



**SELF PROPELLED COMBINE HARVESTER
'SUKHDEV-9100'**



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
ट्रैक्टर नगर, सिरसा रोड़, हिसार- 125001 (हरियाणा)

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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.

** Specified for field work.

Remarks:

- 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.
- 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.
- The back-up torque of the engine was measured as 19.6 % under natural ambient at full throttle.
- The maximum smoke density was recorded as 3.12 (Bosch No.) which is within permissible limit
- The maximum temperature of engine oil, coolant(water) and exhaust gas was observed as 117.4, 102.0 and 501°C respectively.
- 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 pedal force and maximum stopping distance corresponding to mean deceleration of 2.5 m/sec^2 were observed 322 N and 4.16 m.
- 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 92 & 101 dB (a) respectively. Which is on higher side. It calls for suitable measures for noise reduction.

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

The results of the field test are summarized below:

S. No	Parameters	Range of parameters		Average of parameters	
		Wheat Harvesting	Paddy Harvesting	Wheat Harvesting	Paddy Harvesting
1.	Speed of operation (kmph)	2.72 to 3.52	3.04 to 3.12	2.92	3.07
2.	Area covered (ha/h)	0.706 to 0.961	0.841 to 1.043	0.847	0.915
3.	Fuel consumption:				
	- (l/h)	7.00 to 7.721	6.475 to 7.554	7.233	6.925
	- (l/ha)	7.286 to 10.000	6.645 to 8.982	8.561	7.618
4.	Crop throughput (tonne/h)	4.84 to 10.83	8.36 to 17.91	8.36	13.46
5.	Grain breakage in main grain outlet(%)	0.369 to 1.374	0.404 to 0.609	0.959	0.526
6.	Header losses(%)	0.200 to 1.443	0.215 to 0.411	0.865	0.302
7.	Total non-collectable losses(%)	0.238 to 1.537	0.236 to 0.525	0.959	0.402
8.	Total collectable losses(%)	0.170 to 0.613	0.070 to 0.975	0.440	0.560
9.	Total processing losses(%)	0.934 to 2.077	0.684 to 1.671	1.493	1.186
10.	Threshing efficiency(%)	99.83 to 99.98	99.02 to 99.98	99.91	99.45
11.	Cleaning efficiency(%)	97.13 to 98.70	96.37 to 98.30	97.96	97.45

18.7.1.1 Wheat Harvesting:

- i) The grain breakage in all the varieties tested was measured as 0.369 to 1.374%.
- ii) The total non collectable losses ranged from 0.238 to 1.537 percent.
- iii) The total processing losses ranged from 0.934 to 2.077 %.
- iv) The threshing efficiency ranged from 99.83 to 99.98 %.
- v) The cleaning efficiency ranged from 97.13 to 98.70 %.

18.7.1.2 Paddy Harvesting:

- i) The grain breakage ranged from 0.404 to 0.609 %.
- ii) The total non-collectable losses ranged from 0.236 to 0.525 %.
- iii) The total processing losses ranged from 0.684 to 1.671 %.
- iv) The threshing efficiency ranged from 99.02 to 99.98 %.
- v) The cleaning efficiency ranged from 96.37 to 98.30 %.

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.
- ii) The design of stone trap need to be modified for easy cleaning without removing header unit.
- iii) Spark arresting device is not provided in the engine exhaust system which is considered essential.
- iv) Slip clutch / safety device in cutting platform auger drive is considered essential from safety point of view which needs to be provided.
- v) The mechanical arrangement for adjusting the reel speed though provided needs to be modified such that the same could be controlled from operator's position.
- vi) Safety signs, hazard pictorials and warnings are not provided on machine. It should be provided on machine to alert the person to an existing or potential hazard, identify the hazard, describe the nature of hazard, explain the consequences of potential injury from the hazard and instruct the person about how to avoid the hazard. The safety instructions should also be included in operator's manual.

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 at remained zone of knife blade knife guard and rasp bar do not conform with the limits as specified in IS:6025-1999 and IS:10378-1982. These should be looked into at regular production level

18.8.2 The manganese content of knife blade and carbon content of knife back are not conforms the prescribed limit of IS:6025-1999 & IS:10378-1982 respectively.

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:

A literature, operator manual and part catalogue are provided by manufacturer. It having brief information of machine, its operation, adjustments and maintenance schedule are provided in Hindi, English and regional language Punjabi, however it should be updated in accordance with IS:8732:1999.

