



**SELF PROPELLED COMBINE HARVESTER
“SURINDER A – 930”**



सत्यमेव जयते

**भारत सरकार
कृषि मंत्रालय
(कृषि एवं सहकारिता विभाग)**

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

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7	233.8	233.0	0.34
8	215.1	214.1	0.46
9	234.6	233.1	0.64

18 SUMMARY OF OBSERVATIONS, COMMENTS AND RECOMMENDATIONS

18.1 Engine Performance Test:

Engine Brake power, kW (Ps)	Crankshaft torque, Nm(kgf-m)	Engine speed (rpm)	Hourly fuel consump- tion kg/h / (l/h)	Specific fuel consump- tion kg/kwh (kg/hph)	Specific energy, kWh/l (hph/l)
i) Maximum power - 2 hours test:					
92.1 (125.2)	409.2 (41.8)	2250	24.468 (29.611)	0.266 (0.195)	3.110 (4.228)
80.8 (109.9)	496.9 (50.7)	1625	19.185 (23.096)	0.237 (0.174)	3.497 (4.754)**
ii) Power at rated engine speed (2200 rpm)					
94.3 (128.2)	428.6 (43.7)	2200	24.507 (29.634)	0.260 (0.191)	3.182 (4.327)
87.0 (118.3)	395.3 (40.3)	2200	23.858 (29.060)	0.274 (0.202)	2.994 (4.070)*
iii) Maximum torque:					
79.9 (108.6)	550.8 (56.2)	1450	18.878 (22.773)	0.236 (0.174)	3.509 (4.770)
67.7 (92.0)	520.7(53.1)	1300	17.207 (20.959)	0.254 (0.187)	3.230 (4.392)*
71.4 (97.1)	595.0 (60.7)	1200	17.501 (21.111)	0.245 (0.180)	3.382 (4.598)**
iv) Five hour rating test:					
a) Engine loaded to 90% of maximum power:					
81.4 (110.7)	356.6(36.4)	2283	22.441 (27.330)	0.276(0.203)	2.980 (4.052)*
b) maximum power:					
89.7 (122.0)	407.7 (41.6)	2200	24.133 (29.395)	0.269(0.198)	3.052 (4.149)*



* Under high ambient condition.

** At no load speed corresponding to rated speed specified for field work.

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Remarks:

- i) The maximum power output of 2 hrs. test was observed as 92.1 kW (125.2 Ps) & 80.8 kW (109.9 Ps) at 2250 rpm and 1625 rpm of engine at full throttle and setting recommended 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 0.266 & 0.237 Kg/kwh (0.195 & 0.174 kg/hph).
- iii) The back-up torque of the engine was measured as 30.8 % in natural ambient at full throttle.
- iv) The maximum smoke density was recorded as 4.45 (Bosch No.) which is within permissible limit
- v) The maximum temperature of engine oil, coolant (water) and exhaust gas was observed as 108.4, 99.0 and 492.2°C respectively.
- vi) The lubricating oil & coolant consumption during five hours rating test were measured as 0.392(0.288) g/kWh (g/hph) and 0.32% of total coolant capacity respectively.

18.2 Turning ability:

The radius 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 stopping distance corresponding to mean deceleration of 2.5 m/sec² were observed 177 N and 17.63 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 87.5 & 97.5 dB (a) respectively which are within the specified limit as per relevant BIS code.

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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)	2.93 to 3.53	2.69 to 2.99	3.25	2.85
2.	Area covered (ha/h)	0.854 to 1.180	0.787 to 0.901	0.986	0.839
3.	Fuel consumption: - (l/h) - (l/ha)	7.91 to 10.25 8.02 to 10.46	7.79 to 10.26 8.64 to 12.63	9.154 9.336	8.90 10.63
4.	Crop throughput (tonne/h)	9.4 to 13.3	11.9 to 15.8	11.67	13.6
5.	Grain breakage in main grain outlet(%)	0.367 to 0.870	0.402 to 0.801	0.514	0.586
6.	Header losses(%)	0.398 to 0.965	0.413 to 0.821	0.677	0.554
7.	Total non-collectable losses(%)	0.741 to 1.845	0.804 to 1.263	1.231	1.021
8.	Total collectable losses(%)	0.399 to 1.125	0.403 to 0.772	0.721	0.627
9.	Total processing losses(%)	1.453 to 2.095	1.54 to 1.890	1.787	1.680
10.	Threshing efficiency(%)	98.7 to 99.4	99.0 to 99.4	99.0	99.2
11.	Cleaning efficiency(%)	97.5 to 98.2	97.1 to 97.8	97.9	97.4

18.7.1.1 Wheat Harvesting:

- i) The grain breakage in all the varieties tested was measured as 0.367 to 0.870%.
- ii) The total non collectable losses ranged from 0.741 to 1.845 percent.
- iii) The total processing losses ranged from 1.453 to 2.095 % .
- iv) The threshing efficiency ranged from 98.7 to 99.4%.
- v) The cleaning efficiency ranged from 97.5 to 98.2% .



18.7.1.2 Paddy Harvesting:

- i) The grain breakage ranged from 0.402 to 0.801 % .
- ii) The total non-collectable losses ranged from 0.804 to 1.263% .
- iii) The total processing losses ranged from 1.544 to 1.890 % .
- iv) The threshing efficiency ranged from 99.0 to 99.4
- v) The cleaning efficiency ranged from 97.1 to 97.8%

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.

