

Liquid Cooled PM Dynamometer Roller Overhung Chassis Dynamometer

PM motor, Vehicle testing equipment, High efficiency, Oil cooling

Mitsuru Arakawa, Minoru Matsumoto

1. Preface

Meidensha Corporation has manufactured a variety of testing equipment for many kind of cars and trucks etc. In particular, the roller overhung type chassis dynamometers (CHDYs) have been manufactured and delivered as major products in a large quantity since 1992.

And the liquid cooled permanent magnet type dynamometer (PMDY) was developed in 2000 and is obtaining a high reputation because the cooling fan has been eliminated and the feature of low noise has been well-received by our customers.

This paper introduces the newly developed low-noise roller overhung type chassis dynamometer (CHDY), to which the above-mentioned technologies have been applied.

2. Outline of Equipment

Conventional CHDY units have a cooling fan and it generates noise which prohibits noise test application. Because of this problem if the conventional CHDY was used for noise test, only its rollers were installed in an anechoic room and other equipment units (dynamometer, etc.) were installed in a separate room with the intervention of sound insulating sleeves, etc. As a result, there was a variation in mechanical losses due to the effect of the roller bearings. In addition, there were additional problems such that the stability of the road load was lowered and the installation space had to be large.

To solve these problems, the Company has developed the liquid cooled PMDY roller overhung type CHDY.

2.1 Major Equipment Specification

Fig. 1 shows the comparison of the external appearance with conventional models. Fig. 2 shows the outline drawing of the developed equipment, Table 1 shows the comparison of the configuration, and Table 2 shows the major speci-

fications of the developed equipment.

Some noteworthy factors in the equipment configuration are described below.

(1) Use of the roller overhung type

Since this configuration has been adopted, it is possible to measure the driving force, including the

