

(September 12, 192+).

SPECIFICATIONS FOR HAND OPERATED GRAIN HOPPER SCALES

PREFACE

During the one and one-half years approximately following the issuance of Interstate Commerce Commission Docket 9009, entitled "Claims for Loss and Damage of Grain," it developed that many authorities placed different interpretations upon various parts of that report, especially in relation to grain hopper scales.

It was also noted that there were slight differences in the specifications of design between those contained in this report and those followed by the scale manufacturers.

Because of these many uncertainties and misinterpretations a joint conference of all bodies essentially interested was suggested for the purpose of harmonizing interpretations and ideas.

Such a joint conference was called for by Mr. H. A. Foss, Chairman of the Weighmasters Scale Men's Conference. The first meeting was held June 2+, 1921. Several later meetings were held and report herewith submitted was adopted by this conference on March 13, 1922.

Certain suggestions for changes in the I. C. C. recommendations in their Docket 9009 are herewith submitted, and for convenience in comparison the conference recommendations have been printed in parallel columns to those of I. C. C. Docket 9009. Representatives of the following bodies participated in the conference upon which the following recommendations were based:

Weighmasters Scale Men's Conference.
Minnesota Track & Hopper Scale Department.
National Scale Men's Association.
Grain Dealers Grain Conference Committee.
Elevator Builders and Designers.
Scale & Balance Manufacturers Association.
The Bureau of Standards, Department of Commerce,
participated in this work in an advisory capacity.

1. The first part of the report deals with the general situation of the country and the progress of the work during the year.

2. The second part of the report deals with the results of the work during the year and the progress of the work during the year.

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1. General.--Scale mechanism, platform and framing, shall be of such design as will insure proper distribution of the weight among the parts when the load is applied, and shall be of such rigidity as will prevent displacement of the bearings on knife-edges, due to deflection of any member, or to oscillation of platform or hopper.

2. Means for vertical and horizontal adjustment shall be provided to insure the proper alignment of the lever system.

3. The vital parts shall be readily accessible for cleaning, inspection and adjustment.

4. Scales shall be of such construction that they will repeat their weight indications within one-half of the prescribed tolerance on ratio.

5. When check rods are used, they shall be adjustable, and except in the case of suspended hopper scales, set as high as possible and without initial strain, and horizontal when average load is on the scale.

6. Like parts of a scale of given manufacture, type and capacity, shall be interchangeable so far as practicable.

All Parts: The finished castings of the scale shall not be unduly warped; shall be free from blisters, large holes, or other imperfections, and shall be brought to a reasonably smooth finish.

7. The surfaces of castings which bear on wood or masonry shall be smooth and have a true surface to within a tolerance of one thirty-second of an inch, and surfaces of castings which bear on steel members or on each other shall be machined.

8. Levers shall be true to their nominal length between end knife edges within a tolerance of 1-100 of an inch per foot, but in all cases the levers shall be adjusted to correct multiplication.

9. Solid levers of built-in scales shall be provided with leveling lugs upon which a level can be placed to establish the longitudinal adjustment of levers. They shall be accurately faced in reference to a plane established by the knife-edges, and so that when a level is placed thereon the proper position of the lever when set will be indicated. The leveling lugs shall be eleven inches apart when practicable.

Levers: The parts of truss levers shall be so cast, made, machined, and assembled that the completed levers will not be

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warped or drawn out of true lines; and will hang plumb when in position.

Lever Parts: The truss rod for each given truss lever shall be clearly and permanently marked to indicate the lever of which it is a part; and the proper length of the rod shall be indicated thereon in a clear permanent manner. The truss post therefor shall likewise be identified in a similar way.

Marking of Levers: Figures denoting the position of each lever in the assembled scale shall be marked thereon.

10. The multiplication of levers up to the beam shall be 100 to 1, beam 10 to 1, and counterweights 1,000 to 1, except in scales of less than 9,000 pounds capacity.

11. Safety loops or other means shall be provided under levers or hoppers, to prevent damage from breakage.

12. Nose-irons.--To insure parallelism of pivots, guides shall be provided where nose-irons engage the levers. The nose-irons shall be designed for movement by a machine screw, composed of material at least as hard as brass which will not corrode, or other mechanical device. Each nose-iron shall be clamped in position by at least two binding screws or bolts, or an equivalent locking device.

In scales of more than 72,000 lbs. capacity machined guides shall be provided on levers at points where nose irons engage them.

