Introduction of the "Multipurpose Integrated Highly-Advanced Railway Applications (MIHARA) Test Center"

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On October 2, 2014, Mitsubishi Heavy Industries, Ltd. (MHI) opened the "Multipurpose Integrated Highly-Advanced Railway Applications (MIHARA) Test Center," which is located at the Wadaoki Plant of MHI's Mihara Machinery Works in Mihara City, Hiroshima Prefecture. It is Japan's first comprehensive railway transportation system test facility, and has a loop track of approximately 3.2 km.

The purpose of this center is to help Japanese firms to be more competitive against overseas rivals and promote the export of urban transportation systems, which is a pillar of Japan's infrastructure export strategy. The center is intended to be open for use not only by MHI, but also other companies and public/private organizations, and will serve as a powerful support tool for accommodating international specifications and product development. We also expect the center to be useful for the introduction of software – including maintenance and operation – which has been widely acknowledged as the "Japan Model."

1. Path to the construction of the center

Railway officials have been aware of the usefulness of railway test tracks for research, product development, safety evaluation, etc., and at the Railway Group Meeting in June 2008, the Council of Transport Policy proposed the necessity of constructing such facilities. In response to this proposal, the Japan Association of Rolling Stock Industries and related organizations discussed the details of possible domestic test tracks and issued the report in December 2008, but nothing came about.

Under such circumstances, the "Test Track Review Committee" was organized in April 2012 with members from academia, government, public agencies and railway companies/manufacturers, to once again discuss feasible test tracks for the early materialization of such facilities. The topic was set as the "Discussion on the Specifications and Operation of Urban Transportation Railway Test Tracks" and thus, the details of the "MIHARA Test Center" and its intended purposes were laid out.

It is Japan's first full-scale railway test track for urban transportation systems. The committee had the English acronym of the test center "MIHARA" coincide with the name of the city where the test center is located (Mihara City, Hiroshima). They did so in the hope of the test center born in this city becoming the "medium of conveying Japanese railway systems to the world," being cherished by the residents and continuing to grow.

2. Facility overview of MIHARA Test Center

In the MIHARA Test Center, the steel-rail test lines consist of a loop track of approximately 3,170 m, a lead track of approximately 360 m, and a small curve track of 260 m (**Figure 1**).

MHI's Wadaoki Plant already had an approximately 1,270 m standard-gauge test line, which was constructed between 2004 and 2007. For the MIHARA Test Center, this steel-rail test line was drastically expanded into a loop track and was equipped with various facilities for comprehensive testing incorporating rolling stock, signals, communications and operational control. Thus, the newly-completed steel-rail test loop has become ready for use.

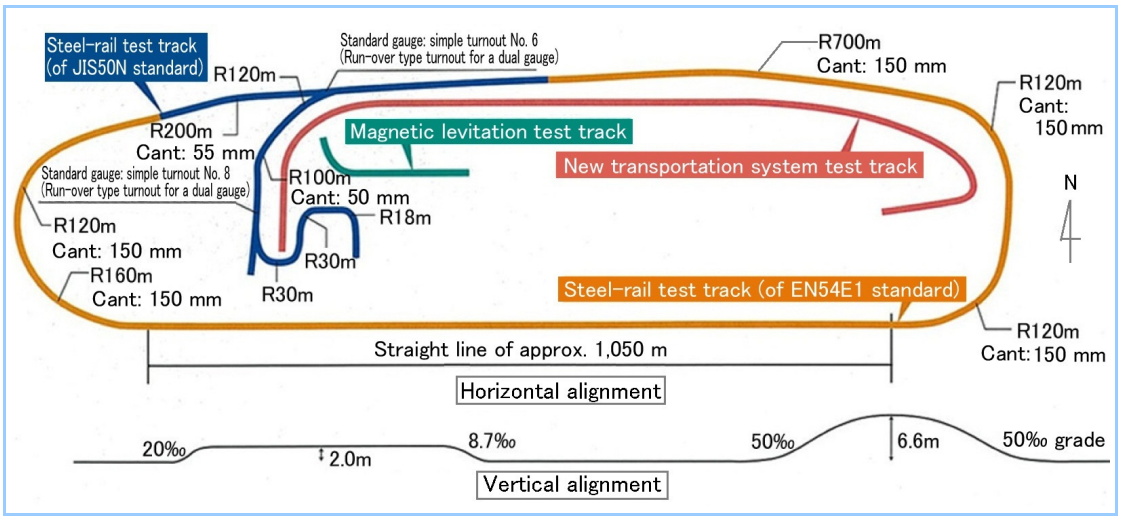

Figure 1 The track layout of MIHARA Test Center

The loop track has a minimum curve radius of 120 m and a maximum cant[Note 1] of 150 mm. The rate of change of the cant[Note 2] is set at 400. The longest straight section is roughly 1,050 m, and the end of this straight section (geographically toward the east) forms a 50‰ upgrade slope. After the summit is a 50‰ downgrade slope, on which a curved horizontal alignment with a minimum curve radius of 120 m was designed. As such, the obtained track layout attained a complicated configuration containing both vertical and horizontal alignment elements, which reflects urban geographical restrictions and the consequently-required difficult routes and slopes (**Figure 2**).

