World Leader for Eddy Current Component Testing

Testing for What?

- Structure testing including identify material mix and correct alloy, verifying correct material properties from heat treatment including hardness, case depth and pattern, retained austenite, and others, confirming as-forged or as-cast conditions prior to heat treatment.
- Detection for surface cracks, seams, pits and other surface flaws.

Zero Defect in Automotive Industry is not easy to reach, but a must for all high class suppliers of forging components, bearings and fasteners. ibg’s eddy current technology helps to achieve this goal by testing each part for surface open defects and correct heat treatment.

100% Test Nearly every automotive company requires that each safety critical parts like bolts, safety belt lockers, drive shafts, valves etc. must be tested for cracks and correct heat treatment to avoid that these components fail during use. ibg Prüfcomputer GmbH is specialized in manufacturing and design of eddy current instruments and handling systems for the 100% test of such components.

ibg Prüfcomputer GmbH
Pretzfelder Straße 27 D-91320 Ebermannstadt, Germany
Tel: +49-9194-7384-0   Fax: +49-9194-7384-10
E-mail: info@ibgndt.de
ibg Prüfcomputer GmbH was established in 1983 and invented the PMFT, is the world leader for eddy current component testing.

ibg products have been widely used worldwide on automotive parts for engines, valve and power train systems, steering, chassis and suspension systems and safety systems. Also on bearings and bearing components, fasteners, forged and cast parts, hard metals, and precision stamped parts.

The headquarter of ibg locates in Germany, with subsidiaries in USA, Swiss, UK, and worldwide representatives.

This booklet collects some of the system pictures installed worldwide by ibg, we hope this could be helpful for you.
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1-1. Steel ball material mix and hardness testing

- For material mix and hardness
- Using Preventive Multi-Frequency Testing (PMFT) instrument eddyliner® p
- 6 frequencies from 800Hz to 80kHz
- Testing speed up to 40,000 balls/hour
- Diameter of balls between 1.5mm and 6mm
1-2. Steel ball material mix and hardness testing

- For material mix and hardness
- Instrument as eddyvisor®
- Testing speed up to 2000-4000 balls/hour
- Ball diameter range from 12mm to 26mm
- One two channel instrument work with two handing systems
1-3. Semi-automatic crack inspection on hip implant balls

- Cycle time: 8 seconds (feed and clamp parts 2 seconds, automatic crack test 4 seconds, remove and sort part 2 seconds)
2. Crack detection of tie rods

- Length of parts 250-400mm
- 1 probe for testing of ball
- 3 probes for testing of shaft
- Minimum crack depth 100um
- 7.5 sec/part
- Change-over time to other parts: max. 3 min
3-1. Crack detection on bearing rings

- 4 probes
- 2 probes at the circumference
- 1 probe each for plane faces
- 4.5 sec/part
- Minimum crack depth 100um
- Fully-automatic feeding, testing and sorting
3-2. Crack detection on bearing rings

- 1mm length tolerance
- 0.5mm diameter tolerance
- Several different part types
- 4 parts/second
3-3. Crack detection of bearing rings on the inner diameter

- Bearing ring ID 30mm to 40mm
- Crack specification:
  - Orientation: longitudinal  
  - Crack depth: 0.100mm  
  - Crack width: 0.050mm  
  - Crack length: 3.000mm
- Cycle time: 6 seconds per part (600 parts/h)
3-4. Crack test on outer rings

- ID test
- 8 seconds cycle time
- Optional Heat Treat Test Upgrade
4-1. Testing for correct heat treatment (intermediate structure) of austempered safety bolts

- Safety part (safety belt)
- 3,600 parts/hour
- Testing with eddyliner P® plus Option 01
- Sorting for O.K. / NOT O.K.
- Possible defects are mix-up of hardened and unhardened parts as well as of parts slightly exceeding or falling below hardness limits. Furthermore, the bolts might be hardened differently, i.e. on one side they are within hardening limits, on the other side outside. This phenomenon may not be detected with conventional hardness testing if the parts are by chance always tested at “hard” pot.
4-2. Test for hardness and material mix on safety belt components

