



**FORCE MOTORS LIMITED,
BALWAN 550 TRACTOR**



भारत सरकार

GOVERNMENT OF INDIA

कृषि मंत्रालय (कृषि एवं सहकारिता विभाग, मशीनीकरण एवं प्रोद्योगिकी प्रभाग)
Ministry of Agriculture (Deptt. of Agri. & Co-op, Mechanization & Technology Division)

केन्द्रीय कृषि मशीनरी प्रशिक्षण एवं परीक्षण संस्थान

CENTRAL FARM MACHINERY TRAINING & TESTING INSTITUTE

(An ISO : 9001-2008 Certified Institute)

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T-869/1381/2013

FORCE MOTORS LIMITED ,
BALWAN 550 TRACTOR –Commercial (Initial)

Manufacturer : M/s. Force Motors Ltd.
Mumbai - Pune Road
Akurdi, PUNE (M.S.) - 411 035

Test requested by : M/s. Force Motors Ltd.
Mumbai - Pune Road
Akurdi, PUNE (M.S.) - 411 035

Selected for test by : Manufacturer

Method of Selection : The tractor was submitted directly by the applicant for test. Hence, method of selection is not known.

1. SPECIFICATIONS

- 1.1. Tractor:**
- Make : M/s. Force Motors Ltd.
 - Model : BALWAN 550
 - Brand, if any : Force
 - Type : Four wheeled, rear-wheel driven, general purpose agricultural tractor.
 - Year of manufacture : 2011
 - Chassis Sr. number : T 23000001L11
 - Country of origin : India
 - Variants if any
- 1.2 Engine:**
- Make : M/s Force Motors Ltd.
 - Model : TD 2600 F(50)
 - Type : Four stroke, naturally aspirated, water, cooled, direct injection, diesel engine.
 - Serial number : D08008833
 - Year of manufacture : 2011
- 1.2.1 Engine speed(Manufacturer's recommended production setting), (rpm):**
- Maximum speed at no load : 2800-2900
 - Low idle speed : 700-750
 - Speed at maximum torque : 1500 - 1700
- Rated speed, (rpm):**
- For PTO use : 2600
 - For drawbar use : 2600
- 1.3 Cylinder & Cylinder Head:**
- Number : Four
 - Disposition : Vertical, Inline
 - Bore/stroke, (mm) : 90.9/100.0
 - Capacity as specified by the applicant, (cc) : 2596
 - Compression ratio : 18.3 : 1 to 18.8 :1
 - Type of cylinder head : Mono block

**17. SUMMARY OF OBSERVATIONS, COMMENTS & RECOMMENDATIONS**

17.1 Evaluative (mandatory) / Non-evaluation (Non-mandatory) parameter applicable for qualifying Minimum Performance criteria as per Clause-4 (Table-1) of IS: 12207-2008 for acceptance of the tractor for the purpose of subsidies/NABARD financing are summarized as under:

S. No.	Characteristic	Category (Evaluative / Non Evaluative)	Requirements as per IS: 12207-2008	Values declared by the applicant (D)/ Require- ment (R)	As observed	Whether meets the require- ments (Yes/No.)
1	2	3	4	5	6	7
17.1.1	PTO Performance :					
a)	-Maximum power under 2 h test, (kW) (Natural ambient condition)	Evaluative	Declared value to be achieved with a tolerance of: - 5/ +10 % for PTO power >35 hp, -7.5/+10% for PTO power ≤ 35 hp	33.00 (D)	32.2	Yes
b)	Power at rated engine speed, (kW)	Non Evaluative	-do-	33.00 (D)	32.2	Yes
c)	Specific fuel consumption corresponding to maximum power, (g/kWh)	Non Evaluative	± 5%	265(D)	263	Yes
d)	Maximum equivalent crankshaft torque, (Nm)	Non Evaluative	± 8%	145.00 (D)	146.96	yes
e)	Back-up torque, percent	Non Evaluative	7 percent, min.	7 percent, min. (R) 20 (D)	24.08	Yes
f)	Maximum operating temperature (°C)					
	1) Engine oil	Non Evaluative	The declared value should not exceed the max. value specified by the oil company and the observed value under high ambient condition should not exceed the declaration.	130 (D)	124	Yes
	2) Coolant (water)	Evaluative	The declared value should not exceed the boiling temperature of coolant under the pressurized or otherwise and the observed value under high ambient condition should not exceed the declaration.	110 (D)	98	Yes
g)	Engine oil consumption, (g/kWh)	Evaluative	Not exceeding 1% of SFC at max. power under High ambient conditions	2.5 (D) 2.64 (R)	2.415	Yes
h)	Smoke level	Evaluative	Maximum light absorption coefficient of 3.25 per meter or equivalent BOSCH No. 5.2 or 75 Hatridge value (As per CMVR)	3.25 (D)	0.94	Yes



