

Specification for

**Weldable structural
steels —
Hot finished structural
hollow sections in
weather resistant steels**

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Iron and Steel Standards Policy Committee (ISM/-) to Technical Committee ISM/12, upon which the following bodies were represented:

BEAMA Ltd.
 British Constructional Steelwork Association Ltd.
 British Railways Board
 British Steel Industry
 Department of Transport
 Institution of Structural Engineers
 Lloyd's Register of Shipping
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 Society of Motor Manufacturers and Traders Ltd.
 Steel Construction Institute
 Welding Institute

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Foreword

This British Standard has been prepared under the direction of the Iron and Steel Standards Policy Committee and is identical to the element of BS 4360:1990 covering hot finished structural hollow sections in weather resistant steels.

This standard, together with BS 7613, BS EN 10113-1 to BS EN 10113-3, BS EN 10155 and BS EN 10210-1, supersedes BS 4360:1990, which is withdrawn. BS 7613 and BS EN 10210-1 are published simultaneously with this standard.

Annex A gives a comparison between grades and designations in this standard and those in BS 4360:1990.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies requirements for weldable weather resistant steels for general structural and engineering purposes in the form of structural steel hollow sections conforming to BS 4848-2:1991. However, in the case of hollow sections formed from plate and with the seams metal arc welded, this standard covers only the requirements for the plate material.

The products are equally suitable for bolted and riveted structures.

This standard applies to material supplied ex-mill or from merchant's stock (see clause 13).

2 References

2.1 Normative references

This standard incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on the inside back cover. Subsequent amendments to, or revisions of, any of these publications apply to this standard only when incorporated in it by updating or revision.

2.2 Informative references

This standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this British Standard, the definitions given in BS EN 10079:1993 apply together with the following.

3.1

parent product

the product rolled from one piece of steel

3.2

manufacturer

the manufacturer of the steel products

3.3

supplier

the manufacturer for material supplied ex-mill, the merchant for material supplied from a merchant's stock (see clause 1)

3.4

purchaser

the purchaser or his representative

4 General

The hollow sections shall conform to the general requirements of this standard and to the specific requirements applicable to the grade concerned. Where any of the options given in Annex B are called up at the time of the enquiry and order, the hollow sections shall, in addition, conform to the requirements of any such options.

NOTE Table 1 gives permitted deviations in product analysis, Table 2 gives chemical composition and Table 3 gives mechanical properties.

5 Information to be supplied by the purchaser

5.1 General

The following information shall be supplied by the purchaser at the time of enquiry and order:

- a) details of the product form, dimensions and quantity;
- b) the grade of steel (see Table 2).

5.2 Options

A number of options are specified in Annex B. In the event that the purchaser does not indicate his wish to implement any of these options and specify his requirements at the time of the enquiry and order, the supplier shall supply in accordance with the basic specification.

6 Steelmaking process

6.1 Process

The steel shall be made by any process except the Bessemer process.

See also option B.1.

6.2 Rimming steel

Rimming steel shall not be supplied.

7 Supply condition

The material shall be delivered in the supply condition given in Table 2. The mechanical properties given in Table 3 refer only to material in the condition specified in Table 2. Where the supply condition is specified as rolled or hot finished, it is permissible for the manufacturer to normalize the material provided the specified properties are obtained after normalizing.

NOTE Purchasers who intend to re-heat any of the steels detailed in this standard over and above those levels implicit in preheating and/or welding in accordance with BS 5135 are advised to discuss the application and proposed re-heat treatment of the steel with the manufacturer.

8 Chemical composition

8.1 Ladle analysis

The chemical composition of the steel shall be determined by ladle analysis and shall be as given in Table 2. The manufacturer shall supply details of the ladle analysis to the purchaser.

See also options **B.2**, **B.3** and **B.4**.

8.2 Product analysis

Any product analysis carried out shall be determined on a test sample used for verification of the mechanical properties or from material at the location shown in Annex C or, if this is not possible, by sampling in accordance with BS 1837:1970.

In the event of dispute, conformity to the standard shall be decided on the basis of an independent analysis using the methods described in BS 6200.

