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Indian code for food loss prevention and safety

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National Test Standards for Agricultural Machinery

- **Bureau of Indian Standards is the statutory authority to inspect the product manufactured & marketed in India.**
- **BIS has developed more than 400 test codes and procedures to test different types of farm machinery.**
- **BIS has its own regional laboratories and authorized testing laboratories to facilitate testing and evaluation of products including farm machinery.**

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Different types of combine harvesters tested in India

Self propelled combine harvester

Tractor mounted combine harvester

Track type combine harvester

Tractor combine harvester

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Types of Tests Performed at our Institute

(1) Commercial

a) Initial Commercial Tests

b) Batch Test

c) Variant tests

(2) Confidential

(3) Testing of Combine Harvesters under CMVR

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Test code for testing of combine harvester

IS: 4905-1968 –Method of random sampling

IS: 8122 (Part-1)-1994 – Test code for combine harvester- thresher : Terminology

IS: 8122 (Part-2)-2000 – Test code for combine harvester- thresher : Performance test

IS: 6024-1983 – Guards for harvesting machines

IS: 6025-1982 – Specification for knife section for harvesting machines

IS: 6283 (Part-1)-2006 and
IS: 6283 (Part-2)-2007 – Tractors and machineries for agriculture and forestry, powered lawn and garden equipment-symbols for operator control and other display.

- **Part 1- Common symbols**
- **Part 2- Symbols for agricultural tractors and machineries**

IS: 10378-1982 – Specification for knife back for harvesting machines

IS: 15806-2018 – Combine harvester- recommendations on selected performance and other characteristics.

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Laboratory Tests

- Specifications of the combine harvester
- Engine performance test
- Header lifting test
- Turning ability test
- Centre of gravity test
- Visibility test
- Brake test
- Mechanical vibration test
- Noise level test
- Wear of critical components
- Air cleaner oil pull over test

Engine performance test

ENGINE PERFORMANCE TEST (NATURAL AMBIENT)

a) Maximum power – 2 hours test
b) Power at rated engine speed
c) Varying load test
- Torque corresponding to maximum power
- 85% of torque obtained at maximum power
- 75% of torque obtained at maximum power
- 50% of torque obtained at maximum power
- 25% of torque obtained at maximum power
- Unloaded

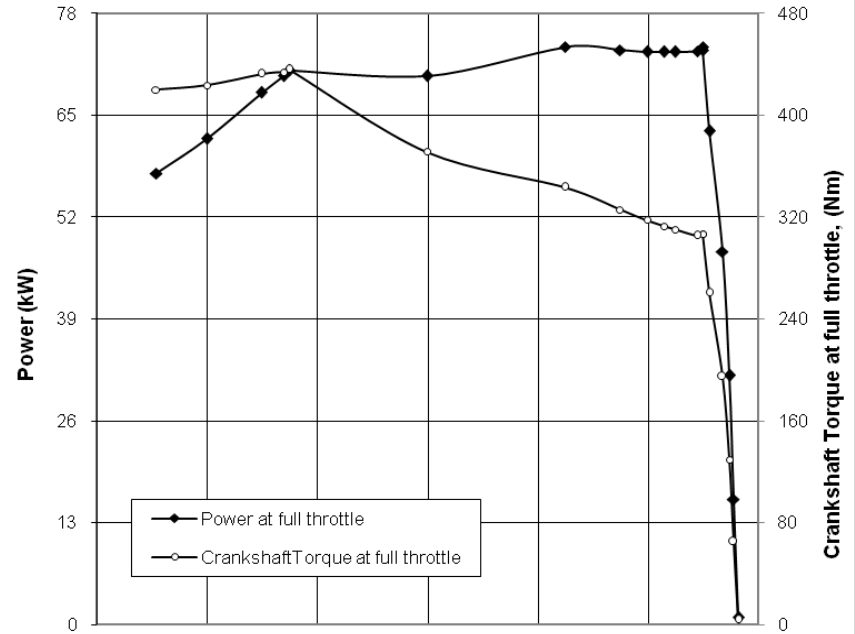
ENGINE TEST (HIGH AMBIENT)

a) Maximum power – 2 hours test
b) Power at rated engine speed

FIVE HOURS RATING TEST

- Engine loaded to 90% of maximum power (4 hours)
- Engine loaded to 100% of maximum power (1 hour)

