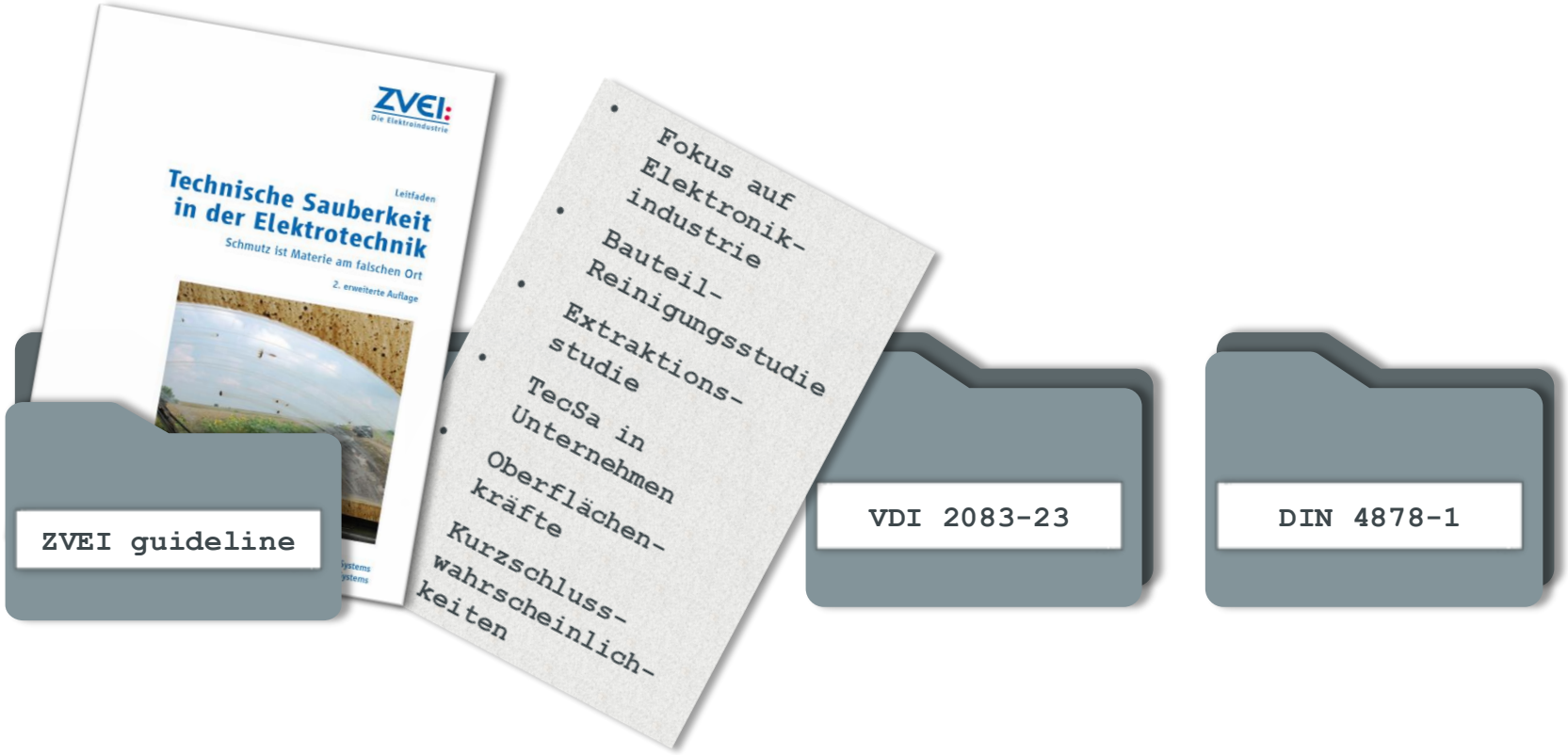
FURTHER STANDARDS AND GUIDELINES



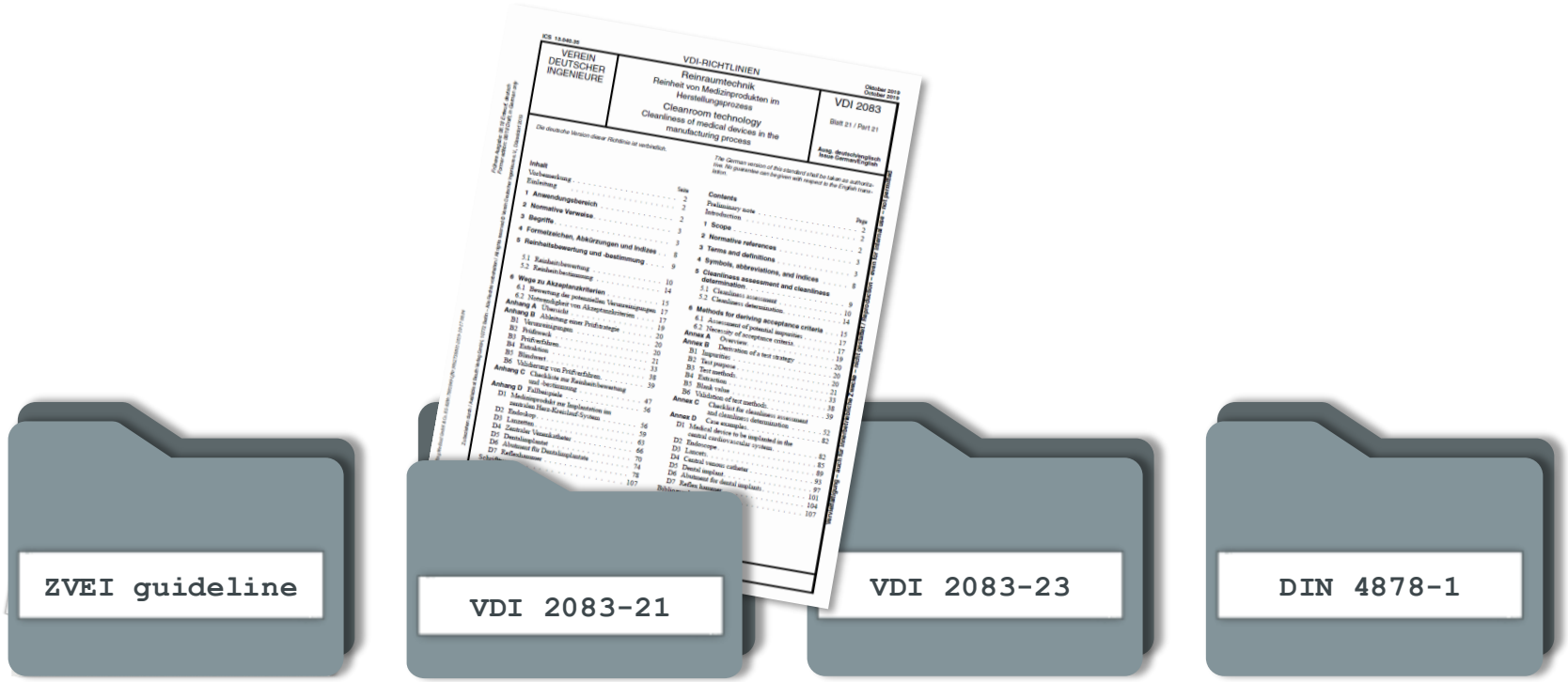
