

# Training

Practical Training Courses on Shot Peening Technology



## Content

Content	Page
Shot Peening Training – Practical and Sustainable . . . . .	3
Shot Peening Level 1 . . . . .	5
Shot Peening Level 2 . . . . .	7
Shot Peening Level 3 . . . . .	9
Rotary Flap Peening. . . . .	11
Shot Peening Practical Course . . . . .	13
Shot Peening Workshop . . . . .	15
Recertification . . . . .	17
Exams and Certificates . . . . .	19
Individual Training . . . . .	21
Nadcap Audit Preparation . . . . .	23
Practical Course Residual Stresses . . . . .	25
Product Training . . . . .	27
sentenso Shot Peening Training – Our Partners . . . . .	29
sentenso Shot Peening Training – Our Trainer Team . . . . .	31

## Shot Peening Training - Practical and Sustainable

The qualification of employees is of essential importance, especially in the field of special processes such as shot peening. However, the knowledge required for this cannot be acquired through the classic training professions or courses of study, but only through specialist training.

Our training programme is based on the specific needs of our customers - a practice-oriented approach to shot peening processes based on requirements and reliability to upgrade your components.

Significant applications for shot peening can be found, for example, in the spring industry, powertrain technology or turbine construction.

### Our Concept

The basis of our wide-ranging training programme is the three-stage shot peening training designed by Electronics Inc. (EI) and accepted by the US Federal Aviation Administration (FAA):

- Level 1: Beginner - Basic knowledge for machine operators
- Level 2: Advanced - User knowledge for process planners, machine programmers and quality inspectors
- Level 3: Professionals - Expert knowledge for process and quality managers

This programme also includes Rotary Flap Peening and recertification training. Students acquire the relevant certificate in training courses at our site or in their own companies.

A particular feature is our supplementary practical course for shot peening level 2 in our own technical centre. All essential training topics are deepened with the help of practical exercises in which the students themselves lend a hand under the expert guidance of our trainers.

As a training partner of Nadcap, we support companies from the aviation industry in preparing for the required audits. Our training programme is completed by flexible individual training courses. For material-oriented users, we offer the practical course on residual stresses.

All EI and sentenso instructors have a certificate of proficiency as well as many years of technical process experience. We enrich the mandatory training material with our own content from our many years of experience in the development and securing of shot peening processes.

### About sentenso

sentenso has been providing innovative solutions for process and quality management in blast cleaning and shot peening since 2009. The goals are systematic, reliable and efficient process control as well as meaningful, significant and simple quality inspection.

Take advantage of our individually adapted product and system solutions to implement your requirements in process development and peening media, process control and machine technology as well as in measuring and testing technology.

Ensure the sustainability of your investment with our advanced services such as engineering, automation, digitalisation, maintenance and training.

### Your Benefits

Thanks to the didactically designed, systematically structured and practically oriented training contents of our industry-experienced trainer team, our students receive effective preparation for their operational tasks in the planning, application and testing of shot peening processes in their companies.

With the acquisition of the relevant certificates, our participants prove their knowledge and skills and thus support the internal quality management of their companies.

Towards interested customers our students document that they have mastered the respective requirements for safe shot peening processes and thus promote the competence of their companies internally and externally.

# Level 1

## Shot Peening Level 1



### Basic Knowledge for Machine Operators

Simple introduction to the process technology of shot peening, clearly and concisely presented

The Shot Peening Level 1 course is primarily aimed at machine operators and conveys the basics of shot peening technology. It is designed for all newcomers to the subject and forms the basis for further training.

After a general introduction to application examples, our trained instructors introduce the participants step by step and systematically to the technical basics of the shot peening process. The students learn about the significance and correlations of peening media, shot peening intensity and coverage, and also how to differentiate between them.