Brake Power, kW	Engine Speed, rpm	Fuel consumption			Specific energy, kWh/l
		l/h	kg/h	Specific, kg/ kWh	



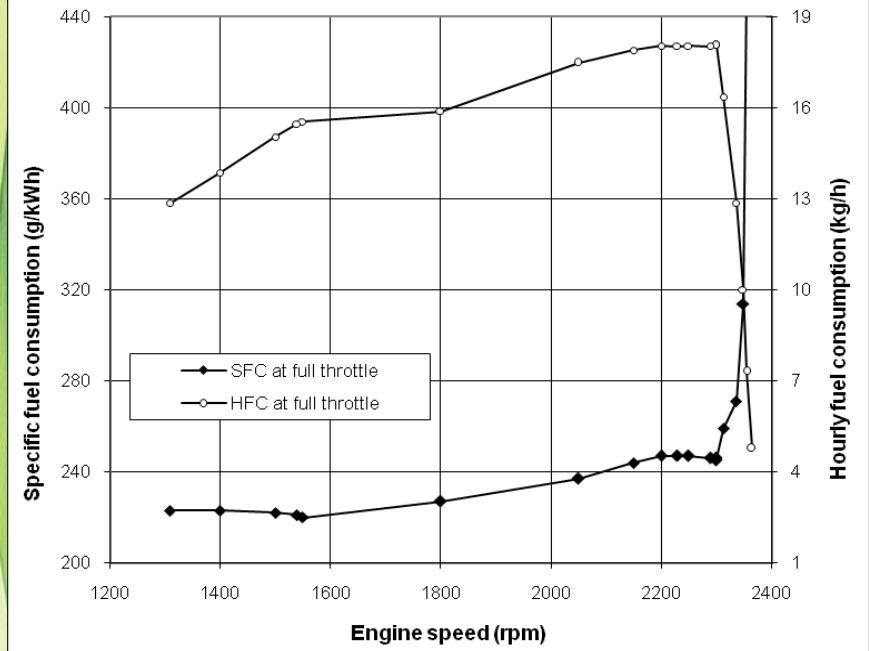
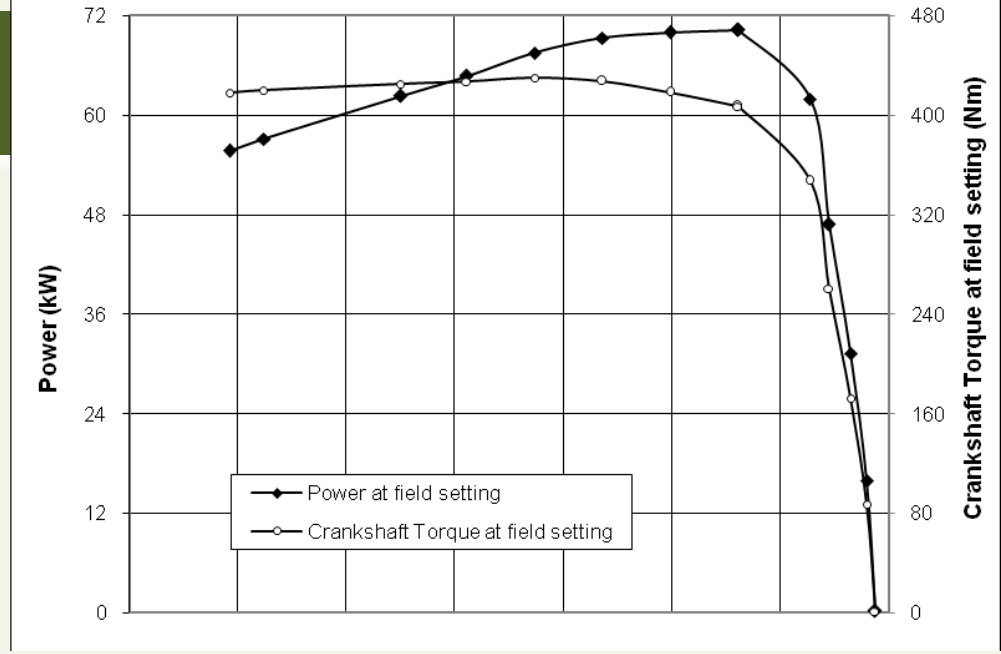


