


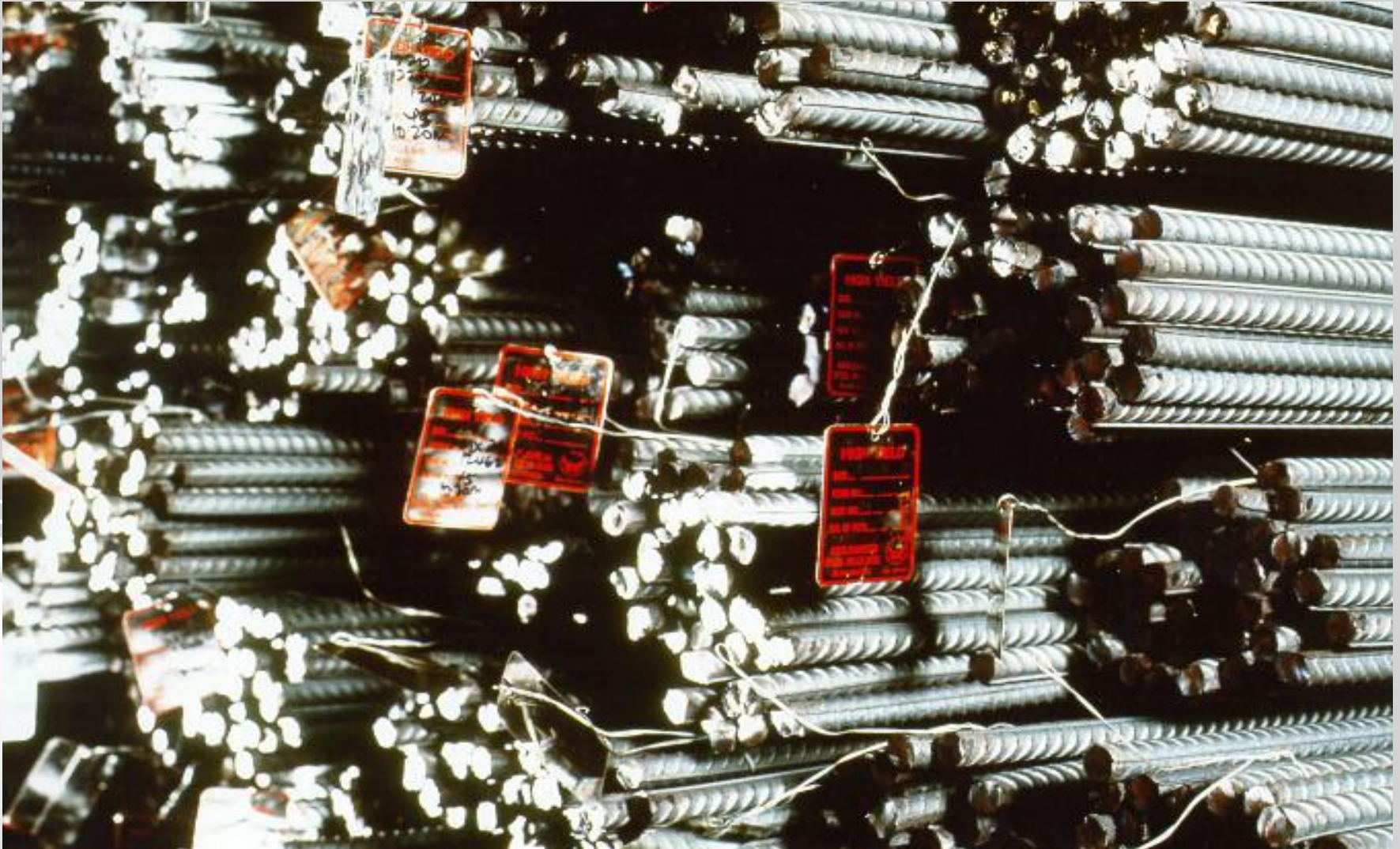
CONSTRUCTION MATERIAL

MS 146: 2014

A decorative graphic in the bottom-left corner consisting of several thin, curved white lines and three small white circles of varying sizes.

BY: Ir. Sabrudin Suren
CIDB Expert Panel (Iron & Steel)
16/12/2015
Grand Season Kuala Lumpur

CONSTRUCTION MATERIAL OF MS 146



REINFORCEMENT BAR (MS 146: 2014)

DEVELOPMENT OF MS 146

DEVELOPMENT OF MALAYSIAN STANDARDS

The **Department of Standards Malaysia (STANDARDS MALAYSIA)** is the national standards and accreditation body of Malaysia.

