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व्यावसायिक परीक्षण रिपोर्ट
COMMERCIAL TEST REPORT (Supplementary)

संख्या / No. : T-1114/1640/2017
माह / Month : November, 2017



SWARAJ 744 FE TRACTOR



सत्यमेव जयते

भारत सरकार

कृषि एवं किसान कल्याण मंत्रालय
(कृषि, सहकारिता एवं किसान कल्याण विभाग)

GOVERNMENT OF INDIA

MINISTRY OF AGRICULTURE AND FARMERS WELFARE

(DEPARTMENT OF AGRICULTURE, CO-OPERATION AND FARMERS WELFARE)

केन्द्रीय कृषि मशीनरी प्रशिक्षण एवं परीक्षण संस्थान

ट्रैक्टर नगर, बुदनी (म.प्र.) ४६६ ४४५

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Farm Equipment Sector, Swaraj Division
Phase- IV, Industrial Area, S.A.S. Nagar,
Mohali, Punjab – 160 055

Month: November	Test Report No. T- 1114/1640/2017	Year : 2017
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Type of Test	: COMMERCIAL (Supplementary)
Test code/Procedure	: IS: 5994-1998 (Reaffirmed in March 2009), and IS: 12207-2014
Period of Test	: December, 2016 to October, 2017
Test Report No.	: T- 1114/1640/2017
Month/Year	: November, 2017

- i) The results reported in this report are observed values and no corrections have been applied for atmospheric and site conditions.
- ii) The data given in this report pertain to the particular machine submitted by the applicant for test.
- iii) The results presented in this report do not in any way attribute to the durability of the machine.
- iv) This report should not be reproduced in part or full without prior permission of the Director, Central Farm Machinery Training and Testing Institute, Budni (M.P.).
- v) This is a supplementary test report and, should be read in conjunction with the Test Report of base model i.e. "Swaraj 744 FE Tractor" bearing No. T- 401/821 released on July, 2000.

SELECTED CONVERSIONS			ABBREVIATIONS	
Sl. No	Units	Conversion Factor		
1	Force:		apa	As per applicant
	1 kgf	9.80665 N	TDC	Top Dead Centre
		2.20462 lbf	IS	Indian Standard
2	Power:		LHS	Left Hand Side/
	1 hp	1.01387 metric hp (Ps)	/RHS	Right Hand Side
		745.7 W	Hg	Mercury
	1 Ps	735.5 W	Temp.	Temperature
	1 kW	1.35962 Ps	N.R.	Not recorded
3	Pressure:		rpm	Revolutions per minute
	1 psi	6.895 kPa	O.D./I.D	Outer diameter/ Inner diameter
	1 kgf/cm ²	98.067 kPa = 735.56 mm of Hg	N.A.	Not available/Not applicable
	1 bar	100 kPa = 10 N/cm ²	PTO	Power take-off
	1 mm of Hg	1.3332 m-bar	R.H.	Relative Humidity
		SIP	Seat Index Point	

**CONTENTS**

	<u>PAGE</u>
1. Scope of Test	05
2. Fuel & Lubricants	08
3. Essential Test	08
3.1 Specifications	08
3.2 Nominal Speed	22
3.3 PTO Performance Test	22
4. Other Applicable Tests	27
4.1 Brake Test	27
4.2 Turning Ability Test	27
5. Adjustments, Defects And Breakdowns	27
6. Summary of Observations, Comments & Recommendations	27
7. Citizen Charter	31
8. Applicant's Comments	31
Annexure -I	32



1. SCOPE OF TEST

The "Swaraj 744 FE" tractor had undergone "Initial Commercial Test" at this institute vide test report No. T-401/821 was released in July, 2000. The firm has made the following changes in the technical specifications of tractor and had requested vide letter No. 20/1607081, dated: 30.07.2016, for Supplementary testing of "Swaraj 744 FE" tractor.

The applicant informed that the last chassis cut off number of tractor model "Swaraj 744 FE" and engine model number "RB 30 TR" generated on production line is WWCK40605045383 and 43.1024/SPK11500 respectively.

The major features of Base model and Supplementary model are listed below :-

S. No.	Parameters	Previous Sample (T-401/821 July, 2000)	Present Sample
1	2	3	4
1.	Tractor:		
	Make	Swaraj	Swaraj
	Model	744 FE	744 FE
	Declared maximum PTO power, kW	29.4	30.1
2.	Engine:		
	-Make	Kirloskar	M/s Swaraj Egnines Ltd.
	-Model	RB30TR	RB30TR
	- Maximum speed at no load, rpm	2100 - 2160	2100 to 2200
	- Low idle speed, rpm	650 ± 50	580 to 700
	- Speed at maximum torque, rpm	1400 ± 150	1200 to 1600
3.	Cylinder & cylinder head:		
	Compression ratio, (apa)	17 : 1	18.5 (± 0.5) : 1
	Type of combustion chamber	Open on piston crown	Cavity toroidal on piston crown
4.	Valve clearance (cold):		
	- Inlet valve, (mm)	0.25	0.25 – 0.30
	- Exhaust valve, (mm)	0.35	0.30 – 0.35
5.	Fuel feed pump:		
	Make	MICO, LIC BOSCH	Bosch, India
	Model/Group combination No.	9440 030 029	FP/KSG 22AD106 (apa)
6.	Fuel Injection pump:		
	Make	MICO, LIC BOSCH	Bosch, India
	Model/Group combination No.	9400 030 694, PES3A90D320RS2888	F 002 A0Z 469, PES3A90D320RS2000
7.	Fuel injectors:		
	Make	MICO, LIC BOSCH	Bosch, India
	Model/Group combination No.	9430 031 261	--
	Nozzle no.	--	F002 C70 552
	Holder no.	--	DSL A 154 P 1542
	Manufacturer's production pressure setting, (MPa)	20.59 ± 0.98	25.0 ± 0.8
	Injection timing	24 ± 1 degree BTDC	13 ± 1 degree before TDC
8.	Governor:		
	Make	MICO, LIC BOSCH	Bosch, India
	Model/Group combination No.	RSV325...1000A1C835 R	RSV 375...1000A1C1377R
	Rated engine speed, (rpm)	2000	2000
	Governed range of engine speed (rpm)	600 to 2160	580 to 2200



1	2	3	4
9.	Exhaust System:		
	Position of silencer outlet with respect to SIP, (mm):		
	- Vertical	915	900
	- Longitudinal	1730	1450
	- Lateral	460 (on LHS)	520 (on RHS)
	Provision against entry of rain water.	Rain cap is provided	A bent is provided at the top of silencer
10.	Lubricating system:		
	Pressure release setting of relief valve of lubricating oil pump, (kPa)	490 ± 49	550 ± 50
	Minimum permissible pressure, (kPa)	177	49
11.	Battery:		
	Make & Model	Exide	Exide Express & MHD1000
	Capacity and rating	12V, 88 Ah at 20 hours	12V, 100 Ah at 20 hours discharge rate
	Location	On bracket at rear of operator's seat	On RHS of clutch housing in separate metallic box.
12.	Model of self starter	2 SM 114	SM 114
13.	Generator:		
	Model	A115-36	A115
	Method of drive	Driven by a V-belt (common to fan) from crankshaft pulley	Through crankshaft pulley by a cogged "V" belt
14.	Voltage regulator:	Not available	In built with alternator
15.	Clutch:		
	Make	Swaraj (apa)	Luk. India
	Type	Dry friction disc	Dual, dry friction plates
	No. of friction plate, (s)	One	Two
	Size, (mm):		
	-Transmission	308	279.63 / 165.70 Ø
	-PTO	Not applicable	279.49 / 165.59 Ø
	Method of operation :		
	-Transmission	By depressing clutch pedal fully provided on LHS of operator's seat	By depressing clutch pedal halfway provided on LHS of operator's seat
	-PTO	Not applicable	By depressing clutch pedal fully provided on LHS of operator's seat
16.	Gear box:		
	Type	Mechanical, combination with constant & sliding mesh gears	Mechanical, combination with sliding mesh gears and epicyclic high - low range selection unit
17.	Differential unit:		
	Type	Crown wheel and bevel pinion, with differential unit accommodated inside the differential housing.	
	Reduction through crown wheel and bevel pinion	NA	3.231:1 (42/13 T)
18.	Power take-off shaft:		
	Type	Type-I, Dependent	Type-I, Semi independent
	PTO speed corresponding to rated engine speed, (rpm):	976	653
	Engine to PTO speed ratio	2.049 : 1	3.0625 : 1



1	2	3	4
19	Towing hitch:		
	Front	Not provided	Provided
	Rear, Height above ground level, (mm)		
	- Maximum	760	815
	- Minimum	595	570
20	Steering system:		
	Make	ZF	Danfoss
	Type	Worm & roller, single drop arm	Hydrostatic (power steering)
21	Service Brake:		
	Type	Mechanical, dry dual disc.	Mechanical, multidisc oil immersed
	No. of disc(s)	Two (on each side)	Four (on each wheel side)
	Area of liners, (cm ²)	721.3 (on each side)	913 (on each wheel side)
	Material of liners	Asbestos	Paper based
22	Wheel Equipment:		
a)	Steering Wheel (s):		
	Track width, (mm)	1200, 1300 (std.), 1400, 1450, 1500, 1550, 1650 & 1750	1230, 1330 (std.), 1440 & 1530
b)	Drive wheel (s):		
	Size	13.6-28	14.9 - 28
	Maximum permissible loading capacity of each tyre, (kgf)	1100 at 103 kPa	2120 at 230 kPa
	Recommended inflation pressure, (kPa):		
	- For field work	93.2	98
	- For transport	103.0	108
	Track width, (mm)	1360 (std.), 1440, 1540, 1600, 1700, 1760 & 1890	1430, 1420 (std.), 1460, 1540, 1620, 1700, 1740 & 1820
23	Wheel base, (mm)	1955	2100
24	Number of external lubricating points:		
	- Grease cups	Nil	02
	- Grease nipples	22	19
25	Colour of tractor:		
	Chassis & engine	Smoke grey	Smoke grey
	Sheet metal:		
	Mudguard	Pale Cream	Cream yellow
	Bonnet	Feroza blue	Blue
	Rim & disc	--	Cream yellow
26	Nominal speeds		
	-Forward	3.29 to 30.95	2.80 to 30.89 (variation of - 0.19 to - 17.53 %)
	-Reverse	4.6 to 15.11	3.31 to 11.45 (variation of - 24.22 to - 28.04 %)
27	No. of engine revolutions for one revolution of driving wheel:		
	- Forward	15.6 to 147.1	15.62 to 172.61 (variation of 0.13 to 20.77 %)
	- Reverse	32.0 to 105.1	42.14 to 145.53 (variation of 31.69 to 38.47 %)
28	Capacity of liquids, (l):		
	Total lubrication capacity	8.20	7.2
	Total cooling capacity	10.5	7.70
	Transmission oil capacity	47.0	50.0
	Steering oil capacity	0.7	1.50