Fig. 7 : ENGINE PERFORMANCE CHARACTERISTICS (Natural ambient)



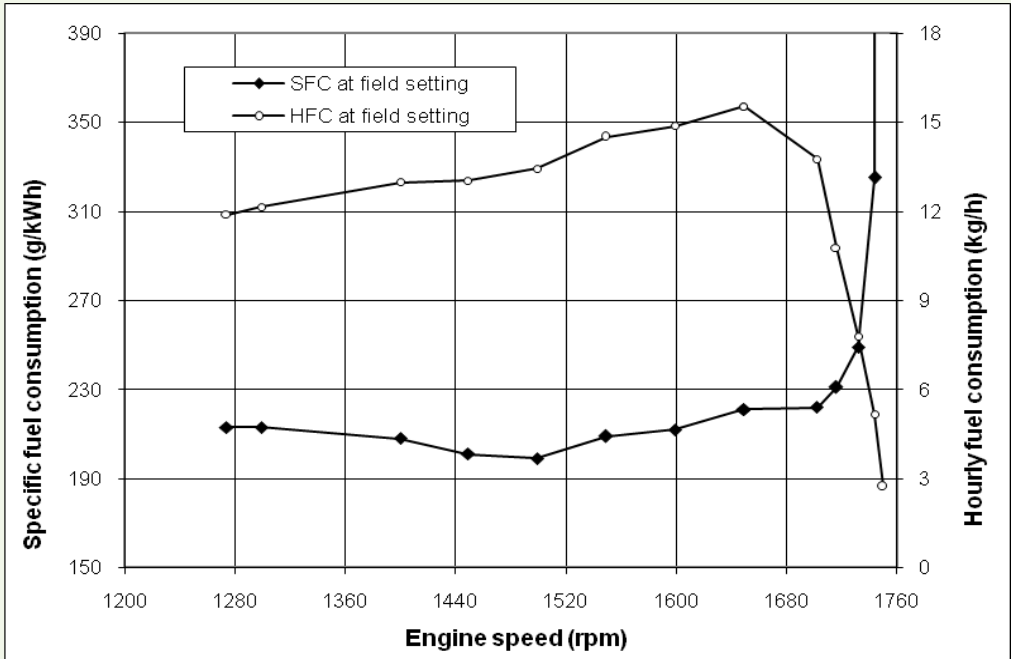


Fig. 8 : ENGINE PERFORMANCE CHARACTERISTICS (Natural ambient at field setting 1750 rpm)

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Header lifting test

- The engine speed is set at speed recommended for field operation
- The assemblies other than hydraulic system shall remain disengaged
- The cycle of lifting and lowering shall be kept continuous & its done for 1000 times
- Before test, oil temperature shall be 65± 5 °C.

Sr. No.	No. of cycles	Temperature of hydraulic fluid (°C)
1	100	83
2	200	94
3	300	97
4	400	101
5	500	102
6	600	105
7	700	107
8	800	110
9	900	111
10	1000	109
Leakage of hydraulic fluid from any part of hydraulic system.		None
Working of hydraulic system		No noticeable defect was observed

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Turning ability test

During the test the header unit shall remain attached and the height of cutter bar above ground level shall be 150 mm.