The permitted deviations for product analysis and purchaser's check analysis shall be as given in Table 1 and are applicable to the specified chemical composition limits given in Table 2.

Table 1 — Permitted deviations in product analysis from specified ladle analysis percentages

Grade	Deviations from specified ladle analysis				
	C %	Si %	Mn %	P %	S %
S345J0WPH	0.03	- 0 + 0.05	0.10	- 0.005 + 0.010	0.005
S345J0WH	0.03	- 0 + 0.05	0.10	0.005	0.005
S345GWH	0.03	- 0 + 0.05	0.10	0.005	0.005

The deviations, other than when maxima only are given in Table 2, shall apply either above or below the specified limits of the range, but not above and below for the same element from different sample products from the same cast. When maxima only are specified, the deviations shall only be positive. As indicated in Table 1, this requirement shall not apply in the case of grade S345J0WPH in respect of phosphorus and all grades in respect of silicon.

See also option **B.5**.

9 Weldability

All steels conforming to this standard are of weldable quality. Welding procedures and consumables appropriate for the various grades and qualities shall be used.

NOTE 1 BS 5135 specifies requirements for the process of manual, semi-automatic, automatic and mechanized arc welding of carbon and carbon manganese steels with carbon equivalents not exceeding 0.54 %. For steels with carbon equivalents above 0.54 %, BS 5135 recommends that the steelmaker, welding consumable supplier or other appropriate authoritative source be consulted. It is further pointed out that for carbon manganese steels with low carbon contents (less than about 0.10 %) additional precautions and modified procedures may be required.

NOTE 2 If weather resistant steels are to be used unpainted, it is necessary to select processes which achieve at least equivalent weathering properties of the permanently exposed surfaces.

10 Quality of finished steel

10.1 Defects

The material shall be sound and free from such internal and external defects or surface flaws as might preclude its use for the purpose for which it is intended.

10.2 Correction of minor defects

It is permissible for the supplier to remove minor surface defects by grinding to a remaining thickness of 12.5 % below the ordered thickness. In all cases the reduction below ordered thickness shall not exceed 3 mm. In no case shall the final outside dimension after grinding and, if appropriate, repair by welding in accordance with **10.3**, be below the minimum allowed by BS 4848-2:1991.

10.3 Repair by welding

It is permissible for the supplier to remove surface defects that cannot be corrected in accordance with **10.2** by grinding or chipping followed by welding subject to the following conditions.

- After complete removal of the defect and before welding, the thickness shall not have been reduced to less than 80 % of its nominal dimension.
- The welding shall be carried out in accordance with BS 5135:1984 by competent operators approved to BS EN 287-1:1992 and the weld shall be ground smooth and flush with the adjacent surface of the product. The supplier shall follow documented welding procedures established in accordance with BS EN 288-1:1992 to BS EN 288-3:1992 which are appropriate for the material being welded.

See also options **B.6** and **B.7**.

NOTE In certain applications repair by welding may not be appropriate or may require special inspection after completion. An example would be where permissible stresses are limited by considerations of fatigue.

Table 2 — Chemical composition (ladle analysis)

Figures in parentheses refer to the notes following this table.											
Grade	Chemical composition										Normal supply condition
	C max.	Si	Mn	P	S	Cr	Ni max.	Cu	Al (sol.) (2)	V	
	%	%	%	%	%	%	%	%	%	%	
S345J0WPH	0.12	0.25 to 0.75	0.60 max.	0.070 to 0.15	0.050	0.30 to 1.25	0.65	0.25 to 0.55	—	—	Hot finished (1)
S345J0WH	0.19	0.15 to 0.50	0.90 to 1.25	0.040 max.	0.050	0.40 to 0.70	—	0.25 to 0.40	0.01 to 0.06	0.02 to 0.10	Hot finished or normalized
S345GWH	0.22	0.15 to 0.50	0.90 to 1.45	0.040 max.	0.050	0.40 to 0.70	—	0.25 to 0.40	0.01 to 0.06	0.02 to 0.10	Hot finished or normalized

(1) For alternative supply conditions see clause 7.
(2) A total aluminium content of 0.010 % to 0.065 % shall be considered to be in conformity with this requirement.
See also options B.2, B.3, B.4 and B.5.