Subsequent to the examination of the case in the light of clause 3.2.4 & 6.0 of Indian Standard 12207: 2014, the following tests were considered to be carried out :

- Specifications checking
- Nominal speed test
- PTO performance test under natural and high ambient condition
- Brake test
- Turning ability test

Manufacturer	: M/s. Mahindra & Mahindra Ltd. Farm Equipment Sector, Swaraj Division Phase- IV, Industrial Area, S.A.S. Nagar, Mohali, Punjab – 160 055
Test requested by	: The manufacturer
Selected for test by	: Testing authority
Place of running-in	: At manufacturer's place
Duration of said running-in (h):	
- Engine	: 28
- Transmission	: 32
Method of Selection	: The test sample was selected randomly out of seven tractors from the production line by the representative of testing authority.

2. FUEL AND LUBRICANTS

2.1 Fuel : The High-speed diesel oil supplied by M/s Indian Oil Corporation Limited having density of 0.836 g/cc at 15°C was used.

2.2 Lubricants:

S. No.	Particulars	As recommended by the manufacturer	As used during the test
1.	Engine & air cleaner oil	SAE 30	As recommended
2.	Transmission, Steering housing, Hydraulic and brake system	ELF 2371	Oil originally filled in the tractor systems were not changed
3.	Grease	MP Grease	MP Grease

3. ESSENTIAL TESTS

3.1. SPECIFICATIONS

	<u>Previous sample</u>	<u>Present sample</u>
3.1.1 Tractor:		
Make	: Swaraj (apa)	Swaraj
Model	:	744 FE
Brand name	: None	Swaraj
Type	: Four wheel, Two wheel driven, Unit construction, General purpose, Agricultural Tractor	
Year of manufacture	: 1999	WY (i.e. 2016)
Chassis Serial number	: 98 GI 56000001	WYCN45922957873
Country of Origin	:	India
3.1.2 Engine:		
Make	: Kirloskar	M/s Swaraj Egrines Ltd.
Model	:	RB 30 TR
Type	: Four stroke, water cooled, direct injection, diesel engine	
Serial number	: 43.1001/F 9900006	43.3009/SWN25221



	Previous sample	Present sample
Engine speed (Manufacturer's recommended production setting)(rpm) :		
- Maximum speed at no load	: 2100 - 2160	2100 to 2200
- Low idle speed	: 650 ± 50	580 to 700
- Speed at maximum torque	: 1400 ± 150	1200 to 1600
Rated speed, (rpm):		
- For PTO use	:	2000
- For drawbar use	:	2000
3.1.3 Cylinder & Cylinder Head:		
Number	:	Three
Disposition	:	Vertical, inline
Bore/stroke, (mm)	:	110 / 110
Capacity as specified by the applicant, (cc)	:	3136 (apa)
Compression ratio, (apa)	: 17 : 1	18.5 (± 0.5) : 1
Type of cylinder head	:	Individual
Type of cylinder liners	: Wet	Wet replaceable
Type of combustion chamber	: Open on piston crown	Cavity torroidal on piston crown
Arrangement of valves	:	Overhead
Valve clearance (cold):		
- Inlet valve, (mm)	: 0.25	0.25 - 0.30
- Exhaust valve, (mm)	: 0.35	0.30 - 0.35
3.1.4 Fuel System:		
Type of fuel feed system	:	Gravity and forced feed
3.1.4.1 Fuel tank:		
Capacity, (l)	: 50.2	50.0
Location	:	Above clutch housing
Provision for draining of sediments/ water	: Water provided	separator Not Provided
Material of fuel tank	: Not applicable	Metallic
3.1.4.2 Water separator	: Provided	Provided
Make	: -	Alert
Type	: -	Transparent, gravity separation, inverted funnel
Location	: -	Between fuel tank and primary fuel filter
Capacity(l)	: -	0.50
3.1.4.3 Fuel feed pump:		
Make	: MICO, LIC BOSCH	Bosch, India
Type	: Plunger	Plunger
Model/Group combination No.	: 9440 030 029	FP/KS224AD62 (apa), 9440030029 (apa)
Provision of sediment bowl	: Provided	Provided (metallic)
Method of drive	:	Through FIP of camshaft
3.1.4.4 Fuel filters:		
Make	: MICO, LIC BOSCH	Bosch, India
Model/Group combination No.	: 9450 030 100	F 002 H20 105
Number	: Two	Two
Type of elements:		
-Primary	: Cloth	Cloth
-Secondary	: Paper	Paper
Capacity of final stage filter, (l)	: 0.45	0.43



	Previous sample	Present sample
3.1.4.5 Fuel Injection pump:		
Make	: MICO, LIC BOSCH	Bosch, India
Model/Group combination No.	: 9400 030 694, PES3A90D320RS2888	F 002 A0Z 469, PES3A90D320RS2000
Type	: Plunger, Inline	Plunger, Inline
Serial number	: 96548011	65876487
Method of drive	:	Through timing gears
3.1.4.6 Fuel injectors:		
Make	: MICO, LIC BOSCH	Bosch, India
Model/Group combination No.:	9430 031 261	-
Nozzle no.	: --	F002 C70 552
Holder no.	: --	DSLA 154 P 1542
Type	: Multi hole	Multi hole (four holes)
Manufacturer's production pressure setting, (MPa)	: 20.59 ± 0.98	25.0 + 0.8
Injection timing	: 24 ± 1 degree BTDC	13 ± 1 degree before TDC
Firing order	: 1 - 2 - 3	1 - 2 - 3
3.1.4.7 Governor:		
Make	: MICO, LIC BOSCH	Bosch, India
Model/Group combination No.	: RSV325...1000A1C835 R	RSV 375...1000A1C1377R
Type	:	Mechanical, centrifugal, variable speed
Rated engine speed, (rpm)	: 2000	2000
Governed range of engine speed (rpm)	: 600 to 2160	580 to 2200
3.1.5 Air Intake system:		
3.1.5.1 Pre-cleaner	:	
Make	: Swaraj (apa)	Swaraj
Type	:	Cyclone with transparent dust collector
Location	: Integral with air cleaner outside the bonnet.	On the top of main air cleaner
3.1.5.2 Air cleaner:		
Make	:	Swaraj (apa)
Type	:	Oil bath
Location	:	On LHS of engine, outside the bonnet
Range of suction pressure at maximum power, (kPa)	: 1.6 to 3.6	3.0
Capacity of oil bath	: 0.80	0.70
Oil change period	: After 8 to 16 hours in dusty condition and 60 hours of operation in normal condition.	After 8 to 16 hours in dusty condition and 50 hours of operation in normal condition.
3.1.6 Exhaust System:		
Type of silencer	: Updraft, cylindrical	Updraft, cylindrical
Position of silencer outlet with respect to SIP, (mm):		
- Vertical	: 915	900
- Longitudinal	: 1730	1450
- Lateral	: 460 (on LHS)	520 (on RHS)
Range of exhaust gas pressure at maximum power, (kPa)	: 2.4 to 6.0	4.9 to 6.5
Provision of spark arrestor	:	None
Provision against entry of rain water.	Rain cap is provided	A bent is provided at the top of silencer



3.1.7 Lubricating system:		Previous sample	Present sample
Type	:	Force feed and splash	
Oil sump capacity, (l)	:	7.60	6.50
Total lub oil capacity, (l)	:	8.20	7.2
Oil change period	:	After every 250 h of operation.	First change after 50 hours and subsequently after every 250 hours of operation
Cooling device, (if any)	:	Provided	
Details of oil cooler:			
Make	:	Posh	Not available
Model	:	3H 007 03 0 00	Not available
Type	:	Circular plate type heat exchanger	Three circular plate type heat exchanger
No. of plates & diameter,	:	3 & 92.0 mm	03 & 93.0 mm
Location	:	On LHS of engine block	On LHS of cylinder's block into the water jacket
Filters:			
Make	:	Not applicable	Not available
Type	:	Full flow, Spin-on throw away, paper element	
Number	:		One
Pump:			
Type	:		Gear
Method of drive	:		Through timing gears
Pressure release setting, (kPa)	:	490 ± 49 (apa)	550 ± 50 (apa)
Minimum permissible pressure, (kPa)	:	177 (apa)	49 (apa)
3.1.8 Cooling system:			
Type	:	Forced water circulation	
Coolant as recommended	:	Not available	Not applicable
Details of pump	:	Centrifugal with semi open impeller having six vanes of 78.8 mm diameter and driven through crankshaft pulley by a 'V'-belt common to alternator.	Centrifugal with semi open impeller having six vanes of 78.9 mm diameter and driven through crankshaft pulley by a cogged 'V'-belt.
Details of fan	:	Suction type having six plastic blades and 388 mm diameter	Suction type having polypropylene blades and 374 mm diameter, and mounted on water pump shaft.
Means of temperature control	:		Thermostat
Bare radiator capacity, (l)	:	6.4	2.7
Capacity of expansion flask, (l)	:	Not available	0.9
Total coolant capacity, (l)	:	10.5	7.70
Radiator cap pressure, (kPa)	:	88	88
3.1.9 Starting System:			
Type	:	12V, DC, Electrical	
Aid for cold starting	:	None	
Any other device provided for easy starting.	:	None	