The main function of STANDARDS MALAYSIA is to foster and promote standards, standardisation and accreditation as a means of advancing the national economy, promoting industrial efficiency and development, benefiting the health and safety of the public, protecting the consumers, facilitating domestic and international trade and furthering international cooperation in relation to standards and standardisation.

Malaysian Standards (MS) are developed through consensus by committees which comprise balanced representation of producers, users, consumers and others with relevant interests, as may be appropriate to the subject at hand. To the greatest extent possible, Malaysian Standards are aligned to or are adoption of international standards. Approval of a standard as a Malaysian Standard is governed by the Standards of Malaysia Act 1996 [Act 549]. Malaysian Standards are reviewed periodically. The use of Malaysian Standards is voluntary except in so far as they are made mandatory by regulatory authorities by means of regulations, local by-laws or any other similar ways.

DEVELOPMENT OF MS 146

MS 146:2014

Committee representation

The Industry Standards Committee on Metallic Materials and Semi-finished Products (ISC P) under whose authority this Malaysian Standard was developed, comprises representatives from the following organisations:

Association of Consulting Engineers Malaysia
Association of Marine Industries of Malaysia
Construction Industry Development Board Malaysia
Department of Standards Malaysia
Federation of Malaysian Manufacturers
IKRAM QA Services Sdn Bhd
Institute of Materials Malaysia
Jabatan Kerja Raya Malaysia
Malaysia Steel Association
Malaysian Automotive Component Parts Manufacturers
Malaysian Iron and Steel Industry Federation
Master Builders Association Malaysia
Ministry of International Trade and Industry
Pertubuhan Akitik Malaysia
SIRIM Berhad (National Centre for Machinery and Tooling Technology)
SIRIM Berhad (Secretariat)
SIRIM QAS International Sdn Bhd
The Institution of Engineers, Malaysia
Universiti Malaya
Universiti Sains Malaysia
Universiti Teknologi Malaysia

The Technical Committee on Steel Bars, Wire Rods and Wire Products which developed this Malaysian Standard consists of representatives from the following organisations

Association of Consulting Engineers Malaysia
Construction Industry Development Board Malaysia
IKRAM QA Services Sdn Bhd
Jabatan Kerja Raya Malaysia
Malaysian Iron and Steel Industry Federation
Master Builders Association Malaysia
Ministry of International Trade and Industry
MMC Gamuda KVMRT (PDP) Sdn Bhd
SIRIM Berhad (Secretariat)
SIRIM QAS International Sdn Bhd
The Institution of Engineers, Malaysia
Universiti Malaya
Universiti Teknologi MARA

Co-opted members:

Amsteel Mills Sdn Bhd
Ann Joo Steel Bhd
Asia Wire Steel Mesh Manufacturers Sdn Bhd
CH Reinforcing Steel (M) Sdn Bhd
Perwaja Steel Sdn Bhd
Southern PC Steel Sdn Bhd
Southern Steel Berhad
Southern Steel Mesh Sdn Bhd

DEVELOPMENT OF MS 146

STANDARD	GRADE	DESCRIPTION	APPLICATIONS
1. BS 4449:1997 * Note: Bar marking at 1.5m with no std. method	i. G 460A and 460B ii. G 250	i. HIGH YIELD DEFORMED HOT ROLLED STEEL FOR REINFORCEMENT OF CONCRETE ii. PLAIN HOT ROLLED STEEL BAR FOR REINFORCEMENT	CONCRETE REINFORCEMENT
2. MS 146:2000 * Note: No bar marking	i. G 460 ii. G 250	i. HIGH YIELD DEFORMED HOT ROLLED STEEL FOR REINFORCEMENT OF CONCRETE ii. PLAIN HOT ROLLED STEEL BAR FOR REINFORCEMENT	CONCRETE REINFORCEMENT

DEVELOPMENT OF MS 146

STANDARD	GRADE	DESCRIPTION	APPLICATIONS
**3. MS 146:2006 (Third revision) *Note: Bar marking at 1.5m apart. No std. identification. (Legible marks or thickened ribs) ** Ref: Based on BS 4449:1997	i. G 460 or G 500 ii. G 250	i. HIGH YIELD DEFORMED HOT ROLLED STEEL FOR REINFORCEMENT OF CONCRETE ii. PLAIN HOT ROLLED STEEL BAR FOR REINFORCEMENT	CONCRETE REINFORCEMENT
**4. MS 146:2014 (Fourth revision) *Note: Bar marking at 1.5m apart. Defined std. identification by CIDB Enforcement of CIDB Act 520 ** Ref: Based on BS 4449:2005	i. B 500A ii. B 500B iii. B 500C	HIGH YIELD DEFORMED HOT ROLLED STEEL FOR REINFORCEMENT OF CONCRETE	CONCRETE REINFORCEMENT FOR STEEL STUCTURAL APPLICATIONS INCLUDING BRC

MS 146:2014

Scope;

This Standard specifies requirements for ribbed weldable reinforcing steel used for the reinforcement of concrete structures.

