



SWARAJ 855 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

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CENTRAL FARM MACHINERY TRAINING & TESTING INSTITUTE

(An ISO : 9001 - 2015 Certified Institute)

Tractor Nagar, Budni (M.P.) 466 445

E-mail fmti-mp@nic.in

Website : <http://www.fmttibudni.gov.in>

Telephone : 07564 - 234729

Fax : 07564 - 234743

T- 1121/1647/2017

SWARAJ 855 FE TRACTOR - Commercial (First Batch Test)

Manufacturer : M/s. Mahindra & Mahindra Ltd.
Farm Equipment Sector, Swaraj Division,
Phase-IV, Industrial Area, S.A.S. Nagar,
Mohali,
Punjab - 160055



Month: December

Test Report No. T- 1121/1647/2017

Year: 2017



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GOVERNMENT OF INDIA
CENTRAL FARM MACHINERY TRAINING & TESTING INSTITUTE
TRACTOR NAGAR, BUDNI (MADHYA PRADESH) 466445, INDIA

E-mail: fnti-mp@gov.in
Telephone: 07564-234729

Web site: <http://www.fmttibudni.gov.in>
FAX: 07564-234743

Type of Test	: COMMERCIAL (Batch)
Test code/Procedure	: IS: 5994-1998 (Reaffirmed in 2009) and IS: 12207-2014.
Period of Test	: December, 2016 to November, 2017
Test Report No.	: T- 1121/1647/2017
Month/Year	: December, 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 tests.
- 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 the First batch test report and therefore, should be read in conjunction with the Test Report of base model i.e. "Swaraj 855 FE" tractor bearing report No. T-469/934 released in March, 2003 and the supplementary report, Swaraj 855 FE bearing report no. T-1117/1643/2017, released in December, 2017.

SELECTED CONVERSIONS

SELECTED CONVERSIONS		
Sl. No	Units	Conversion Factor
1	Force:	
	1 kgf	9.80665 N 2.20462 lbf
2	Power:	
	1 hp	1.01387 metric hp (Ps) 745.7 W
	1 Ps	735.5 W
	1 kW	1.35962 Ps
3	Pressure:	
	1 psi	6.895 kPa
	1 kgf/cm ²	98.067 kPa = 735.56 mm of Hg
	1 bar	100 kPa = 10 N/cm ²
	1 mm of Hg	1.3332 m-bar

ABBREVIATIONS	
apa	As per applicant
TDC	Top Dead Centre
IS	Indian Standard
LHS /RHS	Left Hand Side/ Right Hand Side
Hg	Mercury
Temp.	Temperature
N.R.	Not recorded
rpm	Revolutions per minute
O.D/I.D	Outer diameter/ Inner diameter
N.A.	Not available/Not applicable
PTO	Power take-off
R.H.	Relative Humidity
SIP	Seat Index Point



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The "Swaraj 855 FE" tractor had undergone 'Initial Commercial Test' at this Institute and a test report No. T-469/934 released in March, 2003. Thereafter, the firm had made modification in the specification of the tractor and permanently incorporated since tractor produced with engine number & chassis number 47.3030/SPD03164 and WWCH61617945917. The modification version of tractor was tested under supplementary test vide test report No. T-1117/1643/2017, released in November, 2017. Now the applicant has submitted an application vide letter No. 20/1606076 dated 29.06.2016 for Batch testing of "Swaraj 855 FE".



All necessary tests as per table-1 of clause 6.0 of IS: 5994 - 1998 (Reaffirmed in 2009) were carried out and test report released as under.

Manufacturer	: M/s. Mahindra & Mahindra Ltd., Farm Equipment Sector, Swaraj Division, Phase-IV, Industrial Area, S.A.S. Nagar, Mohali, Punjab - 160055
Test requested by	: The manufacturer
Selected for test by	: The testing authority
Place of running-in	: At manufacturer's works
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.

1. SPECIFICATIONS

1.1 Tractor:	
Make	: Swaraj
Model	: 855 FE
Brand name	: Swaraj
Type	: Four wheeled, Rear-wheel driven, General Purpose Agricultural Tractor.
Year of manufacture	: 2016
Chassis number	: WYCN61929930085
Country of origin	: India
1.2 Engine:	
Make	: M/s Swaraj Engine Ltd. & M/s Kirloskar Oil Engine Ltd.
Model	: RB33TR
Type	: Four stroke, water cooled, naturally aspirated, direct injection, diesel engine.
Serial number	: 47.5004/SWN16368
Year of manufacture	: 2016
Country of origin	: India
1.2.1 Engine speed (rpm), (Manufacturer's recommended production settings):	
- Maximum speed at no load	: 2100 to 2200
- Low idle speed	: 580 to 700
- Speed at maximum torque	: 1000 to 1400
Rated speed, (rpm):	
- For PTO use	: 2000
- For drawbar use	: 2000



1.3	Cylinder & Cylinder Head:	
	Number	: Three
	Disposition	: Vertical, Inline
	Bore/stroke, (mm)	: 110 / 116 (apa)
	Capacity as specified by the applicant, (cc)	: 3308
	Compression ratio	: 17:1
	Type of cylinder head	: Individual
	Type of cylinder liners	: Wet, replaceable
	Type of combustion chamber	: Re-entrant cavity on piston crown
	Arrangement of valves	: Overhead
	Valve clearance (cold/hot):	
	- Inlet valve, (mm)	: 0.25 - 0.30/0.25 - 0.30
	- Exhaust valve, (mm)	: 0.30 - 0.35/0.30 - 0.35
1.4	Fuel System:	
	Type of fuel feed system	: Gravity and force feed
1.4.1	Fuel tank:	
	Capacity, (l)	: 58.8
	Location	: Above clutch housing
	Provision for draining of sediments/ water	: Provided
	Material of fuel tank	: Metallic
1.4.2	Water separator:	
	Make	: Alert
	Type	: Inverted funnel type
	Model/Group combination No.	: Not available
	Location	: In between fuel tank & feed pump on LHS
1.4.3	Fuel feed pump:	
	Make	: Bosch, India
	Type	: Plunger
	Model/Group combination No.	: FP/KSG 22AD105, F 002 A50 040
	Provision of sediment bowl	: Provided
	Method of drive	: Through camshaft of fuel injection pump
1.4.4	Fuel filters:	
	Make	: Bosch, India
	Model/Group combination No.	: F 002 H20 105
	Number	: Two
	Type of elements:	
	- Primary	: Cloth
	- Secondary	: Paper
	Capacity of final stage filter, (l)	: 0.43
1.4.5	Fuel Injection pump:	
	Make	: Bosch, India
	Model/Group combination No.	: F002 AOZ 470, PES3A90D320RS2000
	Type	: Inline, Plunger
	Serial number	: 65869593
	Method of drive	: Through timing gears



- 1.4.6 Fuel injectors:**
- Make : Bosch, India
 Holder Number : F002 C70 552
 Nozzle Number : DSLA 154P 1542
 Type : Multi hole (Five holes)
 Manufacturer's production pressure setting, (MPa) : 25.0 +0.8
 Injection timing : 13 ± 1 °BTDC
 Firing order : 1 - 2 - 3
- 1.4.7 Governor:**
- Make : Bosch, India
 Model/Group combination No. : RSV325...1000A1C1377R
 Type : Mechanical, centrifugal variable speed
 Governed range of engine speed, (rpm) : 580 to 2200
- 1.5 Air intake system:**
- 1.5.1 Pre-cleaner:**
- Make : Swaraj
 Type : Centrifugal with transparent dust collector.
 Location : Above main air cleaner inlet tube, outside the bonnet.
- 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) : 3.2 to 3.3
 Maintenance schedule : First change after every 50 hours of operation in normal condition and 8 to 10 hours in dusty condition.
- 1.6 Exhaust System:**
- Type of silencer : Updraft, Cylindrical
Position of silencer outlet with respect to SIP, (mm):
 - Vertical : 930
 - Longitudinal : 1450
 - Lateral : 460 (on RHS)
 Range of exhaust gas pressure at maximum power (kPa) : 10.7 to 10.8
 Provision of spark arresting device : Not provided
 Provision against entry of rain water : A bend is provided at the top of silencer
- 1.7 Lubricating system:**
- Type : Forced feed-cum-splash
 Oil sump capacity,(l) : 7.5
 Total lub oil capacity, (l) : 8.2
 Oil change period : First change after 50 hours and subsequently after every 250 hours of operation
 Type of cooling device, (if any) : Plate type oil cooler having three numbers of plates.



1.7.1	Filters:		
	Type	:	Spin-on, throw away
	Number	:	One
1.7.2	Pump:		
	Type	:	Gear type (External gear)
	Method of drive	:	Through crankshaft gear.
	Pressure release setting, (kPa)	:	550 ± 50
	Minimum permissible pressure, (kPa)	:	49
1.8	Cooling system:		
	Type	:	Forced circulation of water
	Brand name of the coolant	:	None
	Coolant water ratio	:	NA
1.8.1	Details of Pump	:	Centrifugal, semi open impeller of 78.5 mm diameter having Six vanes, and driven through crankshaft pulley by a cogged 'V'-belt & separate 'V' belt for the drive of alternator.
1.8.2	Details of fan	:	Suction type, having Six plastic blades of 375 mm diameter and mounted on water pump shaft.
	Means of temperature control	:	Thermostat
	Bare radiator capacity, (l)	:	2.65
	Coolant expansion tank capacity,(l)	:	0.9
	Total coolant capacity, (l)	:	8.0
	Radiator cap pressure, (kPa)	:	88
1.9	Starting System:		
	Type	:	Electrical, 12 V, DC
	Aid for cold starting	:	Not Provided
	Any other device provided for easy starting	:	None
1.10	Electrical System:		
1.10.1	Battery:		
	Make and model	:	Exide express & MHD 880
	Number	:	One
	Type	:	Lead Acid
	Capacity and rating	:	12V, 88 Ah at 20 hour discharge rating
	Location	:	On RHS of clutch housing in a separate box
1.10.2	Starter:		
	Make	:	Lucas TVS (apa)
	Model	:	2 SM114
	Type	:	Pre-engaging, solenoid operated
	Power rating	:	12V, 1.9 kW
	Serial number	:	Not available



- 1.10.3 Generator:**
- Make : Lucas TVS
 Model : A115
 Type : Alternator
 Serial number : Not available
 Output rating : 12V, 36 amp
 Method of drive : Through crank shaft pulley by a cogged V-belt
- 1.10.4 Voltage regulator** : In-built with alternator

1.10.5 Details of lights:
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)
Front Lights:				
- Head lights	2, 12V, 35/35W	1245	160 x 100	750
- Parking lights	2, 12V, 5W	1330	65 x 65	192
- Turn Indicators-cum-hazard lights	2, 12V, 21W	1330	70 x 65	125
Rear lights:				
- Tail-cum-brake light	2, 12V, 21/5W	1320	65 x 65	240
- Turn Indicators-cum-hazard lights	2, 12V, 21W	1320	70 x 65	170
Plough light (on RHS mudguard)	1, 12V, 35W	1500	125	190
Reflectors (Red)	2	1320	30 x 55	285
Registration plate Light	Part of rear light assembly			

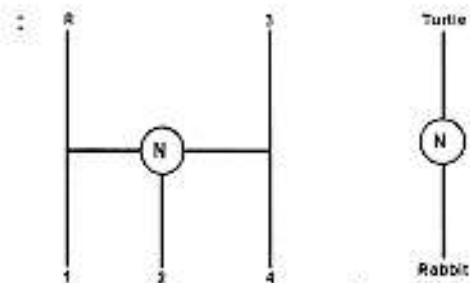
- 1.10.6 Main switch** : Key turn type, having three position viz:
 i) OFF
 ii) 'Circuit' ON
 iii) START
- 1.10.7 Light switch** : Rotary type having four positions viz.
 i) OFF
 ii) Parking lights + Dash board lights
 iii) Head lights (short beam) + (ii)
 iv) Head lights (long beam) + (ii)
- 1.10.8 Horn:**
- Make : Not available
 Type : 12 V, 2B, Electromagnetically vibrated diaphragm
 Location : In front of radiator, under the bonnet
- 1.10.9 Fuse box** : Contains 7 number of fuses of following capacity:

Capacity	15 A	10 A
No. of fuse	4	3

1.10.10	Details of other electrical accessories:	
1.10.10.1	Starting safety switch	: Engine will not start unless the High-Low range shift lever is in neutral position.
1.10.10.2	Flasher Unit:	
	Make	: Interface
	Capacity:	
	- Turn signal	: 12V, 21W x 2 + 2W x 1
	- Hazard signal	: 12V, 21W x 4 + 2W x 2
	Flashes/min.	: 85
1.10.10.3	Seven pin trailer socket	: Provided
1.11	Instrument panel details:	
	i)	Engine speed cum cumulative run hour meter (4 to 24) x 100 rpm
	ii)	Water temperature gauge (with colour zones)
	iii)	Fuel level gauge (with colour zones)
	iv)	Engine oil pressure gauge (with colour zones)
	v)	Starting switch (key-turn type)
	vi)	Light switch (Rotary type)
	vii)	Turn cum hazard indicator
	viii)	Turn indicator switch
	ix)	Hazard light switch
	x)	Head lamp (long beam) 'ON' indicator light
	xi)	Ampere meter (with colour zones)
	xii)	Fuel shut-off knob
	xiii)	Horn push button
	xiv)	Hand accelerator lever
	xv)	Steering control wheel
	xvi)	Rear View mirror
	xvii)	High low lever neutral indicator
	xviii)	Trailer engage indicator
1.12	Transmission System:	
1.12.1	Clutch:	
	Make	: Luk India
	Type	: Dual, dry friction plate
	No. of friction plate(s)	: Two
	Size, (mm):	
	-Main transmission clutch	: 279.6/165.8 Ø
	-PTO clutch	: 279.7/165.8 Ø
	Method of operation:	
	-Main transmission clutch	: By pressing LHS foot pedal halfway.
	-PTO clutch	: By pressing LHs foot pedal fully.
1.12.2	Gear box:	
	Make	: Swaraj
	Type	: Mechanical, Sliding mesh gears with epi-cyclic high-low reduction unit
	No. of speeds:	
	- Forward	: 08
	- Reverse	: 02
	Location of gear shifting levers	: In front of operator's seat



Gear shifting pattern



Gear selection lever

Range selection lever

Oil capacity, (l)

: 50.2 (common with differential, rear axle, hydraulic and brake system)

Oil changing period

: Change after every 1600 hours of operation.

