व्यावसायिक परीक्षण रिपोर्ट
COMMERCIAL TEST REPORT

संख्या / No. : Comb – 109/1601
माह / Month: May, 2014

SELF PROPELLED COMBINE HARVESTER 'SATNAM-952'

सत्यमेव जयते

भारत सरकार
कृषि मंत्रालय
(कृषि एवं सहकारिता विभाग)

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

उत्तरी क्षेत्र कृषि मशीनरी प्रशिक्षण एवं परीक्षण संस्थान
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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 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)
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)	40.086 (5.555)**
iv) Five hour rating test* a) Engine run at 90% of maximum power load					
81.4(110.7)	356.6(36.4)	2283	22.441(27.330)	0.276 (0.203)	2.980(4.052)
b) Engine run at maximum power load					
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 part throttle speed specified for field work (1700 rpm).**

Remarks

i) The maximum power output of the engine was observed as 92.1 kW (125.2 Ps) & 77.2 kW (105.0 Ps) at 2250 rpm and 1400 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 and setting recommended for field operation was measured as 0.266 and 0.237 Kg/kWh (0.195 and 0.174 kg/hph).

iii) The back-up torque of the engine was measured as 30.8 % in natural ambient at full throttle, whereas corresponding to field setting is 5.96%

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 492.2^0 C respectively.

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.

17.2 Turning ability

The radius of turning circle at LHS and RHS was observed satisfactory. Combine is not provided with independent brake pedals for right and left brake.

17.3 Visibility

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

17.4 Braking Performance

i) The pedal force & max. stopping distance required corresponding to mean deceleration of 2.5 m/sec^2 was observed as 321 N m and 7.5 m respectively.

ii) Minimum stopping distance is 5.16 meter against the permissible limit of 7.27m & the corresponding force required to minimum stopping distance is 376 N

iii) The performance of parking brake was found satisfactory.

17.5 Mechanical Vibration

The amplitude of mechanical vibration of components marked as (*) in para 12 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.

17.6 Noise measurement

The noise level at bystander's position found 87.9dB(A) which conforms with specified noise level 88dB(A) in IS 12180:2000. The noise level at driver's ear level is found 97.6 dB(A) which conforms with specified noise level of 98dB(A) in IS 12180:2000

17.7 Field Test

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)	3.06 to 3.54	2.51 to 2.71	3.35	2.62
2.	Area covered (ha/h)	1.016 to 1.153	0.633 to 0.919	1.091	0.808
3.	Fuel consumption: - (l/h) - (l/ha)	 8.058 to 8.857 7.001 to 8.582	 7.000 to 9.036 8.587 to 11.101	 8.365 7.703	 8.009 10.114
4.	Crop throughput (tonne/h)	11.092 to 16.924	8.727 to 12.484	13.113	11.048
5.	Grain breakage in main grain outlet(%)	0.802 to 1.272	0.333 to 1.513	0.991	0.781
6.	Header losses(%)	0.292 to 0.850	0.180 to 0.928	0.539	0.436
7.	Total non-collectable losses(%)	0.309 to 0.867	0.217 to 1.021	0.559	0.514
8.	Total collectable losses(%)	0.131 to 0.779	0.875 to 1.745	0.402	1.283
9.	Total processing losses(%)	0.975 to 1.777	1.534 to 2.637	1.413	2.143
10.	Threshing efficiency(%)	99.22 to 99.87	98.12 to 98.95	99.60	98.50
11.	Cleaning efficiency(%)	96.80 to 98.23	96.00 to 96.53	97.67	96.29

17.7.1 Wheat Harvesting

i) The grain breakage in all the varieties tested ranged from 0.802 to 1.272% (average 0.991%) which is within the specified limit of 2.5% in IS: 15806-2008.

ii) The total non collectable losses ranged from 0.309 to 0.867% (average 0.559%) which is within specified limit of 2.5% as specified in IS: 15806-2008.

iii) The total processing losses ranged from 0.975 to 1.777% (average 1.413%) which is within the specified limit of 2.5% in IS: 8122(Part-1)1994.

iv) The threshing efficiency ranged from 99.22 to 99.87% (average 99.60%) which is above the specified limit of 98% in IS:15806-2008.

v) The cleaning efficiency ranged from 96.80 to 98.23% (average 97.67%). which is above the specified limit of 96% in IS:15806-2008.

