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BUREAU OF INDIAN STANDARDS
AGENDA

No. of meeting	Name of the Committee	Day	Date	Time	Venue
44th	Wrought Steel Products Sectional committee **MTD 4**	Friday	22 Sep 2023	1000h onwards	Lal C Verman Hall Manak Bhawan, BIS, New Delhi-110002

Chairman: Shri Nirvik Banerjee **Member Secretary:** Mr Arun Pucchakayala

Item 0 GENERAL

0.1 Welcome remarks by Head MTD

0.2 Opening Remarks by the Chairman

Item 1 CONFIRMATION OF MINUTES OF LAST MEETING

1.1 The minutes of meeting of 43rdmeeting held on 28 April 2023 at COEP Tech Pune, were circulated to the members by email on 23 May 2023 inviting comments till 31 May 2023. No Comments were received from members on appropriateness of the minutes.

The Committee may like to formally confirm the minutes.

Item 2 ACTION TAKEN REPORT

2.1 Summary of Actions taken on decisions of the Sectional Committee meeting of MTD 4 held on 28 April 2023 and of the Sub-Committee meetings held on 14 July 2023 (MTD 4:2) and 28 July 2023 (MTD 4:3) is placed at **Annex I (Pg 5-95).**

The committee may please note and review the status of pending issues.

Item 3 COMPOSITION OF SECTIONAL COMMITTEE

3.1 Review of the membership in the Committee - In accordance with the guidelines, the composition should be compact and the membership of the committee shall be reviewed after 3 years and the organizations representing for reasonable long time without participation/contribution may be substituted by new organization that are capable of contributing in the new technologies/area of work. BIS has issued following guidelines for appointment of members and vice chairman in the sectional committees.


Appointment of Vice Chairpersons


SPPD_Guidelines_mirembers 23072019-3-

3.2 Balancing of all interested groups in the Committee - It has been decided that the composition of the Technical Committee should be reviewed to have at least two third of the committee members representing Consumers/Technical Bodies/R&D/Testing Laboratories/ educational institutions/ Govt. Departments etc, and the representation of the manufacturing industries/Associations of Industries should be not more than one third of the committee members. NGO's and Consumer Organizations may be co-opted in Technical Committees where there is no adequate representation.

3.3 The Size of the Committee - The size of the committee is often a compromise between a reasonably broad basis of representation and the need to restrict membership to workable numbers. Generally, a smaller membership will be appropriate for a committee dealing with detailed aspects of a standard, with wider representation being provided at the more senior committee levels. In order to keep committee to a workable size, the strength of Sectional Committee is generally 30.

3.4 The composition of Committee MTD 4 is given at **Annex II (Pg 96-97).**

3.4.1 No change is proposed to the existing composition of MTD 4:3 and MTD 4:2.

3.4.2 New instructions from BIS Top management was shared with members through email on 18 Sep 2023.

The Committee may please note.

Item 4 REVIEW OF INDIAN STANDARDS

4.1 Each published Indian standard is required to be reviewed by the concerned sectional committee after every five years of its Revision/Reaffirmation/issue of Amendment. If no revision is called for, the standard(s) may be reaffirmed. Reaffirmation of the standard(s), however, does not prevent from these standard(s) being taken up for revision.

4.2 Standards pending for review/reaffirmation during the year April 2023 – March 2024 is given at the link:

https://docs.google.com/document/d/1uHfiPjiQUx2VlkLrUKS127lh8z6WkbJ2WkcNGCEZeU/edit?usp=sharing

4.3 Recommendations from panels were still waited for 20 ARPs.

Committee may please note.

Item 5 NEW PROPOSALS FOR STANDARDIZATION

5.1 As per guidelines, see 3.1, any new proposal for standardization should essentially be made on the prescribed Performa as a preliminary work item. Where a proposal is made in the Sectional Committee, the member making the proposal should fill up the Performa beforehand and present it in the meeting for consideration of the committee.

The Performa is given below:

Proforma_for_new_
subject- gender resp

5.2 It may further be added that the proposal received at **5.1** has to be analysed by the member secretary in the prescribed proforma for consideration of the technical committee/screening committee keeping the following in view:

i) What is the feasibility of achieving consensus on national standards in this subject area by the proposed target date;
ii) How many members besides the proposer agree to the proposal and how many are ready to actively participate in the development of the project;
iii) Whether any outside funding is possible;
iv) Only those subjects should be taken up which have a potential to mature into a standard in the stipulated time;

5.3 Reports from interns were received placed at Annex-III(Pg 98-157).

Committee may please decide.

The subcommittee may please note.

Item 6 Comments on Indian Standards
6.1 Comments received on IS 513 Pt.2 from JSW.

Committee may please note.

Item 7 IMPLEMENTATION OF INDIAN STANDARDS

7.1 In order to derive maximum advantage of the National Standards, members are requested to adopt these standards in their respective organizations and bring to the notice of BIS DG any difficulty that they may experience in implementation. The feedback would enable the concerned Sectional Committee to review the standards and eliminate wherever possible the bottle necks in the implementation.

The subcommittee may please note.

Item 8 INTERNATIONAL ACTIVITY

8.1 Interaction with ISO

The National Standards Bodies who are members of ISO have the right to participate in the work of its technical committees and subcommittees and working groups as participating (P members) or observer (O member) with the following responsibilities:

a) P members have to participate actively in the work, with an obligation to vote on all questions formally submitted for voting within the technical committee or subcommittee and on draft documents at different stages or processing and, whenever possible, to participate in meeting (s).

b) O members have to follow the work as an observer, and therefore, receive committee documents and have the right to submit comments and to attend meetings

c) National Bodies irrespective of their status as 'P' or 'O' member within a technical committee or subcommittee have the right to vote on draft International Standards.

8.2 The experts comprising of Shri S J Dey and Arun Pucchakayala(BIS) took part in SC meeting held during 06-07 Sep 2023 at France. Next SC meeting is scheduled during Nov 2024 at Dusseldorf, Germany.

Committee may please note.

8.3 India is a `P' member on ISO TC 17. SR ballots due were shared earlier through email dated: 06 June and 04 July 2023. A-1 to ISO 404:2013 may please be send for WC for adoption as recommended by MTD 4:3.

Committee may please decide.

8.4 SARSO Standards

Comments received from Srilanka on SARS 0028-1, SARS 0028-2 and SARS 0028-3 were to be addressed. Member Secretary may be given time till 15 Nov 2023 to complete the same.

Committee may please consider.

Item 9 DATE AND PLACE FOR THE NEXT MEETING

According to the meeting calendar next meeting is scheduled during 15 Dec 2023 at BIS, New Delhi.

Item 10 ANY OTHER BUSINESS

Sl. No	Subject	Decision taken in past meetings	Decision taken by the Committee during the last meeting	Action taken on the decision of the committee/ subcommittee during last meeting
(1)	(2)	(3)	(4)	(5)
1	Comments from JFE on IS 18386:2023 *Hot Rolled And Cold Rolled Steel Strips Intended For Processing Of Semifully Processed Non-Grain Oriented Electrical Steel Or Fully Processed Grain Oriented Electrical Steel*	Comments received from JFE, post WC period were shared with Panel 2 for examining and obtaining views.	Comments received from JFE, post WC period were shared with Panel 2 for examining and obtaining views.	Subcommittee during its meeting held on 28 July 2023, requested the panel convenor Sh Kapil Kapoor to expedite action and submit their recommendation within a month from the date of finalization of the minutes. In addition, we were in receipt of comments from Convenor of Panel, given at **Appendix-1(Pg 39-41).** **Committee may please examine and decide.**
2	New Standard on thin magnetic steel strip for use at medium frequencies -	It was suggested by Mr Kapil Kapoor to adopt IEC standard 60404-8-8 , standard for thin magnetic steel strip for use at medium frequencies - Both for CRNO	Committee was briefed by the member secretary that adequacy of IS 649, with or without awaited modification, only helps	Subcommittee noted the information that an amendment to IS 649 was in process for enhancing the test frequency

	Both for CRNO and CRGO	and CRGO The committee after deliberation agreed that new standard on thin magnetic steel strip for use at medium frequencies needs to be formulated. Mr Kapil Kapoor of Thyssen Krupp was requested to fill the form provided at Annex IV of agenda for proposing new subjects. During the last meeting committee after discussion requested Mr Kapil Kapoor to forward Annex IV for proposing new subject. Since Tata Cogent representatives were also present in the meeting, they were requested to assist Mr Kapil Kapoor with details required for filling up Annex IV. After receipt of this, the same was to be forwarded to committee members, and if agreed by committee members and approved by Chairman, the recommendation for formulating new standard on thin magnetic steel strip for use at medium frequencies , was to be forwarded to MTDC for approval of new subject. The committee was informed that Annex IV was still awaited. The committee noted the information. Shri Kapil Kapoor informed the committee that he will submit the requisite document by 15 January 2019. The duly filled template proposing new standard for use at medium frequencies was received on 12th June 2019 from Sh. Kapil Kapoor. Convener of Panel-18, Sh Kapil Kapoor emphasized on the need to have standard on thin magnetic steel strip for use at medium frequencies - both for CRNO and CRGO and imparted the features of the new work item proposal **(Appendix-2)** to the members and	manufacturers and testing labs in complying with the standard but it does not obstruct adoption of the IEC 60404-8-8 as an Indian Standard, as the comparison of other referred standards in IEC were only captured in national foreword, which would be comprising IS 649 as not identical with various IEC test method standards. On the above grounds, Member secretary requested the committee to agree with the proposal for sending the document for wide circulation. Consequently, the Committee advised the Member Secretary to obtain consent from the subcommittee MTD 4:3 on the above proposal for wide circulation and apprise the same with them in due course for further action.	beyond 400 Hz, for making the standard amenable to cover test methods for thin magnetic steel strip for use at medium frequencies. **In this regard, panel convenor Sh Kapil Kapoor was requested to expedite action and submit their recommendation along with draft amendment within a month from the date of finalization of the minutes.** Further, the members of subcommittee were informed by the member secretary that the desired amendment would only facilitate giving an added advantage for testing as per IS 649 but do not substitute the referred IEC standards in the product Standard. In other words, the foreword of the product standard would be providing a degree of comparison between IEC standards on test methods and IS 649, which would be mentioned as not equivalent against the corresponding IEC standard. Accordingly, it was put forward that the desired amendment should not be construed as deterrent for going ahead with the adoption of IEC 60404-8-8:2017 and suitable changes to the foreword could be considered at a later stage after publishing the desired amendment for IS 649. Also, it was apprised that the product standard needs to be expedited on account of ensuring the quality of imports , which was substantiated through data received from Ministry of Steel and shared with Members during April/May 2023. As a result, the subcommittee during its meeting held on 28 July 2023

		vouched for adoption o The Committee agreed to the proposal in-principle and advised the sub-committee to take further actions for adoption of the IEC standard expeditiously. Also, the Sub-Committee was advised to ensure that the draft document would be circulated among ITMA and IEEMA during wide circulation. Also, the Committee advised the Sub-Committee to examine the adequacy of test methods covered in IS 649 for product covered under IEC 60404-8-8:2017 and decide on the matter. The Subcommittee during its meeting held on 18 April 2022 requested Panel 2 to submit report by 30 June 2022 on adequacy of IS 649 for the proposed adoption of the product standard. Panel 2 held its meeting on 24 May 2022. Report is awaited. The Committee was informed by the Panel Convenor Sh Kapil Kapoor that IS 649 in its present was inadequate to test the products covered under IEC 60404-8- 8:2017, proposed to be adopted as an Indian Standard. The Committee requested the panel convenor either to modify IS 649 suitably for making it amenable for testing of the product as per IEC 60404-8- 8:2017. Also, the Committee requested the panel convenor to provide WC draft as this would be an adoption of modified version of IEC 60404-8- 8:2017. The Panel Convenor Sh Kapil Kapoor was requested to submit the desired draft amendment to IS 649 and the modified version of IEC standard within 15 days from the date of finalization of the		recommended to send the document intended for adoption of IEC 60404-8-8:2017 for wide circulation for 30 days with prior approval of TC. **Committee may please consider the proposal.**

		minutes. Also, it requested Member Secretary to circulate the draft amendment on receipt of it from Panel Convenor, to members of both MTD 4 and MTD 4:3, giving a time period of 21 days for inviting comments. The member secretary was also requested to send the modified version of IEC on receipt from from Panel Convenor Sh Kapil Kapoor for WC for a period of 1 month. Report is awaited from convenor of Panel 2. Panel Convenor Sh Kapil Kapoor briefed the status to the subcommittee. Accordingly, Subcommittee requested Panel Convenor to submit the report within 15 days from the date of finalization of the minutes. Committee noted the status and requested the Panel Convenor Sh Kapil Kapoor to submit the report by 31 Dec 2022. Panel 2 held its meeting on 02 Jan 2023 and agreed to consider an amendment to IS 649 to suit the needs for adoption of IEC 60404-8-8. Draft amendment is awaited. Draft amendment No.6 to IS 649 was awaited from the panel 2, for ensuring adequacy of IS 649 for adoption of IEC 60404-8-8. During the meeting of subcommittee held on 11 April 2023, Convenor of Panel 2, Shri Kapil Kapoor was requested to submit the draft amendment within 14 days.		

3	New standard on Wear & Abrasion resistant steel plates **MTD 4 13289**	During the last meeting comments received from Volvo steel were discussed and after deliberation the committee did not agree to the comments. The committee after deliberation decided to send the document for wide circulation for two month. The document placed at **Appendix 16** is being prepared for wide circulation. The committee noted the information. Before sending the draft for wide circulation, the draft was examined and observations were shared with the panel by MTD. Also, MTD had informed the panel convener that the composition of the panel was not balanced as there was no representation from User Industry. Subsequently, Panel meeting was held on 30 June 2020 to discuss on comments of MTD. Modified draft was received by MTDfrom the panel convener on 07 July 2020.	Committee noted the status and requested the Panel Convenor to examine the test reports and share their recommendation so that further action could be taken in due course. Also, the Committee agreed to send the document for wide circulation, which was previously P-circulated among committee members, in case the desired panel recommendation states that the results of test report were substantiating the requirements as indicated in the P-circulated draft.	During the subcommittee held on 28 July 2023, the summary of the test results were apprised to the members by the Panel Convenor Shri Deepak Gupta (AM/NS). Further, the modified draft on account of the satisfactory results validating the survey of MTCs of importers, involving stipulation of limits for tensile strength instead of a range in the earlier draft, is given at **Appendix-2(Pg 42-47).** **The Subcommittee recommended to send the document for wide circulation for 30 days with prior approval of TC.** **Committee may please decide.**

		During the meeting, Member Secretary had informed the committee that the comments of MTD on the draft document were not addressed by the panel even in the modified draft submitted on 07 July 2020. The Committee noted the information and requested the Panel Convener to submit the modified working draft along with work plan for validation of the grades to the sub-committee within 2 months. Also, the Committee took note of the concerns raised by the Member Secretary on composition of the panel and advised sub-committee to reconstitute the panel by also having representation from the organizations JCB, Volvo, Caterpillar, Tata Hitachi and BEML. Further, the Committee requested, Addl Industrial Advisor to Ministry of Steel to arrange for requisite samples in due course in consultation with importers, necessitated for validation of properties in the draft standard. Subcommittee during its meeting held on 18 April 2022, requested the convenor to P-Draft by 30th June 2022. The Committee noted the status shared by Panel convenor Sh Deepak Gupta. Also, the Committee discussed on possibilities of some of the varieties to be tested for validation of steel grades using steel produced domestically. It requested AM/NS to provide samples to panel for grades of lower hardness and requested Sh Parmjeet Singh (M/o Steel) to help the panel for getting grades of higher hardness from importers. Further, Head MTD clarified to the Panel convenor that the panel report should be inclusive of grades		

		of steel along with corresponding properties and acceptance criteria for validation of grades i.e number of samples to be tested and also to specify coordination required both for collection of samples and getting them tested. Also, it was suggested by the committee that the samples for validation be got tested in any NABL/BIS approved Lab for steels. The Panel Convenor was requested to submit the panel report within 15 days from the date of finalization of the minutes. The report of the panel would be presented during the meeting by convenor of Panel 27 Sh Deepak Gupta, AM/NS. Draft Standard is placed at Appendix-1(Pg 50-56). Panel convenor, Sh Deepak Gupta, apprised the members of the contents of the report. Subsequently, Head MTD raised concerns on chemical composition, as there was no difference amongst the grades except for maximum allowable limit of carbon. Accordingly, Panel Convenor informed the Subcommittee that the panel would revisit the TCs and share the report by 30 Nov 2022. Panel Convenor Sh Deepak Gupta, briefed the committee about the contents of the report and draft standard. The Committee agreed to start the proceedings by initiating the process of testing and validation for grades covered in draft standard as mentioned below:		

		1) As-prepared samples for grades 400,450 to be send to MTD, BIS by AMNS. 2) Cut -pieces of other grades from importers to be arranged by Ministry of Steel and to send the same to MTD, BIS. 3) Testing of samples at CL, BIS subsequent to receipt of as-prepared samples from AMNS for all the grades. Further, the Committee agreed to send the draft standard, Appendix-2(Pg 102-109), among members for P-circulation giving time for a period of 21 days from the date of finalization of the minutes. No comments received during P- circulation. Samples of grades ISAR 400,450 and 500 were sent for testing at BIS lab for alltests barring impact test at -40Deg C. Testing would be carried out for free of cost at CL, Sahibabad (BIS, lab) with exception of impact test at -40 Deg C which would be carried out M/s Spectro analytical lab for which AMNS agreed tobear the costs.		
4	Revision of IS 15911:2010 *Structural Steel (Ordinary Quality)*	IS 15911 was revised and agreed by the committee for printing. However, following observations were made on draft approved for printing. 1. Title of standard is not in line with scope of the standard and not in line with IS 2062.	Committee requested the Panel Convenor to submit its report within 30 days from the date of finalization of the minutes.	Subcommittee during the meeting held on 28 July 2023 requested the Member Secretary for follow-up and ensure that the desired report is made available at the earliest.

		2. Definition of low tensile is not incorporated in thestandard. 3. The word 'sheets' to be included in Sr No iii of table 4. 4. Permissible variation of % silicon in product analysisnot indicated. 5. Variation allowed on which specified value is not clear .Hence definition of product analysis to be reviewed . 6. Review clause 17.2 as there is no clarity in the sentences. During the last meeting Mr Jayanta Saha, convenor of the panel responsible for revision of IS 15911 mentioned thathe will study the observation and if required the revised draft shall be put up after discussion with the panelmembers in one month time. As report was awaited, the committee noted the information and again requested Shri Jayant Saha to submit its recommendations by 15 May 2019. Convener of Panel-26, Dr Jayanta Saha, briefed the committee about the status of the revision. The Committee noted the status and requested Panel Convener to submit the modified draft to the Sub Committee within two weeks. Also, the Committee took note of change in place of posting and/or superannuation from service against someof the members representing the panel and suggested tothe Sub-Committee to reconstitute the panel by inducting Sh S Srikanth(RDCIS), Sh Arunava Dasgupta (DSP) andSh G V Ramana (JSW) into the panel. Subcommittee requested the panel convenor to submit the P-draft by 30th June 2022.		**Report is awaited, Committee may please note.**

		Panel held its meeting on 09 June 2022. The Committee noted the status briefed by member secretary and requested the panel convenor Sh Moreshwar Borkar (JSPL) to submit their report along with P-draft within 15 days from the date of finalization of the minutes. Also, it requested Member Secretary to circulate the P- draft on receipt of it from Panel Convenor, to members of both MTD 4 and MTD 4:3, giving a time period of 21 days for inviting comments. Subcommittee requested the Panel Convenor to submit its report within 15 days from the date of finalization of the minutes. Committee noted the status and requested the Panel Convenor Sh Moreshwar Borkar to submit the reportwithin 30 days from the date offinalization of the minutes. Report is awaited from the panel.		
5	Revision of IS 11587:1986 *Structural weather resistant steels*	A Panel 19 consisting of following members was formed for revision of IS 11587:1986 Structural weather resistant steels 1. Mr Jayanta K Saha - INSDAG – Convenor 2. Mr Deepak Gupta – Essar Steel 3. Mr A Dagupta – SAIL, RSP 4. Mr Avtar Singh – Tata Steel 5. Mr Devasish Mishra, JSW, Bellary 6. Mr M Borkar – JSPL 7. Representative from RDSO During the last meeting committee requested the panel to provide the revised draft based on comments received and agreed by committee by incorporating above proposed changes to BIS. The revised draft	Committee noted the status that convenor of Panel 7 Sought 45 days time from 30 April 2023 to submit the report. Further, the Committee advised the Panel Convenor to hold a physical meeting in the Month of May 2023 and finalize the pending action(s) on priority.	The report received from the panel on account of its meeting held on 09 June 2023, is given at **Appendix-3(Pg 48-60).** Subcommittee during the meeting held on 28 July 2023 , requested the Convenor of Panel 7 to expedite action and submit the desired draft , as mentioned in the report, within 45 days from the date of finalization of the minutes. **Committee may please note.**

		was then to be sent for wide circulation for one month. The draft placed at **Appendix 12** is being prepared for wide circulation. Committee noted the information. Comments on the working draft was shared with panel convener on 25th June 2021 and placed at Appendix-9. Revised draft was awaited. Convener of Panel-19, Dr Jayanta Saha, briefed the committee about the status of the revision (Appendix-9). The Committee noted the status and requested Panel Convener to submit the modified draft to the Sub Committee within One Month. Subcommittee requested the Panel Convenor to submit the P-Draft by 20th June 2022. The committee noted the status briefed by Sh G V Ramana (representing Panel Convenor Sh Devashish Mishra, JSW) and informed that comments of MTD were duly addressed in the final draft, which were observed to be in review mode capturing the comments of MTD and reply of panel convenor. However, the draft was devoid of desired panel draft and consolidated comments from panel members which were duly addressed in shaping the final draft for revision. Head MTD clarified to the Panel convenor that it was desirous of having a report from panel convenor incorporating references of national/ international standards for the changes suggested for revision of the standard and should also be including the decision of the panel along with the changes therein		

		against all the comments received from members of panel. The committee requested the convenor of panel 7 to submit the report within **07 days** from the date of finalization of the minutes. Also, it requested Member Secretary to circulate the P-draft on receipt of it from Panel Convenor, to members of both MTD 4 and MTD 4:3, giving a time period of 21 days for inviting comments. Amendment No. 1 to IS 11587:1986 was issued in August 2022, on account of 41st meeting of MTD 4 held on 28 July 2022, for catering the need of container manufacturers. The grade SPA-H and SPA-C(JIS G 3125) were incorporated in the standard through the amendment. Report is awaited from Panel 7. Subcommittee requested the Panel Convenor to submit its report by 30 Nov 2022. Committee noted the status and requested the Panel Convenor Sh Devasish Mishra to submit the report within 30 days from the date of finalization of the minutes. Report is awaited from Panel 7. Also,nominations to be obtained from IR classand RDSO. During the meeting of subcommittee held on 11 April 2023, on behalf on Panel convenor of Panel 7, Shri G V Ramana Sought 45 days time to submit the report.		

6	Revision of IS 2507:1975 *Cold-rolled steel strips for springs*	Comments received from Bhushan Steel Ltd, Maharashtra During the previous meetings the committee discussed the draft revision and after deliberation some of the committee members requested for some more time to go through the revised standard and give comments on same. The committee agreed to give 21 days to the committee members to give their comments on the draft. In case no comments are received in this period, the draft shall be sent for wide circulation for one month after taking approval of Chairman MTD 4. Vide email dated 3/4/2018 following clarification has been sought from Mr Murlidhar of Bhushan Steel for which reply is awaited. “In the covering letter attached you have informed that for revising this standard you have taken help of ISO 4960. You are requested to kindly inform whether the ISO 4960 can be adopted in total replacing the current standard or only a few clauses need to be taken from ISO 4960. Also as understood the changes made by you are highlighted by red colour. You are requested to inform whether the changes made are as mentioned in ISO standard particularly for chemical composition, physical properties, heat treatment temperature . During the last meeting Committee decided that the	Committee noted the status and requested Panel 11 to hold a physical meeting in the Month of May 2023 and finalize the pending actions on priority.	Report is awaited from Shri Ravindra Gujar (M/s Tata Steel Ltd) and requested Member Secretary to ensure follow up action and obtain the report within 45 days. **Committee may please note.**

		Bhushan Steel should send their comments with justification in the comment format. Mr Murlidhar agreed that he shall send the same to BIS in one week's time. The same shall then be forwarded to committee member for 21 days for comments and in case no comments are received the revised document may be sent for wide circulation for one month. The committee noted the information and after deliberation decided that as no reply has been received from Bhushan Steel the draft document placed at Appendix 14 may be sent for wide circulation for one month. Observations made by Member Secretary, while preparing the draft for wide circulation, were shared with Panel for disposal (see Appendix-11 pg 147-156). Reply is awaited from the Panel Convener. The Committee took note of the comments of MTD (Appendix-11) and advised the Sub-Committee to take decision on the matter. Subcommittee referred the matter to panel 11 to examine the working draft received from Tata-BSL Ltd earlier and submit the P-Draft by 20th June 2022. The committee requested the convenor of panel 11 to submit the report within 15 days from the date of finalization of the minutes. Report is awaited from **Panel 11**. Subcommittee requested the Panel Convenor to submit its report by 30 Nov 2022. Committee noted the status and requested the Panel		

		Convenor Sh Avtar Singh Saini to submit the report within 30 days from the date of finalization of the minutes. Report is awaited from Panel 11. Subcommittee during its meeting held on 11 April 2023 had advised the panelto expedite action. Also, panel was also advised for considering adoptionof ISO 4960.		
7	IS 2062:2011 *Hot Rolled Medium and High Tensile Structural*	In the 32nd meeting, comments received from Mr P.K.Patra, JSW Steel limited were considered and after deliberation the committee decided that some more	Committee noted the status and requested the Member Secretary to send the document for WC for 30 days within	Subcommittee noted that the report was provided by the panel on account of its meeting held on 09 June 2023 and was

	Steel	study is required before permitting higher level of nitrogen in IS 2062:2011. The committee requested Mr P.K.Patra to undertake the study and get the high nitrogen level steel samples tested in WRI,BHEL, Trichy and welding laboratory of Tata Steel and present the findings in the next meeting. Comments received from JSW and TATA Steel were discussed and after deliberatioin the committee decided not to increase the permissible nitrogen content without testing as decided in last meeting. The comments of JSW wereagreed. The amendment was discussed and after deliberation and as pointed by Power Grid, the committee did not find any justification for increasing the chemical composition limits and decreasing the elongation values of existing grades. The committee thus decided to remove this from the proposed amendment. JSW informed that they shall provide justificaition for the same. During the last meeting justification received from JSW for amendment was discussed and after deliberation the committee agreed to the justification provided. The committee also discussed the comments received from DSP and the following decision was taken for the comments made Point 1 & 2 was not agreed by the committee since there is no change in carbon equivalent. Point 3 was agreed by the committee and it was decided that in the amendment it will be mentioned that the elongation was for transverse/longitudinal direction. It was decided to circulate the revised amendment among the committee members for 21 days and incase no comments are received the same was to be sent for wide circulation for one month. The draft amendment was revised as per the comments received and agreed to by the committee and sent for	15 days from the date of finalization of the minutes. Further, the Committee advised the Convenor of Panel 7 to hold a physical meeting in the Month of May 2023 and finalize the pending action(s) on priority.	given at Appendix-2. Further, the Subcommittee during its meeting held on 28 July 2023 requested the Convenor of Panel 7 to expedite action and submit the desired draft, as mentioned in the report, within 30 days from the date of finalization of the minutes. Draft standard for Q&T structural received is given at **Appendix-4(Pg 61-79)** **Committee may please decide.**

		circulation among the members of the committee on 14/10/2018. Following comments were received from Tata steel:  Draft Amendment to IS 2062 tata steel.do The comment received was discussed and committee after deliberation and reviewing the draft amendment decided to modify the amendment. The committee requested the member secretary to circulate the modified amendment placed at **Appendix 8** among members for 14 days. In case no comments are received the modified amendment will be sent for wide circulation for one month. The committee also deliberated and decided to include Quenched and Tempered grades for higher strength material for structural use. It requested the panel revising IS 2062 to consider incorporating quenched and tempered grades in the existing standard or consider a new standard on the same. The committee noted the information and after deliberation decided to refer the matter again to the panel and requested them to submit the draft revision of document within the period of two months. The Draft revision then received will be send in wide circulation for the period of one month in consultation with the Chairman. The comments of MTD for want of justification for the proposed changes seeking details of reference in national/International standards was awaited from the Panel (Appendix-17). The Committee took a note of the comments of MTD (Appendix-17) and requested convener of Panel-17 to		

		submit the modified draft to the sub-committee within three weeks. Subcommittee reconstituted panel 7 and requested them to submit the P- Draft by 30th June 2022. The committee noted the status briefed by Sh G V Ramana on behalf of convenor Sh Devashish Mishra. The committee requested the l convenor of panel 7 to submit the report, indicating references of national/ international standardsfor the changes suggested for revision of the standard and also including the decision of the panel along with the changes therein against all the comments received from panel members, within 15 days from the date of finalization of the minutes. Also, it requested Member Secretary to circulate the P-draft on receipt of it from Panel Convenor, to members of both MTD 4 and MTD 4:3, giving a time period of 21 days for inviting comments Meeting of panel 7 was held on 26 July 2022. Minutes of the meeting , Annex-1 to the minutes and draft standard for revision of IS 2062:2011 is placed at **Appendices- 3,4 & 5**(Pg 79, 80-84, 85-100). Member Secretary was advised to circulate the working draft along with the minutes inviting comments from members of both MTD 4:3 and MTD 4, giving them a time period of 15 days. The Committee was informed by the member secretary that no comments were received from subcommittee on the draft document during P-circulation culminated on 09 Dec 2022. Accordingly, the Committee agreed to send the draft		

		standard, placed at Appendix-10(Pg 102-109), for wide circulation for a period of 30 days. Draft for revision of IS 2062 is being sent for wide circulation. Further, during subcommittee meetingheld on 11 April 2023, Shri G V Ramana was requested to submit proposal for coming up with Q&T structural steel, which is intended to be covered under a new standard IS 2062 Part 2.		
8	Amendment to IS 10748: 2004 *Hot Rolled Steel Strip for Welded Tubes And Pipes*	Modifications are proposed in Section 3 (Clause 3.1), Section 7 - Table 1 (clause 7.1), Sections 8 & 9 - Table 3 (Clauses 8.3 and 9.2.4) Presently, the hot rolled steel composition does not have any provision for addressing fire resistant properties. Inherent fire resistant properties in steel structures can be attained by adding micro-alloying element like Mo and Cr in combination with other elements like Ti, V, Nb. The last three elements are already mentioned in Clause 3.1. Therefore the following modifications are being proposed: 3.1 Micro-Alloying Elements (Page No. 1) Elements, such as niobium, vanadium, titanium, molybdenum and chromium added singly or in combination to obtain higher strength levels combined with better formbility, weldability, toughness and fire resistant property as compared with non-alloyed steel produced to equivalent strength levels.Table 1	Committee noted the status and requested Member secretary to obtain the desired clarification from the proposer.	Clarification is awaited from the proposer. **Committee may please note.**