Currently available is a dual-gauge track for the standard/narrow gauges, and the test track has a section with rail fasteners (where rails are fixed on sleepers) so as to also accommodate the meter gauge in the future.

In the overhead catenary system, the power supply voltage can be either DC750V or DC1500V (**Table 1**). Thus, the MIHARA Test Center offers the facility with a DC1500V feeding system[Note 3], which is often the case with overseas urban transport system requirements.

The MIHARA Test Center has an operational control center (OCC) and an equipment room. At OCC, a large-screen multi-display system enables the monitoring of the power supply status and CCTV footage, and the trains-on-rails status can be checked on the desktop screen (**Figure 3**).

Note 1: In a curved track, the outer rail is placed higher than the inner rail to reduce the influence of centrifugal force on a train running on it. The cant denotes such designs or differences in elevation.
Note 2: The rate of change of the cant is the degree of change in the cant gradient.
Note 3: Through the feeding system, trains can obtain necessary power to move on a track.

Table 1 Summary of the loop track facility at the MIHARA Test Center

		Loop track summary
Test track length		Approx. 3.2 km
Track gauge	(mm)	Standard gauge 1,435 mm + narrow gauge 1,067 mm (dual gauge)
Rail		Long rail for EN54E1/ jointed rail for JIS50N
Maximum grade	(‰)	50
Vertical alignment	(m)	1500
Minimum curve radius	(m)	120 (Note: R100 m in the lead track)
Maximum cant	(mm)	150
Rate of change of cant		400
Slack		16 mm (R120, R160)
Overhead line	Voltage	DC1500V/DC750V/DC600V
	Type	OCS Catenary wire: hard-drawn copper stranded conductor 150 mm^2 (PH 150 mm^2), tensile strength 1,500 kgf Trolley wire: GT-SN 110 mm^2, tensile strength 1,000 kgf
Overhead line height	(mm)	5150
Track bed type		Ballast track and solid bed track
Turnout	Type	Standard gauge, simple turnout No. 6 (Run-over type turnout for a dual gauge (narrow gauge))

Figure 2 The 50‰ grade section

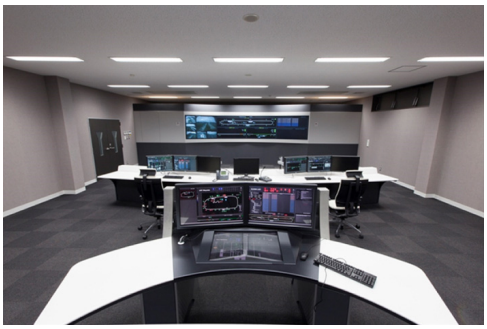

Figure 3 Operational control center

3. Center utilization and expected effects

The MIHARA Test Center is expected to be mainly utilized from the perspective of (1) technological development and safety evaluation, (2) specifications verification and (3) training and practice.

Conducting a demonstration and safety evaluation under a condition similar to the actual operation makes it possible to shorten the time necessary for testing and adjustment, as well as facilitate the practical application of new technologies and new systems. In terms of system validation, for example, data such as RAMS (Reliability, Availability, Maintainability and Safety) and EMC (Electro-Magnetic Compatibility) can be obtained at the MIHARA Test Center and the relevant tests (i.e., durability testing, combination testing and integration testing) can also be performed. The whole process may become shorter owing to the preliminary tests, which can be conducted domestically before track construction is completed overseas.

It is also possible to collect the data in accordance with the standards and specifications given by the client (i.e., an overseas railway company) and assess it accordingly, which may further promote the export of Japanese railway technologies.

The MIHARA Test Center can provide foreign railway officials with opportunities to see the Japanese railway system, encouraging them to become familiarized with the system, understand how it can be different from other countries and get a clear idea of our technological levels. We hope that such occasions may result in an advantage for us when competing against overseas rivals.

We sincerely hope that the use of the center can benefit many stakeholders, making Japan more competitive in the export of its railway infrastructure.