

GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS  
(RAILWAY BOARD)

INDIAN RAILWAY  
STANDARD SPECIFICATION  
FOR  
SPHEROIDAL GRAPHITE CAST IRON INSERTS

SERIAL NO. T-46-1996-2022  
(THIRD REVISION- ..... 2022)

RESEARCH DESIGNS AND STANDARDS ORGANISATION  
LUCKNOW – 226011

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INDIAN RAILWAY STANDARDS SPECIFICATION  
FOR  
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S. NO. T-46-~~1996~~ 2022  
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**0. FOREWORD**

- 0.1 The tentative specification for SGCI inserts was first adopted in 1976 and was revised in 1985 with the following changes:-
- i) Use of oil fired furnaces for melting and heat treatment was prohibited and use of only electrified furnaces was specified.
  - ii) Weight of inserts to different designs was provided.
  - iii) A clause for checking dimensions and weight by sampling plan as per IS:2500 (Pt.I) was introduced.
- 0.2 A task force group was formed in 1990 to study various aspects of manufacture, inspection and quality control of MCI inserts. Based on the recommendations of the task force group, the specification has been revised and is presented in the present form in IRS/T-series.
- 0.3 The present revision in 2022 has been taken up with a view to incorporate modifications found necessary as item has been decontrolled by Railway Board.
- 0.4 All Correction slips /Corrigendum (Corrigendum no. 1 to 3) issued till date have been incorporated in this revision.

**1. SCOPE**

- 1.1 This standard covers the manufactures, ~~approval of samples~~, internal checking/testing and record keeping for quality assurance, offering material for inspection, testing and inspection and packing of spheroidal graphite Cast Iron Inserts for concrete sleepers hereinafter referred to as “Inserts”. Contract awarding party has been referred to as “Purchaser” and its nominated inspection agency/representative as “Inspection Agency/~~Officer~~ authority”. The firm entrusted with manufacture and supply of inserts, is referred to as “Manufacturer”.

- 1.2 ~~“All the provisions contained RDSO’s ISO procedures laid down in Document No. QO D 7.1 11 dated 19.07.2016 (titled “Vendor Changes in approved status”) and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.”~~

## 2. **REFERENCE DOCUMENTS**

- 2.1 This standard refers to the following Indian Standard of BIS. These should be available at the manufacturer works for reference.

S. No.	IS: No.	TITLE
1	IS: 1865	Iron Castings with spheroidal or Nodular graphite – Specification
2	IS:1387	General requirements for the supply of Metallurgical materials ( 1 <sup>st</sup> revision)
3	(i) IS:228 (Pt.1)	Determination of carbon by volumetric method (for carbon 0.05 to 2.5 percent) (3 <sup>rd</sup> revision)
	(ii) IS:228 (Pt.2)	Determination of Manganese in plain carbon and low alloy steels by arsenite method.
	(iii) IS:228 (Pt.8)	Determination of Silicon by Gravimetric method (For Silicon greater than or equal to 0.1 percent)
	(iv) IS:228 (Pt.3)	Determination of Phosphorus by alkalimetric method
	(v) IS:228 (Pt.9)	Determination of Sulphur in plain carbon steel by evolution method.
4	IS:1500	Method of Brinell Hardness test for metallic materials. (2 <sup>nd</sup> revision).
5	IS:2500 (Pt.I)	Sampling inspection Table, Inspection by Attributes & count of defects (1 <sup>st</sup> revision).
6	IS:7739(Pt.V)	Code of practice for preparation of metallographic specimen, Part V Iron & Steel and their examination.
7	IS:1608	Method of tensile testing of steel products other than sheet, strip, wire and tube
8	IS:7754	Method for designation of microstructure of graphite in cast iron
9	IS:8350	Deviations for untolerenced dimensions of Spheroidal or Nodular Graphite Castings

- 2.2 A reference to the specifications quoted herein shall be taken as reference from the latest edition of the specification concerned.

2.3 The specific provision in this specification will override those in the above specifications, where these are not in conformity with each other.