1	2	3	4	5	6	7
17.1.2 Drawbar performance :						
a)	Max. drawbar pull with ballast corresponding to 15 percent wheel slip, (kN)	Non Evaluative	Minimum 65% of static mass with ballast	23.5 (D) 21.9 min.(R)	29.07	Yes
b)	Max. drawbar pull with standard ballast corresponding to 15 percent wheel slip, (kN)	Evaluative	Minimum 65% of static mass of tractor with standard ballast	16.0 (D) 13.2 min (R)	17.31	Yes
c)	Maximum drawbar power without ballast/with standard ballast, (kW).	Evaluative	Min. 80% of PTO power as referred in 17.1.1(a) of PTO performance	26.5 (D) 25.8 min (R)	27.75	Yes
d)	Maximum transmission oil temperature (°C)	Non Evaluative	The declared value should not exceed the maximum value specified by oil company	130 (D)	109	Yes
17.1.3 Power lift and hydraulic pump performance :						
a)	Maximum lifting capacity throughout the range of lift, (kN):					
1)	At hitch points	Non Evaluative	[Tolerance of minus 10%]	14.21 (D)	12.92	Yes
2)	With the standard frame	Evaluative	The lift capacity should at least be 18 kg/PTO hp. and it should be 16 kg/engine hp where the tractor is not provided with a PTO shaft	10.29 (D) 5.75 Minimum(R)	9.17	Yes
b)	Maximum drop in the height of the point of application of the force after each 5 minutes interval for a total duration of 30 minute, (mm)	Non Evaluative	[Tolerance of plus 5 mm]	NIL	NIL	Yes
17.1.4 Brake performance at 25 kmph:						
a)	Maximum stopping distance at a force, equal to or less than 600 N on brake pedal with road ballast, (m):					
1)	Cold brake	Evaluative	10	10 (R)	8.09	Yes
2)	Hot brake	Evaluative	10	10 (R)	8.11	Yes
b)	Maximum force exerted on the brake pedal to achieve a deceleration of 2.5 m/s ² (N)	Evaluative	600	600 (R)	324 to 363	Yes
c)	Whether parking brake is effective at a force of 600 N at foot pedal(s) or 400 N at hand lever	Evaluative	Yes / No	Yes (R)	Yes	Yes