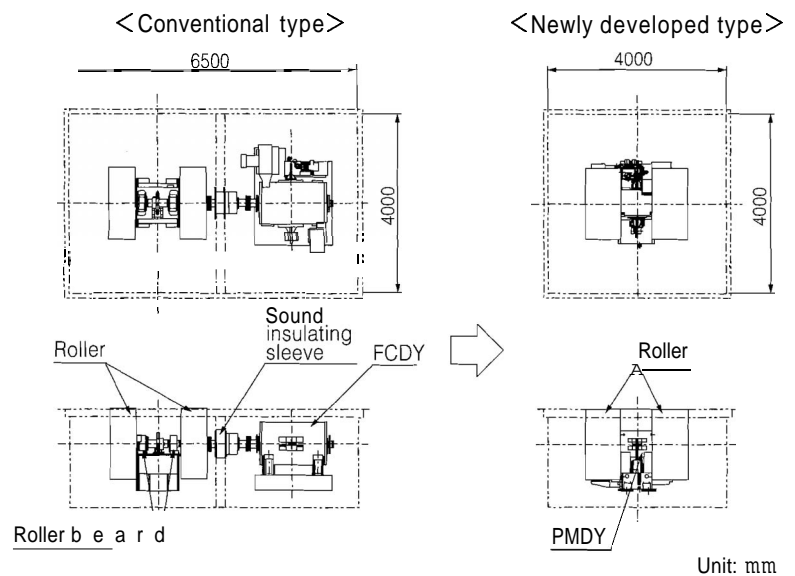


Fig. 1 Comparison of the External Appearance

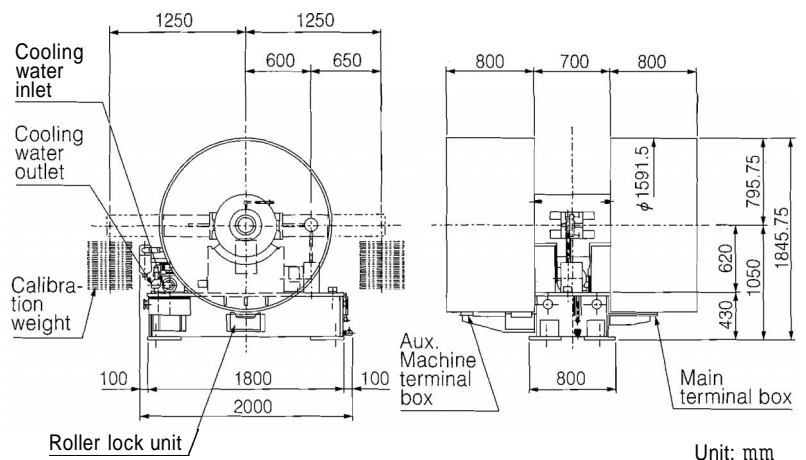


Fig. 2 Liquid Cooled PMDY Roller Overhung Type CHDY

Table 1 Comparison of the Configuration between Conventional and Developed Machines

Item	Conventional machine	Developed machine
Roller	Bearing system	Elimination of appropriate bearings because of union with dynamometer
Absorber unit	Induction motor (FCDY)	Permanent magnet motor (PMDY)
Cooling type	Separately ventilated type	Totally enclosed oil immersed cooling type

Table 2 Standard Specification

Item	Standard specification
Rated speed	100~200km/h
Max. driving force	5.4kN (8.1kN for short time rating)
Equivalent vehicle mass	700~2500kg
Max. axle load	19.6kN
Roller outer diameter	φ1591.5mm
Roller material	Aluminum
Roller surface finish	Smooth
Absorption capacity	150kW
Driving capacity	110kW
Revolving speed	333~667min ⁻¹
Time rating	Continuous
Cooling water	80L/min, 32°C or below No freezing permissible
Ambient temperature	0~+40°C
Relative humidity	30~80%RH without dew condensation
Installation place	Altitude: 1000m or below Minimal floating dust Less corrosive gas content

mechanical losses other than the windage loss of the rollers. In the case of a conventional model, compensation for losses was impossible to carry out and this resulted in an adverse influence upon operation. For the new type, however, the behavior of the bearing losses has become stable.

(2) Attainment of low inertia and light weight

Since permanent magnets (PMs) are used in the rotor, it has become possible to attain low inertia and light mass. The inertial value has been lowered to about 1/10 that of conventional models in terms of the unit body of the dynamometer (except for the roller). For the roller overhung type CHDY, the inertial value has been reduced to about 415. Compared with conventional machines, the mass has been lowered to about 415.

(3) High efficiency

A conventional CHDY was composed of a dynamometer based on the induction motor. However, since permanent magnets have been used in the rotor, the joule loss formerly generated in the rotor has been eliminated. Thus the overall loss generation has been reduced to obtain a higher efficiency. The rotor magnets are embedded in the rotor core by the method referred to as the IPM system. A high efficiency is attained through the utilization of the reluctance torque in addition to the use of the torque produced by the magnetic flux of the magnets.

(4) Improvement of the cooling capability

To improve the cooling capability, this PMDY uses the oil-immersed cooling system by which the heat generating sections are directly cooled. In the case of oil-immersed cooling, there is a problem in regard to the reduction of agitation loss. However, this problem has been solved through the utilization of a low-viscosity coolant and the attainment of smoothness in the coolant flow path.

(5) Low noise and space conservation

The oil-immersed cooling system has been used to eliminate cooling fans. This has resulted in low noise generation, which assures the establishment of a favorable testing environment. If the equipment is used for a noise test and the like, it is possible to install the dynamometer in an anechoic room. Compared with a conventional CHDY system for use in an anechoic room, the installation space has been reduced to approximately 213.

(6) Bearings

Since this dynamometer is a low-speed type, a grease lubrication system has been adopted. As a result, the bearing construction has been simplified and the obtained maintainability is high. The techniques for the oil seal between the oil in the frame and the bearings are sustained by many years of production experience. A highly reliable oil seal is always used.

3. Postscript

The low-noise roller overhung type CHDY introduced in this paper is a product that features compactness, space saving, and low noise. We estimate that the needs for this type of equipment will increase more and more in the future. Meidensha Corporation intends to develop more optimal dynamometers to meet the requirements of our customers.