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Document Title: Specification of Box Type Gauge Cum Level (BG)			



SPECIFICATION OF BOX TYPE GAUGE CUM LEVEL (BG)
(Spec. No. TM-58)

Third revision of 2023

Track Machines & Monitoring Directorate

RESEARCH DESIGNS AND STANDARDS ORGANISATION
Manak Nagar, Lucknow-226011

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1.0 SCOPE:

This specification covers the essential dimensional, functional and material characteristics and method of testing the accuracy of the gauge-cum-level (Broad Gauge). The gauge-cum-level is an instrument used to measure the track gauge in mm with an accuracy of 1 mm. This instrument simultaneously measures the cross level of the rails in mm with an accuracy of 1 mm. In this specification "Box Type Gauge Cum Level (BG)" will be termed as '**gauge-cum-level**' for conveniences.

- 1.1** Preference to make in India: compliance of the instruction contained in public procurement (preference to make in India) order -2017 "Make in India" shall be ensured.
- 1.2** Supplier is fully responsible to maintain the quality of product supplied to Indian Railways.

2.0 REFERENCE DOCUMENTS:

Following BIS/IS codes and references have been referred to in this specification. Updated copies of the same should be available in the works of the manufacturer/Suppliers.

SN	I.S No.	TITLE
i.	IS: 617-1994	Aluminium and Aluminium alloy ingots and castings for general engineering purpose.
ii.	IS: 727-1964	Hard drawn carbon steel for springs for general engineering purpose.
iii.	IS: 733-1983	Wrought Aluminium and aluminium alloy bars, rods and sections for general engineering purpose.
iv.	IS:737-1986	Wrought aluminium and aluminium alloy sheets & springs for general engineering purpose.
v.	IS:2062-1992	Steel for general structural purpose 4th revision supersedes IS: 226-1975.
vi.	IS:6912- 1985	Copper and copper alloy forging-stocks & forgings.
vii.	IRS:M-10	Standard specification for carbon spring steel (for laminated spring)
viii.	IS:3965- 1981	Dimensions for wrought aluminum and aluminum bar, rod and sections
ix.	IS:4170- 1967	Brass rods for general engineering purpose.
x.	IS:5210- 1995	High impact polystyrene sheets.
xi.	IS:6603-1972	Specification for Stainless Steel Bars and Flats.
xii.	IS:5517-1969	Specification for Steel for hardening and tempering.

- 2.1** Full sets of RDSO drawings for gauge cum level, duly incorporating the updated corrections shall be available for reference at the manufacturer's works.

3.0 TERMINOLOGY:

Following terms and definitions shall apply for the purpose of this specification.

- 3.1 Gauge:** It is the minimum linear distance between the inner faces (gauge faces) of the rails measured perpendicular to the longitudinal axis of the track at a depth of 14 mm from the top of rail heads.

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- 3.2 Nominal Gauge:** For B.G. nominal gauge is 1676 mm.
- 3.3 Tight & Slack Gauge:** The gauge which is less than the nominal gauge is called tight gauge and the gauge which is more than the nominal gauge is called slack gauge.
- 3.4 Cross level:** It is the difference between the rail levels measured by keeping the instrument at right angle to the longitudinal axis of the track. It is termed as cant in curved track.
- 4.0 MEASURING RANGE:** The measuring ranges shall be as follows:
 For gauge : 30 mm slack to 15 mm tight.
 For cross level : 1 mm to 30 mm on smaller ramp and 1 mm to 200 mm on longer ramp.
- 5.0 MATERIAL:**
 The gauge cum level shall confirm RDSO drg. No. TM/0108, 0108/1 and 0108/2. The materials to be used for various components of the gauge cum level are specified below:
- 5.1 Main Housing:** This shall be a rectangular tubing of aluminium alloy as per IS: 733-1983 (DESIGN 64430 OR 63400). The size of the rectangular extruded Aluminium alloy shall be 50.8 mm x 25.4 mm x 2 mm.
- 5.2 Handle:** The instrument shall be provided with a suitable handle for carrying purpose. The handle including the handle rod and handle fixture shall be made of Aluminium as per IS: 733: 1983 (Design: 24345).
- 5.3 End Caps & Eye Piece:** The end caps of the main housing and the eye piece including its fixing bracket shall be made of black nylon-6 of IS: 5210-1995. The projecting glass cover shall have a clear vision and shall be of superior quality.
- 5.4 Sliding Assembly:** The connecting rod shall be made of mild steel (Grade A) as per IS: 2062-1992 whereas the Compression spring shall be of spring steel conforming to IS specification No. 727-1964 (Grade 2). The fixed block and sliding bracket shall be made of Aluminium as per IS 733-1983. The sliding scale shall be of Aluminium as per IS 733-1983 (Design: E1BM) and to be anodised.
- 5.5 Ramps:** Sliding of spirit level within the housing of the instrument is over three portions namely longer ramp, the smaller ramp and the horizontal platform. The ramps as well as the horizontal platform shall be made of aluminium alloy conforming to IS: 617-1994 (Design-A 13) and shall be duly machined and finished. The horizontal platform and the longer & smaller ramps shall be suitably fitted with steel plate over it made of stainless steel of grade 04Cr 18Ni 10 conforming to IS: 6603-1972. The longer ramp steel plate shall be provided with graduations to correctly read the cross level up to 200 mm with a least count of 1mm, whereas the smaller ramp steel plate shall be provided with graduations to