		<u>Previous sample</u>	<u>Present sample</u>
3.1.10 Electrical System:			
3.1.10.1 Battery:			
Make & Model	: Exide	Exide Express & MHD1000	
Type	:	Lead acid	
Capacity and rating	: 12V, 88 Ah at 20 hours	12V, 100 Ah at 20 hours discharge rate	
Location	: On bracket at rear of operator's seat	On RHS of clutch housing in separate metallic box.	
3.1.10.2 Starter:			
Make	: Lucas - TVS	Lucas - TVS (apa)	
Model	: 2 SM 114	SM 114	
Type	:	Pre-engaging, solenoid operated	
Capacity and rating	: 12V, 1.9 kW	12V, 1.9 kW	
Serial Number	: 26925812A	Not available	
3.1.10.3 Generator:			
Make	:	Lucas - TVS	
Model	: A115-36	A115	
Type	:	Alternator	
Serial number	: 26921247A 53-98	Not available	
Output rating	:	12V, 36 A	
Method of drive	: Driven by a V-belt (common to fan) from crankshaft pully	Through crankshaft pulley by a cogged "V" belt	
3.1.10.4 Voltage regulator	: Not available	In built with alternator	
3.1.10.5 Details of lights:			

Description	No. & capacity of bulb	Height of the centre of beam above ground level, (mm)	Size, (mm)	Distance between centre of the beam and outside edge of tractor at standard rear track setting, (mm)
1	2	3	4	5
Previous Model:				
Front Lights:				
- Head lights	2, 12V, 35/35W	1205	135 x 105	740
- Parking lights	2, 12V, 5W	1270	55 x 50	123
- Side Indicators	2, 12V, 21W	1270	55 x 55	178
Reflectors	2	1270	55 x 25	85
Rear lights:				
- Tail-cum-brake light	2, 12V, 21/5W	1275	55 x 50	123
- Side Indicators	2, 12V, 21W	1275	55 x 55	178
- Plough light (on RHS mudguard)	1, 12V, 35W	1470	130 Φ	113
- Reflectors (with tail light)	2	1275	55 x 25	85
- Registration plate light (RHS)	Window is provided in RHS rear light to illuminated registration plate.			
Present Model:				
Front Lights:				
- Head lights	2, 12V, 35/35W	1240	130 x 100	775
- Parking lights	2, 12V, 5W	1310	65 x 65	190
- Turn cum hazard light	2, 12V, 21W	1310	70 x 65	125
Reflectors (white)	2	1310	30 x 55	230



1	2	3	4	5
Rear lights:				
- Tail-cum-brake light	2, 12V, 21/5W	1330	65 x 65	240
- Turn cum hazard light	2, 12V, 21W	1330	70 x 65	170
- Plough light (on RHS mudguard)	1, 12V, 35W	1485	125 Φ	200
- Reflectors (Red)	2	1330	30 x 55	280
- Registration plate light (RHS)	Part of rear light assembly			

3.1.11 Instrument panel details:-

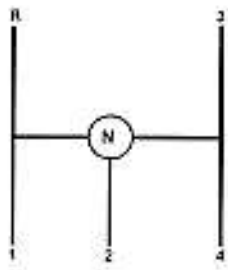
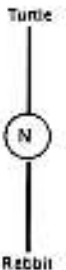
	<u>Previous sample</u>	<u>Present sample</u>
i) Engine speed cum hour meter (with indicator pilot lamp) (with colour zones)	Provided	--
ii) Engine speed cum cumulative run hour meter (4 to 24) x 100 rpm	--	Provided
iii) Water temperature gauge (with colour zones)	Provided	Provided
iv) Fuel level gauge (with colour zones)	Provided	Provided
v) Engine oil pressure gauge (with colour zones)	Provided	Provided
vi) Starting switch (key-turn type)	Provided	Provided
vii) Light switch (Rotary type)	Provided	Provided
viii) Hazard warning switch (toggle type)	Provided	--
ix) Turn cum hazard indicator	--	Provided
x) Turn indicator switch	--	Provided
xi) Hazard light switch	--	Provided
xii) Head lamp (long beam)- 'ON' indicator light	--	Provided
xiii) Side indicator switch (toggle type)	Provided	--
xiv) Ampere meter (with colour zones)	Provided	Provided
xv) Fuel shut-off knob	Provided	Provided
xvi) Horn push button	Provided	Provided
xvii) Fuse box	Provided	--
xviii) Hand accelerator lever	Provided	Provided
xix) Steering control wheel	Provided	Provided
xx) Rear View mirror	Provided	Provided
xxi) Turn pilot lamps provided inside the hour meter for LHS and RHS	Provided	--
xxii) High low lever neutral indicator	Not provided	Provided
xxiii) Trailer engage indicator	Not provided	Provided

3.1.12 Transmission System

3.1.12.1 Clutch:

	<u>Previous sample</u>	<u>Present sample</u>
Make	: Swaraj (apa)	Luk, India
Type	: Dry friction disc	Dual, dry friction plates
No. of friction plate, (s)	: One	Two
Size, (mm):		
-Transmission	: 308	279.63 / 165.70 Ø
-PTO	: Not applicable	279.49 / 165.59 Ø
Method of operation :		
-Transmission	: By depressing clutch pedal fully provided on LHS of operator's seat	By depressing clutch pedal halfway provided on LHS of operator's seat
-PTO	: Not applicable	By depressing clutch pedal fully provided on LHS of operator's seat



	<u>Previous sample</u>	<u>Present sample</u>
3.1.12.2 Gear box:		
Make	: Swaraj (apa)	Swaraj
Type	: Mechanical, combination with constant & sliding mesh gears	Mechanical, combination with sliding mesh gears and epicyclic high - low range selection unit
3.1.12.3 No. of speeds:		
- Forward	: 08	08
- Reverse	: 02	02
Location of gear shifting levers (in <u>Present sample</u>)	: --	In front of operator's seat
Gear shifting pattern (in <u>Present sample</u>)	: 	
	<u>Gear selection lever</u>	<u>Range selection lever</u>
Oil capacity, (l)	: 47.0 (common to differential and hydraulic housing)	50.0 (common with differential, rear axle, hydraulic and brake system)
Oil changing period	: After 1600 hours of operation.	
3.1.12.4 Differential unit:		
Type	: Crown wheel and bevel pinion, with differential unit accommodated inside the differential housing.	
Reduction through crown wheel and bevel pinion	: --	3.231:1 (42/13 T)
Oil capacity, (l)	: --	50.0 (common with gearbox, rear axle, hydraulic and brake system)
Oil changing period	: After every 1600 hours of operation	
Differential lock:	: Not Provided	
3.1.12.5 Rear axle & final drive:		
Type	: Spur gear type reduction units inside differential housing	Bull gear and pinion reduction unit accommodated inside the differential housing
Reduction through final drive	: 4.833:1	4.833:1 (58/12T)
Oil capacity of final drive, (l)	47.0 (common to hydraulic and transmission system)	50.0 (common with gearbox, differential, hydraulic and brake system)
Oil changing period	: After every 1600 hours of operation	



3.1.13 Power lift (hydraulic system):	Previous sample	Present sample
Make	: Swaraj (apa)	Swaraj
Type	: Live, ADDC	Open centre, live, ADDC
No. and type of cylinder	:	One, single acting
Type of linkage lock for transport	: Hydraulic response control knob provided in front of operator's seat	A isolating knob is provided on distributor, when fully tighten acts as transport lock
3.1.13.1 Hydraulic pump:		
- Make	: MICO, LIC-BOSCH	Rexroth
- Type	:	Gear
- Location & drive	:	On RHS of engine, through timing gears.
No. & type of filters	: One & fine wire mesh at suction	One, spin on through away
Hydraulic oil capacity, (l)	: 47.0 (common to transmission housing)	50.0 (common with transmission and brake system)
Oil change period	:	After every 1600 hours of operation.
Provision for external tapping	: Provided on response control valve housing	A isolating knob is provided on distributor
Details of control levers	i) Position control lever (Black knob) ii) Draft control lever (Red knob) iii) Response control knob	Position control lever (black). Draft control lever (Red). Isolation valve knob on distributor
Method of draft sensing	:	Through top link

3.1.13.2 Three point linkage:

S. No	Observations	As per IS: 4468- (Part-1) -1997, (Cat.I / Cat.II), (mm)	As measured (mm)		Remarks in case of Present sample
			Previous sample	Present sample	
I.	Upper hitch points:				
a)	Dia of hitch pin hole	19.30 to 19.50 / 25.70 to 25.90	25.81	25.9	Conforms to Cat. II
b)	Width of ball	44.0 (max.) / 51.0 (max.)	50.72	51.0	Conforms to Cat. II
II.	Lower hitch points:				
a)	Dia of hitch pin hole	22.40 to 22.65 / 28.70 to 29.00	28.7	29.0	Conforms to Cat. II
b)	Width of ball	34.8 to 35.0 / 44.8 to 45.0	44.93	44.9	Conforms to Cat. II
III.	Lateral distance from lower hitch point to centre line of tractor.	359 / 435	364	359	Conforms to Cat. I
IV.	Lateral movement of lower hitch points	100 (min) / 125 (min)	140	260	Conforms to Cat. I & II
V.	Distance from end of power take-off to centre of lower hitch point (lower links in horizontal position)	450 to 575 / 550 to 625	520	530	Conforms to Cat. I
VI.	Transport height	820 (min) / 950 (min)	820	985	Conforms to Cat. I & II
VII.	Power range (without force)	560(min) / 650 (min)	655	650	Conforms to Cat. I & II
VIII.	Leveling adjustment	100 (min) / 100 (min)	239	320	Conforms to Cat. I & II
IX.	Lower hitch point clearance	100 (min) / 100 (min)	220	200	Conforms to Cat. I & II
X.	Lower hitch point height	200 (max) / 200 (max)	165	200	Conforms to Cat. I & II



