KD-Check Systems
Penetrant Testing Systems

KARL DEUTSCH

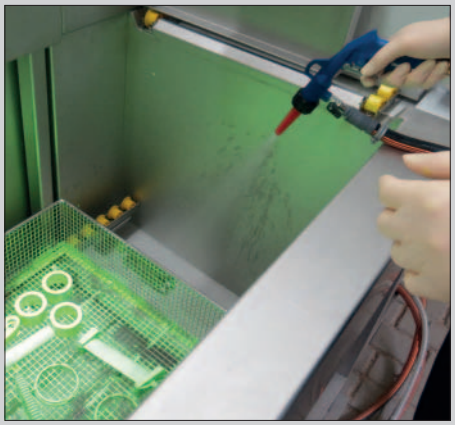
KD-Check Systems
Testing Principle (Part 1)

Pre-Cleaning

In some cases, the test pieces must undergo pre-cleaning. This can be accomplished in many different ways. Slight contaminations can be removed with water. A dip tank (see picture) and/or spray valves can be used. Severe contaminations require alkaline or acid etching with special cleaning agents. Further alternatives are steam degreasing or ultrasonic cleaning.

Penetrant Application

The application of the penetrant depends on the level of automation and the throughput of the testing system. For semi-automated testing systems, spraying (left picture) or dipping is common. For large throughput rates, baskets or workpiece carriers are inserted in dip tanks (right picture). An electrostatic penetrant application is also possible. The penetration time ranges from 5 to 60 minutes in accordance with DIN EN ISO 3452-1.



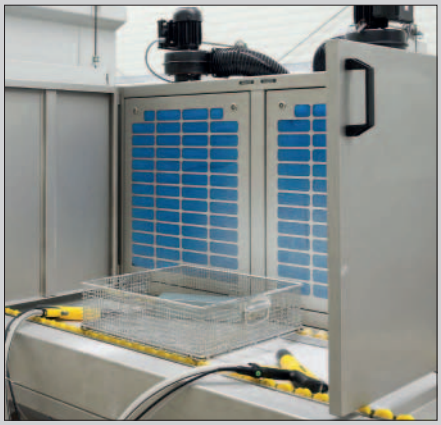
Penetrant Removal

As for the penetrant application, the level of automation and the throughput must be taken into account. The test piece geometry is also an important factor since all surfaces must be carefully cleaned without washing the penetrant out of the relevant surface cracks. A manual spray gun (left picture), nozzle assemblies (right picture), dip tanks or combinations thereof can be employed. An initial step with a dip tank helps to reduce the amount of washing water.

KD-Check Systems
Testing Principle (Part 2)

Drying with Warm Air

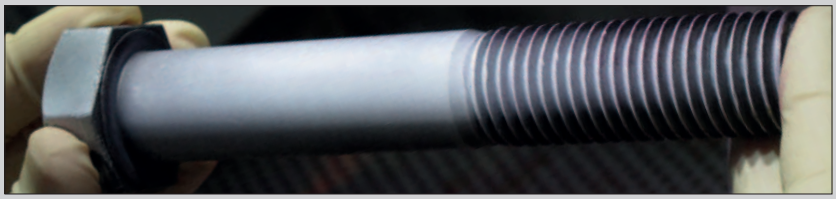
After penetrant removal the test pieces must be prepared for the development. The surface temperature must not exceed 50 °C. Drying can be carried out with air blowers or with ovens with circulating air. The temperature control, the required throughput and the oven design must be well matched.



Developer Application

Dry developer can be applied either by using a vortex chamber (funnel filled with developer powder and air is fed from below, left picture) or by electrostatics (right picture, electrostatic gun). Enclosures or exhaust systems make sure that the developer powder does not pollute the environment. Alternatively, the test pieces are dipped into a wet developer.