1.12.3 Nominal Speed:

Movement	Gear No.	No. of engine revolutions for one revolution of driving wheel	Nominal speed at rated engine speed when fitted with 14.9-28 size tyres of 640 mm radius index, (kmph)
Forward	L1	183.69	2.63
	L2	139.43	3.46
	L3	83.97	5.75
	L4	61.52	7.84
	H1	46.64	10.35
	H2	35.45	13.61
	H3	21.32	22.63
	H4	15.61	30.91
Reverse	LR	145.77	3.31
	HR	37.28	12.94

1.12.4 Differential :

Type

: Crown wheel & pinion with differential unit accommodated inside the differential housing

Reduction through crown wheel & bevel pinion

: 3.231 : 1 (42/13 T)

Oil capacity (l)

: 50.2 (Common with gearbox, rear axle, brakes, final drive and hydraulic system)

Oil changing period

: Change after every 1600 hours of operation

Differential lock:**Not Provided****1.12.5 Rear axle & final drive:**

Type

: Bull & pinion type accommodated inside differential housing

Reduction through final drive

: 4.833 : 1 (58/12T)

Oil capacity of final drive, (l)

: 50.2 (Common with gearbox, differential brakes, and hydraulic system)

Oil changing period

: Change after every 1600 hours of operation.

1.13 Power lift (Hydraulic system):

- Make

: Swaraj

- Type

: Open centre, Live, ADDC

- No. and type of internal cylinder

: One, single acting

- Type of linkage lock for transport

: Hydraulic, response control valve in its fully closed position acts as a transport lock.

**1.13.1 Hydraulic pump:**

- Make & Model	: Rexroth
- Type	: Gear type (External)
- Location & drive	: On RHS of engine & driven through timing gears.
No. & Type of filter	: Two, one strainer at suction line & one spin on throw away type
Hydraulic oil capacity, (l)	: 50.2 (Common with gearbox, rear axle, brakes, final drive and hydraulic system)
Oil change period	: Change after every 1600 hours of operation.
Provision for external tapping	: Provided
Details of control levers	: i) Position control lever (Black) ii) Draft control lever (red) iii) Response control
Method of draft sensing	: Through top link

1.13.2 Three point linkage:

Sl. No.	Observations	As per IS:4468-1997(Part-I) (Cat.I / Cat.II), (mm)	As measured (mm)	Remarks
I.	Upper hitch points:			
	a) Dia of hitch pin hole	19.30 to 19.50 / 25.70 to 25.90	25.90	Conforms to cat II
	b) Width of ball	44.0 (max.) / 51.0 (max)	51.0	-do-
II.	Lower hitch points:			
	a) Dia of hitch pin hole	22.40 to 22.65 / 28.70 to 29.00	29.0	-do-
	b) Width of ball	34.8 to 35.0 / 44.8 to 45.0	45.0	-do-
III.	Lateral distance from lower hitch point to centre line of tractor	359 / 435	364	Does not conform
IV.	Lateral movement of lower hitch points	100 (min) / 125 (min)	250	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	Conforms to Cat I
VI.	Transport height	820 (min) / 950 (min)	970	Conforms to Cat I & II
VII.	Power range (Without force)	560 (min) / 650 (min)	620	Conforms to Cat I
VIII.	Leveling adjustment	100 (min) / 100 (min)	500	Conforms to Cat I & II
IX.	Lower hitch point tyre clearance	100 (min) / 100 (min)	200	-do-
X.	Lower hitch point height	200 (max) / 200 (max)	200	-do-

1.13.3 Linkage geometry dimensions [Refer Fig.-1(A)]:

The following are dimensions observed, corresponding to 640 mm as tyre dynamic radius index:

Sl. No.	Parameter	Notation	Dimension or range, (mm)	Setting used during test, (mm)
1.	Length of lower link	A	780	780
2.	Length of lift arm	B	240	240
3.	Length of lift rods	C	605 to 720	665
4.	Length of top link	D	520 to 680	520
5.	Distance of lift rod connection point from pivot point of lower link.	E	400 & 450	450
6.	Distance of lower link pivot point from rear wheel axis:			
	-Horizontally	F	100, behind	100, behind
	-Vertically	G	165, below	165, below
7.	Distance of upper link pivot point from rear wheel axis:			
	-Horizontally	H	355, 360 & 360, behind	360, behind
	-Vertically	J	255, 285 & 310, above	285, above
8.	Distance of lift arm pivot point from rear wheel axis:			
	-Horizontally	K	70, forward	70, forward
	-Vertically	L	350, above	350, above
9.	Height of lower hitch points relative to the rear wheel axis:			
	- In high position	M	135 to 330	180
	- In low position	N	-600 to -205	440
10.	Height of lower link hitch points when locked in transport position	--	Any height within the power range	180

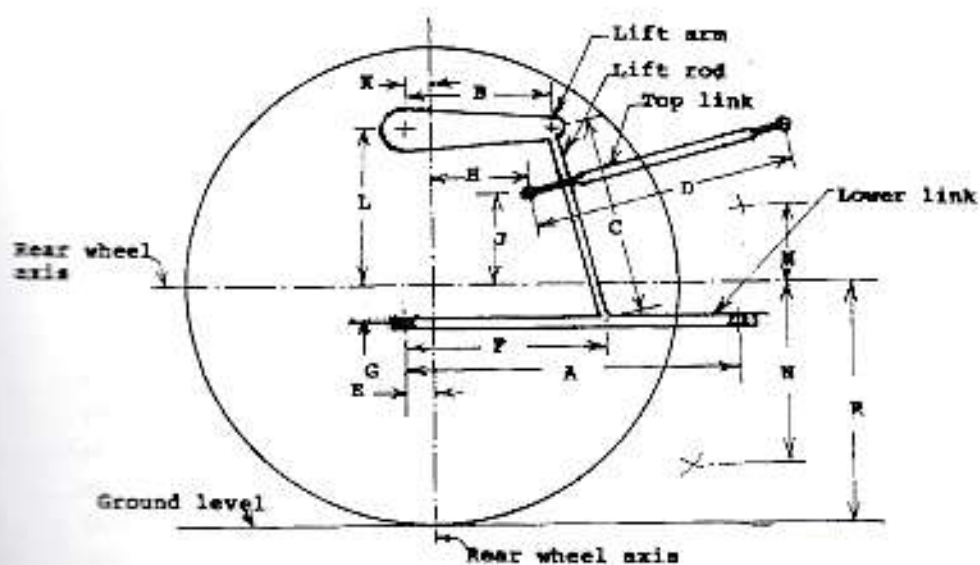


Fig. 1 (A): DIMENSIONAL NOTATIONS FOR TABLE OF LINKAGE GEOMETRY



1.13.4 Drawbar:

1.13.4.1 Linkage Drawbar [Refer Fig. 1 (B)]:

Notation	As per IS: 12953-1995 (Cat. I)/(Cat. II) (mm)	As measured, (mm)	Remarks
A	$683 \pm 1.5 / 825 \pm 1.5$	682	Conforms to cat I
B	75 (min) / 75 (min)	75.0	Conforms to cat I & II
C	30 (min) / 30 (min)	35.3	Conforms to cat I & II
D \varnothing	21.79 to 22.00 / 27.79 to 28.00	27.92	Conforms to cat II
E	39.0 (min) / 49.0 (min)	55.5	Conforms to cat I & II
F \varnothing	12.0 (min) / 12.0 (min)	12.53	-do-
G	15.0 (min) / 15.0 (min)	16.0	-do-
H \varnothing	$25 \pm 1 / 25 \pm 1$	24.88	-do-
J	$80 \pm 1.5 / 80 \pm 1.5$	79.5	-do-
No. of holes	7 / 9	7	Conforms to cat I

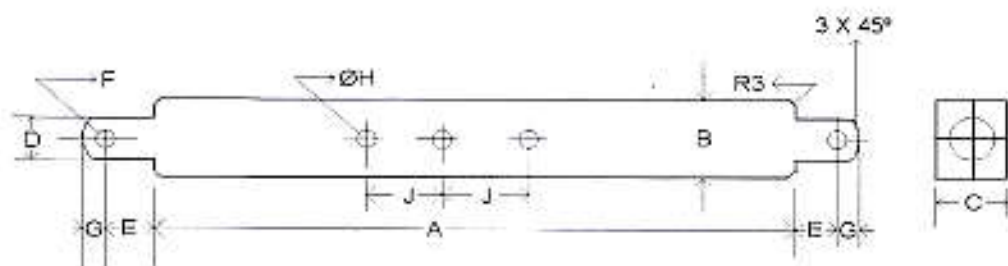


Fig. 1 (B): DIMENSIONAL NOTATIONS FOR LINKAGE DRAWBAR

1.13.4.2 Swinging drawbar : Not provided

1.13.4.3 Provision to attach trailer brake valve : Provided

1.14 Power take-off shaft:

Type : 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 of 2000 (rpm) : 653
 Distance behind rear axle, (mm) : 360
 Engine to PTO speed ratio : 3.0625 : 1
 Whether the PTO shaft is capable of transmitting the full power of engine : Yes
 Other speeds corresponding to rated engine speed : None



1.14.2 Specifications of Power Take-Off Shaft: [Refer Fig. 2]

Specification	As per IS:4931-1995 (Type-I)	As observed	Remarks
Nominal speed (rpm)	540 ± 10	540 rpm of PTO shaft corresponds to 1654 rpm of engine.	Conforms
No. of splines	6	6	-do-
Direction of rotation	Clockwise	Clockwise	-do-
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 LHS of the center line of the tractor	-do-
Dimensions (mm) [Refer Fig. 2(a)]:			
D \varnothing	34.79 ± 0.06	34.76	Conforms
d \varnothing	28.91 ± 0.05	28.86	-do-
B \varnothing	29.4 ± 0.1	29.35	-do-
A \varnothing (Optional)	8.3 ± 0.1	8.56	Doesn't conform
W	8.69 - 0.09 - 0.16	8.56	Conforms
a	7	7	-do-
b (Optional)	25 ± 0.5	25	-do-
c	38	38	-do-
X	30°	30°	--do--
B	76 (min)	78	--do--
h	450 to 675	640	--do--

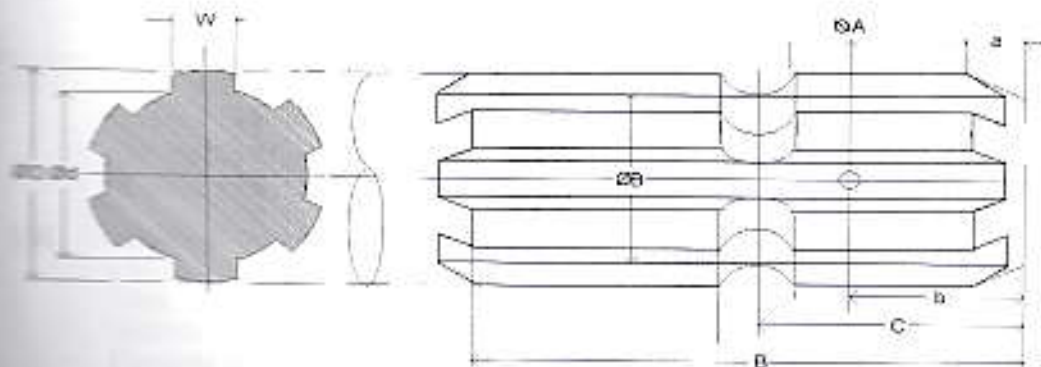


Fig. 2 (a): DIMENSIONAL NOTATIONS FOR TYPE-I POWER TAKE-OFF SHAFT

1.14.3 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
k	70 (min)	70	Conforms
m	125±5	125	Conforms
n	85±5	80	Conforms
p	285±5	285	Conforms
r	76 (max.)	0	Conforms

