

Proline – Ultrasonic Testing for Electron Beam and Laser Weld Seams of Transmission Control Gears – Many more Applications in Production

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Abstract. The ultrasonic testing with pulse echo has been approved since many years as a user suitable and expressive non-destructive testing method for electron beam- and laser weld seams. The PROline-S system is used e.g. for the inspection especially at transmission control gears for the automotive industry at VW Kassel, Opel Powertrain Rüsselsheim.

In the process of immersion technique the ultrasound will be beamed radially into the weld seam of the rotating transmission control gear by means of a fixed vertical transducer. The further developed PROline-S ultrasonic inspection system will be provided now with a waterless coupling by a membran. In doing so with a gear inspector's stamp there will be created a membran-enclosed tank inside the coupler body.

PROline enables cost-efficient solutions with conventional and new designed immersion systems for control gears matched for short cycles and easy handling. The focus is on scan functions by low hardware and control effort as well as simple handling mechanics for the testing in variable inspection system for different parts.

PROline can be leveraged for inline- and offline testing in mechanized and automatic processes as well as for monitoring in production and application in the aerospace-, aviation-, automotive-, railroad-, steel-, plastic- and ceramic industry as well as at universities and research institutions. The application ranges from wall thickness measurement up to the integration into all kinds of production line systems for inline inspection as well as upgrading and retrofitting of existing ultrasonic testing systems and adaption of customer designed software. Primarily the PROline ultrasonic inspection system is designed for production with automatic data acquisition and evaluation. The multifunctional screen display shows the A-, B- or C-scan and at the same time the evaluation of the parts. The ultrasonic system communicates by digital I/O ports with the PLC of the inspection mechanics.

Proline S – Inline Ultrasonic testing of laser welded transmission control gears

Within our PROline ultrasonic instrument family PROline-S is a PC-supported ultrasonic test system, particularly aligned for the application in the automotive industry for the automated ultrasonic testing of laser or electron beam weld seams (figure 1).

Laser beam welded transmission control gears are inspected with the PROline-S ultrasonic system inline in production or offline in quality control laboratories.

PROline-S is available alternatively with almost dry coupling directly on the production conveyor or conventionally with immersion technique by using a water tank.