This standard covers steel delivered in the form of bars, coils and decoiled products.

This standard contains provisions for three steel grades, all of 500 MPa characteristic yield strength, but with different ductility characteristics. The three grades are B500A, B500B and B500C.

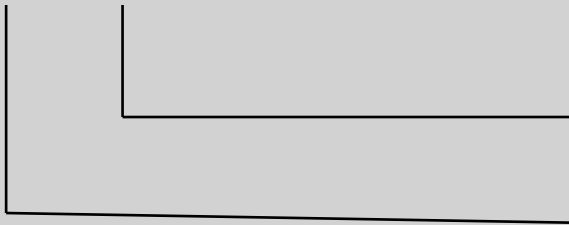
*This standard is identical to BS 4449:2005 and conform to EN 10080 that is aligned with Eurocode 2 (EC2); EN 1992-1-1 (General rules and rules for building) and CE marking.

Comparison Requirements MS 146

Standard	MS 146:2006	MS 146: 2014
Grade	G250, G460 & G500	B500A, B500B & B500C
1. Chemical Composition	√	√
2. Mechanical Properties	YS,TS, A ₅	YS, TS, A _{gt}
3. Bend Test (b)	√	√
4. Re-bend Test (r)	45° (b)+ 23° (r)	90°(b) + 20°(r)
5. Dimensional Tolerance	√	√
6. Fatigue Test	√	√
7. Bond Test	Test Block	Surface Geometry
8. *Bar Marking	*Up to factory	**CIDB to determine

Example: MS 146:2014

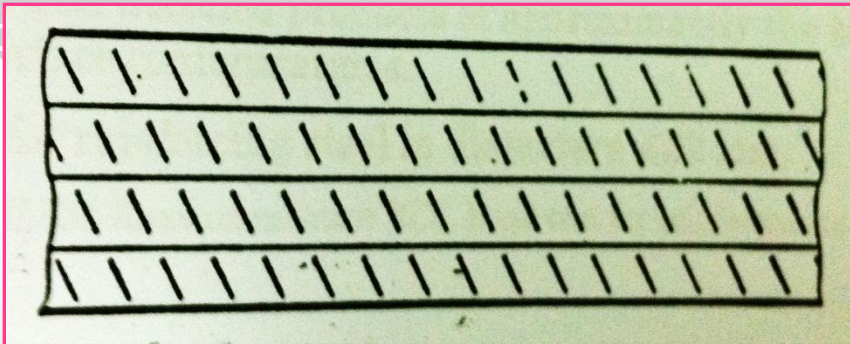
i. **G B500A** _____



Rib Pattern A

Yield Strength 500N/mm² min

**Quality (Steel Grade) for
reinforced steel `B`**



Rib Pattern for A
(Parallel Ribs- Screw Type)

Note: Tensile strength shall be at least 5% greater than the actual yield stress

Example: MS 146:2014

Malaysian Standard
for steel bars reinforcement
of concrete .

i. G B500A

Yield Strength 500 N/mm² min.

