New Developed AC/DC-Pulse Technology for MT-Testing and Demagnetization of Steel Components

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Abstract. HPT Hirsch Prueftechnik GmbH developed and supplies new mobile AC/DC-pulse MT-testing Equipment for surface crack detection and demagnetization of small and large steel components in many industries. The MT-testing device generates short single or multiple AC- or DC-pulses in order to magnetize the parts for MT-testing and demagnetization of steel components. Once testing liquid mixed with iron-oxide particle has been sprayed on the surface of the parts, the magnetic stray field accumulates the particles at the cracks. One important Advantage of the MT-testing with AC/DC Pulse Technology is the fact, that it produces very clear indications without false indications within a very short period of time. Large components like gears, shafts, forged, casted or welded components can be MT-tested or demagnetized quickly and economically. The presentation describes the new developed AC/DC Equipment, type Multipuls-1003 with single or multiple AC/DC current peaks up to 30,000 A to perform MT-testing and demagnetization work with direct current flow or non contact with double-coils on small and very large components like shafts, blades, forged rings, turbine housings, valves, gears, engine components, pressure vessels etc..

Introduction

HPT Hirsch Prueftechnik GmbH in Zweibruecken supplies small low weight and mobile AC/DC pulse MT-testing devices with a DC power peak up to 30,000 A (Fig. 1) in combination with an equipment carrier (Fig. 2) for surface crack detection and demagnetization of steel components.

Fig. 1. 4-Pol-DC-Pulse Hirsch Unit, type Multipuls-1003-E2-1(DC power peak= 30,000 A), with UV-LED-lamp, remote control, test cables and magnetic connectors

Fig. 2. Equipment carrier, type Multipuls-1003-V

Magnetic connectors are used to attach the cables with the construction to be MT tested. An UV-LED-lamp illuminates the surface and provides some greenish crack indications. The measuring device for current, magnetic- and residual field strength is needed to make sure that testing is carried out properly.

MT-testing with AC/DC Pulse Technology can be applied in many industries like submarine ship yards, machine building, foundries, forging shops, mobile cranes, offshore equipment, hydroelectric- and wind power plants, armored vehicles, tanks, casted GGG40-blades etc..

The MT-testing devices generate short, fierce direct current pulses (Fig. 3) in order to magnetize the parts under test.

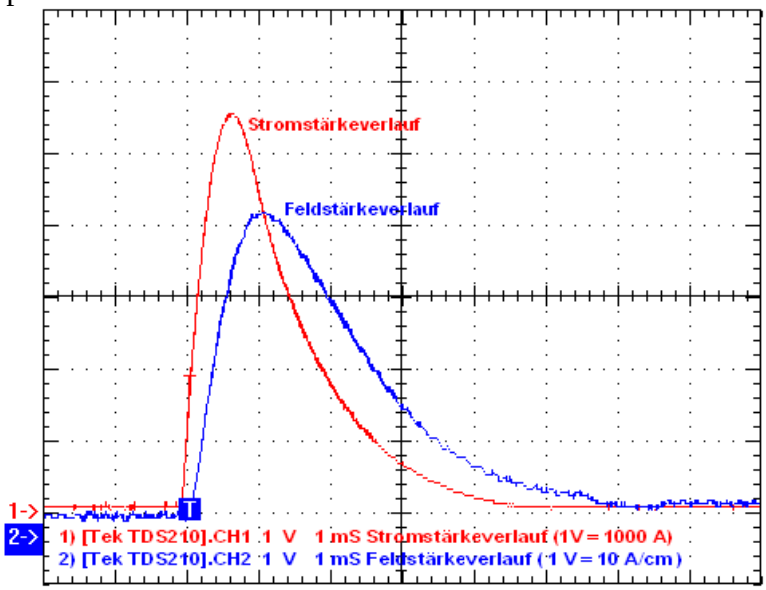

Fig. 3. DC current flow (red) and magnetic field strength (blue) of the Multipuls-1003-C Hirsch Unit (6,000 A)

Like all other MT-testing methods MT-testing with AC/DC Pulse Technology takes advantage of the effect, that at the location of surface cracks magnetic stray fields are escaping from magnetized parts. Once testing liquid mixed with iron or iron oxide particles has been sprayed on the surface of the parts, the magnetic stray fields accumulate the particles at the cracks.