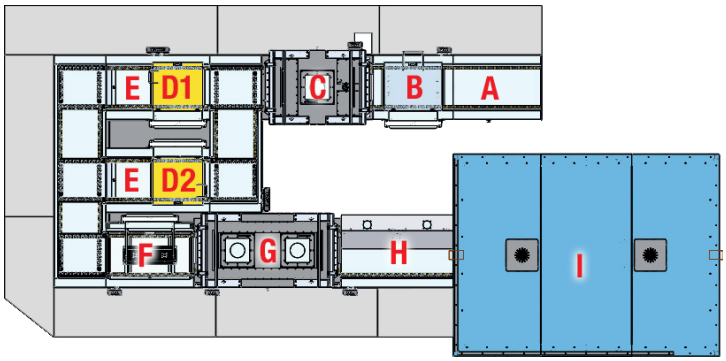
The development takes at least 10 minutes in accordance with DIN EN ISO 3452-1.



Visual Evaluation

When testing with red dyes the evaluation requires white light with a minimum intensity of 500 Lux. A fluorescent inspection is usually more sensitive and requires a darkroom environment and UV light. Conventional UV lamps can be used. Recently, also UV LED lamps have become available in portable or stationary design. They are energy-saving, easy to service, switchable to white light and do not require a run-up time until they reach the nominal light output.

KD-Check Systems
Semi-Automated Testing System for a Large Variety of Test Pieces



Stations of the Testing System

A: Component feeding
B: Pre-cleaning (water bath with additional water nozzles)
C: Dryer 1
D1: Penetrant dip tank (level 2, medium sensitivity)
D2: Penetrant dip tank (level 3, high sensitivity)
E: Draining station (one tank per way, penetrant recirculation to the respective dip tank)
F: Penetrant removal with water and handgun (after lowering into stainless steel tank and swinging out the lateral protection doors)
G: Dryer 2
H: Electrostatic developer application (with exhaust at rear, lateral protection doors)
I: Visual examination under UV light in a darkroom cabin

Semi-automated testing system which can be flexibly used for a large variety of test pieces

Castings of various sizes and geometries for power generation shall be tested with fluorescent penetrants. Penetrants of two different sensitivities can be applied within the testing system.

The test pieces are inserted in baskets which are manually moved from station to station to undergo the penetrant test procedure. Lowering and lifting of the baskets for the respective station is carried out pneumatically.

Each step of the test procedure is started by a push-button. Afterwards, the step is carried out automatically and reproducible test results are therefore achieved. A pre-cleaning station, consisting of a washer and a dryer, is part of the testing system.

Penetrant removal and developer application are manual stations due to the large diversity of the test pieces and the sometimes small number of pieces per batch. Nevertheless, the relevant process parameters are carefully monitored. A batch-specific recording of data is also possible.

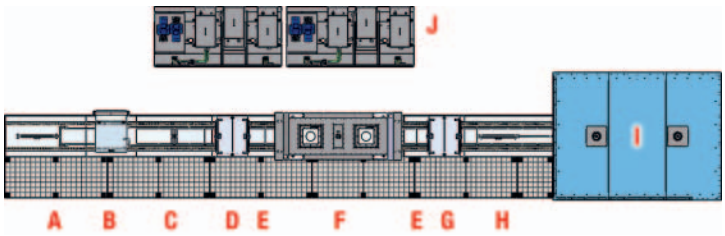
Semi-automated testing system with pre-cleaning unit and two dip tanks for penetrants of different sensitivity.

KD-Check Systems
Fully Automated Testing System for a High Throughput

Fully automated testing system for high throughput, high level of automation and low inspection cost per test piece

