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MAINTENANCE OF ELEVATOR MECHANICAL SAFETY APPLIANCES

By
Executive Committee for the American Standard Safety Code for Elevators, Dumbwaiters, and Escalators

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PREFACE

Mechanical safety devices are provided on elevators to take care of the failure of suspension members or overspeed due to overload or the failure or malfunctioning of electrical apparatus. Because of the shortage of replacement and repair parts, vital elevator equipment will have to give far longer service than has been the practice in the past, and consequently failures of such equipment may increase. Therefore, the maintenance of such mechanical safety devices in the best possible condition becomes of paramount importance.

This is the second of a series of Bureau Circulars on elevator maintenance. The first, Elevator Wire Rope Maintenance, National Bureau of Standards Circular C441, may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5 cents a copy. Plans also have been made for the issuance of similar Circulars dealing with hoistway doors and interlocks, and hoisting machines and brakes.

The work of preparing the preliminary draft was done by J. A. Dickinson, Chief of the Bureau's Safety Code Section. This draft has been reviewed and modified by the Executive Committee for the Elevator Safety Code, and was submitted to the Sectional Committee for comment.

LYMAN J. BRIGGS, *Director.*

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ABSTRACT

This Circular cover the items affecting the proper operation of governors, safeties, and buffers. Governor items include clearances, driving-sheave wear, sluggish action, and condition of jaws and of governor rope. The functional requirements of the releasing carrier are discussed in detail. This is followed by a general paragraph on the function of undercar safeties. There are also paragraphs on cleaning and maintenance of safeties and a discussion of various commonly used types of safety equipment. These include instantaneous, flexible guide-clamp, wedge-clamp, and spring-actuated safeties. The need for periodic tests is stressed.

Section III discusses various requirements for guide rails, the need for adequate rail fastenings, the effect of building settlement, maintenance of rail surface, and inspection of rails after the setting of the safety.

Section IV, on buffers, covers the proper grade of oil for oil buffers, importance of maintanining oil level, correct alinement of buffers, anchorage of buffer cases, corrosion of metallic parts, and flooding.

A paragraph is devoted to the checking of alinement and supports of spring buffers.

CONTENTS

I. INTRODUCTION

In June 1941 the Sectional Committee for the American Standard Safety Code for Elevators, Dumbwaiters, and Escalators, voted to discontinue work on the revision of that code for the duration. A short supplement containing a few necessary modifications and all interim interpretations was issued in lieu of a revision in April 1942.

By the time the annual meeting of the Sectional Committee was held in June 1942, it was evident that the acute shortage of repair and replacement parts would result in a marked decrease in elevator safety unless the utmost care was used in maintaining, as effectively as possible, such important items as cables, undercar safeties, and their associated mechanisms, interlocks, hoisting engines, etc. The Sectional Committee therefore suggested that the Executive Committee prepare a series of service bulletins covering such equipment.

There is an old proverb that "A stitch in time saves nine." Periodic inspection, with the tightening up of loose parts, correction of misalinement and prompt attention to slightly worn equipment should decrease the possibility of serious accident and result in the maximum obtainable use of such equipment. Further, such maintenance should materially decrease the number of minor service interruptions and increase the periods between major overhauls.

The Inspectors' Manual,[1] prepared by the Sectional Committee for the Safety Code for Elevators, Dumbwaiters, and Escalators, covers in considerable detail the methods of inspecting elevator equipment. Occasional references to the Manual will be found in this publication.

As these bulletins are not intended for legal adoption or enforcement they have not been given the status of an American Standards Association project but have been prepared quite informally by the Executive Committee as its contribution toward elevator safety during the emergency.

Adequate maintenance service will do much to prolong the life of elevator machines, and somewhat greater expenditure for this purpose certainly will pay handsome dividends during the present emergency as repair and replacement parts are at a premium and may eventually be practically unobtainable.

[1] May be obtained from The American Society of Mechanical Engineers, 29 West 39th Street, New York, N. Y., for 75 cents a copy.

It is the hope of the Executive Committee that these bulletins may be of real value to owners of elevators, and that they may, by calling attention to certain work that may be done and certain precautions that may be taken, be a means of maintaining the excellent safety record made by vertical transportation during the last two decades.