		Inclusion of point No 6 in the notes against Table 1: "For fire resistant property requirement, Mo in combination with other micro alloying element Ti, Nb, V, Cr, B, Cu, W may be added up to 0.25 %" During the last meeting of the committee comments received from JSW were discussed and after deliberation the committee requested Tata Steel to submit the following clarifications 1. The reason for inclusion of this grade in IS 10748 when there is a separate standard IS 15103 for fire resistant steel . 2.As per JSW comment the validation data submitted now and submitted during previous meeting held in Jan 2018 of MTD 4.36 S.No 25 in Annex2 in which attachment AnnexII have some differences in chemical composition (Mn, Si, Mo & Cr for Trial1 & Trial2) needs to be understood. 1. The data submits very narrow range of validation. 2. Whether the grade proposed is fire resistant or it can be termed as heat resistant. 3. In case the grade is included in the standard, how will Tata Steel handle its patent. Tata steel was requested to send their reply on above issues to BIS. Following reply was received from Tata steel: '1. The chemistry against Trial heat (V44627/55600642) sent to BIS on Sep 13 2017 was a mistake from our side. It was for another trial heat (V27351/Coil ID 37530401), which was not up to our full satisfaction. The document sent on Jan 11 2018 along with chemistry, mechanical properties and fire resistance properties are correct and validated by an independent accredited NABL lab. 2.Regarding patent, Dr Sanjay Chandra, Chief R&D and Scientific Services Tata Steel, has already sent		

		you an email communication on April 27 2018.' The letter mentioned above is attached below:  BIS.pdf The committee noted the information and after detailed deliberation decided that 'Fire Resistance' term is already covered in IS 15103 so including a grade with similar terminology in IS 10748 would be misleading. Also, the grade for which inclusion is being proposed by Tata steel do not meet the requirements specified in scope of IS 15103 and so the proposed cannot be termed as fire resistant grade or cannot be included in IS 15103. Tata steel submitted a changed nomenclature for the grade as 'Elevated temperature application'. The committee agreed to form a new standard for elevated temperature application once requisite approvals are received from BIS as it a patented grade. Member Secretary apprised the committee about procedures involving reference to the patented items in developing a standard, as mentioned below: *a) BIS cannot give authoritative or comprehensive information about evidence,* *validity and scope of patent and like rights but it is desirable that the fullest available information be disclosed. Therefore the originator of a proposal of such a kind shall draw the technical committee's attention to any known patent and like rights on a worldwide basis or any known pending applications, although BIS is not in a position to guarantee the authority of any such information.* *b) If the proposal is accepted on technical grounds, the originator shall ask any known* *patent holder for a statement that he would be willing to negotiate licences under patent and like rights with applicants throughout the world on reasonable terms and conditions. A record of patent holder's statement shall be*		

		placed in the relevant technical file and shall be referred to in the standard. If the patent holder does not provide such a statement, the technical committee shall not proceed with the inclusion. of the patented item unless the respective division council gives permission. *c) Should it be revealed after publication of the standard that licences under a patent and like rights cannot be obtained under reasonable terms and conditions, the standard shall be referred back to the technical committee for further consideration* As the current template of BIS for submitting new proposal, captures all provisions including reference to patents, the Committee suggested the Proposer (M/s Tata Steel Ltd) to submit the proposal for developing new standard on ***Steel for Elevated temperature application*** through BIS portal. Further, the sub-committee was advised to examine the proposal subsequently and send its recommendation to the Committee in due course. Subcommittee Chairman Sh. Avatar Singh volunteered to help member secretary in referring the matter to concerned department/unit of M/s TATA steel ltd. The committee noted the status shared by Member Secretary. Committee noted the status and requested the Member Secretary to expedite action on obtaining the clarification. Clarification is awaited from the proposer.		
9	IS 10748: 2004- Hot Rolled Steel Strip For Welded Tubes And Pipes	During the last meeting comments received from JSW on the proposal fpr amendment in IS 10748 received from Mr B B Prasad of Tata steel were discussed and after deliberation the committee agreed to the comments made. It was decided that Mr B B Prasad shall draft an amendment to IS 10748 based on the agreed comments. The draft amendment shall then be circulated within MTD4 and MTD 19 committee member for 21 days and incase no comments are	Committee noted the status that convenor of Panel 7 Sought 45 days time from 30 April 2023 to submit the report. Further, the Committee advised the Panel Convenor to hold a physical	Report provided by the panel on account of its meeting held on 09 June 2023 is given at **Appendix-3**. During the meeting held on 28 July 2023, Subcommittee requested the Convenor of Panel 7 to expedite action and submit the desired draft standard, as mentioned in the report, within 60 days from the date

		received , the same shall be sent for wide circulation for one month. Draft amendment received from Mr B B Prasad is given below  Amendment to IS10748.2017-R2.do The committee discussed the draft amendment and after deliberation decided to circulate the amendment among committee members of MTD 4 and MTD 19 for 21 days and if no comments are received send the draft amendment for wide circulation for one month. The committee took note of the status and requested Member Secretary to take action. Subcommittee examined the matter and requested Panel 7 to submit their report by 20 June 2022 The Committee noted the status and requested Convenor of Panel 7 to submit their report within 15 days from the date of finalization of the minutes. Comments were received from AM/NS. Panel 11 is requested to dispose them off and submit the modified amendment. Panel Convenor was requested to submit the report by 30 Nov 2022. Report is awaited from Panel 7. Panel Convenor was requested to submit the report within 15 days from the date of finalization of the minutes. Committee noted the status and requested the panel convenor to expedite action on submitting the	meeting in the Month of May 2023 and finalize the pending action(s) on priority.	of finalization of the minutes. **Committee may please note**

		report. Report is awaited from Panel 7.		
10	Harmonization of Indian Standard with ISO standards	The Committee noted the status and advised Sub-Committee reconstitute the Panel -17 by substituting the retired or moved away personnel by the existing personnel representing the same organization in MTD 4. Further, the Sub-Committee to submit its recommendation to the Committee in due course. The matter has been referred to panel 7 with a request submit report to the subcommittee by 30th June 2022.	Committee advised the Convenor of Panel 7 to hold a physical meeting in the Month of May 2023 and finalize the pending action(s) on priority.	Report provided by the panel on account of its meeting held on 09 June 2023 is given at **Appendix-3.** **Committee may please examine and decide.**

		The Committee noted the status and requested Convenor of Panel 7 to submit their report within 15 days from the date of finalization of the minutes. Report is awaited. Panel Convenor was requested to submit the report by 30 Nov 2022. Committee noted the status and requested the panel convenor to expedite action on submitting the report. Report is awaited from Panel 7.		
11	Documents sent for printing			Following documents were sent for printing: **MTD 4 22895** **MTD 4 22896** Committee may please note.
12	Documents sent for wide circulation			**New:** **MTD 4 23033** *Hot-Dip Zinc- Aluminium-Magnesium Alloy Coated Steel Sheets Plates and Strips* **Revisions:** **MTD 4 23040** *Steel Plates And Strips For Pressure Vessels Used At Moderate And Low Temperature* **MTD 4 22804** *Hot Dip Aluminium-Zinc Alloy Metallic Coated Steel Strip And Sheet* **MTD 4 23086** *Steel Plate For Pressure Vessel For Intermediate And High Temperature Service Including Boilers* **MTD 4 22863** *Pre-Painted Aluminium Zinc Alloy Metallic Coated Steel Strip and Sheet (Plain)* **MTD 4 22826** *Pre-Painted Aluminium Zinc Alloy Metallic Coated Steel Strip And Sheet* Comments were received from for all the above documents.

				Report is awaited for all the documents with exception for MTD 4 23086, MTD 4 23040. **Committee may please note and may decide on report on comments received for** MTD **4 23086, MTD 4 23040, given at Appendix-5(Pg 80-81).** **<u>Amendment:</u>** **MTD 4 11513** *Cold Reduced Carbon Steel Sheet and Strip Part 2 High Tensile and Multi-phase Steel Amendment* **MTD 4 13189** *Cold Reduced Carbon Steel Sheet and Strip Part 1 Cold Forming and Drawing Purposes* As no comments received, we may send the documents for printing. **Committee may please decide**
13	Comments on IS 1993	subcommittee noted that comments in IS 1993 were collated and shared with ISO TC 17 SC 9 for further action	Committee noted that comments in IS 1993 were collated and shared with ISO TC 17 SC 9 for further action	Comments were taken up with ISO TC 17 SC 9 during its 28th meeting held on 06-07 Sep 2023. Report was shared with members through email on11 Sep 2023 **Committee may please note.**
14	Comments on IS 648:2022	M/s Posco Maharashtra Ltd was requested to submit draft amendment for IS 648:20222 for inclusion of the grade 35PN440	Committee noted the status.	Draft amendment received from Panel 2 is being examined. **Committee may please note.**
15	Comments on IS 3024	Request was received from ITMA for inclusion of 0.20mm thickness. Matter was referred to Panel 2	NA	Draft amendment received from Panel 2 is being examined. **Committee may please note.**

Sl. No (1)	Subject (2)	Decision taken in past meetings (3)	Decision taken by the Committee during the last meeting (4)	Action taken on the decision of the committee/subcommittee during last meeting (5)	Decision taken by the Subcommittee during the current meeting (6)
16	Revision of IS 1875:1992 *Carbon Steel Billets, Blooms, Slabs and Bars forForgings*	The following panel was formed for revision of IS 1875 1. Mr D. Karmarkar SAIL – Convenor 2. Mr Sanjay Roy, RINL - Member 3. Mr Devashish Mishra, JSW – Member 4. Mr P.K. Biswal, Kalyani Carpenter Special Steel Ltd, Pune – Member 5. Mr Dinesh Singh, Vardhman Steel – Member 6. Dr M Krishnamurthy, CQA(metals) –Member 7. Member from DSP During the last meeting the comments received from Vardhman steel were discussed and agreed. Based on the comments and the discussion heldin the meeting, it was decided to revise draft of IS 1875 and Mr Karmarkar was requested to send the revised draft to BIS. Therevised draft thus received was to be sent for wide circulation for onemonth. The committee noted the information and requested the panel again to send the revised draft to BIS by 30 April 2019 and the document thus received shall be sent for wide circulation for one month. Comments on the draft were circulated to Panel Conveneron 25 June	Committee agreed to send the document for wide circulation. However, it advised Member Secretary to obtain consent from members of MTD 16 on the proposal for wide circulation.	The draft was shared with members of MTD 16 during its 25th meeting held on 11 May 2023. It is informed that no comments were received from members of However, Panel Convenor Sh Saikat De, who was also a member of MTD 16, informed the members that the draft presently was devoid of the grades mentioned in the standards IS 5517(Q&T), IS 4432(case hardening) and IS 3930(Flame and Induction hardening). Accordingly, the Subcommittee agreed to incorporate them and requested Sh Saikat De to provide the draft within two days so that the same could be circulated as Addendum to the minutes. Draft received from Sh Saikat De is being examined. **Committee may please note.**	

		2021. Modified draft was awaited. Member Secretary informed the committee about co - existence of the grades of IS 1875 in IS 13352, an Indian Standard covering steel produced through continuous casting route. The Committee noted the observations andadvised Panel -4 to submit the modified draft to the Sub - Committee within one month.Also, the Sub - Committee was advised by the Committee to reconstitute the panel by getting revised nominations from SAIL - RDCIS and by also inducting SAIL –ISP (Sh SK De). The subcommittee during its meeting held on 28 June2022 deliberated on the need for having IS 1875 and agreed that thestandard should continue to serve steel stock for forging quality produced through ingot route. Accordingly, it reconstituted the panel 4 and requestedthem to share P-draft within **three months** for reviewing both IS 1875 and IS 13352.Composition of reconstituted panel 4 was mentioned below: 1. SAIL RDCIS, Sh S K Jha, convenor 2 Saarloha Steels Ltd, 3. JSW, Salem 4. Tata Steel Long products, DrT Bhaskar 5. Bharat forge 6. CHW forge 7.Forging Manufacturers association			

		8. L&T 9. Mukand Sumi Steels Ltd The Committee noted the status and recommended tohave Sh S K De (SAIL-ISP) as convenor of Panel 4 replacing Sh S K Jha SAIL-RDCIS. Also, it requested the panel on reviewing the proposal of having individual standards on Steels for forging stock both for continuous casting and ingot route respectively. Report awaited from Panel 4. Convenor of Panel 4 was requested to expedite actionand share the report within 45 days from the date of finalization of the minutes. Nominations were obtained from AIFI. Nominations were still awaited from saarloha, CHW forgeand L&T. Further, meeting of Panel 4 was held on 02 March 2023. On the basis of panel report (**Appendix-1, pg 48**) and the draft (**Appendix-2, pg 49-66**), subcommittee recommended for sending the draft document for wide circulation.		

17	Amendment No.2 to IS 280:2006 *Mild SteelWire for General Engineering Purposes*	The committee after deliberation decided that MTD 24 may be requested to consider revision of IS 4826 based on ISO 7989 on priority , since IS 280 is proposed to come under Mandatory certification . The committee also decided the following two members may also be allowed to participate in MTD 24 meeting when revision of IS 4826 is discussed . Mr Nirmal Saraf - SWMAI Mr Shishir Desai – Tata steel Wires division. The committee noted the information. Revised draft for revision of IS 280 was tabled by Shri Shishir Desai andis placed at Appendix 15. The committee deliberated over the document and decided to send the document for wide circulation for one month. This issue was discussed in the meeting of MTD 24 and the committee after deliberation decided that since IS 4826 is cross referred in 18 Indian	Committee noted the status and requested the member secretary to send the document for wide circulation for 30 days within 30 days from the date of finalization of the minutes.	Draft document is being sent for wide circulation for 30 days. **Committee may please note.**	

		Standards it would not be appropriate to make any changes in the same. The committee suggested that the changes may be incorporated in the product standard i.e, IS 280 if agreed by MTD 4 committee. The committee noted the status and requested membersecretary to circulate the P-draft to its members as well alongside members of MTD 4:2. As only one clause was being modified through the proposed revision, it was put forward by Shri Shishir Desai to consider amendment instead of revision. Draft amendment has been prepared considering the above and comments received from CMD-II raising concern on coating requirements for galvanized wire of sizes under 0.2 mm and over 10mm. Draft amendment received from Shr Shishir Desai on 3rd April 2020 is placed at **Appendix-12(Pg 157158)**. Further, the Committee advised Sub-Committee to decide on the matter. The subcommittee examined the comments of MTD and agreed that there was need to specify coating requirements for			

		electrogalvanized wires as well. Further, the members were informed about technological developments in production of EG wires upto 300gsm, at par with HDG wires. Accordingly, the members agreed to modify cl 11 of draftamendment so that requirements reproduced from IS 4826 holds applicable to zinc coating wires regardless of them being HDG or EG. Member secretary was requested to modify theamendment and do P-circulation among member within 21 days from the date of finalization of the minutes. Draft amendment was shared as addendum to the agenda. During the meeting, Sh Shishir Desai expressed that the draft amendment circulated as an addendum to the agenda comprised of requirements as per IS 4826, which were obsolete, instead of the desired requirements prevalent in the industry, which were as per ISO 7989-2. Also, it was informed to the members that the draft amendment circulated during Dec 2020 was comprising of requirements as per ISO 7989-2.			

		The subcommittee examined the requirements and recommended to send the modified draft amendment for wide circulation with prior approval of MTD4. Subcommittee was informed that the Draft amendment was being sent for wide circulation.			
18	Comments received against IS 9550	The subcommittee examined the comments received on IS 9550 from various organizations. It decided to refer the matter to panel constituted at Item 4.3 above with a request to dispose of the comments within 3 months. Report awaited. Subcommittee noted the status and requested the panel convenor to submit the report within 45 days from the date of finalization ofthe minutes.	Committee noted the status and requested the panel convenor to expedite action.	Panel 28 held its meeting on 07 July 2023. Report of the panel was shared with subcommittee during its meeting held on 14 July 2023. Subcommittee deliberated on the draft standard. The resultant draft incorporating the change is given at **Appendix-6.**	
19	Revision of IS 7283	Report of panel on Action research report received for IS 7283:1992 along with draft standard**, Annex-III**(Pg 36-57) , wasdiscussed by the subcommittee along with the proposal put forward by Member Secretary to withdraw IS 7283 for avoiding duplicity of grades, stating that the grades of bars were covered under various standards such as IS 2062, IS 4432, IS 5517 etc. Subcommittee agreed to review the draft standard and above proposal and to send their views indue course	Committee noted the status.	Subcommittee during its meeting held on 14 July 2023, agreed to set this task aside till sucha time as the basis would be dependent on outcome on revisionof IS 5517, IS 4431 and IS 4432.	

From: Kapoor, Kapil
Sent: Wednesday, August 23, 2023 18:53
To: MTD FOUR Metallurgical Engineering Department <mtd4@bis.gov.in>; kapil1671 <kapil1671@gmail.com>
Cc: thukaram <thukaram.k@hitachimetals.co.in>; Kishore kumar G <kishorekumar@cpri.in>; manojkumarg <manojkumarg@powergrid.in>; devasish mishra <devasish.mishra@jsw.in>; Deepak Gupta <Deepak.Gupta@amns.in>; pabitra palai <pabitra.palai@tatasteel.com>; BISWAJIT SARKAR <bsarkar1250@sail.in>; vivek mahajan <vivek.mahajan@posco.net>; paramjeet.singh@gov.in
Subject: RE: Copy of IS 18316:2023 Hot-Rolled and Cold-Rolled Steel Strips Intended for Processing of Semi/Fully Processed Non-Grain Oriented Electrical Steel or Fully Processed Grain Oriented Electrical Steel — Specification

Dear All

With respect to the above standard , the standard has mixed 3 items into one standard

1. Specification for HRNO
2. Specification for HRGO
3. Specification for Cold rolled of CRNO / CRGO which cannot be tested for magnetic parameters

With respect to the above the original idea was to promote a standard for HRNO.

IS 18316 does cover the requirements of HRNO but for HRGO it does not cover all the varieties and compositions and other requirements. Hence it would be prudent to keep this standard only for HRNO and remove the other topics.

With respect to point number 3 – Basis is not clear like what kind of documentary trail that needs to be established , which width , which length neds to be addressed , does it allow all losses to be covered based on only dimension and composition. – Would it not lead to material specification getting diluted

Looking into the above would recommend to hold the standard for any further process and would prepare the modified standard and submit to MTD 4.

To our best understanding standards are required for finished products to have a particular quality. Hot Rolled coil standards are made as some applications used Hot Rolled coils as their input material for their Industry. In Case of HRGO this is not a finished product but an intermediatory product and it cannot be used in any application other than putting it into the process route of producing CRGO due to its extreme characteristics of chemistry, mechanical

properties etc as well as commercially probably not viable for direct application. We already have a standard of CRGO existing.

So IS 18316 should be renamed only for HRNO as technically as well objectively too it does not cover HRGO .

Further comments as shared are being examined and would revert after panel discussion

Kind Regards

Kapil Kapoor
General Manager
Quality Control & Management / Planning & Control /Technical Customer Service
SE-ES/QCM-QM

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For Comments Only **Doc:MTD 04(12171)**

BUREAU OF INDIAN STANDARDS

Draft AMENDMENT

TO

IS 18316 : Hot-Rolled and Cold-Rolled Steel Strips Intended for Processing of Semi/Fully Processed Non-Grain Oriented Electrical Steel or Fully Processed Grain Oriented Electrical Steel — Specification

---

(Title) **— Delete the text**

Delete applicable for Fully Processed Grain Oriented Electrical Steel

Justification

Standard does not cover Specification for Grain oriented. Chemistry and grades as defined in the table 2 are applicable only for HRNO and Not applicable for HRGO

For Comments Only **Doc: MTD 4(13289)**

BUREAU OF INDIAN STANDARDS

Indian Standard

SPECIFICATION FOR WEAR AND ABRASION RESISTANT STEEL SHEETS AND PLATES

ICS 77.140.50

Last date for receipt of comments is 28 12 2018

FOREWORD

(*Formal clauses will be added later*)

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1 SCOPE

This standard covers the requirements for wear and abrasion resistant steel and plates in Quenched (Q) or Quenched and Tempered (Q&T) condition.

2. REFERENCES

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

IS No.	*Title*
IS 228 (in various parts)	Methods for chemical analysis of Steel
IS 1599 : 2012	Metallic materials- Bend test (third revision)
IS 1956 (Part I)	Glossary of terms relating to iron and steel (General metallurgy, heat treatment and testing)
IS 1956 (Part IV)	Glossary of terms relating to iron and steel (Steel sheet and strip)
IS 1608 (Part 1) : 2018/ ISO 6892-1 : 2016	Metallic Materials – Tensile Testing Part 1 Method of Test at Room Temperature (fourth revision)
IS 1730 : 1989	Steel plates, sheets, strips and flats for structural and general engineering Purposes - Dimensions (second edition)
IS 1852 : 1985	Specification for Rolling and cutting tolerances for hot-rolled steel products (fourth edition)
IS 1757 (Part 1) :2014/ ISO 148-1 :2009	Metallic materials – Charpy Pendulum Impact Test Part 1 Test Method (third revision)
IS 4225:2004	Recommended practice for straight beam ultrasonic testing of steel plates
IS 8910 : 2010/ ISO 404 :1992	General technical delivery requirements for steel and steel products (first revision)
IS 1500 (Part 1) :2013/ IS0 6506-1 : 2005	Metallic Materials - Brinell hardness test Part 1 Test method

3. SUPPLY OF MATERIAL

3.1 General requirements for the supply of material shall be as laid down in IS 8910.

3.2 Steel shall be supplied in the form of sheets or plates in mill edge or cut / trimmed edge condition.

3.3 The products shall be supplied in Quenched (Q) or Quenched and Tempered (Q&T) conditions.

4 TERMINOLOGY

4.1 Quenching

The process of quenching or quench hardening involves heating the steel above the upper critical temperature, soaking for sufficient time so as to attain a uniform temperature through the thickness and then rapidly cooling the steel in water / oil / forced air / other media (Quenching) to increase the hardness of steel significantly.

4.2 Tempering

Heating to elevated temperature but below transformation zone, of hardened steel and holding for specified time at temperature followed by cooling at desired rate to develop desired mechanical properties in these steel.

4.3

Wear and Abrasion Resistant Steels

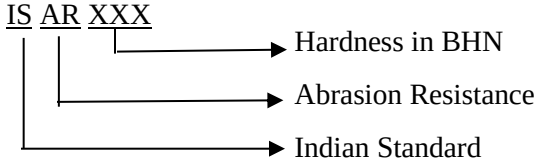
These are steels with higher hardness than conventional steels such that the sheets and plates of this steel resist surface wear and abrasion due to rubbing or friction during use.

5 DESIGNATION AND GRADES

There are five different grades of steel based on hardness levels as given below in Table 1.

Table 1 Designation and Grades

S. No.	Grade	Hardness in BHN	Designation (Quality)
1	ISAR 400	360-430	The number in front of the grade gives the indication of hardness level of steel plates in Brinell Hardness Number (BHN)
2	ISAR 450	410-490	
3	ISAR 500	450-550	
4	ISAR 550	500-580	
5	ISAR 600	550-650	



6 MANUFACTURE

6.1 The steel shall be manufactured by any process of steel making with secondary refining at the discretion of the manufacturer. The steel may be processed through vacuum degassing if agreed between the manufacturer and purchaser at the time of order.

6.2 Steel sheets and plates may be supplied in following heat treated conditions:

a) Quenched (Q)
b) Quenched and Tempered condition (Q&T)

The supply condition may be agreed between the manufacturer and purchaser at the time of order.

7 CHEMICAL COMPOSITION

7.1 Ladle Analysis

Ladle analysis of the material when carried out either by the method specified in the relevant part of IS 228 or any other established instrumental/ chemical method shall be as given in Table 2. In case of dispute, the procedure given in the relevant part of IS 228 shall be the referee method.
The Heat shall be certified based on ladle analysis. Table 3 gives the recommended values for carbon equivalent for each grade of steel.

Table 2 Chemical Composition

Steel Grade	Constituent, *Percent , Max*								
	C	Mn	Si	P	S	Cr	Mo	Ni	B
ISAR 400	0.30	1.60	0.70	0.025	0.010	1.80	0.50	1.20	0.0050
ISAR 450	0.32	1.60	0.70	0.025	0.010	1.80	0.50	1.20	0.0050
ISAR 500	0.35	1.80	0.80	0.025	0.010	2.00	0.60	1.50	0.0050
ISAR 550	0.37	1.80	0.80	0.025	0.010	2.00	0.60	1.50	0.0050
ISAR 600	0.47	1.80	0.80	0.025	0.010	2.00	0.60	1.50	0.0050

Table 3: Recommended Carbon Equivalent Limits for Different Grades

Steel Grade	Carbon Equivalent (in wt% max) Corresponding to Plate Thickness in mm Range							
	>3.00-<8.00	≥8.00-<20.00	≥20.00-<40.00	≥40.00-<50.00	≥50.00-<60.00	≥60.00-<80.00	≥80.00-<100.00	≥100.00-≤130.00
ISAR 400	0.41	0.55	0.55	0.60	0.65	0.70	0.80	0.85
ISAR 450	0.47	0.55	0.60	0.65	0.70	0.75	0.85	0.90
ISAR 500	0.50	0.65	0.70	0.75	0.80	0.85	0.85	-
ISAR 550	-	0.70	0.75	0.80	0.85	0.90	-	-
ISAR 600	-	0.70	0.75	0.85	0.85	0.90	-	-

NOTES

1 Grain refining elements such as Al, Nb, V and Ti may be added singly or in combination. Total grain refining elements shall not be more than 0.25 percent.
2. Elements other than those given in the above table may be added if agreed between the manufacturer and supplier
2. Restricted chemical composition may be mutually agreed between the purchaser and the supplier
3. Nitrogen content of steel shall not exceed 0.012 percent.
4. Carbon Equivalent (CE) based on ladle analysis = C+Mn/6+(Cr+V+Mo)/5+(Cu+Ni)/15
5. Thickness above 130 mm may be supplied if mutually agreed between the manufacturer and purchaser.
6. Carbon Equivalent (CE) for thickness above 130 mm may be mutually agreed between the manufacturer and purchaser

8 MECHANICAL PROPERTIES

Except Hardness Test, Mechanical testing like Tensile, Bend and Impact tests for Wear and Abrasion Resistance Steels are not mandatory for this standard. However, if required, these tests and their values may be mutually agreed between the manufacturer and purchaser at the time of order.

For reference, the representative values for tensile, Bend and Impact test for 20 mm thickness are given in table 5, 6 and 7 respectively.

8.1 Hardness Test

1. Surface hardness test to be conducted on sample drawn from the heat treated sheet / plate. The ranges of hardness values for different grades are mentioned in Table 4 given below:
2. For plates from plate mill, one test sample shall be taken from corner of each plate as rolled. For Sheets/plates produced from coil, three samples from each coil (Head end, Middle and Tail end) shall be taken.

Table 4. Hardness in BHN

Steel Grade	Hardness (BHN)
ISAR 400	360-430
ISAR 450	410-490
ISAR 500	450-550
ISAR 550	500-580
ISAR 600	550-650

NOTES

1 Surface Hardness testing shall be carried out as per IS 1500 Part 1 (2013)
2 Hardness testing to be done after removing a surface layer by milling or grinding as per given in below table

Sheet/ plate Thickness range (mm)	Depth of Grinding (mm)
Up to 10.0	0.50
>10.0 - 25.0	1.00
>25.0 - 50.0	1.50
>50.0 - 80.0	2.00
>80.0	3.00

3 Minimum core hardness shall be 90% of the guaranteed minimum surface hardness.

8.2 Tensile Test

Table 5 gives the indicative tensile test values for 20mm thickness plate for specified grades.