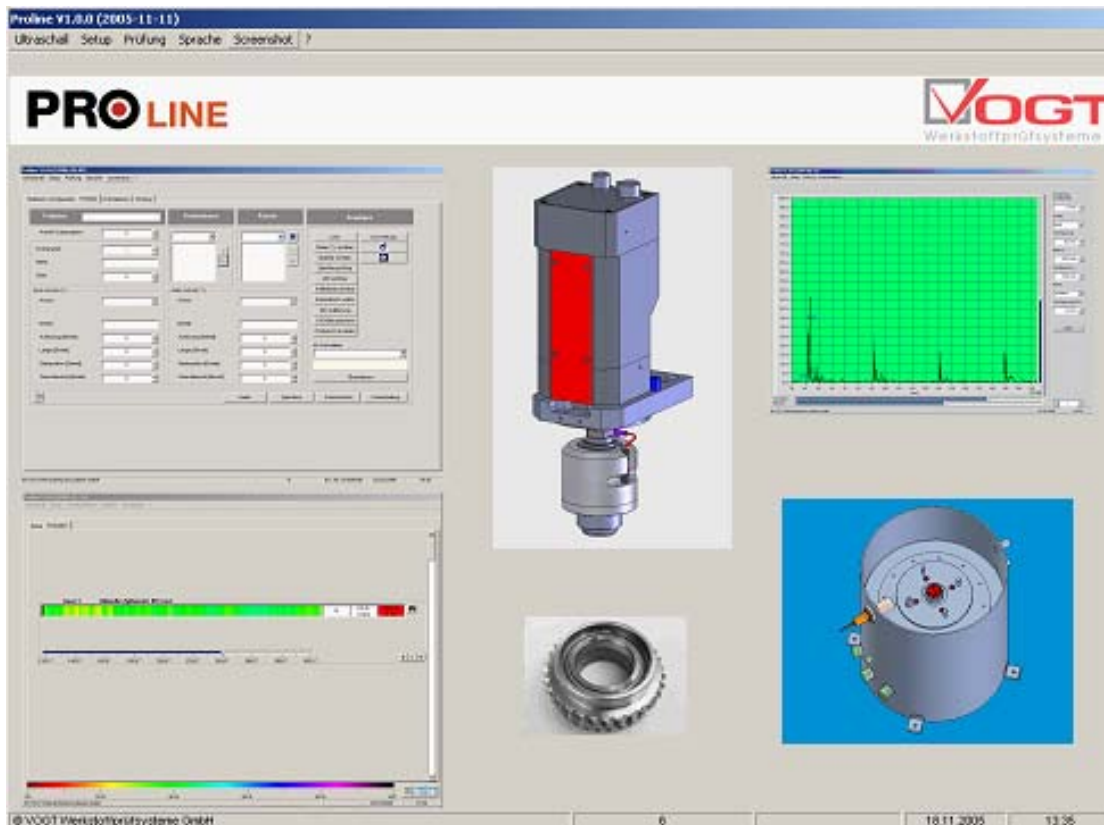


Figure 1: Inline Ultrasonic System for automatic testing of laser- and electron beam-weld seams on automobile transmission control gears

During the ultrasonic inspection of laser- or electron beam-welded control gears the task is therein to supervise the weld seam depth as well as to detect binding and volume flaws in the welding seam in accordance with the specified error sizes (flaw reflection, length and quantity of defect areas).

In the production two transmission control gears – pinion and coupling wheel – are squeezed together and welded by laser- or electron-beam welding system. The inspection system could be new or already at the customer existing inspection mechanics connected to the PROLINE ultrasonic inspection equipment. There are two considerable methods for testing the weld seam (figure 2 and 3).

Usually the ultrasound will be beamed radially into the weld seam of the rotating transmission control gear with immersion technique by means of a fixed vertical transducer and a water containment in which the gear is positioned. Weld depth as well as testing the volume of the weld can be combined by either turning and lifting the wheel or the transducer.

The inspection is made immediately after welding in conventional inspection by using an immersion technique. The transmission control gear is fed over a conveying belt of the inspection mechanics and dropped into a water-filled tank by a manipulator. The transmission control gear or the immersion transducer in the centre of the tank rotates and the sound beams radially into the weld seam. The complete testing is mostly performed during one rotation and for weld seam depth evaluation as C-scan (colored picture of the test area) with multiple rotation and the lifting of the transducer or gear.

The newest developed PROline-S ultrasonic inspection system now uses an innovative waterless coupling by a membrane to reach a membran-enclosed tank inside the coupler body. This is the almost dry inspection method developed by company Vogt with specific inspection stamps for the gear types. The stamp moves inside the bore hole and tests the

weld seam for failures. This is done with a rotating probe (using slipping rings for transfer of ultrasonic signals), radially from the inner side with one or more rotation.



Figure 2: Conventional Immersion Tank

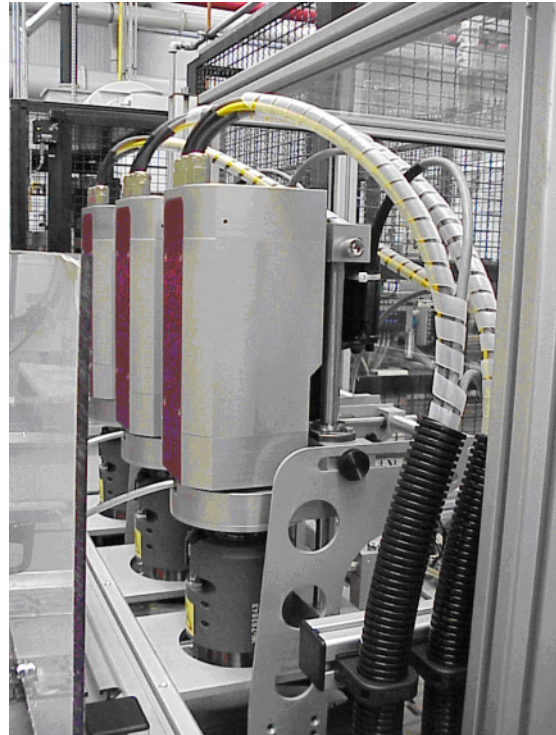


Figure 3: Gear Type Specific Stamp

During the scan the transducer in the inspection head rotates around the bore hole axis. By this PROline enables cost-efficient solutions and easy handling. No drying of the parts is needed after the testing, no additional mechanical manipulators for moving the parts from the production belt to the ultrasonic testing system are needed.

