LOW CARBON STEEL, HOT ROLLED SHEET AND STRIP

1. SCOPE

1.1 This specification provides the requirements for low carbon, hot rolled (HR) sheet and strip steel. There are two grades covered in the specification with Grade A1 identified as the preferred grade, see Table 1. Both Grades A1 and B1 may be specified for sheet or strip product forms. This specification is intended to replace Former Company Material Specifications listed in Annex B and shall be used on all applicable new drawings.

1.2 REVISED GRADES – LEGACY MATERIALS

1.2.1 Revision E of this specification establishes new Grades with chemistry and mechanical property requirements. Former Grades A and B are withdrawn and are replaced with Grades A1 and B1 as described in Table 1. These new grades shall be used where materials on existing drawings are updated by Design Engineering per this specification. Where these material updates are made to a drawing, the change shall be documented in the revision notes on the drawing. Annex B, Table B3 lists National Standard materials previously referenced for the CNH Grades that shall not be used on new or updated drawings. For existing drawings, see Section 3.3 and Annex B.

TABLE 1: Grade and Material Description

CNH Grade	Replaced Grade	Description
A1 (Preferred)	A	Hot rolled low carbon steel, commercial quality.
B1	B	Hot rolled low carbon steel of drawing quality, fully aluminum killed.

2. RELATED SPECIFICATIONS

CNH DWGD100 (86979040) Specifying Steel Sheet Thickness
CNH ENPJ100 (86619032) Significant Characteristics
CNH MAT1003 (86979049) Metallic Material Designations on Engineering Drawings
CNH MAT1010 (86979053) Low Carbon Steel, Cold Rolled Sheet
CNH MAT1011D Design & Material Information, Low Carbon Steel, HR Sheet
CNH MAT1020 (87021626) HSLA HR Sheet

3. APPLICATION

3.1 HR carbon steel sheet and strip are produced to commercial quality for use where bending, forming, welding and moderate drawing may be required. Pickling or other surface preparation is required for applications, such as painted parts, where improved surface finish is needed. See also Section 4.7.

THE INFORMATION HEREON IS THE CONFIDENTIAL AND PROPRIETARY PROPERTY OF CNH INDUSTRIAL N.V. AND/OR ITS SUBSIDIARIES OR DIVISIONS. ANY USE, EXCEPT THAT FOR WHICH IT MAY BE LOANED, IS PROHIBITED.

UNCONTROLLED COPY When Printed

3.1.1 HR Strip may be produced as single width or in multiple widths subsequently slit to the desired width. When the width of the product form equals or exceeds 600 mm (23⅝ in.) it qualifies as a sheet. If the width of product form is less than 600 mm (23⅝ in.) it qualifies as a strip.

3.1.2 HR sheet and strip are commonly produced in the thickness range from 1.2 to 6.0 mm (0.044 to 0.230 in.) in North America; thickness range may be limited to 1.2 to 4.5 mm (0.044 to 0.180 in.) when width exceeds 1200 mm (48 in.). HR sheet in Europe is produced in thickness from under 2.0 to 8.0 mm; while HR strip thickness ranges from 0.80 to 15.0 mm.

3.2 HR strip is produced to similar thicknesses as HR sheet. Sheet and strip are typically provided with mill or cut edges. Strips hot rolled to narrower widths are also produced with square edges per some national standards. Nominal thickness tolerances are equal or tighter for strips than sheets; see national standards for nominal thickness tolerances. Cut strip to narrower width from sheet does not qualify as strip unless it meets strip requirements. Strip may be ordered over sheet when edge condition, tolerance and reduced cost due to avoiding cutting or slitting of strips from sheets or coils is justified by CNH Industrial manufacturing locations.

3.3 For existing drawings, MAT1011 Grades A1 and B1 materials may be substituted respectively where former Grades A and B are specified. Former MAT1011 Grades A and B and previously referenced National Standard materials do not automatically substitute for the new Grades A1 and B1 as new requirements are specified.

3.4 For MAT1011 Grades A1 and B1, strip may be substituted where sheet is specified; sheet shall not be substituted where strip is specified.

3.5 MAT1011 Grade B1, fully killed drawing steel should be used when part fabrication requires severe drawing, forming, or essential freedom from aging. Automatic substitution of Grade B1 drawing quality steel is not permitted where Grade A1 commercial quality steel is specified due to the differences in specified mechanical properties. Where Grade B1 is specified, Grade A1 shall not be used.