3.1.13.3 Drawbar:

3.1.13.3.1 Linkage Drawbar [Refer Fig.1] :

Notation	As per IS: 12953-1990, (Cat.I), (mm)	As measured, (mm)		Remarks in case of <u>Present model</u>
		<u>Previous sample</u>	<u>Present sample</u>	
A	683 ± 1.5/825 ± 1.5	683	684	Conforms to Cat. I
B	75 (min)/75 (min)	75	75	Conforms to Cat. I & II
C	30 (min) / 30 (min)	30	30	Conforms to Cat. I & II
D \varnothing	21.79 to 22.0/27.79 to 28.0	27.85	27.96	Conforms to Cat. II
E	39.0 (min)/49.0 (min)	62.25	54	Conforms to Cat. I & II
F \varnothing	12.0 (min)/12.0 (min)	12.3	12.1	Conforms to Cat. I & II
G	15.0 (min)/15.0 (min)	21.60	16.2	Conforms to Cat. I & II
H \varnothing	25 ± 1/25 ± 1	25.06	24.84	Conforms to Cat. I & II
J	80 ± 1.5/80 ± 1.5	81.5	80	Conforms to Cat. I & II
No. of holes	7/9	07	07	Conforms to Cat. I

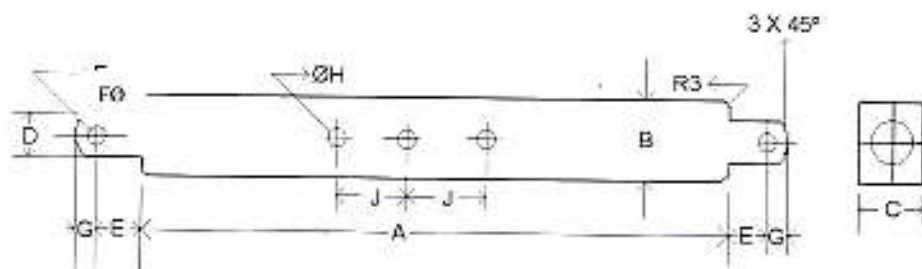


Fig. 1: DIMENSIONAL NOTATIONS FOR LINKAGE TYPE DRAWBAR

	<u>Previous sample</u>	<u>Present sample</u>
3.1.13.3.2 Swinging drawbar	:	Not provided
3.1.13.3.3 Provision to attach trailer brake valve	:	Not provided Provided
3.1.14 Power take-off shaft:		
Type	:	Type-I, Independent Type-I, Semi Independent
Method of engaging	:	By a hand lever provided on LHS of operator's seat.
No. of shaft,(s)	:	One
PTO speed corresponding to rated engine speed, (rpm):	:	976 653
Other speed (rpm)	:	Not provided
Distance behind rear axle, (mm)	:	360
Engine to PTO speed ratio	:	2.049 : 1 3.0625 : 1
Whether the PTO shaft is capable of transmitting the full power of engine	:	Yes
Other speed of PTO shaft corresponding to rated engine speed	:	None



3.1.14.1 Specifications of Power Take-Off Shaft:

Specification	As per IS: 4931-1995 (Type-I / Type II)	As observed		Remarks in case of Present sample
		Previous sample	Present sample	
Nominal speed, (rpm)	540 ± 10 / 1000 ± 25	1000 rpm of PTO shaft corresponds to 2048 rpm of engine.	540 rpm of PTO shaft corresponds to 1654 rpm of engine.	Conforms to Cat. I
No. of splines	6 / 21	21	6	Conforms to Cat. I
Direction of rotation	Clockwise	Clockwise	Clockwise	Conforms to Cat. I
Location	The position of the centre of the end of pto shaft shall be within 50mm to right or left of the centre line of the tractor.	8 mm on LHS	8 mm on LHS	Conforms to Cat. I
Dimensions, (mm) [See Fig.2]:				
D \varnothing	34.79 ± 0.06 / 34.67 ± 0.2	34.6	34.74	Conforms to Cat. I
d \varnothing	28.91 ± 0.05 / 31.1 (min.)	31.1	28.86	Conforms to Cat. I
B \varnothing	29.4 ± 0.1 / (29.35 ± 0.05)	29.3	29.36	Conforms to Cat. I
A \varnothing (optional)	8.3 ± 0.1 / 8.3	NA	8.68	Does not conform
W	8.69 - 0.09 - 0.16 / 2.494 - 0.125 - 0.188	2.48	8.53	Conforms to Cat. I
a	7 / 5	5	7	Conforms to Cat. I
b (optional)	25 ± 0.5 / NA	NA	25.5	Conforms to Cat. I
c	38 / 25.5	25.5	38	Conforms to Cat. I
X	30° / 30°	30°	30°	Conforms to Cat. I
B	76 (min) / 64 (min.)	78	79	Conforms to Cat. I & II
h	450 to 675 / 450 to 675	620	655	Conforms to Cat. I & II

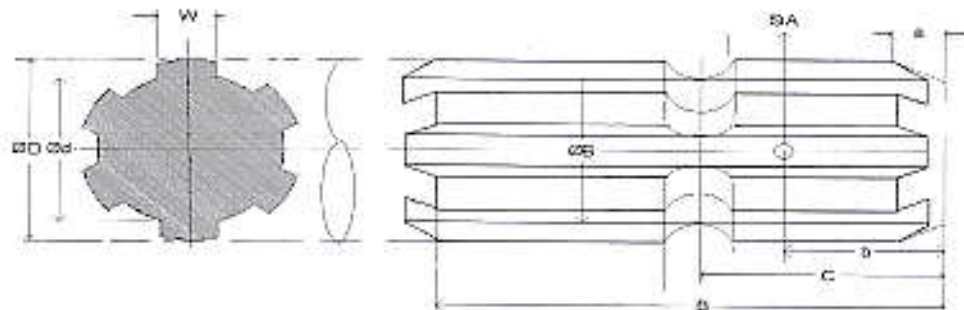


Fig.2 (a): DIMENSIONAL NOTATIONS FOR TYPE - I & II POWER TAKE-OFF SHAFT

3.1.14.2 Power Take-off Master Shield : Provided, Type - I

Dimensions of PTO master shield for type I & II PTO (mm) [Refer Fig. 2(b)]

Specification	As per IS 4931-1995	As observed		Remarks in Present sample
		Previous sample	Present sample	
k	70 (min)	Not applicable	70	Conforms
m	125±5	--do--	125	Conforms
n	85±5	--do--	80	Conforms
p	285±5	--do--	285	Conforms
r	76 (max.)	--do--	0	Conforms

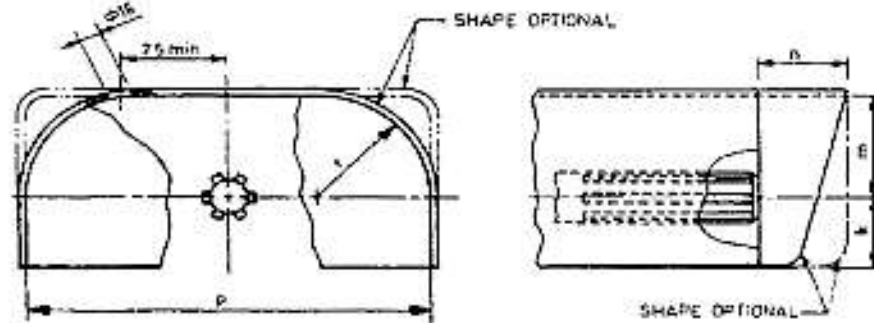


Fig. 2 (b): DIMENSIONAL NOTATIONS OF PTO SHAFT MASTER SHIELD

		<u>Previous sample</u>	<u>Present sample</u>
3.1.15	Towing hitch:		
3.1.15.1	Front	: Not provided	Provided
	Type	: Not applicable	Clevis
	Location	: --do--	At front of front engine support
	Height above ground level, (mm)	: --do--	660
	Type of adjustment	: --do--	Fixed
	Dia of pin hole, (mm)	: --do--	63.4
	Width of clevis, (mm)	: --do--	26.3
3.1.15.2	Rear		
	Type	: Clevis	
	Location	: At the rear of transmission housing	
	Height above ground level, (mm):		
	- Maximum	: 760	815
	- Minimum	: 595	570
	- No. of positions	: 06	06
	- Type of adjustment	: By changing the position of hitch on mounting bracket.	By changing and reversing the position of hitch on its mounting bracket
	Distance of hitch point, (mm):		
	-From rear wheel centre	: 460	455
	-From power take-off shaft end	: 100	95
	Dia of pin hole, (mm)	: 35	34.7
	Width of clevis, (mm)	: 71	79
3.1.16	Steering:		
	Make	: ZF	Danfoss
	Type	: Worm & roller, single drop arm	Hydrostatic (power steering)
	Location of control wheel	: On gear box cover	On top of gearbox housing
	Method of operation	: Manual	Manually through steering control wheel
	Diameter of steering control wheel, (mm)	: 420	370
	Steering oil capacity, (l)	: 0.7	1.50
	Lubricant change period	: After every 1200 hours of operation.	After every 1600 hours of operation.



