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Draft Indian Standard

**PERFORMANCE TESTING OF POWERED INDUSTRIAL TRUCKS WORKING IN
HAZARDOUS AREAS
PART II ELECTRIC BATTERY POWERED INDUSTRIAL TRUCKS
(First Revision)**

(ICS 53.060)

Transport Tractors, Trailors and Industrial Trucks Sectional
Committee, TED 22

Last Date for Comments: 29/10/2022

Transport Tractors, Trailers and Industrial Trucks Sectional Committee, TED 22

FOREWORD

(Formal clause to be added later on)

This standard was first published in 1980. This first revision incorporates the experience gained with the use of this standard and brings the standard in line with the latest development in the field.

Safety in industrial operations is of extreme importance in order to avoid loss of human life or equipment and as incentive to the workman involved in these operations. As more and more industrial trucks are utilized for load movement in potentially hazardous atmosphere in most of the growth industries, there is absolutely a need for unequivocal guidelines on the economization of the risks involved, not only in the design and manufacture, and conversion of trucks, but equally important in the way they are operated, maintained and tested. It may be difficult to make all areas absolutely free of hazardous atmosphere but it may be more economical to devise means to ensure a safe operation for the industrial trucks in hazardous atmospheres.

The performance of such special design features as are provided to ensure the above requirements, is as important as taking care to maintain these special features. Thus, testing plays an important role before the truck is put in operation. This standard on performance testing has been drawn up to fulfil that need.

Industrial trucks may be powered with electric battery or internal combustion engine. As such this standard is issued in the following two parts:

- a) Part I Internal Combustion Engine - Powered; and
- b) Part II Electric Battery Powered Industrial Trucks.

The general requirements of these trucks are covered in IS 8790 (Part I): 1978 and IS 8790 (Part II) : 1978.

In the preparation of this standard assistance has been derived from ANSI B56. 3-1972 Standard for safety-electric-battery-powered industrial trucks, issued by the American National Standards Institute (ANSI).

The composition of the committee responsible for formulation of this standard is given as Annex XXX. (Will be added later)

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1 SCOPE

1.1 This standard covers the tests to check the performance of electric battery powered industrial trucks (except the Type EX, *see* IS: 8790 (Part II)-1978 designed to operate in hazardous areas.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

<i>IS No</i>	<i>Title</i>
IS 8790 (Part II) : 1978	General requirements of powered industrial trucks working in hazardous areas: Part 2 electric - Battery - Powered industrial trucks

3 PERFORMANCE TESTING**3.1 Type E Industrial Electric Trucks**

Please *see* IS 8790 (Part II).

3.1.1 Abnormal-Operation Test

3.1.1.1 As a test of the ability of the truck to withstand abuse, the truck shall be loaded to 110 percent of its maximum rated load capacity. The centre of the load for a forklift truck may be so located as to yield rated load movement about the load axle. The truck shall be quickly and rapidly operated through 25 reversals of direction of travel, reversals of full height lifting, and other operations that may be performed by the truck, such as flashing of lamps, blowing of horn, and other normal operating sequences. There shall be no indication of damage to any part of the vehicles as a result of this test.

3.1.1.2 The test course for fork and platform lift trucks shall be 12 m long. At the end of this course, the load shall be raised to full height and lowered to the hauling position. The truck with the load is then to return by reversal of direction of travel to the starting point. The truck shall be brought to a halt by service brakes only.

3.1.1.3 A thermostat or an overcurrent protective device that causes interruption of power to the traction or pump motor shall not operate during the first five cycles of the test described in **3.1.1.1**. If such interruption does occur during the remainder of the test, a thermostat is to be permitted to reclose and an overcurrent protective device is to be replaced or reclosed. The test is to be then continued until all of the prescribed operations have been concluded.