Track width (mm)

Drive wheels : 2255

Steered wheels : 2034

Items	Diameter of turning circle (m)		Diameter of turning space (m)	
	LHS	RHS	LHS	RHS
Without brake	**14.86**	**13.95**	**15.50**	**16.05**
With brake	**12.64**	**12.45**	**13.59**	**14.4**

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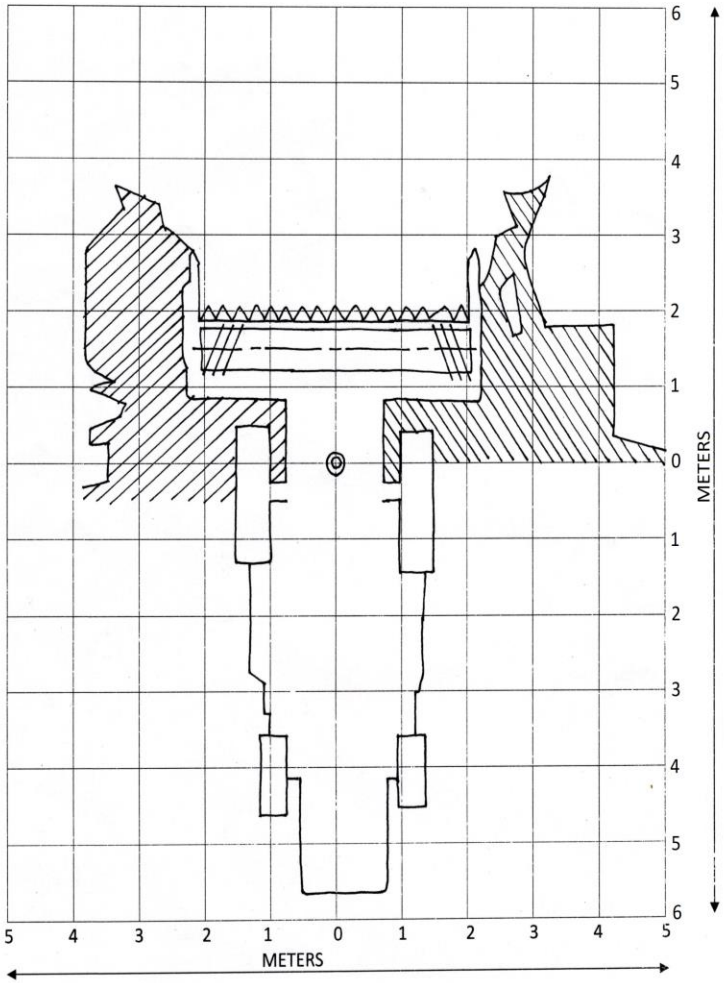
Centre of gravity test

Combine harvester is fitted with all standard accessories & all the liquid reservoirs full, grain tank full with wheat & operator replaced by 75 kg mass on the seat and header assembly in raised position.	
Height above ground level	1274 mm
Distance behind the vertical plane containing the axis of the centre of drive wheel	794 mm
Distance from the median plane parallel to the longitudinal axis of combine bisecting the driving wheel track (mm)	8 mm on LHS

Visibility test



◉	Operators vision
▭	Plan of combine
▨	Invisible area

The visibility test is conducted to assess the visibility mainly of the header assembly from normal sitting position of the operator. The cutter bar height is maintained at 150 mm above the ground level during the test.

Non visible space in front is 3.70 m which is1.17 times the wheel base of combine.

Non visible space on left side is 4.20 m which is 1.72 times the track width of combine.

Non visible space on right side is 3.70 m which is1.52 times the track width of combine.