17.7.2 Paddy Harvesting

i) The grain breakage ranged from 0.333 to 1.513% (average 0.781%) which is within specified limit of 2.5% in IS:15806-2008.

ii) The total non-collectable losses ranged from 0.217 to 1.021% (average 0.514%) which is within specified limit of 2.5% in IS:15806-2008.

iii) The total processing losses ranged from 1.534 to 2.637 % (average 2.143%). Average value is within specified limit of 2.5% in IS:8122 (Part-1)1994.

iv) The threshing efficiency ranged from 98.12 to 98.95 %(average 98.50%) which is above the specified limit of 98% in IS: 15806-2008.

v) The cleaning efficiency ranged from 96.00 to 96.53% (average 96.29%) which is above the specified limit of 96% in IS: 15806-2008.

Losses are within the specified limit and efficiencies are above the specified limit of Indian Standard on both the crops.

17.7.3 Harvesting of any other crops

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

17.7.4 Ease of Operation and Safety Provision

i) The controls provided around the operator are within easy reach and labelled but not with symbols as per Indian standard. Therefore, it is recommended that the symbols as per the requirement of IS-6283-1998 may be provided at production level.

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 lifting platform and grain & tailing elevator are considered essential from safety point of view which needs to be provided at production level.

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) The grain tank needs to be provided with suitable grain fill indicator device.

vii) Mechanical lock for reel in raised position needs to be provided to ensure safety while working on cutter bar.

17.7.5 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.

17.8 Chemical composition

i. Manganese percentage is higher than the prescribed limit in IS 6025:1982 in knife blade.

ii. Carbon percentage is lower than the prescribed limit in IS 10273:1987 in knife back.

Components made of material of specified chemical composition should be used at production level.

17.9 Maintenance/Service problems

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

17.10 Labelling of Combine Harvester

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

17.11 Literature supplied with the Machine

Operator manual for repair and maintenance is provided with machine. However, it needs to be modified as per IS:8132-1999 in Hindi and other regional languages to guide to users and operator of combine.

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

S. No.	Characteristics	Requirement	Declared	Observed	Remark
i.)	**Prime mover performance**				
a)	Max. Power (absolute) Average max. power observed during 2 hrs. max. power test under natural ambient condition kW(Ps)	It should not be less than 5% of the declared value by the manufacturer	96.0 (130.5)	92.1(125.2)	Conforms
b)	Max. power observed during the 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 by the manufacturer	75-80 (102 to108.8)	77.2(105.0) @1700 rpm	Conforms
c)	Power at rated engine speed, kW(Ps)	The observed value must not be less than 5% of the declared value by the manufacturer	96 (130.5)	94.3(128.2)	Conforms
d)	Specific fuel consumption g/kWh.	The average observed value during 2 hr. max. power test must be within ±5% of the declared value by manufacturer.	235±5%	266	**Does not conform**
e)	Max. smoke density (bosch no.) at 80% load between the speed at max. power & 55% of speed at max. power 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

f)	Max. crank shaft torque, observed during the test after no load engine speed is adjusted as per manufacture's recommendation for field work, n-m	It must not be less than 8% of declared value by manufacturer.	475	583.0 (59.5) @1700 rpm	Conforms
g)	Back up torque, percent	7 Percent, Min.	--	30.8	Conforms
h)	Max. operating temperatures, ^{0}C 1.) engine oil 2.) Coolant	To be declared by manufacturer	120 (engine oil) 95 (Coolant)	108.4 99.0	Conforms **Does not conform**
i)	Lubrication oil consumption, g/kWh	1% of SFC at 5hr. max. power test during high ambient condition with tolerance limit of +10%.	2.69+10%	0.392	Conforms
ii.)	**Brake performance**				
a)	Max. stopping distance at a force equal to or less than 600 N on break pedal, m	10 m or S≤ 0.15V + $V^2/130$ V=speed corresponding to 80% of design max. speed, kmph	-	5.33m	Conforms
b)	Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec^2.	≤ 600N.	--	321N	Conforms
c)	Whether parking brake is effective at a force of 600 N at foot pedal or 400 N at Hand and lever	Yes / No	--	Yes	Conforms
iii.)	**Mechanical vibration (amplitude of vibration) at**				
a)	Operator's platform	120 µm Max.	--	120 µm	Conforms
b)	Steering wheel	150 µm Max.	--	200 µm	**Does not conform**
c)	Seat (with driver seated)	120 µm Max.	--	130 µm	**Does not conform**
iv.)	**Air cleaner oil pull over**				
a)	Maximum percentage of oil pull over	0.25% Max.	--	Not applicable as dry type air cleaner is provided	--
v.)	**Noise measurement**				
a)	Max. ambient noise emitted by the combine dB (A)	88 dB (A) as per CMVR	--	87.9dB(A)	Conforms
b)	Max. noise at operator's ear level dB (A)	98 dB (A) as per CMVR,	--	97.6dB(A)	Conforms
vi.)	**Discard limit of**				
a)	Cylinder bore diameter, mm	To be specified by the manufacturer	107.534	107.21(max)	Conforms
b)	Piston diameter, mm	-do-	106.40	106.44(min)	Conforms
c)	Ring end gap, mm	--do--	2.0	0.70(max)	Conforms