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correctly read cross level up to 30 mm with a least count of 1mm.

5.6 Clamping Arrangement: This arrangement consists of a clamping knob fitted on the top of the frame. The material to be used for clamping stud shall be Brass as per IS: 6912-1985 & IS: 4170-1967 (Cu Zn 30) whereas the clamping knob shall be made of Aluminium alloy (as per IS: 733-1983 Design HE 9).

5.7 Rail Seatings: Rail seatings as well as gauge tips provided at the sliding end and at the fixed end shall be made of alloy steel of grade 40NiCrMo15 conforming to IS: 5517-1969 and shall be suitably hardened and tempered to achieve a hardness in the range of 40 HRc-45 HRc.

5.8 Screws, bolts & nuts: All the CSK screws, bolts & nuts shall be of standard quality and shall conform to the 'BIS' codes. For the sake of interchangeability of the components, threaded screw holes shall be made to suit precision fasteners.

6.0 FUNCTIONAL REQUIREMENTS:

6.1 The gauge- cum- level is an instrument which is to be used to measure the gauge as well as the cross level of Railway track simultaneously. Each gauge-cum-level comprises two main items i.e., the 'gauge' and a spirit level conforming to the RDSO specification. The gauge- cum- level shall conform the RDSO standard drawing No. TM/0108, 0108/1 and 0108/2.

6.2 The main housing of the gauge shall be fitted with a suitable handle at the centre and two rail seatings at the end. These rail seatings shall be fitted to the housing body through electrically insulating material so as to make the gauge electrically insulated. The gauge shall be fitted with two gauge tips of which one shall be fixed and other shall be of sliding type. The hardness of rail seatings and gauge tips shall be in the range of 40 HRc to 45 HRc.

6.3 For measurement of cross level, the housing frame shall be provided with three ramps i.e., smaller ramp, horizontal platform and longer ramp. Cross level from 1 to 30 mm shall be measured by smaller ramp whereas cross level from 1 mm to 200 mm shall be measured by the longer ramp. Graduations shall be neatly etched/ embossed on the scales provided on the ramps.

6.4 The sliding assembly shall be housed inside the main frame and shall comprise of one sliding gauge tip (round), a connecting rod with compression spring and one fixed block. The connecting rod shall be fitted with the sliding gauge tip (round) at one end and a movable gauge scale block at the other end through the fixed block which is screwed to the main frame. The sliding tip shall be so designed that it can be reused after reversal of the same by 180° and shall be capable to measure gauge correctly in both positions. In between the fixed block and the sliding bracket compression spring shall be provided. The movable gauge scale block should carry the 'gauge – scale' at the top. The gauge-scale shall be

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graduated to measure gauge variation up to 30 mm slack to 15 mm tight. This scale should be clearly visible from outside through the glass of the eye piece. The glass shall be provided with an indicator at the centre which shall be the reference mark to correctly show the correct reading of the gauge on the sliding scale.

- 6.5** The ends of the main housing frame shall be covered with black nylon end caps to protect from dust, dirt and water.
- 6.6** The track gauge shall have elegant finish and shall be properly painted/ anodized /electroplated or finished with such process so as to make the instrument durable and long lasting.
- 6.7** The Gauge-cum-level shall also be of such design and construction so that all moving parts and sub-assemblies are fully enclosed and are protected against ingress of dust & rain. The design shall also have such fastener and fittings which may not fall off during transit and usage in field.
- 6.8** All the scales shall be finely etched, embossed which should be non-fading and should not deteriorate with usage.
- 6.9** The gauge-cum-level shall conform the following technical requirements:
- | | | | |
|----|---------------------------------|---|--------------------|
| a) | Nominal Gauge (BG) | : | 1676 mm |
| b) | Overall length | : | 1840 \pm 5 mm |
| c) | Height of Rectangular tubing | : | 50.8 mm |
| d) | Width of Rectangular tubing | : | 25.4 mm |
| e) | Thickness of Rectangular tubing | : | 2 mm |
| f) | Length of horizontal platform | : | 205 mm |
| g) | Measuring range for gauge | : | + 30 mm to -15 mm |
| h) | Accuracy for gauge | : | \pm 1.0 mm |
| i) | Super elevation range | : | -30 mm to + 200 mm |
| j) | Cross level precision | : | \pm 1.0 mm |
- 6.10** The manufacturers are required to adhere to the stipulations in the drawing and specification of the gauge-cum-level. However, minor nature of deviations in the design or material of component/sub component may be permitted, provided such changes either improve the functioning of the gauge and in no case reduce the functional and quality requirements stipulated in the drawing and specification. Further, for any deviation from the drawings and specifications, the manufacturer shall submit details of the same with proper justification, bringing out the design improvements and advantages of the proposed deviation/changes along with detailed dimensional drawing and material specifications etc. Decision of the RDSO regarding acceptance or rejection of any or all the proposed deviation shall be final and binding.

