



SELF PROPELLED COMBINE HARVESTER
“SATWANT – 1125”



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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|-----------|------------------------------|-------|------|
| 6 | 231.4 | 230.2 | 0.52 |
| 7 | 213.6 | 212.7 | 0.42 |
| 8 | 233.0 | 231.9 | 0.47 |
| b) | Peg teeth of Concave: | | |
| 1 | 210.8 | 210.4 | 0.19 |
| 2 | 222.5 | 221.7 | 0.36 |
| 3 | 212.6 | 210.7 | 0.89 |
| 4 | 218.7 | 217.4 | 0.59 |
| 5 | 211.2 | 210.4 | 0.38 |
| 6 | 221.7 | 220.7 | 0.45 |
| 7 | 216.6 | 215.6 | 0.46 |
| 8 | 213.7 | 212.4 | 0.61 |
| 9 | 233.4 | 231.4 | 0.86 |

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 consumption kg/h / (l/h) | Specific fuel consumption 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) |
| 77.2 (105.0) | 550.9 (56.2) | 1400 | 18.251 (22.012) | 0.237 (0.174) | 3.505 (4.765)** |
| 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)* |
| 70.0 (95.2) | 583.0(59.5) | 1200 | 17.133 (20.618) | 0.244 (0.179) | 4.086 (5.555)** |
| 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)* |

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| 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.

Remarks:

- i) The maximum power output of the engine was observed as 92.1 (125.2) & 77.2(105.0) kW(Ps) at 2250 rpm and 1400 rpm respectively of engine at full throttle and setting recommend for field operation respectively, under natural ambient conditions during 2 hrs maximum power test.
- ii) The specific fuel consumption corresponding to maximum power at full throttle and settings recommended for field operation was measured as 0.266(0.195) and 0.237(0.174) kg/kWh (kg/hph), under natural ambient conditions during 2 hrs maximum power test.
- iii) The back-up torque of the engine was measured as 30.8 % in natural ambient at full throttle where as field rpm setting it was 5.96 % corresponding to field rpm setting of 1700 rpm respectively.
- iv) The maximum smoke density was recorded as 4.45 (Bosch No.) which is within permissible limit as specified in IS:15806-2008.
- v) The maximum temperature of engine oil, coolant (water) and exhaust gas was observed as 108.4, 99.0 and 492.2 respectively, under high ambient condition.
- vi) The lubricating oil & coolant consumption during five hours rating test were measured as 0.392 g/kWh(0.288 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. Combine is provided with single foot pedals for right and left brake.

18.3 Visibility:

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

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18.4 Braking Performance:

- i) The stopping distance and pedal force corresponding to mean deceleration of 2.5 m/sec² were 6.9 m and 297 N respectively. Minimum stopping distance is 5.4 m corresponding to the pedal force of 379 N.
- 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:

- i) The ambient noise emitted by the machine was measured as 92.9 db(A) as against the maximum specified limit of 88 db(A) with relevant BIS code.
- ii) The noise at driver's ear level was measured as 100.6 dB(A) as against the maximum specified limit of 98 db(A) in relevant BIS code.

18.7 Air cleaner oil pull over test

This test is not applicable due to dry type air cleaner.

18.8 Field Test:

18.8.1 Summary of field tests:

The results of the field test are summarized below:

| S. No | Parameters | Wheat Harvesting | Paddy Harvesting | Average | |
|-------|--|------------------------------------|-------------------------------------|----------------|-----------------|
| | | | | Wheat | Paddy |
| 1. | Speed of operation (kmph) | 3.02 to 4.32 | 2.17 to 2.87 | 3.302 | 2.068 |
| 2. | Area covered (ha/h) | 0.885 to 1.363 | 0.702 to 0.867 | 1.011 | 0.768 |
| 3. | Fuel consumption: - (l/h) - (l/ha) | 7.730 to 10.820 6.530 to 12.220 | 7.961 to 10.126 10.419 to 13.945 | 9.026 9.302 | 9.264 12.130 |
| 4. | Crop throughput (tonne/h) | 6.34 to 11.04 | 13.32 to 18.43 | 9.134 | 16.29 |
| 5. | Grain breakage in main grain outlet(%) | 0.429 to 1.058 | 0.334 to 0.831 | 0.760 | 0.628 |
| 6. | Header losses(%) | 1.026 to 1.368 | 0.354 to 0.970 | 1.170 | 0.667 |