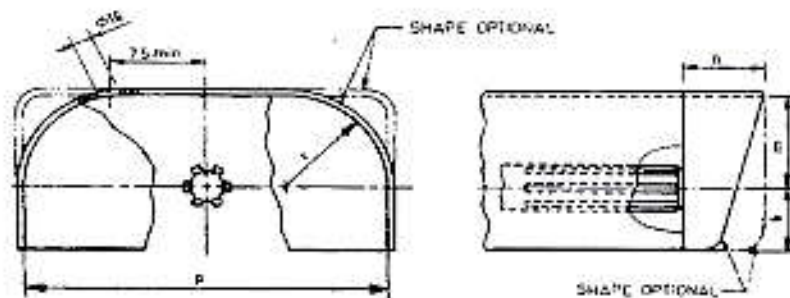


Fig. 2 (b): DIMENSIONAL NOTATIONS OF PTO SHAFT MASTER SHIELD

- 1.15 Towing hitch:**
- 1.15.1 Front:**
- | | |
|---------------------------------|------------------------------|
| Type | : Clevis |
| Location | : At front of engine support |
| Height above ground level, (mm) | : 685 |
| Type of adjustment | : Fixed |
| Width of clevis, (mm) | : 63 |
| Dia of pin hole, (mm) | : 29 |
- 1.15.2 Rear:**
- | | |
|----------------------------------|---|
| Type | : Clevis |
| Location | : At rear of transmission housing |
| Height above ground level, (mm): | |
| - Maximum | : 800 |
| - Minimum | : 560 |
| No. of position | : 6 |
| - Type of adjustment | : By changing the position of hitch on its mounting bracket and by reversing the hitch. |
| Distance of hitch point, (mm): | |
| - From rear axle centre | : 450 |
| - From power take-off shaft end | : 90 |
| Dia of pin hole, (mm) | : 35.4 |
| Width of clevis, (mm) | : 79.4 |
- 1.16 Steering:**
- | | |
|---|---|
| Make | : Danfoss |
| Type | : Hydrostatic (power steering) |
| Location | : Above transmission housing |
| Diameter of steering control wheel, (mm) | : 425 |
| Make & type of Steering drive pump | : Dowty & external gear type |
| Location | : Mounted on RHS of engine |
| Method of drive | : Through timing gears |
| Make, type & number of hydraulic ram cylinder | : Ognibane, double acting, one |
| Location of ram cylinder | : Behind the front axle, on LHS |
| Oil capacity of steering system, (l) | : 1.2 |
| Oil change period | : Change after every 1600 hours of operation. |



- 1.17 Brakes:**
- 1.17.1 Service Brake:**
- Make : JMIL
- Type : Mechanical, oil immersed multidisc
- Location : On half rear axle shaft on both side of final drive
- No. of discs : Four (on each wheel side)
- Area of liners. (cm²) : 918.8 (on each wheel side)
- Material of liners : Paper based (apa)
- Method of operation : Individual /combine RHS foot pedal operation.
- 1.17.2 Parking Brake:**
- Type : Pawl & ratchet arrangement for locking service brake discs.
- Method of operation : By locking the service brake discs through a separate hand lever provided on RHS of operator's seat.
- 1.18 Wheel Equipment:**
- 1.18.1 Steered Wheel(s):**
- Make : GOOD YEAR
- Number : Two
- Type of tyre : Pneumatic, ribbed
- Size : 7.50 -16
- Ply rating : 8
- Maximum permissible loading capacity of each tyre at 370 kPa pressure, (kgf) : 870
- Recommended inflation pressure, kPa :**
- for field work : 235
- for transport : 235
- Track width, (mm) : 1380 (Std.),1440,1290,1270
- Method of changing track width : By reversing the wheel disc & extending the telescopic axle.
- Make & size of rim : WIL & 5.50F x 16
- 1.18.2 Driving wheel:**
- Make : GOOD YEAR
- Number : Two
- Type of tyre : Pneumatic, traction
- Size : 14.9 -28
- Ply rating : 12
- Maximum permissible loading capacity of each tyre at 230 kPa pressure, (kgf) : 2120
- Recommended inflation pressure, kPa:**
- for field work : 98
- for transport : 108
- Track width, (mm) : 1350,1420 (Std), 1520,1640,1700 & 1820
- Method of changing track width : By reversing the wheel disc and changing position of wheel disc on offset rim lugs.
- Make & size of rim : SSWL & W 13 x 28



- 1.18.3 **Wheel base, (mm)** : 2105
 Method of changing wheel base, if any : None
- 1.19 **Operator's seat:**
 Make : Not available
 Type : Cushioned with back rest
 Type of suspension : Two Helical coil springs
 Type of damping : Hydraulic shock absorber
Range of adjustment,(mm):
 - Vertical : Nil
 - Lateral : Nil
 - Longitudinal : ± 65
- 1.20 **Provision for safety and comfort of operator:**
- 1.20.1 **Conformity with IS: 12343-1998: (Re-affirmed in March, 2009).**
 Operator's seat meets all the requirements, **except the following:**
 i) Vertical distance from seat index point to center of clutch pedal.
- 1.20.2 **Conformity with IS: 6283 (Part-1) – 2006 (Re-affirmed in March, 2009) & IS: 6283 (Part-2) – 2007 (Re-affirmed in March, 2009):**
 Controls are identifiable with symbols meets the requirements.
- 1.20.3 **Conformity with IS:8133-1983 (Re-affirmed in March, 2009):**
 Location and movement of various controls meets the requirement.
- 1.20.4 **Conformity with IS: 12239 (Part-1)-1996 (Re-affirmed in February, 2012):**
 Meets the requirements of IS:12239 (Part-1)-1996, **except the following:**
 i) The spark arrester has not been provided in the exhaust system
- 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:**
 i) Differential lock is not provided.
 ii) The working clearance around the position control lever & and draft control is less than 70 mm.
- 1.20.6 **Conformity with IS: 14683 – 1999 (Re-affirmed in March, 2009) :**
 Lighting requirements conform to IS: 14683-1999.
- 1.20.7 **Rear view mirror:**
 Rear view mirror is provided
- 1.20.8 **Slow moving emblem:**
 Slow moving emblem has been provided.
- 1.21 **Labelling of tractor as per IS: 10273-1987 (Reaffirmed in March, 2009):**
Location of labeling :- The labelling plate riveted on LHS of gearbox housing provides the following information:

Name of Manufacturer	Mahindara & Mahindra Ltd., Swaraj Division
Make	SWARAJ
Model	855 FE
Engine Number	47.5004/SWN16368
Chassis Number	WYCN61929930085
Maximum P.T.O Power, kW	33.8
Specific fuel consumption, g/kWh	265

**1.22 Ballast Mass (kg):**

Particular		As used during drawbar test	As used during field test	As used during haulage test
			Dry land	
Front	C.I. weight	140	65	65
	Water	Nil	Nil	Nil
Rear	C.I. weight	560	400	160
	Water	320	Nil	Nil
Additional weight, if any		Nil	Nil	Nil

1.23 Masses:

Particulars		Mass of the tractor without operator but with all the liquid reservoirs full, (kg)		
		Front	Rear	Total
i)	With standard ballast	805	1320	2125
ii)	With ballast as used during drawbar performance test	1010	2135	3145
iii)	With ballast as used during haulage test (including trailer hitch, canopy & linkage drawbar)	910	1485	2400

1.24 Overall dimensions:

Condition	Length, (mm)	Width, (mm)	Height, (mm)		Ground Clearance, (mm)
			With exhaust pipe	Without exhaust pipe	
With unballast	3475	1805	2270	1855 (at pre cleaner)	425 (Below tie rod)

1.25 Number of external lubricating points:

- Oiling : Nil
- Grease nipples : 19
- Grease cups : 02

1.26 Colour of tractor:

- Chassis : Gray
- Sheet metal:**
- Bonnet & Mudguard : Red & Cream white
- Rim & Disc : Cream white

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	SAE 20W40	As recommended
2.	Transmission, differential, final drive, brake, and hydraulic oil	IOCL Transtrac 30	Oil originally filled in the tractor was not changed
3.	Steering system	IOCL Transtrac 30	
4.	Grease	Multipurpose grease	MP Grease

3. PTO PERFORMANCE TEST

Date(s) of test : 17.01.2017 to 19.01.2017

Tractor run at the Institute prior to start of : 2.7

PTO test (h)

Type of dynamometer bench used : Eddy current Fuchino ESF- 1000 S

- 3.1 The results of power take-off performance are tabulated in Table-1 and graphically represented in Fig. 3, 4 and 5.

Table - 1

Power, (kW)	Speed (rpm)		Fuel consumption			Specific energy (kWh/l)
	PTO	Engine	(l/h)	(kg/h)	Specific, (kg/ kWh)	
1	2	3	4	5	6	7
a) Maximum power – 2 hours test:						
33.8	653	1999	10.39	8.69	0.257	3.26
32.0	653	2000	9.94	8.31	0.260	3.22*
b) Power at rated engine speed (2000 rpm):						
33.8	653	1999	10.39	8.69	0.257	3.26
32.0	653	2000	9.94	8.31	0.260	3.22*
c) Power at standard power take-off speed (540 ± 10 rpm):						
31.5	539	1650	9.02	7.54	0.239	3.49
29.7	540	1654	8.61	7.20	0.242	3.45*
d) Varying loads at rated engine speed:						
i) Torque corresponding to maximum power available at rated engine speed:						
33.8	653	1999	10.39	8.69	0.257	3.26
ii) 85% of the torque obtained in (i):						
29.5	669	2048	9.19	7.68	0.260	3.21
iii) 75% of the torque obtained in (ii) :						
22.3	675	2067	7.26	6.07	0.272	3.07
iv) 50% of the torque obtained in (ii) :						
15.2	687	2104	5.73	4.79	0.315	2.65
v) 25% of the torque obtained in (ii) :						
7.9	694	2125	4.21	3.52	0.463	1.81
vi) Unloaded:						
1.7	698	2137	3.09	2.58	1.518	0.54

1	2	3	4	5	6	7
iv) Varying loads at Standard PTO Speed:						
i) Torque corresponding to maximum power available at rated engine speed:						
21.5	539	1650	9.02	7.54	0.239	3.49
ii) 85% of the torque obtained in (i):						
27.7	557	1706	7.93	6.63	0.239	3.49
iii) 75% of the torque obtained in (ii) :						
23.8	559	1712	6.17	5.16	0.248	3.38
iv) 50% of the torque obtained in (ii) :						
14.1	566	1733	4.65	3.89	0.277	3.02
v) 25% of the torque obtained in (ii) :						
7.1	571	1748	3.29	2.75	0.386	2.16
vi) Unloaded:						
1.3	575	1761	2.21	1.85	1.480	0.57

Under high ambient conditions

	Natural ambient	High ambient
-No load maximum engine speed (rpm)	2137	2132
-Equivalent crankshaft torque at maximum power, (Nm)	161.7	152.8
-Maximum equivalent crankshaft torque (Nm)	205.1	193.8
-Engine speed at maximum equivalent crankshaft torque (rpm)	1249	1299
-Backup torque, (%)	26.8	-
-Smoke level, maximum light absorption coefficient, (per meter)	0.28	-
-Range of atmospheric conditions:		
Temperature (°C)	27 to 29	42 to 45
Pressure, (kPa)	98.9 to 99.6	100.9 to 101.2
Relative humidity (%)	37 to 45	15 to 29
-Maximum temperatures, (°C):		
Engine oil	92	100
Coolant	80	92
Fuel	45	60
Air intake	28	44
Exhaust gas	491	501
-Pressure at maximum power:		
Intake air, (kPa)	3.2 to 3.3	3.1 to 3.2
Exhaust gas, (kPa)	10.6 to 10.8	10.8 to 11.1
-Consumptions :		
Lub oil, (g/kWh)	--	0.62
Coolant (% of total coolant capacity)	--	Nil

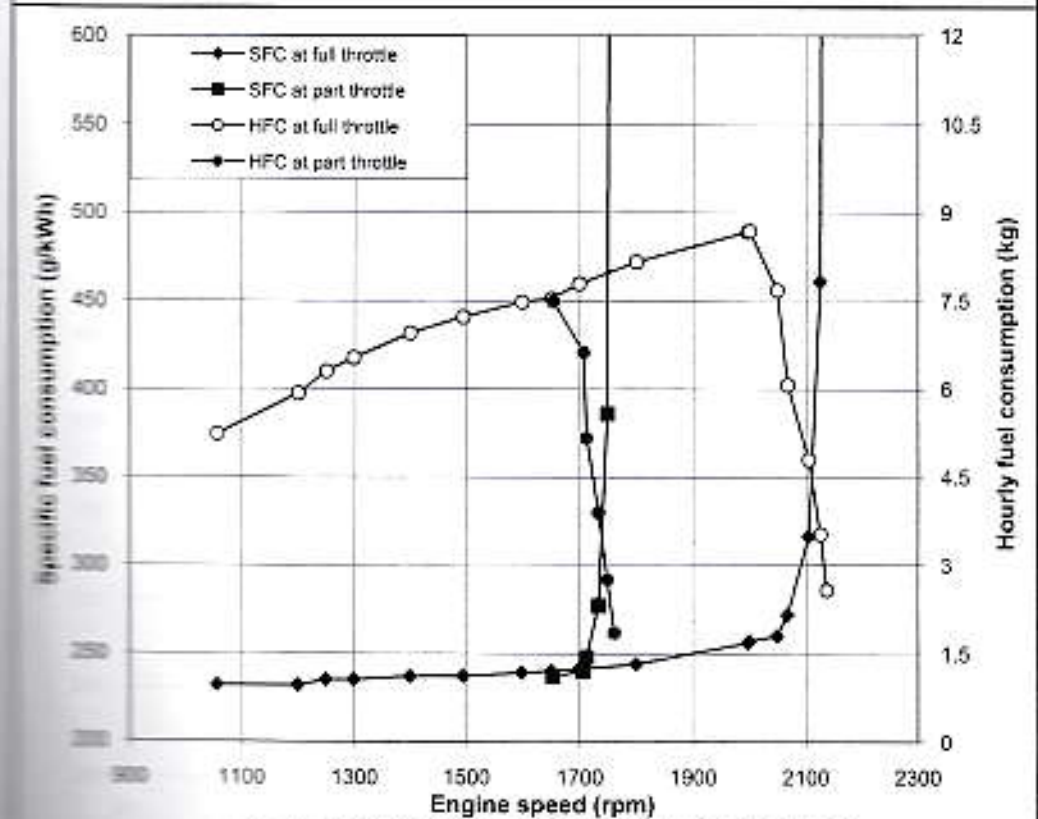
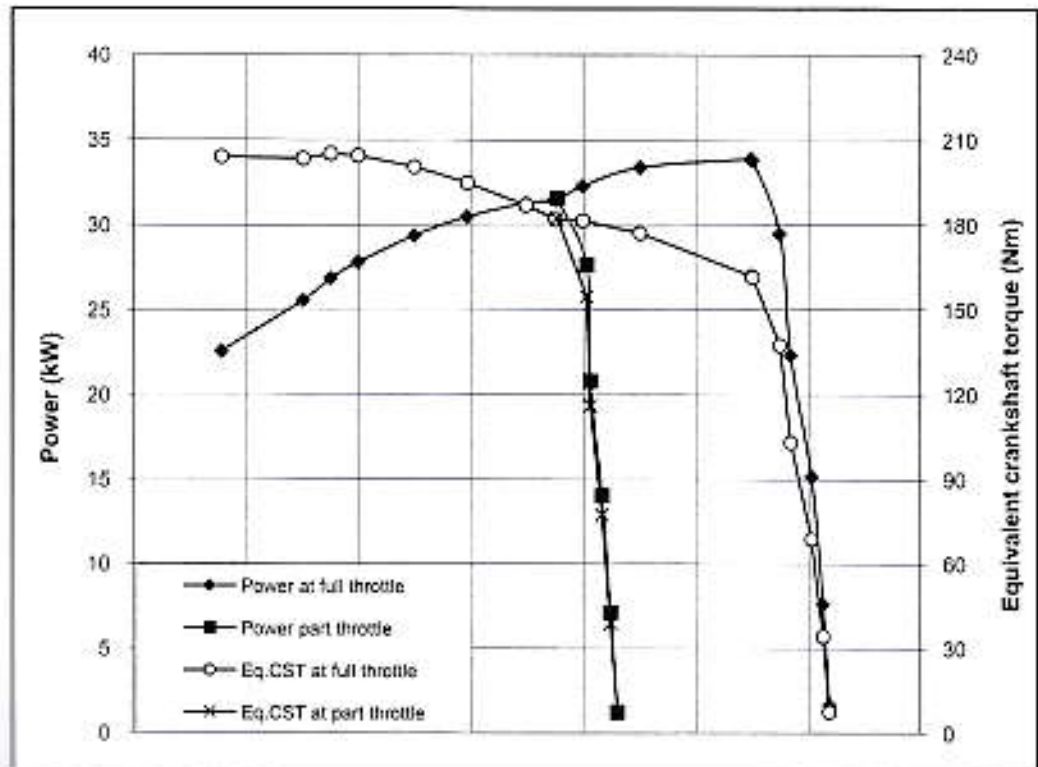