2.4 Drawings of inserts and their checking gauges shall be available for reference at the manufacturers works.

### **3. SUPPLY OF MATERIAL**

3.1 General requirements relating to the supply of inserts shall conform to IS:1387-1967 1993“ General Requirements for the Supply of Metallurgical Materials (First Second Revision)”

### **4. MATERIAL**

4.1 The material for inserts shall generally conform to the requirements of Grade SG 500/7 of IS:1865-1991 “Iron Castings with spheroidal or nodular graphite – specification” (Third Revision).

### **5. RAW MATERIALS**

5.1 Raw materials shall be checked for their quality and lot wise records shall be kept as per **Annexure-I**.

5.2 Steel scrap of different grades shall be kept in separate stacks and records shall be maintained in log sheets to correlate them with casting heats.

### **6. MARKINGS**

6.1 Castings shall be accurately moulded in accordance with the working drawing supplied by the purchaser with the addition of such letters, figures and marks as may be specified therein.

### **7. MANUFACTURE**

#### **7.1 Patterns**

7.1.1 The patterns shall be made of metal or araldite.

7.1.2 All patterns shall be match-plated for moulding. It shall be ensured that there is no looseness between bushes and pins.

7.1.3 The patterns shall be checked periodically, not later than production of 1.0 lakh inserts. However, if dimension defect is observed, then defective pattern shall be fully rectified and documented.

## 7.2 Moulding Sand

- 7.2.1 The moulding sand shall be tested at least twice in a shift and the records shall be maintained as per **Annexure-II**.
- 7.2.2 Sand mould shall be porous to allow fumes to escape out of the moulds when the molten metal is poured.
- 7.2.3 Before reusing the used sand, magnetic particles shall be removed.

## 7.3 Melting

- 7.3.1 Melting shall not be done in oil or coal fired furnace. Only electrically heated furnaces shall be used for melting.
- 7.3.2 Temperature measurement of each of molten metal at the time of tapping shall be done by Pyrometer/recorder/ indicator.
- 7.3.3 Log sheet for each melt showing details of charge (with lot number of raw material), alloys used, starting and finishing of melt time and tapping temperature shall be made in proper proforma and signed by the melter.
- 7.3.4 Carbon and manganese shall be checked before pouring heat wise and records maintained as per **Annexure-III**.

## 7.4 Inoculation (Magnesium Alloy Treatment)

- 7.4.1 The method, chemical composition and quantity of magnesium alloy (with supplier's name) added for manufacture of SGCI in each ladle shall be recorded as for **Annexure-IV**.
  - 7.4.2 Test samples shall be cast from each heat of metal treated with magnesium alloy (herein referred to as "Heat") such that 6 test bars machined out of these samples as per IS:1865-1991 are available for conducting physical tests as an exercise for internal quality control and for inspection purpose. These samples should be cast at the end of pouring.
- 7.5 Detailed chemical analysis of castings shall be carried out heat wise and records maintained as per **Annexure-VI**.

## 7.6 Finishing

- 7.6.1 Further processing e.g. shot blasting and grinding of the inserts shall be done separately for each heat to rule out the possibility of mix up of inserts of different batches.
- 7.6.2 Gating projection shall be finished smooth as per drawing.
- 7.6.3 Grinding of parting line on insert stem need not be done until required for conformity to the insert gauges as per the relevant gauge drawing.

## 8. APPROVAL FOR BULK MANUFACTURE

DELETED

- ~~8.1 The manufacturer shall make few trial castings with the aim of development of inserts. The castings shall be thoroughly checked for dimension, weight, metallurgical properties and chemical composition. If on examination, any change in pattern of gating, risers and runners, and method of moulding is found necessary, it shall be carried out. The same procedure shall be repeated till all aspects of manufacture technology get corrected.~~
- ~~8.2 When the procedure is perfected, the manufacturer shall issue call letter for visit of inspecting officer and sample inserts and test samples shall be made in the presence of inspecting officer. 8 inserts for dimensional checking and other samples and test pieces as instructed by inspecting officers shall be submitted to RDSO for testing. If the samples are found satisfactory dimensionally and metallurgically, the bulk manufacture of inserts shall be allowed. Inspection/testing charges for inspection of firm, checking of gauges, making and testing of samples etc. shall be borne by the manufacturers.~~