Table 3 — Mechanical properties (1)

Figures in parentheses refer to the notes following this table.								
Minimum tensile strength, R_m	Minimum yield strength, R_e , for thicknesses (in mm)			Minimum elongation, A , on gauge length of $5,65\sqrt{S_0}$	Charpy V-notch impact test value			Grade
	Up to and including 12 mm	Over 12 up to and including 25 (2)	Over 25 up to and including 40		Temperature	Energy min.	Thickness max.	
N/mm ² (3)	N/mm ²	N/mm ²	N/mm ²	%	°C	J	mm	
480	345	325	325	21	0	27	12	S345J0WPH
480	345	345	345	21	0	27	40	S345J0WH
480	345	345	345	21	-15	27	40	S345GWH

(1) For details of flattening test see clause 25.
(2) Only circular hollow sections are available in thicknesses over 20 mm.
(3) 1 N/mm² = 1 MPa.

11 Identification of cast

The manufacturer shall identify the products in such a way as to enable the finished steel to be traced to the cast from which it was made or, for hollow sections rolled by the continuous process, the casts from which they were made.

12 Marking

Each piece or parcel of steel shall be legibly marked with the manufacturer's name or trade mark, and with cast number or identification marks by which the steel can be traced to the cast or casts from which it was made. In addition, the material shall be legibly marked with the grade number. When parcels of material are securely bundled, a tab attached to each bundle and marked as above shall be sufficient marking.

See also option B.8.

NOTE It is recommended that the purchaser should consult the supplier concerning agreement to the method of marking to be used.

13 Test certificates

13.1 Manufacturer's supply

The manufacturer shall supply the purchaser with a test certificate endorsed by the manufacturer giving the steel grade, ladle analysis and the results of each of the mechanical tests applicable to the material purchased. The certificate shall indicate the numbers or identification marks of the casts to which it applies, corresponding with the numbers to be found on the material supplied.

13.2 Merchant supply

If any section is supplied from a merchant's stock, the merchant shall satisfy the purchaser by means of numbers or identification marks on the section or tab when sections are bundled, combined with a manufacturer's test certificate, that such section conforms to all the requirements of this standard applicable to the material specified. If the merchant has altered the condition or dimensions of the section in any way, it is his responsibility to ensure that the material he supplies still conforms to this standard.

14 Mass of steel

The mass of steel shall be calculated on the basis that the steel has a density of 7850 kg/m^3 .

15 Tolerances

The dimensional and mass tolerances for hollow sections shall conform to BS 4848-2:1975.

16 Selection and identification of test samples

16.1 Selection of samples

The manufacturer shall randomly select and identify test samples in accordance with clauses 17, 18, 21 and 22.

See also options B.9, B.10, B.11 and B.13.

16.2 Condition of samples

The test samples shall be in the heat treatment condition specified in clause 7.

17 Number of tensile tests

One tensile test shall be made on the finished section for each 40 t or part thereof from the same cast, except for hollow sections made by a continuous process, for which two tensile tests shall be made for each 40 t or less of any section.

See also option B.13.

18 Direction and position of tensile test samples

Tensile test samples shall be cut in the longitudinal direction.

It is permissible to test small hollow sections in full section. Where this is not done, samples from rectangular (including square) hollow sections shall be taken from any side midway between and excluding the corners as shown in Annex C.

Samples shall be cut clear of any welds.

19 Tensile test pieces

19.1 Preparation of test pieces

Tensile test pieces shall be prepared in accordance with BS EN 10002-1:1990, as appropriate, from the test samples obtained in accordance with clause 18, so that, wherever practicable, the rolled surface of the steel is retained on two opposite sides of the test piece.

19.2 Straightening of test pieces

Any straightening of test pieces which is required shall be done cold. Test pieces cut from circular hollow sections shall be tested in the curved condition, but it is permissible for the ends to be flattened cold for gripping.