Fig.3: PTO PERFORMANCE CHARACTERISTICS (Natural ambient)

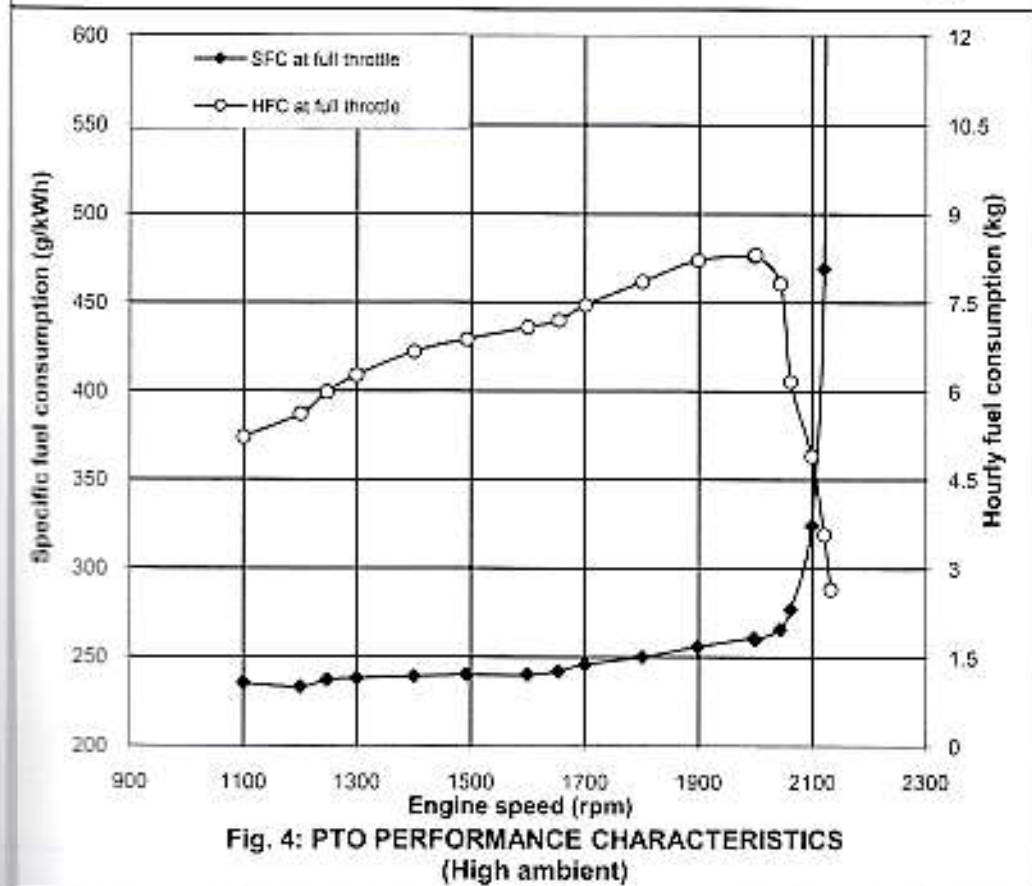
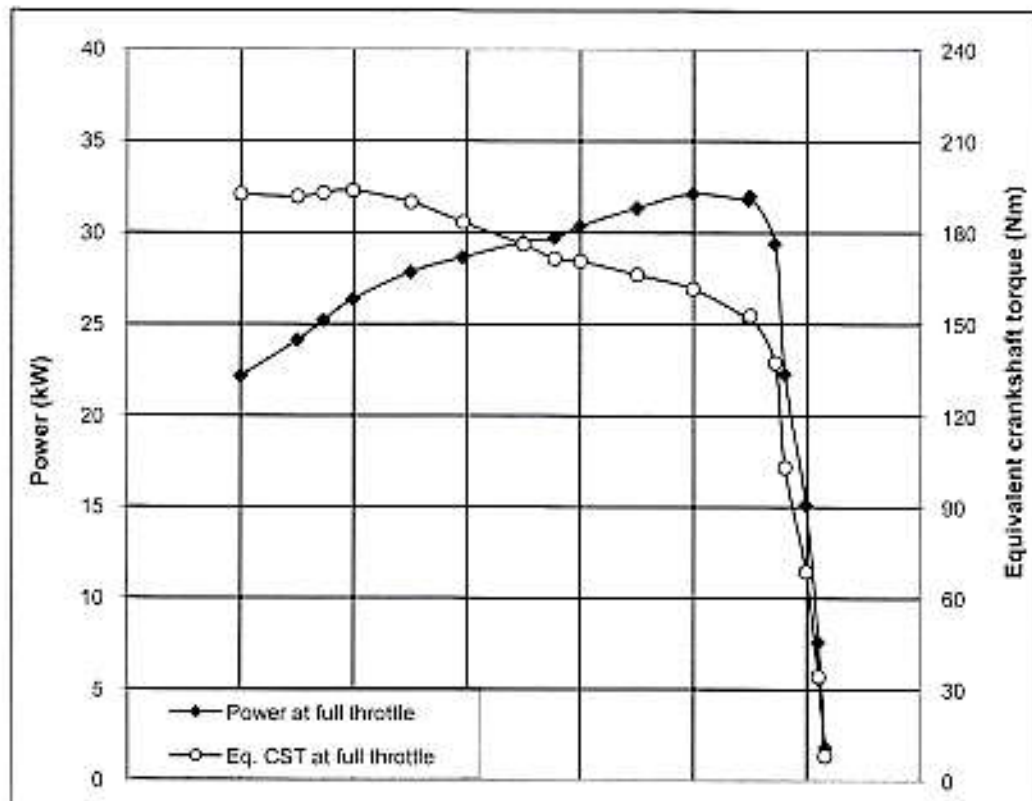
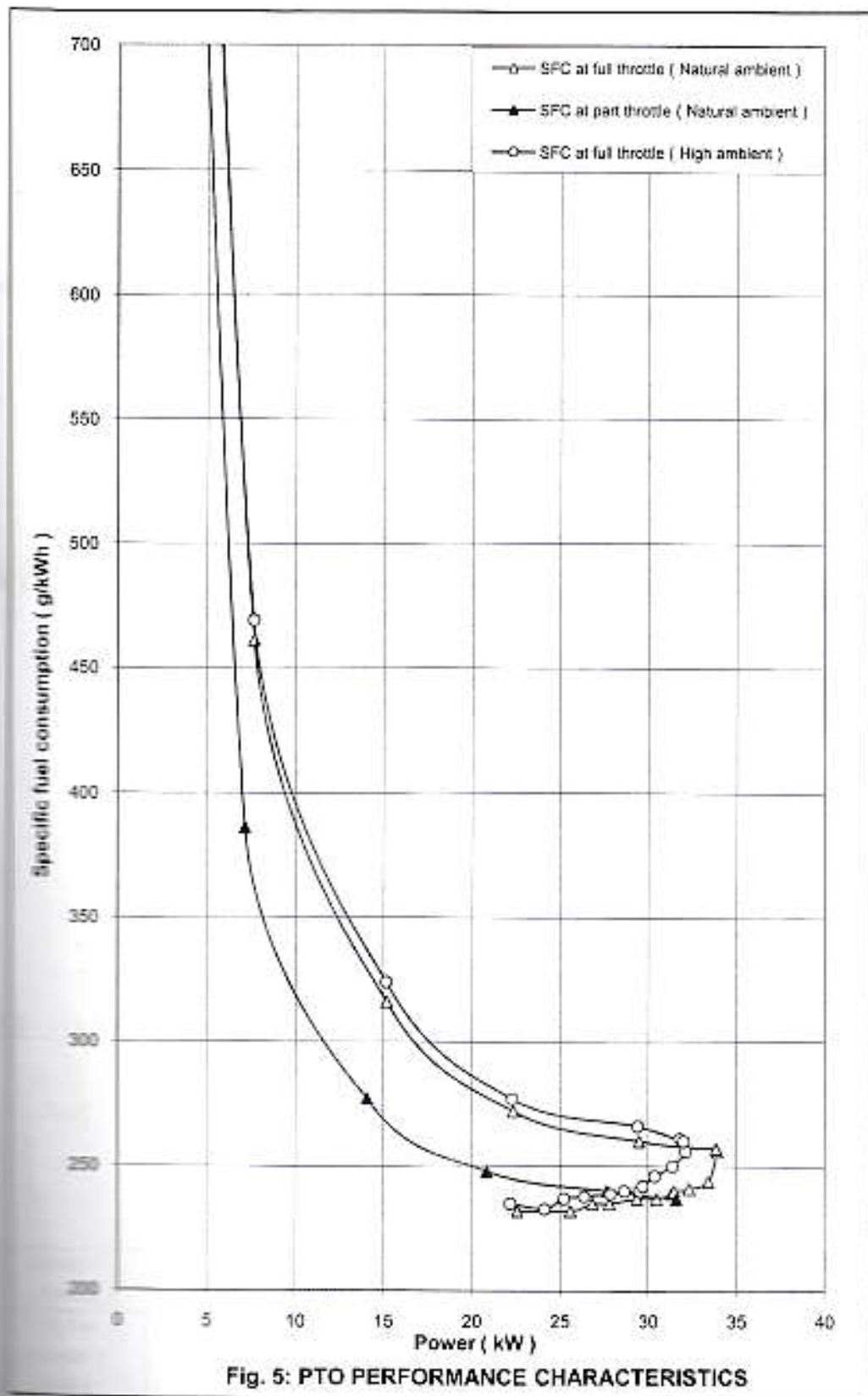


Fig. 4: PTO PERFORMANCE CHARACTERISTICS (High ambient)



4. DRAWBAR PERFORMANCE TEST

Date(s) of test	: 02.06.2017, 03.06.2017 & 04.06.2017
Tractor run at the Institute prior to start of drawbar performance test, (h)	: 45.1
Type of track	: Concrete
Height of drawbar, (mm):	
- With standard ballast	: 625
- With ballast	: 580



- 4.1 The results of drawbar performance test consisting of maximum power and pull with un ballast / with ballast and ten hours test are tabulated in **Table – 2** The results of the tests with ballast, are also represented graphically in **Fig. 6 & 7**.