The sketch (figure 4) shows the arrangement of the transducer as well as the alignment of the sound field to the weld seam.

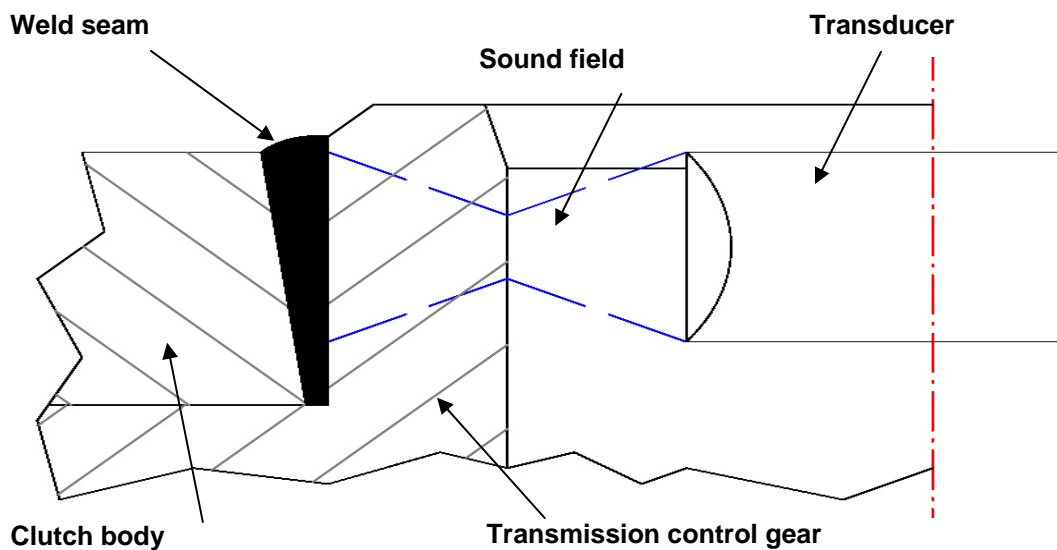


Figure 4: Cross-section through the weld seam, arrangement of transducer and beam direction

For easy handling and setup of the system Vogt Werkstoffprüfssysteme GmbH developed a windows based PROline inspection software. Besides the ultrasonic RF-image the multifunctional screen display also shows information like e.g. start, stop, signal for test

results like good & bad part, statistics, graphic result displays of the ultrasonic amplitudes, - time-of-flight or their signal combinations as well as e.g. also conventional B, C, TD-pictures, coordinates of the defect location in the part.

A-, B-, C-scan or Line scan and at the same time the automated evaluation of the signals is possible. Communication is done via digital I/O ports with the PLC of the inspection mechanics. The PROline ultrasonic testing system communicates via interface, which can be adapted with the respective production control.

Both common procedures for the weld seam inspection on the one hand the conventional examination in the immersion technique and on the other hand the NEW!!! almost dry inspection method with specific inspection stamps for the gear types are available.

Complete systems or OEM-solutions for the integration into customer mechanics are available.

The general PROline concept can be leveraged for inline- and offline testing in mechanized and automatic processes as well as for monitoring the production. PROline supports cost-conscious interbranchly inspection of industrial applications. The user-friendly structure of the software enables reduced training and an easy and reliable handling of the testing technology after a short period of practice.

With the development of this ultrasonic device VOGT offers a basic system, that guarantees on basis of a 19"-module-computer a simple integration in particular in the automated production for the continuous 100%-ultrasonic testing with automatic, ISO-conformal documentation.

The test system is suitable just as outstanding for the armament of old systems with new ultrasonics and as OEM ultrasonic device in connection with customer mechanics or in the form of a mobile device combined with mobile scanners.

Applications are e.g. the ultrasonic inspection of electron-beam resp laser. weld seams of transmission control gears. The non-destructive ultrasonic testing with PROline can be combined among others with mobile scanning systems, like e.g. the magnetic crawler GECCOscan for the scaffold-free ultrasonic inspection of tank walls.

PROline is also well suited for demanding industrial applications. Systems can be equipped with the new ultrasonic inspection system, like immersion technique systems or e.g. full-automated two-axes pipe scanners for weld seam- and corrosion testing as well as for volume- and crack inspection of round materials.