

Industrie Service

Mehr Sicherheit.  
Mehr Wert.

## Defects in glass fibre-reinforced plastics

Examples from industrial practice

Institute for Plastics

# Contents

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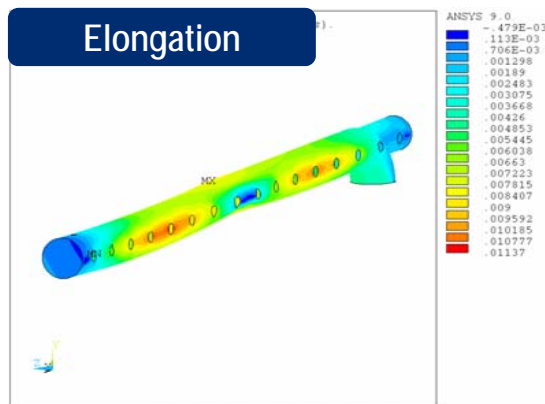
1. Causes of defects
2. Examples of defects
3. Prevention of nonconformities

# 1. Causes of defects

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## 2. Examples of defects Breakage/buckling of a pipe



### EXAMINATIONS

- Determination of wall thickness
- Examination of laminate structure
- Determination of Young's modulus
- Recalculation using finite elements

### SOLUTIONS

- Preventive: Examination of design
- Corrective: Pipe replacement

Non-conforming design – increased compressive stress and pronounced buckling tendency

## 2. Examples of defects

### Pipe leakage



#### EXAMINATIONS

- Visual examination
- Theoretical assessment of resistance to chemicals

#### SOLUTIONS

- Preventive:  
Select material suitable for the application or medium
- Corrective:  
Replace pipe / restrict applicable media

Selection of non-conforming materials (not resistant to chemicals)



## 2. Examples of defects

### Nozzle broken off from a tank



#### EXAMINATIONS

- Visual examination including comparison against requirements
- Inspection / re-calculation

#### SOLUTIONS

- Preventive: Examination of design / information
- Corrective: Installation of a new nozzle