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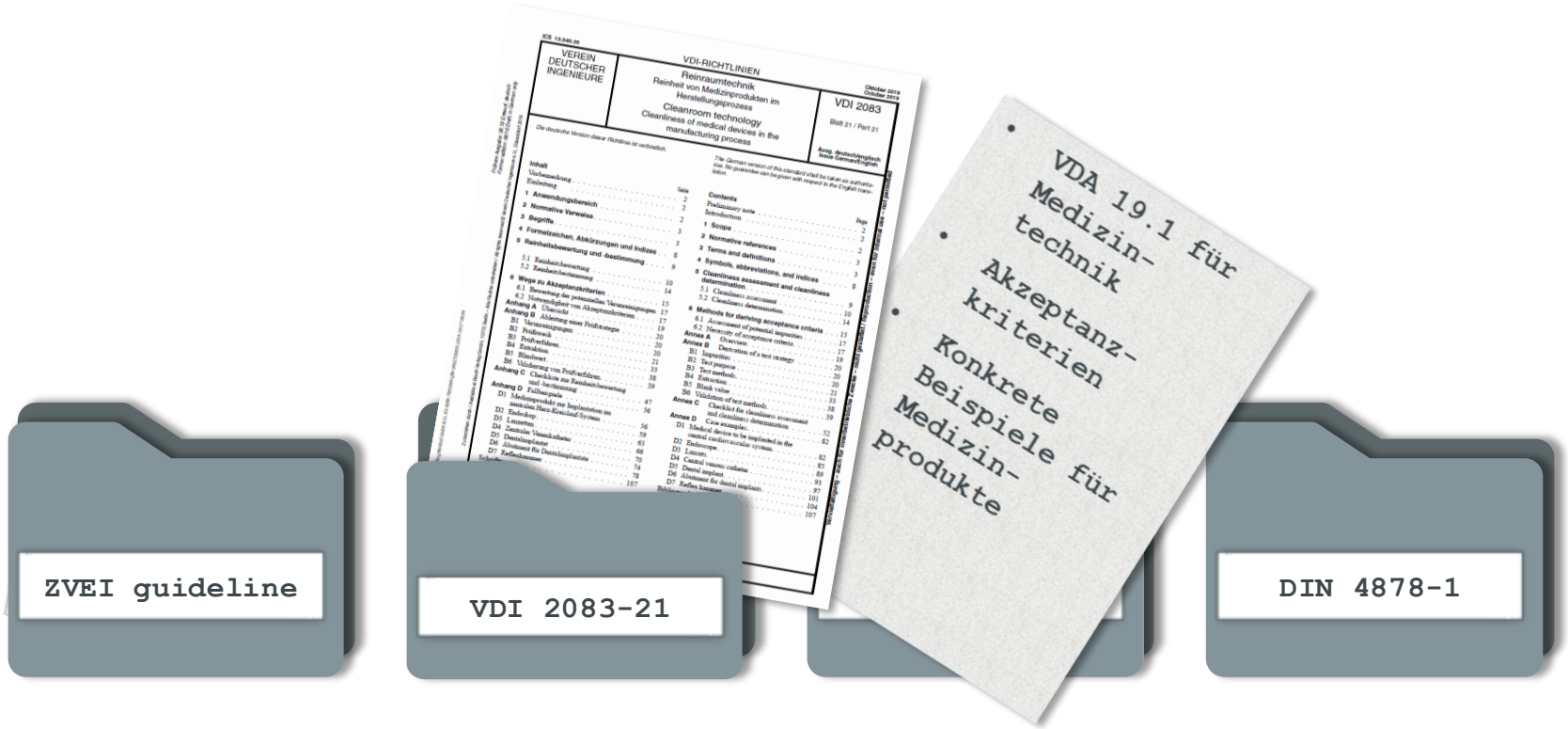
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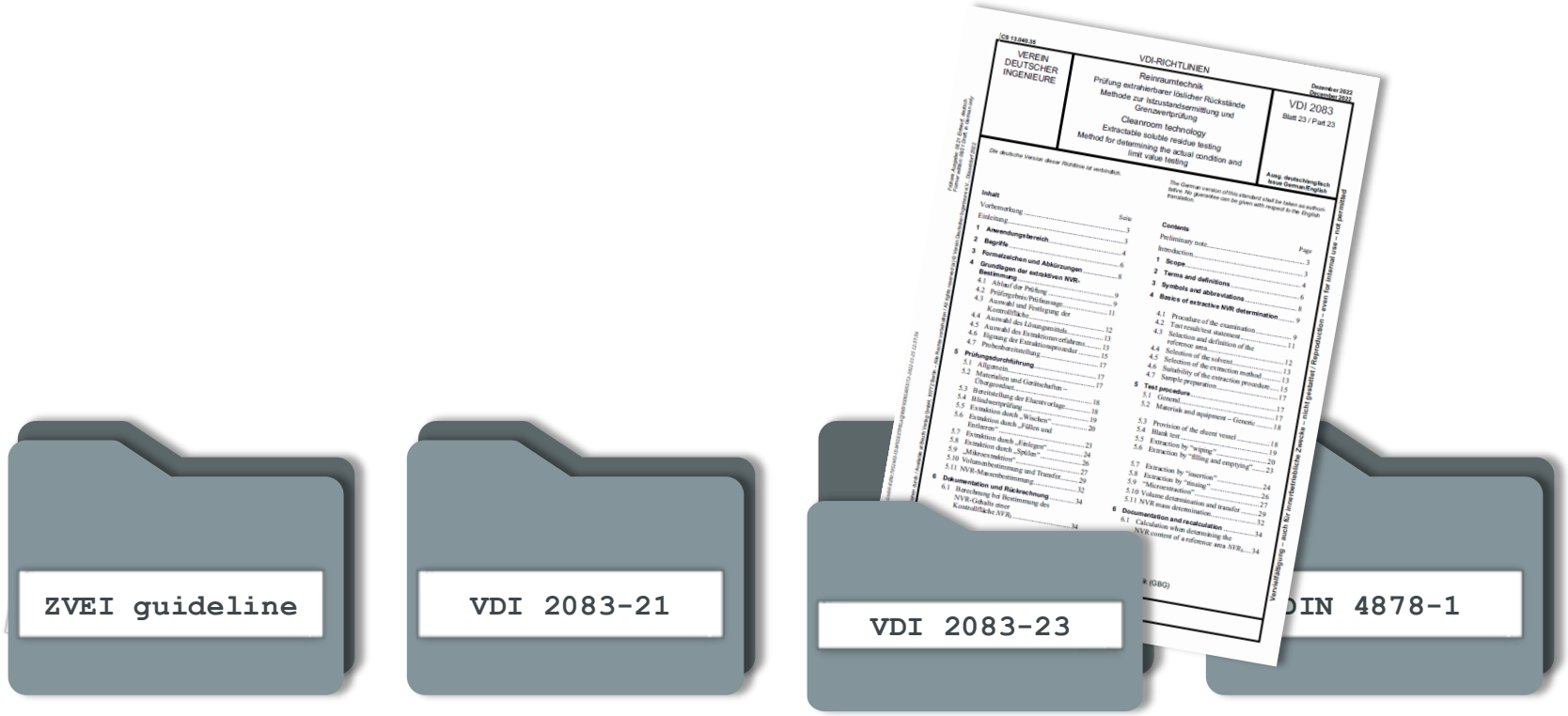