Quality (Steel Grade) with Pattern A

ii. G B500B

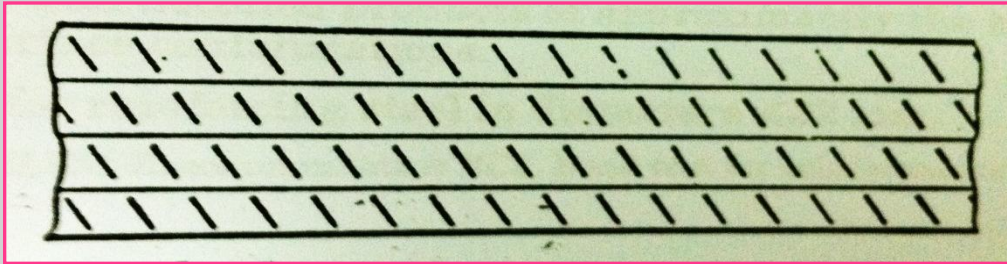
Pattern B

Yield Strength 500N/mm² min

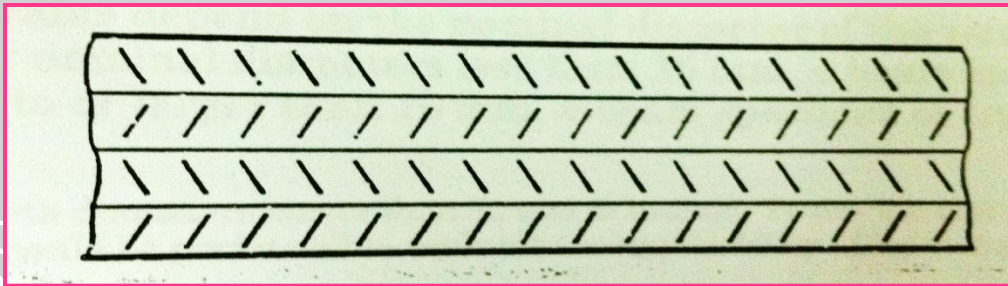
Quality (Steel Grade) with Pattern B

Note: `B` denotes the reinforcing steel

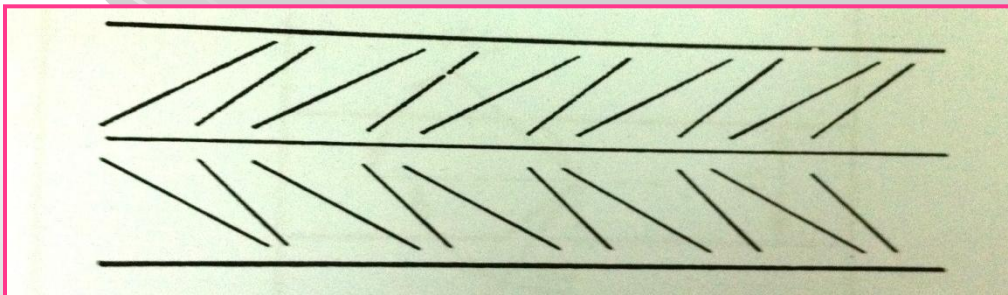
Identification Rib of MS 146: 2014



Rib Pattern for A
(Parallel Ribs – Screw Type)



Rib Pattern for B
(Fish Bone Type)



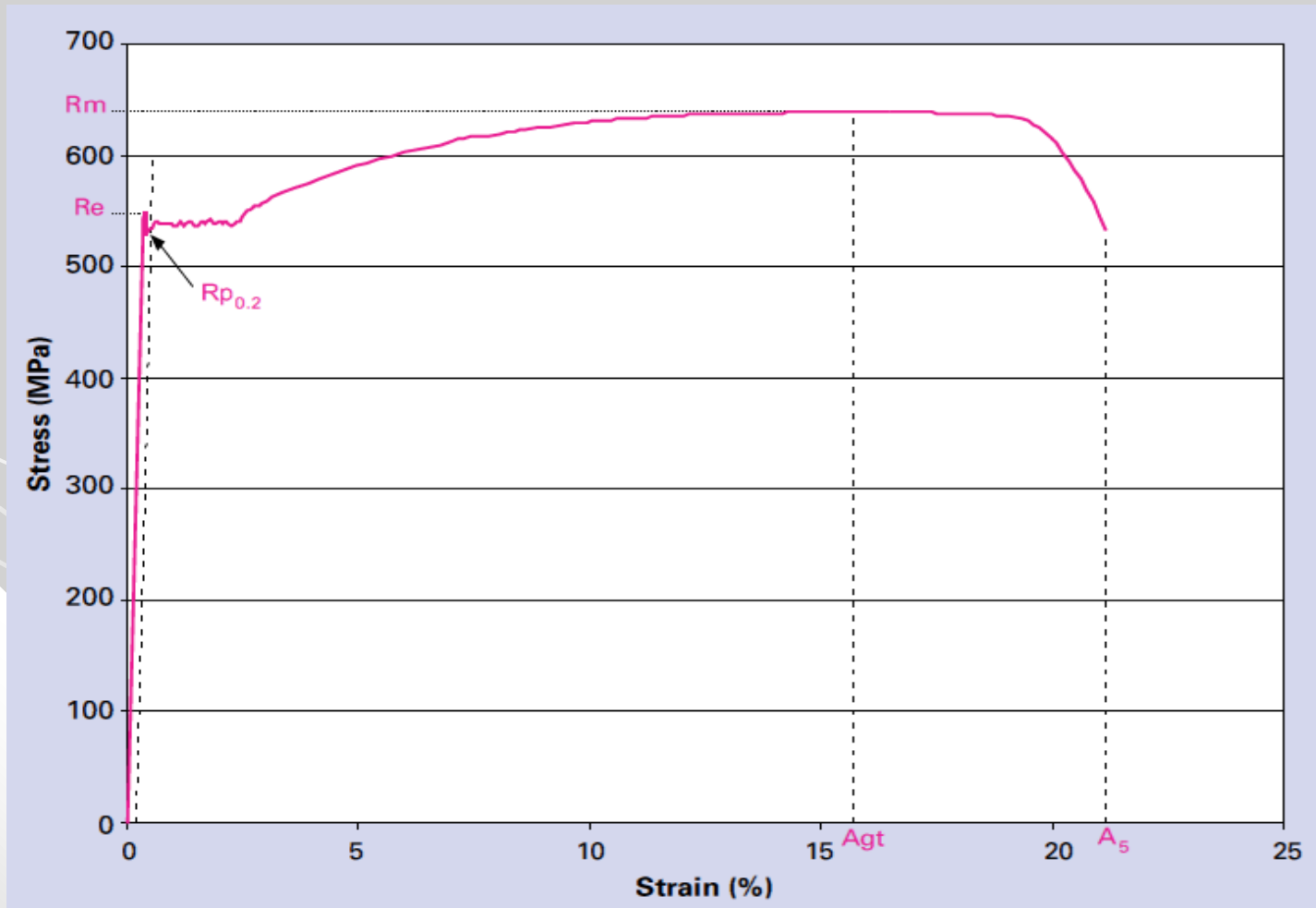
Rib Pattern for C
(Angle Type)