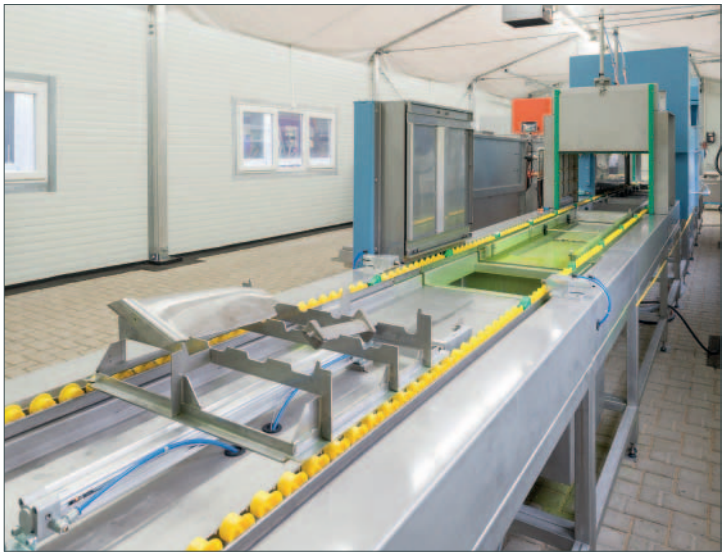
Stainless steel forgings from the automotive industry need to be tested for surface cracks with a high reproducibility. All process steps are fully automated. At the loading station the test pieces are inserted in workpiece holders which are optimized for the respective test piece geometry. The workpiece holders are then fed into the testing system and automatic transport for the entire test procedure is started. After application of the dry developer, the visual evaluation is executed. With the exception of the dip tank for penetrant application all stations are designed for the same working height, which is a big advantage of this testing system and eases transport through the system.

The steps of the test procedure require different dwell times. This causes problems regarding the process flow of fully automated testing systems and a solution is not easy to implement. Also, stations which are not always fully loaded shall not endanger the test reproducibility. Therefore, each station is carefully designed. Buffer stations and a complex process control ensure stable testing conditions.

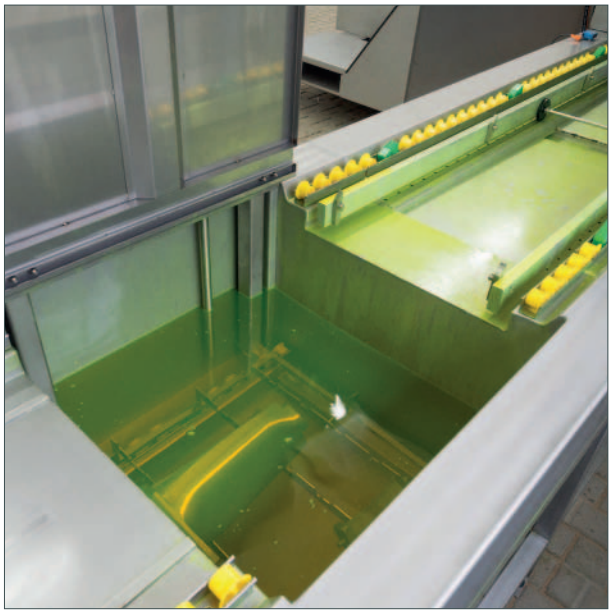


Stations of the Testing System

A: Loading station
B: Penetrant application (pneumatic lowering into dip tank)
C: Draining station and recirculation of excess penetrant
D: Penetrant removal via water-jet tunnel
E: Buffer
F: Dryer (circulated warm air)
G: Dry developer application in a vortex chamber
H: Developing line
I: Visual evaluation
J: Wash water recycling (doubled column for active carbon filtering)



Linear system design with test piece transport by means of a roller conveyor and pneumatic feeding of the workpiece holders. The original parts to be tested are not shown in the picture due to a confidentiality agreement.



A dip tank is used for penetrant application.

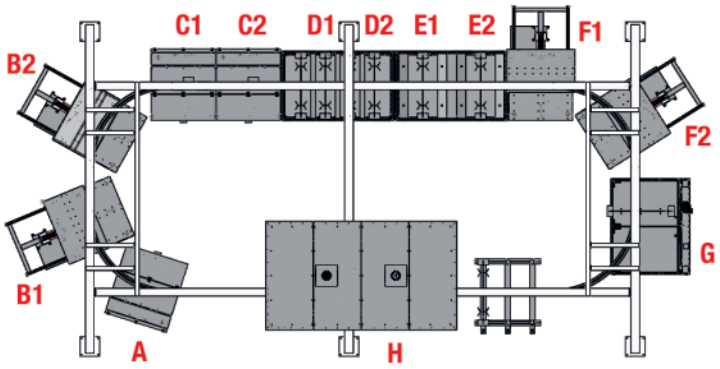
Circuit for the wash water: Regeneration by means of active carbon filtering with a doubled column.