20 Tensile test

20.1 General

The tensile test shall be carried out in accordance with BS EN 10002-1:1990, as appropriate. The tensile strength, R_m , the yield strength R_e , and the elongation, A , shall be determined, and the results obtained shall conform to the values given in Table 3 for the appropriate grade. For the yield strength, it is permissible for the manufacturer to determine either the upper yield stress, R_{eH} , or the 0.5 % proof stress (total extension), $R_{t0.5}$.

20.2 Dispute

If the result is in doubt or dispute, the yield strength shall be deemed not to be reached until the total extension under load as determined by the extensometer or dividers, is observed to be 0.5 % of the gauge length ($R_{t0.5}$).

20.3 Elongation

The specified elongation values relate to a proportional gauge length of $5.65 \sqrt{S_0}$, where S_0 is the original cross-sectional area of the test piece as shown in Table 3 and, if other gauge lengths are used, the corresponding elongation on gauge length of $5.65 \sqrt{S_0}$ shall be obtained as described in BS 3894-1:1965.

21 Number of impact tests

Three adjacent Charpy V-notch test pieces shall be taken from one of the thickest products of each 40 t or part thereof of the same thickness range (see Table 3) from the same cast.

22 Position of impact test samples

The impact test samples shall be taken from the positions shown in Annex C. Impact test samples taken from welded hollow sections shall be cut clear of the weld.

23 Impact test pieces

NOTE 1 Impact tests for material less than 6 mm thick are not normally carried out but may be agreed between the purchaser and the manufacturer at the time of the enquiry and order.

NOTE 2 Test piece size is dependent on the actual thickness of the test sample and for circular products allowance also needs to be made for the radius of curvature of the surface.

23.1 General

The test pieces shall be cut parallel to the principal direction of rolling and the axis of the notch shall be perpendicular to the rolled surface of the product (see Figure 1). The test pieces shall be prepared in accordance with BS EN 10045-1:1990 and 23.2 to 23.4 of this standard.

23.2 Material 20 mm thick and over

For thicknesses of 20 mm and over, standard 10 mm × 10 mm test pieces shall be so machined that they do not include material nearer to the surface than 3 mm.

23.3 Material between 12 mm and 20 mm thick

For material equal to or greater than 12 mm thick up to but excluding 20 mm thick, standard 10 mm × 10 mm test pieces shall be so machined that they do not include material nearer to the surface than 1 mm.

23.4 Material less than 12 mm thick

For material equal to or greater than 6 mm thick up to but excluding 12 mm thick, one of the following sizes of test pieces shall be prepared using the full thickness where necessary:

standard test piece 10 mm × 10 mm;

subsidiary standard test piece 10 mm × 7.5 mm;

subsidiary standard test piece 10 mm × 5 mm.

24 Impact tests

NOTE 1 The specified impact properties are for quality control purposes during the manufacture of the steel and the fact that low temperatures are used for these tests does not necessarily imply that the steels are completely satisfactory for use at these temperatures.

NOTE 2 The steels specified in this standard may be used in many applications for which design and construction codes may differ in requirements in respect of impact testing, e.g. orientation of test samples, frequency of testing or minimum energy values. The purchaser is advised to consult the manufacturer when this is the case.

24.1 Method of testing

The impact test shall be carried out in accordance with BS EN 10045-1:1990 at the temperature given in Table 3 for the grade ordered.

24.2 Values for standard test pieces

The average impact value obtained from the three standard 10 mm × 10 mm test pieces shall be not less than the appropriate value given in Table 3 (see 24.3) for the grade ordered.

24.3 Values for subsidiary standard test pieces

The average impact values obtained from three subsidiary standard test pieces shall be not less than 22 J for 10 mm × 7.5 mm test pieces or 19 J for 10 mm × 5 mm test pieces (see 24.4).