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| 7. | Total non-collectable losses(%) | 1.063 to 1.412 | 0.576 to 1.316 | 1.223 | 0.924 |
| 8. | Total collectable losses(%) | 0.899 to 1.555 | 0.970 to 2.113 | 0.409 | 0.806 |
| 9. | Total processing losses(%) | 1.031 to 1.629 | 1.179 to 2.335 | 1.262 | 1.698 |
| 10. | Threshing efficiency(%) | 99.50 to 99.77 | 98.51 to 99.48 | 99.59 | 99.18 |
| 11. | Cleaning efficiency(%) | 97.10 to 99.35 | 96.00 to 97.60 | 98.18 | 96.94 |

18.7.1.1 Wheat Harvesting:

- The grain breakage in all the varieties tested was measured as 0.429 to 1.058 (Avg. 0.760) which is within specified limit of 2.5% as specified in IS: 15806-2008.
- The total non collectable losses ranged from 1.063 to 1.412 percent (Avg. 1.223) which is within specified limit of 2.5% as specified in IS: 15806-2008.
- The total processing losses ranged from 1.031 to 1.629% (Avg. 1.262 %).
- The threshing efficiency ranged from 99.50 to 99.77% (Avg. 99.59) which is within the specified limit of 98% as specified in IS : 15806-2008.
- The cleaning efficiency ranged from 97.10 to 99.35% (Avg. 98.18) which is within limit of 96% as specified in IS: 15806-2008.



18.7.1.2 Paddy Harvesting:

- The grain breakage ranged from 0.334 to 0.831 % (Avg. 0.628) which is within specified limit of 2.5% as per specified in IS: 15806-2008.
- The total non-collectable losses ranged from 0.576 to 1.316 % (Avg. 0.924) which is within specified limit of 2.5% as specified in IS: 15806-2008.
- The total processing losses ranged from 1.179 to 2.335 % (Avg. 1.698%).
- The threshing efficiency ranged from 98.51 to 99.48 % (Average 99.18) which is with in specified limit of 98% as per specified in IS: 15806-2008.
- The cleaning efficiency ranged from 96.00 to 97.60% (Avg. 96.94) which is within the limit of 96% as specified in IS: 15806-2008.

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:

- 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.
- The design of stone trap need to be modified for easy cleaning without removing header unit.

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- iii) Spark arresting device is not provided in the engine exhaust system which is considered essential.
- iv) Slip clutch / safety device in knife drive and threshing drum drive are 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 by a hydraulic system.

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.

18.9 Hardness and Chemical composition:

18.9.1 Hardness of knife blade in reminder zone and hardened zone was measured as 44 and 63 HRC respectively. The hardness of blade on both zones is not conforming to IS: 6025-1999.

18.10 Maintenance/Service problems:

No noticeable maintenance/service problem was observed during the course of test at this Institute.

18.10 Defects & Problems:

No noticeable defect or problem was observed during entire test of the combine harvester.

18.11 Labelling of Combine Harvester:

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

18.12 Literature supplied with the Machine:

Operator manual for prime mover (engine) for repair and maintenance is provided. However, a manual in respect of combine harvester as a whole should be brought out in Hindi and other regional languages as per relevant Indian standards IS:8132-1999 to guide to users and operator of combine.