Clause 7.3.3 Characteristic tensile properties

Grade	Yield strength R_e (MPa)	Tensile/yield strength ratio R_m/R_e	Total elongation at maximum force A_{gt} (%)
B500A	500	1.05 ^a	2.5 ^b
B500B	500	1.08	5.0
B500C	500	$\geq 1.15, < 1.35$	7.5

Note: Pattern A, B, and C have ductility differences.

Clause 7.3.3 Characteristic tensile properties



Clause 7.3.4 – Fatigue Test

FATIGUE TEST	MS 146: 2014		
Testing Frequency	Upper, middle & bottom of diameter range (initial testing) sample of one diameter shall be tested at least one a year, test sample shall be selected so that all dimension shall be tested over a five year period.		
Sampling	5 pieces of bar for each diameter without defect		
Testing Method & Requirement	Bar size, mm	Stress range, MPa	Shall survive 5 million stress cycles.
	≤16	200	
	>16 ≤20	185	
	>20 ≤25	170	
	>25 ≤32	160	
	> 32	150	
Retest	If one of the five test pcs produces a valid failure, a further 5 samples from the test unit shall be tested.		

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1. Deformed bar Bend Test

Standard	Grade	Nominal Size, mm	Former size, mm	Bending Angle
MS 146:2014	500A 500B 500C	6 - 50	4d to 7d	180°

Clause 7.3.5 - Deformed bar Re-bend test

Standard	Grade	Nominal size, mm	Max. Former size, mm	Bending angle, x	Aging time, (@100°C)	Re-bend angle, y
MS 146:2014	500A	≤ 16	4d	90°	30mins	20° 15
	500B	> 16	7d			
	500C					

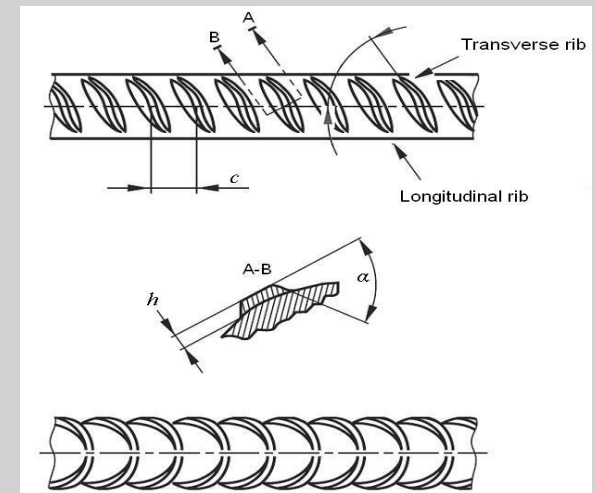
Clause 7.4.2 – Dimensions Tolerances

Item	MS 146: 2014
1. Cut Length	<ul style="list-style-type: none">Nominal length : -0 mm/ +100mm
2. Mass	<ul style="list-style-type: none">For Nominal Size $\leq 8\text{mm}$: Tolerance on mass per metre run = $\pm 6.5\%$For Nominal Size $> 8\text{mm}$: Tolerance on mass per metre run = $\pm 4.5\%$

Clause 7.5 Performance Test – Bond Test

- Ribbed bars are characterised by their surface geometry, by means of which bond with the concrete is achieved.
- A suitable means of factory production control based on the control of surface geometry shall be derived from the bond test results.