3.6 Comparable or higher strength steels such as EN 10025-2 SJ235JR HR Non-Alloyed Structural Steel or CNH MAT1020 (87021626) High Strength Low Alloy (HSLA) HR steels may be substituted where MAT1011 Grade A1 commercial quality material is specified. This substitution is permitted only where manufacturing engineering at the CNH Industrial or supplier processing facility has assured that the substitute material has sufficient formability to meet print specifications for the application.

4. REQUIREMENTS

4.1 Low Carbon HR sheet and strip steel supplied according to MAT1011 shall meet all requirements of this specification, applicable National Standards, and any special requirements specified on the engineering drawing.

4.2 Unless otherwise specified MAT1011 Grade A1 (preferred) shall be supplied to this specification.

4.3 NATIONAL STANDARD MATERIALS

4.3.1 Annex A provides a partial listing of National Standards materials identified as acceptable for supply to the MAT1011 sheet and strip grades. Other National Standard materials, not listed in Annex A, that comply with MAT1011 requirements may also be supplied. In general, it is permissible to produce a part from any of these comparable National Standard grades for a corresponding the MAT1011 Grades when no special strength or composition requirements are specified.

4.3.2 CNH Industrial Design Engineering must consider the differences in dimensional tolerances and properties of National Standard sheet and strip materials supplied to this specification to assure functionality, reliability, and serviceability of a part when manufactured in different parts of the world. In applications where these differences can not be compensated for in the design, the material may be restricted to the originally specified National Standard material as described in CNH MAT1003 (86979049) Metallic Material Designations on Engineering Drawings.

4.4 CHEMISTRY

Steels supplied to this specification must conform to the composition limits in Table 2. Grade B1 steel shall be deoxidized with aluminum to prevent gas evolution during solidification. The material composition shall not be changed by the supplier without the knowledge and consent of both controlling Design Engineering and the procuring CNH Industrial facility.

TABLE 2: Chemistry, HR Sheet and Strip Composition, Weight %, Heat Analysis
(Element Maximum unless otherwise specified)

Grade	C	Mn	P	S	Al	Si	Ni	Cr (1)	Mo	V	Cb/Nb	Ti (2)
A1 (Preferred)	0.02-0.15	0.60	0.045	0.035	--- (3)	---	0.20	0.15	0.06	0.008	0.008	0.025
B1	0.02-0.08	0.50	0.030	0.030	0.010 min	---	0.20	0.15	0.06	0.008	0.008	0.025

--- indicates element content is not specified; report if analyzed
(1) Chromium is permitted, when the carbon content is less than or equal to 0.05%, at the steel producer's option of up to 0.25% maximum.
(2) Titanium is permitted at the steel producer's option, for steels that contain 0.02% carbon or more, to the lesser of 3.4N + 1.5S or 0.025%
(3) Where aluminum deoxidized steel is required, it is acceptable to specify a minimum of 0.01% aluminum

4.5 MECHANICAL PROPERTIES

Materials supplied to Grades A1 and B1 shall meet mechanical property requirements in Table 3.

TABLE 3: Mechanical Properties, Sheet and Strip

Grade	Tensile Strength, MPa (psi)	Yield Strength, MPa (psi)	Elongation % Min.
A1 (Preferred)	310 – 440 (45,000 – 64,000)	205–340 (30,000–50,000)	25 [T<3 mm] 27 [T ≥3 mm]
B1	270 – 410 (39,000 – 59,000)	170-310 (25,000–45,000)	33 [T<3 mm] 35 [T ≥3 mm]

4.6 BEND TEST

Sheet and strip materials supplied shall be capable of being bent at room temperature through 180 degrees flat on itself, either parallel with or transversely to the direction of rolling, without any cracks formed on the outside of the bent portion of the test specimen.

4.7 FINISH AND APPEARANCE

Unless otherwise specified, material shall be supplied as-rolled and dry, normally without removing the surface hot rolled black oxide or scale. Where product is specified to be pickled or blasted to remove surface scale it shall be furnished oiled.

4.8 DIMENSIONS AND TOLERANCES

4.8.1 Sheet and strip products shall conform to the permissible variations in dimensions as specified in the applicable National Standards for the material supplied for an application.

4.8.2 It is recommended that the sheet thickness range be specified on the engineering drawing per established guidelines in CNH DWGD100 Specifying Steel Sheet Thickness.

4.9 It may be required per the National Standard for the material supplied to specify the required edge condition for sheet and strip to the supplier.

