

"TM Series", Load Cells for Measuring Tension*

Shunji Harada**

1 Introduction

In the steel manufacturing process, the tension of flat-rolled steel products is controlled in order to stabilize the shape quality of plates and sheets. A load cell is installed in the lower part of a roll bearing to measure this tension. Tension meters are divided into (1) those directly connected to a load cell and (2) those that are a combination of a lever and a load cell. Both types are required to provide a wide measuring range and high stability. A load cell in which the magnetostrictive effect is made use of is installed in some examples of the former type. At Kawatetsu Advantech Co., Ltd., however, load cell fabrication technology using a strain gauge was used to develop and commercialize the "TM Series", load cells of original structure for tension measurement.

2 Features of the TM Series

- (1) Its low profile requires little space when the load cell is installed.
- (2) There are two types with different strain detection mechanisms, i.e., the H type and the V type. Installation is possible without a substantial modification to existing equipment by appropriately using these two types by considering the direction in which a force acts and the direction of installation in a production line.
- (3) Because the load cell is made of stainless steel and is a waterproof metal enclosure, it can be used in severe environments.
- (4) Nonlinearity is $\pm 0.2\%$ and the load cell has high accuracy.

3 Outline of Product

The load cell that measures horizontal force is called the TM-H type and that measuring vertical force is called TM-V. Models which measure rated loads of 9.8 kN to 98 kN are serialized. The appearance of the TM-V

type is shown in **Photo 1**. The outside dimensions of the TM series are shown in **Fig. 1** and the specifications of the TM series are shown in **Table 1**.

4 Inclined Load Characteristics

In a tension meter, tension acting on a strip is determined by a geometric computer from the magnitude and direction of the force acting on a load cell. Therefore, load characteristics related to the direction of the force are important. The TM-V type is designed so that it can detect a normal force on the installation plane (vertical force component). When a force acts in other directions, for example, in the direction parallel to the installation plane, it is desirable that the output be 0.

An inclined load was applied to a load cell and the angle characteristics were investigated. The results of this investigation are shown in **Fig. 2**. Measured output $V(\theta)$ decreases with increasing inclined angle θ from 0° to

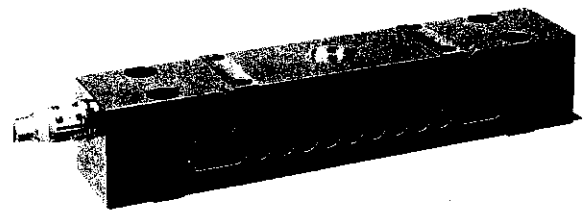
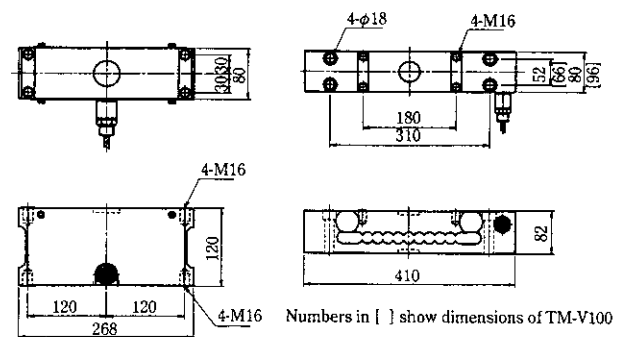


Photo 1 View of TM-V-50



(a) TM-H type

(b) TM-V type

Fig. 1 Outside view of load cell TM series

* Originally published in *Kawasaki Steel Gihō*, 31(1999)4, 274-275

** Staff General Manager, General Technology Dept., Kawatetsu Advantech Co., Ltd.

Table 1 Epecification of TM series

Model	TM-H-10	TM-H-20	TM-V-20	TM-V-50	TM-V-100
Rated load	9.8 kN	19.6 kN	19.6 kN	49 kN	98 kN
Rated output	0.8 mV/V		1.0 mV/V		
Nonlinearity	±0.2% R.O.				
Hysterisis	±0.2% R.O.				
Repeatability	0.03% R.O.				
Input/Output resistance	395 ± 20 Ω/350 ± 5 Ω		800 ± 40 Ω/700 ± 30 Ω		
Temperature effect on zero balance	0.03% R.O./10°C				
Temperature effect on output	0.05% Load/10°C				
Compensated temperature range	-10°C ~ +60°C				
Limited overload range	400% R.L.				