Non-conforming dimensioning / design

## 2. Examples of defects

### Breakage of a skirt-mounted tank



#### EXAMINATIONS

- Visual examinations
- Recalculation using finite elements

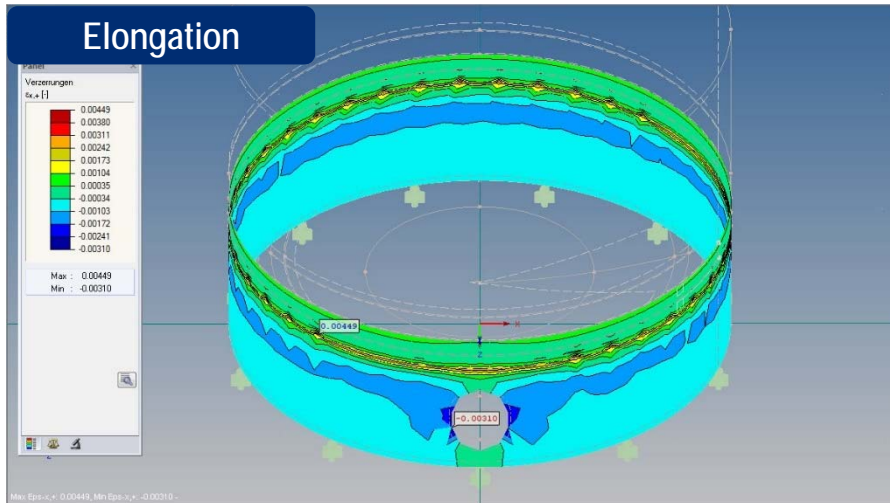
## 2. Examples of defects

### Breakage of a skirt-mounted tank

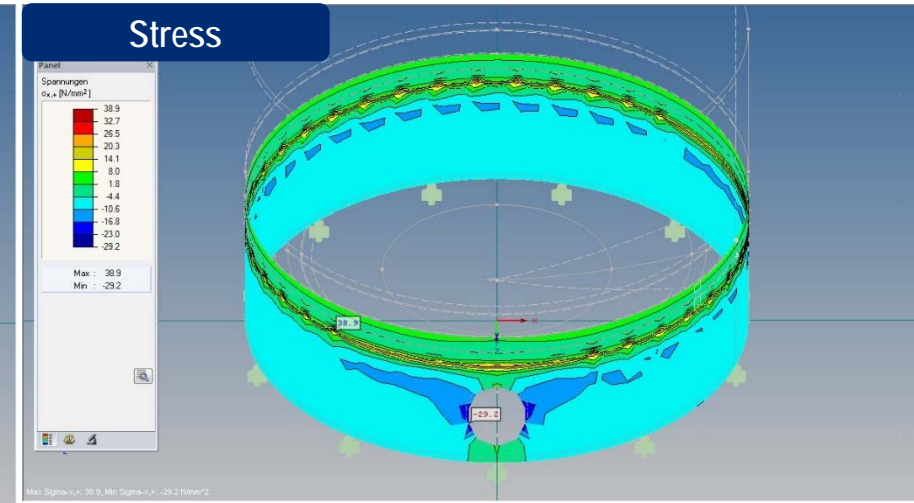


#### Transition zone with filler

##### Elongation

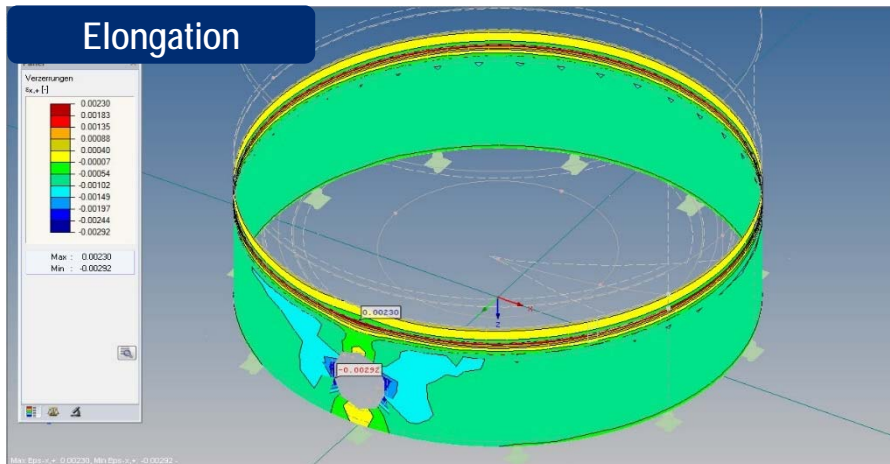


##### Stress

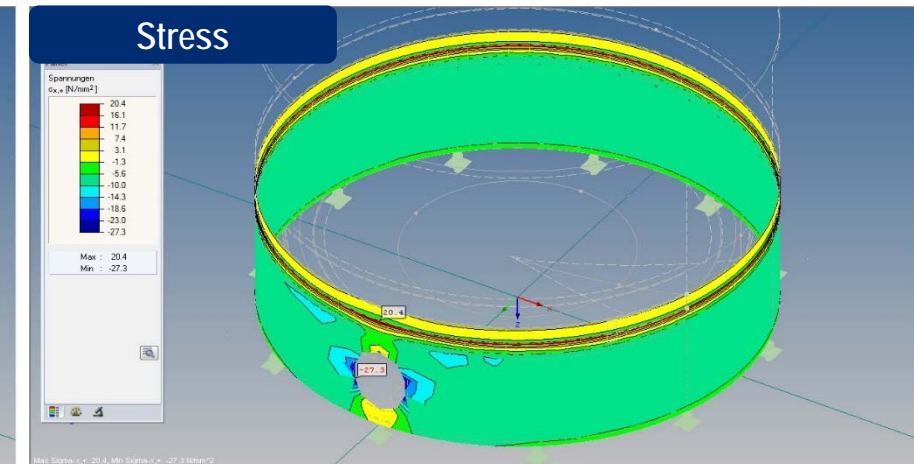


#### Transition zone without filler

##### Elongation



##### Stress





## 2. Examples of defects

### Breakage of a skirt-mounted tank



#### EXAMINATIONS

- Visual examinations
- Recalculation using finite elements

#### SOLUTIONS

- Preventive:  
Examination of design / regular checks by officially authorised experts
- Corrective:  
Exterior/interior over-lamination

Non-conformities in design (impermissible outer fibre strain in axial direction – dimensioning)