- Material mix and hardness for safety belt components
- Cycle time: 2 seconds/part
5-1. Testing of steering racks for multi-positions

- Hardness
- Hardening depth
- Material mix
- 3 test positions (3 test coils)
- Fully-automatic, in-line
- 150 parts/hour
- Lockable container for NOT O.K. parts
5-2. Hardness and case depth test of hydro-steering racks (interlinked in the induction hardening machine)

- Four channel eddyline® P4 instrument integrated into a two-way-hardening-machine
- Test carried out at two positions: at the shaft and at the toothed area. Two racks tested at the same time.
5-3. Testing for hardness and hardness depth of hydro steering racks at 7 test positions

- Cycle time: up to 3 parts/minute
- Part types: universal
5-4. Testing of steering rack on 9 positions

- Hardness
- Hardening depth
- Material mix
- 9 positions (9 sets of coils)
- Semi-automatic system: manual feeding, auto testing and manual unloading
5-5. Crack testing for hydro steering racks (by means of a rotating head)

- Crack Specification: 3.750mm length x 0.080mm width x 0.050 mm depth
- The steering racks are tested along the even shaft after the last surface finishing. The parts are dry and washed.
- Test speed: 200mm/sec. About 600 parts/hour
- Continuous tracing with 2 channel instrument
- Blanking out of the toothed area and piston location
- Careful transport of the parts by means of servo drives
- Non-contact crack inspection, no wear of test and rotating head
- Retrofitable by pattern and hardness test (eddyvisor® for multi-position testing)
6. Hardness testing of flame-hardened valve shaft ends

- Automatic test at the hardening machine
- Sorting o.k. (57-54 HRC), too hard (>57 HRC), too soft (<54 HRC), residual class
- Control of all functions by eddyliner® and integrated shift register
- Resolution of hardness values to ± 1 HRC
7. Testing of connecting rods (twin con-rods) for structure and material

- PMFT 8 frequencies
- Automatic NOT O.K. output
- Test rate 6 seconds/part
8. Water pump shafts test for hardness, material and case depth

- Test rate (handling included) <3 seconds (determined by preceding dimension control and subsequent grinding machine)
- Range of diameter: 12-20mm
- Range of length: 75-112mm
- Hardness: 58HRc+/-1HRC
- Case depth: 1.7mm+/-0.2mm
9-1. Roller crack detection

- Dimensions of parts: Ø 3.65mm x 7.2mm
- Material: steel, hardened and nitrified
- Minimum crack depth: 0.03mm
- Cycle time: 2.8 parts/sec.
9-2. High-speed crack detection of bearing rollers (with rotating head)

- The system scans the entire outer diameter for cracks.
- Using rotating head, with rotation speed up to 5000RPM
- Diameter range 15-45 mm and length range 14-80 mm
- Crack specifications:
  - Longitudinal crack: 0.050mm depth x 0.050mm width x 3.000mm length
- Test speed: feeding rate adjustable up to 170mm/sec., which means testing up to 17 rollers per second with a length of 10mm
9-3. High-speed crack detection of bearing rollers (with rotating head)

- The system scans the entire outer diameter for cracks.
- Using rotating head, with rotation speed up to 5000RPM
- Diameter range: 5.0mm-26.0mm
- Length: 5.0mm-32.0mm
- Test speed: max. 4.5m/min
- Cycle time: max. 204 parts/min
- Crack specifications:
  Longitudinal crack: 0.050 mm depth x 0.050mm width x 0.800mm length
9-4. High-speed crack detection on the outer diameter of cylindrical rollers (with rotating head)

- Diameter range: 9-25mm and 20-55mm
- Length: 10-52mm and up to 85mm
- Test speed: max. 5m/min. (for roller length of 52mm, 1.6 pieces/second)
- Crack specifications:
  - Longitudinal crack: 3.000mm length x 0.050mm width x 0.050mm depth
  - Circumferential crack: 3.000mm length x 0.050mm width x 0.050mm depth
9-5. Crack detection on the outer diameter of cylindrical and spherical bearing rollers