Table 5. Indicative Tensile Strength for 20mm Thickness Plate

Steel Grade	Yield Strength (in MPa)	Tensile Strength (in MPa)	%Elongation (GL: $5.65\sqrt{So}$)
ISAR 400	~~900-1100~~ 900 min	~~1250~~ 1150 min	8.0 min
ISAR 450	~~1000-1200~~ 1000 min	~~1400~~ 1300 min	8.0 min
ISAR 500	~~1250-1400~~ 1200 min	~~1550~~ 1400 min	6.0 min
ISAR 550	~~1400-1650~~ -------	~~1700 min~~ -------	~~6.0 min~~ -------
ISAR 600	~~1600-1800~~ -------	~~1750 min~~ -------	- ---------

NOTE

1. Tensile test should be conducted as per IS 1608 (Part 1).

8.3 Bend Test

Table 6 gives the indicative bend test radii for 20mm thickness plate for specified grades.

Table 6. Bend Angle and Internal Bend Radius for 20 mm Thick Plate

Steel Grade	Bend Radius (Bend angle: 90º)	
	Sample Orientation Transverse to Rolling Direction	Sample Orientation Longitudinal to Rolling Direction
ISAR 400	3.0 x thickness	4.0 x thickness
ISAR 450	4.0 x thickness	5.0 x thickness
ISAR 500	5.0 x thickness	6.0 x thickness
ISAR 550	-	-
ISAR 600	-	-

NOTES

1. Bend test shall be carried out in accordance with IS 1599.
2. The test piece shall be bend at ambient room temperature through 90º.

8.4 Charpy V-notch Impact Test

Table 7 gives the indicative charpy impact values for 20mm thickness plate for specified grades.

Table 7. Indicative Charpy Impact Values for 20mm Plate Thickness

Steel Grade	Average Charpy Impact energy (Joules)	
	Test Temperature -20ºC	Test Temperature -40ºC
ISAR 400	27 min	20 min
ISAR 450	27 min	15 min
ISAR 500	27 min	15 min
ISAR 550	-	-
ISAR 600	-	-

NOTES

1. Impact test shall be carried out in accordance with IS 1757 (Part 1).
2. The sample orientation is longitudinal to rolling direction.

9 NON DESTRICTIVE TEST

The material may be subjected to non-destructive testing to determine the internal soundness of material subject to mutual agreement between the manufacturer/supplier and purchaser at the time of order.

10 RETEST:

10.1 If a test does not give the specified results, two additional tests shall be carried out from same plate as rolled / sheets-plates from coil. Both the retests shall conform to the requirements of the standard

10.2 If any of the retest fails to meet the mechanical requirements specified, the supplier may re-heat treat the material and in that case, all the mechanical properties shall be re-evaluated.

11 FREEDOM FROM DEFECTS

11.1 Sheets and Plates shall be well and cleanly rolled to the dimensions specified. The finished material shall be reasonably free from surface flaws, laminations, rough/jagged and imperfect edges and other harmful defects.

11.2 Minor surface defects may be removed by the manufacturer by grinding provided that the thickness of the sheet /plate shall not go below the thickness tolerance specified at the spot where dressing is done. The grinding shall be even and smooth and shall be widened enough to remove sharp ridges.

11.3 Repair welding of defective spots shall not be permitted.

12 DIMENSIONS AND TOLERANCES

Unless otherwise agreed to between the purchaser and the manufacturer, the rolling and cutting tolerances for steel products conforming to this standard shall be as per IS 1852.

13 MARKING

Each plate as rolled shall to be marked with manufacturer's name, designation of steel and details like plate no., cast/ heat number and nominal dimensions.

Sheets/plates produced from strip or coil form shall be supplied in bundles. Each bundle shall carry a metal tag or adhesive label/sticker bearing the cast/heat number or identification mark or lot number traceable to the cast/heat number and the manufacturer's name or trade mark. Alternatively, top sheet/plate shall be legibly marked with cast/heat number or identification mark or lot number traceable to the cast/heat number, name of the manufacturer or trade-mark.

14 DELIVERY

The plates may be supplied in as heat treated condition or shot blasted and primer coated condition. The technical requirement of the surface coating shall be mutually agreed between manufacture and purchaser at time of order.

15 BIS CERTIFICATION MARKING

15.1 BIS Certification Marking

The material may also be marked with the Standard Mark.

15.1.1 The products(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the BIS Act, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

16. ORDERING INFORMATION

While placing the order, the following are the minimum information to be specified by the purchaser:

a) Grade;
b) Size;
c) Mass of the material;
d) Total order quantity;
e) Marking instruction other than specified, if any;
f) Restricted chemistry and/or properties, if used for special purpose;
g) Dimension tolerance, if any special agreements to be made; and
h) Supply condition (edge condition, delivery condition and type of surface coating if any, etc.)

Appendix-3

Sl. No	Subject	Decision taken in past meetings	Action taken on the decision of the committee/subcommittee during last meeting	Decision taken by the Committee during the current meeting	Decision taken by the Panel during the current meeting
(1)	(2)	(3)	(4)	(5)	(6)
1	Revision of IS 11587:1986 Structural weather resistant steels	A Panel 19 consisting of following members was formed for revision of IS 11587:1986 Structural weather resistant steels 1. Mr Jayanta K Saha - INSDAG – Convenor 2. Mr Deepak Gupta – Essar Steel 3. Mr A Dagupta – SAIL, RSP 4. Mr Avtar Singh – Tata Steel 5. Mr Devasish Mishra, JSW, Bellary 6. Mr M Borkar – JSPL 7. Representative from RDSO During the last meeting committee requested the panel to provide the revised draft based on comments received and agreed by committee by incorporating above proposed changes to BIS. The revised draft was then to be sent for wide circulation for one month. The draft placed at **Appendix 12** is being prepared for wide circulation. Committee noted the information. Comments on the working draft was shared with panel convener on 25th June 2021 and placed at Appendix-9. Revised draft was awaited. Convener of Panel-19, Dr Jayanta Saha, briefed the committee about the status of the revision (Appendix-9).	Report is awaited from Panel 7. Also, nominations to be obtained from IR class and RDSO. During the meeting of subcommittee held on 11 April 2023, on behalf on Panel convenor of Panel 7, Shri G V Ramana Sought 45 days time to submit the report.	Committee noted the status that convenor of Panel 7 Sought 45 days time from 30 April 2023 to submit the report. Further, the Committee advised the Panel Convenor to hold a physical meeting in the Month of May 2023 and finalize the pending action(s) on priority.	Panel reviewed standards existing on the subject namely IS 11587, A423,A588, A606,A709,ISO 630-5, JIS G 3125, EN 10025-5&IRSM 41 and recommended 21 grades as given at **Appendix-1.**

		The Committee noted the status and requested Panel Convener to submit the modified draft to the Sub Committee within One Month. Subcommittee requested the Panel Convenor to submit the P-Draft by 20th June 2022. The committee noted the status briefed by Sh G V Ramana (representing Panel Convenor Sh Devashish Mishra, JSW) and informed that comments of MTD were duly addressed in the final draft, which were observed to be in review mode capturing the comments of MTD and reply of panel convenor. However, the draft was devoid of desired panel draft and consolidated comments from panel members which were duly addressed in shaping the final draft for revision. Head MTD clarified to the Panel convenor that it was desirous of having a report from panel convenor incorporating references of national/ international standards for the changes suggested for revision of the standard and should also be including the decision of the panel along with the changes therein against all the comments received from members of panel. The committee requested the convenor of panel 7 to submit the report within **07 days** from the date of finalization of the minutes. Also, it requested Member Secretary to circulate the P-draft on receipt of it from Panel Convenor, to members of both MTD			

		4 and MTD 4:3, giving a time period of 21 days for inviting comments. Amendment No. 1 to IS 11587:1986 was issued in August 2022, on account of 41st meeting of MTD 4 held on 28 July 2022, for catering the need of container manufacturers. The grade SPA-H and SPA-C(JIS G 3125) were incorporated in the standard through the amendment. Report is awaited from Panel 7. Subcommittee requested the Panel Convenor to submit its report by 30 Nov 2022. Committee noted the status and requested the Panel Convenor Sh Devasish Mishra to submit the report within 30 days from the date of finalization of the minutes.			
2	IS 2062:2011 *Hot Rolled Medium and High Tensile Structural Steel*	In the 32nd meeting, comments received from Mr P.K.Patra, JSW Steel limited were considered and after deliberation the committee decided that some more study is required before permitting higher level of nitrogen in IS 2062:2011. The committee requested Mr P.K.Patra to undertake the study and get the high nitrogen level steel samples tested in WRI,BHEL, Trichy and welding laboratory of Tata Steel and present the findings in the next meeting. Comments received from JSW and TATA Steel were discussed and after deliberatioin the committee decided not to increase the permissible nitrogen content without testing as decided in last meeting. The comments of JSW wereagreed. The amendment was	Draft for revision of IS 2062 is being sent for wide circulation. Further, during subcommittee meeting held on 11 April 2023, Shri G V Ramana was requested to submit proposal for coming up with Q&T structural steel, which is intended to be covered under a	Committee noted the status and requested the Member Secretary to send the document for WC for 30 days within 15 days from the date of finalization of the minutes. Further, the Committee advised the Convenor of Panel 7 to hold a physical meeting in the Month of May 2023 and finalize the pending action(s) on priority.	Panel recommended to have two standards on the subject with part 1 catering HR steels and Part 2 catering Q&T steels. Further, it agreed to draft part 2 on the lines of ISO 630-4 and EN 10025-Part 6. **Sh G V Ramana(JSW) sought 45 days time to submit the draft on the basis of above recommendation.**

		discussed and after deliberation and as pointed by Power Grid, the committee did not find any justification for increasing the chemical composition limits and decreasing the elongation values of existing grades. The committee thus decided to remove this from the proposed amendment. JSW informed that they shall provide justificaition for the same. During the last meeting justification received from JSW for amendment was discussed and after deliberation the committee agreed to the justification provided. The committee also discussed the comments received from DSP and the following decision was taken for the comments made Point 1 & 2 was not agreed by the committee since there is no change in carbon equivalent. Point 3 was agreed by the committee and it was decided that in the amendment it will be mentioned that the elongation was for transverse/longitudinal direction. It was decided to circulate the revised amendment among the committee members for 21 days and incase no comments are received the same was to be sent for wide circulation for one month. The draft amendment was revised as per the comments received and agreed to by the committee and sent for circulation among the members of the committee on 14/10/2018. Following comments were received from Tata steel:	new standard IS 2062 Part 2.		

		 Draft Amendment to IS 2062 tata steel.do The comment received was discussed and committee after deliberation and reviewing the draft amendment decided to modify the amendment. The committee requested the member secretary to circulate the modified amendment placed at **Appendix 8** among members for 14 days. In case no comments are received the modified amendment will be sent for wide circulation for one month. The committee also deliberated and decided to include Quenched and Tempered grades for higher strength material for structural use. It requested the panel revising IS 2062 to consider incorporating quenched and tempered grades in the existing standard or consider a new standard on the same. The committee noted the information and after deliberation decided to refer the matter again to the panel and requested them to submit the draft revision of document within the period of two months. The Draft revision then received will be send in wide circulation for the period of one month in consultation with the Chairman. The comments of MTD for want of justification for the proposed changes seeking details of reference in national/International standards was awaited from the Panel (Appendix-17).			

		The Committee took a note of the comments of MTD (Appendix-17) and requested convener of Panel-17 to submit the modified draft to the sub-committee within three weeks. Subcommittee reconstituted panel 7 and requested them to submit the P- Draft by 30th June 2022. The committee noted the status briefed by Sh G V Ramana on behalf of convenor Sh Devashish Mishra. The committee requested the l convenor of panel 7 to submit the report, indicating references of national/ international standardsfor the changes suggested for revision of the standard and also including the decision of the panel along with the changes therein against all the comments received from panel members, within 15 days from the date of finalization of the minutes. Also, it requested Member Secretary to circulate the P-draft on receipt of it from Panel Convenor, to members of both MTD 4 and MTD 4:3, giving a time period of 21 days for inviting comments Meeting of panel 7 was held on 26 July 2022. Minutes of the meeting , Annex-1 to the minutes and draft standard for revision of IS 2062:2011 is placed at **Appendices- 3,4 & 5**(Pg 79, 80-84, 85-100).			

		Member Secretary was advised to circulate the working draft along with the minutes inviting comments from members of both MTD 4:3 and MTD 4, giving them a time period of 15 days. The Committee was informed by the member secretary that no comments were received from subcommit3e on the draft document during P-circulation culminated on 09 Dec 2022. Accordingly, the Committee agreed to send the draft standard, placed at Appendix-10(Pg 102-109), for wide circulation for a period of 30 days.			
3	IS 10748: 2004- Hot Rolled Steel Strip For Welded Tubes And Pipes	During the last meeting comments received from JSW on the proposal fpr amendment in IS 10748 received from Mr B B Prasad of Tata steel were discussed and after deliberation the committee agreed to the comments made. It was decided that Mr B B Prasad shall draft an amendment to IS 10748 based on the agreed comments. The draft amendment shall then be circulated within MTD4 and MTD 19 committee member for 21 days and incase no comments are received , the same shall be sent for wide circulation for one month. Draft amendment received from Mr B B Prasad is given below  Amendment to IS10748.2017-R2.do The committee discussed the draft amendment and after deliberation decided to circulate the amendment among committee members of MTD 4 and MTD 19 for 21 days and if no comments	Report is awaited from Panel 7.	Committee noted the status that convenor of Panel 7 Sought 45 days time from 30 April 2023 to submit the report. Further, the Committee advised the Panel Convenor to hold a physical meeting in the Month of May 2023 and finalize the pending action(s) on priority.	Panel discussed the standard and agreed to modify it so that it caters to welded steel pipes for all general engineering purposes including structural. Accordingly, it agreed to add SAE grades of HR steel including boron treated grades, high strength low alloy steels and various grades of structural steels including fine grain steels. Also, it agreed to seek help from Sh B B Prasad(tata steel ltd) with regard to identify HR sheets/strips for newly added grades to IS 4923. **Sh G V Ramana(JSW) was requested to submit the draft within 60 days .**

		are received send the draft amendment for wide circulation for one month. The committee took note of the status and requested Member Secretary to take action. Subcommittee examined the matter and requested Panel 7 to submit their report by 20 June 2022 The Committee noted the status and requested Convenor of Panel 7 to submit their report within 15 days from the date of finalization of the minutes. Comments were received from AM/NS. Panel 11 is requested to dispose them off and submit the modified amendment. Panel Convenor was requested to submit the report by 30 Nov 2022. Report is awaited from Panel 7. Panel Convenor was requested to submit the report within 15 days from the date of finalization of the minutes.			
4	Harmonization of Indian Standard with ISO standards	The Committee noted the status and advised Sub-Committee reconstitute the Panel -17 by substituting the retired or moved away personnel by the existing personnel representing the same organization in MTD 4. Further, the Sub-Committee to submit its recommendation to the Committee in due course. The matter has been referred to panel 7 with a request submit report to the subcommittee by 30th June 2022. The Committee noted the status and requested Convenor of Panel 7 to submit	Report is awaited from Panel 7.	Committee advised the Convenor of Panel 7 to hold a physical meeting in the Month of May 2023 and finalize the pending action(s) on priority.	Details were given at **Appendix-2.**

		their report within 15 days from the date of finalization of the minutes. Report is awaited. Panel Convenor was requested to submit the report by 30 Nov 2022. Committee noted the status and requested the panel convenor to expedite action on submitting the report.			
5	ARP on pre-2000 standards				Panel examined the ARP reports of IS 1029 hot-rolled steel strip Baling and IS 8917 steel plates for galvanizing pots. With respect to IS 1029, panel agreed to review the standard and share their inputs in due course. Also, for IS 8917 it requested Member Secretary to send an email to major ISPs and get their inputs. Also, it felt a need to align IS 1852 with corresponding part of IS) 1035 and to be taken up after completion of the ongoing tasks.

Appendix-1

SL No	Specifications examined	Corresponding Grade	Proposal accepted By the panel	New Designation for revision of IS 11587
1	EN 10025-5	S235J0W	S235 as ISH 235WR	ISH 235 WR
	EN 10025-5	S235J2W		
	ISO 630-5	S235W (quality C)		
	ISO 630-5	S235W (quality D)		
2	ASTM A423	Gr1	GR1 of ASTM A 423 as ISH 245WP SG245W1 as ISH 245 WR UTS as 410 Min for both the grades.	ISH 245 WR
	ASTM A423	Gr2		
3	ASTM A709	Gr36(250)		ISH 245 WP
	ISO 630-5	SG245W1		
	ISO 630-5	SG245W2		
4	ASTM A709	Gr50(345)	ISH 345WR	ISH 345WR
	ASTM A709	Gr50S(345S)		
5	ASTM A 606	Type 2	ISH 310 WR	ISH 310 WR
	ASTM A 606	Type 4		
6	IRSM 41_97	Grade1	ISC 300WP	ISC 300WP
7	JIS G 3125 IS 11587	SPA-C WR-Fe 490C	ISC 315 WP	ISC 315 WP
8	ASTM A588	Gr A,GrB, GrC, GrK	EN 10025-5 as ISH 355 WR.	ISH 355 WR
	ASTM A588	GrC		
	ASTM A588	GrK		
	EN 10025-5	S355J0WP		
	EN 10025-5	S355J2WP		
	EN 10025-5	S355J0W		

	EN 10025-5	S355J2W		
	EN 10025-5	S355K2W		
	IS 11587	WR-Fe480B		
	Corten	A		
	Corten	B		
	ASTM A709	Gr50W (345W)		
	ASTM A709	GrHPS50W (HPS 345W)		
9	JIS G3125	SPA-H	SPA-H as ISH 355 WP	ISH 355 WP
	IS 11587	WR-Fe480A WR-Fe 490H		
10	IRSM 41_97	Grade1	Grade1 as ISH 340 WP	ISH 340 WP
11	ISO 630-5	SG365W1	ISH 365 WR1	ISH 365 WR1
12	ISO 630-5	SG365W2	ISH 365 WR2	ISH 365 WR2
13	IS 11587	WR-Fe500	ISH 360 WP	ISH 360 WP
14	ISO 630-5	SG400W	ISH 400 WR	ISH 400 WR
15	ASTM A 871	Gr 60	ISH 415 WR	ISH 415 WR
16	ASTM A 871	Gr 65	ISH 450WR	ISH 450WR
17	ASTM A709	GrHPS70W (HPS 485W)	ISH 460 WR1	ISH 460 WR1
	ISO 630-5	SG460W1		
18	ISO 630-5	SG460W2	ISH 460 WR2	ISH 460 WR2
19	ISO 630-5	SG500W	ISH 500 WR	ISH 500 WR
20	ASTM A 709		ISH 600 WR	ISH 600 WR
21	ISO 630-5	SG700W	ISH 700 WR	ISH 700 WR

Harmonization of ISO 630, ISO 4950, ISO 4951 & ISO 6930

panel compared the following standards with Indian structural steel standard for harmonization:
ISO 630 - 1 to 6
ISO 4950 - 1 to 3
ISO 4951 - 1 to 3
ISO 6930 - 1 & 2

Proposal on Harmonization for ISO 630 is given below:

S. No	ISO Standard	BIS Standard and way forward
1	630-1/ 4950 / 4951	Similar to IS 8910 (ISO 404) – Need to check for any modifications
2	630-2 & 630-3	Covered in IS 2062 part 1 draft
3	630-4	Can be adopted as IS standard for Q & T as per IS 2062 part2 with some modifications as provided below as "Annex A " which were taken from EN 10025-6
4	630-5	IS 11587 under revision will be covered with ISO 630-5, IRSM41/97 for both Hot Rolled & Cold Rolled grades JIS 3125 for SPA-C (CR) grade as SPA-H was already added in IS 11587
5	630-6	IS 15962 is available but grades and its properties are not matching. ISO standard CE values are wider and YS values are given with max values. Annex A for Shapes and dimensions tolerances of H-sections. (Panel discussion required for way forward)
6	ISO 4950-2 (Flat steel- N & CR)	IS 2062 part 1 draft grades E350 & E450 impact upto -20C, covers as subset of this standard grades E355 & E460.
7	ISO 4950-3 (Flat Steel- Q &T)	Mostly covers in ISO 630-4 with small changes
8	ISO 4951-2 (Bars and sections- N & AR)	IS 2062 part 1 draft grades E350, E410 & E450 covers as subset (restricted agreement) of this standard grades E355, E420 & E460.
9	ISO 4952-3 (Bars and sections- TM)	IS 2062 part 1 draft grades E350, E410 & E450 covers as subset (restricted agreement) of this standard grades E355, E420 & E460.
10	ISO 6930	1) Normalized grades S260NC, S315NC, S355NC, S420NC not covered in IS 5986 (Are these grades in use? If so grades shall be added in IS 5986) 2) TM Grades from S315MC to S960MC (11 grades) – IS 5986 covers 9 grades from S315MC (ISH390LA) to S700MC (ISH750LA). 2 grades - S900MC & S960MC shall be added in IS 5986 specifications. 3) Annex C grades (5nos- S345, S415, S485, S550, S690) are not directly covered in IS 5986. These can be AR or N or TM. Customized agreement can be done with TM grades. (Are these grades in use? If so grades shall be added in IS 5986). **We may seek opinion of TC on the above observations.**

Indian Standard

HOT ROLLED QUENCHED AND TEMPERED STRUCTURAL STEEL PLATES AND WIDE FLATS –SPECIFICATION

ICS 77.140.01

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Wrought Steel Products Sectional Committee, MTD 4

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by Wrought Steel Products Sectional Committee had been approved by the Metallurgical Engineering Division Council.

For all the tests specified in this standard (chemical/physical/others), the method as specified in relevant ISO Standard may also be followed as an alternate method.

While preparing the standard, assistance has been derived from the following international specifications:
ISO 630-4:2021 “High yield strength quenched and tempered structural steel plates”
EN 10025-6:2019 “High yield strength structural steels in the quenched and tempered condition”

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (revised). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

HOT ROLLED QUENCHED AND TEMPERED STRUCTURAL STEEL PLATES AND WIDE FLATS – SPECIFICATION

1 SCOPE

1.1 This document specifies qualities for high-yield strength quenched and tempered structural steels. It applies to steel plates and wide flats rolled on reversing mills which are used in the quenched and tempered condition and normally intended for welded or bolted structures.

1.2 This document covers 10 grades and 5 qualities. Grades ISH S460Q, ISH S500Q, ISH S550Q, ISH S620Q, ISH S690Q, ISH S890Q and ISH S960Q are covered in Table A.1, A.2, A.3, and A.4. Grades ISH SG460Q, ISH SG500Q, and ISH SG700Q are covered in Table B.1, B.2, B.3, and B.4. Not all grades are available in all qualities, and some qualities have Charpy V-notch requirements.

1.3 The steels specified in this document are applicable to hot-rolled flat products with a minimum nominal thickness of 3 mm and a maximum nominal thickness of 200 mm for grades ISH S460Q, ISH S500Q, ISH S550Q, ISH S620Q and ISH S690Q, a maximum nominal thickness of 125 mm for grades ISH S890Q and ISH S960Q, a maximum nominal thickness of 100mm for grades ISH SG460Q and ISH SG500Q and a maximum nominal thickness of 150 mm for grade ISH SG700Q.

2 NORMATIVE REFERENCES

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

IS No.	*Title*
228(in various parts)	Methods of chemical analysis of steels
1599: 2019/ ISO 7438: 2016	Metallic materials – Bend test (*fourth revision*)
1608(Part 1): 2022/ ISO 6892-1: 2019	Metallic materials – Tensile testing - Part 1 Method of test at room temperature (*fifth revision*)
1730: 1989	Steel plates, sheets, strips and flats for structural and general engineering purposes – Dimensions (*second revision*)
1757(Part 1): 2020/ ISO 148-1: 2016	Metallic materials – Charpy pendulum impact test Part 1 Test method (*fourth revision*)
1852:1985	Specification for rolling and cutting tolerances for hot rolled steel Products (*fourth revision*)
1956 (in various parts)	Glossary of terms relating to iron and steel (*second revision*)
3803 (Part 1): 1989	Steel – Conversion of elongation values: Part 1 Carbon and low alloy steels (*second revision*)
8910: 2022/ ISO 404 : 2013	General technical delivery requirements for steel and steel products (*second revision*)

IS 9595:1996	Metal arc welding of carbon and carbon manganese steels – Recommendations (*first revision*)
10842 (Part 2): 2019	Destructive Tests on Welds in Metallic Materials - Cold Cracking Tests for Weldments — Arc Welding Processes - part 2 self-Restraint Tests (*first revision*)
ISO 1461: 2022	Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods
ISO 14713-2: 2019	Zinc coatings — Guidelines and recommendations for the protection against corrosion of iron and steel in structures — Part 2: Hot dip galvanizing
ISO 17577: 2016	Steel — Ultrasonic testing of steel flat products of thickness equal to or greater than 6 mm

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 1956 and the following definitions shall apply.

3.1 Quenching: Operation which consists of cooling a ferrous product more rapidly than in still air

3.2 Tempering: Heat treatment applied to a ferrous product generally after quench hardening or other heat treatment to bring the properties to the required level

Note: Tempering consists of heating to specific temperatures (<Ac1) and soaking one or more times followed by cooling at an appropriate rate.

3.3 Fine-grain steel: Steel with fine-grain structure with an equivalent index of grain size ≥ 6 determined in accordance with IS 4748/ ISO 643.

4 SUPPLY OF MATERIALS

General requirements relating to the supply of material shall conform to IS 8910.

5 DESIGNATION (GRADES AND QUALITIES)

There shall be 10 grades of steel. Grades ISH S460Q, ISH S500Q, ISH S550Q, ISH S620Q, ISH S690Q, ISH S890Q and ISH S960Q are covered in Table A.1 to table A.6. Grades ISH SG460Q, ISH SG500Q, and ISH SG700Q are covered in Table B.1 to table B.5. They differ in their minimum yield strength at room temperature.

Each grade is available in up to 5 qualities. These grades and qualities differ in their specified mechanical properties and impact energy requirements:

- Quality A: Impact test not required;
- Quality B: Impact testing at 0°C;
- Quality C: Impact testing at –20°C;
- Quality D: Impact testing at –40°C;
- Quality E: Impact testing at –60°C;

While placing the order, the steel should be designated by ‘Grade’ and ‘Quality’.

The requirements of table A.1 to table A.5 or Table B.1 to table B.5 are to be regarded separately. Each Table A or Table B is independent of the other without combining in any way.

5.1 Options

The following options may apply to products according to this document. If the purchaser does not indicate a wish to implement any of these options at the time of the order, the products shall be supplied in accordance with the basic specification.

1) Testing of tensile and impact properties at a frequency per each plate and wide flat as heat-treated.

2) On special request of the purchaser, the manufacturer shall inform the purchaser at the time of the order which of the alloying elements appropriate to the steel grade required will be deliberately added to the material to be delivered and reported in the heat analysis.

3) On special request of the purchaser, the manufacturer shall inform the purchaser at the time of the order which of the alloying elements appropriate to the steel grade required will be deliberately added to the material to be delivered and reported in the product analysis. The product analysis shall be carried out at an agreed frequency when specified at the time of the order.

4) The steel making process shall be indicated (see clause 6.2).

5) The product shall have a chemical composition required for hot-dip zinc-coating (see clause 10.3)

6) Sheet, plate, strip and wide flats with a nominal thickness ≤ 16 mm shall be suitable for flanging without cracking (see clause 10.2.3).

7) For flat products in nominal thickness ≥ 6 mm, except for hot rolled strip and plate cut from strip, the freedom from internal defects shall be verified in accordance with ISO 17577 (see clause 11).

8) For each heat treatment unit, the impact properties only or the impact properties and the tensile properties shall be verified (see clause 9.5).

9) Testing of impact properties in the transverse direction (see clause 9).

10) For plates and wide flats, the permissible surface discontinuities and for the repair of surface defects by grinding and/or welding (see clause 13.3).

11) Die stamping is not allowed or the position for die stamping shall be as indicated by the purchaser (see Clause 18.1).

6 MANUFACTURE

6.1 Steel shall be supplied in fully killed condition. The steels shall contain sufficient amount of nitrogen-binding elements and have a fine-grain structure.

6.2 The processes used in the steel making, casting and further hot rolling are left to the discretion of the manufacturer/supplier. If required, secondary refining in the form of ladle refining, vacuum degassing may follow steel making.

6.3 The products shall be supplied in the quenched and tempered condition.

Note: Direct quenching after hot-rolling followed by tempering is considered equivalent to conventional quenching and tempering.

7 CHEMICAL COMPOSITION

7.1 Ladle Analysis (Heat Analysis)

The ladle analysis or heat analysis of the steel, when carried out by the method specified in the relevant parts of IS 228 or any other established instrumental/chemical method, shall conform to the requirements as given in Table A.1 & Table B.1. This analysis shall be made from a test sample, preferably taken during casting/teeming of the heat. In case of dispute, the procedure given in IS 228 and its relevant parts shall be the referee method and where test methods are not specified shall be as agreed to between the purchaser and the manufacturer/supplier. The ladle analysis shall be reported in the test certificate.