## **8 9. INTERNAL INSPECTION, TESTING AND QUALITY CONTROL**

- 8.1 9.1** Brinell Hardness testing machine shall be checked daily with standard test block before start of the work.
- 8.2 9.2** Calibration of tensile testing machine shall be got done from a reputed and approved **Govt. lab/NABL accredited lab firm** at least once in a year and test certificates maintained for scrutiny by the Inspecting Officer **authority**.
- 8.3 9.3** Jig and gauges shall be checked everyday before starting checking of inserts.
- 8.4 9.4** At least 2% of the inserts from every heat shall be subjected to Brinell Hardness test and their records shall be maintained.



- 8.5 9.5 One standard test bar as per IS:1865-1991 from every heat and two proportionate test bars machined from castings shall be subjected to physical tests such as tensile test, elongation and micro structure and records kept as per **Annexure-VII**.
- 8.6 9.6 Soundness of castings shall be checked to ensure freedom from harmful defects by sectioning at least one insert per heat.
- 8.7 9.7 100% inserts shall be subjected to visual, dimensional and weight check and records of the same shall be kept heatwise as per **Annexure-VIII**. During visual examination inserts which do not have clear identification mark as per drawing shall also be removed.
- 8.8 9.8 Every insert shall be given one hammer blow as per arrangement shown in annexure ~~XII~~ **V**. Only sound inserts which do not break with blow shall be offered for inspection.

## **9. 10. OFFER FOR INSPECTION**

- 9.1 10.1 Inserts which are satisfactory metallurgically, dimensionally, by weight and with clear identification markings shall only be offered for inspection.
- 9.2 10.2 Call for inspection will be given in the format as per **Annexure-IX** with details such as number of inserts, heats, date of cast, numbers cast and numbers offered heatwise as per **Annexure-X**.
- 9.3 10.3 At least three weeks clear notice will be given to the Inspecting Officer **authority** to arrange inspection.
- 9.4 10.4 Material shall be kept ready for inspection in bags heatwise.
- 9.5 10.5 Material shall be offered for inspection in the room space earmarked for the purpose.
- 9.6 10.6 One set of inspection jig and gauge shall be kept for exclusive use of inspecting officer **authority**. Height gauge, surface table, clamps and vernier etc. shall also be made available for checking the accuracy of the gauges. Balance/scale shall also be provided for taking the weight of inserts to the accuracy of 1 gm.

## **10. ACCEPTANCE TESTS**

Tests as per Para 11 to 14 shall be conducted on SGCI inserts for acceptance of the material.

## 11. METALLURGICAL INSPECTION

### 11.1 Batch

11.1.1 Insert produced from one heat shall comprise one batch.

### 11.2 Chemical composition

11.2.1 Phosphorus content of one insert from each batch shall be checked and shall not exceed 0.08 per cent when tested in accordance with IS:228 (Part 3) – 1987.

### 11.3 Provision of Test Bars

11.3.1 Provision of test samples shall be made as per clause 10.1 of IS:1865-1991. All test samples shall be cast separately and heat number shall be cast on the test samples.

### 11.4 Tensile Test

11.4.1 Dimensions of tensile test bars machined out of test samples shall be as per clause 13.1 of IS:1865-1991.

11.4.2 One test bar from each batch shall be tested in accordance with IS:1608-1972 2005 and results shall be as under:

Tensile strength (Min)	-	500 N/mm <sup>2</sup>
Elongation (Min)	-	7%

11.4.3 In addition, tensile strength shall also be carried out on proportionate test pieces machined out from 1% of the castings selected from every batch. The test pieces shall be machined out from suitable locations on the castings and tested in accordance with IS:1608:1972 2005 'Method of Tensile Testing of Steel Products Other than Sheet, Strip, Wire and Tube'. The tensile strength and elongation shall not be less than 80% of the minimum values specified in clause 11.4.2 above.