5. POWER LIFT & HYDRULIC PUMP PERFORMANCE TEST

Date(s) of test	: 07.04.2017 & 10.04.2017
Tractor run at the Institute prior to start of hydraulic test, (h)	: 24.3
Pump speed at rated engine speed, (rpm)	: 1500 (apa)

5.1 Hydraulic power test:

Pump delivery rate at minimum pressure and rated engine speed, (l/min)	: 28.43
Maximum hydraulic power, (kW)	: 5.9
Pump delivery rate at maximum hydraulic power, (l/min)	: 25.1
Pressure at maximum hydraulic power, (MPa)	: 14.1
Sustained pressure of the open relief valve, (MPa)	: 15.4
Tapping point:	
a) Relief valve test	: External circuit
b) Pump performance test	: Pump outlet
Temperature of hydraulic fluid, (°C)	: 60 to 63

5.2 Lifting capacity test :

Test	Height of lower hitch point above ground in down position, (mm)	Vertical movement with lifting forces, (mm)	Maximum corrected force exerted through full range, (kN)	Corresponding pressure, (MPa)	Moment about rear axle, (kN-m)	Maximum tilt angle of mast from vertical (degrees)
At hitch points	200	615	15.62	13.9	13.75	--
On the standard frame	200	620	13.19	13.9	19.65	11.5



Table - 2

DRAWBAR PERFORMANCE TEST

Gear	Travel Speed, (km/h)	Draw-bar power, (kW)	Draw-bar pull, (kN)	Engine Speed, (rpm)	Wheel Slip, (%)	Fuel consumption		Specific Energy, (kWh/l)	Atmospheric conditions					Temperature (°C)			Max. sustained pull, (kN)
						(kg/kWh)	(lh)		Temp (°C)	Pressure (kPa)	R.H. (%)	Fuel	Trans oil	Coolant (water)	Eng. inlet		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
i) Maximum power test (Tractor Unballasted):																	
L1	2.37	11.7	17.78	2106	15.1	0.424	5.93	1.97	33	96.1	46	39	63	77	87	18.75	
L2	3.09	15.2	17.67	2080	14.8	0.380	6.91	2.20	31	96.1	51	38	61	77	86	18.76	
L3	5.03	25.1	17.91	2043	15.0	0.342	10.27	2.44	29	96.2	58	36	61	79	88	18.22	
L4	7.28	28.4	14.07	2008	8.2	0.306	10.40	2.73	28	98.1	59	35	56	79	86	18.12	
H1	9.81	27.6	10.12	2008	6.3	0.319	10.50	2.63	28	98.1	56	34	39	79	83	13.40	
ii) Maximum power test (Tractor ballasted):																	
L1	2.28	15.6	24.58	2075	15.2	0.392	7.32	2.13	32	98.2	51	38	64	77	88	24.79	
L2	3.00	21.0	25.23	2058	14.5	0.349	8.77	2.39	31	98.2	53	37	61	80	88	26.06	
L3	5.20	26.9	18.64	2001	8.3	0.315	10.14	2.65	30	98.2	55	36	59	80	85	23.63	
L4	7.23	27.6	13.74	1991	6.0	0.313	10.33	2.67	28	99.2	56	35	56	90	96	17.89	
H1	9.75	27.4	10.11	2005	4.7	0.319	10.42	2.63	27	98.1	55	34	50	79	83	12.83	

Contd..Table-2

G o a r	Travel Speed (km/h)	Draw- bar power, (kW)	Draw- bar pull, (kN)	Engine Speed, (rpm)	Wheel Slip, (%)	Fuel consumption		Specific Energy, (kWh/l)	Atmospheric conditions				Temperature (°C)			Max. sust- ained pull, (kN)
						(kg/ kWh)	(lh)		Temp (°C)	Pre- sure (kPa)	R.H. (%)	Fuel	Trans- oil	Coolant (water)	Eng- ine oil	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
iii) Five hours test at 75 percent of pull obtained at max. Power (ballasted wheeled tractor):																
L3	5.48	21.32	14.00	2066	7.0	0.330	8.50	2.51	28	97.9	51	35	50	78	50	--
iv) Five hours test at pull corresponding to 15 percent wheel slip (ballasted wheeled tractor):																
L2	2.95	20.73	25.26	2055	--	0.350	8.94	2.32	33	97.7	41	39	77	79	89	--
									38	98.3	54	47	80	83	92	

i) The coolant (water) and lub oil consumption during 10 hours test were observed as 5.0 ml/h and 5.0 ml/h respectively.

ii) Tyre Creeping. (mm):
- LHS : 35
- RHS : 40

iii) Maximum temperatures during entire drawbar test. (°C):
Engine oil : 92
Coolant (water) : 86
Transmission oil : 80
Fuel : 47



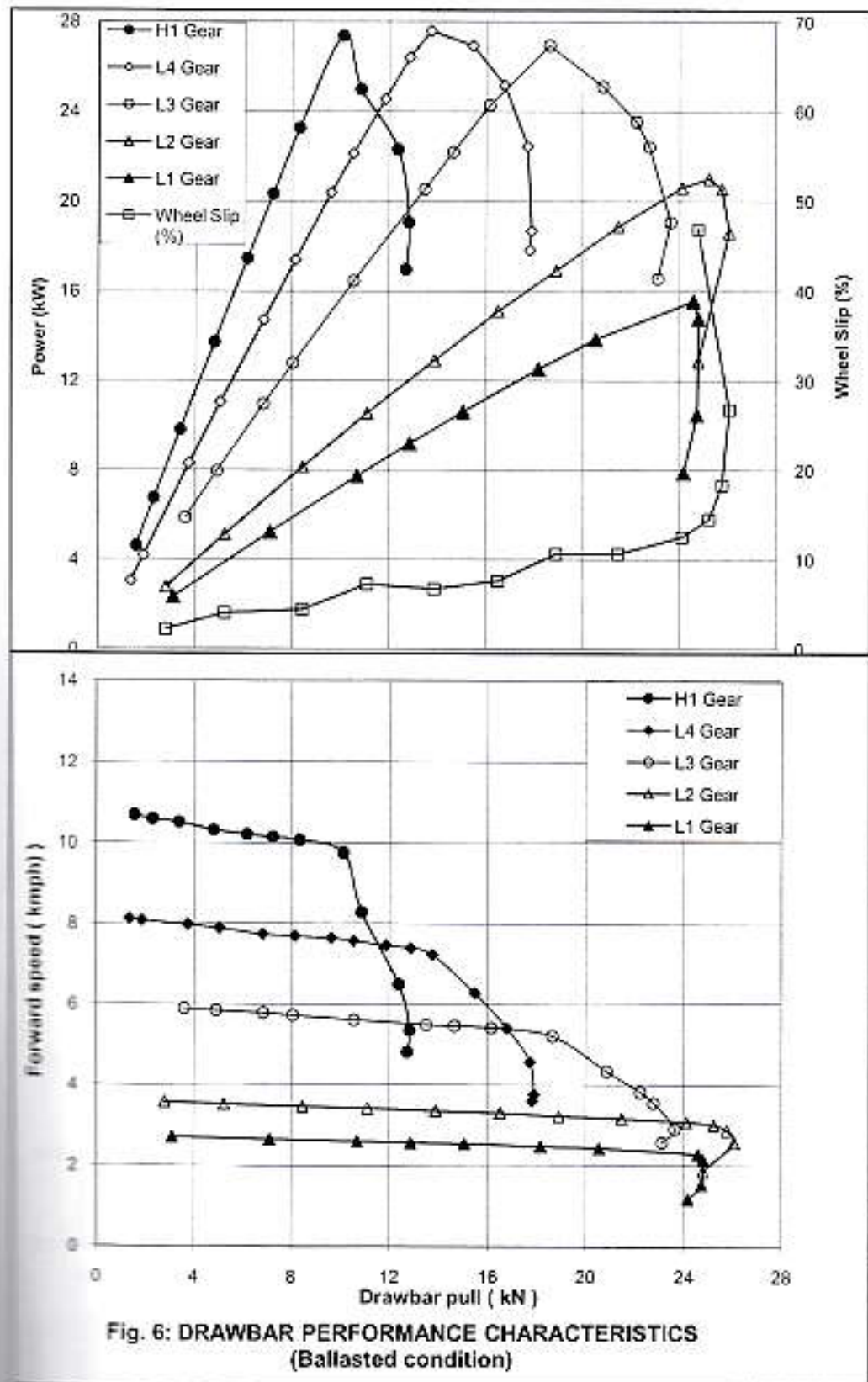


Fig. 6: DRAWBAR PERFORMANCE CHARACTERISTICS (Ballasted condition)

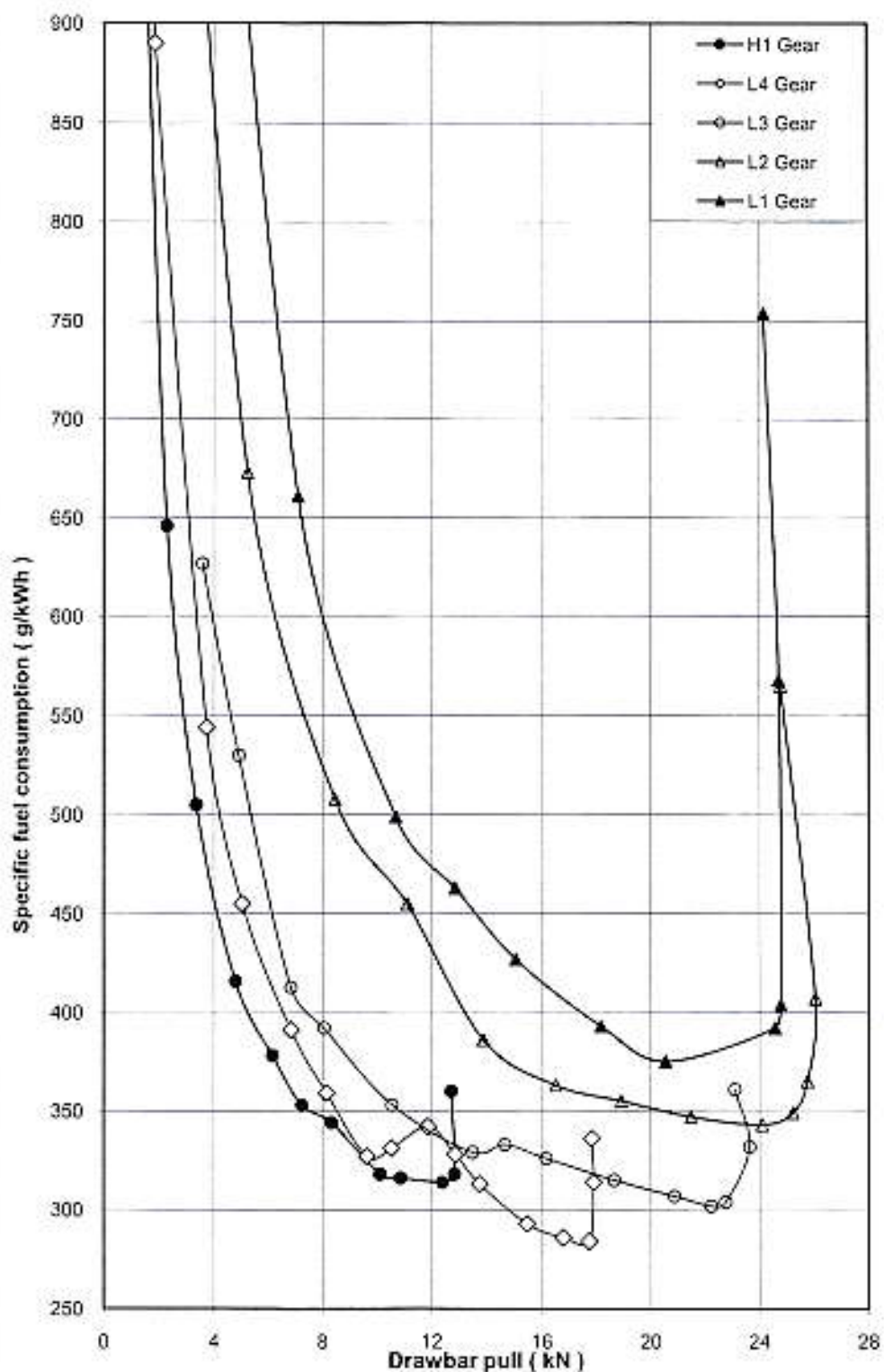


Fig.7: DRAWBAR PERFORMANCE CHARACTERISTICS
(Ballasted condition)



5.3 Maintenance of lift load:

Force applied at the frame. (kN) : 11.87
 Temperature of hydraulic fluid at the : 60
 start of test, (°C)

Test data:

Elapsed time (minute)	5	10	15	20	25	30
Cumulative drop in height of lift, (mm)	07	16	29	38	48	56

6. BRAKE TEST

6.1 Service brake:

6.1.1 Cold brake test:

Date of test(s) : 09.01.2017
 Type of Track : Concrete
 Maximum attainable speed (kmph):
 - With standard Ballast : 32.9
 - With Ballasted (Road work) : 32.9

		At maximum attainable speed			
Unballasted tractor	Braking device control, force (N)	569	457	345	232
	Mean deceleration, (m/sec ²)	3.55	3.22	2.85	2.50
	Stopping distance, (m)	11.93	12.99	14.66	16.70
Ballasted Tractor (Road work)	Braking device control force(N)	566	460	353	247
	Mean deceleration, (m/sec ² .)	3.34	3.07	2.74	2.50
	Stopping distance, (m)	12.27	13.61	15.23	16.70
		At 25 kmph travel speed			
Unballasted tractor	Braking device control, force(N)	551	431	312	192
	Mean deceleration, (m/sec ²)	3.33	3.03	2.76	2.50
	Stopping distance, (m)	7.37	7.97	8.75	9.65
Ballasted Tractor (Road work)	Braking device control force,(N)	516	420	324	229
	Mean deceleration, (m/sec ²)	3.37	2.99	2.79	2.50
	Stopping distance, (m)	7.47	8.06	8.66	9.65

6.1.2 Brake fade test:

		At maximum attainable speed			
Ballasted Tractor (Road work)	Braking device control force(N)	544	449	355	260
	Mean deceleration, (m/sec ²)	3.39	2.99	2.74	2.50
	Stopping distance, (m)	12.39	13.99	15.23	16.70
		At 25 kmph travel speed			
Ballasted Tractor (Road work)	Braking device control force,(N)	564	454	345	236
	Mean deceleration, (m/sec ²)	3.14	3.01	2.80	2.50
	Stopping distance, (m)	7.84	8.02	8.60	9.65

Maximum deviation of tractor from its : None
 original course, (m)

Abnormal vibration : None

The brakes were heated by : Self-braking

6.2 Parking brake test:

Particulars	18 percent slope		12 percent slope with trailer mass of 2.14 ton.	
	Facing up	Facing down	Facing up	Facing down
Braking device control force, (N)	410	425	300	341
Efficacy of parking brake	-----Effective-----			

7. NOISE MEASUREMENT**7.1 Noise at bystander's position:**

Date of test	: 13.02.2017
Type of track	: Concrete
Background noise level, dB (A)	: 54
Atmospheric conditions:	
Temperature, (°C)	: 31
Pressure, (kPa)	: 98
Relative humidity, (%)	: 48
Wind velocity, (m/s)	: 2.5

**TEST DATA:-**

S. No.	G e a r	Travelling speed before acceleration, (kmph)	Noise level, dB (A)
1.	L1	2.11	84
2.	L2	2.78	84
3.	L3	4.63	84
4.	L4	6.30	84
5.	H1	8.36	83
6.	H2	11.01	83
7.	H3	18.12	83
8.	H4	24.95	83

7.2 Noise at operator's ear level:

Date of test	: 02.06.2017
Type of track	: Concrete
Background noise level, dB(A)	: 54
Atmospheric conditions:	
Temperature, (°C)	: 34
Pressure, (kPa)	: 98.1
Relative humidity, (%)	: 39
Wind velocity, (m/s)	: 1.5

TEST DATA:

Gear	Drawbar pull at which the tractor develops the maximum noise level, (kN)	Corresponding travelling speed, (kmph)	Noise level dB (A)
L1	10.69 to 17.72	2.61 to 2.37	94
L2	14.44 to 17.82	3.31 to 3.07	94
L3	15.32 to 17.96	5.38 to 5.01	95
L4*	10.24 to 14.12	7.67 to 7.20	94
H1	4.96 to 10.12	10.54 to 9.81	94

* Gear corresponds to the nominal travelling speed nearest to 7.5 kmph.