II. GOVERNORS AND SAFETIES

1. IMPORTANCE OF ADEQUATE SAFETIES

1. The safety of the passengers in an elevator is ultimately dependent upon the adequate performance of the safety device and its associated mechanism. Therefore, it is of the utmost importance that they be maintained in proper working condition. There are many safeties in use today which would not stop and hold the elevator to which they are attached were the cables to part; therefore, the safety should be tested by competent elevator mechanics at least once each year to determine that it is in proper working order. Defective equipment should be repaired or replaced.

2. GOVERNORS

2. The proper functioning of a safety is dependent upon the proper operation of the equipment discussed in the following paragraphs.

(a) CLEARANCE OF GOVERNOR PARTS

3. The flyballs of the governor (where this type of governor is used) must have adequate clearance from fixed or temporary obstructions to permit them to actuate the tripping mechanism of the rope grips. The clearances should be checked by lifting the flyballs well above the position at which rope grips lock and revolve them at this level. This test will also clear the spindle of congealed oil, grease, or dirt.

(b) CLEARANCE OF GOVERNOR ROPE

4. *With the elevator running,* check the clearance of the governor rope and eliminate any interference.

(c) GOVERNOR-SHEAVE INSPECTION

5. Check the governor-drive sheave to see that it runs free and true; that the shaft or bearings are not worn excessively; and that there is no apparent slip of the governor cable when the elevator starts and stops. If there is apparent slip, eliminate any undue governor friction, and, if necessary, shorten the governor rope so that the idler does not bottom, or add more weight to the idler.

(d) EXAMINATION FOR WEAR AND FREEDOM OF ACTION

6. Examine the linkage and rope-grip attachment for undue wear. Properly lubricate all bearing surfaces. Comparatively slight wear of the pins, links, and particularly of the split collar to which the links are attached, can cause a very considerable rise in the tripping speed.

(e) SLUGGISH ACTION OF GOVERNOR

7. Sluggishness may be the result of paint on pins and other bearing surfaces. Governors should, preferably, not be painted after they are installed. If it is necessary to paint the governor, surplus

paint should first be removed from the brush, and no rotating or sliding surfaces or electric contacts should be coated. Clean all bearing surfaces and relubricate them. After the paint is dry, test the governor for free operation.

(f) GOVERNOR SWITCHES

8. Where governors are equipped with adjustable electric contacts, the adjustment should be such that the contact will open well in advance of the setting of the governor jaws. This setting should be made by a competent mechanic, preferably one employed by the company that made the elevator installation. If the switch fails to open before or, in the case of nonadjustable contacts, at the time the rope grips lock, this condition must be corrected before the elevator is returned to service.

9. Some governors are equipped with an additional switch to regulate the speed of the elevator. This switch should be examined to see that the contacts are in good condition. Any change in the setting of this switch should be made only by a person entirely familiar with the particular control system used.

(g) CONDITION OF GOVERNOR JAWS

10. The jaws of the governor should be examined to make sure that they will not permit the rope to be pulled through with too low a tension. The entire retarding force of wedge-clamp safeties, which at present are the most common type, is derived from the tension in the governor rope. If this tension is too low, the safety will not be applied with sufficient force to stop the car. This is particularly important where the ropes have parted on a traction machine, whereby the effect of the counterweight is lost and the safety must stop the entire weight of the car and load.

(h) SETTING OF GOVERNOR JAWS

11. Many high-speed governors are designed with a spring-backed jaw, permitting the governor rope to be pulled through the rope grips after the requisite tension has been reached. This spring adjustment, if provided, should never be changed except by a trained mechanic familiar with the particular safety system, and he should know exactly what the pull-through value should be for that particular safety. This value varies from manufacturer to manufacturer, and may vary considerably between two different types of governors or safeties made by the same manufacturer. This spring on the governor jaw should be examined to see that it is intact, in the proper position, and supplying enough pressure on the floating or movable jaw.

(i) GOVERNOR ROPE

12. The condition of the governor rope is of the utmost importance. If this rope fails it will be impossible to apply a wedge-clamp safety at all, and some of the newer self-actuating types may fail to pull in far enough to act. Governor ropes, which are generally of iron, run over relatively small sheaves and are very lightly loaded, all of which tends to cause fatigue failure. (A further discussion of this type of failure and a method of testing ropes to indicate their condition,

is included in Bureau Circular C441, Elevator Wire Rope Maintenance.) The American Standard Safety Code for Elevators provides:

> Tiller-rope construction shall not be used for governor cables except that tiller rope may be used for the portion of the cable wound on the safety drum.