5. SPECIAL REQUIREMENTS

Optional conditions listed in National Standards may be applied as special requirements (SPCL). These requirements shall be indicated on the engineering drawing and apply to both the MAT1011 grade and National Standard specified.

6. INSPECTION AND REJECTION

6.1 All sheet and strip material supplied to this specification shall be equivalent in every respect to samples approved by the purchasing CNH Industrial location. While the purchasing location may test samples from incoming shipments for quality assurance, the supplier is responsible for ensuring that shipments meet the stated requirements without depending upon the purchaser's inspection.

6.2 All National Standards and related test methods for evaluation of materials supplied to this specification are to be latest issue unless otherwise specified.

7. DRAWING SPECIFICATIONS

7.1 Specifying a restricted (RSTR) or special (SPCL) material may require the use of a significant characteristic per CNH Industrial Engineering Procedure ENPJ100 (86619032). This will be determined as part of the design review process.

7.2 The title block of engineering drawings shall contain material designations as described in CNH MAT1003 (86979049) Metallic Material Designations on Engineering Drawings.

7.3 This specification contains specific steel composition and mechanical property requirements that are additional to those in the National Standards of the referenced materials. The MAT1011 specification must therefore be reviewed to assure compliance with these specific requirements. Where MAT1011 materials are specified in the drawing title block, the CNH Industrial Material block shall include the generic material name, the CNH Industrial Material Specification number, and grade. The Local Material block shall specify the following. It shall indicate "SEE CNH MAT1011" for standard material designations where applicable National Standard materials are permitted for the specified MAT1011 Grade, see Section 7.3.1. It shall contain "SEE NOTES" for RSTR or SPCL specified materials; the "Material" drawing note shall include the applicable Local or National Standard material that was considered in the original part design, see Sections 7.3.2 and 7.3.3.

7.3.1 Standard MAT1011 material designations.

7.3.1.1 HR Sheet Material

LOCAL MATERIAL SEE CNH MAT1011
CNH MATERIAL HR SHEET, CNH MAT1011, GRADE A1

7.3.1.2 HR Strip Material

LOCAL MATERIAL SEE CNH MAT1011
CNH MATERIAL HR STRIP, CNH MAT1011, GRADE A1

7.3.2 Restricted Material (RSTR)

LOCAL MATERIAL SEE NOTES
CNH MATERIAL HR SHEET, CNH MAT1011, GRADE B1, RSTR

Material Note (on drawing):
HR SHEET, EN 1011, DD13
NO ALTERNATE MATERIAL PERMITTED

7.3.3 Special Requirements (SPCL)

LOCAL MATERIAL SEE NOTES
CNH MATERIAL HR SHEET, CNH MAT1011, GRADE B1, SPCL

Material Note (on drawing):
HR SHEET, ASTM A1011 DS TYPE B
Special Requirements (SPCL) are:
PICKLED AND OILED

ANNEX A
National Standard Materials and Properties Information

1. Table A1 indicates National Standard materials identified by CNH Industrial Materials Engineering that are acceptable for supply to specified MAT1011 Grades. Other National Standard materials, not currently listed, that comply with MAT1011 requirements may also be supplied for part applications without Materials Engineering approval. Additional National Standard materials will be added to this listing by Materials Engineering as this information is available.

TABLE A1: National Standard Materials – MAT1011 HR Sheet and Strip Mechanical Properties for Reference (1)

Grade	Local Material / National Standard	Hardness, Rockwell B	Tensile Strength, MPa (psi)	Yield Strength, MPa (psi)	Elongation % Min.
A1 (Preferred)	ASTM A1011, CS Type B (3)	50 – 75 (2)	360 (52,000) (2)	205-340 (30,000-50,000) (3)	25 (3)
	DIN 1614-2, St W22	---	440 (64,000) max	215 (31, 000) min	25
	ISO 3573, HR1 (4)	---	440 (64,000) max 270 expected min	---	24 [T<3]
	India; IS 1079, HR1 (4)		440 (64,000) max 270 expected min	---	24 [T≤3 mm] 29 [T >3 mm]
B1	ASTM A1011, DS Type B (3)	48 – 68 (2)	340 (50,000) (2)	205-310 (30,000-45,000) (3)	28 (3)
	DIN 1614-2, St W24	---	410 (59,000) max	320 (46,000) max	30
	EN 10111, DD13 (5)	---	400 (58,000) max	170-310 (25,000–45,000)	29
	ISO 3573, HR4	---	380 (55,000) max 270 expected min	---	32 [T<3]
	India; IS 1079, HR4		380 (55,000) max 270 expected min	---	32 [T≤3 mm] 37 [T >3 mm]