13. Set-screws which make indentations in the levers shall not be used, on account of such indentations making it difficult to secure nose-irons in exact position when slight adjustments are made.

14. The position of each nose-iron shall be clearly indicated by a well-defined mark, showing its position on the lever when adjusted at the factory.

15. Knife-edges, pivots and bearings.--Knife-edges, pivots and bearings shall be of hardened and tempered steel. Knife-edges shall be sharp and bear throughout the entire length of the parts designated to be in contact. Bearings shall be smooth and at least as hard as knife-edges.

The requirements for physical properties of the steel used for pivots shall be as follows:

(a) Special Alloy Steel in the Annealed State:

Elastic Limit	Not over 75,000 lb. per sq. in.
Tensile Strength	Not over 110,000 lb. per sq. in.
Elongation in 2"	Not less than 20%
Reduction in Area	Not less than 35%

(b) Special Alloy Steel Hardened:

Elastic Limit	Not less than 160,000 lb. per sq. in.
Tensile Strength	Not less than 200,000 lb. per sq. in.
Elongation in 2"	Not less than 5%
Reduction in Area	Not less than 25%
Shore Hardness	Not less than 85

(c) High Carbon Steel in the Annealed State:

Elastic Limit	Not over 55,000 lb. per sq. in.
Tensile Strength	Not over 117,000 lb. per sq. in.
Elongation in 2"	Not less than 15%
Reduction in Area	Not less than 25%

(d) High Carbon Steel Hardened:

Elastic Limit	Not less than 135,000 lb. per sq. in.
Tensile Strength	Not less than 180,000 lb. per sq. in.
Elongation in 2"	Not less than 5%
Reduction in Area	Not less than 12%
Shore Hardness	Not less than 85.

16. Round-back pivots shall not be used in levers supporting heavy loads, unless of special design to prevent twisting.

17. Knife-edges, pivots and bearing steels shall be properly fitted and so mounted, reinforced and designed in relation to flexure that uniform contact and pressure will be secured under all conditions of loading. All pivots shall be designed and manufactured so that the two sides joining to form the knife-edge shall form an angle that will not exceed 90 degrees; that the tolerance for offset of the knife-edge of pivots, as figured from the center line of the pivot shall be within 10% of the width of the pivot for "machined in" pivots, and 15% of the width of the pivot for "cast in" pivots.

Bearings shall be self-aligning wherever practicable. Knife-edges and bearing steels shall be fitted in machined ways when necessary to comply with the requirements of this paragraph.

The pivots shall be so mounted that each knife edge in a given lever will be maintained in a horizontal plane; and so that the knife edges in a given lever will be parallel to each other.

18. Calking around pivots for the purpose of tightening them in the lever shall not be permitted.

19. Anti-friction contacts shall be used to limit longitudinal displacement between knife-edges or pivots and their bearings. They shall be smooth, at least as hard as the parts with which they come in contact, and so designed as to provide contact at a point on the line of the knife-edge of the pivots.

LEVER FULCRUM STANDS

(a)--Height of Pillars and Area of Bases: The height of the pillars and the dimensions of the bases of the stands shall be sufficient to prevent a tipping action. In stands of the two pillar type, both pillars shall be of equal height.

(b)--Pillars, Positions on Bases: The pillars or upright portions of the stands carrying the bearings shall be so placed on the bases that the centers of the bearing lines shall be over the centers of gravity of the bearing surface of the stands.

(c)--Anchor Bolt Holes: Two or more anchor bolt holes, not less than two (2) inches in diameter, shall be provided in proper places in the bases of all the stands, unless other equally effective means for anchorage is provided.

20. Loops. To reduce friction between the loops and levers, the friction faces of all loops shall be flat, instead of pointed, and the levers equipped with one point hardened contact in line with the knife-edge of the pivot.

21. The loops may be of any type desired, provided the radius of the portion of the bearing making immediate contact with the knife-edge, and the radius of the eye of the loop shall not be less than the length of the longest side of the cross section of the pivot to be used in the loop.

BEARINGS AND LINKS

1.--Material for Bearing Steels: The character of the material for bearing steels will be found under "Steel for Pivots" (No. 23). The bearing steels shall be equal to or greater in hardness than the knife-edges which oppose them. It is found good practice to have the bearing steels not less than 95 points hardness on the Shore recording scleroscope for high carbon steel, and not less than 90 for special alloy steel.