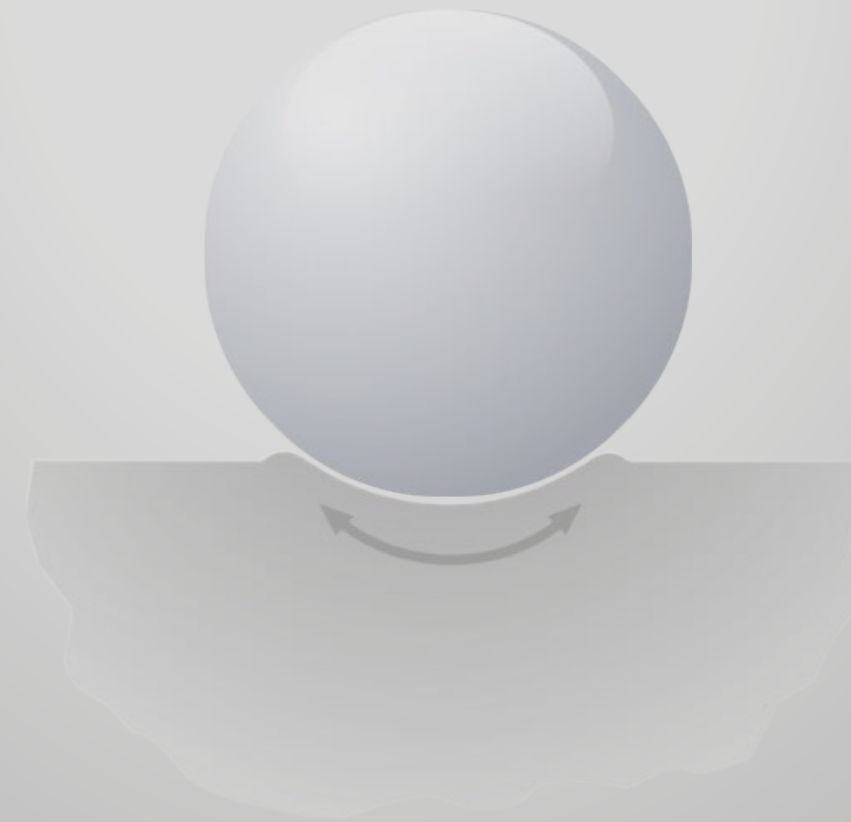
Course contents include:

- Media: Types and grades of peening media, quality inspection by grain size and shape analysis (basics)
- Intensity: Determination with Almen strips and saturation curves (basics)
- Coverage: Determination with visual methods and tools such as magnifying glasses and comparative images (basics)

The knowledge is deepened through practical exercises. Optionally, our trainers can provide further training content with practical relevance, such as carrying out and documenting a shot peening process. In addition, there is the opportunity to discuss and clarify questions from the group of participants.

The course concludes with the "Shot Peening Level 1" course examination.

FAA Course C-IND-IM-130813-K-006-001



# Level 2

## Shot Peening Level 2



**User Knowledge for Process Planners, Programmers and Quality Inspectors**  
 Advanced process understanding in shot peening, lively and practically conveyed.

The Shot Peening Level 2 course is primarily aimed at employees from the areas of process planning, machine programming, quality inspection, machine and tool procurement as well as management personnel in the manufacturing department.

This course provides in-depth knowledge and skills in shot peening technology. It is based on the Shot Peening Level 1 course and can be taken immediately after this or at a later date.

Building on the basics of the Level 1 course, our experienced trainers focus on a systematic and detailed consideration and application of the process-related variables. The students learn to differentiate between machine parameters, process parameters and quality parameters and to apply them correctly.

Course contents include:

- Media: Types and grades of peening media, quality inspection by grain size and shape analysis (advanced)
- Intensity: Determination and development with Almen strips and saturation curves (advanced)
- Coverage: Determination and development with visual methods and aids such as magnifying glasses and comparison patterns (advanced)

The knowledge is deepened through practical exercises. In addition, the advanced surface technology topics of topography, hardness and residual stress are discussed. Optionally, our trainers will provide further training content with practical relevance, such as planning and development of a shot peening process or alternative processes. In addition, there is the opportunity to discuss and clarify questions from the group of participants.

The course concludes with the "Shot Peening Level 2" course examination.

**FAA Course C-IND-IM-130813-K-006-002**



# Level 3

## Shot Peening Level 3



**Expert Knowledge for Process and Quality Managers**  
Deepening of the interrelationships between machine, process and quality in shot peening, worked out in discussions.

The Shot Peening Level 3 course is primarily aimed at managers with practical experience who take responsibility for shot peening processes and the product quality in the company. The course requires the knowledge and skills of the Shot Peening Level 2 course as well as at least one year of practical experience in the application on machines and systems.