Rib height, (h)	Rib spacing, (C)	Rib inclination, β
0.03d to 0.15d	0.4d to 1.2d	35° to 75°



Ribbed weldable reinforced concrete steel

MS 146: 2014

The products covered by this standard shall be designates with the following information:

- a) Description of the product form (i.e.: bar coil, decoiled product);
- b) The nominal dimensions of the product; and
- c) Reference to this standard, and the grade.

For example, the designation for 40 mm diameter bar in 12 m lengths of grade B500B would be:

"Bar MS 146 Grade B500B 40 X 12000".

Test samples report for bars (MS 146:2014)

- Full description of test samples, including size
- Identification of the batch to which the test samples relate
- Name of steel maker or supplier
- Name of the approved test laboratory
- Description of pattern of deformation, mill marks or labels and sign of damage.
- Length and mass of test piece
- Results of chemical composition
- Results of purchaser's test of weldability

Marking of Bars

MS 146:2014- Clause 11 Refer to Annex C

- In order to identify the source of manufacture, deformed bars shall be identified by rolled- on legible marks on the surface or ribs at intervals not greater than 1.5m.

Bar Marking MS 146: 2014

C.1 Bar - Identification of the manufacturer as approved by CIDB.

C.1.1 Each reinforcing steel shall bear on one rib row, a mark identifying the works.

This mark shall be repeated at an interval of not more than 1.5 m.

C.1.2 The mark shall consist of the following:

- a) a symbol denoting the beginning of the mark; and
- b) a numerical system identifying the manufacturer, consisting of the country of origin and the works number.

Note: CIDB is enforcing for bar 10mm and above to use the numerical system identifying the manufacturer, consisting of a country number of origin (1- local and 2- overseas) and a works number (PPS eg. 103) shall use one of the following methods.

- i) Numbers on the surface of the bar (for eg. see Figure C1)
For bars less than 10mm diameter, option is given to use numerical system or dot system.
- ii) Dot marks with a number of normal ribs in between them (for eg. see Figure C2).

Bar Marking MS 146: 2014

Local manufacturer
PPS No: 1.103

PPS NO = 1-103 (LOCAL NO 103)

1/X / 9/ / 1/0/3

Oversea manufacturer
PPS No: 2.3

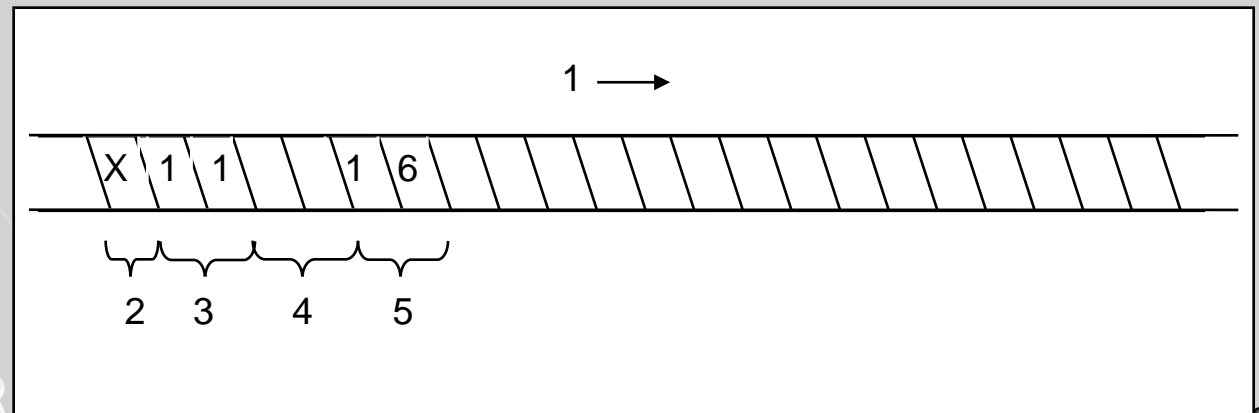
PPS NO = 2-3 (OVERSEA NO 3)

2/X / 9/ / 3/

Figure C1: Bar marking using numerical system for bar ≥ 10mm diameter

KEY

- 1 Direction of reading
- 2 Start
- 3 Country number (11)
- 4 Separations between country number origin and works number
- 5 Works number (16)



Bar Marking MS 146: 2014

Local manufacturer
PPS No: 1.3

PPS NO = 1-3 (local NO 3)

/././././././././././././././.

Local manufacturer
PPS No: 1.103

PPS NO = 1-3 (local NO 103)

/././././././././././H./././.