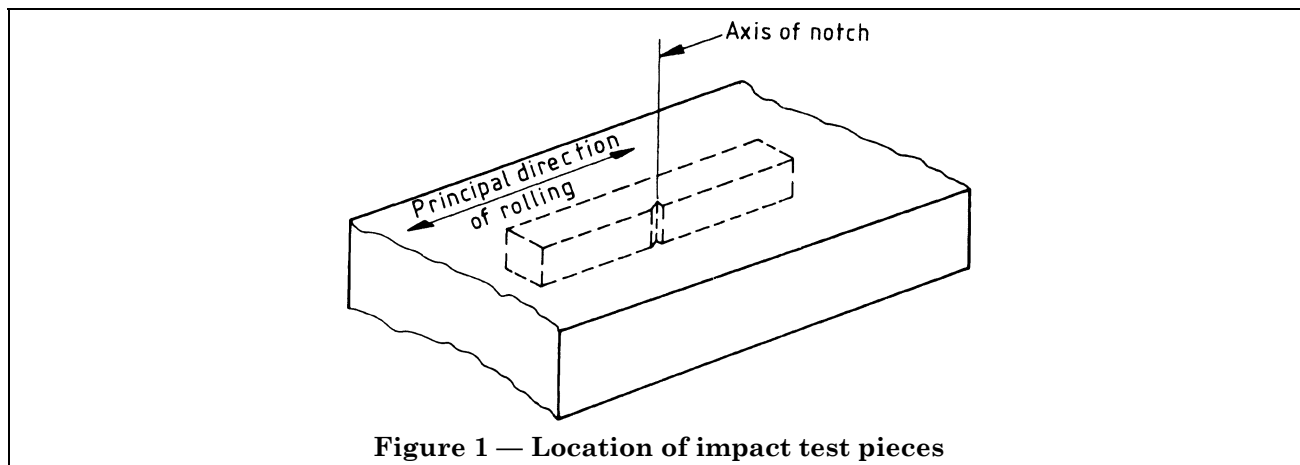


Figure 1 — Location of impact test pieces

24.4 Individual value

For standard and subsidiary standard test pieces, it is permissible for one individual value to be below the average value specified, but it shall not be less than 70 % of that value.

25 Flattening test

A flattening test shall be carried out for hollow sections manufactured by a welding process. A test specimen shall be selected for each 40 t or part thereof of the same size of section which is presented for inspection. The test shall be carried out on circular hollow sections and, where practicable, on rectangular hollow sections in the round form before shaping.

A ring not less than 40 mm in length cut from one end of each selected section shall be flattened cold between two parallel flat surfaces. Burrs shall be removed before testing and the weld shall be placed at 90° to the direction of flattening. No opening of the weld shall take place until the distance between platens is less than 85 % of the original outside diameter of the section. The test shall then be continued until the weld opens and the weld shall show no signs of incomplete fusion.

No cracks or breaks in the metal, elsewhere than in the weld, shall occur until the distance between the platens is less than two-thirds of the original outside diameter of the section.

26 Retests

26.1 Tensile and flattening tests

Should a test result not conform to clause 20, or 25, two further test pieces shall be made from samples taken from the product from which the original test piece was prepared.

Provided the results of both these further tests conform to clauses 20 or 25, all the material represented shall be deemed to conform to this standard.

If the result of either of these additional tests does not conform to clauses 20 or 25, the product from which the samples were cut shall be deemed not to conform to this standard, but the remaining material represented shall be deemed to conform to this standard provided that test pieces from two of the remaining products selected and prepared in accordance with clauses 17, 18 and 19 or 25 are tested and conform to clauses 20 or 25.

26.2 Impact tests

26.2.1 General

If the average value of the three impact tests is less than the minimum average specified in clause 24 or if one individual value is less than 70 % of the specified minimum, three additional test pieces from the same sample shall be tested and the results added to those previously obtained and a new average calculated. The new average value shall be not less than the specified minimum average. Not more than two of the individual values shall be less than the specified value. Not more than one individual value shall be less than 70 % of the specified value.

26.2.2 Products tested on a thickness range basis (see clause 21)

For products tested on a thickness range basis, if the average impact test value of the selected test pieces from the thickest product fails to conform to 26.2.1, the product from which the samples were cut shall be deemed not to conform to this standard but the remaining material represented shall be deemed to conform to this standard provided test pieces from two of the remaining products selected and prepared in accordance with clauses 21, 22 and 23 are tested and conform to clause 24 and, where applicable, 26.2.

