



SELF PROPELLED COMBINE HARVESTER
'MAIJO LIULIN (4LZ-2.0)'



सत्यमेव जयते

भारत सरकार
कृषि मंत्रालय
(कृषि एवं सहकारिता विभाग)

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

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17 SUMMARY OF OBSERVATIONS, COMMENTS AND RECOMMENDATIONS

17.1 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: | | | | | |
| 44.36 (60.31) | 170.6 (17.40) | 2600 | 12.46 (15.00) | 0.281 (0.207) | 2.957 (4.021) |
| 42.82 (58.22) | 180.3 (18.39) | 2375 | 11.42 (13.72) | 0.267 (0.196) | 3.121 (4.243)** |
| ii) Power at rated engine speed (2600 rpm) | | | | | |
| 44.67 (60.73) | 171.8 (17.52) | 2600 | 12.59 (15.15) | 0.282 (0.207) | 2.949 (4.008) |
| 43.63 (59.32) | 167.8 (17.11) | 2600 | 12.23 (14.84) | 0.280 (0.206) | 2.940 (4.002)* |
| iii) Maximum torque: | | | | | |
| 31.23 (42.46) | 195.2 (19.90) | 1600 | 7.97 (9.59) | 0.255 (0.188) | 3.257 (4.428) |
| 31.44 (42.75) | 187.7 (19.14) | 1675 | 7.84 (9.38) | 0.249 (0.183) | 3.352 (4.558)** |
| 32.11 (43.66) | 188.9 (19.26) | 1700 | 8.17 (9.91) | 0.254 (0.187) | 3.240 (4.406)* |
| iv) Five hour rating test: * | | | | | |
| a) Engine loaded to 90% of maximum power: | | | | | |
| 40.29 (54.78) | 151.0 (15.40) | 2668 | 11.45 (13.91) | 0.284 (0.209) | 2.896 (3.938)* |
| b) maximum power: | | | | | |
| 41.76 (56.78) | 160.6 (16.38) | 2600 | 11.74 (14.26) | 0.281 (0.207) | 2.928 (3.982)* |

* Under high ambient condition.

Remarks:

- i) The maximum power output of the engine was observed as 44.36 kW (60.31 Ps) and 42.82 kW (58.22 Ps) at 2600 & 2375 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 setting and setting recommended for field operation was measured as 0.281 Kg/kwh (0.207 kg/hph) and 0.267 Kg/kWh (0.196) kg/hp-h respectively.
- iii) The back-up torque of the engine was measured as 13.62% under natural ambient condition at full throttle.
- iv) The maximum smoke density was recorded as 0.61 (Bosch No.).
- v) The maximum temperature of engine oil, coolant (water) and exhaust gas were observed as 107.2, 95 and 604.3C° respectively.

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vi) The lubricating oil & coolant consumption during five hours rating test were measured as 1.49 g/kWh (1.10 g/hph) and 0.83% of total coolant capacity respectively.

17.2 Turning ability:

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

17.3 Visibility:

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

17.4 Braking Performance:

No specific brake mechanism is provided. The combine stops by bringing the starting control levers LHS and RHS, to the neutral position.

17.5 Mechanical Vibration:

The amplitude of mechanical vibration of components are given in chapter 12 of this report. The observation reading marked (*) for various assemblies on higher side and suitable arrangement should be provided to dampen the vibration for operator's comfort.

17.6 Noise measurement:

- i) The ambient noise emitted by the machine was measured as 90.8 dB(A).
- ii) The noise at driver's ear level was measured as 100.8 dB(A).