8. AIR CLEANER OIL PULL-OVER TEST

Date of test : 20.01.2017

Tractor run at the Institute prior to start of : 18.7

air cleaner oil pull-over test, (h)

Atmospheric conditions:

Temperature, (°C) : 21 to 22

Pressure, (kPa) : 97.8 to 97.9

Relative humidity, (%) : 54 to 56

Mass of oil before test, (g) : 675.6



Sl. No	Position of tractor	Loss of oil (g)	Oil pull-over (%)	Engine oil pressure
i)	Tractor parked on level ground	0.0	0.00	Normal
ii)	Tractor tilted 15° laterally on RHS*	0.1	0.01	Normal
iii)	Tractor tilted 15° laterally on LHS*	0.2	0.03	Normal
iv)	Tractor tilted 15° longitudinally with front end up	0.2	0.03	Normal
v)	Tractor tilted 15° longitudinally with rear end up	0.0	0.00	Normal

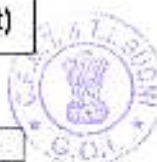
9. MECHANICAL VIBRATION MEASUREMENT

Date of test : 13.02.2017

Type of test surface : Concrete

Sl. No.	Measuring points		Vibration, microns			
			At no load		At load corresponding to 85% of maximum PTO power	
			VD	HD	VD	HD
i)	Foot rest	Left	90	60	190*	170*
		Right	240*	180*	100	260*
ii)	Steering control wheel		40	60	90	70
iii)	Seat	Bottom	160*	80	30	20
		Back	120*	180*	50	100
iv)	Mudguard	Left	30	30	80	80
		Right	30	90	100	90
v)	Head light	Left	100	40	210*	90
		Right	40	40	100	70
vi)	Battery base, centre		180*	180*	300*	240*
vii)	Tail light	Left	60	90	160*	90
		Right	60	60	100	60
viii)	Plough light		70	70	90	90
ix)	Gear shifting lever		30	50	30	40
x)	Accelerator lever	Hand	60	140*	110*	90
		Foot	100	60	60	100
xi)	Brake pedal	Left	60	40	40	90
		Right	90	70	90	100
xii)	Clutch pedal		60	60	60	80
xiii)	Main hydraulic control lever		30	30	40	50
xiv)	PTO engaging lever		30	20	30	30

*The amplitude of mechanical vibration is on higher side.



10. LOCATION OF CENTRE OF GRAVITY

Condition	Particulars	Coordinates
Tractor under unballasted condition but with all the liquid reservoirs full & the operator replaced by a 75 kg mass on the seat	Height above ground, (mm)	753.9
	Distance forward from the vertical plane containing the axis of rear wheels, (mm)	780.0
	Distance from the median plane parallel to the longitudinal axis of tractor bisecting the track, (mm)	16.6 (towards RHS)

11. TURNING ABILITY

Characteristics	Minimum turning diameter, (m)		Minimum clearance diameter, (m)	
	LHS	RHS	LHS	RHS
Brakes released	7.27	7.14	7.50	7.40
Brake applied	6.49	6.45	6.73	6.67

12. FIELD TEST

- 12.1** The field tests comprising of Disc ploughing, Rotavation and Puddling (including water proof test for five hours) were conducted for **10.7, 10.3 and 15.3** hours respectively. All the field tests were conducted at the full accelerator settings, when the no load speed of the engine varied from **2138 to 2174** pm.
- 12.2** The brief specifications of the implements used during field tests are given in **Annexure-I & II**.
- 12.3** The summary of field test observation with Disc plough, Rotavator and Puddling is given in **Table - 3**.

Table - 3

SUMMARY OF FIELD PERFORMANCE TEST

Sl. No.	Parameter/operation	Disc Ploughing	Rotavation	Puddling
i)	Type of soil	Sandy	Sandy	Heavy
ii)	Av. soil moisture, (%) / Av. Depth of standing water, (mm)	7 to 8	7 to 8	10 to 15
iii)	Bulk density of soil, (g/cc)	1.80 to 2.0	1.80 to 2.0	--
iv)	Cone index, (kg/sq.cm) / puddling index, (%)	6.29 to 8.51	6.81 to 7.66	80
v)	Gear used	L2	L2	L2
vi)	Av. speed of operation, (kmph)	3.08 to 3.38	3.63 to 3.66	2.77 to 2.79
vii)	Av. wheel slip, (%) / Av. Travel reduction, (%)	7.6 to 14.0	-2.0 to -1.1	9.3 to 9.9
viii)	Av. depth of cut, (cm) / Av. depth of puddle, (cm)	27 to 28	6	24 to 25
ix)	Av. working width, (cm)	90 to 99	155 to 167	--
x)	Area covered, (ha/h)	0.212 to 0.272	0.418 to 0.540	--
xi)	Fuel consumption:			
	- (l/h)	4.29 to 4.41	5.04 to 6.61	5.11 to 5.14
	- (l/ha)	15.77 to 20.80	9.33 to 15.81	--
xii)	Av. draft of implement, (kN)	5.09 to 5.29	--	--

Remarks: The average lub oil and coolant (water) consumptions during the entire field tests were observed as **5.51 and 2.76** ml/h respectively.

**12.4 Wet land cultivation (Puddling):**

12.4.1 The tractor was fitted with full cage wheel for carrying out the puddling operation. The brief specification of cage wheel used is given in **Annexure –II**.

12.4.2 After completion of puddling test and water proof test, the tractor was partially dismantled to check effectiveness of sealing provided against ingress of water and / or mud in various assemblies / components as per requirements of IS : 11082 – 1984 (Technical requirement of Agriculture tractors for wet land cultivation). The observations recorded were as under :

S. No.	Location	Whether ingress of mud and/or water	Remarks
1.	King pin assemblies	Yes	Droplets of water was found on RHS king pin.
2.	Stub axles	No	
3.	Centre pin assembly	No	
4.	Clutch housing	No	
5.	Brake housing	No	
6.	Engine sump, transmission, hydraulic, brakes & air cleaner oils	No	
7.	Starter motor	No	
8.	Alternator	No	

13. HAULAGE TEST

Type of trailer	:	Two wheel (Single axle)	Four wheel (Double axle)
Gross mass of trailer (tonne)	:	5.0	7.0
Height of trailer hitch above ground level, (mm)	:	635	630
Gear used during the test for negotiating slopes up to 8%	:	H-4	H-4
Average travel speed, (kmph)	:	30.41 to 31.33	31.81 to 32.31
Average fuel consumption:			
- (l/h)	:	6.40 to 7.08	6.69 to 6.87
- (ml/km/tonne)	:	43 to 45	30
Average distance traveled per liter of fuel consumption, (km)	:	4.42 to 4.70	4.70 to 4.75
General observations:			
Effectiveness of brakes	:	Effective	Effective
Maneuverability of tractor-trailer combination	:	Satisfactory	Satisfactory

14. COMPONENTS/ASSEMBLY INSPECTION

The engine and other assemblies were dismantled after **102.5** hours of tractor operation at this Institute.

14.1 Engine:**14.1.1 Cylinder bore:**

Cylinder No.	Cylinder bore dia. (mm)						Max. permissible wear limit, (mm)
	Top position		Middle position		Bottom position		
	Thrust side	Non-thrust side	Thrust side	Non-thrust side	Thrust side	Non-thrust Side	
1.	110.016	110.000	110.016	110.001	110.017	110.015	110.225
2.	110.012	110.025	110.010	110.018	110.012	110.015	
3.	110.031	110.011	110.027	110.007	110.018	110.010	



14.1.2 Piston:

Piston No.	Piston dia. (mm)				Piston to cylinder liner clearance at skirt (mm)	
	Top (above top compression ring)		At skirt		As observed	Max. permissible limit.
	Thrust Side	Non-thrust Side	Thrust side	Non-thrust side		
1.	109.345	109.350	109.874	**	0.143	0.60
2.	109.345	109.347	109.870	**	0.155	
3.	109.348	109.346	109.871	**	0.160	

**Not measured due to piston design

14.1.3 Ring end gap:

Rings	Ring end gap. (mm)									Maximum Permissible limit, (mm)
	Cylinder No.1			Cylinder No.2			Cylinder No. 3			
	Top	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	
1 st comp. ring	0.40	0.40	0.40	0.50	0.50	0.50	0.50	0.50	0.50	1.75
2 nd comp. ring	0.50	0.50	0.50	0.45	0.45	0.45	0.50	0.50	0.50	1.75
Oil ring	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.45	1.75

14.1.4 Ring side clearance:

Rings	Ring side clearance, (mm)			Maximum Permissible Limit, (mm)
	Piston-I	Piston-II	Piston-III	
1 st Compression ring	--Tapered--			--
2 nd Compression ring	0.053	0.057	0.051	0.25
Oil ring	0.065	0.064	0.068	0.25

14.1.5 Main bearings:

Bearing No.	Diametrical Clearance, (mm)	Crankshaft end float, (mm)	Maximum permissible limit, (mm)	
			Diametrical clearance	Crankshaft end float
1.	0.104 to 0.105	0.33	0.30	0.50
2.	0.105 to 0.108			
3.	0.105 to 0.106			
4.	0.110 to 0.112			

14.1.6 Big end bearings:

Bearing No.	Clearance, (mm)		Maximum permissible limit, (mm)	
	Diametrical	Axial	Diametrical	Axial
1.	0.131	0.20	0.30	0.60
2.	0.132 to 0.133	0.20		
3.	0.131 to 0.138	0.20		



14.1.7	Valve, guides and timing gears:	Observation	
	Any marked sign of overheating of valves	: None	
	Pitting of seat/faces of valves	: None	
	Any visual damage to the teeth of timing gears	: None	
	Spring rate, (N/mm):		
	- Intake valve spring :	22.06 to 22.80	Against discard limit of 9.8 N/mm
	- Exhaust valve spring:	22.11 to 22.65	
	Clearance between valve guide and valve stem, (mm):		
	- Intake valve :	0.051 to 0.063	Against discard limit of 0.25 mm
	- Exhaust valve :	0.061 to 0.063	
14.2	Clutch:		
	Any marked wear on clutch friction plates	: None	
	Condition of clutch release bearing	: Normal	
	Condition of springs and release levers	: Normal	
	Condition of pilot bearing	: Normal	
	Presence of oil in clutch housing	: None	
	Any marks on fly wheel/ pressure plate	: None	
	Overall thickness of clutch plate, (mm):		
	for PTO :	7.73 to 7.66	Discard limit wear upto rivet head.
	for transmission :	9.68 to 9.83	
	Height of lining over rivet head, (mm):		
	for PTO :	1.17 to 1.42	Discard limit wear up to rivet head fouling
	for transmission :	2.17 to 2.48	
14.3	Transmission gears:		
	Any visual damage, pitting & chipping of any transmission gear teeth.	: None	
	Backlash between crown wheel and pinion, (mm)	: 0.379	Not mentioned

14.4 Brakes:

Description	Initial specified thickness of brake lining, (mm)	Measured thickness of brake lining after test, (mm)	Height of brake lining over oil groove, (mm)	Minimum permissible height of brake lining above oil groove, (mm)
Left	4.75 ± 0.05	4.76 to 4.81	1.00 to 1.19	Wear till groove base
Right	4.75 ± 0.05	4.78 to 4.81	0.99 to 1.17	

14.5	Front axle:	Observation	
	Any marked wear of king pins	: None	
	Any marked wear of king pin bushes	: None	
	Clearance between king pin and bushes, (mm)	: 0.12 to 0.13	Against the discard limit of 0.60 mm.
	Condition of bearings for stub axles	: Normal	
	Condition of king pin bearings	: Normal	
	Condition of seals for stub axles and king pins	: Normal	
	Clearance between centre pin and bushes, (mm)	: 0.14	Against the discard limit of 0.80 mm.
14.6	Steering system:		
	Visual condition of the components of complete steering assembly	: Normal	
14.7	Starter motor & Alternator:		
	Presence of soil/oil in housing	: None	
	Condition of bearings and other components	: Normal	