Overseas manufacturer
PPS No: 2.3

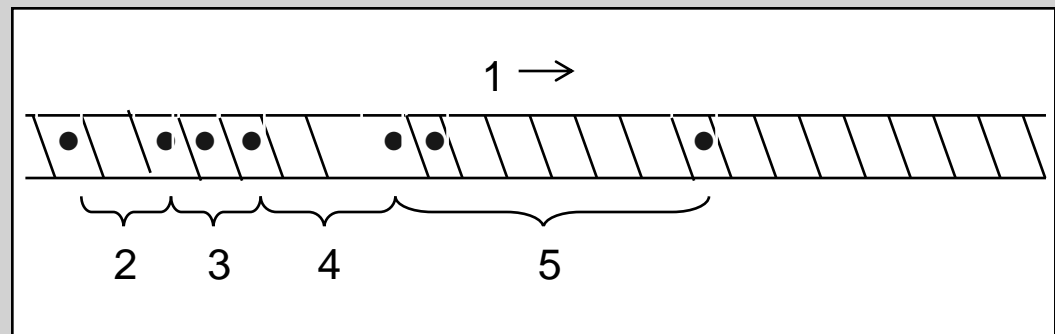
PPS NO = 2-3 (Oversea NO 100)

/.//.//./////////.H.H.

KEY

- 1 Direction of reading
- 2 Start
- 3 Country number (11)
- 4 Separations between country number origin and works number
- 5 Works number (16)

Figure C2: Bar marking using dot system for bar < 10mm diameter



BAR MARKING MS 146:2014

MS 146:2014

Table C.1. Identification of the country of origin

Country	Country number
Austria, Czech Republic, Germany, Poland, Slovakia	1
Belgium, Netherlands, Luxembourg, Switzerland	2
France, Hungary	3
Italy, Malta, Slovenia	4
UK, Ireland, Iceland	5
Denmark, Estonia, Finland, Latvia, Lithuania, Norway, Sweden	6
Portugal, Spain	7
Cyprus, Greece	8
Other countries	9

SAMPLE FOR BAR MARKING IDENTIFICATION



AMSTEEL MILLS SDN BHD (63077-A)

A Member of The Lion Group

MILL TEST CERTIFICATE

Customer : IPMUDA SELATAN SDN BHD

Commodity : DEFORMED BARS FOR CONCRETE REINFORCEMENT

Certificate No. : 25533/12

Address : BGN IPMUDA, NO-4 JALAN DEWANI
(OFF JALAN TANPOI)
81100 JOHOR BAHRU, JOHOR.

Specification : MS 146 : 2006 GRADE 500

D/O No. : 630787

Contract No. :

Issuing Date : 9/08/12

Size (mm)	Heat No.	ECSA (mm ²)	Rolling Mass kg/m	No. of Bundle / Coil	TEST DATE	Mechanical Properties						Chemical Composition (%)							
						Yield (R _{eH}) or R _p 0.2% N/mm ²	Tensile N/mm ²	Stress Ratio	EL %	Bend Test 180°	Rebend Test	C	Si	Mn	P	S	CE		
40.0	186943	1228.75	9.630		30/04/12	558	666	1.18	16	PASSED	PASSED	23	21	81	14	36	40		
40.0	185470	1232.74	9.677		10/03/12	572	671	1.17	18	PASSED	PASSED	21	21	77	13	18	38		
						ITEM(S) = 2 ONLY													
												THIS IS A REPRINT (17/08/12)							

SAMPLE MILL CERT MS 146:2006

Remark: ECSA = Effective Cross Section Area
CE = Carbon Equivalent
EL = Percentage Elongation
T = Thickness
W = Width
LICENCE NO. : PA011103

DELIVER TO : DETECT ENGINEERING SDN BHD

We hereby certify that the material describe herein has been made and tested in accordance with the above specification.



AMSTEEL (KLANG)

AMSTEEL (BANTING)

ANTARA (PASIR GUDANG)

XX = Denote Nominal Size Of Deformed Bar

YEE SEN TAT

Authorised Signature

THIS MILL CERTIFICATE IS A COMPUTER GENERATED COPY AND NO SIGNATURE REQUIRED

Office Address: Lot 1, Jalan Waja, Bukit Raja Industrial Estate, 41050 Klang, Selangor Darul Ehsan, Malaysia.
Mill/Factory Address: Lot 6, Solok Waja Dua, Bukit Raja Industrial Estate, 41050 Klang, Selangor Darul Ehsan, Malaysia.
Tel: 03-33412422, 33412323 Telex: WIRASM MA, 39534 / 39543 Facsimile: 03-33412354 Postal Address: P.O.Box 44, 41700 Klang, Selangor Darul Ehsan.

