व्यावसायिक परीक्षण रिपोर्ट
COMMERCIAL TEST REPORT

संख्या / No. : Comb-137/1711/2015
माह / Month: February, 2015

SELF PROPELLED COMBINE HARVESTER 'BALKAR-654'

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
ट्रैक्टर नगर, सिरसा रोड़, हिसार- 125001 (हरियाणा)

NORTHERN REGION FARM MACHINERY TRAINING AND TESTING INSTITUTE
TRACTOR NAGAR, SIRSA ROAD, HISAR-125001 (HARYANA)

दूरभाष / Phones: 01662-276172
फैक्स स0. / Fax No. 01662-276984

वेबसाईट / Website: http://nrfmtti.dacnet.nic.in
ई-मेल / E-mail: fmti-nr@nic.in

4	227.3	227.2	0.04
5	239.0	238.5	0.21
6	216.8	216.6	0.09
7	239.0	238.7	0.13
8	227.2	226.9	0.13
b)	**Peg teeth of Concave:**		
1	220.5	219.9	0.27
2	221.0	220.8	0.09
3	212.3	212.0	0.14
4	213.7	213.5	0.09
5	212.7	212.5	0.09
6	223.2	223.1	0.04
7	222.4	222.1	0.13
8	217.5	217.0	0.23

17.10 Wear of rasp bar (Maize):

Sr. No.	Mass of rasp bar before test, gram	Mass of rasp bar after 28.89 h of test, gram	Percent wear by mass basis (%)
1.	6130.5	6090.3	0.66
2.	6155.3	6089.1	1.08
3.	6158.2	6110.3	0.78
4.	6145.4	6101.5	0.71

18 SUMMARY OF OBSERVATIONS, COMMENTS AND RECOMMENDATIONS

18.1 Engine Performance Test:

Engine Brake power, kW (Ps)	Engine speed (rpm)	Hourly fuel consumption l/h/kg/h	Specific fuel consump-tion kg/kwh	Specific energy, kWh/l (hph/l)
i) Maximum power - 2 hours test:				
70.7	2200	24.82/20.51	0.290	2.848(3.872)
52.6	1500	15.25/12.65	0.240	3.453(4.695)**
ii) Power at rated engine speed (2200 rpm)				
70.95	2200	24.70/20.53	0.289	2.872(3.905)
69.61	2200	24.55/20.16	0.290	2.835(3.855)*
iii) Maximum torque:				
54.01	1400	15.45/12.81	0.237	3.496(4.753)
51.45	1400	15.13/12.44	0.242	3.401(4.623)*
48.75	1300	13.71/11.38	0.233	3.556(4.835)**
iv) Five hour rating test: **a) Engine loaded to 90% of maximum power:**				
65.0	2282	24.39/20.00	0.308	2.667(3.626)
b) maximum power:				
69.5	2200	24.78/20.32	0.292	2.805(3.184)

* **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 70.7 kW (96.1 Ps) & 52.6 kW (71.5 Ps) at 2200 rpm and 1500 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 0.290 and 0.240Kg/kwh (0.213 & 0.177kg/hph).

iii) The back-up torque of the engine was measured as 19.6% under natural ambient at full throttle.

iv) The maximum smoke density was recorded as 3.12 (Bosch No.) which is within permissible limit.

v) The maximum temperature of engine oil, coolant (water) and exhaust gas was observed as 117.4,102.0 and 501° C respectively.

vi) The lubricating oil & coolant consumption during five hours rating test were measured as 0.334(0.246) g/kWh (g/hph) and 1.90% 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 maximum stopping distance corresponding to mean deceleration of 2.5 m/sec^2 were observed 242 N and 7.02 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 bistander and driver's ear level were measured as 88 & 99 dBA respectively

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	Maize Harvesting	Wheat Harvesting	Paddy Harvesting	Maize Harvesting
1	Speed of operation (kmph)	2.48 to 3.31	2.89 to 3.11	1.09 to 1.18	2.83	2.99	1.15
2	Area covered (ha/h)	0.779 to 0.932	0.767 to 0.812	0.336 to 0.385	0.888	0.791	0.360