Dear Sir,
I have the honor to acknowledge the receipt of your letter of the 10th inst. in relation to the matter mentioned therein. I am sorry that I cannot give you a more definite answer at this time, but I am sure that you will understand my position.

Very truly,
Yours,
[Signature]

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2.--Design of Bearings. Scales shall be so designed that the oscillation of the platform will not displace the bearings at points of contact on the knife edges.

3.--Finish of Bearing Steels: The bearing surfaces shall be brought to a smooth, true and accurate finish to provide continuity of contact with the opposing knife edges. Self aligning bearings shall be used wherever practicable.

4.--Platform Bearings: The tops of platform bearings making contact with the girders shall be true to within $1/32$ of an inch of a true plane that will bring them all to the same height when in position, and in a plane parallel to the bottom of the bases of the fulcrum stands. They shall be as short as is practicable. These tops shall be provided with bolt holes of a sufficiently large diameter to allow for adjustment both transversely and longitudinally to secure alignment of parts.

22. Beam-rod and steel yard rod.--The steelyard rod shall be adjustable as to length by:

(a) Turn-buckles secured by lock nuts at threaded ends.

(b) By specially designed turn-buckles which effectively prevent the accidental change of the length of the steelyard-rod.

23. Beams and poises.--The maximum value of minimum divisions on beam shall be as follows:

On scales of 2,000 lbs., 3,600 lbs., and 6,000 lbs., smallest graduation -- 1 lb.

On scales of 9,000 lbs., smallest graduation -- 2 lbs.

On scales of 12,000 lbs., 18,000 lbs., 24,000 lbs., 30,000 lbs., 36,000 lbs., and 48,000 lbs., capacity smallest graduation -- 5 lbs.

On scales of 60,000 lbs. and over, smallest graduation-- 10 lbs.

24. Weighing beam shall be so marked and graduated, and poises so constructed, that the weights corresponding to any position of the poise may be clearly read without moving the poise whether or not a recording device is used.

25. Compound beams, or beams of the full capacity type shall not be used except where the notches do not represent a greater value than 200 lbs. per inch, and in all such cases

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where notches are used, they shall face outward or downward on the beam, in order to prevent the accumulation of dust or dirt.

26. Where type registering beams are used, the figures shall be of a material at least as hard as bronze.

27. A shoulder stop shall be provided on beam to prevent poise traveling back of the zero graduation.

28. The capacity of scale shall be clearly and permanently indicated on the scale beam in such a place as to be readily visible from the operator's position.

29. Poeses shall be so constructed that no part can be easily detached, and when equipped with set screws or other clamping devices, these shall be retained in such a way that they will not work out or become detached.

30. The adjusting material in poises shall be securely enclosed in a single cavity and firmly fixed in position, and if softer than brass, shall not be in contact with the beam.

31. The normal position of the beam shall be horizontal, and it shall have equal travel in the trig-loop above and below the horizontal position.

32. Beams shall be fitted with a pointer to be used in connection with a fixed indicator which will show a central position in the trig-loop when the beam is horizontal.

33. Loose material used in counterpoise cups for adjusting the balance of beam shall be securely enclosed.

34. The minimum travel of beam in trig-loop shall conform to the following table for the various lengths of beams:

Length of beam fulcrum pivot to trig loop	Minimum travel
	Inch
Under 12 inches.....	0.4
Over 12 inches, including 20 inches.....	0.5
Over 20 inches, including 40 inches.....	0.7
Over 40 inches.....	0.9

35. The sensibility reciprocal is the weight required to move the beam a definite amount from pointer or other indicating device of a scale. In a scale provided with a trig-loop, the sensibility reciprocal is the added weight required to be placed upon the platform to break and turn the beam from a horizontal position in the middle of the loop to a position of equilibrium in the top of the loop. This may be determined by subtracting the weight, instead of adding it, or by using the sliding poise on the beam, if this be done without jarring the beam.

36. The sensibility reciprocal shall never exceed the amount given in the following table No. 37:

Capacity	Sensibility reciprocal	Capacity	Sensibility reciprocal
Pounds	Pounds	Pounds	Pounds
3,000	1	48,000	8
9,000	2	60,000	10
12,000	3	72,000	12
18,000	4	84,000	13
24,000	5	96,000	14
30,000	6	a 120,000	15

a--And up.

COUNTERPOISE STEM

The cup or holder on the base of the counterpoise stem shall be securely fastened to the stem in a manner to insure against a slipping or dropping thereof.