17.7 Field Test:

17.7.1 Summary of field tests:

The results of the field test for paddy harvesting are summarized below:



| S. No. | Observation | Range of observations | Average of observations |
|--------|--|------------------------------------|-------------------------|
| 1. | Speed of operation, kmph | 4.07 to 5.20 | 4.45 |
| 2. | Area covered (ha/h) | 0.418 to 0.597 | 0.540 |
| 3. | Fuel consumption: - (l/h) - (l/ha) | 6.431 to 7.887 11.589 to 18.870 | 6.995 13.017 |
| 4. | Crop throughput (tonne/h) | 788 to 11.93 | 10.18 |
| 5. | Grain breakage in main grain outlet(%) | 0.060 to 1.130 | 0.275 |
| 6. | Header losses(%) | 0.066 to 0.863 | 0.466 |
| 7. | Total non-collectable losses(%) | 0.742 to 2.060 | 1.371 |
| 8. | Total collectable losses(%) | 0.276 to 1.269 | 0.743 |
| 9. | Total processing losses(%) | 1.041 to 2.782 | 1.923 |
| 10. | Threshing efficiency(%) | 98.70 to 99.72 | 99.25 |
| 11. | Cleaning efficiency(%) | 95.70 to 97.27 | 96.67 |

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17.7.1.1 Paddy Harvesting:

- i) The grain breakage ranged from 0.060 to 1.130% (Avg.0.275%) which normal.
- ii) The total non-collectable losses ranged from 0.742 to 2.060% (Avg.1.371%) which is normal.
- iii) The total processing losses ranged from 1.041 to 2.782% (Avg.1.923%) which is slightly higher side.
- iv) The threshing efficiency ranged from 98.70 to 99.72% (Avg. 99.25%) which is normal.
- v) The cleaning efficiency ranged from 95.70 to 97.27% (Avg. 96.67%), which is slightly lower side.

17.7.1 Break down and repairs:

A minor repair was done to check the leakage of radiator during bench testing of engine.

17.7.2 Harvesting of any other crops:

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

17.7.3 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) Spark arresting device is not provided in the engine exhaust system which is considered essential.
- iii) Slip clutch / safety device in knife drive, crop auger drive and threshing drum drive are considered essential from safety point of view which needs to be provided.
- iv) The mechanical arrangement for adjusting the reel speed is not provided, needs to be added such that the same could be controlled from operators position.
- v) During CG test of a combine, beyond 16° of tilt angle, over toppling condition of a machine arrives. Hence, it is to be worked in to at different level, that it works easily on sloppy areas with more than 16° slope.
- vi) Mechanical lock for reel in raised position needs to be provided to ensure safety while working on cutter bar.
- vii) Air cleaner service indicator has been provided for operator's ease and safety of engine.
- viii) A provision for speed variation of threshing drum should be provided for different variety and condition of paddy crops.

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17.7.4 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 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 rack bar of threshing cylinder & concave were observed to be normal.

17.8 Hardness and Chemical composition:

1. The Hardness of knife blade at remainder zone and knife guard are not complying with specified limit of IS: 6025-1999.
2. The chemical composition of a knife blade for Carbon and Manganese content does not complying with in limit of IS: 6025-1999.



17.9 Maintenance/Service problems:

No noticeable maintenance/service problem was observed during the course of test at this Institute. However the air cleaner element change period and air cleaner closing indicator needs to be provided.

17.10 Identification plate of Combine Harvester:

The identification plate is provided on the combine harvester as specified in IS: 10273-1999.

17.11 Literature supplied with the Machine:

Operator, workshop manual and part catalogue are provided with test sample. However following literature should be provided with machine in Hindi and other regional languages for the guidance of the users in accordance with IS:8132-1999.

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18. 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(Ps) | It should not be less than 5% of the declared value. | 52(70.70) | 44.36(60.31) | Does not conform |
| 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. | 50(67.98) | 42.82(58.22) | Does not conform |
| iii) | Power at rated engine speed, kW (Ps) | The observed value must not be less than 5% of the declared value by the applicant. | 50(67.98)) | 44.67(60.73) | Does not conform |
| 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. | 225 | 281 | 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 | 5.2 | 0.61 | 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. | 215 | 195.2 | Conforms |

