COMPARISON OF CRCS GR. D/ DD as per IS: 513 & HRPO GR EDD as per IS: 1079 HR3

SAPTAGIRI INDUSTRIES

Chemical composition & Mechanical properties comparison between CRCS and HRPO steel (Hot Rolled Pickled and Oiled).								
Raw material	Grade	Carbon (C)	Manganese (Mn)	Sulfur (S)	Phosphorus (P)	Yield Point or Proof Stress MPa, Max	Tensile Strength MPa, Max	Hardness HRB Max
C.R.C.S. IS : 513	CR1	0.15	1	0.035	0.08	280	410	
	CR2	0.12	0.5	0.035	0.04	240	370	55
	CR3	0.1	0.45	0.03	0.025	220	350	55
H.R.P.O. IS : 1079	HR1	0.15	0.6	0.035	0.05	-	440	
	HR2	0.10	0.45	0.035	0.04	-	420	
	HR3	0.08	0.40	0.03	0.035	-	400	

IS STANDARD IS 513 & IS 1079

SAPTAGIRI INDUSTRIES

IS 513 (Part 1) : 2016

Table 3 Chemical Composition

(*Clauses* 7.1 *and* 7.3)

Grade	C percent, *Max*	Mn percent, *Max*	S percent, *Max*	P percent, *Max*
(1)	(2)	(3)	(4)	(5)
CR0	0.35	4.00	0.035	0.05[1)]
CR1	0.15	1.00	0.035	0.080
CR2	0.12	0.50	0.035	0.040
CR3	0.10	0.45	0.030	0.025
CR4	0.08	0.45	0.030	0.020
CR5	0.06	0.25	0.020	0.020
ISC270C	0.12	0.50	0.035	0.040
ISC270D	0.10	0.45	0.030	0.025
ISC270E	0.08	0.40	0.030	0.020
ISC270F	0.06	0.25	0.020	0.020
ISC260G	0.01	0.20	0.020	0.020
ISC340P	0.01	0.80	0.025	0.080
ISC370P	0.01	1.00	0.025	0.100
ISC390P	0.01	1.60	0.025	0.100
ISC440P	0.01	1.60	0.025	0.120
ISC270B	0.04	0.80	0.020	0.080
ISC300B	0.04	0.80	0.020	0.080
ISC320B	0.04	0.80	0.020	0.080
ISC340B	0.04	1.00	0.020	0.100
ISC360B	0.04	1.20	0.020	0.100
ISC390B	0.04	1.20	0.020	0.120
ISC440B	0.04	1.40	0.020	0.120
ISC280R	0.10	0.60	0.030	0.100
ISC320R	0.10	0.80	0.030	0.100
ISC360R	0.12	1.00	0.030	0.100
ISC400R	0.12	1.20	0.030	0.100
ISC340W	0.12	0.90	0.030	0.050
ISC370W	0.15	1.30	0.030	0.050
ISC390W	0.20	1.50	0.030	0.050
ISC440W	0.20	1.70	0.030	0.050

NOTES

1 Restricted chemistry can be mutually agreed to between the purchaser and the manufacturer.

2 When the steel is aluminium killed, the total aluminium content shall not be less than 0.02 percent. When the steel is silicon killed, the silicon content shall not be less than 0.10 percent. When the steel is aluminium silicon killed, the silicon content shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent. If mutually agreed to between the purchaser and the manufacturer, for aluminium killed steel, aluminium content can be less than 0.02 percent.

3 For grades where non-ageing characteristics are defined, Nitrogen content shall be 0.007 percent maximum. For grades, where non-ageing characteristics are not defined, Nitrogen content shall be 0.012 percent maximum. This shall be ensured by the manufacturer by occasional check analysis.

4 The steel can be made with micro alloying elements like Chromium, Nickel, Niobium, Vanadium, Titanium, Molybdenum, Boron, Calcium and others, either added individually or in combination,. However in case of boron, the limit shall be 0.006 percentmaximum.

[1)] Phosphorus limit of 0.12 percent maximum can be added and in such cases, carbon content shall be limited to 0.15 percent maximum.

Table 3 Chemical Composition

(*Clauses* 7.1 *and* 7.2)

Sl No.	Quality		Constituent, Percent, *Max*			
	Grade	Designation	C	Mn	P	S
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	HR0	Ordinary	0.25	2.00	0.080	0.050
ii)	HR1	Commercial	0.15	0.60	0.050	0.035
iii)	HR2	General Purpose	0.10	0.45	0.040	0.035
iv)	HR3		0.08	0.40	0.035	0.030
v)	HR4		0.08	0.35	0.030	0.030
vi)	ISH270C	Drawing Quality	0.08	0.45	0.035	0.035
vii)	ISH270D		0.06	0.40	0.030	0.030
viii)	ISH270E		0.06	0.35	0.025	0.025

NOTES

1 Steels of these grades can be supplied with the addition of micro-alloying elements like Boron, Titanium, Niobium and Vanadium either singlyor in combination and shall not exceed 0.2 percent. However, Boron addition shall be restricted to 0.006 percent maximum.