One important advantage of MT-testing with AC/DC Pulse Technology is the fact, that it produces very clear crack indications without false indications within very short time. Large components i.e. tooth wheels, shafts, castings or welded components can be tested quickly and economically. The AC/DC Pulse Technology is used in combination with the following magnetization methods:

- Direct current flow for MT-testing and demagnetization (Fig. 4 – 7)
- Combined MT-testing with direct current flow and coil (Fig. 8 - 10)
- Non-contact MT-testing and demagnetization with double coil (Fig. 11- 12)
- Demagnetization with coil (Fig. 13)

Newest unit developments shall be shown on page 6 following.

1. Direct current flow for MT-testing and demagnetization

Fig. 4. MT-testing and demagnetization of a center beam of an automobile crane (9 m length)

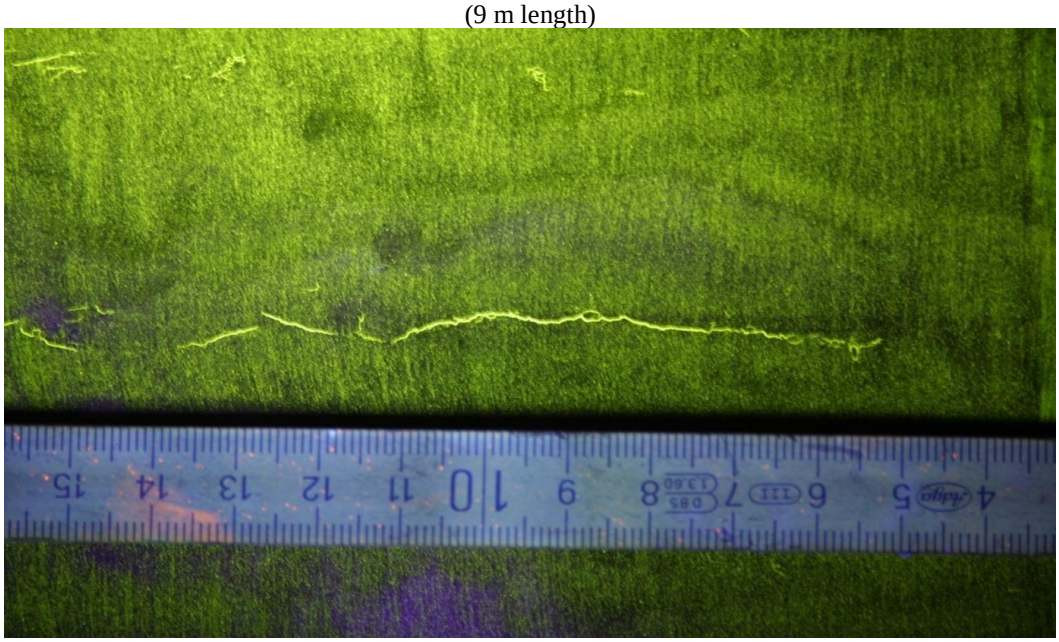

Fig. 5. Typical clear crack indications without any false indications using a Hirsch Unit of any type

Fig. 6. MT-testing of a blade for a hydroelectric power plant (W= 4.5 m; H= 3.0 m) with direct current flow

Fig. 7. MT-testing of a safety valve with direct current flow

2. Combined MT-testing with direct current flow and coil

Fig. 8. Combined MT-testing of a blade shaft for an industrial fan for a power plant