11.4.4 The frequency of testing mentioned in clause 11.4.3 above may be at the discretion of the Inspecting Officer authority be relaxed to one number per heat after ensuring consistency of quality of production in 20000 inserts. In case of results of 2 batches out of 5 batches going beyond permitted values, the frequency of testing shall be reverted back for 20000 inserts.

## 11.5 Hardness Test

11.5.1 Brinell Hardness test shall be carried out on the end face of the head of all the inserts selected for tensile test in accordance with IS: 1500-~~1983~~ 2005 and hardness shall vary between 170 – 241 BHN.

## 11.6 Micro Structure

11.6.1 The castings selected as per clause 11.4.3 or 11.4.4 shall also be subjected to micro examination and the structure shall be as stipulated in clause 9 of IS: 1865-1991.

## 11.7 Internal Soundness

11.7.1 One insert from each batch shall be subjected to destruction test by sectioning in order to ensure internal soundness.

## 11.8 Retests

11.8.1 In addition to the stipulations of retests as given in clause 15 of IS:1865-1991, the following sub-clause shall also be applicable:-

11.8.2 Should any of the tests carried out for tensile **strength**, hardness, micro-examination and internal soundness on the castings selected fails to meet the specified requirements, two more castings from the same batch represented shall be selected for testing in respect of each failure. Should the test pieces from both these additional samples pass, the castings represented by the test sample shall be deemed to comply with the requirements of that particular test. Should the test pieces from either of these additional samples fail, the castings represented by the test samples shall be considered as not having complied with this standard and shall be rejected.

## **12. DIMENSIONAL CHECK**

12.1 Before inserts are offered for inspection, the supplier shall arrange to check 100% inserts for dimensions by 'GO' and 'NO GO' gauges.

12.2 The approved jigs shall only be used for checking dimensions of inserts.

12.3 Inspection of inserts for dimensions shall be as per double sampling plan as detailed in Table 1 and 3A of IS:2500 Part I-2000 assuming an AQL of 2.5% and general inspection level of II. The inserts shall be arranged in convenient lots of approximate 1200 (between 501 and 1000 1200).

Out of each lot, 50 sample inserts are selected at random and checked for dimensional accuracy. Depending upon number of defective inserts action will be taken as given below:

No. of defective inserts out of sample of 50 inserts:-

- i)  $\leq 2$  Lot is accepted.
- ii)  $\geq 5$  Lot is rejected.
- iii) 3 to 4 50 more sample inserts are selected.

Total no. defective inserts in sample 100 inserts.

- a)  $\leq 6$  Lot is accepted.
- b)  $> 6$  Lot is rejected.

### **13. CHECKING OF INSERTS FOR WEIGHT**

13.1 Checking of inserts shall be done as per double sampling plan as detailed in tables 1 and 3A of IS:2500 Part I- 2000 assuming an AQL of 4% and inspection level II. The variation in the weight of insert below the nominal weight of insert beyond 3% of that shown in the drawing will be counted as defect. Lot size used for dimensional check as detailed in clause 12.3 above shall be used for checking weights also for sampling purposes.

13.2 Out of each lot, 50 sample inserts are selected at random and checked for weight. Depending upon number of defective inserts, action is taken as given below:-

- i)  $\leq 3$  Lot is accepted.
- ii)  $\geq 6$  Lot is rejected.
- iii) 4 to 5 50 more samples selected.

Total number of defective inserts out of sample of 100 inserts:

- i)  $\leq 9$  Lot is accepted.
- ii)  $\geq 9$  Lot is rejected.

### **14. GATING PROJECTION**

14.1 Gating projection beyond tolerances shown in the drawing will be accounted for dimensional defect.

### **15. TEST FACILITIES**

15.1 The manufacturer shall supply the samples required for testing free of charge and shall at his own cost furnish and prepare the necessary test

pieces and supply labour, appliances, machinery and plants for such testing as may be required in his own premises in accordance with this specification.