KD-Check Systems
Manual Testing System for Large Batches

Large-scale production and high throughput combined with manual operation need not be a contradiction

For the described system each station was doubled in order to test up to 4500 test pieces per day. An oval crane runway mounted above the testing system provides transport of the workpiece holders which are lowered or raised at the respective stations by means of crane trolleys. Signal lamps inform the operator about the status of each station. Sensors detect proper insertion of the workpiece holder and start the respective step of the test procedure.

After pre-cleaning and drying, the test pieces are immersed in the penetrant. A sensor monitors the fill level of the testing agent. Also the pressure and the water quantity for penetrant removal are checked, and the temperatures in the drying ovens are monitored and regulated. The dry developer is manually applied by an electrostatic gun. The visual examination in the darkroom cabin is carried out while the test pieces are still hanging in the workpiece holders. Subsequently, the manual sorting of the test pieces takes place and the empty workpiece holders are ready to be reused.



Stations of the Testing System

A: Pre-cleaning
B: Dryers (circulated warm air)
C: Penetrant application (dip tanks)
D: Penetrant drainage
E: Penetrant removal (via water nozzles)
F: Dryers (circulated warm air)
G: Electrostatic application of dry developer
H: Visual evaluation under UV light in darkroom cabin

To allow practical pre-acceptance, the testing system was entirely put into operation in the KARL DEUTSCH assembly hall.

KD-Check Systems
Manual Testing Stations for Laboratories and Small Batches

Test station for laboratory

Doubled test station for testing with red dyes (left) and fluorescent dyes (right)

Serial testing of aerospace parts, NADCAP approved

Test station for laboratory with dip tank and drawers

Customized testing station with splash protection doors and integrated drying facility

Laboratory test station for post-emulsifying penetrant method, for foundry institute

Test station with dip tank for red dye testing and visual evaluation under white light

KARL DEUTSCH – NDT Products Made in Wuppertal, Germany
Company Portrait

The company KARL DEUTSCH was founded by Ing. Karl Deutsch in 1949. Since the early 1950's, instruments, magnetic inks and testing systems for magnetic particle testing have been developed and produced. Currently 130 motivated employees work for KARL DEUTSCH in Wuppertal, Germany. Additional 20 employees in several international offices and a worldwide network of sales partners support the export which accounts for more than 50% of the turnover.

Portable ECHOGRAPH ultrasonic flaw detectors and stationary ultrasonic testing systems are used for the detection of internal defects. Test gauges for the measurement of coating thickness, wall thickness, magnetic field and crack depth are also part of the product range for many decades.

For surface crack detection with magnetic particles, mobile DEUTROPULS instruments and stationary DEUTROFLUX testing systems are available. FLUXA magnetic inks are produced in-house.

In 1990, KD-Check penetrants without AZO dyes were introduced for the first time. In the subsequent years, stationary test stations and testing systems were developed. Mechanical construction, part machining and PLC programming are carried out in-house. This provides solutions from a single source and fast reactions to customer-specific requirements.

Works 1 was erected in 1967 and extended in 1972. Administration and the sales department are headquartered here. Portable test instruments, sensors and chemical test liquids are produced in Works 1.

In 1978, Works 2 was erected for the enlarged production of testing systems. It was extended in the years 2004, 2006 and 2013.

Three application laboratories in both workshops are available for customer-specific trials. The available equipment also includes fully operational MT and PT systems. Test method and test agent can be optimized for the samples handed in by our customers.

Our in-house production of MT and PT test agents underlies strict standards. Internal batch testing and external sample testing are described in the data sheets.

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