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16. SUMMARY OF OBSERVATIONS, COMMENTS AND RECOMMENDATIONS

16.1 Compatibility of tractor on the combine

16.1.1 Adequacy of power:
During the period of test, no over loading of the prime mover was observed. The power available from the prime mover to drive the combining unit was found to be adequate.

16.1.2 Modifications on standard tractor:
The following modification in the tractor should be made in order to make it suitable for combine use.

i) One fan should be provided for safe operation of combine during field condition.

16.2 Header lifting test:
During 1000 cycles, no leakage of hydraulic oil was observed and working of hydraulic system is normal.

16.3 Turning ability:
Radius of turning circle of LHS & RHS was found satisfactory.

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

16.5 Braking Performance:

i) The mean deceleration and stopping distance corresponding mean 2.5 m/sec² the declaration was 10.13 m and 192N under cold condition.

ii) The performance of parking brake was found satisfactory.

16.6 Mechanical Vibration:
The amplitude of mechanical vibration of components marked as (*) in chapter 11 of this report are on higher side. This calls for providing suitable remedial measures to dampen the vibration to improve the operational comfort and service life of various components & sub assemblies.
16.7 Noise measurement:

i) The ambient noise emitted by the machine was measured as 87.0 dB(A).

ii) The noise at driver's ear level was measured as 97.6 dB(A).

16.8 Field Test:

16.8.1 Summary of field tests: Summary of field observation are tabulated in Table 4.

Table 4: The results of the field tests.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Parameters</th>
<th>Range of parameters</th>
<th>Average of parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wheat Harvesting</td>
<td>Paddy Harvesting</td>
</tr>
<tr>
<td>1.</td>
<td>Speed of operation (kmph)</td>
<td>2.45 to 3.91</td>
<td>2.51 to 2.73</td>
</tr>
<tr>
<td>2.</td>
<td>Area covered (ha/h)</td>
<td>0.43 to 0.82</td>
<td>0.41 to 0.52</td>
</tr>
<tr>
<td>3.</td>
<td>Fuel consumption:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- (l/h)</td>
<td>5.0 to 6.11</td>
<td>4.83 to 6.64</td>
</tr>
<tr>
<td></td>
<td>- (l/ha)</td>
<td>6.28 to 12.77*</td>
<td>9.50 to 11.92</td>
</tr>
<tr>
<td>4.</td>
<td>Crop throughput (tonne/h)</td>
<td>4.9 to 7.0</td>
<td>9.02 to 14.47</td>
</tr>
<tr>
<td>5.</td>
<td>Grain breakage in main</td>
<td>0.621 to 1.671</td>
<td>0.233 to 1.794</td>
</tr>
<tr>
<td></td>
<td>grain outlet(%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Header losses(%)</td>
<td>0.447 to 1.862</td>
<td>0.181 to 1.056</td>
</tr>
<tr>
<td>7.</td>
<td>Total non-collectable</td>
<td>0.468 to 2.201</td>
<td>0.226 to 1.127</td>
</tr>
<tr>
<td></td>
<td>losses(%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Total collectable losses(%)</td>
<td>0.00 to 0.167</td>
<td>0.00 to 0.940</td>
</tr>
<tr>
<td>9.</td>
<td>Total processing losses(%)</td>
<td>0.696 to 2.177</td>
<td>0.739 to 1.962</td>
</tr>
<tr>
<td>10.</td>
<td>Threshing efficiency(%)</td>
<td>99.8 to 99.9</td>
<td>99.1 to 99.9</td>
</tr>
<tr>
<td>11.</td>
<td>Cleaning efficiency(%)</td>
<td>97.6 to 99.1</td>
<td>96.0 to 97.0</td>
</tr>
</tbody>
</table>

16.8.2 Wheat Harvesting:

i) The grain breakage in all the varieties tested was measured as 0.621 to 1.671%.

ii) The total processing losses varies from 0.696 to 2.177%.

iii) The total non collectable losses ranged from 0.468 to 2.201 percent.

iv) The threshing efficiency ranged from 99.8 to 99.9%.

v) The cleaning efficiency ranged from 97.6 to 99.1%.