Noise level test

- **Combine shall be operated at the recommended travel speed at full accelerator with and with out variator**
- **All mechanisms in the combine shall be in working position**
- **The cutter bar height shall be up to 150 mm above ground level**
- **Test procedure as per IS 12180: Test code for noise level test.**

Noise at bystander's position:

Date of test : 24.05.2022

Type of track : Concrete

Background noise level, dB(A) : 50.3

Location of microphone:

Height of microphone above ground level, m : 1.2

Distance of microphone from line of travel, m : 7.5

Sr. No.	Gear Used	Travelling speed before acceleration (kmph)	Noise level, dB (A)	
			Silencer facing microphone	Silencer facing away from microphone
1.	L1	1.75	80.0	79.4
2.	L2	3.99	80.3	77.9
3.	L3	9.99	80.6	79.2
4.	H1	3.40	81.4	78.9
5.	H2	8.39	81.9	79.8
6.	H3	17.88	85.2	85.1

Noise at operator's ear level

Maximum noise level observed, dB(A) : 93.8

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Mechanical vibration test

- **The observation shall be recorded when the combine sub-assemblies are operating at no load engine speed recommended for field work**
- **The inflation pressure in the tires shall be the same as recommended by the manufacturer for field operation**
- **The height of the cutter bar shall be kept 150 mm above ground level**

Sl. No.	Location	Vibration (microns)	
		HD	VD
1.	Foot rest/Operator's platform Left Right	 173* 192*	 215* 235*
2.	Gear shifting lever	238*	231*
3.	Cutting unit engaging lever	219*	239*
4.	Brake pedal Left Right	 236* 238*	 244* 256*
5.	Hydraulic lever for platform	236*	263*
6.	Clutch pedal	258*	268*
7.	Steering control wheel	244*	287*
8.	Operator's seat Back rest Bottom	 215* 221*	 238* 229*
9.	Accelerator lever	255*	283*
10.	Threshing and cleaning unit engaging lever	193*	234**

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Brake test

- **Test procedure as IS 12061**
- **General Requirements :**
- **The performance of service braking device shall be based on the deceleration calculated over the stopping distance**
- **The performance of parking braking devices shall be based on the ability to hold the machine stationery on up & down slopes**
- **The force, necessary to apply at the control of the parking braking device to hold the combine harvester stationary when facing up & down on 12% gradient in a condition recommended for road transport.**
- **The maximum actuating force shall not be more than 400N for hand operated and 600N for foot operated parking brake device**

Cold brake test				
Braking device control force (N)	470	500	530	570
Mean deceleration (m/sec^2)	2.50	3.59	4.29	6.43
Stopping distance (m)	6.17	4.30	3.60	2.40

Hot brake test				
Braking device control force (N)	475	500	530	565
Mean deceleration (m/sec^2)	2.50	3.09	4.41	5.51
Stopping distance (m)	6.17	5.00	3.50	2.80

Parking brake

Particulars	Combine parked on 12% up slope with header assembly on trailer	Combine parked on 12% down slope with header assembly on trailer
Parking device control force, N	289	309
Efficacy of brakes	Satisfactory	Satisfactory

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Air cleaner oil pull-over test

- Combine parked in horizontal level position
- Combine tilted 10^0 to either side
- Combine tilted 10^0 to forward and backward in relation to the direction of travel of the combine

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Field Performance Tests

- Quality of work
- Rate of work
- Fuel Consumption
- Ease of adjustment and handling
- Operator's comfort and safety

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Field Performance Tests

During field test of combine harvester, following parameter are observed:

A. Crop parameters:

- **Crop height**
- **Plant population (no. of tillers/ m^2)**
- **Length of ear head**
- **Straw/ Grain ratio**
- **Grain & straw moisture**
- **No. of grains per ear head**

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Field Performance Tests

B. Parameters for rate of work of the combine:

- Actual area covered (ha/h)
- Fuel consumption (l/ha)
- Net grain output (kg/ha)
- Grain throughput (net grain out put +header loss + rack loss + shoe loss) in (kg/ha)
- Straw output (kg/ha)
- Combine capacity (Gross grain output & straw output) t/h

Field Performance Tests

C. Parameter for quality of work of the combine

- Losses expressed as percentage of grain throughput
- Header loss
- Grain breakage
- Straw walker loss
- Sieve loss
- Total collectable losses
- Non collectable losses
- Total processing losses
- Threshing efficiency(%)
- Cleaning efficiency (%)