3.1.2 *Temperature Test*

3.1.2.1 *General*

- a) The materials employed in the construction of an industrial electric truck, when tested as specified for the type of truck, shall be such as not to produce any failure of electrical components or insulation that constitutes a fire hazard when the components are subjected to the temperatures attained during operation under the conditions of rated load;
- b) A thermostat or an overcurrent protective device that causes interruption of the power to the traction or pump motor shall not during the tests described in **3.1.2.2(a)** and **3.1.2.3(a)** to **3.1.2.4(b)**.;
- c) Prior to each temperature test, the truck shall be equipped with a fully charged storage battery of the maximum voltage and ampere hour capacity intended to be used with that specific truck. The tests outlined as above, shall be conducted at such a rate of power consumption that the battery is discharged in eight hours. A greater rate of power consumption may be used, if necessary, to enable normal operation of the truck. The rate of power consumption is to be determined by an amper-hour meter. The rate of power consumption for the test described in **3.1.2.4(b)** is not to be controlled.;
- d) The 175°C temperature limit indicated in **3.1.2.2(a)** and **3.1.2.2(c)** to **3.1.2.4(b)** does not apply to the surface of the resistor element employed in these devices. In these clauses, the 175°C temperature limit is based on a 25°C ambient temperature;
- e) If a blower motor operates during the tests described in **3.1.2.2(a)** to **3.1.2.4(b)** the tests are to be repeated with the blower motor disconnected. During the repeated tests, a thermostat or over-current protective device may terminate the test by interruption of power to the traction or pump motor. However, the temperature limits given in **3.1.2.2(a)** and **3.1.2.3(a)** to **3.1.2.4(b)** are also applicable; and

- f) In performing the tests outlined in **3.1.2.2(a)**, **3.1.2.3(a)** and **3.1.2.4(a)**, constant temperatures usually are reached after approximately three hours of operation in the manner outlined.

3.1.2.2 *Fork-lift and platform-lift trucks*

- a) The test course shall be 60 m long, including a grade as specified by the manufacturer over a distance of 10 m for a particular truck, with a total rise not less than 1 m. The truck shall be operated over the course hauling a rated load. At the end of the course, the truck is to negotiate a right angle turn after which the load is to be raised to full height and then lowered to hauling position. The truck with the load is then to return to the starting point, where the load is again to be raised and lowered and deposited at right-angle to the test course. The truck is then to be operated with no load over the same course, and, at the end of the course, the fork or platform is to be raised to full height and lowered. The truck shall then be returned to the starting position, where the load is to be picked up and these runs repeated with alternate loaded and unloaded trips. The test shall be continued until constant temperatures have been reached. During this test, the enclosure surface temperatures of each component shall not exceed 175°C.
- b) If a lift truck has multiple load ratings and corresponding maximum-lift heights, the test in **3.1.2.2(a)** shall be conducted for the rated load condition which shall produce maximum temperatures.

3.1.2.3 *Load-carrying (fixed-platform) trucks*

- a) The test course shall be any convenient length over 60 m. If the length exceeds 90 m, the truck shall be stopped and started at intervals of approximately 60 m. The course shall contain a grade not less than 5 percent, with a total rise of not less than 1 m. The course shall be negotiated not less than six times per hour. The truck shall be operated over the course hauling a rated load. The test shall be conducted so the truck is in motion approximately 80 percent of the time. The test shall be continued until constant temperatures have been reached. During this test, the enclosure surface temperatures of each component shall not exceed 175°C.

3.1.2.4 *Tractors*

- a) The test course shall be any convenient length over 60 m. If the length exceeds 90 m, the truck shall be stopped and started at intervals of approximately 60 m. The course shall contain a grade of not less than 5 percent with a total rise of not less than 1 m. The course shall be negotiated not less than six times per hour. Two loads shall be provided for the truck, consisting of two trains of trailers of trailing vehicles. One of the trains is to be loaded to such capacity as to require a drawbar pull on the level equal to the rated

drawbar pull of the tractor. The other train shall consist of empty trailers equal in number to the loaded train. The tractor shall be operated over the course pulling the loaded train of trailers and returning to the starting point at which point the loaded train shall be uncoupled. The empty train shall then be coupled to the tractor and pulled over the same course. This cycle shall be repeated, alternating between loaded and unloaded trailers, allowing time at the starting point for normal coupling and uncoupling operations. The test shall be continued until constant temperatures have been reached. During this test, the enclosure surface temperatures of each component shall not exceed 175°C.