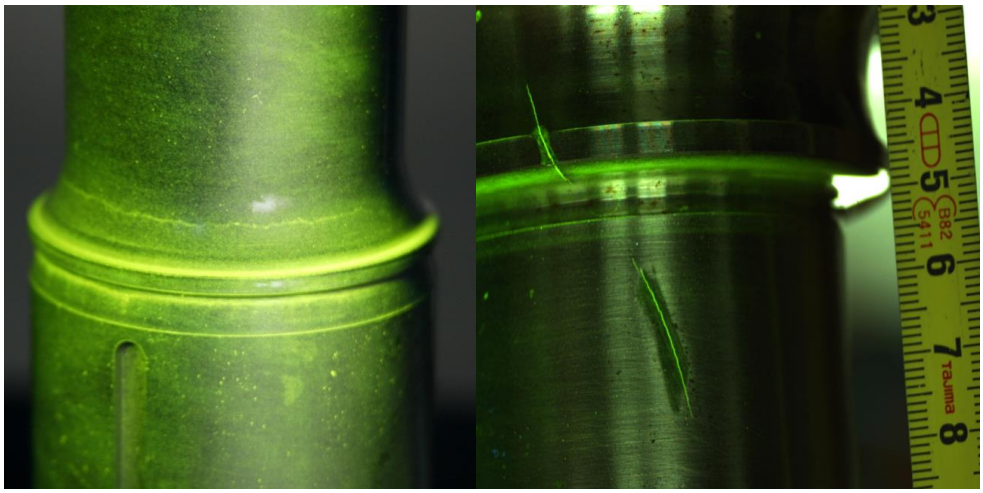

Fig. 9. Crack indication in blade shafts for industrial fans for a power plant

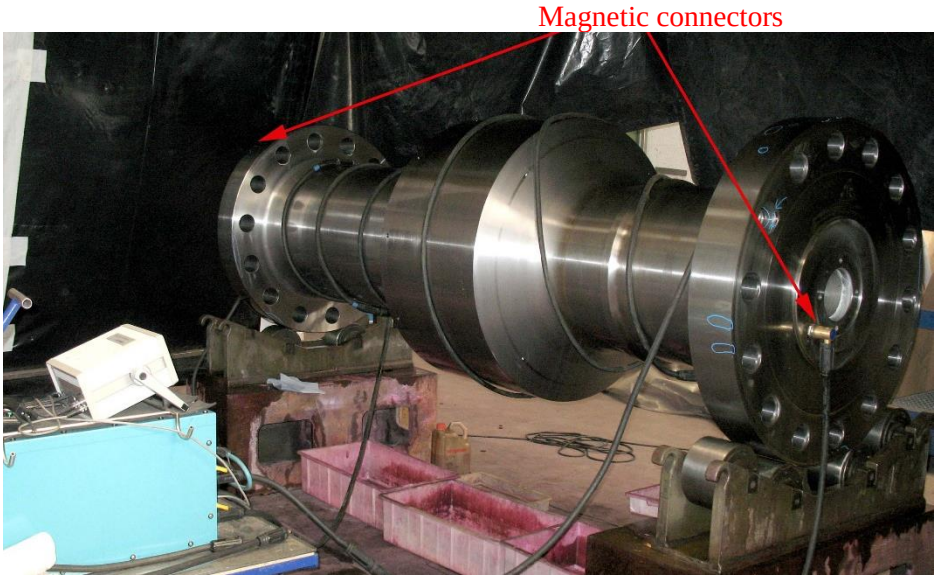

Fig. 10. Combined MT-testing of a water turbine shaft with a Hirsch Unit, type Multipuls-1003-E2 (25,000 A)

3. Non-contact MT-testing and demagnetization with double coil

Fig. 11. Non-contact MT-testing and demagnetization of a planet-wheel carrier with two coils and the Hirsch Unit, type Multipuls-1003-E2-1 (30,000 A)

