



**SELF PROPELLED COMBINE HARVESTER
'G.B. MAJHA-955'**



सत्यमेव जयते

भारत सरकार
कृषि मंत्रालय
(कृषि एवं सहकारिता विभाग)



**GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE
(DEPARTMENT OF AGRICULTURE & COOPERATION)**

उत्तरी क्षेत्र कृषि मशीनरी प्रशिक्षण एवं परीक्षण संस्थान
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17.8 Wear of rasp bar

Sr. No.	Mass of rasp bar before test (g)	Mass of rasp bar after 25.17 h test (g)	Wear (%) by weight
1	5479.0	5451.4	0.50
2	5396.5	5369.1	0.51
3	5431.1	5404.3	0.49
4	5360.6	5334.0	0.50

17.9 Wear of the Peg Teeth:

The wear of the peg teeth of the threshing cylinder and concave was measured. The percentage wear on mass basis was computed and the results are given below:

Sl. No.	Original mass before test (g)	Mass after 25.46 h of test (g)	Percent wear by Weight (%)
a) Peg teeth of threshing cylinder:			
1.	216.7	216.3	0.18
2.	214.6	214.3	0.14
3	223.5	222.3	0.54
4	232.3	230.8	0.65
5	221.7	220.6	0.50
6	222.1	221.2	0.41
7	223.3	222.4	0.40
8	228.2	226.9	0.57
b) Peg teeth of Concave:			
1	226.0	225.8	0.09
2	220.2	219.8	0.18
3	214.4	213.7	0.33
4	233.9	233.0	0.38
5	229.7	228.8	0.39

18 SUMMARY OF OBSERVATIONS, COMMENTS AND RECOMMENDATIONS**18.1 Engine Performance Test:**

Engine Brake power, kW	Engine speed (rpm)	Hourly fuel consumption (l/h)	fuel kg/h	Specific fuel consumption kg/kwh	Specific energy, kWh/l
i) Maximum power - 2 hours test:					
70.7	2200	20.51 (24.82)		0.290	2.848
52.6	1500	12.65 (15.25)		0.240	3.453**
ii) Power at rated engine speed (2200 rpm)					
70.95	2200	20.53 (24.70)		0.289	2.872
69.61	2200	20.16 (24.55)		0.290	2.835*



iii) Maximum torque:				
54.01	1400	12.81 (15.45)	0.237	3.496
51.45	1400	12.44 (15.13)	0.242	3.401*
48.75	1300	11.38 (13.71)	0.233	3.556**
iv) Five hour rating test:				
a) Engine loaded to 90% of maximum power:				
65.0	2282	20.0 (24.39)	0.308	2.667*
b) maximum power:				
69.5	2200	20.32 (24.78)	0.292	2.805*

* Under high ambient condition.

** At field rpm setting specified for field work.

Remarks:

- i) The maximum power output of the engine was observed as 70.7 kW & 52.6 kW at 2200 rpm and 1500 rpm of engine at full throttle and setting recommend for field operation respectively.
- ii) The specific fuel consumption corresponding to maximum power at full throttle and setting recommended for field operation was measured as 0.290 & 0.240 kg/kWh.
- iii) The back-up torque of the engine was measured as 19.6 % under natural ambient at full throttle.
- iv) The maximum smoke density was recorded as 3.12 (Bosch No.) which is within permissible limit.
- v) The maximum temperature of engine oil, coolant (water) and exhaust gas was observed as 117, 102 and 501°C respectively.
- vi) The lubricating oil & coolant consumption during five hours rating test were measured as 0.334 g/kWh and 1.90 % of total coolant capacity respectively.

18.2 Turning ability:

The diameter of turning circle at LHS and RHS was observed satisfactory.

18.3 Visibility:

The visibility around the cutter bar from operator's seat in normal sitting position is satisfactory.

18.4 Braking Performance:

- i) The stopping distance and pedal force corresponding to deceleration of 2.5 m/sec² were measured as 7.65 m and 299 N respectively.
- ii) The performance of parking brake was found satisfactory.

18.5 Mechanical Vibration:

The amplitude of mechanical vibration of components marked as (*) in chapter 13 of this report are on higher side. This calls for providing suitable remedial measures to dampen the vibration in order to improve the operational comfort and service life of various components & sub assemblies.