3. RELEASING CARRIER

(a) IMPORTANCE OF PROPER FUNCTIONING

13. The governor rope is ordinarily attached to the car by means of a spring-backed carrier ("pull-out shackle"), which serves to drive this rope and through it the speed governor. When the car is being accelerated the tension in this rope is increased owing to the inertia of the rope itself and of the governor mechanism. On high-rise elevators the mass of the rope is considerable and, with the high values of acceleration used in such elevators, produces a considerable tension in the governor rope during the period of acceleration or retardation. This tension is sometimes great enough to pull the shackle from its holder. Mechanics sometimes lighten up on the holding spring to prevent such an occurrence. Unfortunately, in the case of many releasing carriers now in service it is possible to tighten this spring until its pull-out value exceeds the pull-through value of the governor jaws, in which case the safety will not be applied when the governor jaws set; in fact, the carrier mechanism on the car may be mechanically locked on the shackle so that it cannot be pulled apart except by physically deforming the car mechanism or the shackle.

(b) PULL-OUT TEST

14. When checking the safety equipment on a car, be sure to test this releasing carrier. A mechanic and helper should be able to pull the governor rope free from the carrier without the use of tools or levers, except in extremely high-rise installations. If two men cannot pull the shackle from the carrier by direct pull, the tension on the carrier spring should be adjusted until this can be done. The proper setting may also be tested by tripping the governor rope-grip jaws by hand and then running the car downward at slow speed until the shackle is pulled from the releasing carrier.

(c) SOCKETING OF ROPES

15. The socketing of the governor and safety ropes should be checked. If babbitt is poured too cold, it may not have filled the spaces between the strands, resulting in a defective fastening, and the drum or governor rope may be pulled from its socket before the proper operating tension is reached.

(d) INSPECTION OF DRUM ROPE

16. The condition of the safety drum rope is very important. The American Standard Safety Code for Elevators requires corrosion-resistant material for this rope, but many elevators are still equipped with drum ropes of iron or steel. Iron or steel drum rope should be carefully inspected, since it does not move nor is it subject to tension except during an application of the safety. Corrosion is particularly rapid in locations where steam, brine, or excessive moisture is encountered. Frequently, in apparently dry hoistways, drum-rope corrosion will occur owing to an excess of wash water being used in the mopping

of cars or the condensation of moisture from warm saturated air entering a somewhat cooler elevator hoistway.

(e) CARE AND MAINTENANCE OF DRUM ROPE

17. During the present emergency, iron or steel ropes may possibly be used extensively as drum ropes owing to the extreme shortage of critical materials. If corrodible drum ropes are used, they must be kept well lubricated, examined at frequent intervals, and renewed whenever the governor rope is replaced.

4. UNDERCAR SAFETIES

(a) GENERAL

18. The design of an adequate undercar safety involves the consideration of many factors. It must be strong enough and exert sufficient force to stop and hold the car with a reasonable overload. The retarding force is the product of the pressure of the jaws on the rail multiplied by the minimum coefficient of friction. Rail lubrication should be limited to light oil or grease as this type of lubricant will be squeezed out when the safety is applied. Solid lubricants, such as graphite, white lead, talc, sulfur, and similar materials, must not be used, as they will materially reduce the coefficient of friction. The tough black coating which accumulates on rails in some hoistways (particularly where the guide shoes cover only a portion of the finished faces of the rail) may similarly seriously affect the operation of the safety.

(b) INSTANTANEOUS SAFETIES

19. On instantaneous safeties it is important to check the point at which the rollers engage the rails. This may be checked by two men under the car, one at each rail, watching the position of the rollers as the lever to which the governor rope is attached is slowly lifted. Rollers should touch the rail and inclined surface at the same time. The point of contact should be below the center of the incline. Rollers that show any cracks, wear, or deformation should be replaced. Any dirt, grease, or other foreign matter must be removed from the pocket before the lever is reset. When the trip lever is released, each roller must return to its pocket and be clear of the rail. The releasing mechanism should be so adjusted that normal acceleration or a sudden jar will not cause application of the safety.