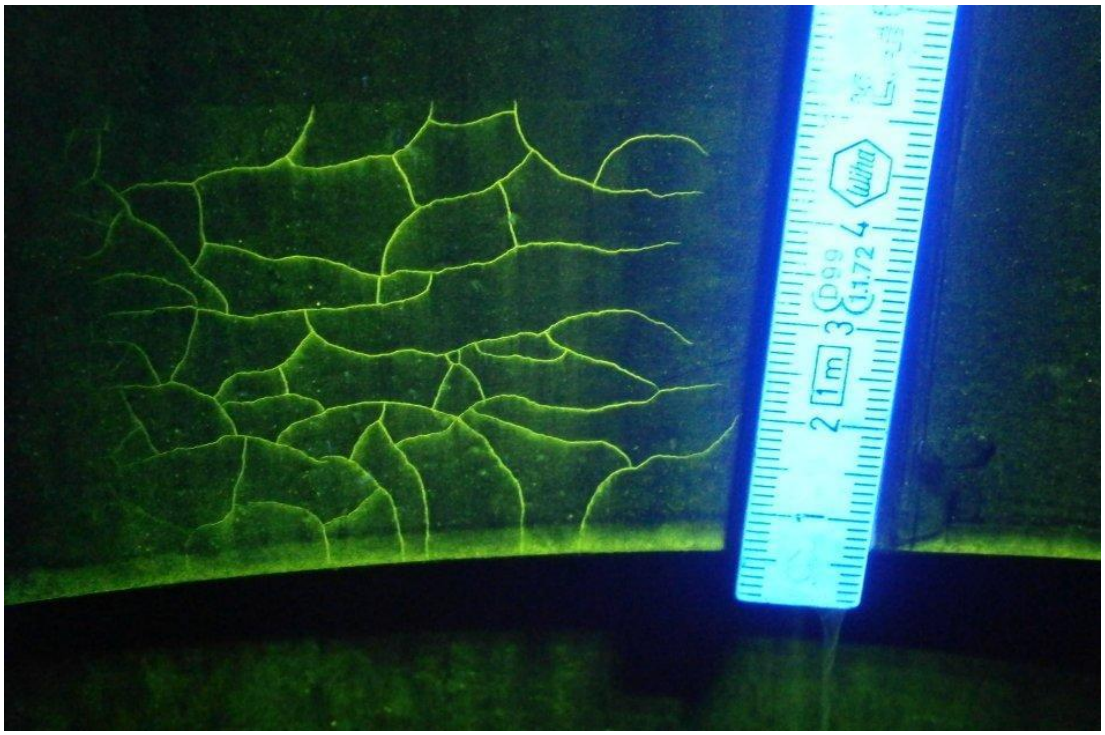

Fig. 12. Results of non-contact MT-testing with two coils and the Hirsch Unit, type Multipuls-1003-E2-1 (30,000 A)

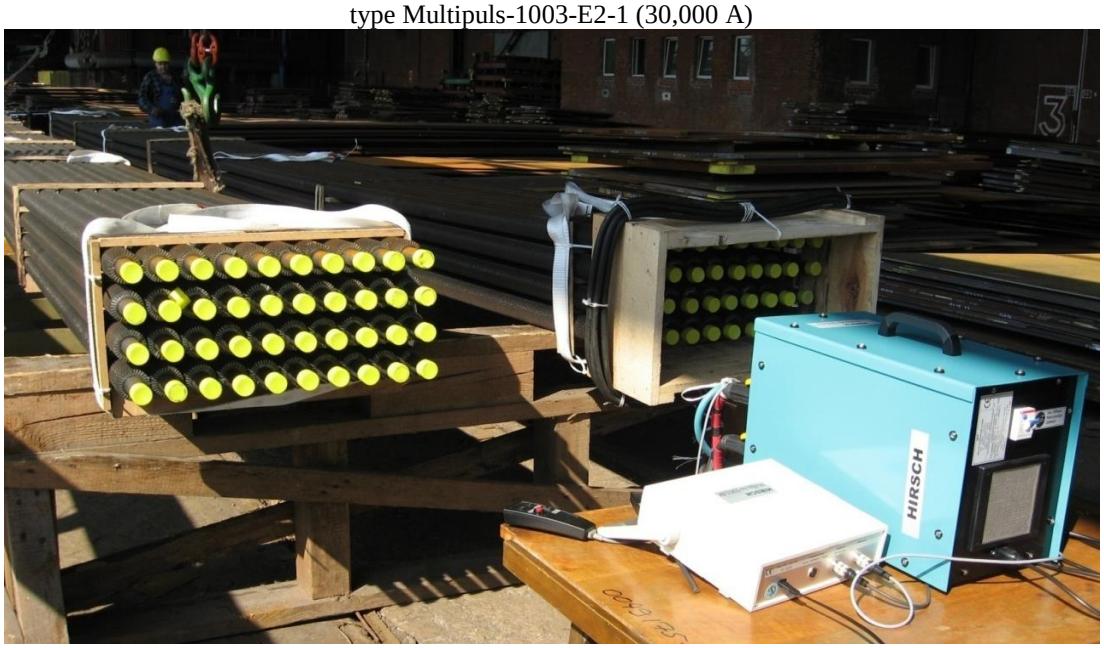

Fig. 13. Demagnetization of 40 pieces of heat exchanger pipes for a power plant within 2 minutes with coil

4. New developments

In the past few years HPT Hirsch Prueftechnik GmbH made developments to improve performance especially on the area of MT-testing huge metal parts. The increasing demand for more powerful equipment with high duty cycles that are still mobile led to the development of the Hirsch Unit, type Multipuls-1003-E2-2 (power peak= 30,000 A; Fig. 14).

In one compact housing on wheels the MT-testing and the measuring device are integrated for mobile application.

Fig. 14. Hirsch Unit, type Multipuls-1003-E2-2 (current peak= 30,000 A) with an increased duty cycle and integrated measuring device for impulse field, residual field and DC current measurement, type Multipuls-1003-M

The further new development is the Hirsch Unit, type Multipuls-1003-E3 (Fig. 16). It's based on a new type of advanced pulse technology, the so called 3 DC Pulse Technology (Fig.15).