16.8.3 Paddy Harvesting:

i) The grain breakage ranged from 0.233 to 1.794%.

ii) The total non-collectable losses ranged from 0.226 to 1.127%.

iii) The total processing losses varies from 0.739 to 1.962%.

iv) The threshing efficiency ranged from 99.1 to 99.9%.

v) The cleaning efficiency ranged from 96.0 to 97.0.

* due to lodged crop condition, lower output (ha/h) of the machine results in higher fuel consumption per hectare.
16.8.4 Harvesting of any other crops:
The performance of combine to harvest wheat and paddy was evaluated.

16.8.5 Ease of Operation and Safety Provision:
i) The controls provided around the operator are within easy reach but not properly labelled with proper symbols and direction of operation of controls are not provided for the guidance of operator. Therefore it is recommended that the symbols as per the requirement of IS-6283-1998 may be provided.

ii) Safety device/slip clutches in threshing drum drive, reel drive, cutter bar drive & feeder conveyor drive are also considered essential from safety point of view.

iii) The grain tank needs to be provided with suitable device to know the grain fill and covered fully in order to avoid any accident while working on the machine.

iv) There is no provision for adjusting the threshing drum speed except the changing of pulley size which make it difficult to adjust the speed for harvesting different varieties of crop. Speed variation through suitable hydraulic variator pulley is recommended.

ev) The design of stone trap need to be modified for easy cleaning.

vi) The safety provisions to protect the grain and tailing auger, blower body from damage while crossing the field bunds are considered essential and may be provided from safety point of view.

16.8.6 Assessment of Wear:
i) The condition of the components of brake system and steering system was observed to be normal.

ii) The condition of the bearing, chains, sprockets and belts was observed to be normal.

iii) The components of starter motor and alternator were found in normal working condition.

iv) The rate of wear of rasp bar and peg teeth of threshing cylinder & concave were observed to be normal.

16.9 Hardness and Chemical composition:

i) The hardness of knife blade in the remainder zone & hardness zone was measured as 46 & 49 HRC against the IS: 6025-1991 limits 20 to 35 & 48 to 58 at remainder zone & hardness zone respectively. The hardness at the remainder zone is on higher side.

16.10 Maintenance/Service problems:
No noticeable maintenance/service problem was observed during the course of test at this Institute.

16.11 Labelling of Combine Harvester:
The labelling plate is provided on the combine harvester.

16.12 Literature supplied with the Machine:

16.12.1 The literature was not supplied with the machine.

16.12.2 It is suggested to bring out technical literature for operation, maintenance & repairs of combine harvester in printed form in Hindi and other regional languages as per IS:8132-1999.
### 17. Selected performance and other characteristics of combine harvester as per IS: 15806-2008.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Performance parameters</th>
<th>Characteristics</th>
<th>Requirement</th>
<th>Declared</th>
<th>Observed</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Max. Power (absolute)</td>
<td>Average max. power observed during 2 hrs. max. power test in natural ambient condition should not be less than -5% of the declared value.</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>ii)</td>
<td>Max. power during field test after adjusting the no load engine speed as per declaration of the applicant, kW</td>
<td>Max. power observed must not be less in -5% of declared value.</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>iii)</td>
<td>Power at rated engine speed, kW</td>
<td>The observed value must not be less -5% of the declared value by the applicant.</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>iv)</td>
<td>Specific fuel consumption g/kWh.</td>
<td>The average observed value during 2 hr. max. power test must be within ±5% of the declared value by applicant/manufacturer.</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>v)</td>
<td>Max. smoke density, bosch no.</td>
<td>Max. smoke density at 80% load between the speed at max. power &amp; 55% of speed at max. or 1000 rpm which ever is higher, should be observed as per CMVR rule requirement which are as below.</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>
### 2. Brake performance

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<tbody>
<tr>
<td>i)</td>
<td>Max. stopping distance at a force equal to or less than 600 N on break pedal, m</td>
<td>10 m or ( \leq 0.15V + \frac{V^2}{130} ) ( V ) = speed corresponding to 80% of design max. speed, kmph</td>
<td>--</td>
</tr>
<tr>
<td>ii)</td>
<td>Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec².</td>
<td>( \leq 600N ).</td>
<td>--</td>
</tr>
<tr>
<td>iii)</td>
<td>Whether parking brake is effective at a force of 600 N at foot pedal or 400 N at Hand and lever</td>
<td>Yes or No</td>
<td>--</td>
</tr>
</tbody>
</table>
### Mechanical vibration