BALANCE BALL

A balance ball shall be provided and its movement shall be controlled by means of a hand operated screw or other device which will not require that the ball be rotated in making any adjustments. The balance ball shall be provided with means for vertical adjustment.

BEAM FULCRUM STAND

(a)--Design: The beam shall be supported on a stand provided with compensating bearings, and shall not be suspended. The height of the pillars and the dimensions of the base of the stand shall be such as to prevent a tipping action.

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Experiment	Material	Temperature	Time	Result
1	Aluminum	20°C	10 min	0.15
2	Aluminum	20°C	20 min	0.25
3	Aluminum	20°C	30 min	0.35
4	Aluminum	20°C	40 min	0.45
5	Aluminum	20°C	50 min	0.55
6	Aluminum	20°C	60 min	0.65
7	Aluminum	20°C	70 min	0.75
8	Aluminum	20°C	80 min	0.85
9	Aluminum	20°C	90 min	0.95
10	Aluminum	20°C	100 min	1.05

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CONCLUSIONS

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APPENDIX A

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(b)--Height: The height of the stand, measured from the bottom surface of the base to the pivot bearing surface, shall not exceed twenty (20) inches.

(c)--Finish: The bearing surface of the base of the stand shall be finished to a plane perpendicular to the axis of the upright portion of the stand and the knife-edge line of the bearing shall be parallel to the base. The center of the bearing line shall be vertically over the center of gravity of the bearing surface of the base.

HEIGHT OF BEAM

The maximum height of the pivot line on the weigh beam shall not exceed 5 ft. 6 in. above the floor line.

38. Weights.--Counterpoise weights shall be made of steel, iron, brass or any other metal or alloy or metals not softer than brass. They shall have plain or smooth surfaces and no sharp points or corners. Surfaces shall be machined with suitable radius on outside edges to avoid chipping.

39. Counterpoise weights of iron or steel shall be given a protective coating, and preferably shall be nickel plated.

40. The adjusting material in weights of two pound value or more shall be securely enclosed in a single cavity in the top or sides of the weights, and firmly fixed in position, and shall not project beyond the surface of the weights.

41. Counterpoise weights shall be clearly marked with their actual values, and also with the values that they represent, when used on the scale for which they are intended. Where the surfaces of the weights are machined and finished, the figures and letters representing these values shall be stamped in the metal and not cast or forged in relief.

42. The tolerance to be allowed in excess or deficiency on commercial counterpoise weights shall not be greater than those shown in the table below, provided, however, that the manufacturer's tolerances or the tolerances to be allowed on new commercial weights shall not be greater than one-half of the values given:

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Weight	Tolerance, ordinary weights (ratio 1:1)	Tolerance, counterpoise weights for multiplying lever scales		
		Ratio less than 100:1	Ratio 100:1 and less than 1000:1	Ratio 1000:1 and over
Pounds	Grains	Grains	Grains	Grains
10	40.0	24.0	16.0	8.0
8	30.0	18.0	12.0	6.0
5	30.0	18.0	12.0	6.0
4	20.0	12.0	8.0	4.0
3	20.0	12.0	8.0	4.0
2	15.0	9.0	6.0	3.0
1	10.0	6.0	4.0	2.0
Ounces	Grains	Grains	Grains	Grains
10	10.0	6.0	4.0	2.0
8	5.0	3.0	2.0	1.0
5	5.0	3.0	2.0	1.0
4	5.0	3.0	2.0	1.0

43. Weight racks, where they come in contact with, or support, the counterpoise weights, shall be provided with a soft material, such as rawhide, fiber, wood, etc., to reduce the wear on the weights to a minimum.

COUNTERBALANCE WEIGHTS

If counter balance weights are to be used, the lower end of the hanger stem shall be threaded; a cup for loose balancing material shall be screwed to the lower end of the stem and each additional weight shall be provided with an elongated hole in the center through which the hanger stem may pass. No slotted counterbalance weights are to be used. When no counterbalance weights are necessary on top of the counterbalance cup the cavity shall be closed by a cover, secured in a positive manner. No counterbalance weights shall be used in any place in the scale, except at the beam.

CLEARANCES

The minimum clearance between fixed and movable parts of the scale shall not be less than $1/2$ " except on dormant hopper scales where the clearance shall not be less than $3/16$ of an inch.