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Acceptance criteria for performance characteristics as per clause 4.1 of IS 15806:2018

r. No	Characteristics	Category (Evaluative/Non evaluative)	Requirement (R)/ Declaration (D)	Tolerance	Observed	Remarks
I.	**Prime mover performance**					
a)	Max. power (absolute) - Average Max. power observed during 2h max. power test in natural ambient condition, kW	Evaluative	**(D)**	±5% of declared value		
b)	Max. power observed during the test after adjusting the no load engine speed as per recommendation of the manufacturer for field work, kW	Evaluative	**(D)**	± 5% of declared value		
c)	Power at rated engine speed, kW (under natural ambient condition)	Non-Evaluative	**(D)**	±5% of declared value		
d)	Specific fuel consumption corresponding to average maximum power under 2h maximum power test, g/kWh.	Evaluative	**(D)**	+5% of declared value		
e)	Max. smoke density at 80% load between the speed at max. power & 55% of speed at max. power or 1000 rpm whichever is higher	Evaluative	As per CMV rules. Maximum smoke density Light absorption coefficient is 5.2 units **(R)**	NIL		
f)	Max. crank shaft torque, (N–m) observed during the test after no load engine speed is adjusted as per manufacturer's recommendation for field work	Evaluative	**(D)**	±8% of declared value		
g)	Back up torque, % (Natural ambient)	Evaluative	7 % min**. (R)**	Nil		

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Acceptance criteria for performance characteristics as per clause 4.1 of IS 15806:2018

Sr. No	Characteristics	Category (Evaluative/Non evaluative)	Requirement (R)/ Declaration (D)	Tolerance	Observed	Remarks
h)	Max. operating temperature, ^{o} C i) Engine oil ii) Coolant	Evaluative	**(D)** **(D)**	Should not exceed the declared value		
i)	Lubrication oil consumption, g/kWh	Evaluative	1 % of SFC at maximum power (high ambient) **(R)**	Nil		
II. Brake performance						
i)	Max. stopping distance at a force equal to or less than 600 N on brake pedal (m)- (cold brake and hot brake) **CMVR does not prescribe hot brake test.**	Evaluative	As per requirement of CMVR **(R)**	Nil		
ii)	Max. force exerted on brake pedal to achieve deceleration of 2.5 m/sec^2 (N)	Evaluative	≤ 600 N **(R)**	--		
iii)	Effectiveness of parking brake at a force of 600 N at foot pedal or 400 N at hand lever	Evaluative	As per requirement of CMVR **(R)**	Nil		
III. Mechanical vibration						
i)	Operator's platform	Non evaluative	120 µm max. **(R)**			
ii)	Steering wheel	Non evaluative	150 µm max. **(R)**			
iii)	Seat with driver seated	Non evaluative	120 µm max. **(R)**			

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Acceptance criteria for performance characteristics as per clause 4.1 of IS 15806:2018

Sr. No	Characteristics	Category (Evaluative/ Non evaluative)	Requirement (R)/ Declaration (D)	Tolerance	Observed	Remarks
IV. Air cleaner oil pull over						
a)	Air cleaner oil pull over in % when tested in accordance with IS 8122 part (II) 2000	Evaluative	0.20 max. **(R)**	Nil		
V. Noise measurement						
a)	Max. ambient noise emitted by combine at by-standers position, dB(A)	Evaluative	88 dB(A) as per CMVR **(R)**	Nil		
b)	Max. noise at operator's ear level, dB(A)	Evaluative	98 dB(A) as per CMVR **(R)**	Nil		
VI. Header lifting Test						
a)	Satisfactory completion of header lifting test	Evaluative	Satisfactory completion of test	Nil		
VII. Discard limit						
a)	Thickness of brake lining, mm	Evaluative	Should not exceed the value declared by the manufacturer	Nil		
b)	Thickness of clutch plate, mm	Evaluative		Nil		