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<tbody>
<tr>
<td>i)</td>
<td>Operator's platform</td>
<td>120 μm max.</td>
<td>--</td>
<td>337</td>
</tr>
<tr>
<td>ii)</td>
<td>Steering wheel</td>
<td>150 μm max.</td>
<td>--</td>
<td>441</td>
</tr>
<tr>
<td>iii)</td>
<td>Seat with driver seated</td>
<td>120 μm max.</td>
<td>--</td>
<td>398</td>
</tr>
</tbody>
</table>

### Air cleaner oil pull over

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<tbody>
<tr>
<td>i)</td>
<td>Max. oil pull over in % age when tested in accordance with IS: 8122 pt. (II)-2000</td>
<td>0.25% max.</td>
<td>--</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

### Noise measurement

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</thead>
<tbody>
<tr>
<td>i)</td>
<td>Max. ambient noise emitted by combine db (A)</td>
<td>As per CMVR 88 db (A)</td>
<td>--</td>
<td>87.0</td>
</tr>
<tr>
<td>ii)</td>
<td>Max. noise at operator's ear level db (A)</td>
<td>As per CMVR, 98 db (A)</td>
<td>--</td>
<td>97.6</td>
</tr>
</tbody>
</table>

### Discard limit

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</thead>
<tbody>
<tr>
<td>i)</td>
<td>Cylinder bore diameter</td>
<td>--do--</td>
<td>--</td>
<td>Not applicable</td>
</tr>
<tr>
<td>ii)</td>
<td>Piston diameter</td>
<td>--do--</td>
<td>--</td>
<td>Not applicable</td>
</tr>
<tr>
<td>iii)</td>
<td>Ring end gap</td>
<td>--do--</td>
<td>--</td>
<td>Not applicable</td>
</tr>
<tr>
<td>iv)</td>
<td>Ring groove clearance</td>
<td>--do--</td>
<td>--</td>
<td>Not applicable</td>
</tr>
<tr>
<td>v)</td>
<td>Diametral and axial clearance of big end bearing</td>
<td>--do--</td>
<td>--</td>
<td>Not applicable</td>
</tr>
<tr>
<td>vi)</td>
<td>Diametral end axial clearance of main bearings</td>
<td>--do--</td>
<td>--</td>
<td>Not applicable</td>
</tr>
<tr>
<td>vii)</td>
<td>Thickness of brake lining</td>
<td>--do--</td>
<td>--</td>
<td>Not applicable</td>
</tr>
<tr>
<td>viii)</td>
<td>Thickness of clutch plate</td>
<td>--do--</td>
<td>--</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

### Field performance

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</thead>
<tbody>
<tr>
<td>i)</td>
<td>Suitability for crops</td>
<td>Wheat &amp; paddy essential</td>
<td>--</td>
<td>Wheat, paddy</td>
</tr>
<tr>
<td>ii)</td>
<td>Grain breakage in grain tank</td>
<td>≤ 2.5%</td>
<td>--</td>
<td>Wheat- 0.621 to 1.671% Avg.0.964 Paddy- 0.233 to 1.794% Avg. 0.629%</td>
</tr>
</tbody>
</table>
### NEW HIRA – TDC 516
TRACTOR POWERED COMBINE HARVESTER

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
<th>Losses</th>
<th>Efficiency</th>
<th>Conforms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>iii)</strong> Non collectable losses</td>
<td>≤ 2.5% for wheat, paddy &amp; gram ≤ 0.4% for soybeans</td>
<td>-</td>
<td>Wheat- 0.468 to 2.201% Avg. 1.211% Paddy- 0.226 to 1.127% Avg. 0.627%</td>
<td>Conforms</td>
</tr>
<tr>
<td><strong>iv)</strong> Threshing efficiency</td>
<td>≥ 98% wheat &amp; paddy</td>
<td>-</td>
<td>Wheat- 99.8 to 99.9% Avg. 99.9% Paddy- 99.1 to 99.9% Avg. 99.4%</td>
<td>Conforms</td>
</tr>
<tr>
<td><strong>v)</strong> Cleaning efficiency</td>
<td>≥ 96% wheat &amp; paddy</td>
<td>-</td>
<td>Wheat- 97.6 to 99.1% Avg. 98.6% Paddy- 96.0 to 97.0% Avg. 96.5%</td>
<td>Conforms</td>
</tr>
</tbody>
</table>