(c) WEDGE-CLAMP SAFETIES

20. All moving parts of a wedge-clamp safety should be kept well lubricated and should work freely. Pulling the drum rope by hand should cause the drum to revolve to the position in which the rail grips bear on the rail surfaces. Most wedge-clamp safeties provide some lateral play of the drum and shafts, so that if one wedge is engaged before the other, the entire assembly may move toward the wedge that is not in contact with its rollers before appreciable force is applied to the first rail grip. In checking a wedge-clamp safety be sure that this equalization can take place before the drum or stop collar on either shaft brings up solid on the bearing or thrust plate.

21. On the type of safety in which the safety rope is run over two sets of sheaves, one set attached to each wedge of a wedge-clamp safety, care must be taken to see that all parts are properly lubricated, and that each run of the operating rope is in the proper groove when the device has been reset.

(1) *Lead Sheaves.*

22. Examine drum-rope lead sheaves to see that they are securely fastened and correctly located. Lag-screw fastenings must not be used, and if found, must be replaced with through bolts.

(d) FLEXIBLE GUIDE-CLAMP SAFETIES

23. Parts should be inspected to see that they are working freely and that pockets for rollers are clean and free from dirt or grease.

(e) SPRING-ACTUATED SAFETIES

24. With safeties in which the actuating force is derived from coiled springs kept under almost full compression, it is particularly important that tests be made to determine that such safeties will stop and hold the fully loaded car from contract speed.

(f) RESETTING SAFETIES

25. A jammed drum rope will prevent proper operation of the safety and has been responsible for some of the most serious accidents ever recorded. After the safety has been set either by governor action or by pulling the cable out by hand, a tension must be maintained on the governor or drum rope while the drum is being turned to make sure this rope will not jam but wind in the groove provided. In resetting all of these safeties, care should be taken to see that the shackle is fully returned to the releasing carrier and that all actuating parts of the safety are clear of the rails.

(g) CLEANING OF SAFETIES

26. In order to ensure prompt and effective action and to decrease the possibility of accidental setting of certain types, all safety devices should be thoroughly cleaned at regular intervals. Cleaning will tend to decrease corrosion and prevent the absorption of oil by dust and lint. Following the cleaning, the operating parts should be relubricated.

(h) CLEARANCE OF SAFETY JAWS

27. Note whether under normal operating conditions (i. e., with the governor-rope shackle properly held in place in the releasing carrier), the wear or play of the guide shoes is great enough to permit the safety jaws to rub on the three contact surfaces of the guide rails. This may be determined by placing the car at a convenient location and using a lever to pry the car toward each surface of the rail on both sides of the car frame or by placing an eccentric load in the car. A thickness gage or a piece of paper may be used as a feeler to determine the clearance between each safety jaw and the rail surface when the car is in its extreme position. In making this test, care should be taken not to apply sufficient force to the lever to spring the guide shoes. Guide shoes should be replaced before the safety jaws touch the rail. When guide shoes are worn, safety jaws should be examined and must be replaced if worn. In some cases it may be necessary to remove the safety jaws for inspection and measurement.

(i) NEED FOR PERIODIC TESTS

28. Regardless of the type of safety, the device should be tested for its ability to stop and hold the car and contract load from governor-tripping speed, or where this speed cannot be reached, the maximum obtainable speed in the down direction. If on test the device fails to do this, it must either be repaired and retested or replaced by a new device. Each car safety should be tested at least once each year by competent elevator mechanics to see that it is in proper operating condition.

III. GUIDE RAILS

1. PURPOSE

29. The functions of elevator guide rails are to control and direct the car and to give a smooth surface along which it may run, and to provide a surface and a structure upon which emergency safety devices may operate.

2. MATERIAL

(a) WOOD GUIDE RAILS

30. There are still some wood guide rails in use for general-purpose elevators. Their use is justified in chemical and explosive plants where metal rails may create an explosion hazard or where certain corrosive atmospheres are encountered.

31. Unless wood rails are straight-grained, sound, and of approximately the same density, they may give very erratic stops when the safety applies. If the wood contains cross grain, checks or similar defects, is badly worn, or has become rotted or spongy, the safety may fail to hold. Where wood rails are used, they should be inspected frequently and kept lubricated with tallow or linseed oil. Any rail damaged by the setting of the safety must be replaced promptly.