1	2	3	4	5	6	7
17.1.5 Noise measurement :						
a)	Maximum ambient noise emitted by the tractor dB(A)	Evaluative	As per CMVR	88 (R)	86.0	Yes
b)	Maximum noise at operator's ear level dB(A)	Evaluative	As per CMVR	98 (R)	97.0	Yes
17.1.6 Amplitude of mechanical vibrations at :						
1)	Left foot rest	Non Evaluative	100 microns (max)	100 (R)	160	No
2)	Right foot rest			100 (R)	70	Yes
3)	Seat (with driver seated)			100 (R)	120	No
4)	Steering wheel			100 (R)	70	Yes
17.1.7 Haulage requirements :						
a)	Gross mass of the trailers, (tones):					
1)	Two wheel	Non Evaluative	--	5.50 (D)	5.5	Yes
2)	Four wheel	Evaluative	--	7.00 (D)	7.00	Yes
b)	Distance travelled / litre of fuel consumption, (km/l):					
1)	Two wheel	Non Evaluative	--	4.0 to 5.0 (D)	4.06 to 4.14	Yes
2)	Four wheel	Evaluative	--	4.0 to 5.0 (D)	3.76 to 3.83	Yes
c)	Fuel consumption (ml/km/tonne):					
1)	Two wheel	Non Evaluative	--	30 to 40 (D)	43.96 to 44.78	Yes
2)	Four wheel	Evaluative	--	30 to 40 (D)	37.35 to 38.00	Yes
17.1.8 Wetland cultivation :						
Sealing for the following assemblies:		Evaluative	The identified assemblies should essentially meet the requirement of IS: 11082. No water ingress in the identified assembly given in column-2. If tractor does not meet the requirements of wetland cultivation, it may be recommended for dry land operation only.	There should be no ingress of water and/or mud (R)	The manufacturer has recommended that the tractor is not suitable for wet land cultivation	NA
1)	Clutch assembly	-do-				
2)	Brake housings	-do-				
3)	Front axle hubs	-do-				
17.1.9 Safety features :						
a)	Guards against moving and hot parts	Evaluative	As per CMVR	At present no requirements	Provided	Yes
b)	Lighting arrangement	Evaluative	As per CMVR		Provided	Yes
17.1.10 Labelling of tractors (Provision of labelling plate):						
1)	Make	Evaluative	Should conform to the requirements of CMVR along-with declared value of PTO HP	--	Force Motors Ltd.	Yes
2)	Model	Evaluative		--	Balwan 550	Yes
3)	Year of manufacture	Evaluative		--	2011	Yes
4)	Engine number	Evaluative		--	D08008833	Yes
5)	Chassis number	Evaluative		--	T23000001L11	Yes
6)	Declaration of PTO power, (kW)	Evaluative		--	33.00	Yes



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17.1.11 Discard limit for:						
(a)	Cylinder bore diameter, (mm)	Evaluative	To be specified by the manufacturer	91.128	90.91 to 90.94	Yes
(b)	Clearance between piston & cylinder liner at skirt, (mm)	Evaluative		0.12	0.034 to 0.056	Yes
(c) Ring end gap (mm):						
	- Top comp. ring.	Evaluative	To be specified by the manufacturer	1.50	0.38 to 0.45	Yes
	- 2 nd comp. ring.			1.50	1.03 to 1.13	Yes
	- Oil ring.			1.50	0.38 to 0.50	Yes
(d) Ring groove clearance (mm):						
	- Top comp. ring.	Evaluative	-do-	0.20	0.082 to 0.105	Yes
	- 2 nd comp. ring.		-do-	0.15	0.034 to 0.068	Yes
	- Oil ring.		-do-	0.10	0.035 to 0.039	Yes
(e) Clearance of main bearings (mm):						
	- Diametrical clearance	Evaluative	-do-	0.24	0.048 to 0.084	Yes
	- Crankshaft end float	Evaluative	--do--	0.50	0.16	Yes
(f) Clearance of big end bearings, (mm):						
	- Diametrical	Evaluative	-do-	0.24	0.067 to 0.077	Yes
	- Axial	Evaluative	-do-	0.50	0.15 to 0.18	Yes
(g)	Clearance between king pin and bush, (mm)	Non Evaluative	-do-	1.5	0.044 to 0.068	Yes
(h)	Clearance between center pin and bush, (mm)	Non Evaluative	-do-	1.5	0.054 to 0.097	Yes