## 2. Examples of defects

### Defect in flange





#### EXAMINATIONS

- Visual examination (laminate structure)
- Examination of dimensioning
- Analysis of material properties

#### SOLUTIONS

- Preventive: Compliance with the requirements of the relevant standards/ Personnel qualification
- Corrective: Replacement of pipe/flange

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- Non-conformities in production (reinforcement structure weakened by inadmissible processing)
  - Non-conforming assembly

## 2. Examples of defects

### Defect in a tank





#### EXAMINATIONS

- Visual examination

#### SOLUTIONS

- Preventive: Surveillance of production, correct design suitable for operating conditions
- Corrective: Manufacturing of a new tank or tank rehabilitation

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- Non-conforming design
  - Non-conforming production
  - Non-conforming operating conditions

## 2. Examples of defects

### Shearing of a threaded connection



#### EXAMINATIONS

- Material analysis
- Microscopy
- Checking of the conditions of assembly/use

#### SOLUTIONS

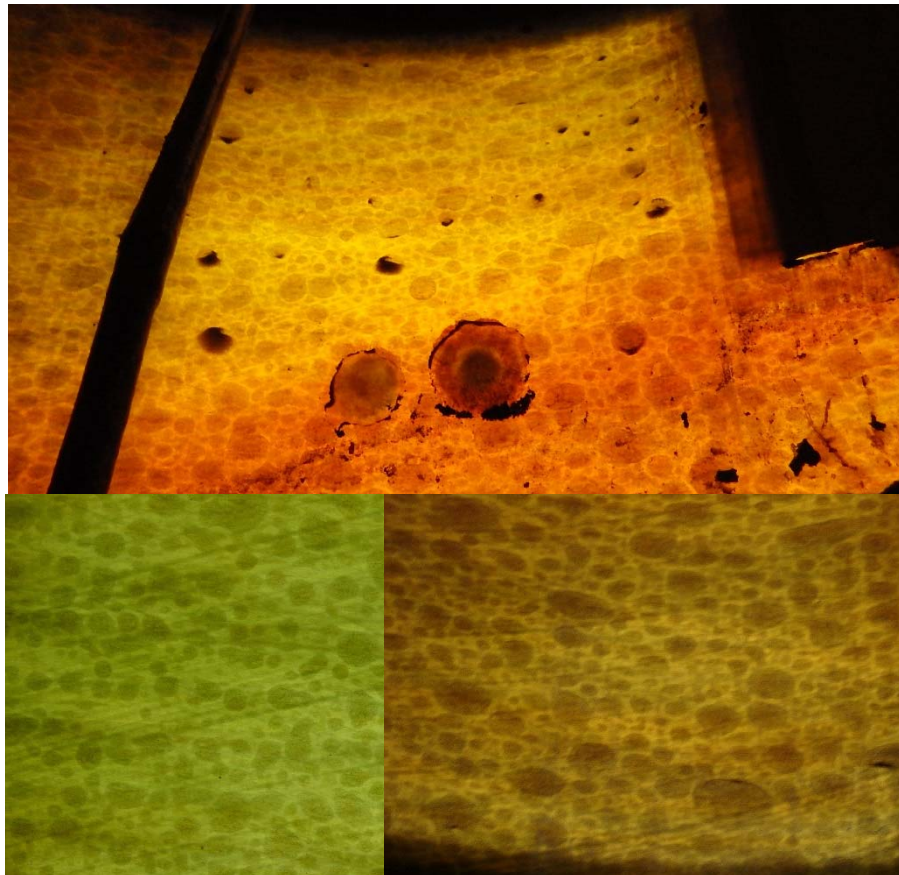
- Preventive: Surveillance of production/ qualification of assembly staff
- Corrective: Replacement of pipes

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- Non-conforming material
  - Non-conforming assembly