- Cycle time: 500 to 1000 parts/hour
- Parts range: diameter 14 to 60mm, length 14 to 70mm
- Crack specifications: 3.000mm length x 0.050mm width x 0.150mm depth
  Orientation: longitudinal ± 15°
10. Bolt crack detection and structure testing

- Bolt dimensions: M10x35 to M20x180
- Test areas: Shaft, Screw area (head)
- Calibration crack specifications: 5.00mm length x 0.06mm width x 0.150mm depth
- Throughput: 1200 parts/hour to 480 parts/hour depending on dimension of parts
- Feeding bin: capacity 300kg
11-1. Ball-Pin crack detection

- Test range: ball, neck, cone, shank, 2 test channels
- Cycle time: 3.8sec/part
- Surface: turned, extruded
- Bolt dimensions: M10x35 to M20x180
- Test areas: Shaft, Screw area (head)
- Calibration crack specifications: 5.00mm length x 0.07mm width x 0.20mm depth
- Inspection for pinholes by means of forked photoelectric barrier
- Integrated in the production process, Parts with cracks and parts without pinhole are sorted out
11-2. Ball-Pin crack detection and structure testing

- For cracks at the equator of the ball, for correct material structure, for cotter pin hole and for damaged thread
- Test rate: 4800 parts per hour (twin system)
11-3. Ball-Pin crack detection

- Test rate: 5400 parts per hour
- Part types: 12
- Calibration crack specifications:
  - 3.75mm length x 0.10mm width x 0.10mm depth
- Crack orientation: longitudinal
- The parts are fed in pairs, and two parts are tested at the same time
12-1. Inspection for hardness and material mix on needles for bearings

- Part diameter: 1.5-3.0mm
- Part Length: 5.0-26mm
- Test rate: 5400 parts per hour
- Test frequencies: 8, from 25Hz-40kHz
12-2. Crack detection for needles (with rotating head)

- Calibration crack specifications: 3.000mm length x 0.070mm width x 0.050mm depth
- Test rate=36,000 parts/h
- Speed of rotating head=6000 RPM
- Rotating probes: max.2
13-1. Crack and porosity inspection on cylinder liners in engine block (with rotating head)

- With eddydector® instrument, eddyscan® rotating system to inspect crack and porosity on cylinder boars of Aluminium V8 engine blocks
13-2. Crack detection of cylinder liners in engine block (with rotating head)

- Versatile test system for engine blocks with 3, 4 and 6 cylinders in line as well as of 6-, 8- and 12-cylinder V-engine blocks
13-3. Crack detection of cylinder on the whole ID and OD

- 3-channel eddydector®
- Diameter OD: 90mm, Diameter ID: 86mm
- Length: 132mm
- Cycle time: 9 seconds/part
- Cycle rate: 400 parts/hour
- Crack specification: 5.000mm length x 0.075mm width x 0.700mm depth
- Crack Orientation: longitudinal and transversal
- Pores specification: Ø ≥ 1.5mm, D ≥ 0.7mm
13-4 Crack and structure detection of cylinder liners

- 6-channel eddydector® and with eddyliner®
- Cylinder liner for trucks and construction machinery
- For three different part types (length approx. 200-350 mm, diameter 120-130 mm)
- Crack and pore detection on the inner diameter and flange end faces
- Crack specification
  - Longitudinal cracks: 5.00mm length x 0.08mm width x 0.50mm depth
  - Circumferential cracks: 3.75mm length x 0.08mm width x 0.70mm depth
  - Pores: Diameter ≥1.500mm, depth ≥0.750mm
13-5. Crack detection on cylinder liners for huge motors

- 6-channel eddydector®
- Cylinder liners OD: 120 - 245mm, height: 220-420mm
- Crack specification
  - Longitudinal cracks: 3.0mm length x 0.2mm width x 0.5mm depth
  - Circumferential cracks: 3.0mm length x 0.2mm width x 0.5mm depth
- Pores: Diameter ≥ 1.0mm, depth ≥ 1.0mm
- Cycle time: approx. 20 seconds per part
- Test areas: outer and inner diameter upper and lower faces and flange well
14-1. Inspection of pinion pins for hardness, case depth and hardening position

