



UST 02

Rail Examination Train of the New Generation for Use on European Railways



The Rail Examination Train UST 02 is designed to work on the European Railways. The combination of the latest measurement systems with the most modern vehicle technique makes it unique in Europe.

At speeds up to 70 kph a comprehensive examination of the rails is carried out. With its advanced ultrasonic sensors the UST 02 is capable of finding squats and vertical split head defects, as well as the usual defects inside the rail. With eddy current sensors rail surface defects as e.g. head checks can reliably be detected and assessed.

The supplementation with a high resolution video system, taking pictures of the running surface of the rail, makes a new pioneering analyses of the rails possible.



EURAILSCOUT

Inspection & Analysis

Structure of the Rail Examination Train

On basis of the experience with the Ultrasonic Measurement Trains UST 76 and UST 96 EURAILSCOUT Inspection & Analysis developed a rail examination train of the new generation for its clients for use on European railways, in order to supplement the present fleet.

The rail examination train UST 02, the newest member of EURAILSCOUT's train fleet, is a two-part train with an overall length of 41.5 m.

To ensure application on the European railway network, the vehicle gauge profile UIC-Mb 505 was taken as a basis. The examination train can be used on standard-track-gauge stretches, and is also adaptable for broad-track-gauge according to the client's requirement. The maximum travelling speed of the train is 120 kph. The UST 02 is powered by means of two propulsion units each consisting of a diesel motor and a hydrodynamic transmission with under-floor design.

The vehicle is comfortably equipped and offers common rooms, sleeping room, sanitary area and a conference compartment as well as storage areas and a workshop for immediate repair of the measurement equipment. The measurement cabin contains 6 desks to deal with the various examination systems.

The rail examination train is equipped with the modern GSM-Rail radio system for its use in Europe. To ensure interoperability the UST 02 is also equipped with SiFa, PZB 90 and the Dutch ATB Railway Safety System.

The rail examination train UST 02 has been especially constructed to cope with the climatic conditions in Europe (- 25°C to + 40°C). Both vehicle sections are equipped with heating and air-conditioning. With its 14,000 litres water reservoir for the examination the UST 02 is ready for any length of shift without a break. The task of the rail examination train is the detection and quantitative analysis of rail damages in real time. Therefore the UST 02 is equipped with three different survey and examination systems: An Ultrasonic System, an Eddy Current System and a high resolution Video Survey of the running edge of the rail.

Qualified professionals who have experience in different European countries operate the UST 02.

The unique combination of these three systems, supported by advanced data processing and operated by committed professionals, allow a comprehensive examination of the tested rail sections. The results are the basis for both safety assessment and maintenance planning like grinding programmes.



1 Rail Examination Train UST 02

The rail examination train is equipped with two powered bogies on the steering-head sides and two running bogies each on the connected side of the train. The two running bogies include the sensors of the measuring system.

The vehicle's brakes are disc brakes additionally supported by a nearly wear-free dynamic brake in retarder form.



2 Measuring Cabin, UST 02

The safety of the railway requires regular examination of the running rails, as well as analysis and evaluation of the data recorded by the rail examination train.

Measuring Systems, Representation and Storage of Data, Evaluation

Ultrasonic Measurement System

The Ultrasonic Measurement System (see pictures below), the third generation in use on the UST 02, was developed on the basis of Ultrasonic Measurement Systems which had already proved their reliability in the UST 76 and UST 96. EURAILSCOUT's demands on the design of the Ultrasonic Measurement System, with the aim of detecting as many track defects as possible, as well as achieving high productivity and reliability, are as follows:

- The doubling of the ultrasonic examination channels to 32 units, in order to be able to detect squats and vertical split head defects
- The possibility of real-time processing of the data,
- Data processing speed which would allow examination at 100 kph
- Preparation for a real-time classification of the defects detected
- Design of the measurement bogie with respect to signalling and operational requirements
- The possibility of remote supervision of the systems using GPRS and UMTS / 3G technology

These improvements made a considerable expansion of both hardware and software capabilities necessary. A new processor-architecture has been developed for the real-time detection and processing of the measurement data, based on the industrial PC-architecture. The signals are digitalised and processed at an early stage during the examination trips, and all measurement results are consistently stored.