(1) Steel Suppliers recognize that European Standard specifications have superseded DIN Standards. For design purposes it is advisable to consider EN values.
(2) Property values referenced are typical (non-mandatory) values from SAE J877–1984 (1997).
(3) Property values referenced are typical (non-mandatory) values from ASTM A1011/A1011M (2018a). These materials may be supplied with the understanding that mechanical properties that vary from the indicated values should be expected. Supplier certified mechanical properties if required may result in a cost penalty to be addressed at the time of ordering.
(4) These materials may be supplied with the understanding that the expected minimum tensile strength may be supplied and varies from the Grade A1 specified values. If required supplier certified mechanical properties that meet Grade A1 values shall be addressed at the time of ordering and may result in a cost penalty.
(5) EN 10111 does not cover material for hot rolled strip (< 600 mm wide) for cold forming, therefore it is recommended to specify DIN material grades under Local Material when strip is specified where EN 10111 materials are supplied.

ANNEX B
Former Company and National Standard Material Information

1. Table B1 shows Former CNH Company material specifications replaced by this specification.

TABLE B1: Former CNH Company Material Specifications

Grade		CASE	NH Pennsylvania FNHA Standard	NH – Zedelgem Engineering Stds.	NH Tractor Engineering
A1	Sheet	MS 436	2-A-001(86050092)	WS 50.04, St W22	Fiat FG52806, FEP11 IVECO 15-2807, FEP11
	Strip	MS 437	2-A-151(9842890)	---	
B1	Sheet	MS 436 Option 19	2-A-014 (86528043)	---	Fiat FG52806, FEP12 IVECO 15-2807, FEP12
	Strip	MS 437 Option 19			
	Sheet	MS 436 Option 20	2-A-006 (86050119)	WS 50.04, St W24	Fiat FG52806, FEP13 IVECO 15-2807, FEP13
	Strip	MS 437 Option 20		---	

2. Table B2 shows National Standard materials previously designated for withdrawn Grades.

TABLE B2: Local Material and National Standard References, Sheet and Strip (1)

Former Grade		ASTM(2)	DIN(3)	BS	EN	FIAT
A (Preferred)	Sheet	ASTM A1011, CS Type B	DIN 1614-2, St W22	(3) BS 1449-1.2, HR3	EN 10111, DD11	Fiat 52807, FEP 11
	Strip			BS 1449-1.8, HS3	---	
B	Sheet	ASTM A1011, DS Type B	DIN 1614-2, St W24	(3) BS 1449-1.2, HR1	EN 10111, DD13	Fiat 52807, FEP 13
	Strip			BS 1449-1.8, HS1	---	

(1) EN 10111 does not cover material for hot rolled strip (< 600 mm wide) for cold forming, therefore it is recommended to specify DIN material grade under Local Material when strip is specified in Europe.
(2) ASTM A1011, CS Type B and DS Type B superseded ASTM A569 and A622 respectively. ASTM A621 HR Drawing Quality carbon steel was discontinued.
(3) Referenced DIN (partially) and BS specifications have been superseded by European Standard EN 10111. DIN and BS designations continue to be recognized by many suppliers and steel producers. See also Table B3

3. Restricted Former Listed National Standard Materials

Table B3 lists National Standard materials that were previously listed as comparable materials for the former Grades. These materials may be designated on existing CNH Industrial drawings and are provided here as a reference only to correlate these materials to former or current Grades. The materials listed in Table B3 shall not be used on new or updated drawings.

TABLE B3: Former Listed National Standard Materials (1) – (For Reference Only)

Grade		ASTM / SAE	DIN (2)	BS (2)	EN	FIAT
A	Sheet			BS 1449-1.2, HR3		Fiat 52807, FEP 11
	Strip	---	---	BS 1449-1.8, HS3	---	
B	Sheet			BS 1449-1.2, HR1		Fiat 52807, FEP 13
	Strip			BS 1449-1.8, HS1		

(1) The materials referenced may be found on some drawings and in previous revisions of MAT1011. When drawings are changed, the material specified should be updated to Grades listed in Table 1. See MAT1011D and/or the referenced National Standard for additional information.
(2) Many DIN and BS specifications have been superseded by European Standard EN 10111. DIN and BS designations continue to be recognized by many suppliers and steel producers.