## 2. Examples of defects

### Osmosis blistering on a tank

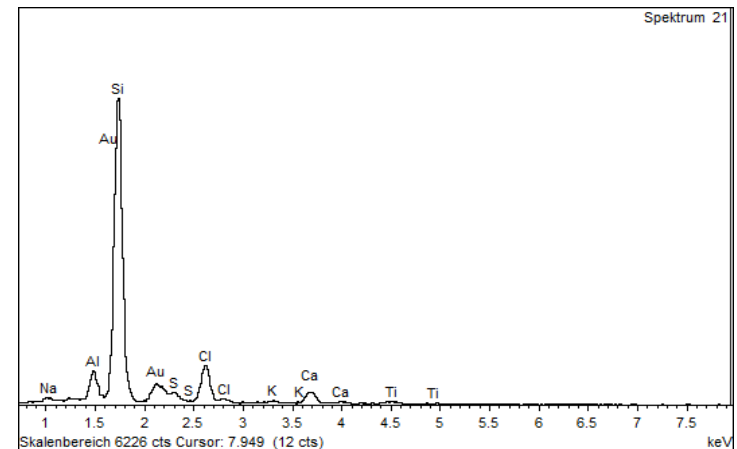
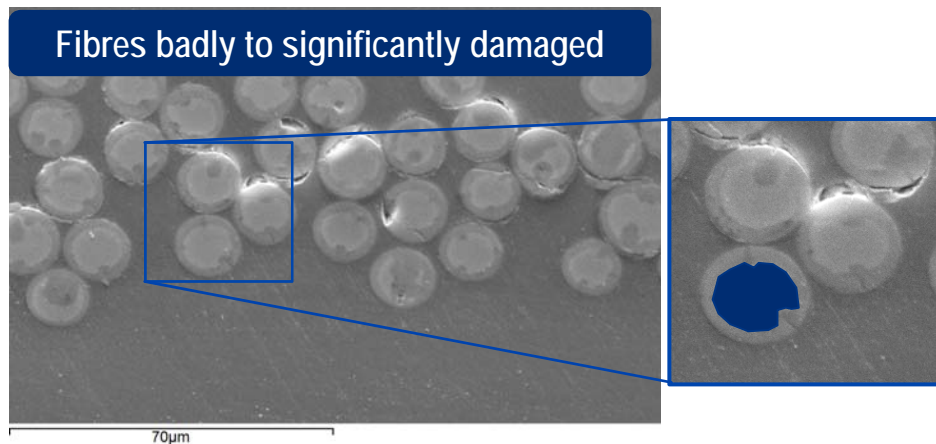
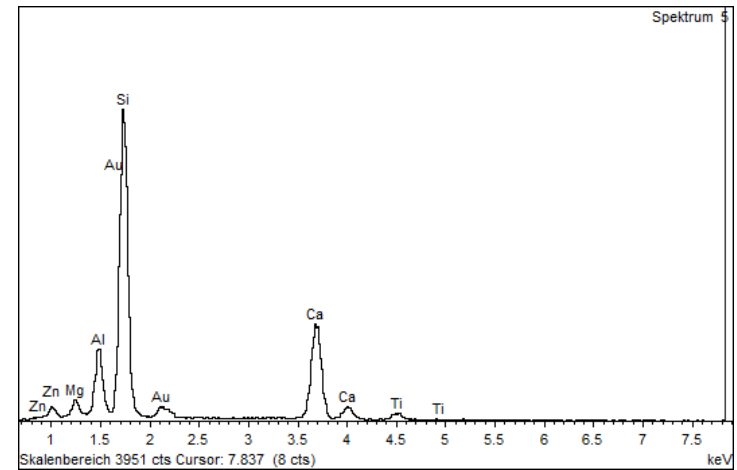
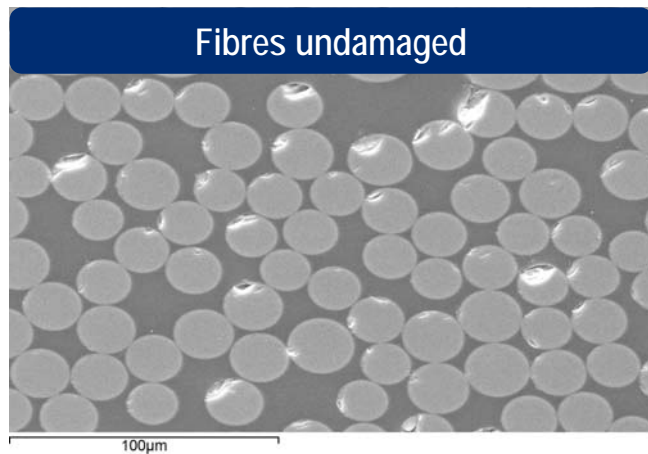