		<u>Previous sample</u>	<u>Present sample</u>
3.1.16.1	Distributor (HSU Unit):	Not applicable	--
	Make	--do--	Danfoss
	Type	--do--	Hydrostatic, open centre
	Location	--do--	On top of gearbox housing
3.1.16.2	Pump:		
	Make	--do--	Rexroth
	Type	--do--	Gear
	Location	--do--	On front RHS of engine
	Method of drive	--do--	Through timing gears (common to hydraulic pump shaft)
3.1.16.3	Hydraulic cylinder:		
	Make	--do--	Not available
	Type	--do--	Double acting, sing connecting
	Location	--do--	On rear LHS of front axle
3.1.17	Brakes:		
3.1.17.1	Service Brake:		
	Make	: Swaraj (apa)	JMIL
	Type	: Mechanical, dry dual disc.	Mechanical, multidisc oil immersed
	Location	: On bull pinion shaft, outside differential housing	
	No. of disc(s)	: Two (on each side)	Four (on each wheel side)
	Area of liners, (cm ²)	: 721.3 (on each side)	913 (on each wheel side)
	Material of liners	: Asbestos (apa)	Paper based
	Method of operation	: Independent / combined	RHS foot operated
	brake oil capacity, (l)	: Not applicable	50.0 (common with transmission and hydraulic system)
	Lubricant change period	: --do--	After every 1600 hours of operation.
3.1.17.2	Parking Brake:		
	Type	: Hand operated locking arrangement for service brakes	Pawl and ratchet arrangement
	Location & Method of operation	: On service brakes & by operating a pawl & ratchet type lock on LHS brake pedal	Service brake acts as parking brake when locked in depressed position by a hand lever provided on RHS of foot rest.
1.18	Wheel Equipment:-		
1.18.1	Steering Wheel (s):		
	Make	:	Good Year
	Number(s)	:	Two
	Type of tyre	:	Pneumatic, ribbed
	Size	:	6.00 -16
	Ply rating	:	8
	Maximum permissible loading capacity of each tyre at 230 kPa pressure, (kgf)	:	450



	Previous sample	Present sample
Recommended inflation pressure, kPa :		
- for field work	:	235.4
- for transport	:	235.4
Track width, (mm)	:	1200, 1300 (std.), 1230, 1330 (std.), 1400, 1450, 1500, 1440 & 1530 1550, 1650 & 1750
Method of changing track width	:	Inverting wheel disc and by extending telescopic front axle.
Make & size of rims	:	Not applicable SSWL & 4.5 E x 16
3.1.18.2 Drive wheel (s):		
Make	:	Good Year
Number	:	Two
Type of tyre	:	Pneumatic, traction
Size	:	13.6-28 14.9 - 28
Ply rating	:	12
Maximum permissible loading capacity of each tyre, (kgf)	:	1100 at 103 kPa 2120 at 230 kPa
Recommended inflation pressure, (kPa):		
- For field work	:	93.2 98
- For transport	:	103.0 108
Track width, (mm)	:	1360 (std.), 1440, 1430, 1420 (std.), 1540, 1600, 1700, 1460, 1540, 1620, 1760 & 1890 1700, 1740 & 1820
Make & size of wheel rim	:	Not applicable WIL & W13 x 28
3.1.18.2 Wheel base, (mm)	:	1955 2100
Method of changing wheel base, if any, and range	:	None None
3.1.19 Operator's seat:		
Make	:	Swaraj (apa) Not available
Type	:	Cushioned with backrest
Type of Suspension	:	Two Helical springs
Type of Damping	:	Hydraulic shock absorber
Range of adjustment, (mm):		
Vertical	:	35 Nil
Lateral	:	Nil Nil
Longitudinal	:	50, in steps of 25 mm ±65
3.1.20 Provision for safety and comfort of operator:		
3.1.20.1 Operator's Seat:		
Meets the minimum requirements of IS: 12343-1998, (Re-affirmed in March, 2009) except the following:		
	<u>Previous sample</u>	<u>Present sample</u>
	Met the minimum requirements	Meets the minimum requirements
3.1.20.2 Conformity with IS: 6283 (Part 1 & 2)-1998 (Re-affirmed in March, 2009) :		
Controls and displays are identifiable with symbols meets the requirements as per IS : 6283 (Part 1&2) – 1998		
	Met the minimum requirements	Meets the minimum requirements
3.1.20.3 Conformity with IS : 8133-1983 (Re-affirmed in March, 2009) :		
Location and movement of various controls meets the requirement of IS : 8133-1983, except the following:		
i)	Provision of safety against accidental start of engine has not been provided.	Meets the minimum requirements



- | | <u>Previous sample</u> | <u>Present sample</u> |
|----------|--|---|
| 3.1.20.4 | Conformity with IS:12239 (Part-1)-1996 (Re-affirmed in March,2007) :
Meets the requirements of IS: 12239 (Part-1) – 1996, except the following:
i) The spark arrester has not been provided in the exhaust system. | i) Width of foot step is less than the 200mm.
ii) The spark arrester has not been provided in the exhaust system |
| 3.1.20.5 | Conformity with IS:12239 (Part-2)-1999 (Re-affirmed in March,2009) :
Meets the requirements of IS:12239 (Part-2)-1999, except the following:
Met the minimum requirements | i) The working clearance around the position control lever & and draft control is less than 70 mm. |
| 3.1.20.6 | Conformity with IS: 14683 – 1999 (Re-affirmed in March, 2009) :
All lighting arrangements meet the requirements of IS: 14683-1999. | |
| 3.1.20.7 | Rear view mirror:
Rear view mirror has been provided. | |
| 3.1.20.8 | Slow moving emblem:
Slow moving emblem has been provided. | |

	<u>Previous sample</u>	<u>Present sample</u>
3.1.21	Mass of unballasted tractor, (kg):	
	- Front	: 750
	- Rear	: 1180
	- Total	: 1930
3.1.22	Over all dimensions:	
	- Length	: 3438
	- Width	: 1730
	- Height (with exhaust pipe)	: 2170
	Minimum ground clearance, (mm)	: 405 (at transmission housing)
		: 745
		: 1325
		: 2070
		: 3470
		: 1820
		: 2240
		: 435 (front axle)

- 3.1.23 **Labelling of tractor:**
Locations of labelling plate:- The labelling plate is riveted on LHS of the gearbox housing and provides the following information:

Name of Manufacturer	: Swaraj Division Tractors Mahindra & Mahindra Ltd.
Make	: Swaraj
Model	: 744 FE
Year of manufacture	: WY (i.e. 2016)
Engine Serial Number	: 43.3009/SWN25221
Chassis Serial Number	: WYCN45922957873
Maximum PTO Power, kW	: 30.1
Specific fuel consumption, g/kWh	: 265

	<u>Previous sample</u>	<u>Present sample</u>
3.1.24	Number of external lubricating points:	
	- Oiling	: Nil
	- Grease cups	: Nil
	- Grease nipples	: 22
		: Nil
		: 02
		: 19
3.1.25	Colour of tractor:	
	Chassis & engine	: Smoke grey
	Sheet metal:	: Smoke grey
	Mudguard	: Pale Cream
	Bonnet	: Feroza blue
	Rim & disc	: --
		: Cream yellow
		: Blue
		: Cream yellow



3.2 NOMINAL SPEED TEST

Movement	Gear No.	No. of engine revolutions for one revolution of driving wheel		Nominal speed at rated engine speed when fitted with 13.6-28 size tyres at an inflation pressure of 103 kPa and rolling radius of 641 mm, (kmph).	Nominal speed at rated engine speed when fitted with 14.9-28 size tyres 640 mm radius index, (kmph).	Variation in nominal speed (%) in <u>Present sample</u> and <u>Previous sample</u>
		<u>Previous sample</u>	<u>Present sample</u>	<u>Previous sample</u>	<u>Present sample</u>	
Forward	L1	147.1	172.61	3.29	2.80	- 14.89
	L2	108.7	131.38	4.45	3.67	- 17.53
	L3	70.1	79.03	6.90	6.11	- 11.45
	L4	51.3	53.90	9.42	8.94	- 05.10
	H1	44.8	50.12	10.79	9.62	- 10.84
	H2	33.1	38.04	14.61	12.67	- 13.28
	H3	21.3	22.90	22.67	21.07	- 07.06
Reverse	H4	15.6	15.62	30.95	30.89	- 00.19
	RL	105.1	145.53	4.60	3.31	- 28.04
	RH	32.0	42.14	15.11	11.45	- 24.22

3.3 PTO PERFORMANCE TEST

S. No.	Particulars	<u>Previous sample</u>	<u>Present sample</u>
1	Date(s) of test	11.10.99 & 12.10.99	31.01.2017 & 01.02.2017
2	Tractor run at this Institute prior to start of PTO test, (h)	9.5	7.23
3	Dynamometer test bench used	--	SAJ-AG 250 Eddy Current.

Maximum power two hours test under natural ambient condition was conducted. The results of Power take-off performance test under natural ambient & high ambient of Previous & Present sample are tabulated in Table-2.

Table-1

	Power, (kW)	Speed, (rpm)		Fuel Consumption			Specific energy, (kWh/l)
		PTO	Engine	(l/h)	(kg/h)	(kg/kWh)	
1	2	3	4	5	6	7	8
a) Maximum power – 2 hours test (under natural ambient condition):							
Previous sample	30.4	976	2000	9.21	7.77	0.255	3.30
	29.5	976	1999	8.90	7.50	0.255	3.32*
Present sample	30.3	653	2000	9.07	7.58	0.250	3.34
	28.8	653	2000	8.67	7.25	0.252	3.32*
b) Power at rated engine speed (2000 rpm):							
Previous sample	30.4	976	2000	9.19	7.76	0.255	3.31
	29.5	976	2000	8.87	7.79	0.254	3.32*
Present sample	30.3	653	2000	9.07	7.58	0.250	3.34
	28.8	653	2000	8.67	7.25	0.252	3.32*
c) Power at standard power take-off speed:							
Previous sample (1000 ± 25 rpm)	30.1	1000	2049	9.21	7.77	0.258	3.27
	26.9	1000	2049	8.19	6.91	0.257	3.28*
Present sample (540 ± 10 rpm)	27.0	540	1654	7.76	6.49	0.240	3.48
	25.6	540	1654	7.43	6.22	0.243	3.45*
d) Varying loads at rated engine speed:							
i) Torque corresponding to maximum power available at rated engine speed:							
Previous sample	30.4	976	2000	9.17	7.74	0.254	3.32
Present sample	30.3	653	2000	9.07	7.58	0.250	3.34
ii) 85% of the torque obtained in (i):							
Previous sample	26.6	1009	2067	8.27	6.98	0.262	3.22
Present sample	26.5	672	2058	8.12	6.78	0.256	3.26