## **16. PACKING**

- 16.1 The inserts shall be packed in suitable double gunny bags weighing not more than 50 Kg and stitched with hessian thread.
- 16.2 The bags shall be sealed at the centre and not on the corners to avoid breakage of seals while handling the bags. Extra stitching thread shall be cut off to avoid pulling of the same, which may lead to snapping of stitches.
- 16.3 Each bag shall show the number of inserts packed in that.
- 16.4 The gunny bag shall not have any exterior stitching whatsoever, except for the edge to be sealed. The hessian thread used for stitching the gunny bag shall be in one piece and free from any knots except at the sealing point.
- 16.5 Suitable chemically based plastic bags may be used in lieu of gunny bags with prior approval of the purchaser in writing.
- 16.6 The manufacturer shall ensure correct quantity packed in the bags. For any short supply, the manufacturer shall be responsible.

## **17. DISPOSAL OF REJECTED INSERTS**

- 17.1 Rejected inserts shall immediately be thrown in the scrap yard and melted at the earliest. A certificate to this effect shall be given by manufacturer in the call letter for inspection of next lot.

## **18. GENERAL**

- 18.1 Separate supervisors for production and quality control shall be engaged.
- ~~18.2~~ ~~Manufacturer shall provide transport to the inspecting officer to and from the railway station/rest house or convenient place of stay.~~
- 18.2 Necessary office accommodation for the inspecting officials at the factory premises shall also be provided by the manufacturer.

**19. INSPECTION OF PREMISES**

19.1 The Inspecting Officer ~~authority~~ or the Purchaser shall have free access at all reasonable times to the Works where the inserts are made. He shall be at liberty to inspect the manufacture at any stage and to reject any material or supplies that do not conform to the terms of the specification. He shall be provided facility to conveniently inspect any part of the works.

**20. CLEAN ENVIRONMENT**

20.1 The manufacturer shall strive to provide clean and well lighted environment in the sheds. Adequate number of exhaust fans shall be provided at critical points such as furnace and sand plant. If necessary, transparent sheets shall be provided in the roof of sheds.

20.2 Waste sand shall be removed from the shed and shall not be allowed to be collected in heaps in the shed.

**21. FACILITY FOR MANUFACTURE AND TESTING**

21.1 Minimum facilities for manufacture and testing of SGCI inserts as brought out in ***Annexure-XI*** shall be provided.

**ANNEXURE-I**

Firm .....

RAW MATERIAL ANALYSIS REPORT

REF.NO.....

Dated.....

Description of the Material .....

.....

Name of the party .....

.....

Address .....

.....

Challan No.....Dated.....

Number of Bags .....

Quantity :

Total weight:.....

Specification

Analysis

-----

-----

-----

-----

-----

-----

Quality: OK/Rejected

Remarks .....

.....

CHIEF CHEMIST

Signature -----

Name-----

**ANNEXURE-II**

Firm .....

Moulding Sand Testing Report

Dated \_\_\_\_\_

S. No	Shift	Time	Green Comp. Strength	Green Permeability	Moisture %	Mould Hardness	Any Other test
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Sig

nature -----

Name-----

Designation.....

**ANNEXURE-III**

Firm \_\_\_\_\_

Chemical analysis report before pouring

Date	Heat No.	Chemistry			
		C	Mn	Other element	Remarks

Signature -----

Name-----

Designation -----



**ANNEXURE-IV**

Firm \_\_\_\_\_

Innoculation (magnesium treatment) of SGCI inserts

Date \_\_\_\_\_  
Shift \_\_\_\_\_  
Innoculant/Magnesium Alloy/Mg  
Supplier's name  
Chemical composition  
Method of Innoculation/  
magnesium treatment

S. No.	Melt Heat No.	Magnesium treatment/Innoculation heat No.	Qty. of inoculant/Mg. Alloy/Mg	Time taken for pouring after inoculation/Mg treatment
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Signature -----  
Name-----  
Designation -----