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- ii) The design of stone trap need to be modified for easy cleaning without removing header unit.
- iii) Spark arresting device is provided in the engine exhaust system which is considered essential.
- iv) Slip clutch / safety device in knife 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 operators position.
- vi) 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 reminder zone and knife guard do not conform with the limits as specified in IS:6025-1999 and IS:6024-1999. These should be looked into at regular production level

18.8.2 Carbon content in knife blade & knife back are not complying with the specified limit in relevant BIS code. This should be looked into at production level.

18.9 Labelling of Combine Harvester:

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

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18.10 Literature supplied with the Machine:

A part catalogue is provided with the machine. However a complete working manual should be brought out as per IS: 8132-1999 in Hindi and other regional languages to guide to users and operator of combine harvester.

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(Ps)	It should not be less than 5% of the declared value.	96.0(130.5)	92.1(125.2)	Conforms
ii)	Max. power observed during test after adjusting the no load engine speed as per recommendation of the manufacturer for field work, kW(Ps)	Max. power observed must not be less than 5% of declared value.	(75-80 kW)	80.8 (109.9) @ 1800 rpm,	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.	96.0 (130.5)	94.3(128.2)	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.	235 \pm 5%	266	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	-	4.45	Conforms



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	vi) 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	It must not be less than 8% of declare value by manufacturer.	~475 N-m	595.0 (60.7), at 1800,	Conforms
	vii) Back up torque, %	7% min.	--	30.8	Conforms
	viii) Max. operating temp. To be declared by manufacturer	i) engine oil ii) Coolant	120 95	108.4 99.0	Conforms Does not conform
	ix) Lubrication oil consumption, g/kWh	1% of SFC at 5hr. max. power test during high ambient condition	2.69 +10%	0.392	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	10.0	4.93	Conforms
	ii) Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec ² .	≤ 600N.	600	360	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 µm max.	--	130	Does not conform
	ii) Steering wheel	150 µm max.	--	120	Conforms
	iii) Seat with driver seated	120 µm max.	--	100	Conforms
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 provided because dry air cleaner is used	--

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5. Noise measurement					
i)	Max. ambient noise emitted by combine dB (A)	88 dB (A) as per CMVR	88	87.8	Conforms
	Max. noise at operator's ear level dB (A)	98 dB (A) as per CMVR,	98	97.5	Conforms
6. Discard limit					
i)	Cylinder bore diameter, mm	Should not exceed the values declared by the manufacture	107.534	107.31	Conforms
	Piston diameter	-do-	106.40	106.48	Conforms
	Ring end gap	--do--	2.0	0.65	Conforms
	Ring groove clearance	--do--	0.20	0.07	Conforms
	Diametrical and axial clearance of big end bearing	-do-	Diametrical - 0.18 Axial - 0.25	Diametrical - 0.11 Axial - 0.20	Conforms
	Diametrical and axial clearance of main bearings	--do--	Diametrical - 0.178 Axial - 0.356	Diametrical - 0.11 Axial - 0.15	Conforms
	Thickness of brake lining	--do--	Up to rivet head	2.4 to 3.99 mm over rivet head	Conforms
	Thickness of clutch plate	--do--	Up to rivet head	2.30 to 3.96 mm over rivet head	Conforms
7. Field performance					
i)	Suitability for crops	Wheat & paddy essential	Wheat & paddy	Suitable for Wheat & paddy	Conforms
	Grain breakage in grain tank	≤ 2.5 %	--	Wheat- (0.367 to 0.870%) Avg.=0.514% Paddy- (0.402 to 0.801%) Avg.=0.586%	Conforms for both wheat and paddy
	Non collectable losses	≤ 2.5% for wheat, paddy & gram ≤ 4.0% for soybean	--	Wheat- (0.741 to 1.845%) Avg.=1.231 Paddy- (0.804 to 1.263%) Avg.= 1.021%	Conforms for both wheat and paddy



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	iv) Threshing efficiency	$\geq 98\%$ wheat & paddy	--	Wheat- (98.7 to 99.4%) Avg.=99% Paddy- (99 to 99.4%) Avg.=99.2%	Conforms for both wheat and paddy
	v) Cleaning efficiency	$\geq 96\%$ wheat & paddy	--	Wheat- (97.5 to 98.2%) Avg.=97.9% Paddy- (97.1 to 97.8%) Avg.= 97.4%	Conforms for both wheat and paddy
8.	Safety requirement				
i)	Guards against all moving part	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 as per CMVR report No. CMVR/Comb-SP/2012-13/97 Dated. 09.05.2012	Conforms
iii)	Grain tank cover	Essential	--	Provided	Conforms
iv)	Spark arrester in engine's exhaust	Essential	--	Not provided	Does not Conform
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	Does not Conform Conforms 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

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9.	Material of construction :					
	i)	Guard should conforms 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)	-	C=0.41% Si=0.32% Mn=0.76% P=0.036% S=0.045%	Unascertainable as the relevant code does not specify the limit of content.
	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=0.84% Mn=0.54%	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=0.11%	Does not conform
10.	Labelling of combine harvester					
	It should conforms to IS: 10273-1987	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)					
		Essential as per IS: 15806-2008 Annexure A ₁ , A ₂ , A ₃	--	None	Conforms	

TESTING AUTHORITY

(J.P. MANDAL) AGRICULTURAL ENGINEER	<i>J.P.Mandal.</i>
(P. K. CHOPRA) SENIOR AGRICULTURAL ENGINEER	<i>P.K.Chopra.</i>
(HIMAT SINGH) -DIRECTOR-	<i>H.S.</i>

**APPLICANTS COMMENT'S
RECEIVED AND ADDED IN THE REPORT**