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7.0 TESTING & CALIBRATION FACILITIES

- 7.1** The manufacturer shall have in-house facility for testing and calibration of the “gauge-cum-level”.
- 7.2** The manufacturer shall have test bench and gadgets consisting of gauges and templates etc. to adjust and calibrate the gauge-cum-level. The manufacturer shall also have facility for checking the electrical-insulation of the gauge-cum-level.
- 7.3** The manufacturer shall maintain a record of all assembled components, sub-assemblies and codes for all dimensional and functional parameters.
- 7.4** The manufacturer shall have facilities for conducting the tests specified in Para 8.1.1 to 8.1.4. Facilities for the tests specified in the Para 8.1.5 are also desirable.
- 7.5** The manufacturer shall produce the documents related to procurement of raw material mentioning the grade/ code of the material, size, date of procurement name and address of the source of procurement.

8.0 TESTS:

- 8.1 ACCEPTANCE TEST:** Every instrument in the consignment shall be subjected to acceptance tests as given below:

The cost of tests shall be borne by the manufacturer/supplier. All arrangements to conduct tests shall be made by manufacturer/supplier.

For this purpose each instrument shall be duly numbered. Manufacturer shall issue certificate in respect of each instrument that the same conforms to the stipulated dimensions accuracy and other requirements of the drawings and specifications. Any deviation in the test result from the requirement in the specification shall be the cause of rejection of the instrument.

- 8.1.1 Visual & Dimensional check:** All the major dimensions of the gauge-cum-level shall be checked to conform the requirements as mentioned in the drawing No. TM/0108, 0108/1 & 0108/2. The major dimensions include the following:

- Overall length of the gauge-cum-level.
- Width (Outside), height (outside) & thickness of the section of main housing. The thickness of the section shall be uniform throughout its length.
- Length of horizontal platform.
- Distance between two gauge tips in maximum slack position, maximum tight position and at correct position of the gauge.
- Linear play of sliding gauge tip.

The instrument shall also be checked visually for overall quality, workmanship, finish, etc. It shall also be checked for straightness of the housing frame, squareness of the gauge tips, and proper fitting of different parts like end caps, rail seats, handle, eye-piece (reading window) etc. The straightness and twist shall be checked with 1 m straight edge and the out of straightness & twist shall not exceed 1.7 mm per meter length (Ref: clause No. 4.5 of IS: 3965-

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1981). The surfaces of the housing frame shall be free from any burrs or scale and shall be smooth.

8.1.2 Test for measuring range for ‘gauge’:

The instrument shall be placed on the “calibration bench” touching the rail seating properly on the rail pieces. For maximum outward position of the sliding gauge tip, the reading of the sliding scale shall be 30 mm slack (indicated by + 30 mm). Thereafter, reading on the scale shall be observed for the inward movement of the sliding gauge tip. This movement to be made by providing suitable “spacers” between the gauge face of rail piece and sliding tip in steps of 1mm. The maximum inward position of the sliding tip shall indicate a reading of 15 mm tight, written as -15 mm on the sliding scale. For “0” reading on the scale, the distance between the two gauge tips shall be 1676 mm.

8.1.3 Test for measuring range of Cross-level:

The instrument shall be placed on the test bench touching the rail seatings properly on rail pieces. A spirit level (as per RDSO specification) shall be placed on the horizontal platform. The graduations on the scales of two inclined ramps (i.e., longer ramp & smaller ramp) shall clearly be visible from outside. One rail seating shall be gradually lifted by providing suitable spacing washers/blocks in steps of 1 mm in between rail seating and top of the rail. Initially the bubble of the spirit level shall be at central position when the spirit level is on horizontal platform and the instrument is perfectly in horizontal position. Both the ramps shall be checked one by one by the aforesaid method. This method should be repeated for both ascending and descending values.