3	Fuel consumption : - (l/h) - (l/ha)	7.038 to 8.647 8.362 to 9.293	6.822 to 8.432 8.587 to 10.390	7.078 to 7.942 19.142 to 21.993	7.798 8.782	7.516 9.504	7.531 20.954
4	Crop throughput (tonne/h)	5.15 to 10.41	8.57 to 10.99	2.78 to 6.67	7.47	9.87	4.32
5	Grain breakage in main grain outlet (%)	0.130 to 0.770	0.232 to 1.134	0.243 to 5.954	0.398	0.757	3.705
6	Header losses (%)	0.150 to 0.358	0.097 to 0.301	0.065 to 0.377	0.250	0.201	0.257
7	Total non-collectable losses (%)	0.220 to 0.543	0.121 to 0.386	0.099 to 0.536	0.350	0.242	0.336
8	Total collectable losses (%)	0.070 to 0.230	1.279 to 1.844	Nil	0.114	1.597	Nil
9	Total processing losses (%)	0.333 to 1.042	1.535 to 2.913	0.250 to 6.113	0.612	2.395	3.784
10	Threshing efficiency (%)	99.77 to 99.93	98.15 to 98.71	100.0	99.89	98.39	100.0
11	Cleaning efficiency (%)	98.83 to 99.37	96.20 to 97.53	93.13 to 97.50	99.10	96.73	94.55

18.7.1.1 Wheat Harvesting·

i) The grain breakage in all the varieties tested was measured as 0.130 to 0.770%. (Avg. 0.398%)
ii) The total non collectable losses ranged from 0.220 to 0.543 %. (Avg. 0.350%)
iii) The total processing losses ranged from 0.333 to 1.042 %. (Avg. 0.612%)
iv) The threshing efficiency ranged from 99.77 to 99.93%. (Avg. 99.89%)
v) The cleaning efficiency ranged from 98.83 to 99.37%. (Avg. 99.10%)

18.7.1.2 Paddy Harvesting:

i) The grain breakage ranged from 0.232 to 1.134% . (Avg. 0.757%)
ii) The total non-collectable losses ranged from 0.121 to 0.386% . (Avg. 0.242%)
iii) The total processing losses ranged from 1.535 to 2.913 % . (Avg. 2.395%)
iv) The threshing efficiency ranged from 98.15 to 98.71%. (Avg. 98.39%)
v) The cleaning efficiency ranged from 96.20 to 97.53% . (Avg. 96.73%)

18.7.1.3 Maize Harvesting

i) The grain breakage ranged from 0.243 to 5.954% . (Avg. 3.705%) which is slightly higher side.

ii) The total non-collectable losses ranged from 0.099 to 0.536% . (Avg. 0.336%) which is normal.

iii) The total processing losses ranged from 0.250 to 6.113 % . (Avg. 2.395%) which is normal.

iv) The threshing efficiency ranged from 100 % which is normal.

v) The cleaning efficiency ranged from 93.13 to 97.50 % . (Avg. 94.55%) which is lower side.

18.7.2 Harvesting of any other crops:

The performance of combine to harvest Wheat, Paddy and Maize crops were 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.

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 grain and tailing auger drive and undershot conveyor 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 operator's position.

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.

N.R.F.M.T.T.I. HISAR

18.8 Hardness and Chemical composition:

18.8.1 Hardness of knife guard and raspbar do not conform with the limits as specified in IS:6025-1999 and IS:10378-1982. These should be looked into at regular production level

18.8.2 The manganese and carbon content of knife blade and carbon content of knife back are not conforms the prescribed limit of IS:6025-1999 & IS:10378-1982 respectively.

18.9 **Labelling of Combine Harvester:**
The labelling plate as per IS:10273-1999 is provided on the combine harvester.

18.10 **Literature supplied with the Machine:**

A single literature of operator manual and part catalogue is submitted by the manufacturer. However, this should be brought out separately 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.	74.3	70.7 (96.1)	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.	Not Specified	52.6 (71.5)	-
	iii)	Power at rated engine speed, kW(Ps)	The observed value must not be less than 5% of the declared value by the applicant.	74.3	70.95(96.5)	Conforms
	iv)	Specific fuel consumption g/kWh.	The average observed value during 2 hr. max. power test must be within ±5% of the declared value by applicant/ manufacturer.	238	290	**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	5.20	3.12	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.	450	358.1	**Does not conform**
	vii)	Back up torque, %	7% min.	-	19.6	Conforms
	viii)	Max. operating temp. To be declared by manufacturer	i) engine oil ii) Coolant	120 108	117.4 102	Conforms Conforms
	ix)	Lubrication oil consumption, g/kWh	1% of SFC at 5hr. max. power test during high ambient condition	2.90	0.334	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≤ 0.15V + $V^2/130$ V=speed corresponding to 80% of design max. speed, kmph	-	7.02	Conforms
	ii)	Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec^2.	≤ 600N.	-	242	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.	-	90	Conforms
	ii)	Steering wheel	150 µm max.	-	430	**Does not conform**
	iii)	Seat with driver seated	120 µm max.	-	120	Conforms
4.	**Air cleaner oil pull over**					
	i)	Max. oil pull over in % age when tested in accordance with IS: P8122 pt. (II)-2000	0.25% max.	Machine is provided with dry type air cleaner hence test is not applicable	NA	--