The clearances between the anti-friction plates and anti-friction points shall not exceed $1/16$ of an inch on the beam, $1/8$ of an inch on the shelf lever, and $1/4$ of an inch on all other levers, and the minimum clearances shall be not less than one-half these amounts respectively.

SECTION 2.--CAPACITY

1. Scales should be designed to sustain on each corner 25% of the nominal capacity of the scale plus 25% of the dead load of the hopper and frame, etc., without developing in the parts, stresses in excess of the proper working stresses.

2. Levers, loops, links, bearings and other parts of scales shall be of such section that under the loading or weight determined from the capacity the following unit stresses should not be exceeded:

Nature of stress	Gray iron castings	Steel castings	Machine steel	Structural steel	Steel for pivots and bearings
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Tension.....	1,500	8,000	8,000	10,000	24,000
Compression.....	8,000	10,000	8,000	10,000	24,000
Transverse bending:					
Tension.....	2,500	8,000	8,000	10,000	24,000
Compression.....	8,000	10,000	8,000	10,000	24,000
Shear.....	2,500	8,000	5,000	7,000	
Torsion.....	2,500	8,000		7,000	

Bearing stress per square inch on steel pins, 15,000 pounds.

Bearing per linear inch of knife-edge not to exceed 6,000 pounds.

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SECTION 5.--CAPACITY

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Bearing on concrete, per square inch 400 pounds.

3. In the design of loops the unit stresses shall not exceed those specified in the table for working or design stresses provided herein; and considering the end of the loop as a simple beam, its section at the point of maximum bending moment should be determined by the formula $W/4(L-l/2)$:

Wherein W = The maximum load to be provided for on the link or loop.

L = The distance between center lines of depending sides.

and

l = The distance over which the load is distributed.

4. Where practicable, pivots shall be supported their full length by integral parts of the levers. The supports should be of such design as to carry the total load applied to the pivots without exceeding the unit stresses herein provided.

Where impracticable to so support the pivots, the bending moments shall be determined as follows:

Let W = total load on both ends of pivot, in pounds.

L = lever arm required, in inches.

l = bearing surface in loop, in inches.

T = distance between friction faces of loop.

E = width of boss or sustaining member enveloping pivot in inches.

M = bending moment in pivots, in inch-pounds.

Then:

$$L = l \frac{1}{2} + (T - E) + \frac{1}{4} \text{ inches.}$$

$$\text{And: } M = \frac{WL}{2} = \frac{W}{2} \left(l \frac{1}{2} + (T - E) + \frac{1}{4} \text{ inches} \right).$$

Structural steel used in connection with scale or installation shall conform to the specifications for steel structures as adopted by the American Railway Engineering Association, except as provided in the values for working stresses, given herein.

5. Timber used in connection with the installation of scales shall be of the best quality, and thoroughly seasoned. In scales of 50,000 lbs. capacity or more, the inside framing and outside framing shall not be of wood.

1. The first part of the report is devoted to a general survey of the situation in the country.

2. The second part of the report is devoted to a detailed analysis of the economic situation in the country.

3. The third part of the report is devoted to a detailed analysis of the social situation in the country.

4. The fourth part of the report is devoted to a detailed analysis of the political situation in the country.

5. The fifth part of the report is devoted to a detailed analysis of the cultural situation in the country.

6. The sixth part of the report is devoted to a detailed analysis of the international situation in the country.

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8. The eighth part of the report is devoted to a detailed analysis of the diplomatic situation in the country.

9. The ninth part of the report is devoted to a detailed analysis of the judicial situation in the country.

10. The tenth part of the report is devoted to a detailed analysis of the administrative situation in the country.

11. The eleventh part of the report is devoted to a detailed analysis of the financial situation in the country.

7. The bushel capacity of hopper shall govern the size of platform or structure supporting the hopper, also the length of scale lever. The hopper shall not extend beyond the frame of the scale to such an extent nor be of such height as may result in a tipping action of the platform.

The capacity of the hopper shall not exceed 30 cubic feet per 1000 lbs., or 1.2 cubic feet per bushel of the indicated capacity of the scale.

It shall be substantially constructed, grain tight; be braced and stayed to prevent bulging; be smooth on the inside and free from all obstructions.

The bottom shall be so formed, or the valleys filled so that sharp V valleys will be avoided. In all cases of wood construction the valleys in the hopper shall be covered with metal. The pitch of the valleys shall be not less than 30°. All fastenings, extending into the interior, shall be countersunk flush with the inside.