1	2	3	4	5	6	7	8
iii) 75% of the torque obtained in (ii):							
Previous sample	20.2	1018	2086	6.82	5.76	0.285	2.96
Present sample	20.1	678	2076	6.56	5.49	0.273	3.06
iv) 50% of the torque obtained in (ii):							
Previous sample	13.6	1026	2102	5.45	4.60	0.339	2.49
Present sample	13.6	686	2101	5.22	4.36	0.321	2.61
v) 25% of the torque obtained in (ii):							
Previous sample	6.7	1034	2119	4.00	3.38	0.503	1.68
Present sample	6.8	692	2119	3.88	3.25	0.478	1.75
vi) Unloaded:							
Previous sample	--	1041	2133	2.76	2.33	--	--
Present sample	0.1	697	2135	2.61	2.19	21.900	0.04
d) Varying loads at standard PTO speed							
In <u>Previous sample</u> part load at part throttle (at standard PTO speed 1000 ± 25): This test was not conducted separately because maximum power was observed at rated engine speed i.e. 2000 rpm and 976 rpm of PTO speed which in the limit of standard PTO speed (1000 ± 25)							
i) Torque corresponding to maximum power available at standard PTO speed: (540 ± 10 rpm):							
Present sample	27.0	540	1654	7.76	6.49	0.240	3.48
ii) 85% of the torque obtained in (i):							
Present sample	23.6	556	1703	6.86	5.73	0.243	3.44
iii) 75% of the torque obtained in (ii):							
Present sample	17.9	561	1718	5.47	4.57	0.255	3.27
iv) 50% of the torque obtained in (ii):							
Present sample	12.1	570	1746	4.26	3.56	0.294	2.84
v) 25% of the torque obtained in (ii):							
Present sample	6.1	575	1761	3.07	2.57	0.421	1.99
vi) Unloaded:							
Present sample	0.1	579	1773	1.93	1.61	16.100	0.05

* Under high ambient conditions

Sl. No.	Parameters	Previous sample		Present sample	
		Natural Ambient	High Ambient	Natural Ambient	High Ambient
1	2	3	4	5	6
i)	No load maximum speed, (rpm)	2133	2129	2135	2128
ii)	Equivalent crankshaft torque at maximum power (Nm)	145.4	140.7	144.6	137.6
iii)	Maximum equivalent crank shaft torque (Nm)	165.6	161.2	173.4	162.9
iv)	Engine speed at maximum equivalent crankshaft torque, (rpm)	1299	1350	1299	1299
v)	Backup torque (%)	13.9	14.6	19.9	18.4
vi)	Smoke level at 80 % of max. power (Bosch No.)	2.4	--	0.16	--
vii)	Range of atmospheric condition :				
	- Temperature, ($^{\circ}$ C)	26 to 29	41 to 46	27 to 30	41 to 44
	- Pressure, (kPa)	97.8 to 98.2	97.8 to 98.1	99.2 to 99.4	100.2 to 100.5
	- Relative humidity, (%)	58 to 88	33 to 50	44 to 48	18 to 30
viii)	Maximum Temperature, ($^{\circ}$C):				
	- Engine oil	92	106	92	100
	- Coolant	93	107	80	92
	- Fuel	43	57	45	60
	- Air intake	33	48	28	44
	- Exhaust gas	498	556	491	501
ix)	Pressure at maximum power:				
	- Intake air, (kPa)	2.5 to 2.8	2.7 to 2.9	3.0	2.9 to 3.0
	- Exhaust gas, (kPa)	5.5 to 5.6	5.6 to 5.7	4.9 to 6.5	6.1 to 6.8
x)	Consumptions:				
	Lub. Oil (g/kWh)	--	1.02	--	0.574
	-Coolant (% of total coolant capacity)	--	3.05	--	Nil

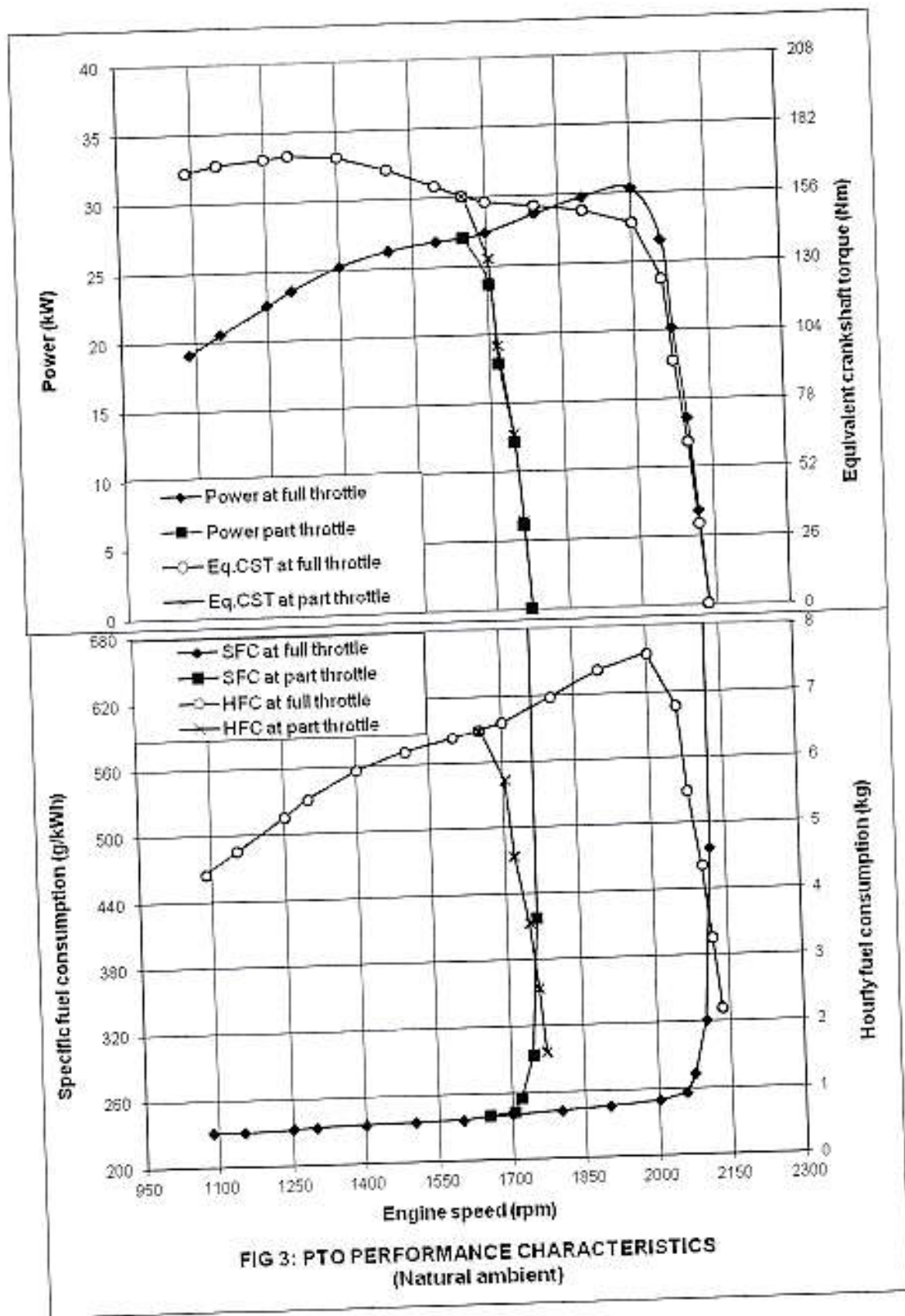


FIG 3: PTO PERFORMANCE CHARACTERISTICS (Natural ambient)