26.3 Re-heat treatment

Notwithstanding the requirements of 26.1 and 26.2, the manufacturer shall have the right to heat treat or re-heat treat any material, including material already found not to conform to clauses 20, 24 and 25, and re-submit it for testing.

Annex A (informative) Comparison between grades and designations in this standard and BS 4360:1990

Table A.1 gives comparisons between grades and designations in this standard and those in BS 4360:1990

Annex B (normative) Options (see 5.2)

B.1 Steelmaking process

The steelmaking process shall be specified by the purchaser (see 6.1).

B.2 Ladle analysis: additional elements

Details of elements in addition to those given in Table 2 shall be supplied. The purchaser shall indicate which elements are required (see 8.1 and Table 2).

B.3 Actual carbon equivalent value (CEV)

The manufacturer shall either:

- a) state on the test certificate the actual carbon equivalent value (CEV) of the steel based on ladle analysis and calculated using the formula:

$$C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}; \text{ or}$$

- b) at his discretion, report in the details of the ladle analysis (see 8.1 and Table 2) the elements in the CEV formula.

B.4 Maximum carbon equivalent value (CEV)

The grades listed in Table B.1 shall be supplied with a CEV based on ladle analysis (see 8.1 and Table 2) and calculated using the following formula. The CEV shall not exceed the maximum values given in Table B.1.

$$C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

The ladle analysis shall include details of all the elements in the CEV formula.

B.5 Product analysis

Product analysis (see 8.2 and Table 2) shall be determined by the manufacturer. The analysis shall be carried out on the basis of one test per cast.

B.6 Repair by welding

No repair by welding shall be carried out without permission (see 10.3).

B.7 Repair by welding

No repair by welding shall be carried out (see 10.3).

B.8 Marking

Each section shall be marked with a continuous white paint line not less than 12.5 mm wide throughout its length. (This option is not applicable to material supplied in bundles.)

(See clause 12.)

Table A.1 — Comparison between grades and designations in this standard and BS 4360:1990

BS 4360:1990				BS 7668:1993			
Grade	Minimum tensile strength	Minimum yield strength at 12 mm	Charpy V-notch impacts at 27 J	Designation according to EN 10027-1 and IC 10	Minimum tensile strength	Minimum yield strength at 12 mm	Charpy V-notch impacts at 27 J
	N/mm ²	N/mm ²	°C		N/mm ²	N/mm ²	°C
WR 50A	480	345	0	S345J0WPH	480	345	0
WR 50B	480	345	0	S345J0WH	480	345	0
WR 50C	480	345	– 15	S345GWH	480	345	– 15

The steel name is derived from EN 10027-1 and IC 10 as follows:

- the letter S for structural steels;
- the indication of the minimum specified yield strength for thickness ≤ 12 mm expressed in N/mm²;
- the characters J0 to indicate an impact requirement of 27 J at 0 °C
- or
- the letter G to indicate an impact requirement of 27 J at – 15 °C;
- the letter W indicating that the steel has an improved atmospheric corrosion resistance (weather resistant);
- the letter P for the class with a greater phosphorous content;
- the letter H to indicate that the product is a hollow section.

B.9 Purchaser's selection and identification of test samples: prior to products being cut to ordered size

The purchaser shall randomly select and identify test samples in accordance with clauses 17, 18, 21 and 22, prior to the products being cut to ordered size (see clause 16).

B.10 Purchaser's selection and identification of test samples: after products have been cut to ordered size

The purchaser shall randomly select and identify test samples in accordance with clauses 17, 18, 21 and 22, after the products have been cut to ordered size (see clause 16). In this case the purchaser shall accept the material from which the test samples have been cut provided always that the test results conform to this standard.

B.11 Purchaser's witnessing of mechanical tests

The mechanical tests (namely, tensile, impact) applicable to the purchaser's order shall be carried out in the purchaser's presence (see clause 16).

B.12 Purchaser's visual inspection

With respect to surface condition (see 10.1 and 10.2) and/or product marking (see clause 12) and/or relevant dimensional and shape tolerances, the manufacturer shall make available for the purchaser's visual inspection all, or a random selection of, the items produced for his order, as specified by the purchaser (see clause 16).