**ANNEXURE-V**

**DETAILS OF HEAT TREATMENT**

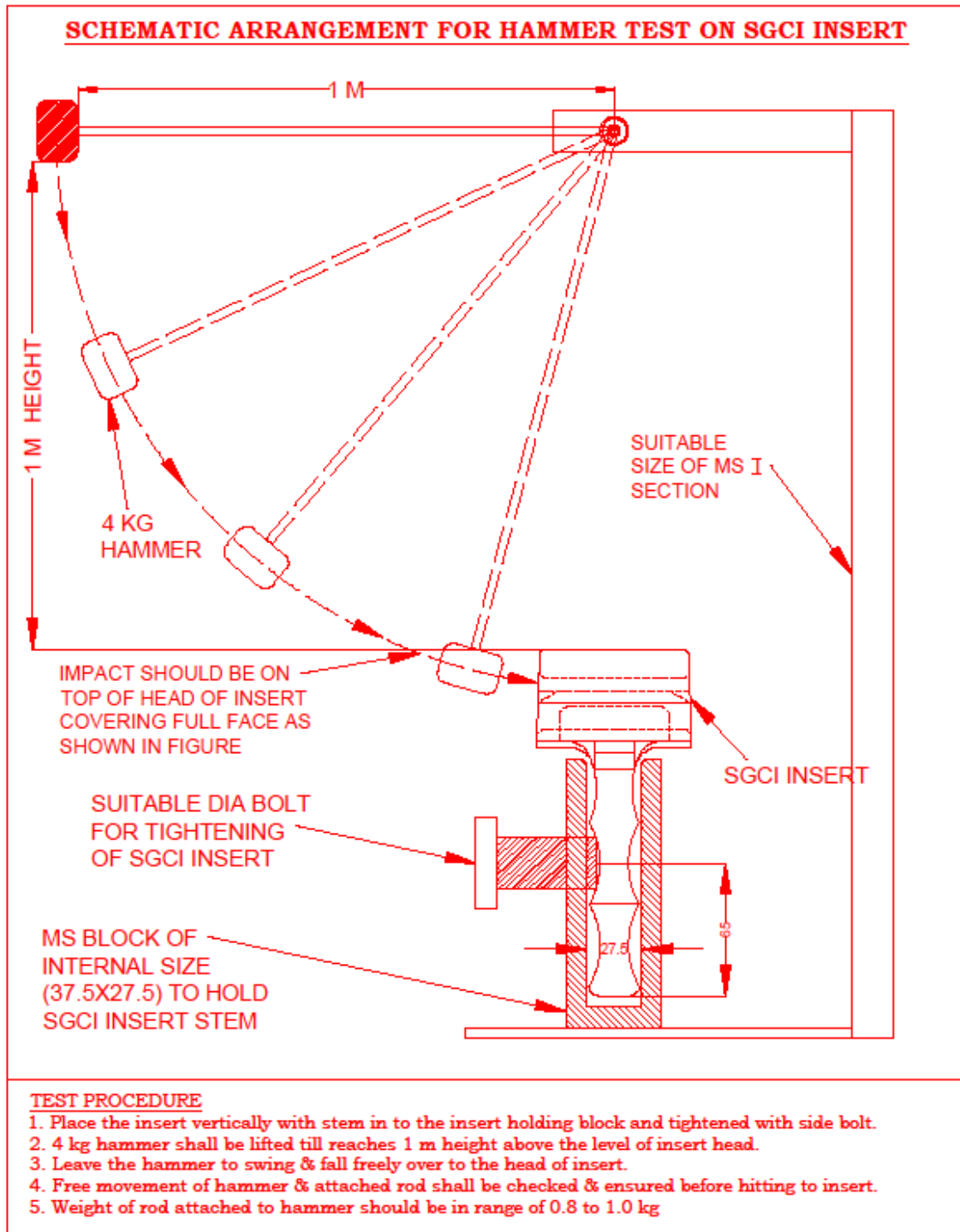
(If the heat treatment done)

\_\_\_\_\_ Type of the furnace : \_\_\_\_\_ Electrical

\_\_\_\_\_ Batch no. \_\_\_\_\_

S. No	Heat No. as per Mg treatment	No. of Castings	Time & Date of Loading	Time & Date of Unloading	Relative Graph Number / reg. record	Remarks
-------	------------------------------	-----------------	------------------------	--------------------------	-------------------------------------	---------