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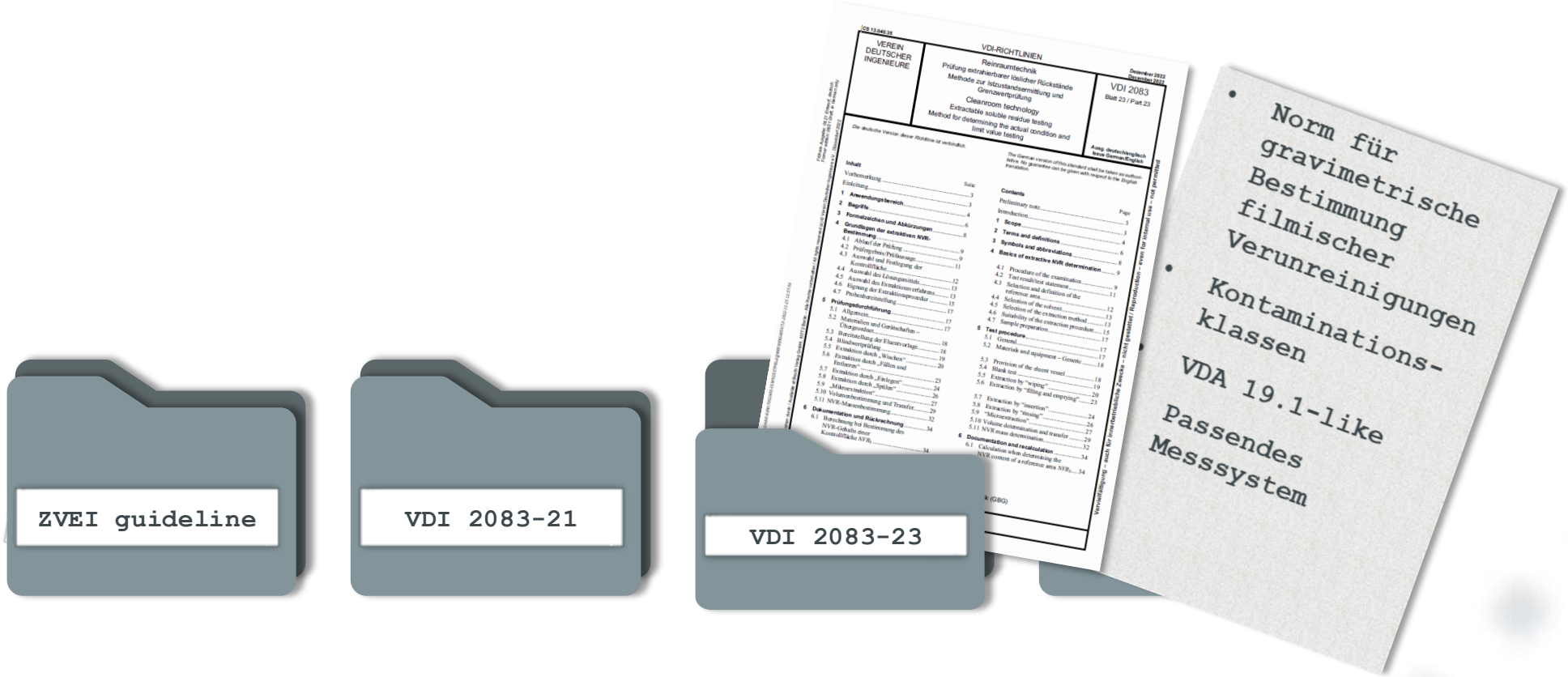
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