18.6 Noise measurement:

The ambient noise emitted by the machine at bystander and driver's ear level were measured as 90 & 98 dB (a) respectively.

18.7 Field Test:**18.7.1 Summary of field tests:**

The results of the field test are summarized below:

Sr. No	Parameters	Range of parameters		Average of parameters	
		Wheat Harvesting	Paddy Harvesting	Wheat Harvesting	Paddy Harvesting
1.	Speed of operation (kmph)	3.26 to 3.41	1.56 to 1.98	3.33	1.76
2.	Area covered (ha/h)	0.91 to 1.03	0.52 to 0.65	0.97	0.57
	Fuel consumption:				
	- (l/h)	5.67 to 7.69	7.10 to 8.0	6.261	7.60
	- (l/ha)	5.90 to 7.46	11.55 to 15.17	6.44	13.33
4.	Crop throughput (tonne/h)	7.52 to 9.23	8.44 to 12.0	7.97	10.21
5.	Grain breakage in main grain outlet (%)	1.406 to 2.651	0.400 to 0.652	1.905	0.453
6.	Header losses (%)	0.925 to 3.208	0.667 to 1.356	2.10	0.873
7.	Total non-collectable losses(%)	0.971 to 3.232	0.695 to 1.385	2.128	0.897
8.	Total collectable losses (%)	0.030 to 0.393	0.438 to 0.507	0.236	0.479
9.	Total processing losses (%)	1.845 to 2.928	0.898 to 1.103	2.17	0.956
10.	Threshing efficiency (%)	99.6 to 99.9	99.5 to 99.6	99.7	99.5
11.	Cleaning efficiency (%)	96.5 to 97.6	96.2 to 97.7	97.2	97.1

18.7.1.1 Wheat Harvesting:

- i) The grain breakage in all the varieties tested was measured as 1.406 to 2.651 %.
- ii) The total non collectable losses ranged from 0.971 to 3.232 %.
- iii) The total processing losses ranged from 1.845 to 2.928 %.
- iv) The threshing efficiency ranged from 99.6 to 99.9 %.
- v) The cleaning efficiency ranged from 96.5 to 97.6 %.

**18.7.1.2 Paddy Harvesting:**

- i) The grain breakage ranged from 0.400 to 0.652 %.
- ii) The total non-collectable losses ranged from 0.695 to 1.385 %.
- iii) The total processing losses ranged from 0.898 to 1.103 %.
- iv) The threshing efficiency ranged from 99.5 to 99.6 %.
- v) The cleaning efficiency ranged from 96.2 to 97.7 %.

18.7.2 Harvesting of any other crops:

The performance of combine to harvest wheat, paddy crops was evaluated as the same were recommended by the applicant.

18.7.3 Ease of Operation and Safety Provision:

- i) The controls provided around the operator are within easy reach, but not labelled with symbols as per Indian standard. Therefore it is recommended that the symbols as per the requirement of IS-6283-1998 may be provided. Warning notice & hazard symbols should also be provided on machine.
- ii) The design of stone trap need to be modified for easy cleaning without removing header unit.
- iii) Slip clutch/safety device at undershot conveyor, front feeding auger and grain and tailing elevator are considered essential from safety point of view which needs to be provided.
- iv) The mechanical arrangement for adjusting the reel speed though provided, needs to be modified such that the same could be controlled from operators position.
- v) The grain tank needs to be provided with suitable grain fill indicator device.

18.7.4 Assessment of Wear:

- i) The wear of engine components i.e. cylinder liners, piston, piston rings, valves, valve guides, springs, big-end bearings and main bearings were observed within the permissible limit.
- ii) The transmission gears and components were found in normal working condition.
- iii) The timing gears, clutch lining, release bearing were found in normal working condition.
- iv) The condition of the components of brake, hydraulic system and steering system was observed to be normal.
- v) The condition of the bearing, chains; sprockets and belts was observed to be normal.
- vi) The components of starter motor and alternator were found in normal working condition.
- vii) The rate of wear of rasp bar and peg teeth of threshing cylinder & concave were observed as normal.

18.8 Hardness and Chemical composition:

18.8.1 Hardness of knife blade in hardened zone and the hardness of knife guard are lower than the limit as specified in IS:6025-2004 and IS:6024-2004 respectively. These should be looked into at regular production level.

18.8.2 Carbon content in knife back is lower than the limits as specified in IS:10378:2006. These should be looked into in future production.