\_\_\_\_\_  
Signature \_\_\_\_\_  
Name \_\_\_\_\_  
Designation \_\_\_\_\_



**ANNEXURE-VI**

Firm \_\_\_\_\_

Chemical Analysis Report of finished Castings

Date	Heat No	C H E M I S T R Y						Remarks
		C	Mn	Si	P	S	Other element	

Signature -----

Name-----

Designation -----

**ANNEXURE – VII**

FIRM-----

Physical properties of SGCI inserts to Drawing No. \_\_\_\_\_

S No.	Heat No.	STB or PTB *	Length (original) (L)	Dia D & area A X-Section (original) [D] (A)	Length after breakage (L1)	Elongation (L1-L)	Load at breakage	% elongation (L1-L) x100 ----- L	UTS	Micro-structure	Remarks

Signature ----- Date-----

Name-----

Designation -----

\*STB = Standard test bar  
PTB = Proportionate test bar



**ANNEXURE-IX**

No. \_\_\_\_\_

Date: \_\_\_\_\_

(Address of Inspection Agency)

Dear Sirs,

SUB: Railway Board/Railway Contract No. \_\_\_\_\_  
dated \_\_\_\_\_ for manufacture & supply of  
\_\_\_\_\_ SGCI inserts to Drg. No. RDSO/T \_\_\_\_\_  
Alt. \_\_\_\_\_

\*\*\*\*\*

SGCI inserts as per the following details are offered for inspection. The inserts have been internally checked as per Drawing No. \_\_\_\_\_ Alt. \_\_\_\_\_ and IRS/T-46-1996 and found satisfactory.

1. Installment No.
2. Qty. on Order
3. Qty. previously inspected & passed
4. Qty. offered for inspection
5. Rate
6. Delivery period
7. Marking on inserts
8. Packing
9. consignee

Heatwise details of the inserts offered for inspection are as per Annexure.

Inspection of the inserts may please be carried out.

Thanking you,

Encl: One annexure

Yours faithfully,

(Signature with Date)  
Name \_\_\_\_\_  
Designation \_\_\_\_\_

**ANNEXURE-X**

DETAILS OF SGCI INSERTS HEAT-WISE (Mg. Treatment)

S.No	Heat No.	Date of cast	Nos. cast	Nos. rejected internally	Nos. offered for inspection
1	2	3	4	5	6

Total :

-----  
-----

**MIN. FACILITIES FOR MANUFACTURE AND TESTING OF SGCI INSERTS**

- 1) Melting facilities such as
  - a) Electric melting furnace with control panel
  - b) Temperature measuring device for molten metal which can be immersion/optical/radiation pyrometer.
- 2) Pattern shop with facilities for making metal/araldite patterns, height gauge & surface table, clamps, vernier calliper & slip gauge etc.
- 3) sand plant/sand muller for preparation of moulding sand.
- 4) Weighing scale/machine.
- 5) Moulding machines and air compressor
- 6) Core making facilities
- 7) Iron separator and seiver.
- 8) Mould boxes.
- 9) Sand testing facilities such as rapid moisture tester, permeability meter, compressive strength machine, sieving set, mould/core hardness tester, sand weighing scale, sand rammer, drying oven etc.
- 10) Vibrator to remove sand or hand knocking.
- 11) Shot blasting machine, tumbling machine.
- 12) Grinders.
- 13) Ladle for Inoculation (magnesium treatment).
- 14) Electric heat treatment furnace, thermostatically controlled fitted with temperature indicator and automatic temperature recorder which can achieve temperature up to 1000<sup>0</sup> C.



- 15) Turning facility (Lathe) for preparation of tensile test piece and other machining facilities such as shaper, drill machine, Hexa etc.
- 16) Chemical laboratory with apparatus such as Strohleins, apparatus, muffle furnace, barometer, distillation plant and other apparatus and standard samples, chemicals and glass ware to determine contents of carbon, sulphur, manganese, silica and phosphorus etc.
- 17) Brinell Hardness test machine and standard hardness testing block.
- 18) UTS machine of at least 20 tonne capacity.
- 19) Metallurgical microscope with minimum magnification of 100.
- 20) Polishing machine for preparation of micro test piece.