7.2 The ladle analysis shall be determined once per cast.

Table A.1 — Chemical composition of the Ladle analysis
(*Clauses 5, 7*.1)

Designation		Ladle Analysis, Percent, Max														
Grade	Quality	C	Mn	S	P	Si	Cr	Ni	Mo	N	B	Cu	Nb (b,c)	Ti (b,c)	V (b,c)	Zr (b,c)
All Grades	A to C D, E	0.20	1.70	0.015 0.010	0.025 0.020	0.80	1.50	4.0	0.70	0.015	0.0050	0.50	0.06	0.05	0.12	0.15

Notes:

a. Depending on the thickness of the product and the manufacturing conditions, the manufacturer may add to the steel one or several alloying elements up to the maximum values given in order to obtain the specified properties.

b. There shall be at least 0.015% of a grain-refining element present. Aluminium is also one of these elements. The minimum content of 0.015% applies to soluble aluminium, this value is regarded as attained if the total aluminium content is at least 0.018%; in case of dispute, the soluble aluminium content shall be determined.

c. Nitrogen binding elements shall be in amounts sufficient to bind the nitrogen (for example min. 0.020% total aluminium). The usual guideline is a minimum aluminium to nitrogen ratio of 2:1, when no other nitrogen binding elements are present.

d. For killed steel, when the steel is killed by aluminium alone, the total aluminium content shall not be less than 0.020%. When the steel is killed by silicon alone, the silicon content shall not be less than 0.10%. When the steel is silicon-aluminium killed, the silicon content shall not be less than 0.03% and total aluminium content shall not be less than 0.010%.

Table B.1 — Chemical composition of the Ladle analysis
(*Clauses 5, 7*.1)

Designation		Ladle Analysis, Percent, Max													
Grade	Quality	C	Mn	S	P	Si	Cu	Ni	Cr	Mo	V	Nb	Ti	B	Zr
ISH SG460Q	A, B, C	0.18	1.70	0.035	0.035	0.55	a	a	a		a	a	a	a	b
ISH SG500Q	A, B, C	0.22	2.00	0.040	0.035	0.55	a	a	a	0.05	0.11	0.05	a	a	b
ISH SG700Q	A, C, D	0.21	2.00	0.035	0.035	0.80	0.50	1.50	2.0	0.60	0.10	0.06	0.10	0.006	0.15

Notes:

a. There is no requirement, but the amount of these elements shall be determined for each heat and shall be reported in the inspection document. However, depending on the thickness of the product and the manufacturing conditions, the manufacturer may add to the steel one or several alloying elements to obtain the specified

properties up to the maximum limits specified in table A.1.

b. There is no requirement.

c. For killed steel, when the steel is killed by aluminium alone, the total aluminium content shall not be less than 0.020%. When the steel is killed by silicon alone, the silicon content shall not be less than 0.10%. When the steel is silicon-aluminium killed, the silicon content shall not be less than 0.03% and total aluminium content shall not be less than 0.010%.

7.2 Product Analysis

The product analysis shall be carried out when specified at the time of the order. The product analysis shall be carried out on the finished product from the standard position.
The product analysis of grades ISH S460Q, ISH S500Q, ISH S550Q, ISH S620Q, ISH S690Q, ISH S890Q and ISH S960Q shall comply with the values given in Table A.2.
The permitted deviations on analysis of grades ISH SG460Q, ISH SG500Q, and ISH SG700Q, relative to the values for heat analysis, are given in Table B.2.

7.2.1 If a product analysis has been agreed upon at the time of enquiry and order, the purchaser shall specify the frequency if not once per cast.

Table A.2 — Chemical composition of the Product analysis based on Table A.1
(*Clauses 5, 7.2*)

Designation		Ladle Analysis, Percent (%), Max														
Grade	Quality	C	Mn	S	P	Si	Cr	Ni	Mo	N	B	Cu	Nb (b,c)	Ti (b,c)	V (b,c)	Zr (b,c)
All Grades	A to C D, E	0.22	1.80	0.017 0.012	0.030 0.025	0.86	1.60	4.1	0.74	0.016	0.0060	0.55	0.07	0.07	0.14	0.17

Notes:

a. Depending on the thickness of the product and the manufacturing conditions, the manufacturer may add to the steel one or several alloying elements up to the maximum values given in order to obtain the specified properties.

b. There shall be atleast 0.010% of a grain-refining element present. Aluminium is also one of these elements. The minimum content of 0.010% applies to soluble aluminium, this value is regarded as attained if the total aluminium content is atleast 0.013%; in case of dispute, the soluble aluminium content shall be determined.

c. Nitrogen binding elements shall be in amounts sufficient to bind the nitrogen (for example min. 0.015 % total aluminium). The usual guideline is a minimum aluminium to nitrogen ratio of 2:1, when no other nitrogen binding elements are present.

Table B.2 — Permissible Variation for Product Analysis vs Ladle analysis of Table B.1
(*Clauses 5, 7.2*)

Element	Range of specified element, %	Permissible Variation Over/Under the Specified Limit, % max
Carbon	≤0.15	0.03
	>0.15≤0.22	0.04
Silicon	≤0.80	0.06
Manganese	≤2.00	0.10
Phosphorus	≤0.035	0.01
Sulfur	≤ 0.04	0.01

Vanadium	≤0.10	0.01
	>0.10≤0.25	0.02
Niobium	≤ 0.06	0.01
Boron	≤ 0.006	0.001
Titanium	≤0.10	0.01
Copper	≤0.50	0.03
Nickel	≤ 1.00	0.03
	>1.00≤1.50	0.05
Chromium	≤0.90	0.04
	>0.90≤ 2.00	0.06
Molybdenum	≤0.20	0.01
	>0.20≤0.40	0.03
	>0.40≤0.60	0.04
Zirconium	≤0.15	0.03

7.3 Carbon equivalent value

The maximum carbon equivalent value (CEV) requirements for Table A.1 grades are given in Table A.3 and for Table B.1 grades are given in Table B.3.

Carbon equivalent value (CEV) would be calculated based on ladle analysis, only.

$$CEV = \mathbf{C} + \frac{\mathbf{Mn}}{\mathbf{6}} + \frac{(\mathbf{Cr+Mo+V})}{\mathbf{5}} + \frac{(\mathbf{Ni+Cu})}{\mathbf{15}}$$

Table A.3—Maximum CEV based on the ladle analysis for table A.1
(*Clauses 7*.3)

Designation		**Maximum CEV in % for nominal product thickness in mm**			
Grade	**Quality**	**≤50**	**>50 ≤100**	**>100 ≤125**	**>125 ≤200**
ISH S460Q	C, D, E	0.47	0.48	0.50	0.50
ISH S500Q	C, D, E	0.47	0.70	0.70	0.70
ISH S550Q	C, D, E	0.65	0.77	0.83	0.83
ISH S620Q	C, D, E	0.65	0.77	0.83	0.83
ISH S690Q	C, D, E	0.65	0.77	0.83	0.83
ISH S890Q	C, D, E	0.72	0.82	0.83	-
ISH S960Q	C, D	0.82	0.85	0.85	-

Note: Max. CEV is increased for ***Option 5*** (Clause 5.1), see 7.4.

Table B.3 — Maximum CEV[a] based on the heat analysis for table B.1
(*Clauses 7*.3)

Designation		Maximum CEV in % for nominal product thickness in mm	
Grade	**Quality**	≤50	>50≤100
ISH SG460Q	A, B, C	0.44	0.47
ISH SG500Q	A, B, C	0.47	0.50
ISH SG700Q	A, C, D	0.60	0.63
a By agreement for ISH SG700Q.			

Note: Max. CEV is increased for ***Option 5*** (Clause 5.1), see 7.4.

7.4 When products are supplied with a control on Si e.g. for hot-dip zinc-coating so that there could be a need to increase the content of other elements like C and Mn to achieve the required tensile properties, the maximum carbon equivalent values of Table A.3 and table B.3 shall be increased as follows:
— for Si ≤ 0,04 %, increase the value of the CEV by 0,02;
— for Si ≤ 0,25 %, increase the value of the CEV by 0,01.

8 TENSILE TEST

The tensile properties at room temperature shall comply with the values specified in Table A.4 or Table B.4

8.1 Number of Tensile Tests

Number of test samples shall be 2 from each cast/heat and same form, grade, quality and delivery condition for thickness range as specified in table A.4 & table B.4 for the yield strength. On Mutual agreement the test unit shall be taken on each plate and wide flat as heat treated for grades mentioned in table B.4.

8.2 Location of samples and orientation of test pieces

The samples shall be taken from any product of the test unit, from the location in the product as shown in fig 1.

Additionally, for plates, sheet, wide strip and wide flats the samples shall be taken so that the axes of the test pieces are approximately midway between the edge and center line of the products.

For wide strip the sample shall be taken at an adequate distance from the end of the product.
For narrow strip (<600 mm wide) the sample shall be taken at an adequate distance from the end of the coil and at one third of the width.

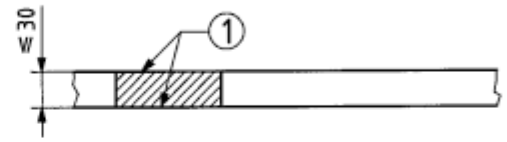
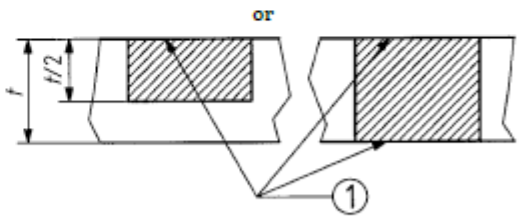
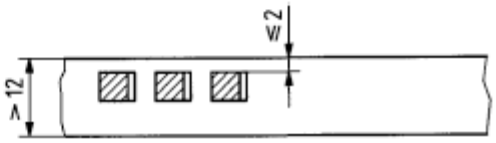
Type of test	Nominal thickness of product	Direction of the longitudinal axis of the test piece in relation to the principal direction of rolling for product nominal widths of		Distance of the test piece from the rolled surface
		< 600	≥ 600	
Tensile [a]	≤ 30	longitudinal	transverse	 1 rolled surface
	> 30			or 
Impact [b d]	> 12 [c]	longitudinal	longitudinal	

Fig 1: Sample location

a In case of dispute, for products of nominal thickness greater than or equal to 3 mm use proportional test pieces of gauge length $L_o = 5.65\sqrt{S_o}$, see 8.3.1 and 8.3.2

b The axis of the notch shall be perpendicular to the surface of the product.

c For nominal thicknesses $t \leq 12$ mm see 9.1.

d For products nominal thickness $t \geq 40$ mm impact test pieces shall be taken from ¼ t position.

8.3 Tensile Test Pieces

The tensile strength, yield strength and percentage elongation of steel shall be determined from standard test pieces.

8.3.1 For flat products of nominal thickness > 30 mm a round test piece may be used with the longitudinal axis at 1/4 thickness, if a testing machine with an adequate capacity is not available. In cases of dispute, the total thickness of the plate shall be subdivided in equal thick flat test pieces. The average of the individual results of the mechanical tests shall be valid.

8.3.2 As a rule, test pieces with a proportional gauge length complying with the requirements $L_o = 5.65\sqrt{S_o}$ should be used for the tensile test, where L_o is the gauge length and S_o is the cross-sectional area of the test piece.

8.3.3 Test pieces with a non-proportional gauge length, other than $5.65\sqrt{S_o}$ may be used in which case the elongation values shall be converted to $5.65\sqrt{S_o}$ in accordance with IS 3803 (Part 1).

8.4 Tensile Test

Yield strength, tensile strength and percentage elongation, when determined in accordance with IS 1608 (Part 1), shall conform to the requirements as given in Table A.4 and table B.4.

For the specified yield strength, the upper yield strength (*R*eH) shall be determined.
If a yield phenomenon is not present, the 0.2% proof strength (*R*p 0.2) shall be determined.

8.4.1 Should a tensile test piece break outside the middle half of the gauge length (*see* IS 1608 (Part 1)) and the percentage elongation obtained is less than that specified, the test may be discarded at the manufacturer/supplier's option and another test made from the sample plate, strip, or flat.

8.5 The maximum stress-relief temperature should be at least 30 °C below the tempering temperature and not be held for more than 1 hour. As this temperature is normally not known in advance it is recommended that the purchaser if he intends to perform a stress relief treatment to contact the steel producer. If the purchaser intends to stress relief the products at higher temperatures or for longer times than mentioned above the minimum values of the mechanical properties after such a treatment should be agreed upon at the time of the order.

Table A.4 Tensile Properties at room temperature
(*Clause 5 and 8.4*)

Designation		**Minimum Yield Strength** R_{eH}, MPa[2)] **Nominal Thickness, mm**				**Tensile Strength** Rm, MPa[2)] **Nominal Thickness, mm**				**Elongation A**, % *Min* **at Gauge Length,** $L_0=5.65\sqrt{So}$
Grade	**Quality**	≥3 ≤50	>50 ≤100	>100 ≤125	>125 ≤200	≥3 ≤50	>50 ≤100	>100 ≤125	>125 ≤200	≥3 ≤200
ISH S460Q	C, D, E	460	440	400	400	550-720		500-670		17
ISH S500Q	C, D, E	500	480	440	440	590-770		540-720		17
ISH S550Q	C, D, E	550	530	490	490	640-820		590-770		16
ISH S620Q	C, D, E	620	580	560	560	700-890		650-830		15
ISH S690Q	C, D, E	690	650	630	630	770-940	760-930	710-900		14
ISH S890Q	C, D, E	890	830	830	-	940-1100	880-1100	880-1100	-	11
ISH S960Q	C, D, E	960	850	850	-	980-1150	900-1100	900-1100	-	10

NOTES:

1. For plates and wide flats with widths ≥600 mm, the direction transverse to the rolling direction applies.
2. 1MPa = $1N/mm^2$ = $1MN/m^2$ = 0.102 kgf/mm^2 = 144.4 psi.
3. If R_{eH} is not pronounced, refer to 8.4.

Table B.4 Tensile Properties at room temperature
(*Clause* 5, *and 8.4*)

Designation		**Minimum Yield Strength** Min R_{eH}, MPa[a)] **Nominal Thickness, mm**				**Tensile Strength** Rm, MPa [a)] **Nominal Thickness, mm**	**Elongation** [b)] **A**, % *Min* **Nominal Thickness (≤150), mm**		
Grade	**Quality**	≤16	>16 ≤40	>40 ≤100	>100 ≤150	≤ 150	L_0=5.65 √So	Gauge Length=50 mm [d]	Gauge Length=200 mm
ISH SG460Q	A, B, C	460	450	420	e	570-720	15	20	15
ISH SG500Q	A, B, C	500	500	500	e	600-760	17	19	17
ISH SG700Q	A, C, D	690	690	620	620	760-930	14	16	14

NOTES:

a 1 MPa = 1 N/mm2.

b Only one of the three requirements is required. Unless specified in the order, the manufacturer may use either a proportional or fixed gauge length specimen. When the test value is reported, the specimen used shall be reported.

c The producer should be contacted for possible thickness limits.

d If measured using a 40 mm wide tension test specimen, the elongation is determined in a 50 mm gauge length that includes the fracture and shows the greatest elongation.

e Not available.

9 IMPACT TEST

The verification of the impact energy value shall be carried out, unless otherwise agreed upon.
The impact properties of Charpy V-notch test pieces shall comply with the values specified in Table A.5 or Table B.5. The orientation of the specimens shall be longitudinal, unless a transverse orientation is agreed between the purchaser and manufacturer (see ***option 9*** clause 5.1 and the values are in Table A.6).

9.1 Preparation of impact test pieces

V-notch test pieces shall be machined and prepared in accordance with IS 1757(Part 1)/ ISO 148-1. In addition, the following requirements apply for flat products:

— for nominal thicknesses 12 < *t* < 40 mm, standard 10 mm x 10 mm test pieces shall be machined in such a way that one side is not further away than 2 mm from a rolled surface, for nominal thicknesses ≥ 40 mm impact test pieces shall be taken from 1/4*t* position for plates;

— for nominal thicknesses ≤ 12 mm, when test pieces with reduced widths are used, the largest width possible has to be chosen; If agreed upon at the time of enquiry and order, sub-sized test pieces shall be used in the case of nominal thicknesses of 6 mm ≤ *t* ≤ 12 mm. The largest possible standard sub-sized test piece (7,5 mm or 5,0 mm) shall be used.

— for nominal thickness < 6 mm no impact tests are required.

9.2 Impact test

The impact test shall be carried out in accordance with IS 1757(Part 1)/ ISO 148-1 on V-notch specimen using 2 mm striker.

The average value of the three test results shall meet the specified requirement. One individual value may be below the minimum average value specified, provided that it is not less than 70 % of that value.

Three additional test pieces shall be taken from the same sample in accordance with 9.3 and tested in any one of the following cases:

— if the average of three impact values is lower than the minimum average value specified;
— if the average value meets the specified requirement, but two individual values are lower than the minimum average value specified;
— if any one value is lower than 70 % of the minimum average value specified.

The average value of the six tests shall be not less than the minimum average value specified. Not more than two of the individual values may be lower than the minimum average value specified and not more than one may be lower than 70 % of this value.

9.3 The test sample shall be taken from the thickest product. One test sample shall be taken from thickest product per cast/heat. If the test sample taken from the thickest product rolled from a cast meets the requirements, the whole cast shall be deemed to meet the requirements of the test, if not, the test shall be performed on a product of next lower thickness rolled from same cast, if it meets the requirements specified, this particular thickness as also other sections of lower thickness shall be deemed to satisfy this specification. If this thickness also does not meet the requirements, the test shall be carried out on the next lower thickness and so on, because the toughness of the product will be dependent on the rolling direction as well as on the product size.

9.4 Impact test at different temperatures other than specified in table A.5, table A.6 and table B.5 may be mutually agreed between the purchaser and the manufacturer/supplier accordingly the impact test values may be mutually agreed between the purchaser and the manufacturer/supplier.

9.5 If specified at the time of the order on each heat treatment unit the impact properties only or the impact properties and the tensile properties shall be verified.

Table A.5 — Longitudinal Charpy V-notch properties [a]
(*Clauses 5, 9*)

Designation		Minimum energy, J at test temperature [b], °C			
Grade	**Quality**	0	−20	−40	−60
ISH S460Q ISH S500Q ISH S550Q ISH S620Q ISH S690Q ISH S890Q ISH S960Q	C	40	30	—	—
ISH S460Q ISH S500Q ISH S550Q ISH S620Q ISH S690Q ISH S890Q ISH S960Q	D	50	40	30	—
ISH S460Q ISH S500Q ISH S550Q ISH S620Q ISH S690Q ISH S890Q ISH S960Q	E	60	50	40	30

[a] For nominal thicknesses ≤12mm, Where sub-sized test pieces are used (see 9.1), the minimum impact energy values given shall be reduced in proportion to the cross-sectional area of the test piece.

[b] Unless otherwise specified, the testing temperature for each quality is the lowest available with a specified energy value.

Table A.6—Transverse Charpy V-notch properties [a,c]
(*Clauses 5, 9*)

Designation		Minimum energy, J at test temperature [b], °C			
Grade	**Quality**	0	−20	−40	−60
ISH S460Q ISH S500Q ISH S550Q ISH S620Q ISH S690Q ISH S890Q ISH S960Q	C	30	27	—	—
ISH S460Q ISH S500Q ISH S550Q ISH S620Q ISH S690Q ISH S890Q ISH S960Q	D	35	30	27	—
ISH S460Q ISH S500Q ISH S550Q ISH S620Q ISH S690Q ISH S890Q ISH S960Q	E	40	35	30	27

[a] For nominal thicknesses ≤12mm, Where sub-sized test pieces are used (see 9.1), the minimum impact energy values given shall be reduced in proportion to the cross-sectional area of the test piece.

[b] Unless otherwise specified, the testing temperature for each quality is the lowest available with a specified energy value.

[c] See ***option 9*** clause 5.1.

Table B.5—Longitudinal Charpy V-notch properties [a]
(*Clauses 5, 9*)

Designation		Minimum impact energy, J, at test temperature, °C			Maximum thickness, mm
Grade	Quality	0	-20	- 40	
ISH SG460Q	A	—	—	—	100
	B	27	—	—	100
	C	—	27	—	100
ISH SG500Q	A	—	—	—	100
	B	27	—	—	100
	C	—	27	—	100
ISH SG700Q	A	—	—	—	150
	C	—	27	—	150
	D	—	—	27	150

a For nominal thicknesses ≤12mm, Where sub-sized test pieces are used (see 9.1), the minimum impact energy values given shall be reduced in proportion to the cross-sectional area of the test piece.

10.0 TECHNOLOGICAL PROPERTIES

10.1 Weldability

The steels specified in this document do not have unlimited suitability for the various welding processes, since the behavior of a steel during and after welding depends not only on the material but also on the dimensions and shape and on the manufacturing and service conditions of the components.

General requirements for arc welding of the steels specified in this document shall be as given in IS 10842 part 2 or ISO 17642 part 2.

NOTE With increasing product thickness and strength level cold cracking can occur. Cold cracking is caused by the following factors in combination:

— the amount of diffusible hydrogen in the weld metal;
— a brittle structure of the heat affected zone;
— significant tensile stress concentrations in the welded joint.

10.2 Formability and flame straightening

10.2.1 Hot-forming

Hot forming is not recommended for quenched and tempered steels as the necessary heat treatment after hot forming is very difficult to reproduce.

10.2.2 Cold formability

Cold forming leads to reduction in the ductility. Furthermore, it is important to draw the attention to the risk of brittle fracture in connection with hot-dip zinc coating.

10.2.3 Flangeability

If specified at the time of the order and mutually agreement between the purchaser and the manufacturer, plates and wide flats with a nominal thickness ≤ 16 mm are suitable for flanging without cracking with the indicative values for the inside minimum bend radii for cold forming as given in table A.7. (See ***Option 6***, Clause 5.1 for Flangeability without cracking).

Table A.7— Minimum recommended inside bend radii for flanging
(Informative for clause 10.2.3)

Designation		Minimum recommended inside bend radii for nominal thicknesses (t) $3 \leq t \leq 16$ mm [a]	
Grade	**Quality**	**Axis of bend in transverse direction**	**Axis of bend in longitudinal direction**
ISH S460Q ISH S500Q ISH S550Q ISH S620Q ISH S690Q	C, D, E	3.0t	4.0t
ISH S890Q ISH S960Q	C, D, E	4.0t	5.0t

a The values are applicable for bend angles ≤ 90°.

10.3 Hot-dip zinc-coating

ISO 1461 should be used to specify coating requirements. ISO 14713-2 provides further guidance, including information on the influence of various factors, including steel chemical composition, on the coating formation.

Option 5, Clause 5.1 can be used to order steels with a chemical composition required for hot-dip zinc coating. When option 5 is implemented, the purchaser and manufacturer shall agree to a steel composition (heat analysis) of silicon and phosphorous according to either Category A (or steels satisfying the formula Si ≤ 0,03 % and Si+2,5P ≤ 0,09 %) or Category B (limited to 0,14 % ≤ Si ≤ 0,25 %) or Category D (limited to 0,25 % < Si ≤ 0,35 %)

NOTE 1 ISO 14713-2:2019, Table 1, gives guidance on typical coating characteristics associated with certain steel compositions on the basis of the surface composition of silicon and phosphorous.

The maximum carbon equivalent shall be increased by 0,02 or by 0,01 (see 7.4).

NOTE 2 Products quenched in water can be susceptible to stress corrosion cracking after hot-dip zinc-coating.

In some cases, steels above S460 may be sensitive to cracking during galvanizing and therefore special care should be taken.

11 INTERNAL SOUNDNESS

Ultrasonic testing may be agreed upon at the time of the order. If specified at the time of the order, ultrasonic testing shall be carried out for flat products in nominal thicknesses ≥ 6 mm, except for hot rolled strip and plate cut from strip in accordance with ISO 17577 or with test methods and acceptance criteria agreed upon.

See ***Option 7***, Clause 5.1 (Ultrasonic testing for flat products).

12 RE-TESTS

12.1 If a test does not give the specified results, two additional tests shall be carried out at random on the same lot. Both retests shall conform to the requirements of this standard; otherwise, the lot shall be rejected.

In the case of strip, retests on a rejected coil shall be carried out after the cutting of an additional longitudinal section of sufficient length to remove the coil end effect with a maximum of 20 m.

12.2 Re-heat Treatment

If any heat treated material fails to meet the mechanical requirements specified, the supplier may re-heat treat the material and in that case, all mechanical properties shall be re-evaluated.

13 FREEDOM FROM DEFECTS

13.1 All finished steel shall be well and cleanly rolled to the dimensions, sections and masses specified. The finished material shall be reasonably free from surface flaws; laminations; rough/jagged and imperfect edges and all other harmful defects.

13.2 Minor surface defects may be removed by the manufacturer/supplier by grinding provided the thickness is not reduced locally by more than 4 percent below the minimum specified thickness. Reduction in thickness by grinding greater than 4 percent but not exceeding 7 percent may be made subject to mutual agreement between the purchaser and the manufacturer/supplier.

13.2.1 Subject to agreement with the purchaser, surface defects which cannot be dealt with as in 13**.2** may be repaired by chipping or grinding followed by welding and inspection by a mutually agreed procedure such that,

a) after complete removal of the defects and before welding, the thickness of the item is in no place reduced by more than 20 percent;
b) welding is carried out by approved procedure by competent operators with approved electrodes and that the welding is ground smooth to the correct nominal thickness; and
c) subsequent to the finish grinding, the item maybe required to be normalized or otherwise heat-treated at the purchaser’s discretion.

13.3 Alternatively, the requirements for surface condition can be agreed at the time of enquiry and order in accordance with ISO 7788 for plates and wide flats
See ***Option 10***, Clause 5.1 (surface condition).

14 DIMENSIONS

Unless otherwise agreed to between the purchaser and the manufacturer /supplier, the nominal dimensions of rolled products conforming to this standard shall be in accordance with the relevant Indian Standard.

15 TOLERANCES

Unless otherwise agreed to between the purchaser and the manufacturer/supplier, the rolling and cutting tolerances for steel products conforming to this standard shall be those specified in IS 1852.

16 CALCULATION OF MASS

The mass of the steel shall be calculated on the basis that steel weighs7.85 g/cm^3.

17 DELIVERY

The products shall be supplied in the quenched and tempered condition (Q) as defined in Clause 3 and 6.3.

NOTE Direct quenching after hot-rolling followed by tempering is considered equivalent to conventional quenching and tempering.

18 MARKINGAND PACKING

18.1 The products shall be legibly marked using methods such as painting, stamping, laser marking, bar coding, durable adhesive labels or attached tags with the following:

— the grade, the quality and if applicable the delivery condition indicated by its abridged designation;
— heat number or cast number;
— the manufacturer’s name or trademark.

The type of marking may be specified at the time of the order.

NOTE 1 Where the option for hot dip galvanizing is chosen (see ***option 5*** Clause 5.1) the marking methods and materials used can be agreed upon in order to avoid interference with preparation for hot dip galvanizing (see ISO 14713-2).

In addition, if specified at the time of the order there shall be either no die stamping or only die stamping in positions indicated by the purchaser.
See ***Option 11***, Clause 5.1 (Die stamping not allowed or at special position).

18.2 Marking shall be at a position close to one end of each product or on the end cut face at the manufacturer's discretion.

18.3 Where products are supplied in securely tied bundles the marking shall be on a label attached to the bundle or on the top product of the bundle.

18.4 BIS Certification Marking

The material may also be marked with Standard Mark.