8.1.4 Test for Hardness:

Hardness test of rail seatings and gauge tips: Minimum hardness of the rail seatings as well as of gauge tips shall be in the range of 40 HRc to 45 HRc.

8.1.5 Test for Mechanical properties:

Mechanical Properties (tensile test) of the material of the main housing frame shall conform to the provisions in the IS: 733-1983.

8.2 The tests, as listed in clause 8.1.1 to 8.1.5 shall also be carried out in the premises of the manufacturer under witnessing of the inspecting official. If the manufacturer does not have the facilities for testing mechanical properties specified in Para 8.1.5, the samples shall be sent for these tests to a reputed test house, as decided by the inspecting officials. The samples shall be numbered and duly sealed by the inspecting officials at the manufacturer’s premises for sending them to the test house. The manufacturer shall arrange for the testing of the samples at the test house nominated by the inspecting officials. After tests the manufacturer shall obtain certificate from the test house mentioning details of tests conducted, test results, deviations if any, etc. for each of the test samples. All arrangements and expenses in connection with the testing including cost of testing shall be borne by the manufacturer.

8.3 For manufacturing the instrument only specified raw materials shall be used, which shall be suitably hardened and tempered, wherever required, to achieve stipulated

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hardness. The supplier shall conduct hardness tests on the materials for ensuring their conformation to the stipulated hardness, before these are used for manufacture of instrument. The supplier shall issue certificate with each instrument that the materials/ processed materials used in the manufacture of the instrument conform to the stipulations of the specifications in respect of chemical composition, strength and hardness. The result of the hardness tests shall also be furnished in the certificate.

8.4 The acceptance tests enumerated in clause 8.1 as well as hardness test shall also be carried out under witnessing of the consignee/ inspecting official, if desired by him. The manufacturer shall also produce all relevant documents as a proof for conformity of the quality of all the raw materials used in the instrument, if so required by the inspecting official.

8.5 Inspection: The inspection of the instrument shall be carried out as per following Para:

8.5.1 If any instrument fails in any acceptance test, same shall be rejected.

8.5.2 The inspection of the gauge cum level shall be carried out by the purchaser Zonal railway or any representative/other agency authorized by purchaser/ zonal railway. The cost of inspection and testing shall be borne by the manufacturer/supplier.

8.5.3 Minimum level of inspecting official shall be SSE.

8.5.4 Compliance of specification shall be verified at the time of inspection.

9.0 WARRANTY & AMC:

9.1 Any part of the instrument failing or providing unsatisfactory in service due to defective design, material or workmanship within 18 months from date of supply shall be replaced by the manufacturer at his own expense including transportation cost. Further, should any replacement or modification in any instrument or to any of its part is made by the supplier for rectification, the period of eighteen months would commence from the date such replaced/ modified instrument or part is commissioned.

9.2 Copies of Maker's certificate guaranteeing the performance of the instrument shall be supplied in duplicate along with the delivery of each instrument. The manufacturer shall also submit a certificate that materials used for different parts of the instrument have been strictly followed as per the specifications mentioned in this standard.

9.3 During procurement of the gauge-cum-level, railways should go post-warranty AMC with the supplier for a pre-determined period as decided by the purchaser railway as per Comprehensive Guidelines on Procurement, Operation, Maintenance and Repair of Small Track Machine Report no TM 227. This may be incorporated in the tender document as a condition of contract/Tender/Supply.

9.4 Drawings: In order to facilitate subsequent maintenance in service, the

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manufacturer/supplier shall supply details drawings of the machine exhibiting clearly the materials and dimensions.

10.0 TOOL & SPARE LIST:

10.1 Tools: Each gauge-cum-level shall be supplied with a complete tools kit required by the operator in emergency and for normal working of the gauge.

Spare: The manufacturer shall provide a spare parts inventory list indicating descriptions, part No, expected life and source of procurement. The manufacturer shall be responsible for subsequent availability of spares to ensure trouble free service of the instrument. A copy of such a spare parts list shall be supplied with each instrument.

10.2 Detailed operation manual, repairing and maintenance manual shall be supplied in duplicate with each gauge-cum-level.

11.0 MARKING & PACKING:

11.1 The machine shall be legibly and indelibly marked with:

- i) Name, initials, contact no. and trade-marks of manufacturer.
- ii) Serial number of gauge cum level.
- iii) Month & year of supply.

11.2 The instrument shall be supplied with proper packing as per best trade practice to avoid any damage during transshipment. The supplier shall also have option to supply the instruments individually packed in wooden boxes, if so specified by the purchaser in the tender enquiry.

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