#### EXAMINATIONS

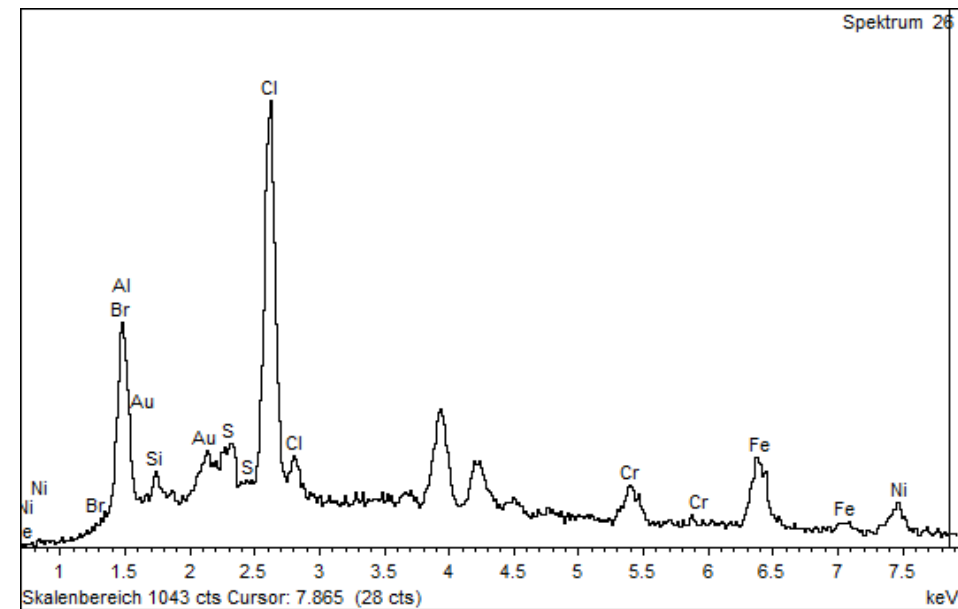
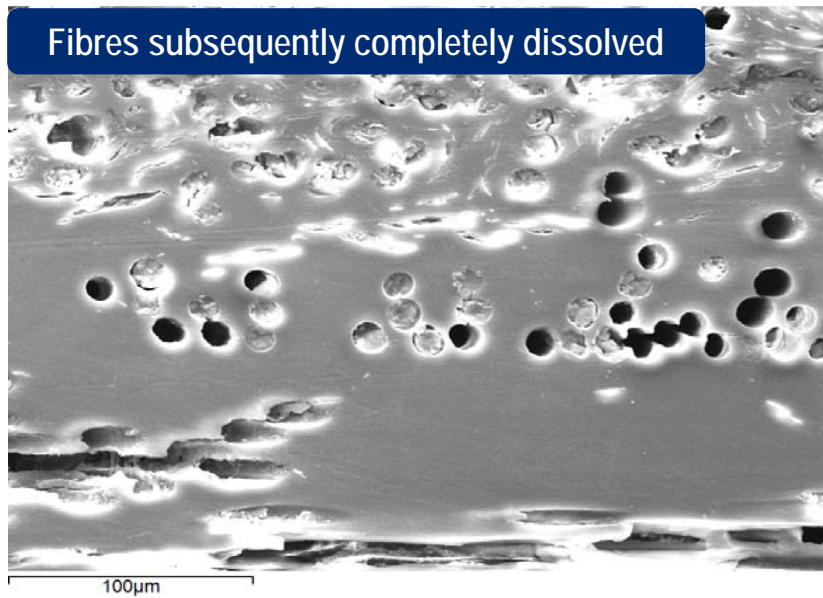
- Visual examination (macroscopy / REM)
- Measurement of pH value