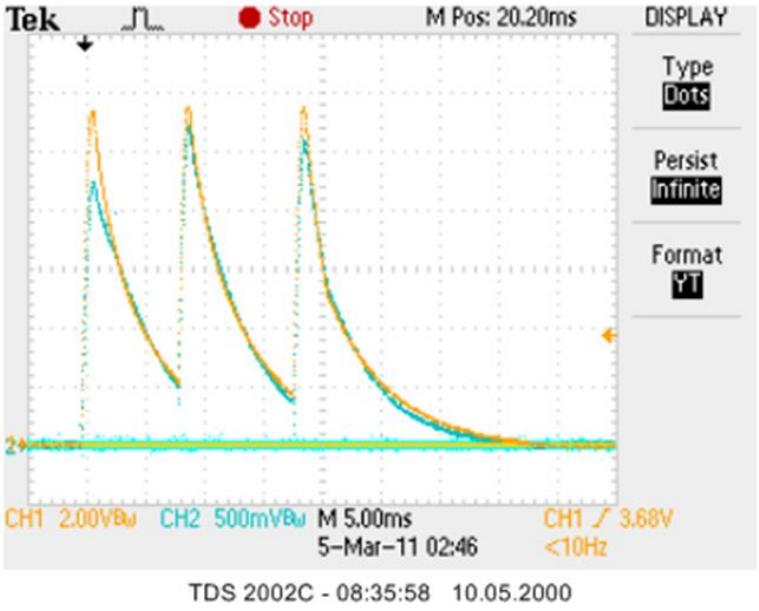

Fig. 15. The new developed 3 DC Pulse Technology with current peaks up to 30,000 A to cope with MT-testing of large metal components with rough surfaces

This 3 DC Pulse Technology improves crack indication results on rough surfaces, which are usually found on large casted components. With a DC peak of 3 x 30,000 A it has more energy to produce a strong magnetically field strength and is still convenient in handling long cable with the magnetic connectors.

Fig. 16. Hirsch Unit, type Multipuls-1003-E3 (current peak= 3x30,000 A) based on the new 3 DC Pulse Technology for MT-testing of large metal components with rough surfaces

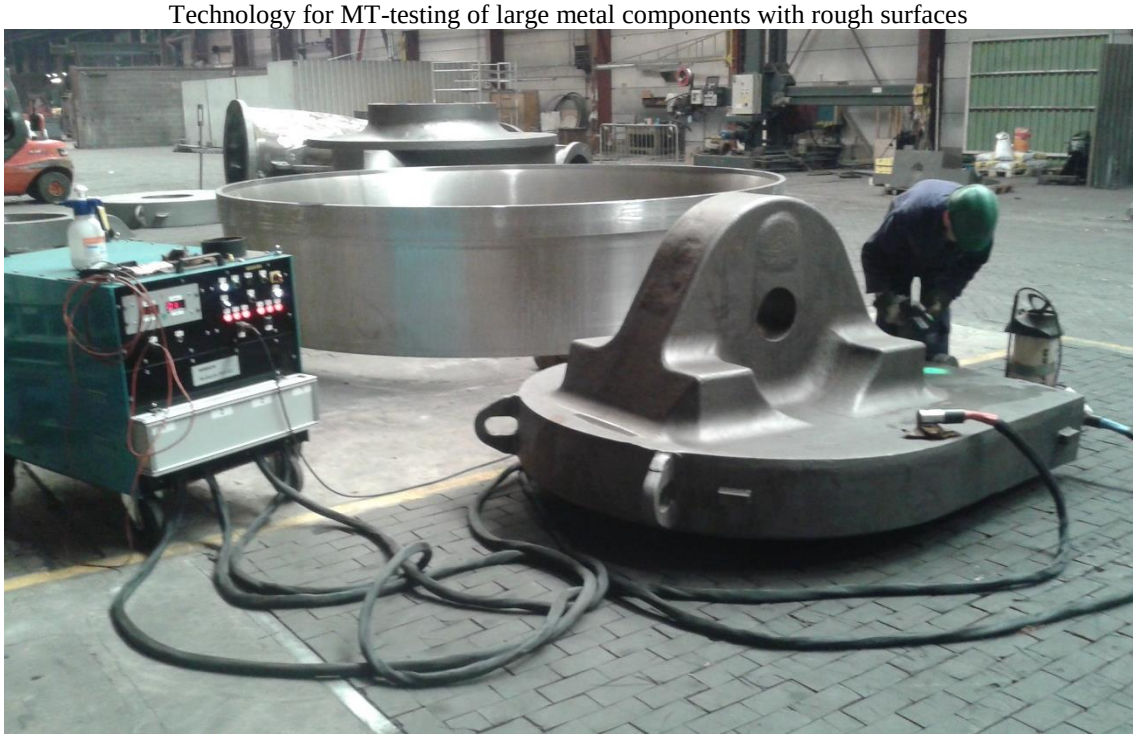

Fig. 17. Mt-testing of a casted component with direct current flow using 3 DC Pulse Technology