Consequently, our trainers with many years of practical experience guide the participants to deepen and penetrate the relevant topics technologically. Building on the knowledge of peening media, peening intensity and coverage, the influences of shot peening on surface topography, surface hardness as well as the targeted residual stress in near-surface layers of the component are discussed intensively in a small group of participants.

Course contents include:

- Peening parameters: Machine, process and quality parameters
- Procedures and processes: Development, execution and documentation, alternative processes
- Residual stresses: Mechanisms, benefits and determination

Furthermore, questions on machine technology and operation, troubleshooting, process optimisation, measurement and testing techniques as well as component design are discussed. In addition, our trainers look forward to discussing company-specific issues. The aim is to promote process awareness and problem-solving skills so that participants can move confidently in the technology after the training.

The course concludes with the Shot Peening Level 3 course examination. The exam consists of answering challenging, open questions on shot peening processes and quality assurance, which are to be explained in keywords, as free text or in the form of sketches.

**FAA Course C-IND-IM-130813-K-006-003**

## Value and Special Significance of Level 3 Shot Peening Training

With the Level 3 training and examination, the participants meet the increased requirements for a process or quality manager for shot peening. Such experts know or recognise the connections between process management with machine settings or shot peening parameters on the one hand and quality management with the associated measured variables or quality characteristics on the other.

On this basis, the process or quality manager develops and optimises shot peening processes and defines the required machine-specific processes and control plans. In addition, he identifies potential defects and takes actions for error avoidance, detection and elimination.

With the Level 3 certificate of the training programme provided by EI and sentenso, the student acquires an excellent practical and specialised qualification that cannot be acquired through classical apprenticeship programmes or university studies.

With the Level 3 graduate, the company receives a proven expert who can meet the requirements of shot peening in terms of its complexity, process reliability and reproducibility.

# Rotary Flap Peening



**Manual but Safe Repair Processes**  
Theory and practice with user-friendly tools for aviation applications complying to SAE AMS 2590.

## Rotary Flap Peening

Rotary Flap Peening is a manual repair process that has been established in aviation for decades. With the rotating media embedded in the so-called flap, a cold work effect similar to that of shot peening is achieved, but the media is prevented from entering components and structures of the aircraft. The particular benefit is the high flexibility and low effort of manual processing on site, as these parts usually do not have to be removed or only need to be partially dismantled. Neighbouring surfaces do not have to be protected from a peening effect.

The special process has a wide range of applications, such as the local peening of reworked surfaces, the repair of previously shot-peened components, the straightening of geometrically deformed parts, etc.

The Rotary Flap Peening course is aimed primarily at users from the aerospace industry, regardless of whether the application in question is the repair of aircraft components or the treatment of new parts.

The training starts with the theoretical basics and parameters of the process. As with shot peening, the following main content is the determination of the quality parameters intensity and coverage. The practical implementation is clearly explained with the help of pictures and explanatory videos. Another training element is information and selection criteria on the necessary equipment. The theoretical part ends with a 45-minute Rotary Flap Peening course examination. Passing the exam is the condition for access to the practical part.



In the practical part, our trained instructors teach the correct working technique through practical demonstration. All participants then acquire the tool handling in this manual process while working with a suitable flap peening drive.

Participants take a practical examination and must demonstrate that they are able to master the technique in accordance with the SAE AMS 2590 standard in a safe and reproducible way.

**FAA Course C-IND-IM-130813-K-006-005**

# Practical

## Shot Peening Practical Course



**Unique Training Programme on Real Peening Machines**  
Machine technology, process development and quality testing with practical tasks.

As a special opportunity for the practical application of the freshly acquired knowledge, we recommend our special shot peening practical course in our well-equipped technical centre, as a supplement to the Level 2 course.

In practical training on real machines and test equipment, our participants put the theoretical training content into practice themselves. Due to the increasing demands on the stability of processes and quality in shot peening, we place particular emphasis on the accurate proceeding in all work steps.

For process management, our technical centre provides, among other equipment, a compressed air and a wheel shot peening unit with automated workpiece and nozzle movement as well as sensors and actuators for process control.