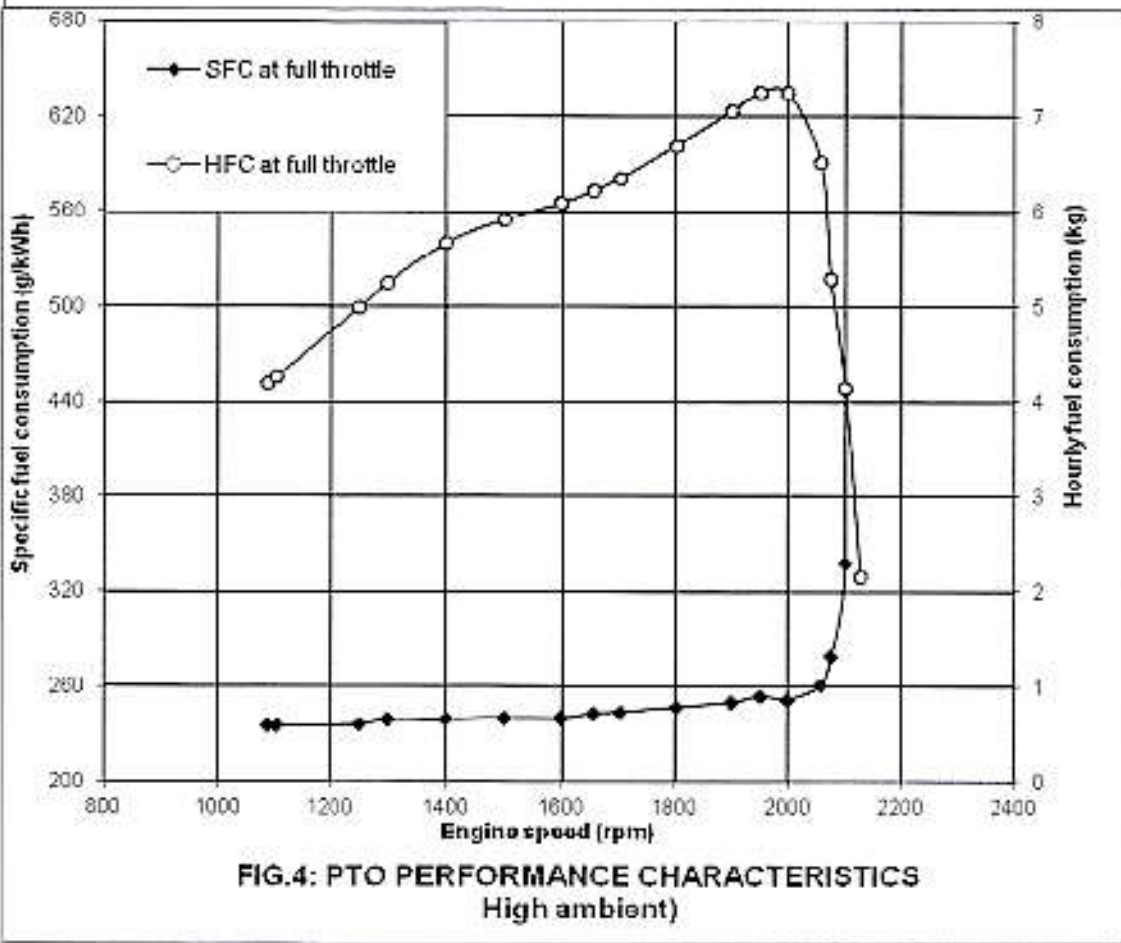
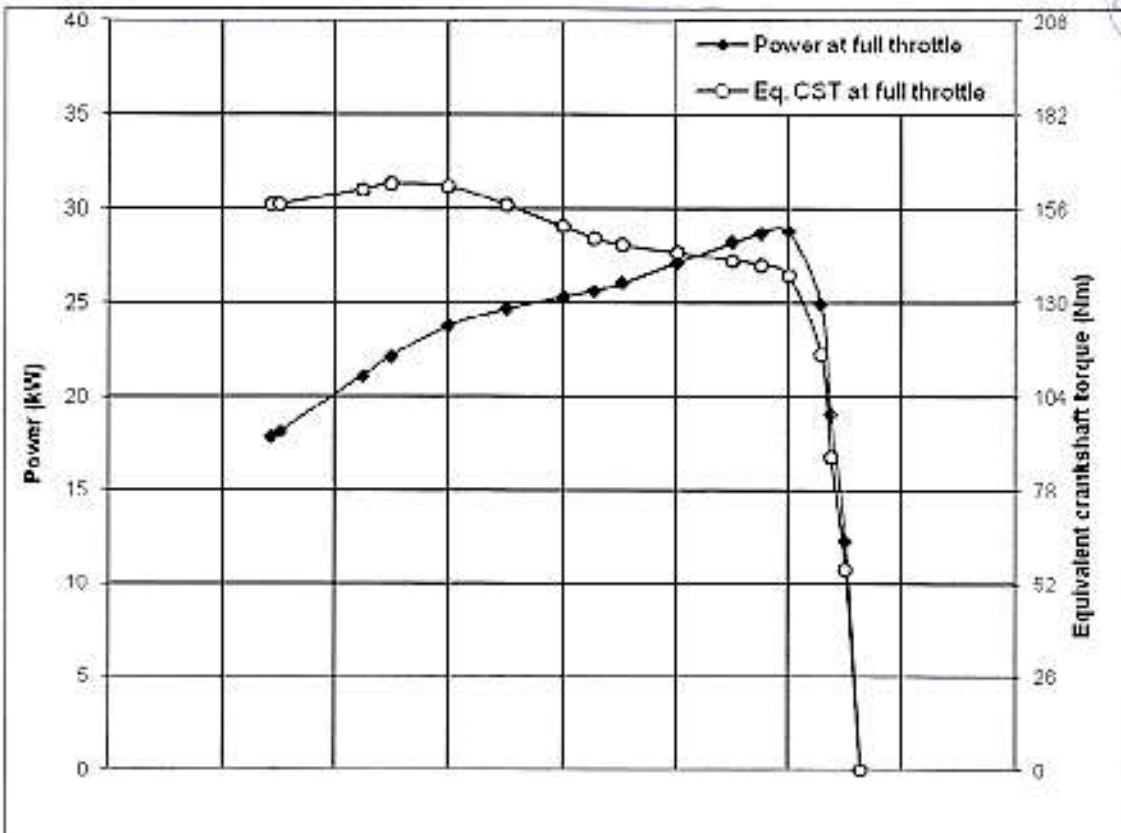
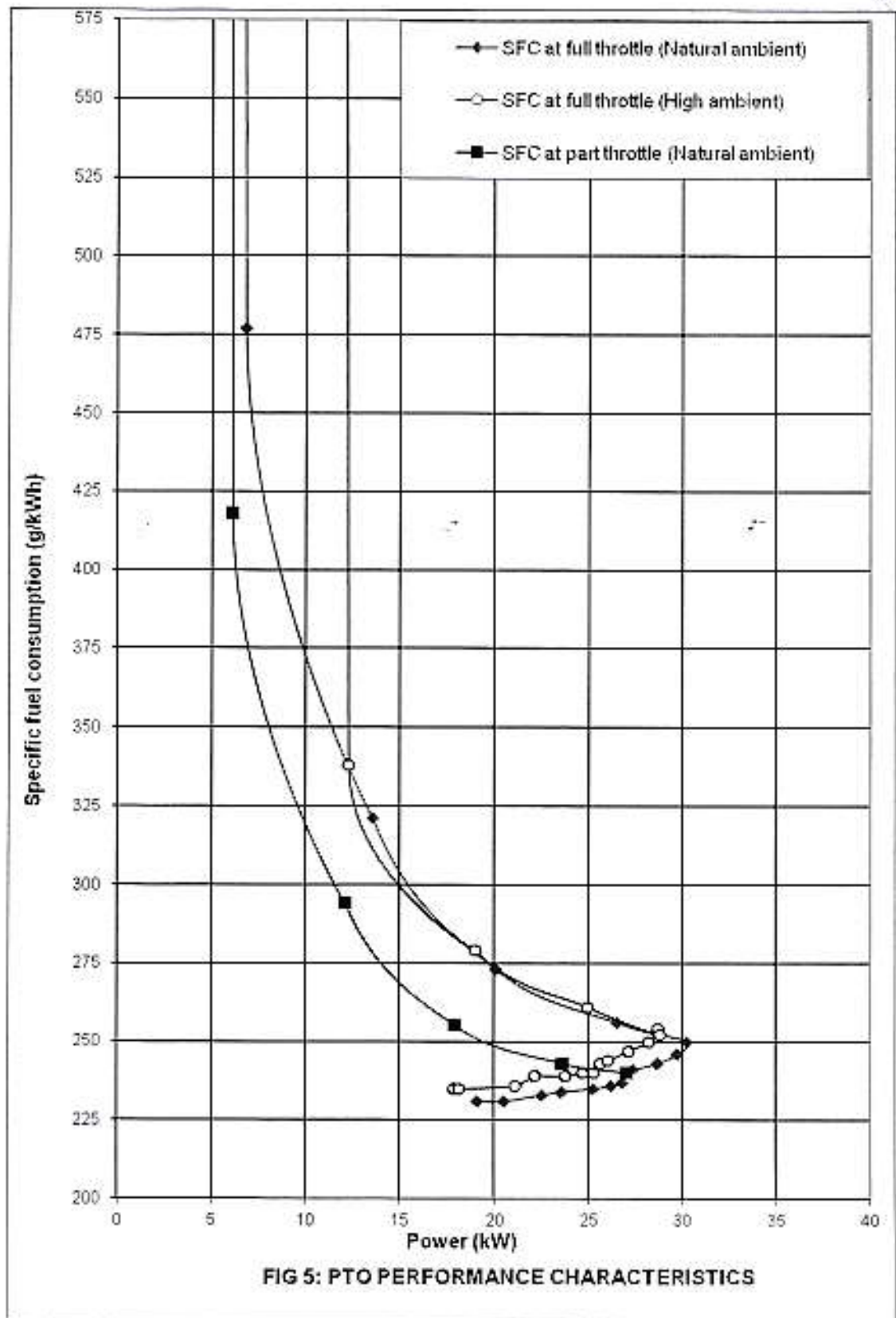


FIG.4: PTO PERFORMANCE CHARACTERISTICS (High ambient)





4. OTHER APPLICABLE TESTS

4.1 BRAKE TEST

4.1.1 Service brake:

4.1.1.1 Cold brake test:

Date of test(s)	:	10.01.2017 & 06.01.2017
Type of Track	:	Concrete
Maximum attainable speed (kmph):		
-Without Ballast	:	33.0
-With Road Ballasted	:	33.0

		At maximum attainable speed			
Unballasted tractor	Braking device control, force (N)	501	400	300	200
	Mean deceleration, (m/sec ²)	3.58	3.35	3.09	2.50
	Stopping distance, (m)	11.87	12.54	13.62	16.81
Road ballasted tractor	Braking device control force(N)	503	405	307	209
	Mean deceleration, (m/sec ²)	3.46	3.33	2.97	2.50
	Stopping distance, (m)	12.15	12.62	14.15	16.81
		At 25 kmph travel speed			
Unballasted tractor	Braking device control, force(N)	533	420	307	193
	Mean deceleration, (m/ sec ²)	3.40	3.14	2.79	2.50
	Stopping distance, (m)	7.19	7.68	8.65	9.65
Road ballasted tractor	Braking device control force,(N)	502	405	308	211
	Mean deceleration, (m/sec ²)	3.36	3.06	2.78	2.50
	Stopping distance, (m)	7.39	7.88	8.69	9.65

4.1.1.2 Brake fade test:

		At maximum attainable speed			
Braking device control force (N)		527	436	346	256
Mean deceleration, (m/ sec ²)		3.59	3.30	3.00	2.50
Stopping distance, (m)		12.21	12.74	14.02	16.81
		At 25 kmph travel speed			
Braking device control force,(N)		528	431	334	237
Mean deceleration, (m/ sec ²)		3.23	3.04	2.81	2.50
Stopping distance, (m)		7.48	7.94	8.58	9.65

Maximum deviation of tractor from its original course, (m)	:	None
Abnormal vibration	:	None
The brakes were heated by	:	Self braking

4.1.2 Parking brake test:

Particulars	18 percent slope		12 percent slope with trailer of 2.08 tones.	
	Up	Down	Up	Down
Braking device control force, (N)	309	343	298	334
Efficacy of parking brake	-----Effective-----			

4.2 TURNING ABILITY

Characteristics	Minimum turning diameter, (m)		Minimum clearance diameter, (m)	
	LHS	RHS	LHS	RHS
Brakes released	7.24	7.06	7.44	7.29
Brake applied	6.41	6.39	6.63	6.59

5. ADJUSTMENTS, DEFECTS, BREAKDOWNS AND REPAIRS

S. No.	Adjustment/Defect/Breakdown and Repairs	Tractor run hours
	-----None-----	



6. SUMMARY OF OBSERVATIONS, COMMENTS & RECOMMENDATIONS

6.1 On the basis of test conducted the performance results have been summarized as evaluative (mandatory) and non – evaluative (not mandatory) parameters applicable for qualifying Minimum Performance Criteria as per clause-4 table-1 of Indian Standard 12207: 2014 for acceptance of tractor for the purpose of subsidies/NABARD financing for the applicable features for this tractor model.