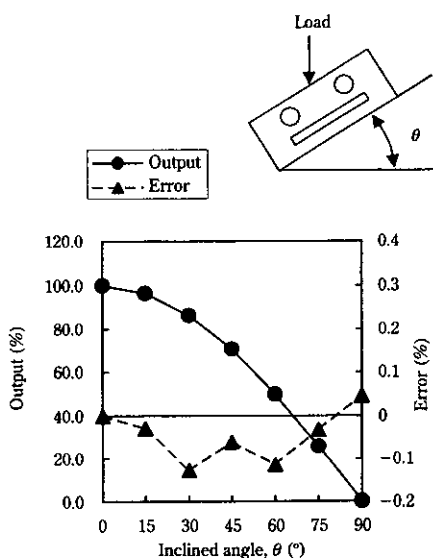


Fig. 2 Inclined load test

90° and is almost 0 when θ is 0°. The graph also shows a difference between the measured output $V(\theta)$ at each inclined angle and the output calculated from a geometric relationship $V_c(\theta) = V(0) \times \cos \theta$ as an error defined by the following equation:

$$\{V(\theta) - V_c(\theta)\} / V(0) \times 100(\%)$$

Errors are within ±0.15% and the two are in good agreement with each other.

5 Examples of Installation.

Examples of the TM-H and TM-V types installed in tension meters are shown in Figs. 3 (a) and (b), respectively. The TM-H type is suitable for use in a line with a large horizontal force component and the TM-V type is suitable for installation in a line with a large vertical force component.

6 Concluding Remarks

The "TM Series" load cells for tension measurement,

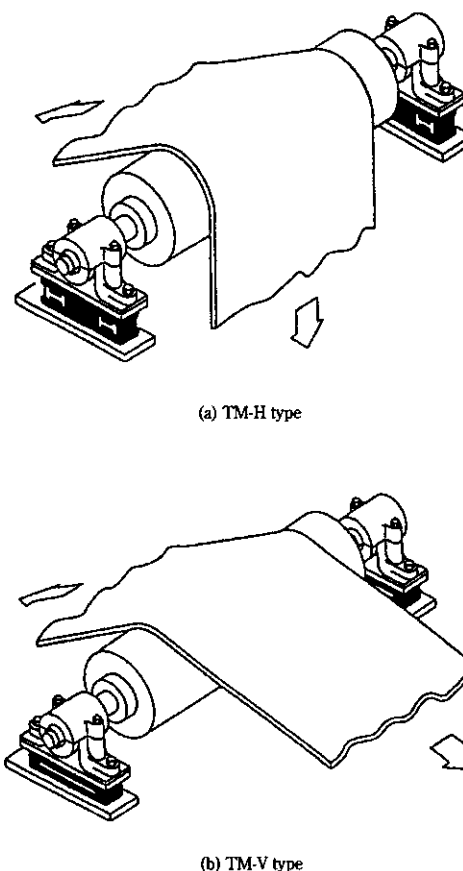


Fig. 3 TM series load cells installed in tension meters

developed in 1994, have been used in steel manufacturing equipment at home and abroad with good field-proven results. Recent examples of use include an application in an overload detector of a crane and other fields. We intend to work to further expand the range of their application.

For Further Information, Please Contact to:

Weighing System Sales Sec., Kawatetsu Advantec Co., Ltd.
 Phone: 0798(66)1507
 Fax: 0798(66)1510