For quality management, suitable testing equipment is used to qualify media properties as well as to determine surface properties. For this purpose, our laboratory has various measuring devices ranging from a sieving machine for grain size analysis up to an X-ray stress analyser for determination of residual stresses.

The practical exercises are supported by provision of helpful training material. Our dedicated technical team supports the trainers during the practical to provide the adequate guidance, so that the training objectives are being achieved.

The recognition of the shot peening practical course as a training module by the US aviation authority FAA is in preparation.



# Workshop

## Shot Peening Workshop

Our twice-yearly shot peening workshop with a selected, practice-oriented training programme of shot peening topics is aimed at all shot peening users at different training levels, from machine operators to process managers in the company. During the Workshop our qualified instructors will convey all shot peening basics in clearly illustrated lectures on process and quality management.



### Process Management

In Process Management students will learn the basics for an appropriate proceeding by correlation of machine settings and the peening parameters in the real process.

### Quality Management

In Quality Management we show our students how to examine shot peening media and how to determine peening intensity and coverage, with an additional excursion on residual stress.



### Practice

Our workshop proves its sustainability through the various practical exercises which enable our students to apply the newly acquired knowledge and thus deepen the information given beforehand.

### Individual Questions

In addition, there are numerous occasions for discussing individual tasks and answering application-related questions. Moreover our students take the chance to exchange experiences with peers from other companies.

**Ideal Combination of Theory and Practice**  
Multi-day Level 1 to 3 training programme and excellent networking opportunity.



# Recertification

## Recertification



### Renewal of Acquired Shot Peening Certificates

Refreshing of training content and discussion of application-specific questions.

Various companies using shot peening technology require regular recertification of their personnel in their process specifications and quality guidelines. One important reason for that is the limitation in non-destructive testing of target surface properties like stress on the component itself. So since the result of a shot peening treatment can mainly be verified by in-process control, it is recommended to regularly re-train, deepen and check the process understanding of the employees.

Shot peening treatments are described in detail in specifications and standards, but in practical everyday work there is often need for interpretation. Here, the experienced participant of a recertification training can discuss approaches for solving problems or interpretations of standards and specifications with trainers, colleagues and peers.

The recertification training therefore offers a very good opportunity to exchange ideas with colleagues specialising in shot peening and to network. This networking, independent of company-specific tasks that may need to be kept secret, allows mutual help with practical shot peening questions that arise on a daily basis.

The training material consists of the respective core contents of shot peening level 1, level 2 and level 3 or rotary flap peening. In addition to individual questions, new developments and the current state of the art are covered.

Recertification courses can only be booked if the corresponding courses have been successfully completed beforehand. The training concludes with a course examination. Successful participants receive the corresponding certificate.

# Certificates



**Proof of Shot Peening Competence**  
Acquisition of certificates for Level 1 to 3 and Rotary Flap Peening, accepted by the FAA.

## Exams and Certificates

FAA certified courses are completed with a course examination. Successful participants receive the corresponding certificate, in the other case a certificate of attendance.

**FAA IA/AMT course exams offered incl. 8 hours credit**

<b>Shot Peening Level 1</b> FAA Course C-IND-IM-130813-K-006-001	45-minute exam
<b>Shot Peening Level 1 Recertification</b> FAA Course C-IND-IM-130813-K-006-001	45-minute exam
<b>Shot Peening Level 2</b> FAA Course C-IND-IM-130813-K-006-002	60-minute exam
<b>Shot Peening Level 2 Recertification</b> FAA Course C-IND-IM-130813-K-006-002	60-minute exam
<b>Shot Peening Level 3</b> FAA Course C-IND-IM-130813-K-006-003	90-minute exam
<b>Shot Peening Level 3 Recertification</b> FAA Course C-IND-IM-130813-K-006-003	90-minute exam
<b>Rotary Flap Peening</b> FAA Course C-IND-IM-130813-K-006-005	45-minute exam
<b>Rotary Flap Peening Recertification</b> FAA Course C-IND-IM-130813-K-006-005	45-minute exam



# Individual

## Individual Training

The great variety of possible training topics or company-specific questions and requirements in shot peening, blast cleaning and finishing partly requires individually elaborated contents.

Based on the many years of theoretical and practical experience of our trainers, we create requirement-oriented course programmes and adjust them to the individual needs of the companies and participants.