SECTION 5.--FOUNDATION.

1. The supporting structure for hopper scales shall be rigid and extend up from the main foundation of the elevator. The immediate supports of hopper scale shall be the scale floor, constructed preferably of reinforced concrete. Floor openings under scale and hopper shall not be greater in number and size than required for reasonable clearance around discharge outlet and test weight supports.

Scales supported or suspended from four corners shall not rest on pin cribbing.

The scale shall be so located that its load will be approximately equally distributed on the supporting members of the building.

2. The beam shelf or stand shall be supported by the structure which immediately supports the scale and hopper.

3. The masonry on which scale or scale supports rest should be constructed of concrete, vitrified brick, or cut stone. When either of the latter two materials is used, they shall be laid in cement mortar. Foundations shall be constructed in accordance with the best engineering practice.

4. When scales are supported directly by masonry foundations, the bearing surfaces shall be true.

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Structural steel members supporting scales or to which scale parts are connected, shall not be stressed beyond 16,000 pounds per square inch. Other materials shall have an equivalent factor of safety.

SECTION 4.--INSTALLATION

On request, the manufacturer shall furnish to the purchaser plans of design showing stresses and detailed dimensions for all scale parts and the material of which they are to be fabricated; also assembly plans showing location of all field connections and all information necessary for the purchaser to erect the scale.

The purchaser shall furnish to the supervising agency, on request, the foregoing plans, together with his plans for the construction and location of all receiving pits, boots, boot pans, elevating legs, heads of same, garners, hoppers, spouting, shipping bins and accessories and appurtenances thereto, essential to the receiving and shipping of commodities through the scales to be installed, including the foundations thereof.

Scales must be so located that they will not be affected by vibration or strong air currents, and there shall be no obstruction that will interfere with the testing or weighing. No scales shall be installed in a bin, over an open bin or open pit.

Hopper scales must be so located that no part of the hopper will be nearer than six inches to any part of the building, nor an adjacent hopper, and in every case all parts of the scale shall be accessible for inspection and maintenance.

1. No extra or extension levers shall be used to connect to the weigh beam; providing, however, when necessary, a shelf lever or equivalent may be arranged for this purpose. The connections from the main levers to the shelf lever, or equivalent, and to the beam shall be of such design that the twisting effect will be avoided, and so that the load will be distributed properly on the knife edges. The shelf lever, or equivalent, shall be carried on a support which will not yield under maximum load. Twisted one-piece connections shall not be used.

2. All metal parts of scales, including structural steel, shall have not less than two (2) coats of paint before installation, and shall be cleaned and painted at such other times as may be necessary.

and the other is a copy of the original. The first is a copy of the original and the second is a copy of the original. The first is a copy of the original and the second is a copy of the original.

October 10, 1907

I have the honor to acknowledge the receipt of your letter of the 10th inst. and in reply to inform you that the same has been forwarded to the proper authorities for their consideration.

I am, Sir, very respectfully,
Yours,
J. H. [Name]

I am, Sir, very respectfully,
Yours,
J. H. [Name]

I am, Sir, very respectfully,
Yours,
J. H. [Name]

I am, Sir, very respectfully,
Yours,
J. H. [Name]

I am, Sir, very respectfully,
Yours,
J. H. [Name]

3. The hopper may be constructed of either wood or steel, preferably the latter.

4. The scale hopper shall be supported vertically over the centers of the lever load knife edges. The design of the scale and structure shall be such that the bearings will not be displaced at points of contact with the knife edges when load is applied.

The bearing feet shall be securely bolted to the platform in proper positions without the use of clips or other outside fastenings; shall be plumbed and aligned, to insure the coincidence of the center lines of the platform bearings with the center lines of the levers, and so that the load pivot knife edges will make contact on the center lines of the bearing steels.

5. The garner shall be of as great a capacity as is practicable, preferably larger than maximum carload capacity. Shall be substantially constructed, grain tight, be braced and stayed to prevent bulging; be smooth on the inside, and free from all obstructions.

The bottom shall be so formed, or the valleys filled so that sharp V valleys will be avoided. In all cases of wood construction the valleys in garner shall be lined with metal. The pitch of the valleys shall be not less than $\pm 0^\circ$. All fastenings, extending into the interior, shall be countersunk flush with the inside.

The outlets or discharges from the garner shall be not less than ten (10) inches at their shortest dimensions and shall be substantially made of steel or iron, and so constructed that they will not leak. They shall be located so as to accomplish an even distribution of the load in the scale hopper. The valves shall operate freely.