d)	Ring groove clearance, mm	--do--	0.20	0.16(max)	Conforms
e)	Diametrical and axial clearance of big end bearing , mm	-do-	Diame-trical 0.18 Axial 0.25	Diametrical 0.06(max) Axial - 0.25(max)	Conforms
f)	Diametrical and axial clearance of main bearings, mm	--do--	Diame-trical 0.178 Axial 0.356	Diametrical 0.08(max) Axial 0.15	Conforms Conforms
g)	Thickness of brake lining mm	--do--	Not specified	2.2 (minimum)	--
h)	Thickness of clutch plate, mm	--do--	up to rivet head	1.73 (min)	Conforms
vii.)	**Field performance**				
a)	Suitability for the crops	Wheat & paddy essential	Wheat & paddy	Suitable for Wheat & paddy	Conforms
b)	Grain breakage in grain tank	≤ 2.5 %		Wheat 0.802-1.27 (avg. 0.991) Paddy 0.333 to 1.513 (avg. 0.781)	Conforms for both wheat and paddy
c)	Non collectable losses	≤ 2.5% for wheat, paddy & gram ≤ 4.0% for soyabean		Wheat 0.309-0.867 (avg. 0.559) Paddy 0.217-1.021 (avg. 0.514)	Conforms
d)	Threshing efficiency	≥ 98% wheat & paddy	--	Wheat- 99.22 to 99.87% (avg. 99.60%) Paddy- 98.12 to 98.95% (avg. 98.50%)	Conforms
e)	Cleaning efficiency	≥ 96 % wheat & paddy	--	Wheat- 96.80 to 98.23% (avg. 97.67%) Paddy- 96.00 to 96.53 (avg. 96.29%)	Conforms
viii.)	**Safety requirement**				
a)	Guards against all moving parts/drives and hot parts	Essential	--	Provided	Conforms
b)	Lighting arrangement - Head light - Parking light - Indication - Reverse gear - Brake - Number plate	As per CMVR	--	Provided	Conforms
c)	Grain tank cover	Essential	--	Provided	Conforms
d)	Spark arrester in engine's exhaust	Essential	--	Not provided	Does not Conform (However the

					turbo charged engine eliminates the requirement of the separate spark arrester to great extend)
e)	Stone trap before concave	Essential	--	Provided	Conform
f)	Rear view mirror	Essential	--	Provided	Conforms
g)	Slip clutch at following drives – a) Cutting platform auger drive b) under shot conveyor drive c) Grain & tailing elevator drive	Essential	--	Not Provided Provided Not provided	**Does not Conform** Conforms **Does not confirm**
h)	Anti slip surfaces at operators platform & ladder & proper gripping for the control levers	Essential	--	Provided	Conforms
i)	Working clearance around the controls	Essential 70 mm, min.	--	Provided	Conforms
j)	Labelling of control gauge	Essential	--	Provided	Conforms
ix.)	**Material of construction**				
a)	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)	-	Not provided	--
b)	Knife blade As per IS :6025 - 1982	It must have Chemical composition as Carbon 0.70-0.95 % Manganese0.30-0.50 %	-	Carbon 0.82% Manganese 0.75%	Conform only for carbon
c)	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 %	-	Carbon 0.11%	**Does not conform**

x.)	**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
xi.)	**Break down (critical, major & minor)**				
	As per annexure A of IS: 15806-2008 Critical- NIL Major- 3, Max Minor- 5, Max		--	NIL	Conforms

TESTING AUTHORITY

(R.M. TIWARI) AGRICULTURAL ENGINEER	
(P. K. CHOPRA) SENIOR AGRICULTURAL ENGINEER	
(HIMAT SINGH) **-DIRECTOR-**	

APPLICANT'S COMMENTS

Sr. No.	Our Reference	Applicant's comment
1.	Para 18 (i) (d)	High SFC can be attributed to diesel density etc.
2.	Para 18 (i) (h)	Coolant temperature varies between 95 to 120^{0}C under high ambient conditions.
3.	Para 12 and 18 (iii) (b) and (c) mechanical vibration	We will make necessary improvements to dampen the vibration of different assemblies and sub assemblies.
4.	Para 18 (viii) safety requirements (g)	Only one slip clutch of undershot conveyor drive is sufficient. It controls all the over loadings which occurs further.
5.	Para 18 (ix) material of construction (b) and (c)	We are using best quality of blade and knife back available in the market. We will search other makes who are using material as per Indian standard.