Specific topics, for example:

- Process management in shot peening
- Quality management in shot peening
- Process planning, general approach or planning for special components
- Job audits according to individual or manufacturer specifications
- Compressed air shot peening technology, incl. sensors and actuators
- Wheel shot peening technology, incl. sensors and actuators
- Machine procurement, preparation of specifications
- Digitisation in shot peening
- Standards, specifications and best-practise for shot peening usw.

Individual training in your own company offers an excellent opportunity to deal precisely and in detail with specific tasks and to work out suitable solutions together in a team.



### Individual Training Content According to Requirements

Customer and application-specific shot peening training live on production machines or in sentenso's technical centre.

## Nadcap Audit Preparation

Quality audits in companies must be planned very thoroughly. The diverse questions and special features of shot peening technology also require dedicated audit preparation, regardless of whether the audits are conducted by authorities, customers or internally.

In the aerospace industry, Nadcap has established itself as a specialised quality audit for component manufacturers and service providers. The audit is based on the following Nadcap questionnaires:

<b>AC7117</b>	<b>Nadcap Audit Criteria for Surface Enhancement Peening</b>
AC7117/1	Nadcap Audit Criteria for Computer Controlled Peening
AC7117/2	Nadcap Audit Criteria for Automated Peening
AC7117/3	Nadcap Audit Criteria for Peen Forming
AC7117/4	Nadcap Audit Criteria for Flapper Peening
AC7117/5	Nadcap Audit Criteria for Manual Peening

The criteria for equipment and processes listed in the catalogues must be met in order to obtain Nadcap certification in the field of surface enhancement by shot peening. The a.m. catalogues are divided according to the peening processes used in the company and are supplemented by manufacturer-specific requirements.

This course deals with individual specific tasks and questions of the Nadcap audit, as well as with its significance in the context of the company's quality management. The trainers place great emphasis on the optimisation of the operational process and quality management in the shot peening process, so that the benefits of the audit become apparent to all participants. This proceeding is intended to overcome widespread reservations about the introduction of new quality standards.

Since the result of a shot peening treatment can usually not be checked directly on the workpiece, but mainly indirectly via in-process control, the key topic of process control is the starting point of this training.

Linked with the process, special topics of calibration for machine and measuring equipment as well as maintenance routines for machines and systems are discussed in detail.

In addition, the training programme deals with the importance of the associated documentation with index-compliant document management.

The training programme is completed by discussion of generally valid but sometimes underestimated quality principles such as order and tidiness.



**Audit Preparation for Shot Peening Applications Complying to Nadcap AC7117**  
Analysis and optimisation of operational processes and documentation within the internal quality management.

# Practice



**New Ways and Fast Results in X-ray Diffraction**  
Basic understanding and practical determination of residual stresses with the X-ray stress analyser.

## Practical Course Residual Stresses

The essential target of shot peening is to introduce residual stresses into near surface layers of the component in order to increase its lifetime under dynamic loads. The positive effect of shot peening on the fatigue strength opens up a technologically extremely important potential to design components lighter in order to save material and energy.

Nevertheless, the challenging relations of shot peening and material science tend to discourage users, as clear explanations and simple measurement methods are not very widely spread and difficult to access.

Therefore the aim of the first part of the training is to develop technical understanding in residual stresses step by step. Building on this in the second part the determination of residual stresses by means of a new, simple and extremely fast method of X-ray diffraction will be the subject of several practical exercises.

The main contents of the practical course on residual stresses are:

- Model explanation of residual stresses
- Mechanism and targeted introduction of residual stresses
- Benefits of residual stresses
- X-ray determination of residual stresses by means of a simple and extremely fast X-ray stress analyser with area detector performing practical exercises
- Residual stress mappings, complex stress states and measurement automation



# Products



**Optimised Use of Product Potentials**  
Supporting technicians and engineers in the design and application of machine and measurement technologies with process and quality relevance.

## Product Training

Our product training courses are aimed at all users of our innovative products. Even though we attach great importance to simple and intuitive use and operation, the full technical potential of some process and quality management products and systems can be used even better after systematic training.

The training courses support engineers and technicians of machine manufacturers in the design of process-relevant machine functions and components. For machine owners, the training ensures efficient use and value-preserving maintenance for products of process and machine technology and provides support in specific machine upgrades. Quality inspectors and quality managers receive valuable advice on the effective use of measuring and auxiliary equipment.