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| | vii) | Back up torque, % | 7% min. | - | 13.62 | Conforms |
| | viii) | Max. operating temp. To be declared by manufacturer | i) engine oil | 130(Max) | 107.2 | Conforms |
| | | | ii) Coolant | 95(Max) | 95 | Conforms |
| | ix) | Lubrication oil consumption, g/kWh | 1% of SFC at 5hr. max. power test during high ambient condition | 2.850 + 10% | 1.490 | 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 | Not applicable as no service brake is provided | -- | -- |
| | ii) | Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec ² . | $\leq 600N$. | Not applicable | -- | -- |
| | 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 | Not applicable | -- | -- |
| 3. | Mechanical vibration | | | | | |
| | i) | Operator's platform | 120 μ m max. | - | 330 | Does not conform |
| | ii) | Steering control lever | 150 μ m max. | - | 1200 | Does not conform |
| | iii) | Seat with driver seated | 120 μ m max. | - | 370 | Does not conform |
| 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 dry type air filter is provided | - | - |
| 5. | Noise measurement | | | | | |
| | i) | Max. ambient noise emitted by combine dB (A) | 88 dB (A) | | 90.8 | Does not conform |
| | ii) | Max. noise at operator's ear level dB (A) | 98 dB (A) | | 100.8 | Does not conform |



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| 6. | Discard limit | | | | |
| i) | Cylinder bore diameter | Must not exceed the values declared by the manufacture | 100.13 | 100.05 | Conforms |
| ii) | Piston liner side clearnce | -do- | 0.40 | 0.19 | Conforms |
| iii) | Ring end gap | -do- | 1.50 | 0.50 | Conforms |
| iv) | Ring groove clearance | -do- | 1.50 | 0.06 | Conforms |
| v) | Diametrical and axial clearance of big end bearing | -do- | Diametrical 0.20 | Diametrical 0.11 | Conforms |
| | | | Axial 0.40 | Axial 0.40 | Conforms |
| vi) | Diametrical and axial clearance of main bearings | -do- | Diametrical 0.25 | Diametrical 0.16 | Conforms |
| | | | Axial 0.50 | Axial 0.15 | Conforms |
| vii) | Thickness of brake lining | Not applicable | - | - | - |
| viii) | Thickness of clutch plate | Not applicable | - | - | - |
| 7. | Field performance | | | | |
| i) | Suitability for crops | Wheat & paddy essential | Paddy | The combine was operated in paddy crop only | Conforms |
| ii) | Grain breakage in grain tank | ≤ 2.5 % | - | Avg. 0.275 (0.060 to 1.130) | Conforms |
| iii) | Non collectable losses | ≤ 2.5% for wheat, paddy & gram ≤ 4.0% for soybean | - | Avg. 1.371 (0.742 to 2.060) | Conforms |
| iv) | Threshing efficiency | ≥ 98% wheat & paddy | - | Avg. 99.25 (98.70 to 99.72) | Conforms |
| v) | Cleaning efficiency | ≥ 96 % wheat & paddy | - | Avg. 96.67 (95.70 to 97.27) | 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 | Not applicable | - | - |
| iii) | Grain tank cover | Essential | - | Provided | Conforms |

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|-------|--|--------------------------|---|--------------|------------------|
| iv) | Spark arrester in engine's exhaust | Essential | - | Not provided | Does not conform |
| v) | Stone trap before concave | Essential | - | Provided | Provided |
| vi) | Rear view mirror | Essential | - | Provided | Provided |
| vii) | Slip clutch at following drives - a) Cutting platform b) under shout 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.

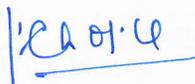
Material & Construction

| | | | | | |
|------|---|--|-----|----------------------|------------------|
| 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 | - |
| ii) | Knife blade As per IS :6025 -1982 | It must have Chemical composition as C= 0.70-0.95 % Mn =0.30-0.50 % | N.A | C- 0.64% Mn-0.23% | 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 % (min). | N.A | Carbon 0.43 % | Conforms |

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| 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 | | Minor leakage of radiator in bench performance test of engine | Does not conform |

TESTING AUTHORITY:

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|--|--|
| (J.P. MANDAL) AGRICULTURAL ENGINEER |  |
| (P. K. CHOPRA) SENIOR AGRICULTURAL ENGINEER |  |
| (HIMAT SINGH) -DIRECTOR- |  |

Tests conducted/Reports compiled by:
S.A. HINGE (Senior Technical Assistant)

Applicant's comments

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| 1. | Para 18.1 | The difference in power observed with reference to the declared power by the manufacturer may be due to elevation pressure & environmental temperature at testing place at Hisar |
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