5.	**Noise measurement**					
	i)	Max. ambient noise emitted by combine dB (A)	88 dB (A) as per CMVR		88	Conforms
	ii)	Max. noise at operator's ear level dB (A)	98 dB (A) as per CMVR,		99	**Does not conform**
6.	**Discard limit**					
	i)	Cylinder bore diameter, mm	Should not exceed the values declared by the manufacture	104.02		Conforms
	ii)	Piston diameter	-do-	103.92		-
	iii)	Ring end gap	--do--	1st comp – 0.30 2nd comp- 0.40 Oil control- 0.35		Conforms Conforms Conforms
	iv)	Ring groove clearance	--do--	1st comp- - 2nd comp- 0.05 Oil control- 0.04		- Conforms Conforms
	v)	Diametrical and axial clearance of big end bearing	-do-	Diametrical- 0.08 Axial-0.20		Conforms Conforms
	vi)	Diametrical and axial clearance of main bearings	--do--	Diametrical- 0.10 End float- 0.07		Conforms
	vii)	Height over the rivet of brake lining	--do--	Up to rivet	2.05	Conforms
	viii)	Height over the met of clutch plate	--do--	Up to rivet	1.58	Conforms
7.	**Field performance**					
	i)	Suitability for crops	Wheat & paddy essential		Provided	Conforms
	ii)	Grain breakage in grain tank	≤ 2.5 %		**Wheat** 0.130 to 0.770% (Avg. 0.398) **Paddy** 0.232 to 1.134% (Avg. 0.757) **Maize** 0.243 to 5.954% (Avg. 3.705)	Conforms Conforms -

	iii)	Non collectable losses	≤ 2.5% for wheat, paddy & gram ≤ 4.0% for soybean		**Wheat** 0.220 to 0.543% (Avg. 0.350%) **Paddy** 0.121 to 0.386% (Avg.0.242) **Maize** 0.099 to 0.536% (Avg.0.336)	Conforms Conforms -
	iv)	Threshing efficiency	≥ 98% wheat & paddy		**Wheat** 99.77 to 99.93% (Avg. 99.89) **Paddy** 98.15 to 98.71 (Avg. 98.39%) **Maize** 100.0%	Conforms Conforms -
	v)	Cleaning efficiency	≥ 96 % wheat & paddy		**Wheat** 98.83 to 99.37% (Avg.99.10) **Paddy** 96.20 to 97.53% (Avg. 96.73) **Maize** 93.13 to 97.50% (Avg.94.55)	Conforms 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-COMB-SP/2012-13/112 dated 13 Feb., 2013		Provided	Conforms
	iii)	Grain tank cover	Essential		Provided	Conforms
	iv)	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

	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 Not Provided Not provided	Conforms **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	--	Provided	Conforms
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)	-	Uncertain able as the relevant code does not specify the content limit	--
	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= 0.21% Mn= 1.03%	**Does not conform** **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= 0.19%	**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

G.R. AMBALKAR **Agricultural Engineer**	Ambalkar
R.K. NEMA **Senior Agricultural Engineer**	Ram
HIMAT SINGH **Director**	HS

Test report compiled by: **Sh. S.A. Hinge, Sr. Tech. Assistant**

20. APPLICANT'S COMMENTS

Para No.	Our reference	Applicant's comment
20.1	19.(3(ii))	We will arrange to reduce the vibration in regular production.
20.2	19(9(ii)	We will provide superior quality in regular production.
20.3	19(8(vii))	We will provide the slip clutch in future.
20.4	19(1(iv, vi))	We will rectify with support of engine supplier ashok Leyland.