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

S. 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.	Not Specified	52.6	-
iii)	Power at rated engine speed, kW	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	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	5.20	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.	450	358.1	Does not conform
vii)	Back up torque, %	7% min.	-	19.6	Conforms
viii)	Max. operating temp. To be declared by manufacturer	i) engine oil	120	117.4	Conforms
		ii) Coolant	108	102	Conforms
ix)	Lubrication oil consumption, g/kWh	1% of SFC at 5hr. max. power test during high ambient condition	2.90+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	-	4.16	Conforms
ii)	Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec ² .	$\leq 600N$.	-	322	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.	-	100	Conforms
ii)	Steering wheel	150 μ m max.	-	120	Conforms
iii)	Seat with driver seated	120 μ m max.	-	100	Conforms
4.	Air cleaner oil pull over				
i)	Max. oil pull over in % age when tested in accordance with IS: P8122 pt. (II)-2000	0.25% max.	Machine is provided with dry type air cleaner hence test is not applicable	NA	--

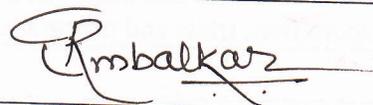
5. Noise measurement						
i)	Max. ambient noise emitted by combine dB (A)	88 dB (A) as per CMVR			92	Does not conform
ii)	Max. noise at operator's ear level dB (A)	98 dB (A) as per CMVR,			101	Does not conform
6. Discard limit						
i)	Cylinder bore diameter, mm	Should not exceed the values declared by the manufacture	104.15		104.02	Conforms
ii)	Piston diameter	--do--	Not specified		103.89	-
iii)	Ring end gap	--do--	1 st comp - 1.2		0.40	Conforms
			2 nd comp-1.2		0.40	Conforms
			Oil control-1.2		0.15	Conforms
iv)	Ring groove clearance	--do--	1 st comp-0.7		NA	-
			2 nd comp-0.2		0.04	Conforms
			Oil control-0.1		0.03	Conforms
v)	Diametrical and axial clearance of big end bearing	-do-	Diametrical-0.12		0.09	Conforms
			Axial-0.6		0.20	Conforms
vi)	Diametrical and axial clearance of main bearings	--do--	Diametrical-0.13		0.10	Conforms
			End float-0.4		0.10	Conforms
vii)	Thickness of brake lining	--do--	NA		21.15	-
viii)	Height of timing over clutch plate	--do--	Up to rivet		2.35	Conforms
7. Field performance						
i)	Suitability for crops	Wheat & paddy essential			Provided	Conforms
ii)	Grain breakage in grain tank	≤ 2.5 %			Wheat (0.369 to 1.374 %) Avg. 0.959% Paddy (0.404 to 0.609%) Avg. 0.589%	Conforms

iii)	Non collectable losses	$\leq 2.5\%$ for wheat, paddy & gram $\leq 4.0\%$ for soybean		Wheat (0.238 to 1.537%) Avg. 0.959% Paddy (0.236 to 0.525%) Avg. 0.402 %	Conforms
iv)	Threshing efficiency	$\geq 98\%$ wheat & paddy		Wheat (99.83 to 99.98%) Avg. 99.91% Paddy (99.02 to 99.98%) Avg. 99.45%	Conforms
v)	Cleaning efficiency	$\geq 96\%$ wheat & paddy		Wheat (97.13 to 98.70%) Avg. 97.96% Paddy (96.37 to 98.30%) Avg. 97.45%	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		Provided	Conforms
iii)	Grain tank cover	Essential		Provided	Conforms
iv)	Spark arrester in engine's exhaust	Essential		Not provided	However the turbo charged engine eliminates the requirement of the separate spark arrester

v)	Stone trap before concave	Essential		Provided	Conforms
vi)	Rear view mirror	Essential		Provided	Conforms
vii)	Slip clutch at following drives – a) Cutting platform b) under shot conveyor drive c) Grain & tailing elevator	Essential		Not provided Provided Not provided	Conforms except cutting platform auger
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)	Guard should conform to IS: 6024 -1983	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)		Uncertain able as the relevant code does not specify the content limit	--
ii)	Knife blade As per IS :6025 -1999	It must have Chemical composition as C= 0.70-0.95 % Mn =0.30-0.50 %		C= 0.87% Mn= 0.56%	Conforms Does not conform
iii)	Knife back Must meet the requirement of IS:10378-1982	The knife back shall be manufactured from Carbon Steel having minimum carbon content of 0.35 %		C= 0.23%	Does not conform

10.	Labelling of combine harvester				
	It should conform to IS: 10273-1987	Essential, It should mention make & model, Engine No. Chassis No., Year of manufacture, Power & SFC of engine		Not provided	Does not conform
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

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R.K. NEMA Senior Agricultural Engineer	
HIMAT SINGH Director	

Test report compiled by: Sh. S.A. Hinge, Sr. Tech. Assistant



20.

APPLICANT'S COMMENTS

No specific comment is submitted by the applicant.