(b) STEEL GUIDE RAILS

32. Steel rails are generally used today. They should be kept clean and free from solid lubricants to offer a good surface for the application of safeties.

3. RAIL FASTENINGS

33. During a safety stop, the guide rails must carry a load greater than the weight of the car, contract load, and various ropes and cables. All rail fastenings should be checked for tightness at regular intervals and after all safety tests.

4. EFFECT OF BUILDING SETTLEMENT

34. Buildings settle, and this may cause a bowing, or springing, of the elevator guide rails, in which case they should be realined by competent elevator mechanics.

5. MAINTENANCE OF RAIL SURFACES

35. Lubrication should be furnished on the rail surface to reduce friction and wear between guide shoes and rails. They will in time, with proper lubrication, wear to and maintain a smooth surface and give satisfactory operation for many years. If rail surfaces become

gummy, they should be cleaned and relubricated. If there is an accumulation of old lubricant and dirt, the entire machined surface should be cleaned. (See also par. 18.) This may be done with a high-flash-point solvent, unless this coating has been accumulating over a period of years, in which case mechanical means may be necessary for removing it. Roller guides with rubber-tired wheels should operate on dry rails.

6. INSPECTION OF RAILS AFTER SETTING OF SAFETY

36. After a safety has set, the guide-rail surfaces should be thoroughly inspected to make sure that the surface of the guide rail has not been roughened unduly and that none of the fastenings have been loosened. If the surface of the rail has been cut or torn, it should be rubbed down with an abrasive block or a rail file. This smoothing of the surface should not be carried to the point that the marks are entirely eliminated, as the rail thickness may be decreased too much. With wedge-clamp safeties, variations in rail thickness produce violent fluctuations in retardation. If any rail fastenings are loose, see that they are tightened before the elevator is again put in service. For maximum service and safety, maintain rails in good condition.

IV. BUFFERS

1. TYPES

37. Buffers are of two types, either oil or spring.

2. IMPORTANCE OF PROPER OIL IN BUFFERS

38. Because the flow of oil varies with viscosity, it is important to use an oil of the same viscosity as that provided by the manufacturer for the original filling. The use of a heavier or lighter oil will seriously affect the buffer action. The oil used should be 100 percent mineral and free from acid.

3. IMPORTANCE OF PROPER OIL LEVEL

39. The piston must operate in oil during the entire stroke; therefore, it is vitally important that the oil level be maintained. All buffers will show a gradual decrease in oil level due to their use and slow evaporation of the oil in the buffer. The oil level should be checked at each inspection, and oil of the proper grade to maintain the original viscosity should be added when necessary.

4. ALINEMENT OF BUFFER

40. The buffer plunger as originally installed is substantially vertical. This alinement should be checked occasionally. If found to be out of plumb, it should be realined.

5. ANCHORAGE

41. The bolts holding the buffer in the pit should be checked to be sure that they have not become loosened. Where pits are located in the neighborhood of railroad tunnels, subways, etc., vibration may

loosen these holding bolts. Where this occurs, lock washers should be provided.

6. CORROSION

42. Buffers should be protected against corrosion by painting the cylinder with a good grade of machine paint or enamel, and the plungre should be given an occasional coating of oil. If the plunger shows any rusting or pitting, it should be thoroughly cleaned with fine emery paper or cloth (care being taken not to let abrasive dust fall into the openings in the buffer) and then be coated with oil. After the car has compressed the buffer, an inspection should be made to ascertain that the plunger has returned to the fully extended position.

7. FLOODING

43. Whenever the buffer has been submerged, as a result of a flood or pit leakage, the pit must be thoroughly drained, the oil buffer emptied, cleaned, and refilled with fresh oil of proper viscosity. The cleaning and refilling of the buffer should be done by the manufacturer, as most buffers are provided with very powerful return springs which may cause serious accidents to persons attempting to dismantle them unless they are quite familiar with their construction and are provided with suitable tools or equipment. Cleaning and refilling must be done before the elevator is again placed in operation.

8. SPRING-BUFFER INSPECTION

44. Spring buffers should be checked frequently to see that they are in correct vertical alinement without lateral support and properly seated in the cup or on the mounting provided. The supports of spring buffers must permit the spring coils to be fully compressed. Following the operation of spring buffers, they should be examined carefully to make sure that they have not been deformed or have taken a permanent set.

Washington, November 16, 1942.

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