## 2. Examples of defects

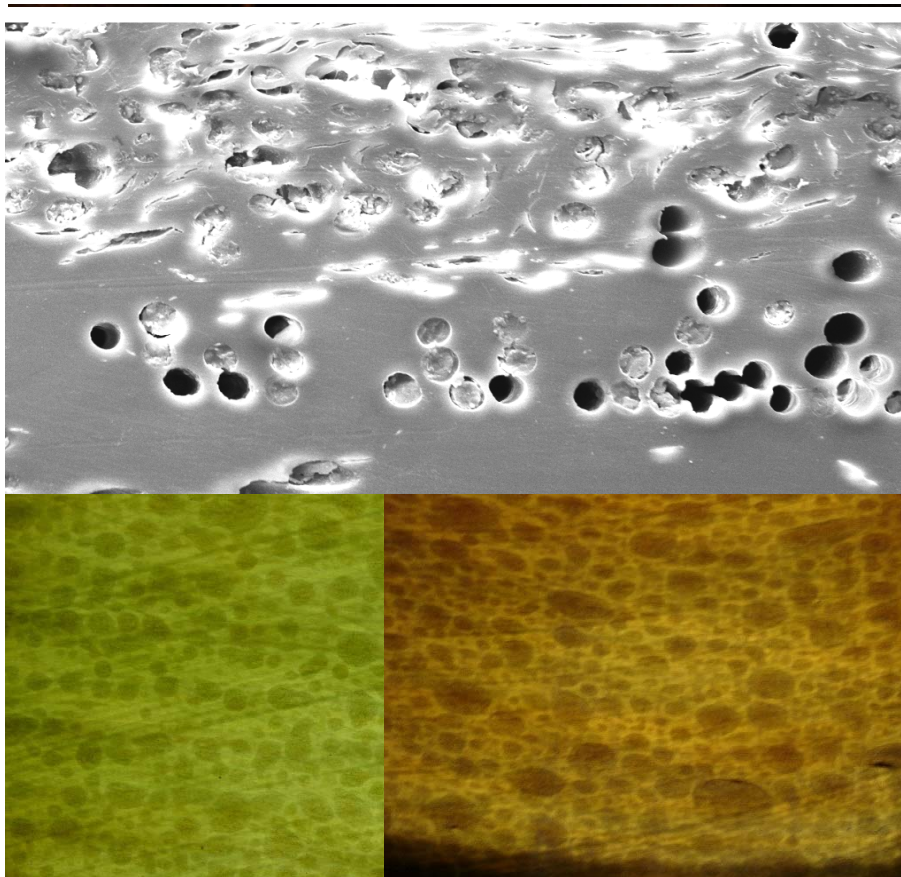
### Osmosis blistering on a tank



## 2. Examples of defects Osmosis blistering on a tank



## 2. Examples of defects Osmosis blistering on a tank



### EXAMINATIONS

- Visual examination (macroscopy / REM)
- Measurement of pH value

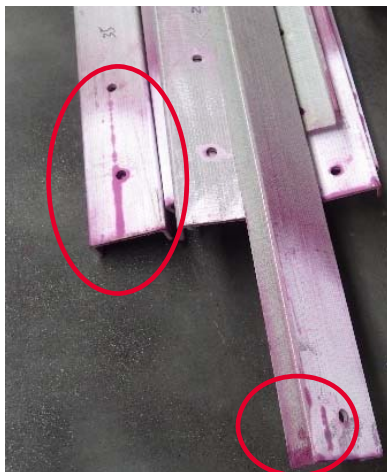
### SOLUTIONS

- Preventive: Periodic inspection
- Corrective: Removal of the chemical resistant lining and, if necessary, the load-bearing laminate / Application of new layers

Non-conforming design and/or operating conditions



## 2. Examples of defects Dry pultruded profiles



### EXAMINATIONS

- Glass content / Ashing
- Dye penetrant testing
- Visual examination (microscopy)

### SOLUTIONS

- Preventive: Adjustment of tolerances and requirements
- Corrective: Scrapping and re-production with intensified surveillance

Non-conforming production (insufficient impregnation of the glass fibres)