- Diameters: 12-25mm
- Length: 25-45mm
- Cycle rate: 72 parts/min.
14-2. Crack and heat treatment test on pins

- Not only fast but also versatile
- Cycle rate: 12000 parts/hour
- eddydector® (for crack detection) + eddyvisor® S (for heat treatment testing)
15-1. Crack inspection for hydro steering racks by means of a rotating head

- Cycle Rate: up to 20 parts/min
- Parts Diameter: 8-30mm
- Length of parts: 250-650mm
- Crack specification (longitudinal and circumferential cracks):
  5.000mm length x 0.075mm width x 0.050mm depth
15-2. Crack detection on piston rods

Crack detection with eddy current always requires a relative movement between probe and test part. A rotational movement is well suitable (either the test part rotates or the probe rotates). Thus it is possible to integrate the crack test into production processes which already provide the rotational movement. An example are turning machines, grinding machines or, as in this case, a super-finishing machine. However, it has to be mentioned that the ambient conditions are not optimum for integration of eddy current crack detection into such a production machine (vibration, chips, limited control possibilities) and this will lead to cuts of test sensibility (adaptation of crack specification necessary). Such an integration can only be seen an compromise (low investment costs versus reduced sensitivity).

(Test module with probes and adjustment mechanism)
16. Camshaft hardness testing
17-1. Monitoring of hardening process on gears

- 16 channel eddyliner® P16 PMFT instrument
- In the hardening shop of a major automobile manufacturer in Aspern/Vienna/Austria, 11 different gears are carburized and hardened in a continuous heat-treating furnace. In regular intervals, the parts are tested by destructive methods: cutting, embedding, grinding, polishing and microexamination. In case of a malfunctioning of the furnace, complete containers must be scrapped, even if half of the parts are OK.
- After the test system has been installed, saving approximate DM 386000 each year can (not even considering labor cost for sorting due to furnace malfunctioning).
17-2. Crack detection on face side of gears

- Cycle time: <20 seconds per part
- Crack specification:
  - 10,000mm length x 0.100mm width x 0.500mm depth
- Crack Orientation: radial
18. Hardness, hardness depth and hardness pattern test of strud rods

- Hardness test on 8 positions which can be set individually for every type of parts to be tested via adjustable light barriers
- Cycle rate: > 500 parts/h
- Hardness tolerance: 56 HRC ± 2 HRC
- Hardness depth: 2.3mm ± 0.3mm
- Position: ± 1.0mm
19-1. Crack and structure test of spindles

- Testing Hardness, hardening depth at 4 positions, tempering of basic material, correct alloying and surface cracks.
- Cycle time: ≤ 25sec.
- Crack specification: 3.750mm length x 0.075mm width x 0.50mm depth
- Crack Orientation: longitudinal and circumferential
19-2. Crack and structure test on spindles and followed by laser marking

- The entire stub and radius is scarred without any gap.
- Cycle time: 12 seconds/part
- Crack specification
  Longitudinal and circumferential cracks: 3.000mm x 0.075mm width x 0.2000mm depth
19-3. Crack test on wheel hubs (CNC following)

- Crack test on >90% of part surface (including ID)
- Crack specification
  Longitudinal and circumferential cracks: 3.000mm x 0.075mm width x 0.2000mm depth
- Cycle time: 15 seconds/part
- Turned and as forged surfaces
- Allen Bradley CNC
19-4. Crack and structure test on spindles

- Cycle time: 12 seconds
- Crack specification:
  - Longitudinal cracks: 0.120” length x 0.004” width x 0.008” depth
  - Circumferential cracks: 0.120” length x 0.003” width x 0.012” depth
20. Crack detection on axle shafts
(three channel instrument)

- 3 different parts, mixed
- Cycle time 14.1 sec
- Pick up from conveyor belt
- Unload of tested OK parts onto the same conveyor belt
- Internal conveyor belt for NOK parts
21. Inspection of hubs for correct heat treatment and material mix