18.9 Labelling of Combine Harvester:

The labelling plate as per IS: 10273-1999 is provided on the combine harvester.

18.10 Literature supplied with the Machine:

Manufacturer has submitted following literature

1. Part's catalogue in English, Hindi & Punjabi.
2. Combine operator manual in English.
3. Service book in English

Although the literature supplied are sufficient but the service book & operator manual need to be developed in some other regional languages as per IS : 8132-1999 for the guidance of users & service personnels.

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19. **SELECTED PERFORMANCE AND OTHER CHARACTERISTICS AS PER IS: 15806-2008.**

Sr. No.	Characteristics	Requirement	Declared	Observed	Remark
1.	Prime mover performance				
i)	Max. Power (absolute) Average max. power observed during 2 hrs. max. power test in natural ambient condition kW	It should not be less than 5% of the declared value.	74.3	70.7	Conforms
ii)	Max. power observed during test after adjusting the no load engine speed as per recommendation of the manufacturer for field work, kW	Max. power observed must not be less than 5% of declared value.	55.0	52.6	Conforms
iii)	Power at rated engine speed, kW(Ps)	The observed value must not be less than 5% of the declared value by the applicant.	74.3	70.95	Conforms
iv)	Specific fuel consumption g/kWh.	The average observed value during 2 hr. max. power test must be within $\pm 5\%$ of the declared value by applicant/ manufacturer.	238 $\pm 5\%$	290	Does not conform
v)	Max. smoke density (bosch no.) at 80% load between the speed at max. power & 55% of speed at max. or 1000 rpm which ever is higher, should be observed as per CMVR rule	For tractor :- 5.2 bosch no. or 75 hartridge For engine :- Free deceleration or natural aspirated or turbo charges - 65 hartridge		3.12	Conforms



vi)	Max. crank shaft torque, (N-m) observed during the test after no load engine speed is adjusted as per manufacture's recommendation for field work	It must not be less than 8% of declare value by manufacturer.	~350	358	Conforms
vii)	Back up torque, %	7% min.	--	19.6	Conforms
viii)	Max. operating temp. To be declared by manufacturer	i) engine oil ii) Coolant	120 108	117 102	Conforms
ix)	Lubrication oil consumption, g/kWh	1% of SFC at 5hr. max. power test during high ambient condition	2.92+10%	0.334	Conforms
2.	Brake performance				
i)	Max. stopping distance at a force equal to or less than 600 N on break pedal, m	10 m or $S \leq 0.15V + V^2/130$ V= speed corresponding to 80% of design max. speed, kmph	--	6.28	Conforms
ii)	Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec ² .	$\leq 600N$.	--	299	Conforms
iii)	Whether parking brake is effective at a force of 600 N at foot pedal or 400 N at Hand and lever	Yes or No	--	Yes	Conforms
3.	Mechanical vibration				
i)	Operator's platform	120 μ m max.	--	160	Does not conform
ii)	Steering wheel	150 μ m max.	--	170	Does not conform
iii)	Seat with driver seated	120 μ m max.	--	130	Does not conform

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4.	Air cleaner oil pull over					
	i)	Max. oil pull over in % age when tested in accordance with IS: 8122 pt. (II)-2000	0.25% max.	--	Not applicable as the engine has dry type air cleaner	--
5.	Noise measurement					
	i)	Max. ambient noise emitted by combine dB (A)	88 dB (A)	--	90	Does not conform
	ii)	Max. noise at operator's ear level dB (A)	98 dB (A)	--	98	Conforms
6.	Discard limit					
	i)	Cylinder bore diameter, mm	Should not exceed the values declared by the manufacture	104.15	104.02	Conforms
	ii)	Piston diameter	-do-	103.25	103.91	Conforms
	iii)	Ring end gap	--do--	1.2	0.50	Conforms
	iv)	Ring groove clearance	--do--	Top-0.7 Second-0.2 Oil ring-0.1	Top - Taper Second-0.08 Oil ring-0.07	Conforms
	v)	Diametrical and axial clearance of big end bearing	-do-	Diametrical - 0.12 Axial-0.60	Diametrical - 0.11 Axial-0.35	Conforms
	vi)	Diametrical and axial clearance of main bearings	--do--	Diametrical - 0.13 Axial-0.40	Diametrical - 0.09 Axial-0.15	Conforms
	vii)	Thickness of brake lining	--do--	NA	Not applicable as ceramic material brake lining is provided	Conforms
	viii)	Thickness of clutch plate	--do--	Up to rivet head	2.0 to 2.5 mm over the rivet head	Conforms
7.	Field performance					
	i)	Suitability for crops	Wheat & paddy essential	--	Wheat & paddy	Conforms
	ii)	Grain breakage in grain tank	≤ 2.5 %	--	Wheat (1.406 to 2.651%) Av.=1.905%	Conforms



