

**Legislative Council Panel on Transport
Subcommittee on Matters Relating to Railways**

**MTR Corporation Limited's Rail Inspection:
Advanced Ultrasonic Testing Vehicle**

The MTR Corporation Limited ("MTRCL") introduced an advanced Ultrasonic Testing Vehicle ("UTV") for its rail inspection, with a view to strengthening railway safety. This paper reports to the Subcommittee the details.

Background

2. Rail inspection is an integral part of maintaining reliable train service. MTRCL has in place stringent inspection and maintenance of rails. Regular inspections including (a) ultrasonic rail testing; (b) visual inspection; and (c) dye penetrant testing are conducted as part of the routine maintenance regime. Details are set out in Annex I. The Corporation conducts regular visual inspection of rails every few days, as well as two to three dye penetrant testings and hand-held ultrasonic testings per year on different railway lines. These inspections aim to identify irregularities or rail cracks/breakages in their early stages of development so that preventive maintenance or replacement of the rail can be conducted in a timely manner, instead of waiting till the problem gets serious. This preventive measure helps keep the risk of service delays to minimal.

Advanced UTV

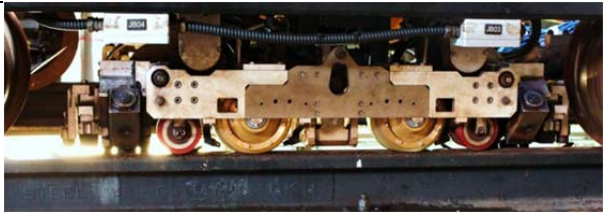
3. To enhance the work efficiency of inspection and maintenance of rails in the MTR network, MTRCL commissioned an advanced UTV for service in January 2013. At a cost of \$46 million, it can detect the smallest irregularities in the rails.


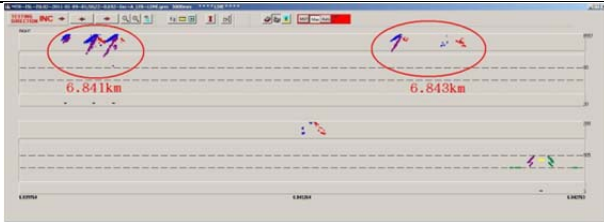
4. The UTV was procured from Australia. Before the UTV was shipped to Hong Kong, a Factory Acceptance Test was conducted in Australia to ensure that the UTV was of a satisfactory quality before commissioning in the MTR system.

5. Using ultrasonic technology, the device allows maintenance personnel to not only check normal wear and tear on the track but to also look into the core of the metal to gauge internal track conditions and detect the smallest irregularities that may be developing. The UTV's penetrating vision comes from the silent ultrasonic waves sent out by external wheel probes rolling along the rails. Information collected by the ultrasonic probes is transmitted to computers on board the UTV to generate real-time data for analysis by technicians. This all-revealing inspection helps determine whether and when appropriate follow-up actions need to be taken.

Main Constituents

6. The UTV comprises three main constituents:

Constituent	Description	Photo
Testing carriage	The testing carriage is lowered onto the rail, with ultrasonic probes automatically aligned to the rail. The probes contain fluid which is sprayed onto the rail to facilitate transmission of ultrasonic signals to the rail and detection of signal reflections.	

Computer processing system	The computer processing system processes and transmits data collected from the probes to the display unit.	
Operator interface	The UTV operators monitor the visual display units to identify any rail irregularities, after which the computerised identification system immediately and automatically issues alert.	

New Features

7. The advanced UTV provides higher sensitivity, enhanced signal analysis functions and faster testing speed to increase the effectiveness and efficiency of the ultrasonic testing of rails.
8. The advanced UTV complements the original inspection arrangement mentioned in paragraph 2 above to ensure rails are in top condition to offer reliable train service.
9. Details of the enhanced functions of the UTV are set out in Annex II.

Conclusion

10. MTRCL has one of the most stringent rail inspection and maintenance regimes among the world's major railway systems. Ultrasonic testing is usually carried out once every three to twelve months in other railway systems in the world. MTRCL spends more than \$5 billion each year to maintain the MTR network, upgrade assets and buy new equipment. MTRCL will continue to explore the use of new technology to strengthen its rail inspection and maintenance regime.

MTR Corporation Limited
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Details of Rail Inspection Works

Method of Inspection	Details
Ultrasonic testing	<ul style="list-style-type: none"> • Ultrasound has been widely adopted in the detection of irregularities in metals. Through the ultrasound emitted from the ultrasonic transmitter, irregularities inside metals can be detected according to the strength and time difference, etc. of the ultrasound the device receives. • Staff responsible for ultrasonic testing are required to attend professional training and attain relevant professional qualification.
Visual inspection	<ul style="list-style-type: none"> • Staff responsible for visual inspection are required to attend professional training in order to identify rail irregularities in all forms, such as crack developing and surface shelling, etc.
Dye penetrant testing	<ul style="list-style-type: none"> • Staff responsible for dye penetrant testing are required to attend professional training and attain professional qualification. • Steps of the test includes pre-cleaning, application of penetrant, removal of excess penetrant and application for developer. • All steps of the test must be conducted in accordance with stipulated guidelines.

Enhanced Functions of the Advanced UTV

Feature	Description
Higher testing speed	<ul style="list-style-type: none"> • With high testing speed, the new UTV as an example only needs an overnight maintenance period of 3 hours at a maximum design speed of 35 kph to complete checking the entire Kwun Tong Line. In the past, older UTVs took two nights to complete.
Enhanced computerised identification system	<ul style="list-style-type: none"> • Real-time synchronised scan testing can be carried out. • Audible and visual alarms are triggered when a possible irregularity is detected. • Possible defects are immediately categorised in terms of their depths and sizes for easy identification.
Higher resolution	<ul style="list-style-type: none"> • Ultrasonic pulse can be sent along every 2 mm of rail at a vehicle speed below 30 kph, enabling the smallest irregularities to be detected.
Enhanced test recording, playback, and audit capability	<ul style="list-style-type: none"> • With improved data analysis functions, the state of the same sections of rail can be automatically compared with data collected from the previous survey in real-time.
Easy-to-use management system	<ul style="list-style-type: none"> • The Windows platform manages data conveniently and efficiently.
Wide application to different rail types	<ul style="list-style-type: none"> • The UTV can be used to test different rail types in the MTR network.