

## Analysis of Elevator Speed Limiter Online Detection Technology

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**Abstract:** During the operation process of the elevator, the elevator speed limiter safety tongs linkage protection device is an indispensable safety protection device. It can stop the elevator in time to prevent accidents in the event of accidents such as elevator runaway and the breakage of suspension device. It is an important line of defense for elevator safety. In accordance with the requirements of TSG T7001-2009 "Elevator Supervision Inspection and Periodic Inspection Rules-Traction and Forced Driving Elevator" and its No. 2 amendment order, inspection subject, supervision unit and inspection cycle of the elevator speed governor were adjusted. This paper mainly describes the changes in the standard for detecting elevator speed governor, and introduces several mainstream online detection technologies to provide technical references for each elevator detection agency, user unit, maintenance unit, and monitoring unit.

### 1. Technical Background

During the rapid development of the domestic economy, especially driven by the development of the real estate industry, the market demand for elevators is increasing day by day, and it has gradually become an indispensable means of transportation for the daily travel of the general public. The holding value of elevators has exceeded 6.27 million units and has become an important part of daily life and work. However, elevator safety accidents occurred from time to time and have attracted wide attention from the society.

According to the data of the "Notification on the Situation of Safety of National Special Equipment in Recent Years", there were 56 elevator accidents in 2017, and the number of accidents involving people trapped in elevators occurred frequently. For example, on September 14, 2014, the elevator accident led to the death of a student cut by the elevator in Huaqiao University. On July 17, 2015, elevator fall accident in Shenyang caused 12 people to be injured, which caused great shock in China. Whether the elevator can run safely and the safety of traction passenger elevators has become the focus of public attention. In the elevator's safe operation system, the speed governor plays a very important role. The speed governor is a device that limits the speed of the elevator and is used as a set with safety tongs. When the lift car goes up or down by speeding, the elevator stops running through electrical contacts. When the lift car goes down by speeding, the electrical contacts action still cannot stop the elevator. After the speed reaches a certain value, the speed governor mechanically moves and the lift car stops by pulling the safety tongs and clamping the guide rail. It can be seen that the speed governor plays an important role in the safety of the elevator, and its safe and effective action is the key to ensure the effectively stop of the elevator when danger occurs.

### 2. Standard Analysis

According to the requirements of Article 9.9.1 of the standard GB7588-2003 "Standard for Elevator Manufacturing and Installation Safety", the content is as follows:

#### 9.9 Speed limiter

9.9.1 The action of the speed governor that operates the lift car safety tongs should at a speed at

least equal to 115% of the rated speed. But it should be less than the following values:

- a) 0.8m / s for safety tongs of instantaneously type expect non-falling roller type;
- b) 0.8m / s for safety tongs of non-falling roller type and instantaneous type;
- c) 1.5m / s for safety tongs of progressive type with rated speed less than or equal to 1m / s;
- d) 1.25v plus 0.25/v m/s for safety tongs of progressive type with rated speed more than 1m / s;

Note: For elevators with a rated speed more than 1m / s, it is recommended to use the action speed value close to d).

According to the inspection regulations issued in 2017, TSG T7001-2009 "Elevator Supervision Inspection and Periodic Inspection Rules-Traction and Forced Driving Elevator" and its No. 2 Amendment List (hereinafter referred to the new inspection regulations), Article 2.9, the content is as Table 1 :

Table 1 Article 2.9 from the TSG T7001-2009

<p>(4) The maintenance unit of the lift to be inspected shall perform an action speed check of the speed governor every two years (for speed governor with durable years that not exceed 15 years) or every year (for speed governor with durable years that exceed 15 years), and the check results shall meet the requirements.</p>	<p>Examine the check record of action speed of speed governor, and compare the relevant parameters on the nameplate of speed governor to judge whether the check result meets the requirements; for elevators with a rated speed of less than 3m / s, the inspectors also need to observe and confirm the verification process of the maintenance unit every two years.</p>
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By comparing traditional standard inspection regulations with new inspection regulations, there are three important changes:

- 1) Extension of the inspection period: from the elevator with an original service life of more than 2 years change to: for speed governor with a service life of not more than 15 years should be checked every two years; for speed governor with a service life of more than 15 years should be checked every year. It is important to point out that in terms of the better operability and significance, original inspection regulations are referring to the service life of the elevator, and the new inspection regulations are referring to the service life of the speed governor.
- 2) Change of inspection subject: from the elevator inspection agency or detection of elevator production unit that originally stipulated and licensed change to: maintenance unit of the inspected elevator, that is, the new inspection regulations limit the speed governor inspection unit to the maintenance unit of inspected elevator.
- 3) Changes of verification results: the original standard required the inspector to check the report according to the speed governor 's action speed, and check whether the nameplate parameters meet the requirements; except checking whether the speed governor's inspection report and nameplate parameters meet the requirements, the new inspection regulations require that the elevators with speed less than 3m / s, on-site observation and confirmation of the verification process are required every two years. This change reflects the inspector's role of on-site audit of the speed governor inspection technology of the inspected maintenance unit, as well as the supervisory role of on-site inspection of the speed governor, providing a deeper guarantee for public safety.

### 3. Detection Technology

According to the type of technology, online detection of elevator speed limiter can be divided into three types of online detection technology: traditional detection technology of speed limiter, conventional detection technology of speed governor, and new detection technology of speed

limiter.

### **3.1. Traditional detection technology of speed limiter**

Traditional speed limiter detection is one of the elevator speed limiter detection methods commonly used by maintenance units: it is a type of speed limiter detection technology for non-specialized instruments through the use of driven electric drill and tachometer. This technology requires two people to operate. One person holds the driven electric drill to drive the rope sheave of the speed governor that has loosened the steel wire rope, and the other holds the tachometer to touch the knot of the rope sheave groove and follows the rotation of rope sheave to drive the tachometer. When the inspector hears the sound of the electrical switch action, he is required to record the speed value observed by the eye at that moment; when he hears or sees the moment that the speed governor mechanical action stops, then the speed value observed at that moment is recorded. The result that recorded is the electrical and mechanical protection action value of the elevator speed governor.