- b) Immediately after taking the final temperature readings, the tractor shall be operated an additional one-minute period against a bumping post or other obstruction. This action is to cause the wheels to slip and the tractor to exert maximum drawbar pull in effect. During this additional one-minute period, the enclosure surface temperature of each component shall not exceed 175°C.

3.1.3 Brake Test

3.1.3.1 Immediately following the temperature test, the truck, while hauling its rated load, shall be operated over the test course. The truck shall be brought to a complete stop every 15 m by application of the brakes. The test shall be continued until constant temperatures are reached on the external surfaces of the brakes.

3.1.3.2 During the test, the temperatures on the external surfaces of the brakes shall be not higher than 175°C, based on a 25°C ambient temperature. The brakes shall not ignite or emit flame or hot particles.

3.1.4 Arc-Rupturing Tests

3.1.4.1 Motor controllers and switches in motor circuits

- a) All switches or current-rupturing devices connected in the motor circuit (such as contractors and speed controllers) shall show no welding, complete disintegration of the contact material or failure to make the load circuit. There shall be no arcing to the frame or enclosure, other manifestation of fire hazard (such as burning or melting of the load insulation) or failure of the device to function either mechanically or electrically, when subjected to 100 CYC~S of making and breaking the stalled rotor current of the motor which they control.
- b) In conducting the test described in **3.1.4.1(a)**, a fully charged battery of the nominal voltage and maximum ampere-hour capacity is to be used as the supply source. If two or more current-rupturing devices are connected in series and operate in a sequence so that normally one device is intended to make and break the circuit, all but that one are

to be shunted out of the circuit in order that, in turn, all switches in that circuit may be tested under stalled-rotor conditions.

- c) If the frame of the truck is not normally connected to the current-carrying parts, the frame is to be connected through a 30 ampere cartridge fuse to the positive pole of the battery for the first 50 cycles of operation and to the negative pole for the remaining 50 cycles. The rate of operation is to be one complete make-and-break operation every ten seconds, with the device remaining energized for approximately one second per cycle.
- d) If the frame of the truck is normally connected to the current carrying parts, the following test is to be conducted. The rate of operation and the duration of the 'on' period are to be as indicated in **3.1.4.1(c)**. If the battery is protected by a fuse having a current rating not more than 125 percent of the current drawn by the motor under locked-rotor conditions, the performance is not acceptable if the fuse is blown.
- e) The test may be interrupted at not less than 25 operations to permit cooling of the motor.
- f) In the case of speed controllers, the test is to be conducted with the speed control handle moved from the 'off' position through all running positions to the full-speed and then back to the 'off' position. This is to be counted as one cycle of operation.

3.1.4.2 Switches controlling other than motor circuits

- a) Switches connected in other than motor circuits shall show no welding, complete disintegration of the contact material, or failure to make the load circuit. There shall be no arcing to the frame or enclosure, or other manifestation of fire hazard, such as the burning or melting of lead insulation or failure of the device to function, either mechanically or electrically, when subjected to 100 cycles of making and breaking the circuit in which, they are connected.
- b) In conducting the test described in **3.1.4.2(a)**, a fully charged battery of the nominal voltage and maximum ampere-hour capacity shall be used as the supply source.
- c) If the frame of the truck is not normally connected to the current-carrying parts, the frame is to be connected through a 30-ampere cartridge fuse to the positive pole of the battery for the first 50 cycles or operation and to the negative pole for the remaining 50 cycles. The rate of operation is to be one complete make-and-break operation every ten seconds, with the device remaining energized for approximately one second per cycle.

- d) If the frame of the truck is normally connected to the current carrying parts, the following test is to be conducted. The rate of operation and the duration of the 'on' period are to be as indicated in **3.1.4.1** (c).
If the battery is protected by a fuse having a current rating not more than 125 percent of the maximum current carried by the switch, the performance is not acceptable, if the fuse is blown.
- e) The test may be interrupted at not less than 25 operations to permit cooling of the load.