- Hardening depth on bearing surface
- Test for surface hardness, tempering of basic material and correct alloying
- Cycle time $\leq 8$ seconds
22-1. Crack detection on piston pins (with rotating head)

- Parts diameter: 15 to 40mm, length: 45 to 100mm
- Crack specification:
  - 3.750mm length x 0.075mm width x 0.050mm depth
- Crack Orientation: longitudinal and circumferential
- Rotation speed of the rotating head: 3,600 rpm
- Change-over time: ≤ 10 min.
- Test speed: 50mm/sec., Test rate: 1,800 to 4,500 parts/h (depending on parts length)
22-2. Structure test of pinion pins after the grinding machine

- Test rate: 3,600 parts/h
- Range of parts: \( \varnothing \text{18mm up to 28mm, length: 55mm up to 100mm} \)
23. Structure test on cam rollers with quattro sorter

- Four channel instrument: eddyline®P4, four parts tested at the same time
- Cycle time: 18,000 parts/hour (5 parts/second)
24-1. Structure test on forged parts
24-2. Test on forged and cast parts for material mix

- Large heavy parts, Max. 800mm length x 300mm width x 300mm height, Max. weight : 25kg
- Dynamic testing
- The operator puts the part by hand onto the conveyor belt which moves with constant speed and so transports the test part through the test coil. An optical sensor trigger measurement according to the Preventive Multi-Frequency Test (PMFT).
25. Test of tooth gear assembly for correct structure

After carburization and hardening, the test part is random-like tested at 8 test frequencies for correct hardness, case depth and core hardness at each of the 4 test positions according to the Preventive Multi-Frequency method.
26. Structure test on Bells of CV joints

- Test on inner and outer diameter with eddyliner® P 3 three channel instrument
- Hardness
- Case depth on shaft inside the bell of CV bells
- Core hardness
- Hardness at shaft (runout)
- Cycle time: 15 seconds/part
27-1. Structure test on drive shafts

- with eddyliner® P4, four channel instrument
- Test for hardness, hardness depth and hardness runout in the spline
27-2. Structure test of inductively hardened drive shafts

- With eddyliner® P16, at up to 16 programmable positions
- Test for hardness, hardness depth and hardness runout
27-3. Structure test on axle shafts

- With eddyliner® P16, at 15 positions along the shaft and in the fillet area in transition from shaft to flange
- Test for hardness, case depth, core hardness and hardening runout in the spline
28. Test on rocker pins for correct heat treatment

- Two channel eddyliner® P2 instrument and a twin sorter
- Test rate: 8,400 parts/hour
- Parts diameter: φ3.3mm up to 5mm,
- Parts length 12.5mm up to 55mm
- Part types: 32
29. Crack detection of jacket tubes for injection systems

- Test parts: diameter approx. 6-8 mm, length 34 mm
- Cycle time: 3,600 parts per hour (Triple System)
- Crack specification (outer and inner diameter):
  - Longitudinal crack: 2.000mm length x 0.075mm width x 0.080mm depth
  - Circumferential crack: 2.000mm length x 0.075mm width x 0.150mm depth
- Crack specification (rear side of flange with radius):
  - Longitudinal and radial cracks: 2.000mm length x 0.075mm width x 0.100mm depth
30. Crack detection of extruded hollow shafts for truck trailers

- Part range: 16 different part types
- Cycle time: 27 seconds per part, 133 parts per hour
- Crack specification (longitudinal): 6.250mm length x 0.100mm width x 0.125mm depth
- Test location: outer machined surface area (without thread area)
- Twin System: two parts are tested at the same time.
31. Crack detection of gear switch forks

- Test Time: 8.0 seconds per part
- Cycle time: Max. 450 parts per hour
- Crack specification (longitudinal to the main axis):
  3.000mm length x 0.100mm width x 0.700mm depth
32. Test of roller clutch races at two test lines for surface hardness, case depth, core hardness and cracks in the race