Sl. No.	Characteristic	Category (Evaluative / Non Evaluative)	Requirements as per IS: 12207-2014	Values declared by the applicant/ requirement		As observed		Whether present model meets the requireme nts (Yes/No.)
				Previous sample	Present sample	Previous sample	Present sample	
1	2	3	4	5 a	5 b	6 a	6 b	7
6.1.1	PTO Performance :							
a)	- Max. power under 2 h test, (kW) (Natural ambient condition)	Evaluative	Declared value to be achieved with a tolerance of: -5 / +10% for PTO power >26 kW. -7.5/+10% for PTO power ≤ 26 kW or -5 / +10% for engine power >26 kW. -7.5/+10% for engine power ≤ 26 kW	29.4	30.1	30.4	30.3	Yes
b)	Power at rated engine speed, (kW)	Non Evaluative	-do-	29.4	30.1	30.4	30.3	Yes
c)	Specific fuel consumption corresponding to maximum power, (g/kWh)	Non Evaluative	+ 5%	265	265	255	250	Yes
d)	Maximum equivalent crankshaft torque, (Nm)	Non Evaluative	± 8%	165 (D)	165 (D)	165.6	173.4	Yes
e)	Back-up torque, percent	Non Evaluative	10 percent, min.	7 % min. (D)	10% min. (D)	13.9	19.9	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	130	106	100	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.	115	115	107	92	Yes
g)	3) Engine oil consumption, (g/kWh)	Evaluative	Not exceeding 1% of SFC at max. power under High ambient conditions	2.7 (R)	2.65 (R)	1.02	0.574	Yes
h)	4) Smoke level	Evaluative	Maximum light absorption coefficient of 3.25 per metre or equivalent BOSCH No. 5.2 or 75 Hartridge value (As per CMVR)	3.25 m ⁻¹ (R) 3.25 max. (D)	3.25 m ⁻¹ (R) 3.25 max. (D)	2.4 (Bosch No.)	0.16 m ⁻¹	Yes
6.1.2	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)	10 (R)	5.00	7.39	Yes
	2) Hot brake	Evaluative	10	10 (R)	10 (R)	5.1	7.48	Yes



1	2	3	4	5 a	5 b	6 a	6 b	7
b)	Maximum force exerted on the brake pedal to achieve a deceleration of 2.5 m/s ² (N)	Evaluative	600	600 (R)	600 (R)	172 to 185	211 to 237	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 (R)	Effective	343	Yes

1	2	3	4	5	6	7	
6.1.3	Safety features :						
a)	Guards against moving and hot parts	Evaluative	Belt drives, pulley, silencer, hydraulic pipes (As per IS 12239 (part 2))	--	Meets the requirement	Yes	
b)	Lighting arrangement (Tractor having more than 1150 mm rear track width)	Evaluative	As per CMVR	--	Meets the requirement	Yes	
c)	Seating requirement (Tractors having more than 1150 mm rear track width)	Non-Evaluative	Should meet the requirements of IS 12343 (as amended from time to time)	--	Meets the requirement	Yes	
d)	Technical requirements for PTO shaft	Non-Evaluative	Should meet the requirements of IS 4931 (as amended from time to time)	--	Does not meet the requirement	No	
e)	Dimension of three point linkage	Non-Evaluative	Should meet the requirements of IS 4468 (part 1) (as amended from time to time)	--	Meets the requirement	Yes	
f)	Specification of linkage and swinging drawbars	Non-Evaluative	Should meet the requirements of IS 12953 and IS 12362 (part 3) (as amended from time to time)	--	Meets the requirement	Yes	
6.1.4	Labeling of tractors (Provision of labeling plate):						
1)	Make	Evaluative	Should conform to the requirements of CMVR along-with declared value of PTO HP	--	Swaraj	Yes	
2)	Model	Evaluative		--	744 FE	Yes	
3)	Year of manufacture	Evaluative		--	WY (i.e. 2016)	Yes	
4)	Engine number	Evaluative		--	43.3009/SWN 25221	Yes	
5)	Chassis number	Evaluative		--	WYCN459229 57873	Yes	
6)	Declaration of PTO power, kW	Evaluative		--	30.1	Yes	
6.1.5	Literature (Submission to test agency)						
(a)	Operator manual	Evaluative	Provided/ Not Provided	Provided	Provided	Yes	
(b)	Parts Catalogue	Evaluative	Provided/Not Provided	Provided	Provided	Yes	
(c)	Workshop/ Service manual	Evaluative	Provided/Not Provided	Provided	Provided	Yes	



6.2	Conformity with following IS:	Previous sample	Present sample
i)	Guide lines for declaration of power and specific fuel consumption and labeling of agricultural tractors (First revision) [IS 10273:1987 (Reaffirmed in March, 2009)]	Conformed	Conforms
ii)	Agricultural tractors – Rear mounted power take-off - Types 1, 2 and 3(third revision)[IS: 4931-1995 (Reaffirmed in March, 2009)]	Conformed	Does not conform
iii)	Agricultural wheeled tractors - Rear mounted three-point linkage: Part 1 Categories 1, 2, 3 & 4 (fourth revision) [IS 4468(Part-I):1997/ISO 730-1:1994 (Reaffirmed in March, 2009)]	Conformed	Conforms
iv)	Drawbar for agricultural tractors – Link type [IS 12953:1990 (Reaffirmed in March, 2007)]	Conformed	Conforms
v)	Agricultural tractors - Operator's seat technical requirement [IS 12343 –1998 (First revision) (Reaffirmed in March, 2009)]	Conformed	Conforms
vi)	Guide for safety & comfort of operator of agricultural tractors: Part 1 General requirements (first revision) : [IS 12239 (PT-1) 1996/ISO 4254-1:1989 (Reaffirmed in (Reaffirmed in March, 2007)]	Conformed	Does not conform
vii)	Tractors and machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays [IS: 6283 (Part-1 & Part-2) –2006 & 2007 (Reaffirmed in March, 2009)]/ ISO 3767-2:1991]]	Conformed	Conforms
viii)	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)]	Did not conform	Does not conform
ix)	Guide lines for location and operation of operator controls on agricultural tractors and machinery (first revision) (IS: 8133 – 1983) (Reaffirmed in March, 2009)]	Did not conform	Conforms
x)	Agricultural Tractor & Machinery Lighting device for travel on public roads (IS: 14683-1999) (Reaffirmed in March, 2009)]	Conformed	Conforms

6.3 Salient Observations:

6.3.1 Laboratory tests:

6.3.1.1 PTO Performance:

- The maximum PTO power was recorded as **30.3 kW** against the declaration of **30.1 kW**, which meets the requirement of IS: 12207-2014 with regard to tolerance limit.
- The specific fuel consumption corresponding to maximum power was recorded as **250 g/kWh** against the declaration of **265 g/kWh**, which is within the tolerance limit of IS: 12207-2014.
- The maximum equivalent crankshaft torque was recorded as **173 N-m** against the declaration of **165 N-m**, which is not within the permissible limit and hence, it does not meet the non – evaluative requirement of IS: 12207-2014. This should be looked into for necessary corrective action.
- The backup torque is **19.9 %**.
- There is PTO power drop of **4.95 %** from natural to high ambient condition. This should be looked into for necessary corrective action.

6.3.1.2 Three point linkage:

Some of the parameters of three point linkage conform to Cat. I and some of them conform to Cat.II. Keeping in view the spirit of standardization, necessary improvement may be incorporated.



- 6.3 Maintenance / Service Problems:**
No noticeable maintenance or service problem was observed during the test.
- 6.4 Recommendation with regard to safety on tractor:**
The following requirements, inter alia, may be considered for incorporation on the tractor:
- There should be provision for spark arresting device in exhaust system.
 - There should be provision of differential lock.
 - Width of foot step is should be at least 200mm for easy ascending / descending on tractor
 - The working clearance between the position and draft control lever should be provided as per IS: 12239 (Part-2) – 1999.
- 6.5 Adequacy of Literature supplied with machine:**
- 6.5.1** Literature was supplied with the tractor for reference during the test.
- Operator's manual of tractor model **SWARAJ 744 FE**.
 - Parts catalogue of tractor model **SWARAJ 744 FE**.
 - Service Manual of tractor model **SWARAJ 744 FE**.
- 6.5.2** The supplied literature was found adequate; except the following
- If tractor is fitted permanently with oil immersed brake then information related to dry type should not be provided in operator's and service manual. It should be taken as necessary corrective action.
- However, these literatures should be brought out in other vernacular languages of India for guidance of users

7. CITIZEN CHARTER

Duration of Test	Time frame for Testing & Evaluation as per Citizen Charter	Whether the Test Report is released within the time frame given in Citizen Charter	Remarks
10 Months (December , 2016 to, October 2017)	10 Months	Yes	-None-

TESTING AUTHORITY:

RAJNEESH PATEL
AGRICULTURAL ENGINEER

Y.K. RAO
SENIOR AGRICULTURAL ENGINEER

J.J.R.NARWARE
DIRECTOR

The report compiled by: Shri Rajneesh Patel, Agricultural Engineer.

8. APPLICANT'S COMMENTS

Para No.	Our Reference	Applicant's comments
		--None--



ANNEXURE-I

TRACTOR RUN HOURS DURING TEST

A.	LABORATORY AND TRACK TESTS	HOURS
1.	Running -in	--
2.	PTO Performance Test	12.5
3.	Theoretical speed test	0.56
4.	Brake test	2.08
5.	Turning ability test	0.42
B.	Miscellaneous test and other run hours, including idle run transportation, trial and preparation for test.	Nil
	Total	15.56