15. ADJUSTMENTS, DEFECTS, BREAKDOWNS AND REPAIRS

Sl. No.	Adjustments/Defects/Breakdowns and Repairs	Tractor run hours
	None	

16. COMPARISON OF SPECIFICATION AND PERFORMANCE CHARACTERISTICS OF PREVIOUS SAMPLE (TEST REPORT No. T-469/934) AND PRESENT SAMPLE

		<u>Previous sample</u>	<u>Present sample</u>
16.1	Specification:		
16.1.1	Tractor:		
	Make	: Swaraj	Swaraj
	Model	: Swaraj 855 FE	855 FE
16.1.2	Engine:		
	Make	: Swaraj Kirloskar	M/s Swaraj Engine Ltd. & M/s Kirloskar Oil Engine Ltd.
	Model	: RB33TR	RB33TR
	Bore/Stroke, (mm)	: 110/116	110/116
	Specified cubic capacity, (cu.cm)	: 3308	3308
	Rated engine speed (rpm)	: 2000±35	2000
16.1.2.1	Fuel system:		
	Make & model of fuel feed pump	: MICO LIC Bosch & 9440 030 029	Bosch, India & F 002 A50 040
	Make & model of fuel filters	: Mico LIC Bosch & 9 450 030 100	Bosch, India & F 002 H20 105
	Make and model of fuel injection pump	: Mico LIC Bosch & 9400030694, PES3A90D320RS288	Bosch, India & F002 AOZ 470, PES3A90D320RS 2000
	Make & model of fuel injectors	: Mico LIC Bosch & 9 430 031 281	Bosch, India & F 002 C70 552 (Holder no) DSL A154P 1542 (Nozzle no)
	Type of injector	: Multiholes	Multiholes (05)

	<u>Previous sample</u>	<u>Present sample</u>
Manufacturer's production pressure setting, (MPa)	: 20.2±0.98	25.0±0.8
Injection timing	: 22±1 BTDC	13±1° BTDC
Make & model of governor	: Mico LIC Bosch & RSV325...1000A1CB 35R	Bosch ,India & RSV325...1000A1C137 7R
16.1.2.2 Lubricating system:		
Total lubricating oil capacity,(l)	: 7.10	8.20
16.1.3 Transmission:		
16.1.3.1 Clutch:		
Type of clutch plate	: Dual, Dry ,friction plate	
Size, OD/ID,(mm):		
For PTO	: 279.5	279.7/165.8
For transmission	: 280	279.6/165.8
16.1.3.2 Gear Box:		
No. of speeds:		
- Forward	: 08	08
- Reverse	: 02	02
Range of speed, (kmph) :		
- Forward	: 3.39 to 31.90	2.63 to 30.91
- Reverse	: 4.74 to 15.58	3.31 to 12.94
16.1.4 Service Brake:		
Make	: Swaraj (apa)	JMIL
Type	: Mechanical oil immersed discs	
No. of friction disc	: Not mention in test report	04 (Each side)
Area of liners, (cm ²)	: 466.5 (each side)	918.8 (each side)
16.1.5 Wheel equipment:		
Make & Size of tyres:		
- Front	: GOOD YEAR	GOOD YEAR
- Rear	: GOOD YEAR	GOOD YEAR
Standard Track width, (mm):		
- Front	: 1305	1380
- Rear	: 1350	1420
16.1.5.1 Wheel base, (mm)	: 1935	2105
16.1.6 Overall dimensions, (mm):		
- Length	: 3420	3475
- Width	: 1715	1805
- Height (at pre cleaner)	: 1670	1855
- Ground clearance, (mm)	: 400	425
16.1.7 Operational mass of unballasted tractor(kg):		
- Front	: 820	805
- Rear	: 1200	1320
- Total	: 2020	2125



16.1.8 Conformity with following IS:		<u>Previous sample</u>	<u>Present sample</u>
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	Conforms
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	Does not conform
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	Does not conform
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 – 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
viii)	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
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



16.2 Performance Characteristics:

16.2.1 PTO Performance:

	<u>Previous sample</u>	<u>Present sample</u>
Maximum Power, (kW)	34.3	33.8
Power at Rated engine speed,(kW)	34.1	33.8
Specific fuel consumption corresponding to maximum power, (g/kWh)	245	257
Maximum equivalent crankshaft torque,(Nm)	182.5	205.1
Back up torque, (%)	11.5	26.8

		<u>Previous sample</u>		<u>Present sample</u>	
Maximum temperatures (degree):					
	Engine oil	:	114	:	103
	Coolant	:	105	:	96
	Lub oil consumption, (g/kWh)	:	0.94	:	0.62
16.2.2	Drawbar performance :				
	Maximum power with unballasted tractor, (kW)	:	28.5	:	28.4
	Maximum pull with unballasted Tractor, (kN)	:	15.0	:	17.91
	Maximum transmission oil temperature (deg. C)	:	101	:	80
16.2.3	Hydraulic performance:				
	Hydraulic pump discharge at minimum pressure and rated engine speed (l/min.)	:	24.7	:	28.4
	Maximum hydraulic power, (kW)	:	4.8	:	5.9
	Sustained pressure of the open relief valve, (MPa)	:	17.0	:	15.4
	Maximum lifting capacity, (kN):				
	- At the hitch point	:	14.11	:	15.62
	- At the standard frame	:	11.41	:	13.19
	Total drop in height of lift during load maintenance test, (mm)	:	02	:	56
16.2.4	Brake performance test at 25 kmph speed (max).				
	Parameter	<u>Previous Sample</u>		<u>Present Sample</u>	
		Cold	Hot	Cold	Hot
	Maximum Stopping distance, (m)	6.70	8.00	7.47	7.84
	Maximum force exerted on the brake Pedal effort required to achieve deceleration of 2.5 m/sq sec, (N)	170 to 210		192 to 236	
	Weather parking brake is effective at a force of 600N at foot pedal (s) or 400 N at hand lever	Effective		Effective	
16.2.5	Noise measurement:				
	- Maximum noise at bystanders position, dB(A)	:	86	:	84
	- Maximum noise at operator's ear level dB(A)	:	96	:	95
16.2.6	Mechanical vibration:				
	Maximum amplitude of vibration at (microns):				
	- Foot rest – LHS & RHS	:	120 & 85	:	190 & 260
	- Steering wheel	:	140	:	90
	- Driver's seat, (driver in seat):	:	150	:	180
16.2.7	Haulage Test:	<u>Two wheel trailer</u>		<u>Four wheel trailer</u>	
		<u>Previous /Present</u>		<u>Previous /Present</u>	
	-Gross mass of trailer, (tonnes)	:	5.0	:	7.0
	- Average speed, (kmph)	:	27.58 to 28.40/ 30.41 to 31.33	:	27.92 to 28.53/ 31.81 to 32.31
	- Distance traveled per litre of fuel consumed, (km)	:	5.58 to 5.61 / 4.42 to 4.70	:	5.52 to 5.56/ 4.70 to 4.75
	- Average fuel consumption (cc/km/tonne)	:	35.7 to 36 / 43 to 45	:	25.7 to 25.9/ 30.0





16.3 Qualifying performance (comparable limit) for batch model in comparison to ICT model (please refer Clause 7.6 of IS: 12207-2014):

S. No.	Characteristic	Requirements as per IS: 12207-2014		As observed		Whether meets the requirement (Yes/No)
		Column 4 of Table-1	Clause 7.6	Previous sample	Present sample	
1	2	3	4	5	6	7
16.3.1 Drawbar performance:						
a)	Maximum drawbar pull with ballast corresponding to 15 percent wheel slip, (kN)	Minimum 65% of static mass with ballast	The performance shall be within 7.5% of ICT or limit specified under Column 3 whichever is higher	23.7	25.23	Yes
b)	Maximum drawbar pull without ballast corresponding to 15 percent wheel slip, (kN)	Minimum 65% of static mass of tractor without ballast		15.0	17.91	No
c)	Maximum drawbar power without ballast, (kW)	Minimum 80 % of PTO power as referred in SI No. i) a) of PTO performance in case of tractors having total static mass > 1500 kg Minimum 75 % of PTO power as referred in SI No. i) a) of PTO performance in case of light weight tractors having 1500 kg total static mass of tractor Minimum 75 % of the engine power as referred in SI No. i) a) of engine performance in case of tractors which do not have a PTO shaft.		28.5	28.4	Yes
d)	Maximum transmission oil temperature (°C)	The declared value should not exceed the maximum value specified by oil company		101	80	Yes
16.3.2 Hydraulic performance:						
a) Maximum lifting capacity throughout the range of lift, (kN):						
1)	At hitch points	[Tolerance of minus 10%]	The performance shall be within 7.5% of ICT or limit specified under Column 3 whichever is higher	14.11	15.62	No
2)	With the standard frame	The lift capacity should at least be 24 kg/PTO kW, And it should be 21.5 kg/engine kW where the tractor is not provided with a PTO shaft		11.41	13.19	No
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)	The observed value should not exceed 50 mm		02	56	No



16.4 Salient Observations:

16.4.1 Laboratory test:

Previous SamplePresent Sample

16.4.1.2 Drawbar Performance:

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- i) During ten hours drawbar test, creeping of LHS & RHS rear tyre over the rims was recorded as 35 & 40 mm respectively. This should be looked into for necessary corrective action.

16.4.1.3 Hydraulic Performance:

- i) The Maximum drop in the height during maintenance of lift load test was recorded as **02 mm**.

- i) During the hydraulic load maintenance test the drop in vertical height of the lower links was observed as **56 mm** against the maximum permissible limit of 50 mm. This may be looked into for necessary corrective action.

16.5 Adequacy of literature:

The following literature was supplied with the tractor for reference during the test.

- a) Operator's manual
b) Spare parts catalogue

Following combined literature of Swaraj 855 FE model were supplied with the test sample for reference during the test.

- a) Operator's manual
b) Parts catalogue
c) Service/Repair Catalogue

17. SUMMARY OF OBSERVATIONS, COMMENTS & RECOMMENDATIONS

Evaluative (mandatory) / Non-evaluative (Non-mandatory) parameters applicable for qualifying Minimum Performance criteria as per Clause-4 (Table-1) of IS: 12207-2014 for acceptance of the tractor for the purpose of subsidies/NABARD financing are summarized as under:

Characteristic	Category (Evaluative / Non Evaluative)	Requirements as per IS: 12207-2014	Values declared by the applicant/ (D) Requirement (R)	As observed	Whether meets the requirements (Yes/No)
2	3	4	5	6	7
PTO Performance :					
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 >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	33.8 (D)	33.8	Yes
Power at rated engine speed, (kW)	Non Evaluative	-do-	33.8 (D)	33.8	Yes
Specific fuel consumption corresponding to maximum power, (g/kWh)	Non Evaluative	+ 5%	265 (D)	257	Yes



1	2	3	4	5	6	7
d)	Maximum equivalent crankshaft torque, (Nm)	Non Evaluative	± 8%	173.6 (D)	205.1	No
e)	Back-up torque, percent, %	Non Evaluative	10 percent, min.	10 (D)	26.84	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)	103	Yes
2)	Coolant	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 (D)	96	Yes
g)	Engine oil consumption, (g/kWh)	Evaluative	Not exceeding 1% of SFC at max. power under High ambient conditions	2.60 Maximum (R)	0.62	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 per meter Maximum (R)	0.28	Yes
17.1.2 Drawbar performance :						
a)	Maximum drawbar pull with ballast corresponding to 15 percent wheel slip, (kN)	Non Evaluative	Minimum 65% of static mass with ballast	23.7 (D) 20.05 (R) Minimum	25.23	Yes
b)	Max. drawbar pull with standard ballast corresponding to 15 percent wheel slip, (kN)	Evaluative	Minimum 65% of static mass of tractor without ballast or with standard ballast, as the case may be	15.0 (D) 13.55 (R) Minimum	17.91	Yes
c)	Maximum drawbar power with standard ballast, (kW).	Evaluative	Minimum 80 % of PTO power as referred in SI No. i) a) of PTO performance in case of tractors having total static mass > 1500 kg Minimum 75 % of PTO power as referred in SI No. i) a) of PTO performance in case of light weight tractors having 1500 kg total static mass of tractor Minimum 75 % of the engine power as referred in SI No. i) a) of engine performance in case of tractors which do not have a PTO shaft.	28.5 (D) 27.0 (R) Minimum	28.4	Yes



1	2	3	4	5	6	7
d)	Maximum transmission oil temperature ($^{\circ}\text{C}$)	Non Evaluative	The declared value should not exceed the maximum value specified by oil company	110 (D)	80	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%]	14.71 (D)	15.62	Yes
	2) With the standard frame	Evaluative	The lift capacity should at least be 24 kg/PTO KW, and it should be 21.5 kg/engine KW where the tractor is not provided with a PTO shaft	10.78 (D) 7.96 (R) Minimum	13.19	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 Minutes, (mm)	Non Evaluative	The observed value should not exceed 50 mm	50 (D) Maximum	56	No
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)	7.37	Yes
	2) Hot brake	Evaluative	10	10 (R)	7.84	Yes
b)	Maximum force exerted on the brake pedal to achieve a deceleration of 2.5 m/s^2 (N)	Evaluative	600	600 (R) Maximum	192 to 236	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	Yes	Yes
17.1.5 Noise measurement :						
a)	Maximum ambient noise emitted by the tractor dB(A)	Evaluative	As per CMVR	88(R)	84	Yes
b)	Maximum noise at operator's ear level dB(A)	Evaluative	As per CMVR	96(R)	95	Yes
17.1.6 Amplitude of mechanical vibrations at:						
	1) Left foot rest	Non Evaluative	100 microns (max)	100(R)	170	No
	2) Right foot rest				260	No
	3) Seat (with driver seated)				160	No
	4) Steering wheel				90	Yes
17.1.7 Air cleaner:						
	Air cleaner oil pull over, (%)	Non Evaluative	0.25 % (maximum)	0.25 % (maximum)	0.03	Yes