					Paddy (0.400 to 0.652%) Av.=0.453%	
iii)	Non collectable losses	$\leq 2.5\%$ for wheat, paddy & gram $\leq 4.0\%$ for soybean	--		Wheat (0.971 to 3.232%) Av.=2.128% Paddy (0.695 to 1.385%) Av.=0.897%	Conforms
iv)	Threshing efficiency	$\geq 98\%$ wheat & paddy	--		Wheat (99.6 to 99.9%) Av.=99.7% Paddy (99.5 to 99.6%) Av.99.5%	Conforms
v)	Cleaning efficiency	$\geq 96\%$ wheat & paddy	--		Wheat (96.5 to 97.6%) Av.=97.2% Paddy (96.2 to 97.7%) Av.=97.1%	Conforms
8.	Safety requirement					
i)	Guards against all moving per	Essential			Provided	Conforms
ii)	Lighting arrangement a) Head light b) Parking light c) Indication d) Reverse gear e) Brake f) Number plate	Essential as per CMVR	--		Provided	Conforms
iii)	Grain tank cover	Essential	--		Provided	Conforms
iv)	Spark arrester in engine's exhaust	Essential	--		Not provided however turbo charger eliminates the requirement of spark arrester	--

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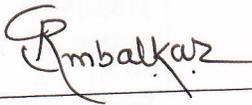
v)	Stone trap before concave	Essential	--	Provided	Conforms
vi)	Rear view mirror	Essential	--	Provided	Conforms
vii)	Slip clutch at following drives – a) Cutting platform auger b) under shot conveyor drive c) Grain & tailing elevator	Essential	--	Not provided	Does not conform
viii)	Anti slip surfaces at operator platform & ladder & proper gripping for the control levers	Essential	--	Provided	Conforms
ix)	Working clearance around the controls	Essential 70 mm, min.	--	Provided	Conforms
x)	Labelling of control gauge	Essential	--	Provided	Conforms
9.	Material of construction :				
i)	Knife guard should conform to IS: 6024 -2004	The guard (except ledger plate) shall be manufactured from malleable iron casting (IS: 2108-1977), steel casting (IS: 1030-1974) or steel forging (IS: 2004-1978)	-	C=0.2774% Si= 0.5912% Mn= 0.4715% P= 0.0156% S=Nil	Unascertainable as the relevant code does not specify the content limits.
ii)	Knife blade As per IS :6025 -2004	It must have Chemical composition as C= 0.70-0.95 % Mn =0.30-0.50 %	-	C= 0.7424% Mn= 0.4908%	Conforms for carbon only
iii)	Knife back Must meet the requirement of IS:10378-2006	The knife back shall be manufactured from Carbon Steel having minimum carbon content of 0.35 %	-	C= 0.2314%	Does not conform

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10. Labelling of combine harvester					
	It should conform to IS: 10273-2004	Essential, It should mention make & model, Engine No., Chassis No., Year of manufacture, Power & SFC of engine	--	Provided	Conforms
11. Break down (critical, major & minor)					
Sr. No	Category of breakdowns	Category (evaluative/ Non evaluative)	Requirements as per IS: 15806-2008	As observed	Whether meets the requirements (Yes/No.)
1.	Critical	Evaluative	No critical breakdown	None	Yes
2.	Major	Evaluative	Not more than three and neither of them should be repetitive in nature	None	Yes
3.	Minor	Evaluative	Not more than five and frequency of each should not be more than three	None	Yes

TESTING AUTHORITY

G.R. AMBALKAR Agricultural Engineer	
R.K. NEMA Senior Agricultural Engineer	
HIMAT SINGH Director	

Test report compiled by: Sh. B.N. Dixit, Sr. Tech. Assistant

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APPLICANT'S COMMENTS

No specific comments are offered by applicant.