- For hardness profile, case depth, surface hardness and core hardness
- Crack specification
  - Longitudinal cracks: 3.750mm length x 0.100mm width x 0.250mm depth
  - Circumferential cracks: 3.750mm length x 0.100mm width x 0.300mm depth
- Cycle time: 9 seconds per part
33. Crack detection of input flanges

- The system is designed for the automatic crack test of input flanges on the cylindrical outer diameter as well as on the upper face.
- Cylindrical diameter crack specification:
  - Longitudinal cracks: 3.750mm length x 0.075mm width x 0.100mm depth
  - Circumferential cracks: 3.750mm length x 0.075mm width x 0.150mm depth
- Top face crack specification:
  - Radial cracks: 3.750mm length x 0.075mm width x 0.100mm depth
- Cycle time: 10.5 seconds per part
34 Crack detection of tubes for airbags (with rotating head)

- The system is designed for crack detection on the cylindrical outer diameter of airbag housings.
- Crack specification:
  - Longitudinal cracks: 5.000mm length x 0.100mm width x 0.100mm depth
  - Circumferential cracks: 3.000mm length x 0.100mm width x 0.200mm depth
- Cycle time: 6 seconds per part
35-1. Test for structure and cracks of planetary gear pins (with rotating head)

- Diameter range of rollers: 7.5mm
- Length range of rollers: 15 -25mm
- Crack specification: 7.500mm length x 0.100mm width x 0.075mm depth
- Area for crack detection: whole OD
- Cycle time: 12,000 parts/hour
35-2 Test for structure and cracks of planetary gear pins

- Test rate: 1,125 parts/hour
- Dimensions: $\varnothing8.0\text{mm}$ up to 13mm, 26mm to 63mm
- Part types: 13
- Case depth: 0.8mm up to 2.1mm
- Crack specification: 7.500mm length x 0.050mm width x 0.075mm depth
- Crack Orientation: longitudinal and circumferential
36. Crack detection on steering knuckles for lorries

- Test location: plane area, radius area and cylindrical area of the stem
- Kind of test: semi-automatic; the system is fed and discharged by means of a crane; crack test runs automatically
- Crack specification: 5.000mm length x 0.100mm width x 0.300mm depth
- Cycle time: < 3 minutes
37. Structure test on drive shaft forks

- Number of part types: 4
- Number of test locations per part type: 3 or 4
- Kind of test: manual

The test table includes four test stations for four different part tapes. The test part is put by hand into the relating test station. A proximity switch automatically triggers the test and each part is tested at three resp. four different locations for surface hardness, case depth, correct hardness position and material mix.
38. Crack test on sprockets

- Aluminum silicon sinter material
- Crack specification: 3.000mm length x 0.075mm width x 0.200mm depth
- Cycle time: 10 seconds
- 0.6mm diameter tolerance
39. Heat treat test on linear rails

- Rails 15-100mm wide and 6m long
- Test every 25mm
- Data base with visualization
- Continuous Ink jet marking
40. Heat treat test on break shafts

- Manual load/unload/sort
- Several part families
- 3 locations: 2x shaft, 1xtip
- NO PLC needed
- Prepared for automation
41. Crack detection on the threaded area of gas bottles

- With rotating head
- Test on threaded area for longitudinal cracks
- Crack specification: 10.0mm length x 0.1mm width x 0.5mm depth
- Cycle time: <25 seconds
- The system is designed for automatic operation. It is equipped with automatic master part run.
42. Test for surface-open defects and material mix on Sleeves

- Inconel material
- Test for heat treatment and surface-open defects on the outer diameter.
- Cycle time: 1.5 seconds
- MD probes + Micro probes
- Crack specification
  - Longitudinal cracks: 3.750mm length x 0.075mm width x 0.075mm depth
  - Circumferential cracks: 3.750mm length x 0.075mm width x 0.150mm depth
43. Test on stamping parts for correct heat treatment

- Feeding of parts is effected via a vibration feeder to the escapement of the test system where the test part are individually pushed into the test coil. Testing for heat treatment and depending on the test result, sorted either to good or bad parts.
- Cycle time: less than 4.5 seconds per part
ibg’s customers including:

Authorized representative