3.1.5 Burnout Test

3.1.5.1 There shall be no emission of flame or molten metal from the truck enclosure or other manifestation of a fire hazard as evidenced by the ignition of the cotton or paper placed in accordance with **3.1.5.2** and the enclosure surfaces of each component of the truck (excluding the surface of the resistor elements) shall not exceed 175°C (based on an ambient temperature of 25°C) when a stalled truck motor is energized for a five minute period with its controller in each position. Melting of solder employed in electrical components or at electrical connections is acceptable if this performance does not result in a fire hazard as above or the dropping of molten solder into the operator's compartment.

3.1.5.2 For each section of this test, a fully charged battery of nominal voltage and maximum ampere-hour capacity is to be employed. All covers provided are to be in their intended positions. All necessary control switches and interlocks are to be defeated, so that energy can be continuously supplied to the circuit under test. Only one circuit is to be tested at a given time. If more than one motor and resistor circuit is employed, each circuit is to be tested individually. Cotton or other readily combustible material is to be placed around and about all openings. Clean paper is to be placed under the truck, and cotton is to be supported at the bottom and sides of the driving and other motors, and on any exposed part in any portion of the truck involving contact with or collection of combustible materials.

3.1.5.3 Arranged in this manner, it is advisable to test control positions first where resistors are energized, allowing them to cool between test, and subsequently testing the motor alone. If more than one section off a resistor or step in operating speed is provided on the control, the truck is to be tested in each position with control switches blocked so that the circuit under test can be quickly placed across the battery. The controls are to be thrown to the desired position and maintained in that position for a 5-minute period. Between each portion of the test, the trucks are to cool to room temperature. The test is to be considered acceptably completed at the end of 5 minutes of operation, if the results are in accordance with **3.1.5.1**, even though the truck may be inoperative after the test. The emission of dense smoke, but not flame, is acceptable.

3.1.5.4 It is anticipated that provision may be made in the design of the truck to include fuses, circuit breakers, or other overcurrent devices in the power circuit to open the circuit before the truck manifests a hazard when subjected to the test described in **3.1.5.1**. To determine the

reliability of such devices, the test in **3.1.5.1** is to be conducted three times, each time allowing temperatures to return to ambient temperature. Such devices are to perform satisfactorily when connected directly across the fully charged battery. There is to be no ignition of cotton placed around the overcurrent device or enclosure, if enclosed, during this test.

3.1.5.5 For Type E trucks only, the burnout test is to be waived if a disconnect switch or battery connector is provided that is positive in action and operable by the driver of the vehicle without leaving his normal driving position.

3.1.5.6 There shall be no emission of flame or molten material when a motor of the control, blower or signal-circuit type: (a) has a locked rotor current of 15 amperes or less, and (b) is protected by an over-current protective device, having a maximum rating or setting of 15 amperes is subjected to the following test. The motor is to be energized continuously under locked-rotor conditions until thermal equilibrium is attained, and the circuit is permanently opened by winding burnout or by the protective device. The temperature on any exposed surface of the motor shall be not higher than 175°C based on an ambient temperature of 25°C.

3.1.6 *Dielectric-Withstand Test*

3.1.6.1 A truck shall withstand for one minute without breakdown the application of a 50 Hz essentially sinusoidal potential of 1 000 V plus twice rated voltage, if the truck is rated at more than 60 V, or 500 V, otherwise. The test potential is to be applied immediately after the temperature test and arc-rupturing test between the current-carrying parts and the frame with the battery disconnected, and with all current carrying parts normally connected to the frame disconnected.

3.1.6.2 Where an opposite polarity potential normally occurs on a switching device or on a terminal board, those parts which are at opposite polarity shall withstand without breakdown the application of 50 Hz essentially sinusoidal potential of the value specified in **3.1.5.1** for one minute.

3.1.6.3 With reference to **3.1.6.1** and **3.1.6.2**, it is not intended that the test potential be applied across energy-converting components. Tests are to be conducted with switches in open as well as closed positions -if necessary, to provide the required test conditions for the various positions of the controls.

3.2 Type EE Industrial Electric Truck

3.2.1 A type EE industrial electric truck shall comply with the -performance requirements for Type E industrial trucks, except, that the use of device to disconnect the battery circuit shall not be caused for waiving the burnout test.