This traditional detection technology has the characteristics of low cost, and can be measured quickly without installation. The disadvantages are as follows: Firstly, the technology uses electric rotation to increase speed and is manually adjusted by human. The magnitude of acceleration is difficult to control accurately, and excessive acceleration will cause the error of the tachometer reading to increase. In severe cases, it is impossible to artificially distinguish the electrical or mechanical protection action value. Secondly, the traditional operation must be coordinated by two people at the same time. It has the disadvantages of requiring multiple people to operate and manual error. Thirdly, the reading of the tachometer is entirely based on human senses (hearing and vision). Whether in terms of the principle of sensory transmission or the resolution, there are large human errors and reading errors of data resolution.

### **3.2. Conventional detection technology of speed limiter**

Conventional detection technology of speed limiter mainly uses a split-type special speed limiter detection method, which is generally designed with a dedicated driving device, a Hall induction rotating speed device, and an electrical switch detection terminal. The detection technology is: the magnetic steel is attached to the side of the rope sheave of speed governor, the magnetic induction plate of the Hall induction rotating speed device is magnetically attracted to the magnetic steel side of the iron plate housing of the speed governor, and the induction terminal is arranged on the side of the magnetic steel running track. After the steel wire rope of the speed governor is loosened through the special locking pliers of the elevator, the hand-held special driving device is pressed against the rope sheave of the speed governor. The driving device starts self-acceleration rope sheave of rotation speed governor, and the Hall induction rotating speed device will read the rotary speed frequency of magnetic steel on the speed governor wheel. The electrical action speed value is recorded at every moment of the electrical switch detection end action. When the speed increases to the speed governor mechanical switch action, the Hall induction rotating speed device records its maximum speed as the speed value of the mechanical switch action.

This conventional detection method has the convenience of a single person to detect the speed governor and high automatic detection characteristics, but it still has disadvantages: firstly, the measurement technology has many operating steps and requires the input of parameters such a steel wire rope diameter, pitch circle diameter, rated speed value, etc. The Hall induction rotating speed device and the electrical switch detection terminal should be installed, which needs higher requirements for operators.

Secondly, the acceleration set by the principle of this detection technology is low, resulting in a long measurement time; if the acceleration is set too large, there is a risk that the detection error of the magnetic steel rotating speed will become large. Thirdly, it generally uses direct plug-in on-site power supply. There is no built-in battery design, which is greatly affected by the power supply socket during on-site testing, and the convenience of operation is greatly reduced.

### **3.3. New detection technology of speed limiter**

The new detection technology of speed limiter is mainly the new integrated detection instrument technology of speed limiter, which adopts the integrated design of drive and speed measurement. This detection technology uses an integrated device of handheld drive and speed measurement to drive rope sheave of the speed governor of the elevator to increase to the speed of speed governor's electrical switch disconnection action. The electrical switch detection terminal reads the electrical disconnection signal in real time to obtain the speed value of the electrical action. Continuing to increase the speed until the stop action of the mechanical switch of the speed governor. The speed measuring device recognizes the change of the stalling of the speed governor wheel to obtain the speed value of the mechanical action at this time.

This new detection technology has the advantages of high detection accuracy and convenient operation. It realizes the advantages of fast measurement by single person, simple operation steps and simple wiring, greatly improving the convenience of operation. At the same time, the built-in battery design of the instrument relieves the influence of the power socket in the elevator machine room. Secondly, the new instrument technology uses a real-time contact-type test method, which can set a higher acceleration to shorten the measurement time, and improve the detection efficiency. Moreover, the new instrument technology has many advantages such as high reliability, even speed regulation, and high stability of output data. Its shortcomings are: in terms of limited scope of application, when the pitch circle of the speed measuring wheel and the speed governor wheel do not match, because the large drive wheel cannot directly contact the position of the governor pitch circle with a smaller wheel groove, it is difficult to detect. In addition, this technology requires that the speed measuring wheel is accurately pressed against the position of the rope sheave of speed governor pitch circle, which is difficult to operate. The displacement between the instrument drive wheel and the contact point of rope sheave of the speed governor will reduce the measurement accuracy and affect the detection result.

#### **4. Conclusion**

Elevator speed limiter detection is an important detection method to ensure the safety of elevators. By analyzing changes in the old and new standards of elevator speed limiter and the analysis of inspection and detection techniques, this paper conducted a comprehensive analysis of the background of testing technology, requirement analysis of new inspection regulations, traditional detection technology, conventional detection technology, new detection technology, etc., providing important technical analysis reference for each elevator testing agency, user unit, maintenance unit, and supervision unit.

#### **References**

- [1] GB 7588-2003 "Standard for Elevator Manufacturing and Installation Safety" [S].
- [2] TSG T7001-2009 "Elevator Supervision Inspection and Periodic Inspection Rules-Traction and Forced Driving Elevator" (including its No. 2 amendment list) [S].
- [3] Yue Zhang, Research on Application and Selection of Elevator Speed Governor Verification Device [J]; China Plant Engineering; 2017 (10); 60-63.
- [4] Zhancheng Li, Discussion on Elevator Speed Governor Verification Analysis and Its Key Points of Quality Control [J]; Equipment Machinery; 2018 (11); 72.
- [5] Yadong Wang, Tengfei Zhao. Online Verification Device for Elevator Speed Governor [J]. Technological Innovation, 2018 (10): 153-154.