SAMPLE FOR BAR MARKING IDENTIFICATION (MS 146:2006)

AMSTEEL (KLANG)

SAMPLE ON BAR MARKING



AMSTEEL (BANTING)



ANTARA (PASIR GUDANG)

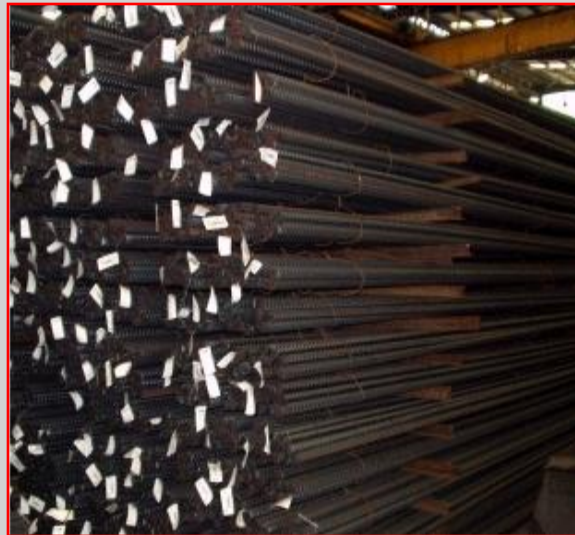


Note: XX is the bar size (mm)

DEFORMED BAR END APPLICATION

MS146:2014

HIGH YIELD DEFORMED BAR FOR REINFORCEMENT OF CONCRETE
GRADE B500B



High Strength Bar Reinforced Concrete (MS 145)

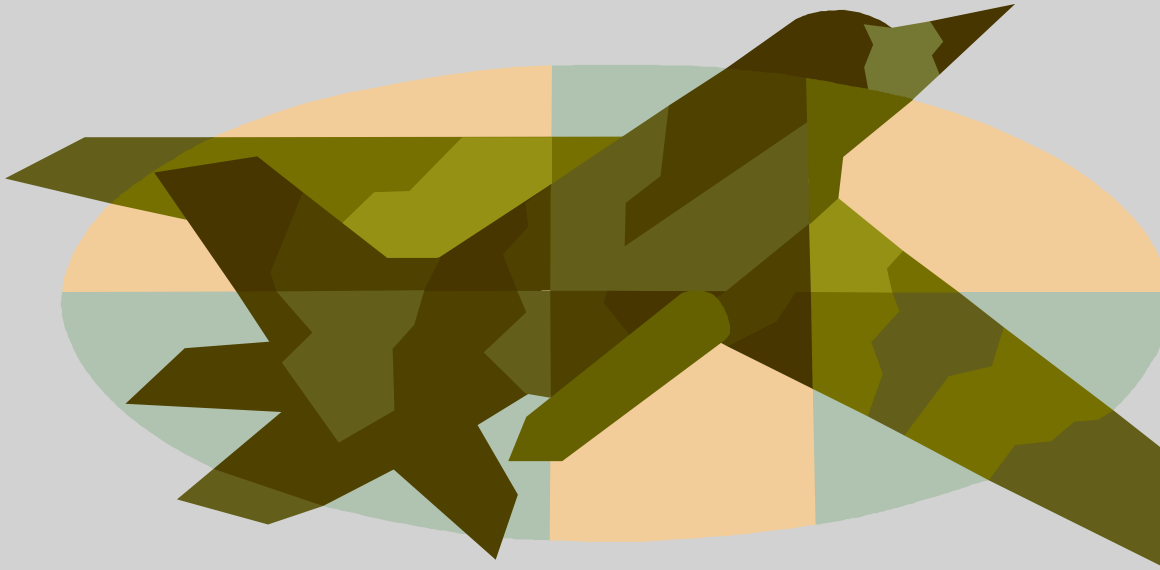


Wire Mesh

Note: Material use shall be MS 146: B500A, B500B or B500C

Conclusion

1. Refer to Fourth Schedule Act 520 on product standard for construction materials
- 2. Refer to the latest version of MS 146: 2014
3. Register PPS for bar marking



SEKIAN
TERIMA KASIH

Table 5

Comparison of properties

Standard	Grade	R_e (MP _a)	R_m^c/R_e	A_5 (%)	A_{gt} (%)
BS 4449:1997	460A	460	1.05	12	2.5
BS 4449:1997	460B	460	1.08	14	5.0
BS 4449:2005	B500A	500	1.05 ^a	N/a	2.5 ^b
BS 4449:2005	B500B	500	1.08	N/a	5.0
BS 4449:2005	B500C	500	>1.15 ≤1.30	N/a	7.5

^a 1.02 for sizes < 8mm^b 1.0% for sizes < 8mm^c R_m = Ultimate Tensile Strength