3 Ultrasonic Measurement System

The processing of ultrasonic measurement data requires that related data, e.g. track profiles, kilometres travelled and detected track defects are summarised to form so-called clusters. These are evaluated and classified, partly automatically and partly manually by the ultrasonic examiner on the rail examination train.

The UST 02 Ultrasonic Measurement System offers the possibility of a broader automation of the classification process in real-time, through the consistent storage of measurement data.

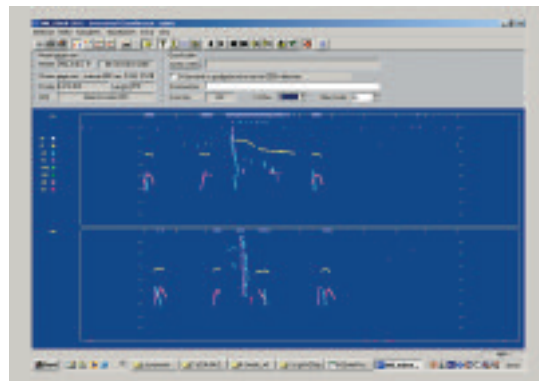
The recognition of vertical cracks and squats in the rail-head is now possible; thanks to the integration of a second measuring bogie in the rail examination train UST 02, the expansion of the ultrasonic channels to 32 units, as well as the use of new additional ultrasonic examination-heads.

Despite these expansions the UST 02 is able to examine the rails with speeds up to 70 kph, like the UST 96 did. The design of the measurement bogies is optimised to prevent interference with signalling systems. Thus the measurement can be carried out with very little operational disturbances.

The number of real-time markers – used for, among other things, communication between the different measurement systems – has also been increased to 32 units. Other real-time markers, e.g. tunnels, switches or railway crossings, are submitted by the vehicle driver. Supported by GPS- information which is stored constantly these markers are used to determine the exact location of the detected fault in the track.

Ultrasonic B-Scans of defects are durably stored on CD; reports and scans of the defects are transmitted on paper or digital data-carriers to the commissioner within 24 hours. Furthermore, they can be issued in different languages.

The reports can be generated according different standards and requirements, e.g. towards DB-AG norm (Germany), the Dutch norm or in accordance to the UIC norm. The measurement results are treated in such a way that they can easily be transferred to the client's database system.



4 Ultrasonic Measurement System

On demand all defects found are marked with high precision GPS coordinates which make it easy to find the defect in the track. Having this information hand measurements for the evaluation of the reported defects can be done in an efficient manner.

Eddy Current Measurement System

By using the Eddy Current Examination System, EURAILSCOUT is able to detect and evaluate surface defects in the running-edge area of the rail.

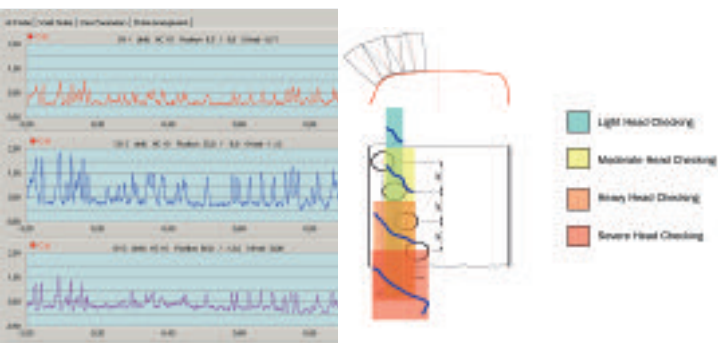
The eddy current sensor heads are guided along the running edge in a distance of less than a millimetre to enable them to identify reliably smallest cracks in the surface of the rail. Multiple cracks at the running edge, so called head checks, are automatically classified and evaluated in length, quantity and depth. Joints, all kinds of welds and other surface defects are detected automatically too.

This data is the basis for rail grinding works and can also be used to assess the quality of the carried out grinding action.

The Eddy Current Measurement System (fig. 5) covers an area of approximately 25 mm on the running-edge of each rail, with four sensors per rail. The Eddy Current sensors are guided independently of the ultrasonic measurement-head transmitters to be able to follow the wear profile of the examined rail.

Due to the measuring range of the sensors and their arrangement along the running edge of the rail, an easy classification of head-checks according to the "RailTrack"- Standard is possible (fig. 6).