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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) at (1600-1800) rpm | 77.2(105.0) @ 1700 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 whichever 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 |
| 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. | 475 N-m | 583.0 (59.5) At 1700 rpm | Conforms |



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| | vii) | Back up torque, % | 7% min. | -- | 30.8 | Conforms |
| | viii) | Max. operating temp. To be declared by manufacturer | i) engine oil | 120 | 108.4 | Conforms |
| | | | ii) Coolant | 95 | 99.0 | 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 | 5.40 | Conforms |
| | ii) | Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec ² . | $\leq 600N$. | 600 | 297 | 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. | -- | 150 | Does not conform |
| | ii) | Steering wheel | 150 μ m max. | -- | 160 | Does not conform |
| | iii) | Seat with driver seated | 120 μ m max. | -- | 120 | Conforms |
| 4. | Air cleaner oil pull over | | | | | |
| | i) | Max. oil pull over in % age when tested in accordance with IS: 8122 pt. (II)-2000 | Not applicable | - | Dry type air cleaner is used | - |
| 5. | Noise measurement | | | | | |
| | i) | Max. ambient noise emitted by combine dB (A) | 88 dB (A) as per CMVR | -- | 92.9 | Does not conform |
| | ii) | Max. noise at operator's ear level dB (A) | 98 dB (A) as per CMVR, | -- | 100.6 | Does not conform |

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| 6. | Discard limit | | | | |
| i) | Cylinder bore diameter, mm | Should not exceed the values declared by the manufacture | 107.534 (max) | 107.30 | Conforms |
| ii) | Piston diameter | -do- | 106.40 (min) | 106.51 | Conforms |
| iii) | Ring end gap | --do-- | 2.0 | 0.65 | Conforms |
| iv) | Ring groove clearance | --do-- | 0.20 | 0.04 | Conforms |
| v) | Diametrical and axial clearance of big end bearing | -do- | Diametric al – 0.18 | Diametrical – 0.06 | Conforms |
| | | | Axial – 0.25 | Axial – 0.04 | Conforms |
| vi) | Diametrical and axial clearance of main bearings | --do-- | Diametric al – 0.178 | Diametrical – 0.100 | Conforms |
| | | | Axial – 0.356 | Axial – 0.050 | Conforms |
| vii) | Height over the rivet of a brake lining | Not applicable | - | - | Conforms |
| viii) | Height over the rivet of a clutch plate | --do-- | Up to rivet head | 1.25 to 2.25 | |
| 7. | Field performance | | | | |
| i) | Suitability for crops | Wheat & paddy essential | Wheat & paddy | Suitable for Wheat & paddy | Conforms |
| ii) | Grain breakage in grain tank | ≤ 2.5 % | -- | Wheat - 0.760 (0.429 to 1.058) Paddy - 0.628 (0.334 to 0.831) | Conforms for both wheat and paddy |
| iii) | Non collectable losses | ≤ 2.5% for wheat, paddy & gram ≤ 4.0% for soybean | -- | Wheat - 1.223 (1.063 to 1.412) | Conforms |
| | | | | Paddy - 0.924 (0.576 to 1.316) | Conforms |
| iv) | Threshing efficiency | ≥ 98% wheat & paddy | -- | Wheat - 99.59 (99.50 to 99.77) | Conforms |
| | | | | Paddy - 99.18 (98.51 to 99.48) | Conforms |
| v) | Cleaning efficiency | ≥ 96 % wheat & paddy | -- | Wheat - 98.18 (97.10 to 99.35) | Conforms |
| | | | | Paddy - 96.94 (96.00 to 97.60) | Conforms |

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| 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 with CMVR certification No. CMVR/ COMB-86/2010/55 dated 16.11.2010 | Conforms | |
| | iii) | Grain tank cover | Essential | -- | Not provided | Does not conform | |
| | 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 | Provided Provided Not Provided | Not Provided Not Provided Not provided | Does not conform Does not conform 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 | -- | Labelled with symbols | 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) | - | C - 0.43 Si - 0.23 Mn - 0.61 P - 0.050 S - 0.027 | The limits are not specified in the relevant code. |
| ii) | | Knife blade As per IS :6025 -1982 | It must have Chemical composition as C= 0.70-0.95 % Mn =0.30-0.50 % | - | C - 0.80 Mn - 0.61 | Conforms Does not conform | |

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| | 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 - 0.30 | 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 | -- | Provided | Conforms |
| 11. | Break down (critical, major & minor) | | | | |
| | | Essential as per IS: 15806-2008 Annexure A1, A2, A3 | -- | None | Conforms |