18.4.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations made there under. The details of conditions under which the license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Appendix-5

TEMPLATE FOR SENDING COMMENTS ON BIS DOCUMENTS

Date:		Document No.:		Title of the Document:	STEEL PLATES AND STRIPS FOR PRESSURE VESSELS USED AT MODERATE AND LOW TEMPERATURE – SPECIFICATION
Name of the Commentator/ Organization:	SAIL, Bhilai Steel Plant			Abbreviation of the Commentator/Organization:	SAIL, BSP

(Comments on each clause/sub-clause/table/fig, etc. be started on a fresh box. Information in column 5 should include reasons for the comments/suggestions for modified wordings of the clauses when the existing text/provision is found not acceptable. Adherence to this format facilitates Secretariat's work)

Abbreviation of the Commentator /Organization	**Clause/ Subclause No.** (e.g. 3.1)	**Paragraph No. / Figure No. / Table No.** (e.g. Table 1)	**Type of Comment** [1]	**Comments/Suggestions along with Justification for the Proposed Change**	**Proposed Change/Modified Wordings**	**Committee Decision**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
BSP	6.2		te	The steel shall be fully killed and made to fine austenitic grain size~~, where Al (total) content on ladle analysis shall be 0.02 percent Min.~~ The steel may be vacuum degassed and micro-alloyed.	The steel shall be killed and shall conform to the fine austenitic grain size requirement. The steel may be vacuum degassed and micro-alloyed.	Change 6.2 "The steel shall be fully killed and made to fine austenitic grain size. The steel may be vacuum degassed and micro-alloyed"
BSP		Table 1	te	"The minimum Al (total) content may not be applicable, if Nb, Ti or V either singly or in combination are additionally used for Nitrogen binding".	To be retained in the footnote.	No Change

1) **Type of comment:** **ge** = general **te** = technical **ed** = editorial

TEMPLATE FOR SENDING COMMENTS ON BIS DOCUMENTS

Date:	23.08.2023	Document No.:	IS 2002:2009 (draft)	Title of the Document:	Steel Plate For Pressure Vessel For Intermediate and High Temperature Service Including Boiler:2009 (Reaffirmed 2018)
Name of the Commentator/ Organization:	SAIL, Bhilai Steel Plant			Abbreviation of the Commentator/Organization:	SAIL, BSP

(Comments on each clause/subclause/table/fig, etc be started on a fresh box. Information in column 5 should include reasons for the comments/suggestions for modified wordings of the clauses when the existing text/provision is found not acceptable. Adherence to this format facilitates Secretariat's work)

Abbreviation of the Commentator /Organization	**Clause/ Subclause No.** (e.g. 3.1)	**Paragraph No. / Figure No. / Table No.** (e.g. Table 1)	**Type of Comment** [1)]	**Comments/Suggestions along with Justification for the Proposed Change**	**Proposed Change/Modified Wordings**	**Committee Decision**
BSP	2.0 & 9.1(b)		ed	Incorporation of "IS16998:2018" in lieu of supreceded / replaced document IS / ISO 7452:2013	The replaced spec. IS 16998:2018 needs to be incorporated in both clause	
BSP	15.1		te	Testing specification should not be restricted to IS 11630 only	to be corrected as: -----in accordance with IS 11630 or equivalent National / international Ultrasonic Testing Standard.	Already available "No Change"
BSP	7.1		te	" Normalising Rolling" needs to be addressed for plates below / equal to 50mm, since many BSP caters to many Orders with "Normalising Rolling" delivery condition.	To be corrected as:----"normalized", "normalizing rolling" or " stress relived" or "normalized and stress relived condition".	Already available "No Change"
BSP	13.2.1		te	Proposed for revision of Clause 13.2.1 of existing IS 2002:2009 to incorporate Test piece width & length, in line with Clause 5.3 & 5.7 of existing IS 1599:2019.	Proposed to include the wordings of IS 1599:2019 for Clauses 5.3 & 5.7, for Test piece width & length.	"No Change"

1) **Type of comment:** **ge** = general **te** = technical **ed** = editorial

Draft Indian Standard

BRIGHT STEEL BARS — SPECIFICATION

(*Second Revision of IS 9550*)

1 SCOPE

1.1 This standard covers cold drawn, turned, turned and reeled, or ground steel bars of grades and cross sections regarded as generally suitable for heat treatment, for machining into component or for use in 'as finished' condition in constructional applications or other similar purposes, such as for the manufacture of threaded and machined components for general engineering purposes.

1.2 This document does not apply to the following steel qualities:

— Steel for Cold Heading/Cold Extrusion Applications – Wrought Carbon and Low Alloy Steels as per IS 11169 Part 1;
— Steel for Cold Heading/Cold Extrusion Applications – Stainless Steels as per IS 11169 Part 2;
— Tool steels as per IS 3748;
— Stainless steel semi-finished products, bars, wire rods and bright bars as per IS 6603.

2 REFERENCES

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

3 TERMINOLOGY

3.1 For the purpose of this standard the definitions given in IS 1956 (Part 3) and the following shall apply.

3.1 Bright Bars : Bright bars are drawn or peeled/turned bars with smoother surface quality and better dimensional accuracy in comparison to hot-rolled bars.

3.2 Drawn Products

Products of various cross section shapes obtained, after descaling, by drawing of hot rolled bars or rods on a draw bench (cold deformation without removing material). This operation gives the product special features with respect to shape, dimensional accuracy, surface finish and mechanical properties. In addition, the process causes cold working of the product, which can be eliminated by subsequent heat treatment. Products in lengths are delivered straightened regardless of size.

3.3 Peeled/ Turned Products

Peeled/turned products round bars produced by peeling or turning where the product can be further processed by straightening and polishing. This operation gives the bar special features with respect to shape, dimensional accuracy and surface finish. The removal of metal is carried out in such a way that the bright product is generally free from rolling defects and surface decarburization.

3.4 Ground Products

Drawn or turned round bars given an improved surface quality and dimensional accuracy by grinding and polishing.

3.5 Thickness

nominal dimension of the product

Which means:

a) the diameter in the case of rounds;

b) the lateral length in the case of squares;

c) the width over flats in the case of hexagons;

d) the shorter lateral length in the case of flats (rectangular bars) and wide-flats

3.6 Out-Of Round

Difference between the smallest and largest dimension measured across the pairs of opposing points at a common cross-section

4 SUPPLY OF MATERIAL and PRODUCT DESIGNATION

4.1 General requirements relating to the supply of material shall be as laid down in IS 8910.

4.2 The treatment condition of the bars shall be as follows

Sl No.	Treatment condition at delivery	Symbol
1	As-rolled and peeled/ turned[a]	+SH
2	Cold drawn	+C
3	Soft annealed and peeled/turned	+A+SH
4	Soft annealed and cold drawn	+A+C
5	Treated to ferrite-pearlite structure and hardness range and peeled/turned	+FP+SH
6	Treated to ferrite-pearlite structure and hardness range and cold drawn	+FP+C
7	Quenched and tempered and peeled or cold drawn and quenched and tempered	+QT+SH+C+QT
8	Quenched + tempered and cold drawn	+QT+C
9	Other heat-treated conditions, for example stress relieved (+SR), normalized (+N), cold drawn and annealed or normalized (+C+A, +C+N)	
a Peeling is in general possible for diameters of 16 mm and over.		

4.3 The Bright bars shall be delivered in or a combination of the following surface conditions:

a) Cold Drawn, +C
b) Cold Drawn, Heat treated, +C+QT, +C+N, +C+SR, +C+A
c) Peeled/Turned, +SH
d) Ground, + G, and
e) Polished , +PL.

4.3 Unless otherwise agreed, bars up to 45 mm in dimensions are normally delivered with sheared ends. The ends of the product shall be as specified by the purchaser at the time of enquiry and order, for example, chamfering, facing, etc

4.4 Basis for order

While placing an order for the steels covered by this standard, the purchaser should specify clearly the following:

a) Chemical composition;(*see* 6)
b) Mechanical properties;(*see* 7)
c) Dimensions ;(*see* 8.1)
d) Dimensional tolerance;(*see* 8.2)
e) Treatment condition of bars (*see* 4.2)
f) Supply surface conditions (*see 4.3*)
g) Surface quality class : (*see* table 8)
h) Decarburization depth (*see* 9.1)
i) Optional test if required (see 11)

4.5 Product Designation

4.5.1 The product designation shall follow the sequence below:

(a) Number of this Indian Standard with prefix IS.
(b) Corresponding product standard (CPS) as applicable
(c) Number of corresponding Indian Standard on bars, if any
(d) Grade/Designation of the bars as per (c) above , if any

Example 1 IS 9550 CPS 2062/ E250 BR
Example 2 IS 9550 XXXX (in case of grade without any CPS, where XXXX is a grade supplied on mutual agreement between the manufacturer and the purchaser)

5 MANUFACTURE

5.1 The processes used in making the steel and in manufacturing bright steel products are left to the discretion of the manufacturer.

5.2 Unless specified otherwise, the steel shall be supplied in the rimmed, semi-killed or killed condition, as per mutual agreement between the purchaser and the manufacturer.

6 CHEMICAL COMPOSITION

6.1 The chemical composition of bright bars shall be as per relevant product Indian standard or it may be as agreed between purchaser and supplier. The material specification and heat treatment, if any, shall be so selected that the rolled bars used for the manufacture of bright bars will ensure the desired mechanical properties as per the requirements of the purchaser.

6.2 The analysis of steel shall be carried either by the method specified in the relevant parts of IS 228 or any other established instrumental/chemical method. In case of dispute, the procedure given in the relevant part of IS 228 shall be referee method. However, where the method is not given in IS 228 or its relevant parts, the referee method shall be as agreed to between the purchaser and the manufacturer

6.3

7 MECHANICAL PROPERTIES

7.1 The mechanical properties of bright bars shall be as agreed to between the purchaser and the manufacturer. The test method standard shall be the relevant standards depending on the mechanical properties such as IS 1608 (various parts) for tensile test, IS 1500 for brinell hardness, etc

8 DIMENSIONS AND TOLERANCES

8.1 Dimensions

Bars~~, sections and flats~~ shall be supplied as per the dimensions specified in the orders.

8.2 Tolerances

8.2.1 *Diameter, Thickness and Width*

Tolerances on dimensions shall be as specified by the purchaser and shall be in accordance with 1S 919 (Part 2) as given in Table 1

Table 1 Tolerance Class According to Finished Conditions

Sl No.	Surface condition at delivery	Symbol	Tolerance class to IS 919 Part 2[a]			
			Rounds	Squares	Hexagons	Drawn flats Special sections
(1)	(2)	(3)	(4)	(5)		(6)
i)	Cold drawn or heat-treated and cold drawn	+C	h10 (h9 to h12) *see* Table 3	h11 for $d \leq 80$ mm, h12 for $d > 80$ mm (h11 or h12); *see* Table 3		h11, h12 *see* Table 4
ii)	Cold drawn, heat treated	+C+QT (+C+N) (+C+SR) (+C+A)	h11 *see* Table 3	– b	– b	–
iii)	Peeled/turned	+SH	h10 (h9 to h12) *see* Table 3	–	–	–
iv)	Ground	+G	h9 (h6 to h12) *see* Table 3	–	–	–
v)	Polished	+PL	h9 (h6 to h12) *see* Table 3	–	–	–

NOTES
a Standard tolerance classes unless otherwise specified. In brackets: other possible tolerance classes according to IS 919 Part 2 if required at the time of enquiry and order.
b To be agreed at the time of enquiry and order.
c stress relieved (+SR), normalized (+N), annealed (+A), Quenched and tempered (+QT).

8.2.1.1 Unless specified otherwise, tolerances on dimensions shall be as follows:

a) For drawn round bars other than those under (e), or turned bars: h10 to Table 3.
b) For hexagonal and square drawn bars: h11 for dimensions up to and including 80 mm, h12 for dimensions over 80 mm according to Table 1 and 3.
c) For drawn flats: in accordance with Table 4 and 5;
d) For ground products: in accordance with Table 1 and 2
e) For drawn round bars in the heat treated condition: h 11.

8.2.2 *Length*

Unless otherwise agreed at the time of enquiry and order, the length and the tolerance on length shall be as specified in Table 2.

Table 2 TYPES OF LENGTH AND LENGTH TOLERANCES

Sl No.	Type of length	Length mm	Length tolerances mm	To be stated in order
(1)	(2)	(3)	(4)	(5)
i)	Manufacturing length[a]	3000 to 9000	±500	Length
ii)	Stock length[a]	3000 or 6000	0, +200 0, +200	e.g. stock 6000
iii)	Cut to length	Up to 9000	Corresponding to specifications with ±5 minimum	Length and tolerance

[a] Short bars: each bundle may contain a percentage of short bars.

NOTES
1 Dimensions ≤ 25 mm: the percentage is 5 % maximum, the length of these short bars being at the minimum two thirds the nominal length ordered.
2 Dimensions > 25 mm: the percentage is 10 % maximum, with the same restriction on the minimum length
3 If agreed at the time of enquiry and order bright products are delivered without any short bars.

8.2.2.1 The ends of the bars shall be cut square without disturbing the dimensional tolerances.

Table 3 – Tolerance Classes for rounds, squares and hexagons

Nominal Thickness mm	**Tolerances Class to IS 919 Part 2[a]**						
	h6	h7	h8	h9	h10	h11	h12
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1 < t ≤ 3	0.006	0.010	0.014	0.025	0.040	0.060	0.100
3 < t ≤ 6	0.008	0.012	0.018	0.030	0.048	0.075	0.120
6 < t ≤ 10	0.009	0.015	0.022	0.036	0.058	0.090	0.150
10 < t ≤ 18	0.011	0.018	0.027	0.043	0.070	0.110	0.180
18 < t ≤ 30	0.013	0.021	0.033	0.052	0.084	0.130	0.210
30 < t ≤ 50	0.016	0.025	0.039	0.062	0.100	0.160	0.250
50 < t ≤ 80	0.019	0.030	0.046	0.074	0.120	0.190	0.300
80 < t ≤ 120	0.022	0.035	0.054	0.087	0.140	0.220	0.350
120 < t ≤ 180	0.025	0.040	0.063	0.100	0.160	0.225	0.400
180 < t ≤ 250	0.029	0.045	0.072	0.115	0.185	0.290	0.460

[a] The above deviation values are negatively disposed about the nominal dimension. For example, a 20 mm nominal diameter having a tolerance class h9 has 20 mm – 0.052/+ 0 mm or 19.948/20.000 mm.

Table 4 Width Tolerances for Drawn Flats
(*Clauses 8.2.1.1*)

Sl No.	Width	Deviation		IS 919-2
	mm	mm	mm	Class
(1)	(2)	(3)	(4)	(5)
i.	$w \leq 18$	-	-	h 11
ii.	$18 < w \leq 30$	+0	-0.13	h 11
iii.	$30 < w \leq 50$	+0	-0.16	h 11
iv.	$50 < w \leq 80$	+0	-0.19	h 11
v.	$80 < w \leq 100$	+0	-0.22	h 11
vi.	$100 < w \leq 150$	+0.50	-0.50	
vii.	$150 < w \leq 200$	+1.00	-1.00	
viii.	$200 < w \leq 300$	+2.00	-2.00	
ix.	$300 < w \leq 400$	+2.50	-2.50	
x.	$400 < w \leq 500$	+1%	-1%	

Table 5 Thickness Tolerances for Drawn Flats
(*Clauses 8.2.1.1*)

Sr. No.	Thickness[b] mm	Deviation[a]		
		mm	mm	
(1)	(2)	(3)	(4)	(5)
i.	$3 < t \leq 6$	+0	-0.075	h 11
ii.	$6 < t \leq 10$	+0	-0.090	h 11
iii.	$10 < t \leq 18$	+0	-0.11	h 11
iv.	$18 < t \leq 30$	+0	-0.13	h 11
v.	$30 < t \leq 50$	+0	-0.16	h 11
vi.	$50 < t \leq 60$	+0	-0.19	h 11
vii.	$60 < t \leq 80$	+0	-0.30	h 12
viii.	$80 < t \leq 120$	+0	-0.35	h 12
ix.	$120 < t \leq 140$	+0	-0.40	h 12

NOTES
a The tolerances in this table apply to low carbon ($C \leq 0.20$ %) and low carbon free-cutting steels only. For all other steels, deviation may increase to 150 % of the mentioned tolerance class.
b For $w > 150$ mm and $t \leq 18$ mm the tolerance of the thickness is h12.

8.2.3 *Straightness Tolerance*

8.2.3.1 Unless otherwise agreed, the permissible deviations for straightness given in Table **6** and Table **7** shall apply**.** The methods for evaluating straightness are given in Annex B.

Table 6 — Deviation from straightness for rounds, squares and hexagons [a]

Product form	Steel group[b]	Nominal dimension	Deviation *Max* mm
(1)	(2)	(3)	(4)
Rounds	Non-alloy steels < 0.25 % C		1.0
	Non-alloy steels ≥ 0.25% C, alloy steels, quenched and tempered steels		1.5
Squares and hexagons	Non-alloy steels < 0.25 % C	t≤ 75mm	1.0
	Non-alloy steels ≥ 0.25% C, alloy steels, quenched and tempered steels	t≤ 75mm	2.0
	Non-alloy steels < 0.25 % C	t >75 mm	1.5
	Non-alloy steels ≥ 0.25% C, alloy steels, quenched and tempered steels	t >75 mm	2.5

[a] For the method of evaluating straightness *see* Annex B.
[b] *see* IS 7598

Table 7 — Deviation from straightness for flats

Product form	Steel group	Nominal dimension	Deviation *Max* mm	
			for w/t≥ 10:1	for w/t < 10:1
(1)	(2)	(3)	(4)	(5)
Flats	Non-alloy steels < 0.25 % C	*w* < 120	2	1.5
		w ≥ 120	2.5	2
	Non-alloy steels ≥ 0.25% C, alloy steels, quenched and tempered steels	*w* < 120	2.5	2
		w ≥ 120	3	2.5

[a] For the method of evaluating straightness *see* Annex B.

8.2.3.2 Any other details regarding measuring and sampling method for straightness tolerance of bright bars shall be agreed upon at the time of inquiry and order

8.2.4 *Out of Shape*

Maximum deviation from ‘out of shape’ shall be not more than half the specified tolerance.

8.2.5 *Edges of Non-round Bars*

Non-round bars, that is, square, hexagon and flat in widths up to and including 150 mm shall have sharp corners without radius. For widths over 150 mm the corner profile may be undefined within a distance of 0.5 'mm of the hypothetical edge, unless sharp corners have specifically been ordered.

9 SURFACE CONDITION

The surface quality of the steel product shall be one of the classes according to Table 8 ~~5~~. Drawn products shall have a smooth, scale free surface. Products in the final heat treated condition shall be free from loose surface scale, but may have surface discoloration or darkening.

NOTES
1 Drawn products may have minor surface imperfections, for example, pores, pits, scoring.
2 Non-circular sections will not have the same quality of surface finish as round sections.
3 Products in drawn and turned condition are not supplied with a specified surface finish.
4 Longitudinal surface cracks cannot be entirely eliminated from surfaces of drawn products without removal of material.
5 Products in the 'technically crack free by testing' condition are only available in the turned or turned and ground condition.
6 Bars shall be reasonably free from harmful internal defects.

9.1 Decarburization

9.1.1 No surface decarburization shall be permitted for turned and ground bars.

9.1.2 In cold drawn bars, total decarburization shall not be permitted. The maximum extent of partial decarburization that can be permitted for cold drawn bars will be guided by the maximum depth of defects ~~for Class 2~~ bars as given in Table 8. It however, a lower depth of decarburization is required, it shall be mutually agreed to between the purchaser and the manufacturer.

9.1.3 The depth of decarburization shall be checked as per the method specified in IS 6396.

TABLE 8 Surface Quality Classes

Condition	Class			
	1	2	3	4
(1)	(2)	(3)	(4)	(5)
Permissible depth of discontinuities	0.3 mm *Max* for $t \leq 15$ mm; 0.02t *Max* for $15 < t \leq 100$ mm	0.3 mm *Max* for $t \leq 15$mm; 0.02t *Max* for $15 < t \leq 75$ mm 1.5mm *Max* for t > 75mm	0.2 mm *Max* for $t \leq 20$ mm; 0.01t *Max* for $20 < t \leq 75$mm; 0.75mm *Max* for t > 75mm	Technically crack free by manufacture [e]
Maximum percentage of delivered weight with discontinuities in excess of specified level	4%	1%	1%	0.2%
Product form[a]				
Rounds	+	+	+	+
Squares	+	+(for $t \leq 20$ mm)[c]	-	-
Hexagons	+	+(for $t \leq 50$ mm)[c]	-	-
Flats	+[b]	-	-	-
Special Sections	+[d]	-	-	-
t = nominal thickness that means diameter of bars and distance across flats of squares and hexagons.				
NOTES a + indicates available in these classes, - indicates not commonly available in these classes. b Maximum depth of discontinuities refers to respective section (Width or thickness) c Crack detection with eddy current device not possible for $t > 20$ mm or $t > 50$ mm as indicated. d Reference dimensions to be agreed at the time of enquiry and order e The surface quality class shall be better than class 3 . The requirements and the kind of verification are to be agreed at the time of enquiry and order.				

10 SAMPLING

10.1 Sampling for Chemical Analysis

If the product analysis is required by the purchaser, at least one sample product shall be taken from each cast/lot.

10.1.1 For product analysis, the selection of sample shall be carried as per mutual agreement between the purchaser and the supplier. Product analysis shall not be applicable for rimming steel.

10.2 Sampling for Mechanical Tests:
For the purpose of Mechanical tests, samples shall be selected on the following basis:

Condition	*Number of Samples*
Peeled /Turned, Polished or Ground	One of every 20 tonnes or part thereof with a minimum one per cast
Cold Drawn	One of every cast
Cold Drawn, Heat-treated	One of every batch (not over 20 tonnes) with a minimum of one per cast

10.2.1 Test pieces for mechanical properties shall be taken in the direction of the fibre , the rolling direction.

10.3 Selection and preparation of samples and test pieces shall be done in accordance with IS 3711.

11 OTHER TESTS

11.1 If required and mutually agreed to between the purchaser and the manufacturer, the following tests may be carried out and test certificates furnished by the manufacturer:

a) Hardenability (*see* IS 3848);
b) Inclusion content (*see* IS 4163)
c) Grain size (*see* IS 4748);
d) Microstructure [*see* IS 7739(Part 1), IS 7739 (Part 2) and IS 7739 (Part 5)]
e**)** Crack testing (*see* IS 2595, IS 3658, IS 3664 and IS 3703);
~~f) Decarburization (*see* IS 6396);~~
f) Microscopic examination for depth of defects; and
g) Any other tests (that is, surface roughness in micron), etc.

11.1.1 Acceptance values and details of tests in absence of any Indian Standard shall be as agreed to between the purchaser and the manufacturer

12 RETEST

Should any one of the test pieces first selected fail to pass any of the tests specified in this standard, two further samples shall be selected from the same lot for testing in respect of each failure. Should the test pieces from both these additional samples pass, the material represented by the test samples shall be deemed to comply with the requirement of that particular test. Should the test pieces from either of these additional samples fail, the material represented by the test samples shall be deemed as not conforming to this standard.

13 SURFACE PROTECTION AND PACKING

A suitable clear temporary rust preventive shall be applied on all the bars to avoid rust during transit (see IS 1153 and IS 1154). The material shall be suitably packed in bundles- hessian wrapped to prevent sagging, corrosion and damage during transit.

14 MARKING

14.1 Each bar over 50 mm in diameter or of equivalent cross sectional area shall be stamped at one end with the cast identification and supplier's identification mark/ code. Bars of 50 mm in diameter or of equivalent cross sectional area and below shall be bundled together and tied with suitable steel strappings at 3-4 places along the length 'of the bars. The metal tag shall be securely attached to each bundle and shall bear the information such as supplier's name, cast heat number, size and mass, order No., etc.

14.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed there under, and the product(s) may be marked with the Standard Mark.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 919 (Part2) : 1993/ ISO 286-2 :2010	Geometrical Product Specifications (GPS) — ISO Code System for Tolerances on Linear Sizes Part 2 Tables of Standard Tolerance Classes and Limit Deviation for Holes and Shafts (*second revision*)
IS 1153:2021	Temporary Corrosion Preventives, Hard Film, Solvent Deposited — Specification (*third revision*)
IS 1154:2022	Temporary Corrosion Preventive Fluid, Soft Film, Solvent Deposited, Water Displacing – Specification (*second revision*)
IS 1956 (Part 3):2019	Glossary of Terms Relating to Iron and Steel Part 3 Long Products (Including Bars, Rods, Sections and Wires) (*second revision*)
IS 2595:2008	Industrial Radiographic Testing — Code of Practice (*second revision*)
IS 3658:1999	Code Of Practice for Liquid Penetrant Flaw Detection (*second revision*)
IS 3664:1981	Code Of Practice for Ultrasonic Pulse Echo Testing By Contact and Immersion Methods (*first revision*)
IS 3703:2023	Recommended practice for magnetic particle flaw detection (*third revision*)
IS 3711 : 2020/ ISO 377:2017	Steel and Steel Products — Location and Preparation of Samples and Test Pieces for Mechanical Testing (*third revision*)
IS 3848:1981	Method for end quench test for hardenability of steel (*first revision*)
IS 4163:2021/ ISO 4967: 2013	Steel — Determination of Content of Non-metallic Inclusions — Micrographic Method Using Standard Diagrams (*fourth revision*)
IS 4748 : 2021/ ISO 643 : 2019	Steel — Micrographic Determination of the Apparent Grain Size (*third revision*)
IS 6396: 2000	Methods of measuring decarburized depth of steel (*second revision*)
IS 7598:1990	Classification of steels (*first revision*)
IS 7739 (Part l):1975	Code of practice for preparation of metallographic specimens -general feature
IS 7739 (Part 2):1975	Code of practice for preparation of metallurgical specimens-Electrolytic polishing
IS 7739 (Part 5):1976	Code of practice for preparation of metallurgical specimens-Iron and steel and their examination
IS 8910:2022 /ISO 404:2013	Steel and Steel Products — General Technical Delivery Requirements (*second revision*)

ANNEX B

(*Clause* 8.2.3.1)

METHODS FOR EVALUATING STRAIGHTNESS

B-1 This annex specifies two methods for the evaluation of the straightness of the bright steel bars as provided for in 8.2.3. The method specified in B-2 is the preferred method and B-3 is an alternative method. The choice of method shall be as agreed at the time of enquiry and order.

B-2 PREFERRED METHOD

B-2.1 The bar shall be supported on a suitably so as to eliminate or minimize sagging.

B-2.2 A 1-m long straight edge shall be placed on the surface of the bar at any position along its length. No part of the straight edge shall be within 150 mm of the ends of the bar.

B-2.3 Straightness shall be determined by measuring the maximum gap between the bar and the straight edge by suitable means, for example, feeler gauge. The bar shall be deemed straight where the maximum gap does not exceed the values specified in **8.2.3.1.**

B-3 ALTERNATIVE METHOD FOR ROUND BARS

B-3.1 The round bar shall be supported on centres placed 1 m apart and capable of being rotated.

B-3.2 Straightness shall be measured by means of a suitable dial or indicator gauge placed at any position between the supporting centres.

B-3.3 The bar shall be deemed straight when rotating the bar through 360° the indicated reading is not greater than twice the deviation specified in **8.2.3.1.**

MTD 4:3 Subcommittee Meeting last three Meeting attendance

Sl No.	Date	Place	Chairperson
1. 41st meeting	28th July 2022	Manak Bhawan	Nirvik Banerjee
2. 42nd meeting	15th December 2022	Manak Bhawan	
3. 43rd meeting	28th April 2023	COEP Technological University, Pune.	

Sl No.	Name of Organization	Represented	1st	2nd	3rd	Attendance
1.	All India Induction Furnace Association, New Delhi	Sh A. K. Sharma Sh Prabhakar Mishra (Alt)	N	N	N	0/3
2.	AM/NS India, Hazira	Sh Deepak gupta Sh Kalpesh kumar Dave (Alt) Sh Hemant Pandhare	Y	Y	Y	3/3
3.	Bharat Heavy Electrical Ltd, Bhopal	Sh S K Mahajan Sh Arun Khare (Alt)	N	N	N	0/3
4.	Central Power Research Institute, Bengaluru R&D Organization	Shri G Kishore Kumar	Y	Y	N	2/3
5.	CORSMA	Sh Rajiv Chaturvedi Sh N K Sood (Alt)	Y	Y	N	2/3
6.	Defence Metallurgical Research Laboratory, Ministry of Defence, Hyderabad	Sh Ch. R V S Nagesh	N	N	N	0/3
	In individual capacity	Sh A.C.R.Das	N	N	N	0/3 (withdrawn)
7.	Institute of Steel Development and Growth, Kolkata	Sh P.L Rao Sh Sajal Kumar Ghorai (Alt)	N	N	N	0/3
8.	Indian Machine Tools Association	Sh Y. Balaramaiah	N	N	N	0/3
9.	JSW Steel Ltd Vasind / Bellary	Sh G V Ramana Shri Devasish Mishra	N	Y	Y	2/3
10.	JSW Steel Limited Raigad/Salem	Sh Subhasis Chakrabarty Sh B M Hasan (Alt)	N	N	N	3/3
11.	JSW Raigad	Sh Pankaj Khasne Sh Srimanta Sam	-	-	Y	0/1
12.	Jindal Steel and Power Limited, New Delhi	Sh Joy Dutta Sh Borkar	Y	Y	N	2/3
13.	Ministry of Defence (DGQA) Ichapur	Sh K Yadav Sh G. Subba Rao (Alt)	N	Y	Y	2/3
14.	Ministry of Steel (Govt of India), New Delhi	Sh Parmjeet Singh Sh Bhagirathi Pradhan (Alt)	Y	Y	Y	3/3
15.	Ministry of Ports, Shipping and Waterways, New Delhi	Sh Anil Pruthi Sh Ramji Singh (Alt)	Y	Y	Y	3/3
16.	Ministry of Commerce and Industry, Department for Promotion of Industry and Internal Trade, New Delhi	Sh T.S.G Narayannen Sh S.k Jain (Alt)	N	N	N	0/3
17.	Ministry of Defence (DGOFB), Kolkata	Sh RD Barma	N	N	N	0/3
18.	Ministry of Railways (RDSO), Lucknow	Sh M K Gupta Sh Shailesh Oraon	N	N	N	0/3

19.	Power Grid Corporation, Gurugram	Sh Manoj Kumar Gupta Sh Deepak Kr Sahoo (Alt)	N	N	N	0/3
20.	Rashtriya Ispat Nigam Limited, Visakhapatnam	Ms Ruchira Gupta Sh Shankar jee (Alt)	Y	N	N	1/3
21.	SAIL,Bhilai Steel Plant,Bhilai	Sh shrirang khankhoje Sh K.V. Shankar (Alt)	Y	N	N	1/3
22.	SAIL,Bokaro Steel Plant, Bokaro	Ms Biswasi Sunita Minz Ms Roselin Dodrae (Alt)	N	Y	Y	2/3
23.	SAIL , ISP	Sh A Dasgupta Sh Saikat De (Alt) Ms Preeti Dewangan(YP)	Y	Y	Y	3/3
24.	Society of Indian Automobile Manufacturers (SIAM), Delhi	Sh kartike Karwal (Alt) Ms Kanishka Chana	N	Y	Y	2/3
25.	Tata Motors Limited , Pune	Sh Shailesh Sonwane (Alt)	N	Y	Y	2/3
26.	SAIL, Rourkela	Sh Kuntal Patwari Sh Ramakrishnan R	-	N	N	0/2
27.	Steel Authority Of India Limited (SAIL), Research & Development Centre for Iron & Steel, Ranchi	Sh P.Pathak Sh S. Srikanth (Alt)	N	Y	Y	2/3
28.	The Tinplate Company of India Limited, Jamshedpur	Dr Sourajyoti Dey Sh Subrata Sadhu (Alt)	Y	Y	Y	3/3
29.	Tata BlueScope Steel Private Limited, Bengaluru	Sh Rajesh Maheshwari	Y	Y	N	2/3
30.	Tata Steel Ltd, Jamshedpur	Sh Avtar Singh Saini Sh Sudipto Sarkar (Alt) Sh G Senthil Kumar	Y	Y	Y	3/3
31.	Thyssenkrupp Electrical Steel India Private Limited, Nashik	Sh Kapil Kapoor	Y	Y	N	2/3

ZINC-ALUMINIUM-COATED STEEL WIRES

BUREAU OF INDIAN STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

MENTOR:
Mr Arun Puchakayala

Submitted by:
Ankur Kumar
MNIT, JAIPUR

Contents

Why standard formulation is required on Zinc-Aluminium Coated Steel Wires?