## 2. Examples of defects

### Shrinkage cracks on pultruded profiles





#### EXAMINATIONS

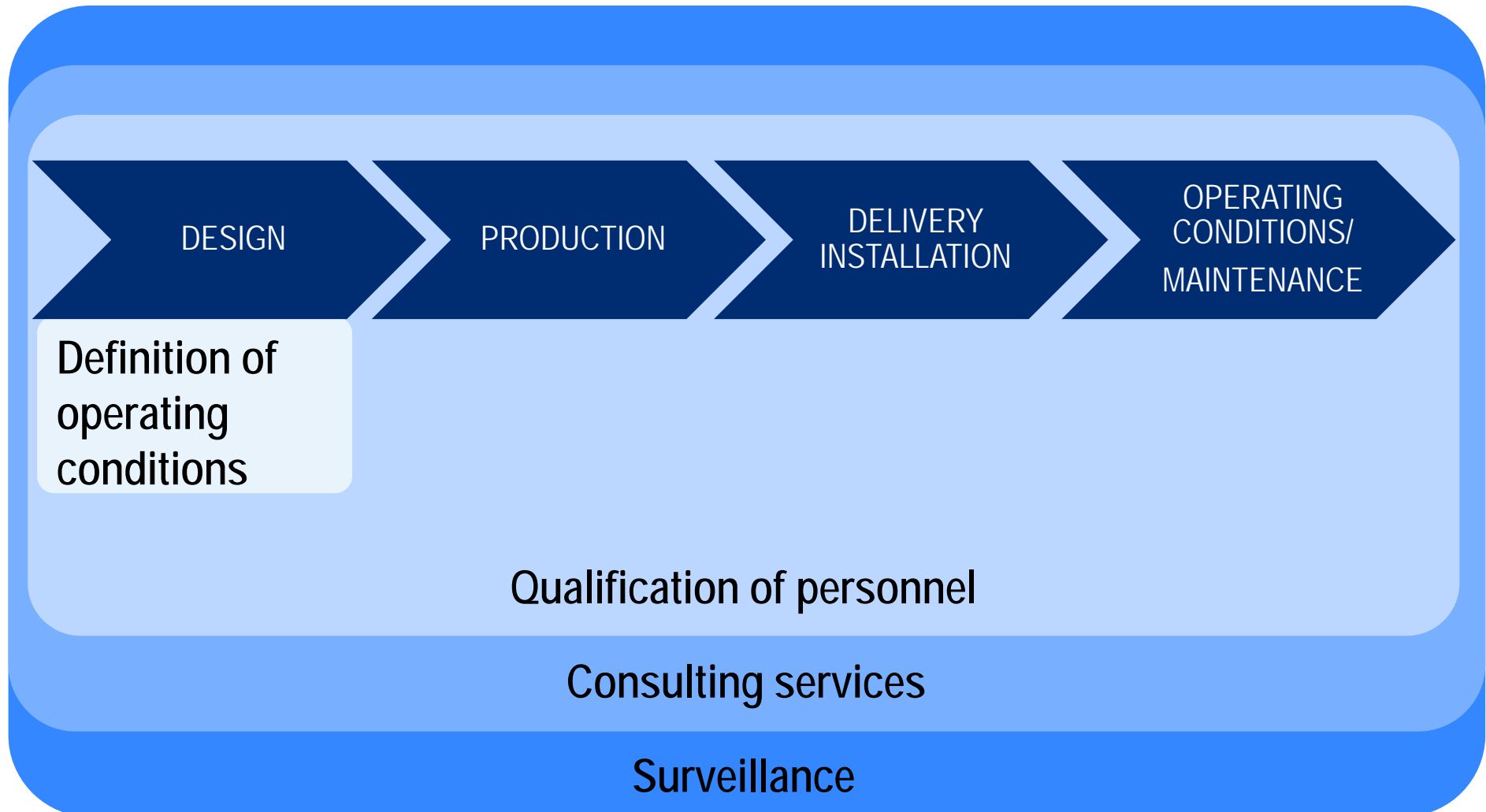
- Visual examination

#### SOLUTIONS

- Preventive: Complete specification
- Corrective: Scrapping and re-production with intensified surveillance

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- Selection of non-conforming material (resin reactivity)
  - Non-conforming design (layer structure)
  - Non-conforming conditions of production (tempering, run time)

### 3. Prevention of non-conformities





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# THANK YOU FOR YOUR ATTENTION!

Should you have any questions, please do not hesitate to contact us.

TÜV SÜD Industrie Service GmbH  
Institute for Plastics

Phone: +49 89 5190-3273  
Email: [stefanie.sagerer@tuev-sued.de](mailto:stefanie.sagerer@tuev-sued.de)

Phone: +49 89 5190-3229  
Email: [marcus.demetz@tuev-sued.de](mailto:marcus.demetz@tuev-sued.de)

Phone: +49 89 5190-3229  
Email: [achim.doerfler@tuev-sued.de](mailto:achim.doerfler@tuev-sued.de)