17.1.12 CATEGORY OF BREAKDOWNS / DEFECTS :

S. No.	Characteristic	Category (Evaluative / Non Evaluative)	Requirements as per IS: 12207-2008	As observed	Whether meets the requirements (Yes/No.)
1.	Critical	Evaluative	No critical breakdown	None	Yes
2.	Major	Evaluative	Not more than two and neither of them should be repetitive in nature	Mj7	Yes
3.	Minor	Evaluative	Not more than five and frequency of each should not be more than two.	None	Yes
4.	Total breakdowns	Evaluative	In no case, the total number of breakdowns should exceed five, that is, (2 major + 3 minor) or 5 minor breakdowns.	None	Yes



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17.2 Optional requirements as per Clause-4 (Table-2) of IS:122107-2008:				
S. No.	Characteristic	Requirements as per IS: 12207-2008	AS observed	Remarks
1	2	3	4	5
1	Air cleaner oil pull over, max. oil pull over (%)	0.25% (max.)	0.22	Yes
2.	Seating requirements	Should meet the requirements of IS: 12343-1998	Meet the requirement	Yes
3.	Fitment of ROPS	With a provision for fitment of ROPS.	Not provided	No
		If ROPS fitted it should meet the requirement of IS: 11821-1992	ROPS not provided	--
4.	Technical requirements for PTO shaft	Should meet the requirements of IS: 4931 -1995	Meet the requirement	Yes
5.	Dimensions of three point linkage	Should meet the requirements of IS: 4468 (Part-I)-1997	Meets the requirement	Yes
6.	Specifications of linkage drawbar	Should meet the requirements of IS: 12953-1990	Meets the requirement	Yes
	Specifications of swinging drawbar	Should meet the requirements of IS:12362 Part 3-1994.	Not provided	--
7.	Accessories	Trailer hitch, front tow hook, linkage drawbar may be provided.	Provided	Yes

17.3 Conformity with following IS:

- i) Guidelines for declaration of power and specific fuel consumption and labeling of agricultural tractors (First revision) [IS 10273:1987 (Reaffirmed in March, 2009)] : Conforms
- ii) Agricultural tractors – Rear mounted power take-off - Types 1, 2 and 3(third revision)[IS: 4931-1995 (Reaffirmed in March, 2009)] : Conforms
- iii) Agricultural wheeled tractors - Rear mounted three-point linkage: Part 1 Categories 1, 2, 3 & 4 (fourth revision) [IS 4468(Part-I):1997 (Reaffirmed in March, 2007)] : Conforms
- iv) Drawbar for agricultural tractors – Link type [IS 12953:1990 (Reaffirmed in March, 2007)] : Conforms
- v) Agricultural tractors - Operator's seat technical requirement (First revision) [IS 12343:1998 (Reaffirmed in March, 2009)] : Conforms
- vi) Guide for safety & comfort of operator of agricultural tractors: Part 1 General requirements (first revision) : [IS 12239(PT-1)-1996 (Reaffirmed in March, 2007)]/ISO 4254-1:1989] : Does not conform
- vii) Tractors and machinery for agriculture and forestry – Technical means for ensuring safety Part 2: Tractors (first revision) [(IS : 12239 (PT-2)-1999 (Reaffirmed in March, 2009)] : Does not conform
- viii) Tractors and machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays [IS: 6283 (Part-1)-2006 (Reaffirmed in March, 2009) and IS:6283 (Part-2)-2007 (Reaffirmed in March, 2009)] : Does not conform