Zinc-aluminium-coated steel wires are used in a variety of applications, including bridge cables, electrical conductors, gabion wires, fencing, and others. These applications require a high degree of reliability and safety, so it is important to have standards that specify the properties and performance of these wires.

Here are some of the reasons why a standard is required on zinc-aluminium coated steel wires:

- **To ensure the quality and consistency of the product:** Standards help to ensure that zinc-aluminum-coated steel wires meet certain minimum requirements for properties such as tensile strength, elongation, corrosion resistance, and properties of coating. This helps to ensure that the wires will perform as expected in their intended applications.
- **To facilitate trade**: Standards can help to facilitate trade by providing a common set of requirements that can be used by manufacturers and buyers around the world. This can help to reduce trade barriers and make it easier for zinc-aluminum-coated steel wires to be traded internationally.
- **To protect consumers**: Standards can help to protect consumers by ensuring that zinc-aluminum-coated steel wires meet certain safety requirements. This can help to prevent injuries and damage caused by faulty wires.

Pre-Standardization Report: Zinc-Aluminium Coated Steel Wires

1. Subject Area:

The subject of this pre-standardization report is Zinc-Aluminium coated steel wires, focusing on their properties, manufacturing, potential applications, and sustainability impact. Adding Aluminium to the Zinc coating has significantly enhanced its corrosion resistance. However, some types of Zn-Al marginally reduced the cathodic protection at edges and scratches. To address the cathodic protection concern, Zn 5%Al alloy, known as galfan, can be utilized. Galfan offers the same level of cathodic protection as pure Zinc while demonstrating even better corrosion resistance. These wires are most beneficial in applications where long-term, low-maintenance performance is crucial. Moreover, galfan with a minimized fine-grained structure holds greater market value compared to conventionally produced galfan due to its heightened corrosion resistance.

The choice of engineering application depends on the type of steel wire used. For instance, steel wires with low or mild carbon content are employed in producing Gabion wires, whereas medium and high carbon content steel wires are suitable for conducting wires.

The popularity of these wire types is soaring due to their myriad advantages over conventional Zn wires, making them a preferred choice in various industries. They can be used for many applications like Gabion baskets, fish trawling nets, conductors, wire for animal cages, fencing, agriculture, etc.

2. Line Ministry of Government of India:

The Ministry of Steel, Government of India, oversees policies and regulations related to the steel industry, including the production and usage of Zinc-Aluminium coated steel wires.

3. Other Relevant Government Ministries:

a) Ministry of Commerce and Industry - Facilitating export-import policies and regulations.
b) Ministry of Environment, Forest, and Climate Change - Monitoring environmental impacts and sustainability measures.

4. Relevant Missions or Schemes of the Government:

- Production Linked Incentive (PLI) Scheme for Specialty Steel: This scheme was launched to promote the production of speciality steel in India. Zn-Al coated steel wires are one of the products covered under this scheme. The scheme provides a financial incentive of up to 20% of the incremental capital expenditure incurred by eligible companies.

- Scheme for Promotion of Technology Upgradation in the Steel Sector (SPUTS): This scheme was launched in March 2017 to promote the adoption of new technologies in the steel sector in India. Zn-Al coated steel wires are one of the products covered under this scheme. The scheme provides a financial incentive of up to 30% of the cost of technology upgradation.

5. Identification of Stakeholders:

a) Leading Industries - 1. Bedmutha Industries
2. Nirmal Group
3. Anordica
4. Bekaert

b) Leading MSMEs - 1. Southern Metals and Alloys Pvt. Ltd.
2. Kothari Metsol Pvt. Ltd.

c) R&D Organizations - 1. Nirmal Wires' R&D
2. IIT Bombay

d) Testing Laboratories - IIT KHARAGPUR,NIRMAL WIRES TESTING LABORATORY, CL Sahibabad

e) Consumer Organizations - Maccaferri- Minimol Korulla, StarLink Enterprises.

f) Academia - IIT Kharagpur, IIT Bombay

6. Export/Import Data:

- Nirmal Group has a monthly production capacity of 1500 mt**.**

9. Technology Scan at National Level:

- Wireless wires are mainly produced by the hot-dip coating process. In this process, wires after sufficient de-scaling and pickling are dipped in a hot bath of Zinc-Aluminum bath for sufficient time to have desired coating thickness. After it is cooled so that the coating adheres to the surface.

10. Technology Scan at International Level:

10.1. HOT-DIP COATING: The oxide-free steel wire passes through a molten zinc bath until the coating has the right thickness.

10.2.ELECTRO-PLATING: The steel wire passes through a chemical solution that contains the corresponding ions of the metallic coating. Next, electricity dissolves the anodes in the metal and transfers the ions onto the wire.

11. Sustainability Impact:

- Bekaert's Ranjangaon plant in India and have a zero liquid discharge water purification system. As a result, all industrial wastewater streams there are recycled and reused in the production process.
- The Nirmal group are also carrying r&d regarding galvanizing without the use of acids and flux.
- Goal 9 of SDG's goals fulfilled with the use and manufacture of such coated wire.

12. Other Relevant National and International Standards:

ASTM B750, ASTM B997, ASTM B802, ISO 19203

13. Constraints, if any:

The major ongoing challenges in the Indian steel wire industry are *unsteady availability* of steel wire rods of proper quality, *less to no awareness* of potential products and their potential uses in different infrastructure projects and agriculture, housing, horticulture, The price of the steel wires largely gets influenced by the cost of the raw material which is mainly imported.

LITERATURE SURVEY

This report explores ZINC-ALUMINIUM COATED STEEL WIRES, an innovative type of coated wire. Adding Aluminium to the Zinc coating has significantly enhanced its **corrosion resistance**. These wires are most beneficial in applications where **long-term, low-maintenance** performance is crucial. To address the cathodic protection concern, Zn 5%Al alloy, known as galfan, can be utilized. Galfan offers the same level of cathodic protection as pure Zinc while demonstrating even better corrosion resistance. Moreover, galfan with a minimized fine-grained structure holds greater market value compared to conventionally produced galfan due to its heightened corrosion resistance.

The 55%Al-Zn coating has good corrosion resistance, and **high-temperature oxidation resistance**(up to 350°c). and heat reflectivity characteristics

The choice of engineering application depends on the type of steel wire used. For instance, steel wires with low or mild carbon content are employed in producing *Gabion wires*, whereas medium and high carbon content steel wires are suitable for *conducting wires(ACSR)*. *Lead and cadmium*, and to a lesser extent tin and antimony, are known to cause intergranular corrosion in zinc-aluminium alloys. For this reason, it is important to maintain the levels of these elements below the limits specified.

The popularity of these wire types is soaring due to their myriad advantages over conventional Zn wires, making them a preferred choice in various industries.

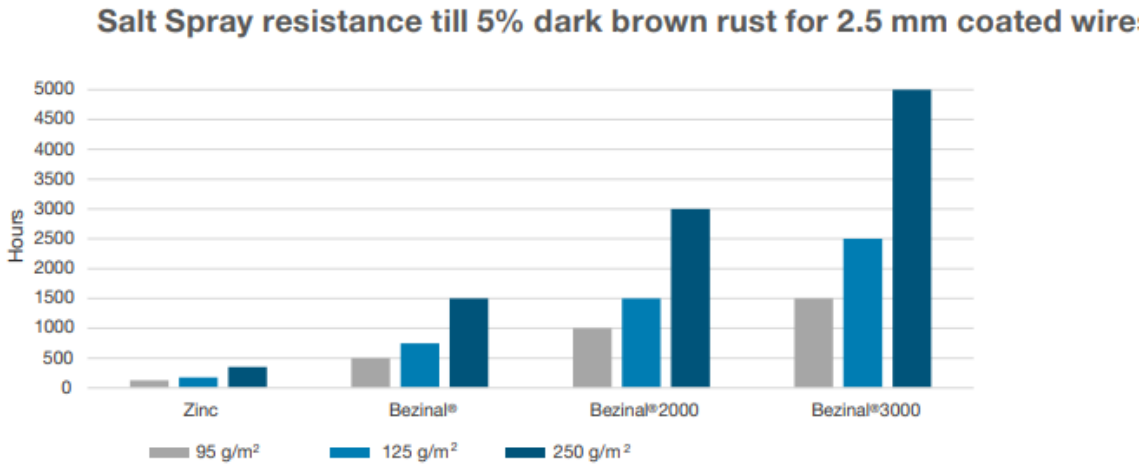
5 = Best
1= Worst

	Galfan	Hot Dip Galvanized	Electrogalvanized	Galvanneal	Galvalume	Aluminized	Zincrometal
Formability	5	3	5	3	3	2	5
Corrosion Resistance (bare)	4	3	3	2	5	5	2
Sacrificial Protection	5	5	5	5	3	1	2
Corrosion Resistance (formed)	5	3	3	3	3	2	2
Paint Adhesion	5	4	5	5	4	2	5
Corrosion Resistance (painted)	5	4	4	5	3	3	2
Weldability	3	4	5	5	2	1	2
Heat Resistance/Reflectivity	3	3	3	2	4	5	1
Relative Cost	3	4	2	4	3	3	5

FIGURE 9.7 Comparative properties of Galfan, Galvalume and other zinc or other hot dip coatings (Zinc Institute, 1987).

(from Zinc Handbook by Frank Porter)

*Salt Spray Test as per ISO 9227.



Bezinal=Zn-5%Al Bezinal@2000=Zn-10%Al Bezinal@3000=ZN-Al-2%Mn

Referenced standards and documents for report:

1. I have read some standards like **IS: 4826, 6745, 280, 2633** and **ASTM: B750, 997,802** for the formulation of the report.
2. I have also read **Zinc Handbook by Frank Porter** to learn about Zinc-Aluminium coating properties.
3. I have understood the manufacturing process and some mechanical and chemical tests used for the final preparation of coated wires.

Questionnaire:

Feature	Description	Remarks
Scope	Application of the wire clearly indicating the intended uses and base steel. Need for standard?	IN DRAFT Lack of related Indian standard
Raw Material	Details of standards used for procuring Grades of Zn, Grades of Al, base steel	IN DRAFT
References	Customer specific standard, supplier specification or any other reference document	NO

Manufacture	Hot-Dip coating or electrolytic deposition. In the case of hot dip-coating, how to check the bath composition? Is any stress-relieving carried out on base steel before coating? Any stress-relieving carried out on coated steel wire?	Hot-dip Spectrometry yes, during applying layer borax No
Specific Tests	Tensile (YS, TS, %EL or reduction in area Variation of properties with respect to applying condition (as-coated, annealed, normalised or any other special heat treatment)	TS: IS 1608
Coating Test	Adhesion test, mass of coating, durability tests Long term test, if any? Is any test method under development? How to ascertain that Zn Al coated wire offers resistance that Zn coated wires covered under IS 280?	IN DRAFT Salt-Bath test No Test results
Sizes/Shape	Diameters/shapes of wires produced	As per IS: 280

Dimensional Tolerances	Tolerances on wires ISO 22034-2:2016(en) Steel wire and wire products — Part 2: Tolerances on wire dimensions??	∓2.5% As per ASTM B750
Marking and packing	The practice adopted for marking and packing of the product	
Supply condition	as-coated, annealed, normalized, or any other special heat treatment Following IS 8910:2022 for supply or not?	Annealed No
Sustainability	Measures taken to control/mitigate pollution for making the produce sustainable Efforts taken to reduce emissions? Is any green technology roped in?	Industry far from locality and plantation

Industrial Visit data:

- During my industrial visit, I had the privilege of exploring one of the finest companies in the industry, renowned for its exceptional wire production and related products. Nirmal Wires Pvt. Ltd., is the leading producer in this domain.
- The focus of the visit was centred around Zinc-Aluminium coated Steel wires, an innovation in the field of galvanized wires. Nirmal Wires are among the pioneers in manufacturing such coated wires. In fact, they hold the distinction

of being the sole company currently engaged in the production of such wire in India.

- ❖ Steel grade range from 1006 carbon to 1082 carbon. Material made out of it is soft as well as hard as per customers requirement. Quantity can go up to 1500 mt per month at the present zn-Al capacity. They have also registered the product under the Trademark name NIZNAL**.**
- ❖ The sizes of wires produced are from 0.125mm to 10mm with a tolerance of 2.5%.
- ❖ Zinc with purity >99.99% & Al with purity >99.7% is used to make Zn-Al ingots.
- ❖ Indian Standards like IS 1906 and others are used for mechanical tests.
- ❖ For the coating test, coating mass is determined as per IS 6745, and coating uniformity as per IS 2633, adhesion test as per IS 4826.

Test results on different sizes of Zn-10%Al coated wires

Coil no.	Diameter	Composition				Tensile Strength	Mass of Coating
	(mm)	%c	%Mn	%S	%P	(N/mm^2)	min 10% Al, rem Zn (gm/m^2)
specification	3.4∓2.5%					450-550	Min. 250
1	3.4	0.09	0.52	0.006	0.025	525	298
2	2.2	0.008	0.54	0.008	0.022	500.78	255
3	2.7	0.09	0.55	0.007	0.018	496	280

Elongation	Adhesion	Dip test	Wrapping
G.L=200mm	4D*10 turns	at(18∓2°c)	1D*8 turns on
		No Cu deposit on surface	
Min. 10%	Zn-Al layer shouldn't crack	3*1 mins.	No breakage/ split
11	pass	pass	pass
12.5	pass	pass	pass
12.5	pass	pass	pass

Manufacturing process:

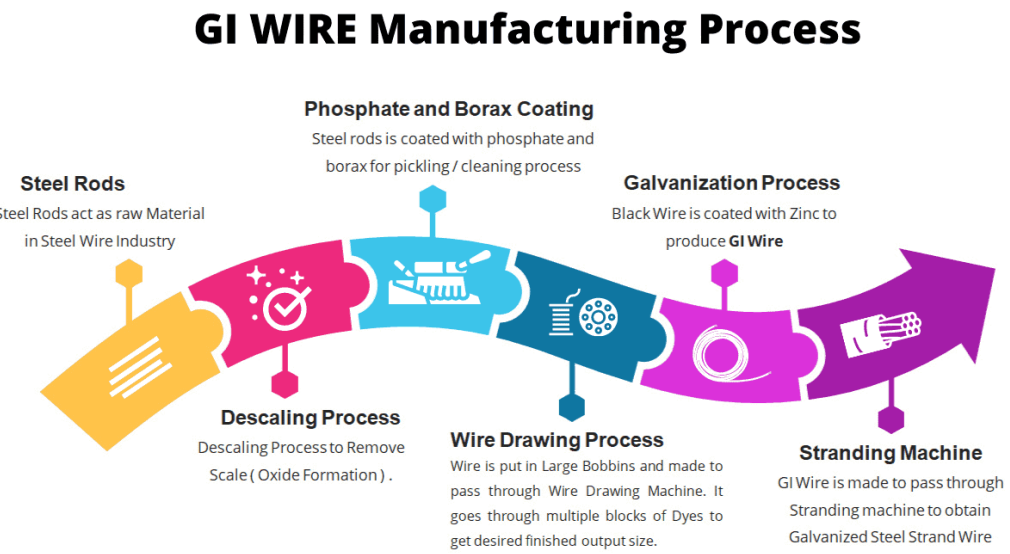
- The manufacturing process of hot-dipped galvanized Zn-Al alloy-coated steel wires consists of three primary stages: surface treatment, wire drawing, and GI process (softening and galvanizing). Each stage plays a crucial role in achieving the desired properties and quality of the coated wires.
- Surface Treatment: In this stage, the base steel wire undergoes de-scaling. Surface treatment is commonly referred to as pickling. Pickling involves the removal of any impurities, such as oxides, scales, or other contaminants, from

the surface of the wire. This process typically utilizes an HCl solution to clean and then it is washed with water to remove the acid from the surface. Further, a layer of borax is applied to smoothen the surface.

- ❖ Wire Drawing: After the surface treatment, the pickled steel wire is subjected to the wire drawing process. Wire drawing involves passing the wire through a series of dies with progressively smaller diameters to reduce its diameter and achieve the desired wire size.
- ❖ From a specific diameter of Die, the more size we reduce, the more dies of progressively smaller diameter are required.
- ❖ G.I. process: Following the wire drawing stage, the wire undergoes a lead bath solution at 700 degrees Celsius and then pickling is done to remove any scale, oxide formation for softening treatment to improve its ductility and reduce the risk of brittleness. After the wire is hot dipped galvanized in a Zn-Al bath and cooled for coating deposition. Then the wires are coiled and stored in appropriate condition.

BASIC OUTLINE OF MANUFACTURING PROCESS:

SURFACE CLEANING → DRAWING → GALVANIZING → PACKING



ZINC-ALUMINIUM-COATED STEEL WIRES

(P-Draft)

1. SCOPE

This standard specifies the requirements and test methods for hot-dipped galvanised Zinc-Aluminum alloy-coated steel wires. The hot-dipped galvanised Zn-Al alloy coating provides significantly improved corrosion protection, and heat resistance compared to traditional zinc-coated wires, offering around three times the level of corrosion resistance.

2. REFERENCES

IS 4826:1979 Hot-dipped galvanised coatings on round steel wires.

IS 1956: 2019 Glossary of terms relating to iron and steel: long products.

IS 7887: 1992 Mild steel wire rod for general engineering purposes.

IS 7904: 2018 High carbon steel wire rods

IS 2629: 1966 Recommended Practice for Hot-Dip Galvanizing of Iron and Steel

ASTM B750 Standard Specification for GALFAN (Zinc-5% Aluminum-Mischmetal) Alloy in Ingot Form for Hot-Dip Coatings

ASTM B997 Standard specification for Zinc-Aluminium Alloys in Ingot Form for Hot-Dip Coatings

IS 228 Methods for chemical analysis of steels

3. TERMINOLOGY

For this standard, the definitions given in IS 1956 (Part 5) shall apply.

4. SUPPLY OF MATERIALS

General requirements relating to the supply of material shall conform to IS 1387.

5. GENERAL REQUIREMENTS

5.1 QUALITY OF ZINC: Zinc ingots conforming to at least Grade Zn 99.99 shall be used for galvanising.

5.2 QUALITY OF ALUMINIUM: Aluminium ingots at least 99.7% pure shall be used for galvanising.

5.3 ZINC-ALUMINIUM INGOT: Ingots as per ASTM B997 should be used for galvanizing.

6. MANUFACTURE

The manufacturing process of hot-dipped galvanised Zn-Al alloy-coated steel wires consists of three primary stages: surface treatment, wire drawing, and GI process(softening and galvanising). Each stage plays a crucial role in achieving the desired properties and quality of the coated wires.

Surface Treatment: In this stage, the base steel wire undergoes de-scaling. Surface treatment, commonly referred to as pickling. Pickling involves the removal of any impurities, such as oxides, scales, or other contaminants, from the surface of the wire. This process typically utilizes an HCl solution to clean and then it is washed with water to remove the acid from the surface. Further, a layer of borax may be applied to smoothen the surface.

Wire Drawing: After the surface treatment, the pickled steel wire is subjected to the wire drawing process. Wire drawing involves passing the wire through a series of dies with progressively smaller diameters to reduce its diameter and achieve the desired wire size.

G.I. process: Following the wire drawing stage, the wire may undergo a lead bath solution at 700 degrees Celsius and then pickling is done to remove any scale, oxide formation for softening treatment to improve its ductility and reduce the risk of brittleness. After the wire is hot-dipped, it is galvanized in a Zn-Al bath and cooled for coating deposition.

7. CHEMICAL COMPOSITION

7.1. BATH COMPOSITION

Tolerance of the bath composition as per(ASTM B750)

	ALUMINIUM CONTENT(%)	TOLERANCES(%)
1.	5	4.2-7.2
2.	10	8.4-14.4
3.	15	12.6-21.6

The remainder is Zinc with some amount of trace elements.

7.2.COMPOSITION

7.2.1 For the chemical composition of low and medium-carbon steel wires refer to Table 1 of IS 7887: 1992.

7.2.2 For the chemical composition of high carbon steel wires refer to Table 1 of IS: 7904

7.2.3 Chemical composition of the ingot should be as per ASTM B997.

8. SIZES

Mild steel wires for general engineering purposes shall be from 0.125mm to 10mm as per IS 280: 2006.

Note: Sizes other than those mentioned above shall be supplied subject to agreement between the purchaser and the manufacturer.

9. TOLERANCES

Tolerances permitted on the diameter of wire shall be as given in Table 1

Tolerances on the Diameter of wire

(All dimensions in millimetres)

Size of wire	Tolerance	Maximum difference Between two readings Taken on any two Diameters of the Cross-section
(1)	(2)	(3)
All sizes	∓2.25 per cent with a Minimum of ∓0.025	∓2.25 per cent with a Minimum of ∓0.025

10. SAMPLING

10.1 The degree of sampling shall be that specified in the standard governing the wire or article fabricated from the wire. In the absence of such a standard, the degree of sampling shall be agreed to between the galvanizer and the purchaser.

10.1.1 The purchaser shall select the coil for testing.

10.1.2 Portions of wire which are damaged shall not be used for samples.

11. ADHESION OF ZINC-ALUMINIUM COATING

-In accordance with IS 4826: 1979

-The test specimen consists of a piece of wire long enough to allow the test to be carried out correctly.

-The test specimen is wound around a cylindrical mandrel so as to form close spirals as specified in Table 3.

Table 3. **ADHESION TEST**

Nominal Diameter of Wire(mm)	Minimum Complete Turns Wraps	Ratio Between Mandrel Diameter and Wire
(1)	(2)	(3)
Up to and including 3.55	10	4
Over 3.55 and up to Including 7.10	10	6
Over 7.10 and up to	3/4 (one 90° bend)	6 Including 10.00

Procedure

1. Winding shall be carried out at a rate of at most 15 turns per minute.

2. When so wound or bent around the mandrel, the Zn-Al coating shall remain adherent to the steel wire. It shall be considered as meeting this requirement if owing to such winding or bending, it does not flake off, nor crack to such an extent that it is possible to remove any alloy coating by rubbing with bare fingers.

12. Coating requirement

12.1. Uniformity of coating

1. Uniformity of Zinc-Aluminium coating shall be determined according to IS: 2633-1986.

2. At all points more than 25 mm from a cut end, the coating shall be able to withstand the minimum number of dips specified in Tables 1 and Table 2.

Table 1. Minimum Mass of Coating and Number of Dips

Nominal Diameter of Galvanized Wire		Light Coated Wires			Heavily Coated Wires		
Above	Upto and Including	soft + hard			soft + hard		
		Mass of Coating (g/m^2)	number of dips 1 min	½ min	Mass of Coating (g/m^2)	Number of dips 1 min	½ min
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
0.20	0.32	15	—	-—	45	—-	-—
0.32	0.40	15	—	—-	70	-—	1

0.40	0.50	15	—	-—	90	1	—-
0.50	0.56	20	—-	—-	100	1	—-
0.56	0.63	20	—-	—-	110	1	—-
0.63	0.71	20	—-	—-	120	1	—-
0.71	0.80	30	—-	—-	140	1	1
0.80	0.90	40	—-	—-	150	1	1
0.90	1.00	40	—-	—-	150	1	1
1.00	1.25	40	—-	—-	160	2	1
1.25	1.40	40	—-	—-	180	2	—-
1.40	1.60	50	—-	—-	190	—	
1.60	1.80	60	—-	1	200	—-	—-
1.80	2.24	60	—-	1	210	—-	—-
2.24	2.80	70	1	—-	230	2	1
2.80	3.15	70	1	—-	240	3	—-
3.15	3.55	80	1	—-	250	3	—-
3.55	4.00	90	1	1	260	3	—-
4.00	4.50	100	1	1	275	3	1
5.00	7.10	110	1	1	290	3	1
7.10	10.00	110	1	1	300	4	—

Soft indicates galvanized after drawing and annealing.

Hard indicates galvanized after drawing, but without annealing.

Table 2. REQUIREMENTS FOR MEDIUM COATING

Nominal Diameters of Galvanized Wire, mm	Mass of Coating g/m^2	Number of Dips 1 min	½ min
0.200 and up to 0.32 inclusive	30	—	—
Above 0.32 to 0.40 inclusive	35	—	—
0.40 to 0.50	45	—	—
0.50 to 0.71	60	—	1
0.71 to 1.00	75	—	1
1.00 to 1.40	90	1	—
1.40 to 1.80	95	1	—
1.80 to 2.24	105	1	—
2.24 to 2.50	110	1	1
2.50 to 3.25	120	1	1
3.25 to 4.00	135	1	1
4.00 to 5.00	150	2	—

12.2. FREEDOM FROM DEFECTS

The zinc-Aluminium coating shall be uniform, adherent, reasonably smooth, and free from such imperfections as flux, ash and dross inclusions, patches, black spots, pimples, lumpiness, runs, rust stains, fat white deposits, and blisters (the terms have been defined in IS: 2629-1966).

12.3. Mass of Zinc-Aluminum Alloy Coating

When determined per A90/ IS: 6745-1972, the mass of Zinc-Aluminium alloy coating shall not be less than the mass specified in Table 1. For medium coating, the requirements given in Table 2 shall apply.

13. PACKING

Each coil of wire shall be suitably bound and fastened compactly. If the purchaser requires, each coil shall be protected by suitable wrapping.

14. MARKING

Each coil of wire shall be marked legibly with the finish, size of wire, type of coating, lot number, and name of the manufacturer.

REPORT ON

HOT ROLLED MEDIUM AND HIGH CARBON STEEL SHEETS, PLATES, AND STRIPS

Submitted By:

Ketan Dakhare

MNIT JAIPUR

CONTENTS

Why standard formulation is required on Hot rolled medium and high carbon steel flat products?

Hot rolled medium and high carbon steel flat products are used widely for various applications such as seat tongs, diaphragms, chain links, and in the automotive industry. These have large applications and need quality control checks and safety checks too. So it is important to have standard for the hot rolled medium and high-carbon flat products.

Some of the reasons for having standards for hot rolled medium and high carbon steel sheets, strips, and plates are

- Quality and Consistency: Standards define benchmarks for quality and performance. By adhering to the standards, products, and services can meet minimum requirements, providing consistent and reliable experiences to the user.

- Efficiency: Standards streamline processes and workforce by providing a common framework, which can lead to increased efficiency in manufacturing, development, and reducing errors.

- Customer confidence: When a customer sees that a product or service adheres to recognized standards they gain confidence in its quality and safety. This can positively impact purchasing decisions.

- Trade Efficiency: Standards can help to facilitate trade by providing a common set of requirements that can be used by manufacturers and buyers around the world. This can help to reduce trade barriers and make it easier for hot-rolled steel flat products to be traded internationally.

SUBJECT AREA

Hot rolled medium and high carbon steel sheets, plates, and strips:

The subject area of this pre-standardization report focuses on hot rolled medium and high-carbon steel sheets, plates, and strips. The Medium and high-carbon steel products exhibit superior strength, hardness, and wear resistance compared to low-carbon steel sheets.
It has various engineering applications such as automobile, mechanical, automobile industry, and others. Hot rolled medium and high carbon steel sheets, plates, and strips are a type of steel that is produced by rolling a heated steel slab into a thin strip. The carbon content of these steels is typically between 0.25% and 1.20%.
The hot rolling process is a metalworking process where steel is heated above its recrystallization temperature and then passed through a series of rollers to achieve the desired thickness and shape. This process enhances the materials mechanical properties making it suitable for a wide range of applications.
Medium Carbon steel contains a carbon content between 0.25% and 0.50%. High Carbon steel contains carbon ranging from 0.60% to 1.00%. It offers excellent hardness. High Carbon steel is commonly used in cutting tools, springs, knives, and wear-resistant components. It has wide applications such as seat tongs, diaphragms, chain links, etc.

LINE MINISTRY OF GOVERNMENT OF INDIA

Ministry of Steel:
The Ministry of Steel deals with the formulation of all the policies regarding steel production, distribution, and pricing in India.