In addition to this classification, a statement about depth of the head-checks can be made using the amplitude of the eddy current signals. In consideration of the different initial angles of the cracks, the measurable damage depth is approximately 2-3 mm.



5 Eddy Current System Signals

6 Measurement Protocol, Eddy Current

Using D-GPS (Global Positioning System), tacho encoders and special markers the measurement results are accurately located. This facilitates a later location of the damage spots measured. All measurement systems on board are synchronised. The use of the synchronised results from all three measurement systems ensures a qualified assessment of a rail defect.

The examiner can supervise the quality of the measurement data on an inspection monitor during the measurement. This offers sufficient information to recognise the disturbance-free functioning of the measuring system. The data are automatically evaluated during the measurement run. At the end of the day, a list with the results of this evaluation is available.

Eurailsout as the pioneer of Eddy Current rail examination has many years of experience with the combined Ultrasonic / Eddy Current rail testing. The UST 02 is operated by highly qualified professionals with experience on the various rail networks throughout Europe.

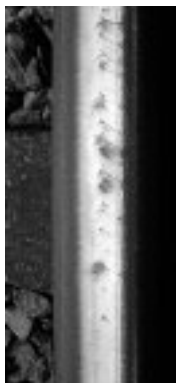
Video Inspection System

By using modern video technique and image processing the Video Inspection System of the UST 02 makes a major reduction of track patrolling possible. Digital line scan cameras consistently record grey scale images of the rails which are stored on hard disks. The resolution of these images is 0.5 x 0.5 mm per pixel. The survey area can be chosen freely, usually the running edge and the inner side of the web is recorded.

The Video Inspection System is capable of recording rail images and localisation information of the 'central position recording system' at speeds up to 100 kph. With the intelligent software of the Video Inspection System the operator can jump to any recorded track position, either by manual selection or automatically by the other measurement systems. That means: head checks found by the Eddy Current System or squats identified with Ultrasonic examination can be evaluated easily by looking at the corresponding pictures of the Video Inspection System.

By supplementing the Ultrasonic and the Eddy Current Systems with the Video Inspection System it is possible to make a highly reliable and efficient evaluation of the current state of the rail.

Above that the unique combination of examination techniques on the UST 02 enables Eurailsout to achieve pioneering new assessment methods and is the foundation for advanced research and development. Eurailsout can use new methods for training their examination staff by providing all gathered information.



7 head check images



Technical Data of the UST 02

Year of construction:	2004
Rail gauge:	1,435 mm
Vehicle length over the buffer:	41,500 mm
Bogie pivot pitch:	13,200 mm
Wheel base of the bogie:	2,600 mm
Minimum curve radius:	120 m
Vehicle weight per coach part: approx.	70 tonnes
Traction:	diesel hydraulic
Maximum speed, self-propelled:	120 kph
Maximum speed, in convoy:	120 kph
Maximum measurement speed:	100 kph
Sifa:	present
Vehicle interference (ATB, PZB):	present
Train radio system:	Mesa 2002, TeleRail, GSM-R

Results

The advantages of the new rail examination train UST 02 are not only in the area of vehicle technology, but also in the means of measurement technology. The vehicle is designed to fulfil the needs of almost all European countries.

The newly developed 32-channel Ultrasonic Measurement System, now in use, assures the detection of all 'usual' rail defects as well as squats and vertical split head defects. Like on the predecessor, the reliable UST 96, the UST 02 can carry out ultrasonic inspections with speeds up to 70 kph. That keeps operational influences limited.

The Eddy Current System, well known from the UST 96, is further developed regarding the exact guidance of the sensors along the rail edge, even at strongly worn rails. Head checks can now be found and classified even more precisely. The detection of other surface defects is improved as well.

The supplementation of both examination techniques by a high resolution Video Inspection System allows new possibilities in the comprehensive assessment of rail defects. Research and development as well as training of new examination staff profit from this unique combination. After the introduction of Eddy Current examination in the 90's Eurailscout is pioneer in rail testing again.

Through the unique combination of examination systems, while simultaneously optimising the vehicle, EURAILSCOUT has succeeded, with the rail examination train UST 02, in setting new standards of excellence in measurement precision and flexibility of use in the interests of its clients, the European railways.



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