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- ix) Guide lines for location and operation of operator controls on agricultural tractors and machinery (first revision) (IS: 8133 – 1983 (Reaffirmed in March, 2009)) : Conforms
- x) Agricultural Tractor & Machinery Lighting device for travel on public roads [(IS: 14683-1999 (Reaffirmed in March, 2009))] : Conforms
- 17.4 Salient Observations:**
- 17.4.1 Laboratory tests:**
- 17.4.1.1 PTO Performance:**
- The backup torque is **24.08%**.
 - The specific fuel consumption corresponding to maximum power was measured as **263g/kWh** against the declaration of **265 g/kWh**, which is within the tolerance limit as specified in the IS: 12207-2008.
 - The maximum equivalent crankshaft torque was recorded as **146.96 kN** against the declaration of **145 kN**, which meet the requirement of IS:12207-2008 in respect of tolerance. This should be looked into.
- 17.4.1.2 Drawbar performance**
During drawbar performance test, rear tyre creeping was observed as 40 & 120 mm for LHS and RHS tyres respectively which is on higher side and calls for necessary corrective action.
- 17.4.1.3 Hydraulic Performance:**
- The lifting capacity at standard frame was recorded as **9.17 kN** and the moment about the rear axle was computed as **13.11 kN-m**. The moment about rear axle is on higher side when compared to the moment about front axle i.e. **15.89 kN**. It is therefore, recommended that the lifting capacity of the hydraulic system may be reduced suitably or additional standard ballast mass at front axle may be provided to avoid front lifting of the tractor.
 - Total drop in height of lift during lift load maintenance test was recorded as **NIL** against the preferably maximum requirement of 50 mm.
- 17.4.1.4 Mechanical Vibration:**
The amplitude of mechanical vibration on various assemblies marked as (*) in Chapter-9 of this test report is on higher side, especially at the steering control wheel, foot rest and operator's seat. This calls for dampening down of vibrations to improve the operational comfort and service life of components.
- 17.4.1.5 Three point linkage:**
Some of the parameters of three point linkage conforms to Cat.I and some of them conforms to Cat.II. Keeping in view the spirit of standardization, necessary improvement may be incorporated.
- 17.4.1.6 Specifications of PTO Shaft:**
Dimension "D Φ " and "d Φ " (Refer Fig. 2) of PTO shaft meet the requirement of IS:4931:1995.
- 17.4.1.7 Operator's Seat:**
- Instead of longitudinal adjustment on operator's seat, two positions at a distance of ± 60 mm has been provided for the seat. This meets the minimum and optimum requirements of ± 25 mm and ± 100 mm respectively. In view of the enhancing comfort level of operator, this may be looked into for increasing.



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- 17.4.1.8 Symbols of operator's control and other displays:**
The power take-off shaft engaged position, starting switch, are identifiable & oil lubricant type & frequency is not identifiable with the symbols as per IS: 6283 (Part-1&2)-1998. This needs to be looked into.
- 17.4.1.9 Location and operation of operator's control:**
Operator's control meet the requirements of IS: 8133-1983.
- 17.4.2 Field performance:**
- 17.4.2.1 Dry land operation:**
The average area covered in disc plough . ploughing operation with recommended size of plough was recorded in the range of **0.244 to 0.254 ha/h**. Keeping in view the PTO power of the tractor, the area coverage is considered less, hence the recommended size of the plough may be reviewed.
- 17.4.2.2 Wetland operation (Puddling operation):**
The manufacturer has recommended that the tractor is not suitable for wetland cultivation (puddling operation). Hence, the wetland cultivation (puddling operation) was not conducted. **Therefore, the declaration of the fact that the tractor is not suitable for Wetland cultivation (Puddling operation) should be mentioned clearly and boldly in all the literature relevant to this tractor model.**
- 17.4.2.3 Haulage test:**
- The distance travelled per litre of fuel consumption with four wheel trailer & two wheel trailer was observed as 3.76 to 3.83 km/l & 4.06 to 4.136 against the declaration 4.0 to 5.0 km/l & 4.0 to 5.0 respectively . This meet the requirement of IS: 12207-2008.
 - The fuel consumption with four wheel trailer & two wheel trailer were observed as 37.35 to 38.0 & 43.96 to 44.78 ml/km/tonne against the declaration 30 to 40 & 30 to 40 respectively ml/km/tonne. This meets the requirement of IS: 12207-2008.
- 17.4.3 Wear assessment and final inspection:**
During wear assessment and final inspection, small scratches wear found on king pin bush and Small scratches and chipped off at edge of one fixed spur gear teeth within 89.53 hours of tractor run. This should be looked into for necessary corrective action.
- 17.5 Maintenance / Service problems:**
No noticeable maintenance and service problems was observed during the test.
- 17.6 Recommendation with regard to safety on tractor:**
The following requirements, inter alia, may be considered for incorporation on the tractor:
- Provision for spark arresting device in exhaust system.
 - The minimum cautionary notice as per clause 11.2 of IS: 12239 (Part-2)-1999 has not been provided.
- 17.7 Adequacy of Literature supplied with machine:**
- 17.7.1** The following literature was supplied with the tractor for reference during the test.
- Operation and maintenance owner's manual for Balwan 550
 - Workshop manual
 - Spare Parts Catalogue for Balwan 550
- 17.7.2** The revised literature supplied was found adequate. However, the following points needs to be incorporated in owners/operator's manual.
- Details of all variants along with their features at a glance should be provided in the operator's manual.