OTHER RELEVANT GOVERNMENT MINISTRIES:

- Ministry of Commerce and Industry
  It deals with trade policies, exports, and imports, which can impact the steel industry's international transactions.
- Ministry of Environment, Forest, and Climate Change
  It is a nodal agency in the administrative structure of the central government for the planning, promotion, and coordination of India's environmental policies and programs. It deals with policies related to greenhouse gas emissions and net zero waste policies which also is related to the steel sector.

IDENTIFICATION OF STAKEHOLDERS

- **Leading Industries-large scale enterprises:**
  1)JSW STEEL PLANT– It is one of the leading producers of hot rolled products. There are two central manufacturing units of hot rolled products situated at Vijaynagar (Karnataka) and Dolvi(Maharashtra). At Vijaynagar, HSM-1 has commissioned a capacity of 3 MTPA, and HSM-2 has commissioned a capacity of 5 MTPA, equipped with sizing presses and an automatic line inspection facility. It is one of the widest Hot Strip mills in India, capable of rolling up to 2150 mm. JSW Steel’s Dolvi unit in Maharashtra has commissioned a capacity of 3.6 MTPA.

2)TATA STEEL PLANT– It is one of the leading producers of hot rolled products. There are two central manufacturing units located in Jamshedpur and Kalingnagar. These two plants have Hot Strip Mills, which produces hot rolled steel flat products.

- **Testing Laboratories:**
  JSW Steel plant has its testing laboratory, which is NABL accredited. Here all the products manufactured in the plant undergo chemical and mechanical tests. The quality of the product is checked through testing and provide data regarding the same.

  BIS Labs are also laboratories with adequate testing equipment and are among the top-notch laboratories. Here many tests can be carried out for the products.

- **Consumer Organizations:**
  Consumer organizations can cover a wide range of areas and focus on various consumer-related concerns. The common issues may include consumer rights, product safety, fair trade and pricing, and sustainability concerns.

- **Environmental Organizations:**
  The Ministry of Environment, Forest and Climate Change(MoEFCC) is currently stressing sustainability and greenhouse gas emissions reduction at a broader scale. As steel is produced in many quantities in our nation, the steel industry has an environmental impact directly. So to oversee the climatic impact, it is necessary to have environmental organizations as part of the panel for the same.

PLAN OF ACTION

- My research for the product included the study of various international and national standards and the industrial visit. The industrial visit paved a path for understanding manufacturing methods, testing methods, and various developmental operations regarding the product under standardization.
- I prepared a plan of action for the industry visit, which included several parameters; the questionnaire helped extract each detail about the hot rolled medium and high carbon steel flat products. Below is the questionnaire prepared by me:

Sr No	Area of questions	Questions
1)	**Product Specification**	1) What are the typical dimensions (length, breadth, width) of the hot rolled medium and high carbon steel sheets, strips, and plates produced by JSW steel? (Product portfolio) 2) What carbon grades are commonly used for manufacturing hot rolled medium and high carbon steel sheets, plates, and strips? Do you follow any standards for the same? If so, please specify the standards for the same.
2)	**Manufacturing Process**	1) What are the quality control measures and inspections carried out during the manufacturing process or after it? 2) What are the operational limitations w.r.t grades and specific elements? 3)In which grades do they face problems, or which grades are more technically demanding during manufacturing?
3)	**Testing and evaluation**	1) What are common tests you proceed with here for the hot rolled medium and high carbon steel sheets, plates, and strips? 2) Are there any specific testing standards(Indian) or protocols followed by the industry here? (IS 3711; ISO 6929) 3) How do you ensure the consistency and reliability of the test results for the hot rolled medium and high carbon sheets, plates, and strips?
4)	**Performance and applications**	1) Are there any challenges and applications

		with the use of hot rolled medium and high carbon steel products? 2) How do you assess the performance of these products in terms of durability and other relevant parameters? Are there any standards you use for the same?
5)	**Marking and Packing**	1) Practice adopted for marking and packing of the product.
6)	**Supply condition**	Do you follow IS 8910:2022 for supply or not?
7)	**Sustainability**	1)Measures taken to control pollution to make the product sustainable. 2)Do you follow any protocols to keep a check on carbon emissions, and which measures do you take to reduce emissions?
8)	**Feedback and suggestions**	1)Based on your experience, what improvements or modifications would you recommend to standardize these products? 2) What is the product protection followed during its use, transport, and storage?

Plan of Action for industrial visit and Report

1) I proceeded on the Industrial visit to study production techniques, Quality control, heat treatment processes, testing, and other important aspects of Hot Rolled flat products.

2) Interaction with the head of the industry assessing quality control and enquiring about products such that standards are being followed for the products.

3) I asked all the questions as prepared in the questionnaire.

4) I collected all the specific data such as chemical composition, dimensions, and amount of manufacturing of each product and will ask for the same.

5) I gathered information about the company's customers and obtained Test certificates of HR material supplied to them. If possible, copies of Technical delivery conditions (TDC) also. This

will give important insight into the product and its specifications and help in the standard formulation.

5) I gathered export data and expansion plans by the industry and market capital of the product in the country and outside the country.

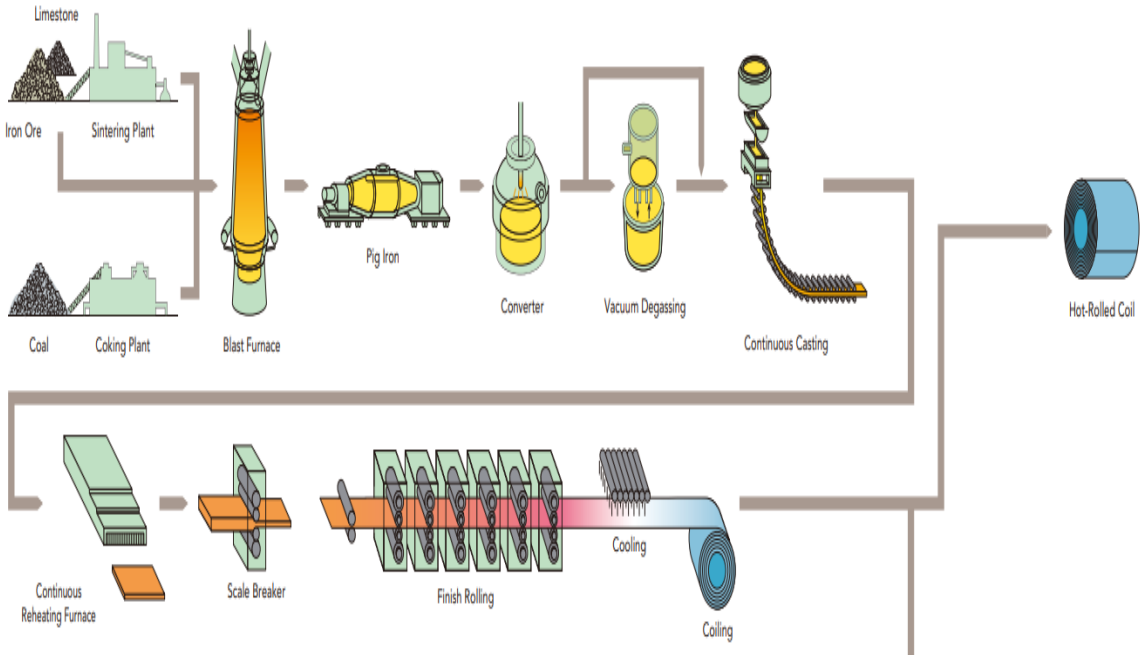
6) I talked about economic and environmental sustainability with keeping in mind the quality of the product.

7) I asked his views on modifying the standards they are currently following for the product, which will enhance quality and fulfill the demand of the customers in the market.

8) After the data collection from the industry visit, I analyzed the data and planned for the pre-standardization report accordingly.

MANUFACTURING PROCESS

The below diagram depicts all the processes for producing hot rolled medium and high carbon steel flat products. These are processes carried out for the production of hot-rolled flat products. For steels, hot rolling is carried out at 850-1200 degree Celsius, in the austenitic phase. During each rolling pass, strain is imparted to the material which leads to work hardening.
During my industrial visit, I visited Steel Melting Shop(SMS) and Hot Strip Mill(HSM) departments where the production is carried out for hot rolled medium and high carbon steel flats.



INDUSTRIAL VISIT DATA

I visited one of the most prominent steel-producing industries, JSW Steel, Bellary plant. My area for the pre-standardization report is hot rolled medium and high carbon steel sheets and plates. So JswSteel, Bellary plant is one of the largest industries producing tons of hot rolled products, including medium and high carbon grades. I studied hot-rolled production. Processes and testing methods. The variety of consumers have various needs, and as per their needs, the testing is carried out in this arena considerably hardness is generally tested. In some cases, inclusion control testing is also carried out. The laboratory at Jsw Steel is NABL accredited, so the testing results of the products are at a top level compared to any labs. These are the major grades in hot rolled medium and high carbon products, which are produced at the industrial level at JSW STEEL and other prominent steel-producing companies such as TATA STEEL and Nippon Steel(AMNS) in India.

Standard	Spec	Grade	Remarks	FY22 Prod in tons	FY23 Prod in tons	FY24 (till May) Prod in tons
EN	10083	20MnB5		212	1865	
EN	10083	22MnB5		1624	3746	489
EN	10083	26MnB5		690	1386	503
EN	10083	34MnB5		2825	914	
SAE		1030_Mod	Mn: 1.1-1.5	20731	12458	521
SAE		1035_Mod	Mn: 1.1-1.5	6054	2560	
SAE	J403	1536		8649	12268	3132
SAE	J403	1541		17064	21784	1571
SAE	J403	1020		26106	18465	3678
SAE	J403	1021		6060	1988	708
SAE	J403	1026		24867	18502	4341
SAE	J403	1035		495		
SAE	J403	1040		12200	6941	
SAE	J403	1045		2044	2586	622
EN	10083	C45		4617	5314	1540
EN	10083	C50		5869	4655	
SAE	J403	1055		11179	9118	1863
SAE	J403	1060		8823	6507	1430
SAE	J403	1080		113	1174	
DIN	50CrV4	50CrV4		1789	2324	1126
EN	10027	58CrV4		2536	1147	487
EN	10132	16MnCr5		4183	3491	794
SAE	J403	8620		821	883	

Key Takeaways:

- With respect to the manufacturing process, the steel is heated upto austenitic phase(750-800 degrees Celsius) then water cooled after passing through rollers which brings it up to 600-650 degrees Celsius which is in pearlitic structure.
- No heat treatment is carried out in coiled condition and the coils and sheets are delivered in asrolled condition itself; the consumer further carries out the heat treatment as per their final use of the hot rolled flat product.
- With respect to heat treatment condition at delivery of the flat products, it is in an untreated condition.
- The mechanical tests are carried out in as rolled condition only as the delivery condition for the flats are as rolled condition only. The mechanical tests which need to be carried out are entirely on the basis of the agreement between the consumer and supplier. As the consumer further carries out the heat treatment on their own as per their final requirement. So generally subject to agreement between supplier and consumer hardness and inclusion control tests are carried out for the medium and high carbon grades.
- The hot rolled medium and high carbon grades are used for chain parts, automotive parts, diaphragms, seat tongs, etc.
- With respect to the adoption of **ISO 683-1**. Modifications are required in line with other standards and present practice. Additional grades are required to add as per present import data and Indian industry production. This standard can be referred to for formulation of the BIS standard.We need to check for other parts of ISO 683 to verify grades under production in India and imported as mentioned above. As the standard ISO 683-1 only deals up to 0.65% carbon grades but in India, there is production of up to 0.80-0.90% carbon grades as well as some alloyed steel grades so it is important to add all steel grades in a single standard only.

INFORMATION GATHERED CONCERNING QUESTIONNAIRE

- Standards related to the production of hot rolled medium and high carbon steel sheets, plates, and strips, including standards related to different grades and practices, are SAE standard grades(1020,1030,1050,1070,1541,1536);EN 10083, EN 10028; JIS 4051; SAE J403.
- Concerning the deoxidation process of these products, steel is produced in killed conditions only in industries. Still, subject to agreement between the supplier and consumer, semi-killed steel can be produced.
- Concerning testing methods for mechanical properties for hot rolled medium and high carbon steel sheets, plates, and strips, mechanical tests carried out are:
  1) Hardness Test is carried out for the flat products; these can be carried out by IS 1586-2.
  2)In some cases, by agreement between supplier and consumer, an inclusion control examination is carried out by IS 4163:2004.
  3)The mechanical testing is entirely dependent on the end use of the product by the consumer, as studied from the Technical Delivery Condition.

STUDY FOR THE REPORT & LITERATURE SURVEY

- I studied the international standards and Indian standards for my pre-standardization report and industrial visit. I studied EN standards such as EN 10083, EN 10025, EN 10028, JIS 4051, IS:2062,1079,5986,2002,10748, and some ASTM standards to identify major grades for the product.
- During my industrial visit at the Jsw steel Bellary plant, I studied production techniques and processes for the hot rolled flat products. I understood the necessary mechanical tests required for the product.
- I analyzed and understood the various standards, TDC(Technical Delivery Conditions), and product requirements at the industrial level and developed my report.
- The production data is shown in the above table for the hot rolled medium and high carbon grades in the Jsw Steel Bellary plant.
- Key Terms:
  Descaling - Removal of surface scale from a hot-worked or heat-treated product by pickling, shot-blasting, etc. Also removal of scale during hot working by the application of steam under high pressure, water, coal dust, brushwood, oil, etc.
  Sheet - A hot or cold-rolled flat product, rolled in rectangular sections of thickness below 5 mm and supplied in straight lengths. The width is at least 100 times the thickness and the edges can be milled, trimmed, sheared, or flame cut. A sheet can also be obtained by cutting off strips.
  Slab - A semifinished rolled, forged, or continuously cast product intended for re-rolling or forging. The cross-section is rectangular. The thickness does not exceed one-third of the width.
  Strip - A hot- or cold-rolled flat product and rolled approximately in a rectangular cross-section of thickness usually 10 mm and below with mill, rolled, trimmed, or sheared edges and supplied in coil or flattened coil (straight length) form. Usually, an arbitrary width is chosen to demarcate between narrow and wide strips. The width chosen for such demarcation varies from country to country.

IMPORT DATA

The below table demonstrates the quantity of hot rolled medium and high carbon steel flat products imported in India consisting of sheets, strips, and plates. The quantity is mentioned in a million tonnes. The below data illustrates different grades, which establish requirements of various grades in the country.

Sr. no.	Product Description	Grade_name	Quantity (Tonnage)	Composition
1	HOT ROLLED PICKLED AND ANNEALED STEEL COIL OF GRADE S35C FOR AUTOMOTIVE USAGE	S35C	222.565	High C
2	HOT ROLLED STEEL STRIP IN COILS PICKLED AND OILED	S45C	156.921	High carbon not covered under IS for HR flat steel under QCO.
3	HOT ROLLED STEEL STRIP IN COILS PICKLED AND OILED	S45C	113.515	High C
4	HOT ROLLED STEEL SHEET IN COIL FOR PIPE MAKING AND AUTOMOTIVE USAGE	SAE1530K	236.95	C> 0.35% for HR Steel
5	HOT ROLLED STEEL SHEET IN COIL FOR PIPE MAKING AND AUTOMOTIVE USAGE	NPH670-ASB 26G	1599.55	High Carbon (>0.25)
6	HOT ROLLED STEEL SHEET IN COIL FOR PIPE MAKING AND AUTOMOTIVE USAGE	NPH490	145.38	High Carbon (>0.25)
7	HOT ROLLED STEEL SHEET IN COIL FOR PIPE MAKING AND AUTOMOTIVE USAGE	NPH470M	465.14	High Carbon (>0.25)
8	HOT ROLLED STEEL SHEET IN COIL FOR PIPE MAKING AND AUTOMOTIVE USAGE	NK1536M	2839.5	High Carbon (>0.25)
9	HOT ROLLED STEEL SHEET IN COIL FOR PIPE MAKING AND AUTOMOTIVE USAGE	NA001	25.98	High carbon equivalent (>0.45)

Sr. no.	Product Description	Grade_name	Quantity (Tonnage)	Composition
10	Hot rolled steel coil of grade: SAE1536HT	SAE1536HT	403.18	C> 0.35% for HR Steel
11	HOT ROLLED STEEL COIL OF GRADE: SAE 1080	SAE 1080	239.19	High C
12	HOT ROLLED PICKLED & ANNEALED - FINE BLANKING AUTOMOTIVE PART	C45-PA	24.528	High carbon content (> 0.35)
13	HIGH CARBONHOT ROLLEDSTEEL STRIPSIN COILS MILLEDGE CK85	CK85	372.81	High carbon content (> 0.35)
14	High Carbon HR Strip	75CR1	470.3	High C HR Steel
15	HIGH CARBON HOT ROLLED STEEL STRIPS IN COILS, SK85(SK5) Grade	SK85(SK5)	501.78	High C
16	HIGH CARBON HOT ROLLED STEEL STRIPS IN COILS, SK120(SK2) Grade	SK120(SK2)	266.13	High C
17	HIGH CARBON HOT ROLLED STEEL STRIPS IN COILS	SAE1070(C67S)	858.36	C> 0.35% for HR Steel
18	HIGH CARBON HOT ROLLED STEEL STRIPS IN COILS	SAE1060(C62)	2592.82	C> 0.35% for HR Steel
19	HIGH CARBON HOT ROLLED STEEL STRIPS IN COILS	POS1516CR	617.07	Alloy content is greater than 1%
20	HIGH CARBON HOT ROLLED STEEL STRIPS IN COIL	SK95 (SK4)	1091.675	High C
21	High Carbon Hot Rolled Steel Strips in Coil	SAE1074	10129.33	C> 0.35% for HR Steel

This data shows that it is indispensable to consider for standardization of the hot rolled medium and high carbon steel sheets, plates, and strips. As the trade of million tonnes is carried out for the product and is necessary to consider its production surging to new highs up till 2030. These upcoming years will be skyrocketing for its production. So there is a need for standards on the product.

EXPORT POTENTIAL

India has great potential for surging production in the hot rolled medium and high carbon flat products.In 2021, India imported above 70 million dollars in hot rolled sheets and was among one of the top importers. Currently, the USA, China, Japan, and South Korea are among the top exporters and producers of these products. India has major producing plants such as JSW Steel, Tata Steel, and AMNS plants. The production plants are planning for expansion in hot strip mills and claiming for expansion of steel production capacity. For example, JSW Steel Bellary plant has a Steel producing capacity of 12.2 MTPA, it is one of the largest in the country.

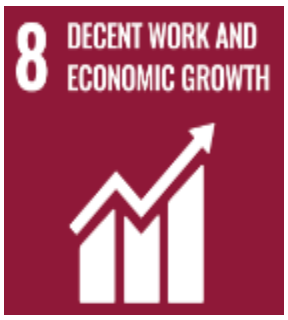
RELEVANT NATIONAL AND INTERNATIONAL STANDARDS ON PRODUCT AND TEST METHODS:

- EN 10083-2:This standard deals with hot rolled medium and high carbon steel sheets, and plates and provides different grades of medium and high carbon grades for the same.
- IS 1586:This standard deals with the Rockwell hardness test, for hot-rolled flat products hardness is an indispensable property. Therefore, hardness tests are carried out for the same.
- IS 1730(1989): This standard deals with the dimensions for steel plates, sheets, strips, and flats for general engineering purposes. This provides various length, width, and thickness combinations.
- SAE J403:These standards discuss various grades for hot rolled products such as 1020,1030,1040,1050,1070, etc. These give a good range of steel grades for general engineering purposes.
- IS 1079: These standards deal with the hot rolled low carbon steel sheets and strips for general engineering purposes.

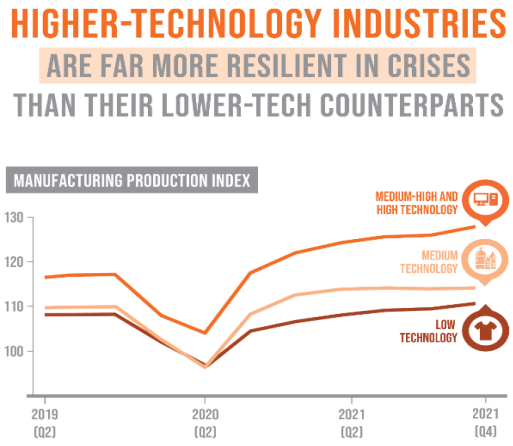
SUSTAINABILITY IMPACT COVERING ENVIRONMENT, CARBON FOOTPRINT & CIRCULAR ECONOMY

- Environmental Impact: The main ingredient in the production of steel is iron ore mined from the earth. Over 2000 million tons of iron ore is mined annually- about 95% is used by the steel industry. The mining of iron ore is highly energy intensive and causes air pollution in the form of nitrous oxide, carbon dioxide, carbon monoxide, and sulfur dioxide from diesel generators, trucks, and other equipment.
- Greenhouse emissions: On average,1.83 tons of CO_2 is emitted for every ton of steel produced making steel production a major contribution to global warming adding 3.3 million tons annually to global emissions.

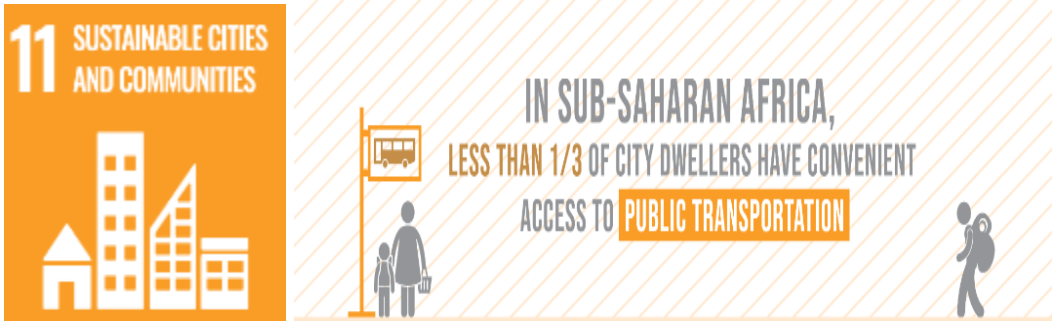
- Moving to a circular economy in the Steel sector:
  Most G-20 member countries have committed to net zero ambitions and are working to mitigate greenhouse gas emissions. To ensure growing resource consumption in an environmentally responsible manner, there is also a need to raise the current recycling rates of 15%-25%. Given the crucial role of steel in infrastructure development, its efficient utilization is essential. The demand for steel is poised to grow, especially in growing economies such as India. Globally, about 7% of energy sector emission is attributed to iron and steel production. Transitioning towards a circular steel sector is a strategy to tackle steel sector emissions. The key lies in ensuring collaboration among the G-20 member countries for knowledge sharing, technology co-development, and technology transfer. The presidency document for knowledge on the 'Circular Economy in Steel Sector' is a potential blueprint for a net zero pathway for the steel industry, reducing resource utilization and minimum wastage. Under India's G-20 presidency, there is an emphasis on the significance of the EPR (Extended Producer's Responsibility) framework in integrating circularity throughout the value chain. As different countries have implemented different EPR models, it is necessary that G-20 member countries share best practices to accelerate the transition to a circular economy.
- Sustainable Development Goals which could be achieved by these standards and technology are
  SDG Goal 8: Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.



SDG Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.



SDG Goal 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.



INTERNSHIP REPORT

Carbon and Low Alloy Steels for Submerged Arc and Gas Shielded Arc Welding Electrodes

Submitted by: Aditya Rathaur
Mnit Jaipur

Table of Contents

Subject Area

In this report, I will be presenting a detailed account of my industrial visit, which centered on the topic **Carbon and Low Alloy Steels for Submerged Arc and Gas Shielded Arc Welding Electrodes**. Throughout the report, we will discuss valuable insights i found from literature survey of existing research and studies. Additionally, I will be providing thorough details of industrial tour, highlighting the key elements and technologies used in the production of these specialized Steels for welding electrodes. Furthermore, I will also be sharing my own personal findings and perspective on the challenges faced by the industry. The report concludes with a comprehensive analysis of the manufacturing process, along with testing data.

Line Ministry of Government of India

The steel industry in India is overseen and regulated by the **Ministry of Steel**.

Other relevant Government Ministries

- **Ministry of Commerce and Industry:** Deals with trade policies, exports, and imports, which can impact the steel industry's international transactions.
- **Ministry of Environment, Forest, and Climate Change:** Responsible for environmental regulations and policies that may impact the steel industry's operations.
- **Ministry of Labour and Employment:** Responsible for labor-related policies that are relevant to the steel industry's workforce.
- **Ministry of Shipping:** Concerned with ports and shipping, which are crucial for the import and export of steel products.
- **Ministry of Railways:** Plays a significant role in the transport and consumption of steel products in india.

Relevant missions or schemes of the government:

- **Production Linked Incentives (PLI scheme)**
- **Standardization and Quality Control of Iron and Steel**
- **Research and Development (R&D) Schemes of the Ministry of Steel**

Identification of Stakeholders

- **Leading Industries-** IISCO Steel plant, Tata Steel Wiron, JSW Vijaynagar, etc
- **Leading MSME-** GEE limited, Ador Welding, ESAB India, etc
- **R & D -** Central Sail R & D Centre for Iron & Steel Ranchi, inhouse R&D
- **Testing laboratories:** All mechanical tests are conducted at inhouse facility known as **RCL** department at SAIL IISCO
- **Academia:** Indian Institute of Welding (IIW), Bangalore.

From Literature

I learned about welding processes and terms related to welding. I came to know about the nomenclature* of welding rods, the differences between solid and composite electrode types, and the international and Indian standards that regulate the production of welding electrode wires.

Furthermore, I learned about the various tests used for the quality and performance testing of welding electrode wires. These tests make sure the products meet the necessary requirements and work well during welding. I also identified a few of the industries involved in the manufacturing of these electrode wires.

Lastly, I also gained knowledge about formulating a P draft for standard formulation. Overall, this literature survey provided a comprehensive understanding of welding electrode technology and its industry.

➢ *For nomenclature of welding electrodes, please refer:*

- *Classification System for the International System of Units (SI) in ANSI/AWS A5.23 /A5.23M:1997*
- *ISO: 14341*
- *JIS Z3211*

Need for standardization

In a growing country like India where both exports and domestic consumption of these electrodes are increasing, With a rising demand for infrastructure development, industrial growth, and construction projects.

Having standard for these welding electrodes is vital for India's welding sector as it ensures that the country can meet international quality standards, making its exports more competitive and reliable in the global market.

In the domestic market, standardization ensures that Indian industries and manufacturers have access to reliable and high-quality welding electrodes. This contributes to improved welding outcomes, reduced maintenance costs, and enhanced overall safety in various applications.

Moreover, as India's manufacturing sector expands, the need for standardization becomes even more critical. Standardized welding electrodes provide a common reference point for manufacturers, researchers, and welders, facilitating collaboration and promoting technological advancements within the industry.

Production per Year

The rated capacity of **Wire Rod Mill (WRM)** at IISCO steel plant is **0.55 mtpa** Electrode grades production per year:

- **EM12k: 1000 tons**
- **MIG: 1500 tons**
- **Low Alloy: 98 Tons**

Technology scan

- **IISCO Steel plant has three high speed Rolling Mills for the manufacturing of semi finished products**
  1. **Bar Mill (Capacity: 0.90MTPA)** for production of TMT rebar. It is equipped with Hot Charging facilities and Endless Billet Weld Rolling facilities for enhanced yield and productivity. TMT bars are offered in the diameter range of 8mm to 4mm.

  2. **Universal Section Mill (Capacity: 0.85 MTPA)** for production of Structural sections. It is a state of the art facility that is equipped with tandem rolls to produce Parallel Flange Beam of 240mm to 750mm, Universal Beams of 200mm to 450mm, Channels of 200mm to 400mm, Equal Angles of 150mm and 200 mm, as well as Z and U Special Sections as per the global requirements.

  3. **Wire Rod Mill (Capacity: 0.55MTPA)** for production of Wire Rods & TMT Coil. It is equipped with high speed rolls with speed up to 115 mtr/sec and produces a wide range of steels with **level 2 automation** to cater to different industries. It produces coils of wire rod in the diameter range of **5.5mm to 22mm**.

- The Steel plant is equipped with a sophisticated in-house testing facility, **RCL department**, it tests for Products quality with its Sophisticated modern machinery

and testing equipment. Product is thoroughly tested and its mechanical properties are verified before sending the items out to customers.

- well-developed IT infrastructure and ERP

Relevant National standards

IS 228: METHODS FOR CHEMICAL ANALYSIS OF STEELS

IS 812: GLOSSARY OF TERMS RELATING TO WELDING AND CUTTING OF METALS

IS 1387: GENERAL REQUIREMENTS FOR THE SUPPLY OF METALLURGICAL MATERIALS
ANSI/AWS A5.23/A5.23M:1997

IS 7739: PREPARATION OF METALLOGRAPHIC SPECIMENS

IS 1956: GLOSSARY OF TERMS RELATING TO IRON AND STEEL: LONG PRODUCTS

IS 7887: MILD STEEL WIRE ROD FOR GENERAL ENGINEERING PURPOSES - SPECIFICATION

IS 1608: MECHANICAL TESTING OF METALS - TENSILE TESTING

Relevant International Standards:

- ANSI/AWS A5.23 /A5.23M:1997
- ANSI/AWS A5.18 /A5.18M:2005
- ANSI/A5.17 /A5.17M-97 (R2007)
-

Testing Methods

The ladle analysis of steel when analyzed in accordance with relevant parts of IS 228 or any other established instrumental/chemical method shall be as given in **Table 1**.