1	2	3	4	5	6	7	
17.1.8	Haulage requirements :						
a)	Gross mass of the trailers, (tonnes):						
	1)	Two wheel	Non	--	5.0 (D)	5.0	Yes
	2)	Four wheel	Evaluative	--	7.0 (D)	7.0	Yes
b)	Distance travelled / liter of fuel consumption, (km/l):						
	1)	Two wheel	Non	--	4.0 to 7.0 (D)	4.42 to 4.70	Yes
	2)	Four wheel	Evaluative	--	4.0 to 7.0 (D)	4.70 to 4.75	Yes
c)	Fuel consumption (ml/km/tonne):						
	1)	Two wheel	Non	--	25 to 45 (D)	43 to 45	Yes
	2)	Four wheel	Evaluative	--	25 to 45 (D)	30.1 to 30.4	Yes
17.1.9	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)	No	Yes
	1)	Clutch assembly	-do-				
	2)	Brake housings	-do-				
	3)	Front axle hubs	-do-				
	4)	Engine Oil	-do-				
	5)	Transmission Oil	-do-				
17.1.10	Safety features :						
a)	Guards against moving and hot parts		Evaluative	Belt drives, pulleys, silencer, hydraulic pipes (As per IS 12239 (Part2))	--	Provided	Yes
b)	Lighting arrangement		Evaluative	As per CMVR	--	Provided	Yes
c)	Seating requirements (Tractors having more than 1150 mm rear track width)		Non Evaluative	Should meet the requirements of IS: 12343 (As amended from time to time)	--	Does not meet the requirement	No
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)	Dimensions of three point linkage		Non Evaluative	Should meet the requirements of IS: 4466 (Part-I) (As amended from time to time)	--	Does not meet the requirement	No
f)	Specifications of linkage drawbar		Non Evaluative	Should meet the requirements of IS 12953 and IS 12362 (Part 3) (As amended from time to time)	--	Meet the requirements	Yes
	Swinging drawbar				--	Not Provided	--



1	2	3	4	5	6	7
17.1.11	Labelling of tractors (Provision of labelling plate):					
	1) Make	Evaluative	Should conform to the requirements of CMVR	--	Swaraj	Yes
	2) Model	Evaluative		--	855 FE	Yes
	3) Engine number	Evaluative		--	47.5004/SWN16368	Yes
	4) Chassis number	Evaluative		--	WYCN61929930085	Yes
	5) Declaration of PTO power (kW)	Evaluative		--	33.8	Yes
17.1.12	Discard limit for:					
(a)	Cylinder bore diameter, (mm)	Evaluative	To be specified by the manufacturer and supported by the printed literature	110.225 (D)	110.00 to 110.03	Yes
(b)	Clearance between piston & cylinder liner at skirt, (mm)	Non Evaluative		0.60 (D)	0.143 to 0.160	Yes
(c)	Ring end gap (mm):					
	- Top comp. ring.	Evaluative	-do-	1.75(D)	0.40 to 0.50	Yes
	- 2 nd comp. ring.		-do-	1.75(D)	0.45 to 0.50	Yes
	- Oil ring.		-do-	1.75(D)	0.40 to 0.45	Yes
(d)	Ring groove clearance (mm):					
	- Top comp. ring.	Evaluative	-do-	0.25 (D)	-Tapered-	--
	- 2 nd comp. ring.		-do-	0.25 (D)	0.051 to 0.057	Yes
	- Oil ring.		-do-	0.25 (D)	0.064 to 0.068	Yes
(e)	Clearance of main bearings (mm):					
	- Diametrical clearance	Evaluative	-do-	0.30 (D)	0.104 to 0.112	Yes
	- Crankshaft end float	Evaluative		0.50 (D)	0.33	Yes
(f)	Clearance of big end bearings, (mm):					
	- Diametrical	Evaluative	-do-	0.30 (D)	0.131 to 0.138	Yes
	- Axial	Evaluative	-do-	0.60 (D)	0.20	Yes
(g)	Clearance between king pin and bush, (mm)	Non Evaluative	-do-	0.60 (D)	0.115 to 0.131	Yes
(h)	Clearance between centre pin and bush, (mm)	Non Evaluative	-do-	0.80 (D)	0.139 to 0.142	Yes
17.1.13	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



17.1.14 CATEGORY OF BREAKDOWNS / DEFECTS :					
Sl. No.	Category of breakdowns	Category (Evaluative / Non Evaluative)	Requirements as per IS: 12207-2014	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	None	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
17.2 Optional requirements as per Clause-4 (Table-2) of IS:12207-2014:					
S.No.	Characteristic	Requirements as per IS: 12207-2014	As observed	Remarks	
1.	Fitment of ROPS	With a provision for fitment of ROPS.	Not provided	No	
		If ROPS fitted it should meet the requirement of IS: 11821 (As amended from time to time) or equivalent International Standards	ROPS not provided	Not applicable	
2.	Accessories	Trailer hitch, front tow hook, may be provided.	Provided	Yes	

17.3

Salient Observations:

17.3.1

Laboratory tests:

17.3.1.1

PTO Performance:

- i) The maximum power was recorded as **34.3 & 33.8 kW** in case of previous & present sample respectively against the declaration of **33.8 kW**, which meets the requirement of IS: 12207-2014 with regard to tolerance.
- ii) The specific fuel consumption corresponding to maximum power in case of previous and present sample was measured as **245 & 257 g/kWh** respectively against the declaration of **265 g/kWh**, which meets the requirement of IS: 12207-2014 with regard to tolerance.
- iii) The maximum equivalent crankshaft torque in case of previous and present sample was measured as **182.5 & 205.1N-m** respectively against the declaration of **173.6-m**, which does not meets requirement of **IS: 12207-2014** with regard to tolerance limit. This should be looked into for necessary corrective action.
- iv) The backup torque was observed as **11.5 & 26.8 %** in case of previous and present sample, respectively which meets the requirement of IS: 12207-2014 with regard to tolerance.
- v) There is PTO power drop of **5.3 %** from natural to high ambient condition. This should be looked into for necessary corrective action.



17.3.1.2 Drawbar performance test:

- i) The maximum drawbar power under unballasted condition was observed as **28.5 & 28.4 kW** in case of previous & present sample respectively which meets the requirement of IS: 12207-2014 with regard to tolerance.
- ii) The maximum drawbar pull under unballasted condition was observed as **15.00 & 17.91 kN** in case of previous & present sample respectively which meets the requirement of IS: 12207-2014 with regard to tolerance.
- iii) The maximum drawbar pull under ballasted condition was observed as **23.7 & 25.23 kN** in case of previous & present sample respectively which does not meet the requirement of IS: 12207-2014 with regard to tolerance. This should be looked into for necessary corrective action.
- iv) During ten hours drawbar test, creeping of LHS & RHS rear tires over the rims were observed as **35 & 40 mm** in case of previous and present sample, respectively. This should be looked into for necessary corrective action.

17.3.1.3 Hydraulic performance test:

Maximum drop in the height during maintenance of lift load test was recorded as **56 mm** against the maximum permissible limit of **50 mm**. Which does not meet the requirement of IS: 12207-2014. This should be looked into necessary corrective action against internal leakage of hydraulic fluid.

17.3.1.4 Mechanical Vibration:

The amplitude of mechanical vibration on various assemblies marked as (*) in Chapter – 9 of this test report is on higher side. This calls for dampening down of vibrations to improve the operational comfort and service life of components.

17.3.1.5 PTO shaft:

The dimension "AØ" of PTO shaft does not meet the requirement of the IS: 4931 - 1995. This should be looked into for necessary corrective action.

17.3.1.6 Three point linkage:

- i) The lateral distance of the lower hitch point from the center line of the tractor does not meet the requirements of IS 4468 (Part -1) 1998.
- ii) 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.

17.3.1.7 Operator's Seat:

The vertical distance of SIP from clutch pedal does not meet the requirement of IS: 12343-1998 (Re-affirmed in March, 2009) and calls for necessary corrective action.

17.3.2 Field performance test:

17.3.2.1 Wetland cultivation (Puddling operation):

No ingress of mud and / or water was noticed during puddling operation of the tractor and meet the requirements of IS: 11082-1984 (Technical requirements of agricultural tractors for wetland operation). Therefore, the tractor is found suitable for wetland operation (Puddling).

17.3.3 Specifications, components/assembly inspection:

- 17.3.3.1** After completion of puddling test and water proof test, the tractor was partially dismantled it was observed that a droplet of water was presence in RHS king pin. It should be looked into for necessary improvement.



17.4 Maintenance / Service Problems:

No noticeable maintenance or service problem was observed during the test.

17.5 Recommendation with regard to safety on tractor:

The following requirements, inter alia, may be considered for incorporation on the tractor:

- i) There should be provision for spark arresting device in exhaust system.
- ii) There should be provision of differential lock.
- iii) Width of foot step is should be at least 200mm for easy ascending / descending on tractor
- iv) The working clearance between the position and draft control lever should be provided as per IS: 12239 (Part-2) – 1999.
- v) There should be provision to attach trailer brake system.

17.6 Adequacy of Literature supplied with machine:

17.6.1 Literature was supplied with the tractor for reference during the test.

- a) Operator's manual of tractor model **SWARAJ 855 FE**.
- b) Parts catalogue of tractor model **SWARAJ 855 FE**.
- c) Service Manual of tractor model **SWARAJ 855 FE**.

17.6.2 The supplied literature was found adequate; except the following

- a) The front tyre size is mention as 6.00-16 & 8PR in operator's manual where as 7.50-16 & 8PR tyre size fitted in tractor model.
- b) Servicing and maintenance scheduling chart is not provided in operator's manual.
- c) Grade of oil for air cleaner is recommended as 20W40 in operator's manual where as it is specified SAE30 in specifications submitted by applicant.
- d) Grade of oil for steering system is recommended as EP90 in operator's manual where as it is specified 80W & Elf 2371 in specifications submitted by applicant.
- e) Servicing interval of steering system is recommended as after every 1200 hour of operations in operator's manual where as it is specified 1600 hour in specifications submitted by applicant.

However, these literatures should be brought out in other vernacular languages of India for guidance of users

18. Citizen charter



Duration of Test	Test duration under citizen charter	Whether the report released within time frame given in the citizen charter	Remark
11 Months (December, 2016 to, November, 2017)	10 Months	No	Delay due to Seasonal constraints

TESTING AUTHORITY:

PRAMOD YADAV
AGRICULTURAL ENGINEER

C. V. CHIMOTE
TEST ENGINEER

Y.K. RAO
SENIOR AGRICULTURAL
ENGINEER

J. J. R. NARWARE
DIRECTOR

19. APPLICANT'S COMMENTS

Para No.	Our Reference	Applicant's comments
19.1	1.20.1, 1.20.4, 1.20.5 & 17.5	These requirements are being revisited for necessary corrective action at our end.
19.2	16.1.8 (iii),(v), (vi)& (vii), 17.3.1.5, 17.3.1.6, 17.3.1.7 & 17.3.3.1	Study and trial are under progress for necessary corrective action.
19.3	17.1.10 (c),(d),(e), 17.3.1.1 (iii) (v), 17.3.1.2 (iii) (iv) & 17.3.1.3	These requirements are being revisited for necessary corrective action at our end.

ANNEXURE – I**BRIEF SPECIFICATION OF IMPLEMENTS USED DURING FIELD TEST**

S. No.	Parameters	Disc Plough	Rotavator	Puddler
1	Make	Fieldking	ACE	Not available
2	Type	Mounted	Mounted	Mounted
3	No. of Discs / Blades	Three	42 in 7 flanges	12 (6 in 2 gangs)
4	Type of Discs / Blades	General purpose	Hatchet	Notched
5	Size of Discs / Blades (mm)	250	130 x 115 x 7	460
6	Spacing of Discs /Flanges, (mm)	510	210	165
7	Lower hitch point span, (mm)	825	750	680
8	Mast height, (mm)	570	640	450
9	Overall Dimensions (mm):			
	Length	2010	620	1190
	Width	1335	1760	1810
	Height	1200	1130	1330
10	Gross Mass, (Kg)	350	345	210

ANNEXURE-II**BRIEF SPECIFICATION OF HALF CAGE WHEEL**

S. No.	Parameters	Specification
1	Type	Half cage wheel
2	Outer dia. (mm)	1800
3	Width (mm)	355
4	No. & Type of Lugs	12, straight lugs made of MS angle section welded to angle iron frame
5	Size of angle section, (mm)	50 x 45 x 5
6	Length of lug, (mm)	350
7	Spacing of lug, (mm)	205
8	Weight of each cage wheel (kg)	100

ANNEXURE - III

TRACTOR RUN HOURS DURING TEST

A.	LABORATORY AND TRACK TESTS:	HOURS
1.	Running-in	--
2.	PTO performance test	16.0
3.	Power lift and hydraulic pump performance test	1.7
4.	Drawbar performance test	14.9
5.	Air cleaner oil pull over test	3.5
6.	Turning ability	0.4
7.	Location of centre of gravity	-
8.	Operator's field of vision	-
9.	Brake test	2.1
10.	Noise measurement	1.8
11.	Mechanical vibration test	1.0
12.	Theoretical speed test	0.9
B.	FIELD TEST:	
1.	Rotavation	10.3
2.	Puddling test (including water proof test)	15.3
C.	HAULAGE TEST:	5.3
D.	Miscellaneous test and other run hours including idle run, transportation, trials and preparation for test	27.7
	TOTAL:	102.5