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ii) The specification details as max .power, specific fuel consumption, drawbar pull and power, hydraulic power, haulage requirement and its performance, recommendation of ballasting for various operation, preparation and maintenance of tractor for wet land cultivation should be update in owner's manual in secured binding form.

17.7.3 iii) The hydraulic external circuit lever details should be provided in owner's manual. These literatures may also be brought out in National & other regional languages for guidance of user's.

18. CITIZEN CHARTER

Time frame for Testing & Evaluation as per Citizen Charter	Duration of Test	Whether the Test Report is released within the time frame given in Citizen Charter	Remarks
10 Months	6 Months (August, 2012 to January, 2013)	Yes	None

TESTING AUTHORITY:H. L. YADAV
SENIOR AGRICULTURAL ENGINEERC.R. LOHI
DIRECTORTest Report compiled by: **Shri. Pratyush Satya**, Senior Technical Assistant.**19. Applicant's Comments**

Para No.	Our Reference	Applicant's comments
19.1	1.14.5	Care will be taken in series production.
19.2	17.3	Safety of operators and others is taken care in Tractor design.
19.3	17.4.2.3	We will investigate to identify the root cause.



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FORCE MOTORS LIMITED ,
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S. No.	Item	Disc Plough	Rotavator
1.	Make	M & M	Green field
2.	Type	Mounted	Mounted
3.	No. of bottoms/blades	Three	36
4.	Type of bottoms/blades	Plane concave	Hatchet
5.	Size of bottoms/blades, (mm)	610	170 x 55 x 6
6.	Spacing of bottoms/flanges, (mm)	520	255
7.	Lower hitch point span, (mm)	855	870
8.	Mast height, (mm)	440	540
9.	Overall dimensions, (mm):		
	- Length	1890	1905
	- Width	1080	1180
	- Height	1070	1120
10.	Gross mass, (kg)	365	480

ANNEXURE - II**TRACTOR RUN HOURS DURING TEST**

A.	LABORATORY AND TRACK TESTS:	HOURS
1.	Running-in	--
2.	PTO performance test	12.83
3.	Power lift and hydraulic pump performance test	1.83
4.	Drawbar performance test	14.6
5.	Turning ability	0.5
6.	Location of centre of gravity	0.2
7.	Operator's field of vision	0.0
8.	Brake test	2.0
9.	Noise measurement	1.00
10.	Air cleaner oil pull over test	4.5
11.	Mechanical vibration test	1.0
12.	Theoretical speed test	0.57
B.	FIELD TEST:	
1.	Mould board ploughing	16.23
2.	Rotavation	19.27
3.	Puddling (including five hours water proof test)	0.00
C.	HAULAGE TEST:	9.92
D.	Miscellaneous test and other run hours including idle run, transportation, trials and preparation for test	5.08
	TOTAL:	89.53