For determination of Mechanical properties, tension test is performed according to **IS 1608,** and the mechanical test data is shown in **table 2.**

Tour Details

During My visit at IISCO Steel Plant, I came to know about:

- Sail IISCO Burnpur plant has three facilities for production of semi finished long products namely Wire Rod Mill (WRM), Bar Rod Mill (BRM) & Universal section Mill (USM).

- Out of these three mills, WRM produces long wire products. Some common grades that this facility produces are SAE1006, SAE1008, SAE1010, SAE 1018, SWR 10, SWR 14, PC115, EWNR, MIG, HC62A, HC72A, HC82B, HC78B, CAQ, SAE10B21, SAE15B25, HC80B, C20MnA, SEQR, C20 EQR, and FE550D.

- The grades of Electrode wire produced are: **AWS A5.18 ER70S (MIG), IS2879 EWNR, EA2 (SAW), and EM12K (SAW).**

- Features of WRM at SAIL IISCO:
    - The diameter produced may range from **5.5 to 22 mm**
    - Walking Beam reheating furnace (up to 1250 C)
    - High speed rolling (115 M/s) with **level 2 automation**
    - Combination of horizontal and vertical strands for **no twist rolling**
    - Automatic compacting and strapping machine
    - Rated capacity of WRM is **0.55 mtpa.**

- The plant operates through a combination of three key departments: **operational, mechanical, and electrical**. These departments work in harmony to ensure the continuous and uninterrupted production and smooth functioning of the plant.

- The manufacturing process follows a sequence of steps, starting with high-speed hot rolling, water cooling, and air cooling. It begins by introducing a billet into a Walking beam reheating furnace, where it's heated to temperatures up to 1150 °C. Next, the billet undergoes hot rolling, passing through a series of 30 strands equipped with both vertical and horizontal rolls, along with loopers. During this process, 7 water boxes are used to maintain the billet's temperature and cool the rolled wire, forming martensite on the outer surface.

  Once the wire reaches the desired diameter, it goes through the Laying head to form coils. These coils are then air-cooled and passed through Easy Down for compression, creating a roll. Finally, the roll is secured with straps and labeled with essential information.

- Operational Standards followed:

ISO 9001:2015 - Quality management system
ISO 45001:2018 - Occupational health and safety management system
ISO 14001:2015 - Environmental Management system

- For determination of mechanical properties, **tension test** is performed in accordance with IS 1608.
- Visual inspection is an important part of the process to judge the product's surface finish and cracks.
- SAIL manufactures wire coils of diameter 1200mm, which are subsequently purchased by niche manufacturers. These manufacturers then draw the wire into the appropriate diameter and apply a copper coating to enhance its properties. These specialized manufacturers produce the finished products and package them into spools, drums, and other forms as needed by the consumers.
- CE certification is required for export to EU markets and CARES certification required for export to UK, Singapore, and Hong Kong markets

Limitations

From my personal findings, following are the limitations:

- The Process of Section change is time consuming and affects the production efficiency of the mill.
- Most of the operational information is communicated through Social media groups like WhatsApp.
- The work environment is hectic, with a messy atmosphere, challenging working conditions, and oil and grease present everywhere. These factors contribute to a decrease in labor efficiency.

Relevant Sustainability Goals

In the context of manufacturing steels, Following **Sustainable Development Goals (SDGs)** from the United Nations are relevant:

- **SDG 9: Industry, Innovation, and Infrastructure:** This goal promotes the development of sustainable and resilient infrastructure and encourages technological advancements in manufacturing processes. Emphasis should be placed on resource efficiency, waste reduction, and sustainable practices.

- **SDG 12: Responsible Consumption and Production:** This goal focuses on sustainable production patterns and responsible consumption. Manufacturers should strive to minimize waste, energy consumption, and emissions, and adopt cleaner production methods.

- **SDG 13: Climate Action:** Manufacturers should take measures to reduce greenhouse gas emissions during the production process. This includes investing in energy-efficient technologies and using low-carbon energy sources.

- **SDG 14: Life Below Water** and **SDG 15: Life on Land:** The steel industry, can have significant impacts on ecosystems and biodiversity. Manufacturers should take steps to minimize environmental harm and promote sustainable land and water management practices.
- **SDG 17: Partnerships for the Goals:** Collaboration among stakeholders, including governments, industries, and civil society, is crucial for achieving sustainable manufacturing practices. Partnerships can facilitate knowledge-sharing, technology transfer, and capacity building for the manufacturing sector.

Sustainability Considerations:

The Furnace reuses CBM mixed gas produced in the blast furnace.
Metal Scraps are reused.
Safety related parameters are present at appropriate places.
Monitoring of crucial parameters, such as SPM (Suspended Particulate Matter), SOX (Sulfur Oxides), NOX (Nitrogen Oxides), and water testing.
Water is reused for cooling purposes.
As per the NDCs of the steel sector submitted to MoEF&CC, average CO2 emission intensity of the Indian steel industry was projected to reduce from 3.1 T/tcs in 2005 to 2.64 T/tcs by 2020 and 2.4 T/tcs by 2030 (i.e. approx. 1% per year).

Questionnaire for Industry Visit:

Carbon and Low Alloy Steels for Submerged Arc and Gas Shielded Arc Welding Electrodes.

Sl No	Area of questions	Questions
1)	Product Specification	**1) What is the recommended electrode diameter range?** **2) What are the desired chemical composition requirements? Also, what grades are produced there.** **3) Are there any required Mechanical and Chemical properties that the product must possess.** **4) Any international standards to which the company might be referring.**
2)	Manufacturing Process	**1) Are there any quality control measures and inspections carried out during the manufacturing process?** **2) Are there any specific processing or heat treatment steps involved in the manufacturing process? If yes, please provide details.** **3) details on the temperature, duration, and cooling methods used in heat treatment.** **4) Are there any post-manufacturing processes, such as straightening, cutting, or packaging, that should be considered?** **5) Are there any specific environmental considerations or sustainability practices incorporated into the electrode manufacturing process?** **6) Are there any certifications or standards that the electrode manufacturing process should adhere to?** **7) questions related to manufacturing time and capacity.**

3)	Testing and certifications	**1) Are there any mandatory tests that should be conducted on the electrodes?** **2) Mechanical and chemical tests and their acceptable limits and tolerances** **3) recommended procedures for testing and quality control** **4) Any necessary Certifications the product must have?**
4)	Import/ Export	**1) yearly consumption of manufactured products in India and internationally** **2) Are mandatory regulations and permits required for exporting finished products?**
5)	packaging	**1) What are the packaging methods in use for these electrodes?** **2) considerations to prevent damage, contamination, or moisture absorption during transport** **3) details on labeling on the package with relevant informations** **4) standard size and dimensions of packages in use**
6)	General questions	**1) Recommendations on topics a standard should cover.** **2) Nomenclature to distinguish different grades of electrodes.** **3) types of industries that consume these electrodes** **4) Recommendation of committee members.** **5) Unique practices employed by the SAIL IISCO Plant in the manufacturing of these electrodes.**

Answers based on Information Gathered During the Industry Visit:

1. **Product specification:**
   1.1. The diameter produced may range from 5.5 to 22 mm as per mutual agreement between the customer and manufacturer

1.2. The chemical composition of the electrode wires is given in Table 1, The grades of Electrode wire produced are: **AWS A5.18 ER70S (MIG), IS2879 EWNR, EA2 (SAW),** and **EM12K (SAW).**
Other products produced at WRM facility are **SAE1006, SAE1008, SAE1010, SAE 1018, SWR 10, SWR 14, PC115, EWNR, MIG, HC62A, HC72A, HC82B, HC78B, CAQ, SAE10B21, SAE15B25, HC80B, C20MnA, SEQR, C20 EQR,** and **FE550D.**

1.3. The produced material must adhere to the chemical and mechanical properties as given in table 1 and table 2

1.4. International standards company is referencing:
1.4.1. ANSI/AWS A5.23 /A5.23M:1997
1.4.2. ANSI/AWS A5.18 /A5.18M:2005
1.4.3. ANSI/A5.17 /A5.17M-97 (R2007)

2. Manufacturing Process:

2.1. In certain strands, front and end portions are discarded to eliminate any temperature gradient that might occur. After the coil's formation, a thorough visual inspection is performed to identify any visible surface defects and evaluate the surface finish before securely strapping the coil.

2.2. The heat treatment process involves two stages. Initially, during hot rolling, the metal is water-cooled using seven waterboxes to create martensite on the outer surface, effectively regulating the temperature. Subsequently, once the coil is formed, it undergoes air cooling to enhance its strength by forming Pearlite on inner surface.

2.3. A billet of area 150X150 mm is heated to 1150 C and is subsequently hot rolled using 30 Strands which reduces the diameter as per the requirement.

2.4. After the manufacturing process, a visual inspection is carried out to identify any detrimental surface defects. Once the coils are sufficiently cooled, they are compacted and securely strapped with color coded labels for easy identification.

2.5. Continuous monitoring of crucial parameters, such as SPM (Suspended Particulate Matter), SOX (Sulfur Oxides), NOX (Nitrogen Oxides), and water testing, is conducted in strict adherence to the guidelines set by the Pollution Control Board. Additionally, active gases produced in the blast furnace are efficiently reused to heat the furnace, promoting sustainable practices. Also, ISO 14001:2015 (Environmental management system) is followed.

2.6. ISO 9001: 2015 is followed for quality management system.

2.7. The rated capacity of WRM is 0.55 mtpa, and time required for production of one coil is 3-4 minutes

3. Testing

3.1. After the coil is produced, it undergoes two essential tests: visual inspection and tensile testing. These tests ensure the coil's quality and strength are assessed thoroughly.

3.2. Data related to chemical and mechanical properties is given in table 1 and table 2.

3.3. Ladle analysis is conducted to obtain the chemical composition data of the material. Additionally, tensile testing is performed following IS 1608 standards to determine crucial parameters such as Yield strength, Upper tensile strength, and reduction ratio.

4. Export Permits:

4.1. CE certification is required for export to EU markets and CARES certification required for export to UK, Singapore, and Hong Kong markets

5. Packaging:

5.1. After forming, the coil is securely strapped in a diameter of 1200mm and labeled with color coding for identification purposes

5.2. The strapping is done in a dry environment to prevent contact with humidity.

5.3. Each coil of wire rod is marked with the grade, size of the wire rod, cast number, and trade-mark or name of the manufacturer.

5.4. The coil formed has an inner diameter of 1200mm

More information:

- SAIL manufactures wire coils of diameter 1200mm, which are subsequently purchased by niche manufacturers. These manufacturers then draw the wire into the appropriate diameter and apply a copper coating to enhance its properties.

These specialized manufacturers produce the finished products and package them into spools, drums, and other forms as needed by the consumers.

- Operational Standards followed:
  ISO 9001:2015 - Quality management system
  ISO 45001:2018 - Occupational health and safety management system
  ISO 14001:2015 - Environmental Management system

Examples of Technical Delivery Conditions:

GWELD SEAL OF TRUST	PURCHASING SPECIFICATIONS OF RAW MATERIAL	DOC.NO.	: QR/PURS/06
		ISSUE NO.	:01
		REV.NO.	:02
		DATE	:19.06.2017

EM 12K WIRE RODS

Ref. No. – QR/PURS/06/88

Acceptance Limit:

Chemical:

1.	C%	-	0.08 – 0.12
2.	Mn%	-	0.90 – 1.20
3.	Si%	-	0.15 – 0.25
4.	S%	-	0.025 (Max)
5.	P%	-	0.025 (Max)
6.	Cu%	-	0.050 (Max)
7.	N (PPM)	-	75 (Max)

Mechanical

1.	UTS (N/mm2)	-	510 (Max)
2.	R.A. %	-	70 (Min)

TATA STEEL LONG PRODUCTS LIMITED

Technical Offer

Format No : F/QA 1/04

Customer's Name :

TDC No.

Application : Drawing into Wire for Electrode

Parameters	M/s TSLPL Offer Dated 18.01.2022
Supply condition	We will Supply As Rolled Wire Rod Coil Form
Grade	ER90SG
Size	5.5 mm
Process Route	MBF → EAF → LRF → VD → CCM → WRM
Chemical Composition	%C = 0.07 - 0.10 %Mn = 1.70 - 1.90 %Si = 0.50 - 0.70 %P = 0.025 Max. %S = 0.025 Max. %Mo = 0.40 - 0.60
Gas Content	Nitrogen = 80 ppm max
Surface Defects	Wire rod surface shall be reasonably free from visible surface defects. Micro defects like seam, crack, lap, and deep scratches to be allowed up to a maximum depth of 1% of supplied diameter. As rolled coil surface may contain rust.
Dimensional Specification	For the sizes 5.5 mm, Dimensional Tolerance: ± 0.25 mm and Out of Roundness: 0.40mm maximum
Mechanical Properties	As Rolled UTS = 90 Kgf/mm² max,
Decarburisation	Partial decarburisation to be allowed up to a depth of 1% of supplied diameter maximum. Measurement as per IS 6396 : 2000 standard.
Microstructure	Microstructure shall consist of Ferrite+Pearlite+Bainite
Grain Size	5 or finer As per ASTM E 112
Inclusion Rating	Type : Thin / Thick = A : 1.5/1.0, B : 1.5/1.0, C : 1.5/1.0, D : 1.5/1.0 max As per ASTM E45
Test Certificates	Will be certified as per approved feasibility
Package Marking	Each coil should have two nos of identification tags having details like grade, size, heat number.
Claim Settlement	Each claim to be dealt seperately as case to case basis based on mutually agreed claim quantity with direct customer. In case of surface defect, entire heat shall not be considered as rejected due to localized defect occurrence. Rejection shall be considered on processed / WR stage subject to M/s TSLPL Investigation and mutual agreement.

P Draft

Carbon and Low Alloy Steels for Submerged Arc and Gas Shielded Arc Welding Electrodes

1 SCOPE:

This draft specifies requirements for Carbon and Low Alloy Steels for Submerged Arc and Gas Shielded Arc Welding Electrodes. It covers manufacturing & testing guidelines. The standard defines characteristics, mechanical properties, and chemical composition. It also outlines marking and packaging requirements.

2 References:

The following standards are referred to in the formulation of this draft:

IS 228: METHODS FOR CHEMICAL ANALYSIS OF STEELS

IS 812: GLOSSARY OF TERMS RELATING TO WELDING AND CUTTING OF METALS

IS 1387: GENERAL REQUIREMENTS FOR THE SUPPLY OF METALLURGICAL MATERIALS
ANSI/AWS A5.23/A5.23M:1997

IS 7739: PREPARATION OF METALLOGRAPHIC SPECIMENS

IS 1608: MECHANICAL TESTING OF METALS - TENSILE TESTING

International Standards referred to:

- ANSI/AWS A5.23 /A5.23M:1997
- ANSI/AWS A5.18 /A5.18M:2005
- ANSI/A5.17 /A5.17M-97 (R2007)

3 Terminology:

For the purposes of this standard, the definition given in **IS 812 1957** shall apply

To classify solid electrodes, only chemical analysis is required *(Refer table 1)*

3.1 Wire A product in coil form obtained from wire rod, generally in round, half round, square, hexagonal, flat, or of any other section, including grooved section, characterized by the fact that it has been subjected to cold drawing through a die or by other mechanical means. It is usually more severely drawn than bright bars.

3.2 Wire Rod It is generally a square, round, half round, rectangular, or polygonal, hot-rolled product in the coiled form, and it

is generally intended for conversion into wire.

3.3 Coil A continuous length of rod or wire in the form of a coil

4 Supply of Materials:

4.1 General requirements relating to the supply of material shall conform to **IS 1387.**

4.2 Steel for electrode core wire shall be supplied in the form of billets, blooms, cast billet ingots, or wire rods in sizes as specified by the purchaser.

5 MANUFACTURE:

5.1 Steel shall be manufactured by any process of steelmaking. It may also be followed by secondary refining or vacuum refining.

5.2 Steel shall be of rimming or non-rimming quality. Macro examination [see **IS 7739** (Part 5)] may be used to distinguish rimming steel from non-rimming steel.

5.3 The manufacturing process is a sequential combination of hot rolling, water cooling, and air cooling. Initially, a billet is introduced into a furnace and subjected to heating below its fusion temperature. Subsequently, it undergoes the hot rolling procedure, which involves passing it through a series of strands consisting of both vertical and horizontal rolls as well as loopers. Concurrently, water boxes are employed to maintain the billet's temperature and facilitate the cooling of the rolled wire. Once the wire reaches the desired diameter, it is directed through a coiler to form coils. These coils are then air cooled and subsequently compressed to create a roll, which is further secured with straps and labeled with essential information as mentioned in Section 13.

5.4 If required, discards shall be made at each strand to ensure freedom from piping, segregation, and other harmful defects.

6 DEFECTS:

6.1 The material must be free from any detrimental defects, such as surface cracks, poor surface finish, end splits, and defects resulting from non-homogeneous cooling.

6.2 Prior to rolling, the hot billet must undergo a thorough descaling process to ensure the quality of the final product.

6.3 To ensure a high-quality product, it is essential to control various parameters such as billet temperature, laying head temperature, cooling conveyor speed, number of reduction strands, reduction ratio on each strand, heat treatment, etc. These variables are essential for ensuring the desired quality is maintained throughout the production process.

6.4 To ensure homogeneous rolling throughout, it may be necessary to discard the front and end portions of the rolled wire. This helps maintain consistent quality by removing any potential temperature gradient or imperfections that may have occurred during the initial stages of rolling.

6.5 The surface of the wire rod shall be reasonably free from visible surface defects. Microdefects like seams, cracks, laps, and deep scratches can be allowed up to a certain limit.

7 CHEMICAL COMPOSITION

The ladle analysis of steel when analyzed in accordance with relevant parts of IS 228 or any other established instrumental/chemical method shall be as given in **Table 1**. In case of dispute, the procedure given in the relevant part of IS 228 shall be the referee method. However, where the method is not given in IS 228 or its relevant parts, the

referee method shall be as agreed to between the purchaser and the manufacturer.

8 DIMENSIONS:

8.1 The size of billets, blooms, and cast billet ingots is left to the discretion of the manufacturer.

8.2 The determination of the wire rod diameter is subject to mutual discussion and agreement between the manufacturer and the consumer.

9 Reeling conditions:

9.1 Prior to reeling, inspect the wire for any defects or abnormalities that may affect its performance. Discard the batch that does not meet the required quality standards.

9.2 Ensure that the reeling conditions for electrode wire are carried out in a dry environment to avoid contact with moisture. Moisture can have adverse effects on the performance and quality of the wire.

9.3 Maintain a uniform diameter throughout the reeling process.

9.4 1 The wire shall be closely wound in layers on the spool in one continuous length and shall be free from kinks, waves, sharp bends or twists, and shall be free to unwind without restrictions. The adjacent layers within a layer need not necessarily be touching.

10 Tests:

For the classification of solid electrodes, only a chemical analysis is required (refer to **Table 1**).

For mechanical properties determination The tension test is performed according to **IS 1608**
Mechanical Test data is shown in **table 2**

11 Finishing:

To enhance the properties of these wire rods, a finishing operation is conducted. Initially, the wires are Cold rolled/ Drawn to achieve the desired diameter. Subsequently, they undergo a copper coating process in a copper bath. This coating serves to increase electrical conductance, improve heat dissipation, and facilitate a high rate of deposition during welding.

12 Packaging:

Each coil of wire rod shall be bound and fastened compactly. and also labeled with all the necessary information in accordance with Section 13 of the standard document.

13 Tagging:

13.1 Each coil of wire rod shall be legibly marked with the grade, size of the wire rod, cast number, and trade-mark or name of the manufacturer.

13.2 The material may also be marked with the Standard Mark. The details are available with the Bureau of Indian Standards.

Table 1
Chemical Composition Requirements for Solid Electrodes

AWS Classification[c]	UNS No.[d]	Weight Percent[a,b]										
		C	Mn	Si	S	P	Cr	Ni	Mo	Cu[e]	V	Other
EL12[f]	K01012	0.04–0.14	0.25–0.60	0.10	0.030	0.030	—	—	—	0.35	—	—
EM12K[f]	K01113	0.05–0.15	0.80–1.25	0.10–0.35	0.030	0.030	—	—	—	0.35	—	—
EA1	K11222	0.05–0.15	0.65–1.00	0.20	0.025	0.025	—	—	0.45–0.65	0.35	—	—
EA2	K11223	0.05–0.17	0.95–1.35	0.20	0.025	0.025	—	—	0.45–0.65	0.35	—	—
EA3	K11423	0.05–0.17	1.65–2.20	0.20	0.025	0.025	—	—	0.45–0.65	0.35	—	—
EA3K	K21451	0.05–0.15	1.60–2.10	0.50–0.80	0.025	0.025	—	—	0.40–0.60	0.35	—	—
EA4	K11424	0.05–0.15	1.20–1.70	0.20	0.025	0.025	—	—	0.45–0.65	0.35	—	—
EB1	K11043	0.10	0.40–0.80	0.05–0.30	0.025	0.025	0.40–0.75	—	0.45–0.65	0.35	—	—
EB2[g]	K11172	0.07–0.15	0.45–1.00	0.05–0.30	0.025	0.025	1.00–1.75	—	0.45–0.65	0.35	—	—
EB2H	K23016	0.28–0.33	0.45–0.65	0.55–0.75	0.015	0.015	1.00–1.50	—	0.40–0.65	0.30	0.20–0.30	—
EB3[g]	K31115	0.05–0.15	0.40–0.80	0.05–0.30	0.025	0.025	2.25–3.00	—	0.90–1.10	0.35	—	—
EB5	K12187	0.15–0.23	0.40–0.70	0.40–0.60	0.025	0.025	0.45–0.65	—	0.90–1.20	0.30	—	—
EB6	S50280	0.10	0.35–0.70	0.05–0.50	0.025	0.025	4.50–6.50	—	0.45–0.70	0.35	—	—
EB6H	S50180	0.25–0.40	0.75–1.00	0.25–0.50	0.025	0.025	4.80–6.00	—	0.45–0.65	0.35	—	—
EB8	S50480	0.10	0.30–0.65	0.05–0.50	0.025	0.025	8.00–10.50	—	0.80–1.20	0.35	—	—
EB9	S50482	0.07–0.13	1.25	0.30	0.010	0.010	8.00–10.00	1.00	0.80–1.10	0.10	0.15–0.25	Nb(Cb): 0.02–0.10 N: 0.03–0.07 Al: 0.04
ENi1	K11040	0.12	0.75–1.25	0.05–0.30	0.020	0.020	0.15	0.75–1.25	0.30	0.35	—	—
ENi1K	K11058	0.12	0.80–1.40	0.40–0.80	0.020	0.020	—	0.75–1.25	—	0.35	—	—
ENi2	K21010	0.12	0.75–1.25	0.05–0.30	0.020	0.020	—	2.10–2.90	—	0.35	—	—

(continued)

Table 1 (Continued)

AWS Classification[c]	UNS No.[d]	Weight Percent[a,b]										
		C	Mn	Si	S	P	Cr	Ni	Mo	Cu[e]	V	Other
ENi3	K31310	0.13	0.60–1.20	0.05–0.30	0.020	0.020	0.15	3.10–3.80	—	0.35	—	—
ENi4	K11485	0.12–0.19	0.60–1.00	0.10–0.30	0.020	0.015	—	1.60–2.10	0.10–0.30	0.35	—	—
ENi5	K11240	0.12	1.20–1.60	0.05–0.30	0.020	0.020	—	0.75–1.25	0.10–0.30	0.35	—	—
EF1	K11160	0.07–0.15	0.90–1.70	0.15–0.35	0.025	0.025	—	0.95–1.60	0.25–0.55	0.35	—	—
EF2	K21450	0.10–0.18	1.70–2.40	0.20	0.025	0.025	—	0.40–0.80	0.40–0.65	0.35	—	—
EF3	K21485	0.10–0.18	1.70–2.40	0.30	0.025	0.025	—	0.70–1.10	0.40–0.65	0.35	—	—
EF4	K12048	0.16–0.23	0.60–0.90	0.15–0.35	0.030	0.025	0.40–0.60	0.40–0.80	0.15–0.30	0.35	—	—
EF5	K41370	0.10–0.17	1.70–2.20	0.20	0.015	0.010	0.25–0.50	2.30–2.80	0.45–0.65	0.50	—	—
EF6	K21135	0.07–0.15	1.45–1.90	0.10–0.30	0.015	0.015	0.20–0.55	1.75–2.25	0.40–0.65	0.35	—	—
EM2[h]	K10882	0.10	1.25–1.80	0.20–0.60	0.015	0.010	0.30	1.40–2.10	0.25–0.55	0.25	0.05	Ti: 0.10 Zr: 0.10 Al: 0.10
EM3[h]	K21015	0.10	1.40–1.80	0.20–0.60	0.015	0.010	0.55	1.90–2.60	0.25–0.65	0.25	0.04	Ti: 0.10 Zr: 0.10 Al: 0.10
EM4[h]	K21030	0.10	1.40–1.80	0.20–0.60	0.015	0.010	0.60	2.00–2.80	0.30–0.65	0.25	0.03	Ti: 0.10 Zr: 0.10 Al: 0.10
EW	K11245	0.12	0.35–0.65	0.20–0.35	0.030	0.025	0.50–0.80	0.40–0.80	—	0.30–0.80	—	—
EG	Not Specified											

[a] The electrode shall be analyzed for the specific elements for which values are shown in this Table. If the presence of other elements is indicated, in the course of this work, the amount of those elements shall be determined to ensure that their total (excluding iron) does not exceed 0.50 percent.

[b] Single values are maximum.

[c] The letter "N" when added as a suffix is an optional supplemental designator indicating that the limits on the phosphorus, vanadium, and copper are as follows:

P = 0.012% max. V = 0.05% max. Cu = 0.08% max.

See A2.1 for explanation and intended use.

[d] SAE/ASTM Unified Numbering System for Metals and Alloys.

[e] The copper limit includes any copper coating that may be applied to the electrode.

[f] The EL12 and EM12K classifications are identical to those same classifications in ANSI/AWS A5.17/A5.17M, *Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding*. They are included in this specification because they are sometimes used with an alloy flux to deposit some of the weld metals designated in Table 2.

[g] The letter "R" when added as a suffix is an optional supplemental designator indicating that the limits on sulfur, phosphorous, copper, arsenic, tin and antimony are as follows:

S = 0.010% max. P = 0.010% max. Cu = 0.15% max. As = 0.005% max. Sn = 0.005% max. Sb = 0.005% max.

See A7.1.2 for explanation and intended use.

[h] The composition ranges of classifications with the "EM" prefix are intended to conform to the ranges for similar electrodes in the military specifications.

Table 1
Chemical Composition Requirements for Solid Electrodes and Rods

AWS Classification[b]		UNS[c]	Weight Percent[a]												
A5.18	A5.18M	Number	C	Mn	Si	P	S	Ni	Cr	Mo	V	Cu[d]	Ti	Zr	Al
ER70S-2	ER48S-2	K10726	0.07	0.90 to 1.40	0.40 to 0.70	0.025	0.035	0.15	0.15	0.15	0.03	0.50	0.05 to 0.15	0.02 to 0.12	0.05 to 0.15
ER70S-3	ER48S-3	K11022	0.06 to 0.15	0.90 to 1.40	0.45 to 0.75	0.025	0.035	0.15	0.15	0.15	0.03	0.50	—	—	—
ER70S-4	ER48S-4	K11132	0.06 to 0.15	1.00 to 1.50	0.65 to 0.85	0.025	0.035	0.15	0.15	0.15	0.03	0.50	—	—	—
ER70S-6	ER48S-6	K11140	0.06 to 0.15	1.40 to 1.85	0.80 to 1.15	0.025	0.035	0.15	0.15	0.15	0.03	0.50	—	—	—
ER70S-7	ER48S-7	K11125	0.07 to 0.15	1.50 to 2.00[e]	0.50 to 0.80	0.025	0.035	0.15	0.15	0.15	0.03	0.50	—	—	—
ER70S-G	ER48S-G	—	Not Specified[f]												

Notes:
a. Single values are maximum.
b. The letter "N" as a suffix to a classification indicates that the weld metal is intended for the core belt region of nuclear reactor vessels, as described in the Annex to the specification. This suffix changes the limits on the phosphorus and copper as follows:
P = 0.012% maximum
Cu = 0.08% maximum
c. SAE HS-1086/ASTM DS-56, *Metals & Alloys in the Unified Numbering System.*
d. Copper due to any coating on the electrode or rod plus the copper content of the filler metal itself, shall not exceed the stated 0.50% max.
e. In this classification, the maximum Mn may exceed 2.0%. If it does, the maximum C must be reduced 0.01% for each 0.05% increase in Mn or part thereof.
f. Chemical requirements are not specified but there shall be no intentional addition of Ni, Cr, Mo, or V. Composition shall be reported. Requirements are those agreed to by the purchaser and the supplier.

***** Table 1 is taken from ANSI/AWS A5.23/A5.23M:1997 and A5.18/A5.18M:2005***

Table 2
Mechanical Properties

Grade	Diameter	YS(N/mm2)	UTS(N/mm2)	RA(%)
EA2	5.5mm	-	463.48	77.12
EM12K	5.5mm	296.28	443.35	82.14
MIG	5.5mm	357.75	536.24	81.237