Examples of topics for our product training courses are:

- Media flow: Sensors and actuators, MagnaValve operation, adjustment and calibration, use of flux:on Media Flow Management
- Rotary Flap Peening: Correct application of the RotoFlapMaster and other tools
- Residual stresses: Measurements with the  $\mu$ -X360s X-ray stress analyser, stress profiling, measurement automation

We have been carrying out training courses both in our own technical center and at companies on site. This allows us to respond flexibly to specific questions and tasks of our customers. For further information, please contact our sales team.



# Partners

## Partners



### sentenso Shot Peening Training – Our Partners



#### Training Organiser sentenso Smart Peening Solutions

sentenso GmbH has been delivering services and innovative equipment for process and quality management in blast cleaning and shot peening since 2009. Since then, we have been carrying out shot peening training both as part of workshops in our own technical center and at companies on site. The training focuses on applications in the aerospace, automotive and other demanding industries.

Our experienced team of trainers continues to work on improving and updating our training program and is open to suggestions from outside.



#### About our Training Partner strahlportal

strahlportal with its owner Volker Schneidau has been providing practice-oriented engineering services in blast cleaning and shot peening technology since 2007.

strahlportal provides technological consulting in applications, neutral system planning and the development of blast cleaning and shot peening processes on its own machines. Another focus is training, authoring and lectures on various topics in shot peening.



#### About our training partner Electronics Inc., USA

Electronics Inc. (EI) has been developing and producing equipment for process reliability and quality assurance in shot peening since 1974, and continues to set globally recognized standards.

EI is the founder of shot peening education in 1991 and continues to lead the way in high quality shot peening training. Since then, EI and its global partners have trained thousands of shot peening users from a wide range of industries, including Aerospace, Automotive, Energy and Medical.

#### A strong team

Our network of partners and trainers form a strong team with practical experience for practice-oriented shot peening training.

# Trainer

## sentenso Shot Peening Training – Our Trainer Team



### Competence and Commitment

Our shot peening trainers not only bring experience from processes and applications, but are very personally involved also.

#### Dave Barkley, EI SPT Training Manager

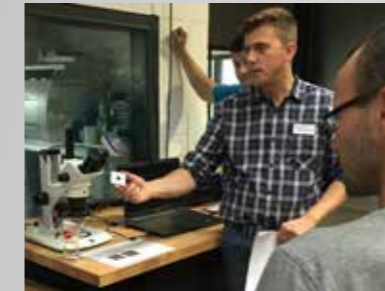


Dave Barkley has been involved in shot peening education for Electronics Inc. since 1987.

He is an active member of the SAE Surface Enhancement Committee which maintains industry specifications for Shot Peening and Roto-Flapper Peening processes. Dave Barkley is an FAA FAAsteam representative specialising in shot peening education.

Focus: Training development, FAA training

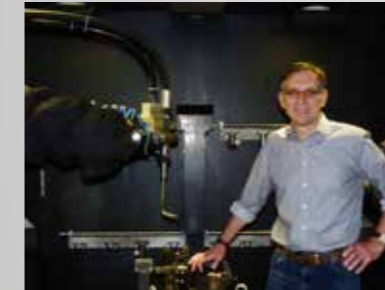
#### Dipl.-Ing. Volker Schneidau



Volker Schneidau has been working in blast cleaning and shot peening technology since 1997. The mechanical engineer worked for 10 years as a designer, project and sales manager in machine construction. In 2007 he founded strahlportal engineering firm. In 2009 he founded sentenso GmbH.

Focus: Applications in automotive, drive and chassis components

#### Wolfgang Hennig



Wolfgang Hennig has been working in the aviation industry since 1990, focusing on shot peening.

In addition he has been working as a shot peening trainer since 2005. His professional positions were Liebherr Aerospace-Lindenberg and Rolls-Royce Germany.

Focus: Applications in aviation and engine components

#### Holger Polanetzki



Holger Polanetzki has worked in process development in the aviation industry for MTU Aero Engines AG since from 1986 to 2022. Since 2002, his main area of responsibility has been shot peening. The process engineer conducts shot peening audits worldwide and is a member of SAE committees and the „International Scientific Committee for Shot Peening“.