B.13 Number of tensile tests

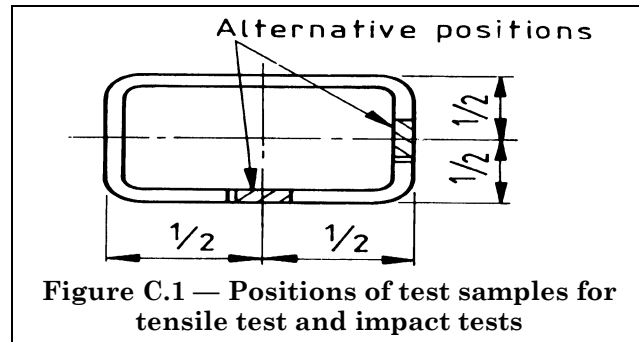
One additional test shall be made for each size of section ordered (see clause 17).

Table B.1 — Maximum CEV

Grade	Maximum CEV %	Thickness mm
S345J0WH S345GWH	0.54	Up to and including 40

**Annex C (normative)
Positions of test samples for tensile test and impact tests**

The position of test samples for tensile testing (see clause 18) and for impact testing (see clause 22) shall be as shown in Figure C.1.



List of references (see clause 2)

Normative references

BSI standards publications

BRITISH STANDARDS INSTITUTION, London

- BS 1837:1970, *Methods for the sampling of iron, steel, permanent magnet alloys and ferro-alloys.*
 BS 3894, *Method for converting elongation values for steel.*
 BS 3894-1:1965, *Carbon and low alloy steels.*
 BS 4848, *Hot-rolled structural steel sections.*
 BS 4848-2:1991, *Specification for hot-finished hollow sections.*
 BS 5135:1984, *Specification for arc welding of carbon and carbon manganese steels.*
 BS 6200, *Sampling and analysis of iron, steel and other ferrous metals.*
 BS EN 287, *Approval testing of welders for fusion welding.*
 BS EN 287-1:1987, *Steels.*
 BS EN 288, *Specification and approval of welding procedures for metallic materials.*
 BS EN 288-1:1992, *General rules for fusion welding.*
 BS EN 288-2:1992, *Welding procedure specification for arc welding.*
 BS EN 288-3:1992, *Welding procedure tests for the arc welding of steels.*
 BS EN 10002, *Tensile testing of metallic materials.*
 BS EN 10002-1:1990, *Method of test at ambient temperature.*
 BS EN 10045, *Charpy impact test on metallic materials.*
 BS EN 10045-1:1990, *Test method (V- and U-notches).*
 BS EN 10079:1993, *Definition of steel products.*

Informative references

BSI standards publications

BRITISH STANDARDS INSTITUTION, London

- BS 4360:1990, *Specification for weldable structural steels.*
 BS 7613:1992, *Specification for hot rolled quenched and tempered weldable structural steel plates¹⁾.*
 BS EN 10025:1993, *Hot rolled products of non-alloy structural steels and their technical delivery conditions¹⁾.*
 BS EN 10027, *Designation systems for steel.*
 BS EN 10027-1:1992, *Steel names, principal symbols.*
 BS EN 10113, *Hot rolled products in weldable fine grain structural steels.*
 BS EN 10113-1:1993, *General delivery conditions¹⁾.*
 BS EN 10113-2:1993, *Delivery conditions for normalized/normalized rolled steels¹⁾.*
 BS EN 10113-3:1993, *Delivery conditions for thermomechanical rolled steels¹⁾.*
 BS EN 10155, *Structural steels with improved atmospheric corrosion resistance. Technical delivery conditions¹⁾.*
 BS EN 10210, *Hot finished structural hollow sections of non-alloy and fine grain structural steels.*
 BS EN 10210-1:1993, *Technical delivery requirements¹⁾.*

Other references

ECISS IC 10, *Designation systems for steel — additional symbols for steel names.*

¹⁾ Referred to in the foreword only.

BSI — British Standards Institution

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