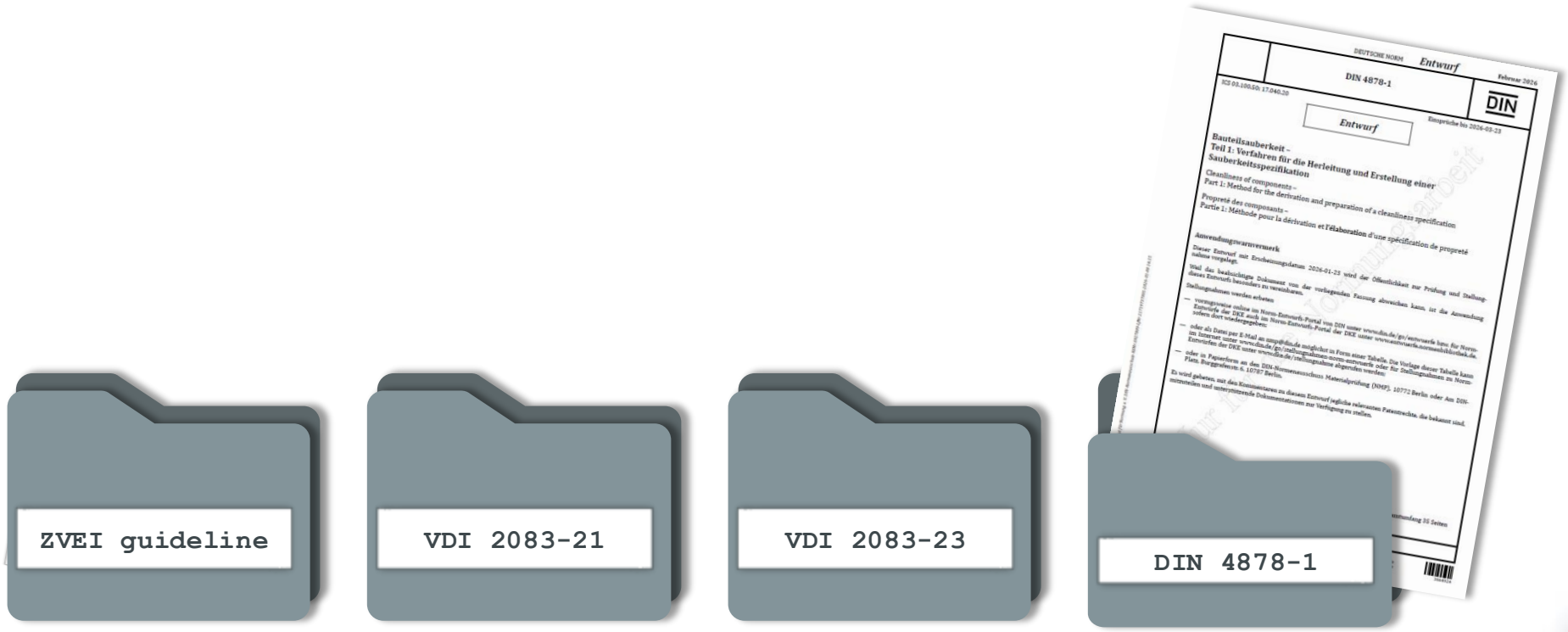
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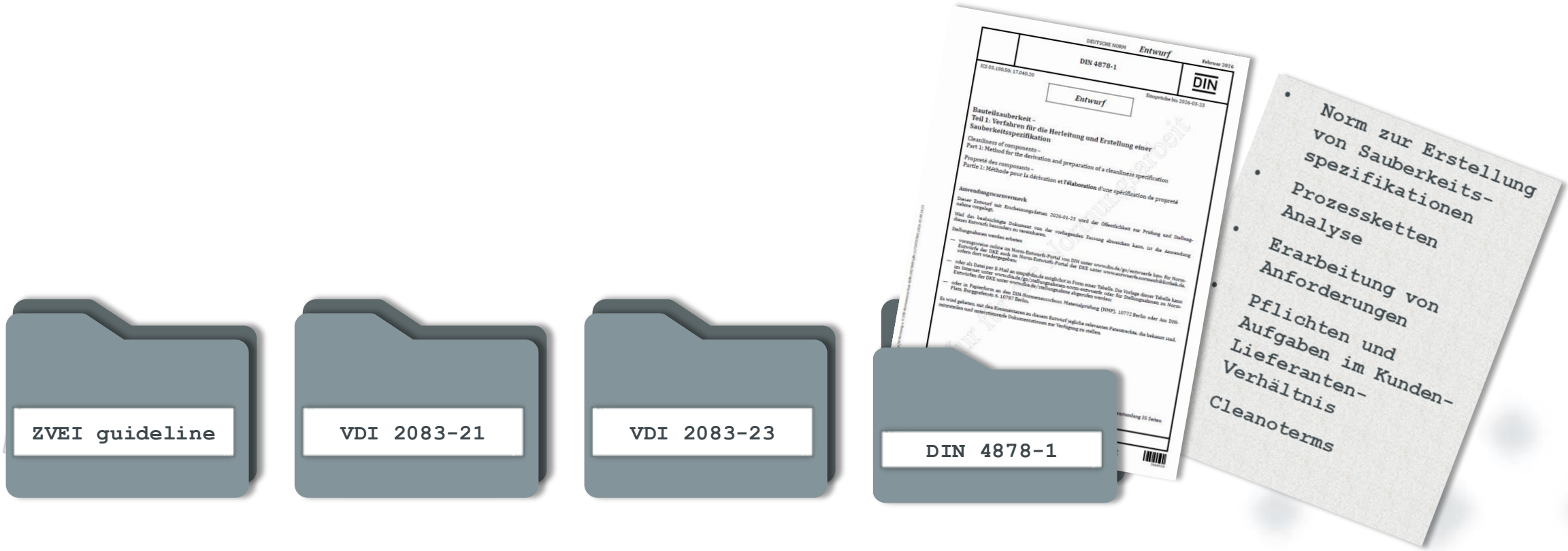
FURTHER STANDARDS AND GUIDELINES



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FURTHER STANDARDS AND GUIDELINES



QUESTIONS



Do you have any questions about the presentation?

Chat



E-Mail

seminar@cleancontrolling.de

Thank you for your attention