Focus:  
Aero engine and stationary gas turbine components

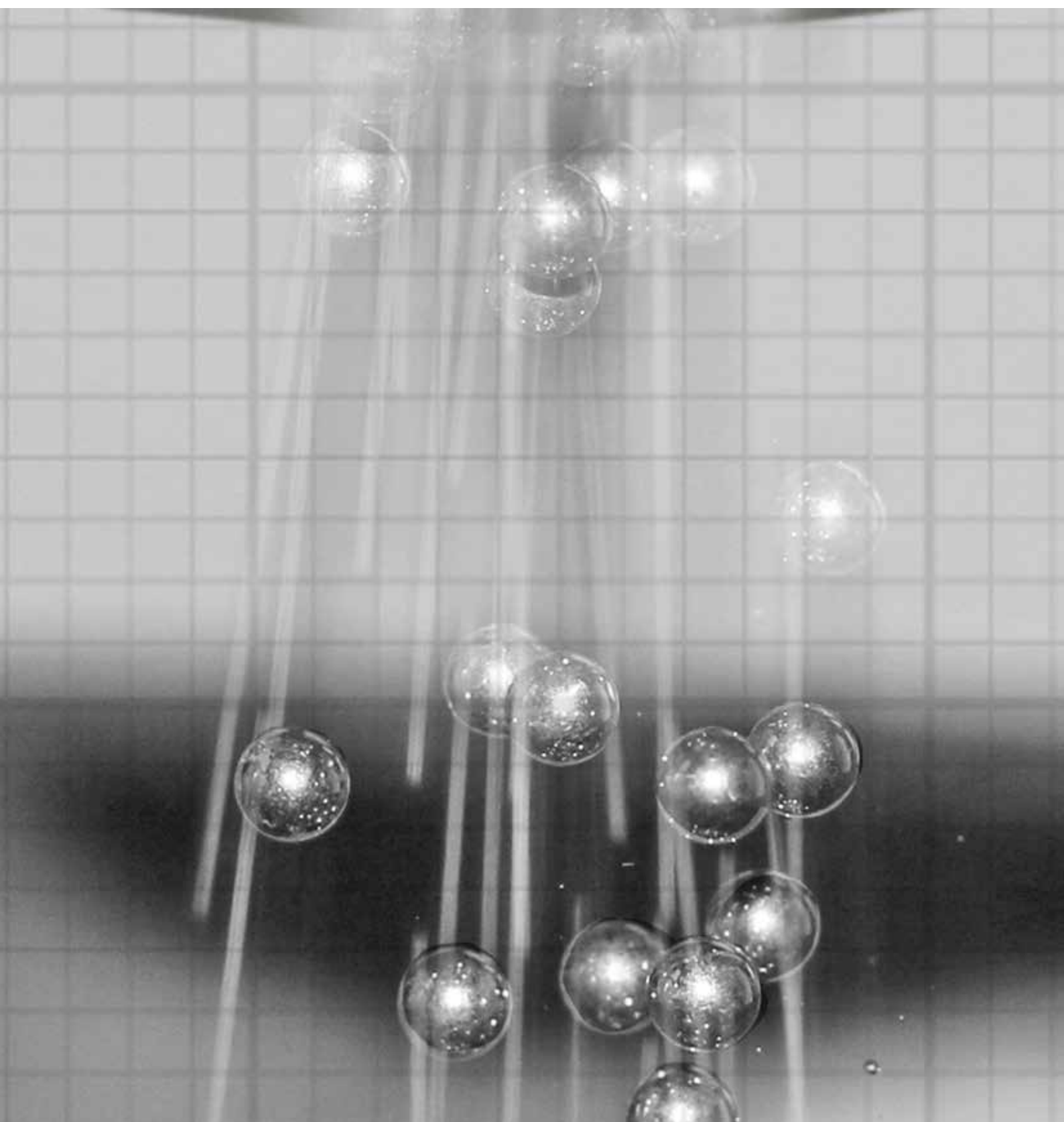
#### B. Eng. Jörg Behler



The mechanical engineer has been working in the fields of service, process and product development at sentenso GmbH since 2009.

Focus: Surface enhancement and residual stresses





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