#### Safety requirement

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
<th>Provided</th>
<th>Conforms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>i)</strong> Guards against all moving parts</td>
<td>Essential</td>
<td>-</td>
<td>Provided</td>
</tr>
<tr>
<td><strong>ii)</strong> Lighting arrangement</td>
<td>Essential</td>
<td>Provided as per report No. CMVR/comb - TM/2009/17 15.10.2009 of NRFMT&amp;TI Hisar</td>
<td>Conforms</td>
</tr>
<tr>
<td><strong>iii)</strong> Grain tank cover</td>
<td>Essential</td>
<td>-</td>
<td>Not provided</td>
</tr>
<tr>
<td><strong>iv)</strong> Spark arrester in engine's exhaust</td>
<td>Essential</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>v)</strong> Stone trap before concave</td>
<td>Essential</td>
<td>-</td>
<td>Provided</td>
</tr>
<tr>
<td><strong>vi)</strong> Rear view mirror</td>
<td>Essential</td>
<td>-</td>
<td>Provided</td>
</tr>
<tr>
<td><strong>vii)</strong> Slip clutch at following drives - a) Cutting platform b) under shout conveyor drive</td>
<td>Essential</td>
<td>-</td>
<td>Not provided</td>
</tr>
<tr>
<td></td>
<td>NEW HIRA – TDC 516 TRACTOR POWERED COMBINE HARVESTER</td>
<td>COMMERICAL</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Grain &amp; tailing elevator</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>viii) Anti slip surfaces at operation platform &amp; ladder &amp; proper gripping for the control levers</td>
<td>Essential</td>
<td>Provided</td>
</tr>
<tr>
<td></td>
<td>ix) Working clearance around the controls</td>
<td>Essential 70 mm. min.</td>
<td>Provided</td>
</tr>
<tr>
<td></td>
<td>x) Labelling of control gauge</td>
<td>Essential</td>
<td>Provided</td>
</tr>
<tr>
<td>9. Material of construction</td>
<td>i) Guard should conforms to IS:6024-1983</td>
<td>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)</td>
<td>C=0.41% Si=0.22% Mn=0.72% P=0.038% S=0.037% Unascerttainable as the relevant code does not specify the content limit.</td>
</tr>
<tr>
<td></td>
<td>ii) Knife blade Must meet the requirement of IS: 6025-1999</td>
<td>It should have chemical composition as C=0.70 to 0.95% Mn=0.30 to 0.50%</td>
<td>C=0.64% Mn=1.03% Does not conform</td>
</tr>
<tr>
<td></td>
<td>iii) Knife back Must meet the requirement of IS: 10378-1982 material requirement</td>
<td>The knife back shall be manufactured from Carbon Steel having minimum carbon content of 0.35%</td>
<td>C=0.28% Si=0.19% Mn=0.46% P=0.045% S=0.039% Does not conform</td>
</tr>
<tr>
<td>10. Labeling of combine harvester</td>
<td>Essential as per IS: 10273</td>
<td>Provided</td>
<td>Conforms</td>
</tr>
</tbody>
</table>
11. Break down (critical major & minor) | Essential as per IS: 15806-2008 Annexure A1, A2, A3 | None | conforms

TESTING AUTHORITY

(R.M. TIWARI)  
ASSISTANT ENGINEER (W/S)

(P. K. CHOPRA)  
SENIOR AGRICULTURAL ENGINEER

A. N. MESHRAM  
-DIRECTOR-

Tests conducted/Reports compiled by:

1. Sh. B.N. Dixit, Senior Technical Assistant

Applicant's comments:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Para No.</th>
<th>Applicant's comments</th>
</tr>
</thead>
</table>
| 1.    | Sr. No. 8 (Page No. 37) | 1. We shall be providing proper lighting arrangement in future production.  
2. We shall be providing grain tank cover in future production.  
3. We shall be providing slip clutch in future production. |
| 2.    | Sr. No. 11 (Page No. 23) | We have synchronized the components and necessary correction has been made to control vibration. |