2 The nitrogen content of the steel shall not be more than 0.007 percent. For aluminium killed or aluminium silicon killed the nitrogen content shall not exceed 0.012 percent.This has to be ensured by the manufacturer by occasional check analysis.

3 When the steel is Aluminium killed, the total Aluminium content shall not be less than 0.02 percent. However, aluminium less than 0.02 percent can be mutually agreed to between the purchaser and the supplier for Aluminium killed steel. When the steel is silicon killed, the silicon content shall not be less than 0.10 percent. When the steel is Aluminium silicon killed, the silicon content shall not be less than 0.03 percent and total Aluminium content shall not be less than 0.01 percent.

4 When copper bearing steel is required the copper content shall be between 0.20 and 0.35 percent.

5 Restricted chemical composition may be mutually agreed to between the purchaser and the supplier.

Table 5A Mechanical Properties at Room Temperature in as Delivered Condition
(Cut Lengths and Coils)
(*Clauses* 8.1.2, 8.1.3, 8.1.5, 8.5.2 *and* 8.6.2)

Designation	Grade	Yield Point or Proof Stress MPa, *Max*	Tensile Strength MPa, *Max*	Minimum Elongation		Mean Plastic Strain Ratio *r*-Bar	Tensile Strain Hard-ening Component *n*-Value	Test Direction
				Gauge Length- 80 mm	Gauge Length- 50 mm			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
General Purpose	CR1	280	410	27	28	–	–	T
	CR2	240	370	30	31	–	–	T
	CR3	220	350	34	35	1.3 min	0.16 min	T
	CR4	210	350	36	37	1.4 min	0.19 min	T
	CR5	190	350	38	40	1.7 min	0.22 min	T

NOTES for Table 5A

1 1 N/mm^2 = 1 MPa.
2 Stricter mechanical properties requirement may be agreed to between the manufacturer and the purchaser, before placing the order.
3 Mechanical properties apply only to annealed followed by skin-passed products.
4 The values of yield stress are the 0.2 percent proof stress for products which do not represent a marked yield point and the lower yield stress for the others.
5 Test Piece Direction – L : Rolling Direction, Test Piece Direction – T: Perpendicular to rolling direction.
6 For thickness upto and less than 0.6 mm, elongation values given in the table shall be reduced by 1.
7 *r*-Bar and *n*-Value are only applicable to thickness greater than 0.5 mm. For thickness more than 1.00 mm , *r*-bar/*r*-90 value is reduced by 0.10 For thickness greater than 2.0 mm, *r*-Bar value is reduced by 0.2 and *n*-value reduced by 0.02.
8 Mechanical properties are not generally tested on CR1 Grade and values mentioned are for information only.
9 *r*-bar and *n*-values may be modified or excluded from this requirement, by agreement between manufacturer and purchaser.
10 Grade CR1 may be supplied in any of the temper grades as mentioned and mechanical properties (for temper other than annealed and skin passed) may not apply and shall be as per mutual agree-ment between Manufacturer and purchaser before placing of an order.
11 Only hardness values are applicable to Grade CR0 – which is supplied in as cold rolled condition.
12 (–) — Not required.

Table 2 Type of Oiling

(*Clause* 6.3)

Type of Oiling		As Hot Rolled	Pickling	Skin Pass	Shot Blast
Normal Rust preventive Oil[1)]		*x*	√	*x* /√	√
Special Rust preventive Oil[2)]	High Lubrication rust preventive oil[3)]	*x*	√	*x* /√	*x*
	Solid lubricant[4)]	*x*	√	*x* /√	*x*
No Oiling		*x*	*x* / √	*x* / √	*x*

where *x* = Not applicable, √ = Applicable, and *x*/√ = Not applicable or applicable as per mutual agreement.

1) Commonly used for steel strip, plate and sheet for rust prevention.
2) Special rust preventive oil is applied to the steel sheet, plate and strip with pickling finish.
3) The rust preventive oil in combined use as press oil and rust preventive oil. This kind of oil shall be mutually agreed.
4) Solid lubricant is for better frictional properties during press work. This kind of lubricant shall be mutually agreed.

NOTES

1 Guarantee of rust prevention is depend on type of oil and quantity of oil. Purchaser should evaluate before confirming the oiling.
2 For material ordered "No Oiling", there is risk of rusting of steel. In that case, supplier has no responsibility, if oxidation/rusting occur.

Table 5 Tensile Properties

(*Clauses* 8.3 *and* 8.3.1)

Sl No.	Quality		Tensile Strength *Max*, MPa	Percentage Elongation After Fracture A, *Min*			
				$t \leq 3$		$t > 3$	
	Grade	Designation		GL $L_o = 80$ mm	GL $L_o = 50$ mm	GL $L_o = 5.65\sqrt{S_o}$	GL $L_o = 50$ mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	HR0	Ordinary	1)	1)	1)	1)	1)
ii)	HR1	Commercial	440	23	24	28	29
iii)	HR2	General Purpose	420	25	26	30	31
iv)	HR3		400	28	29	33	34
v)	HR4		380	31	32	36	37

MATERIAL TEST CERTIFICATE OF IS 1079 HRPO EDD

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