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Acceptance criteria for performance characteristics as per clause 4.1 of IS 15806:2018

Sr. No	Characteristics	Category (Evaluative/ Non evaluative)	Requirement (R)/ Declaration (D)	Tolerance	Observed	Remarks
VIII. Field performance						
a)	Suitability for crops	Evaluative	Wheat & Paddy (Wheel type) Paddy (Track type)	Nil		
	Average processing losses (%)	Evaluative Wheat Rice/ Paddy	 Max. 3% Max. 4% **(R)**	Nil		
	Threshing efficiency	Evaluative	≥98 percent for Wheat & Paddy **(R)**	Nil		
	Cleaning efficiency	Evaluative	≥96 percent for Wheat & Paddy **(R)**	Nil		
	Grain breakage in main grain tank	Evaluative	≤ **2.5** percent **(R)**	Nil		
	Non collectable losses	Evaluative	≤ **2.5** percent for Wheat, Paddy & Gram ≤ **4.0** percent for Soybean **(R)**	Nil		

Acceptance criteria for performance characteristics as per clause 4.1 of IS 15806:2018

Sr. No	Characteristics	Category (Evaluative/ Non evaluative)	Requirement (R)/ Declaration (D)	Tolerance	Observed	Remarks
IX. Safety requirement						
a)	Guards against all moving parts	Evaluative	Belt and chain drives, pulleys, hydraulic pipes (Around operators workplace) **(R)**	--		
b)	Lighting arrangement	Evaluative	As per CMVR **(R)**	-		
c)	Grain tank cover	Evaluative	Essential **(R)**	-		
d)	Spark arrester in engine's exhaust in case naturally aspirated engine	Evaluative	Essential **(R)**	-		
e)	Stone trap before concave	Evaluative	Essential **(R)**	-		
f)	Rear view mirror	Evaluative	Essential **(R)**	-		
g)	Fire extinguisher	Evaluative	Essential **(R)**	-		
h)	Slip clutch at following drives – i) Cutting platform ii) undershot conveyor drive iii) Grain & tailing elevator	 Evaluative Non evaluative Non evaluative	 Essential **(R)** Optional Optional	-		
i)	Anti slip surfaces at operator platform & ladder & proper gripping for the control levers.	Evaluative	Essential **(R)**	-		
j)	Working clearance around the controls	Non evaluative	Essential 70 mm, min **(R)**	-		
k)	Labelling of control and gauges	Evaluative	Essential **(R)**	-		

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Acceptance criteria for performance characteristics as per clause 4.1 of IS 15806:2018

Sr. No	Characteristics	Category (Evaluative/ Non evaluative)	Requirement (R)/ Declaration (D)	Tolerance	Observed	Remarks
X. Material of construction						
a)	Knife guard should conform to IS: 6024 -1983	Non evaluative	Should have maximum hardness 163 HB **(R)**	-		
b)	Knife blade as per IS: 6025 -1982	Non evaluative	It must have chemical composition as C = 0.70 - 0.95 % Mn = 0.30 - 0.50% **(R)**	-		
c)	Knife back should meet the requirement of IS: 10378-1982	Non evaluative	The knife back shall be manufactured from carbon steel having minimum carbon content of 0.35 % **(R)**	-		

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Acceptance criteria for performance characteristics as per clause 4.1 of IS 15806:2018

Sr. No	Characteristics	Category (Evaluative/ Non evaluative)	Requirement (R)/ Declaration (D)	Tolerance	Observed	Remarks
XI. Break down (critical, major & minor)						
a)	Critical	Evaluative	No critical breakdown	None		
b)	Major	Evaluative	Not more than two and neither of them should be repetitive in nature	None		
c)	Minor	Evaluative	Not more than five and frequency of each should not be more than two	None		
d)	Total breakdown	Evaluative	In no case total no of (major + minor) breakdowns exceed five	None		

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Thank You!