6. The devices for operating the scale hopper and garner slides shall be located on the beam side of the hopper, within convenient reach, but shall not interfere with the action or accuracy of the scale. They shall be equipped with means to indicate the closed position of the slides, and to prevent accidental opening thereof. All hopper valve levers shall be moved in same directions to perform similar functions.

All garner valve levers shall be moved in the same direction to perform similar functions.

7. When canvas is used inside to close opening between garner and hopper, it shall be attached to and suspended from the garner only, and provision made for the free escape of air.

1. The first part of the report
describes the general situation
of the country and the
state of the economy.

2. The second part of the report
describes the situation in the
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7. The seventh part of the report
describes the situation in the
different branches of the
economy and the different
sectors of the population.

8. Vent pipes extending through the roof of the elevator shall not be placed in scale hoppers.

No pipes, signal wires, or other obstructions of a similar nature shall pass through a scale hopper or be attached thereto or to the scale parts.

9. Where scale levers are located beneath the floor, a permanent runway or gallery shall be provided wherever possible, to permit full accessibility for inspection, cleaning or adjusting.

The corner fulcrum stands shall be set level and plumb, without shims, and securely anchored in proper alignment and position.

The corner fulcrum eye bolts shall pass through the approximate centers of their supporting plates or stands. They are to be straight, plumb, and properly spaced and aligned for the levers which they support. Bearing surfaces of corner plates or stands, and nuts on eye bolts shall be true and at right angles to the axes of the bolts.

SECTION 5.--TESTING

1. The standard of mass for testing grain scales shall be derived from primary weights, verified by the United States Bureau of Standards, Washington, D. C., to within what is known as their "Class B" tolerance, as is given in the following table:

Weights avoirdupois Pounds	Tolerance Class B Grains	Weights avoirdupois Ounces	Tolerance Class B Grains
50	2	10	0.2
25	1.2	5	.1
20	1.2	5	.1
15	.8	4	.1
10	.8	2	.06
8	.8	1	.04
5	.6	1/2	.04
4	.4	1/4	.02
3	.4	1/8	.01
2	.3	1/16	.01
1	.2	1/32	.01
		1/64	.004

2. The 50 pound secondary or working cast-iron weights used directly in testing scales should be rectangular, and of such design as to facilitate stacking; they shall be free from pockets, blow-holes, etc., which are liable to catch and hold foreign matter. No adjusting cavity or cavities in the bottoms of such weights shall be permitted.

3. These weights shall be tested and adjusted in comparison with the master weight, which has been verified to within "Class E" tolerance. The working weights shall be adjusted to within 20 grains and maintained to within 50 grains of their true value.

4. Standard counterpoise weights shall be used for testing leverage ratio and value of poises.

5. All scales shall be tested with standard test weights to at least eight per cent of their maximum capacity, and these weights are to be used in multiples of 1,000 lbs. New, repaired, or rebuilt scales shall be tested prior to being put in service. For individual corner tests, at least one-quarter of the respective test loads specified shall be used. The sensibility reciprocal shall be determined, and the sliding poise and counterpoise weights tested by comparison with the standard counterpoise weights applied at the end of the beam.

6. In conjunction with the above test, a load test shall be made to determine if any interference occurs between the fixed and movable parts of the scale, and to discover any weakness due to yielding in supporting structure, etc., by filling scale hopper with grain to its usual working or maximum capacity, less the amount of test weights used. The beam shall be balanced, after which sufficient time shall elapse to determine any leakage through gate valves; if none occurs, the test weights can be applied to prove the correctness of the scale under load. The sensibility reciprocal shall again be obtained under this maximum load for comparison with that shown under test with test weights alone, or when scale is not loaded.

7. The location of the scale shall be such that adequate means can be provided to permit of the suspension of standard test weights at each corner, so that the center of gravity of the test load will be on a vertical line that passes through the center of the main bearings.

8. All scales shall be tested when loaded to their working capacity.

9. Scales in regular service shall be tested at least once each year, and every six months where practicable.

10. Scales will be considered commercially accurate when any error, developed by the test through applying calibrated standard test weights uniformly distributed, does not exceed one-half pound per 1000 pounds of the load of standardized test weights used, said test load being applied to the scale with the scale hopper empty, approximately one-half loaded, and approximately loaded to capacity, provided, however, that for test weights applied to the corners, the allowable error for any corner shall not exceed twice the foregoing tolerance applied on that corner.

The error observed at any step may be plus or minus.

For new scales and wherever adjustments or repairs are made or wherever in the judgment of the inspector the errors indicated by the scale are excessive, the corner tests shall be carried out at zero and full load.

RULES FOR WEIGHING GRAIN ON HOPPER SCALES

1. Approval.--All scales before being placed in service shall be tested and approved; and shall comply with the specifications for hopper scales provided herein.

2. Examination.--

(a) Receiving pits or sinks.--Receiving pits or sinks shall be examined to see if they are in good order.

(b) Elevator legs, spouts, etc.--All spouts, legs and other equipment used for conveying grain from car to scale or from scale to car shall be examined to see that they are graintight.

(c) Garners.--Where garners are located over scales they shall be examined to see that they are grain tight.

(d) Scale hopper.--Scale hoppers shall be examined to see that the hopper and slides do not leak.

(e) Freedom of scale parts.--All live parts of the scale and hopper shall be free from interference, both empty and loaded; and the check rods shall be loose when the scale is either loaded or empty.

3. Balancing the scale.--The scale shall be kept in balance at all times while being used, and shall be checked after each draft. The scale is balanced when the beam is in a position of equilibrium in the center of the loop.

4. Records.--All records shall be kept in bound books, and in a clear systematic manner.

5. Entry of weights.--The record of the weight shall be entered immediately on making the weighing.

6. Check system.--Check systems shall be used when scales are provided with them. Where there is no check system, a record of the dimensions of the weights used in each weighing shall be kept. Immediately on weighing the written record shall be compared with the check system used.

7. Delivery of grain to scale.--After a car is unloaded and before the weighing is completed, examine the car to see that all of the grain has been removed. Before the final draft is weighed all pits and garnerers must be examined to see that all the grain has been delivered to the scale.

8. Delivery of grain to car.--Care shall be taken to insure that all the grain weighed out reaches the car to which it belongs.

APPENDIX No. 3

SECTION III. 'OTHER SHIPPERS' FACILITIES

1. No dust collecting devices of any kind should be operated which are located between the scale and the car or between the car and scale, except as required by insurance regulations and then only under proper supervision.

2. Machinery for conveying inbound and outbound grain to cars, long distances, consisting of screw or belt conveyors and re-elevating legs should be eliminated as far as practicable from any plan for handling grain from scale to car, or car to scale. And in any plans for conveying such grain to or from scales, the distance the grain is to be conveyed should be as short as possible.

3. The equipment for conveying grain to and from cars and scales should be so constructed and arranged that such inbound and outbound grain will be handled direct from car to scale and scale to car. The handling of grain from car to scales and scales to cars by means of elevator legs or short conveyor belts, should not be considered indirect handling, provided such transfer is not interrupted until the entire transaction is completed.

4. Elevator legs and loading out spouts that are to pass through bins should have wells built around them.

5. Spouts carrying grain from cars to receiving scales and from shipping scales to cars should be direct free from holes, cracks or other defects, such as would permit the loss of grain, and without any valves or diverting slides.

6. Turn spouts leading to two or more scales or spouts should be positive in their delivery of grain, and be so equipped as to permit of sealing.

7. Unloading sinks and conveyors should be so arranged (and where necessary-equipped with interlocking devices) that grain cannot be diverted from the intended channels. They should be so arranged as to permit of thorough inspection.

Receiving pits shall be substantially built, grain tight, smooth on the inside, and free from all obstructions.

The bottom shall be so formed or the valleys so filled that V valleys will be avoided. The pitch of the valleys shall be not less than $\pm 0^\circ$.

All fastenings in or extending into the interior shall be countersunk flush with the inside. The construction is to be such that all commodities will clear freely.

8. Loading spouts should not be located over unloading sinks, provided, however, that where loading spouts are now located over unloading sinks, grain tight covers should be provided and be in place when cars are loaded at such sinks.

9. Floor at loading spout.--A grain tight floor should be provided so that any grain spilled during the loading of any car can be readily gathered up, and placed in the car to which it belongs.

10. All records should be kept in bound books, and in a clear systematic manner.

The first part of the paper is devoted to a general discussion of the problem. It is shown that the problem is of great importance in the theory of the structure of the atom.

The second part of the paper is devoted to a detailed discussion of the problem. It is shown that the problem is of great importance in the theory of the structure of the atom.

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