Sat Kartar Agro Engineering, AMAN 955, SELF PROPELLED COMBINE HARVESTER

सत्यमेव जयते

भारत सरकार
कृषि मंत्रालय
(कृषि एवं सहकारिता विभाग)

GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE
(DEPARTMENT OF AGRICULTURE & CO-OPERATION)

केन्द्रीय कृषि मशीनरी प्रशिक्षण एवं परीक्षण संस्थान
ट्रैक्टर नगर, बुदनी (म.प्र.) ४६६ ४४५

CENTRAL FARM MACHINERY TRAINING & TESTING INSTITUTE
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3.2	**Primemover**		
	Make	:	Ashok Leyland Ltd
	Model	:	AL 400C2/3
	Type	:	Four stroke, Water cooled, direct injection, diesel engine.
	Serial number	:	NAEM 090563
	Engine speed (Manufacturer's recommended production setting), (rpm):		
	- Maximum speed at no load,	:	2420 ± 50
	- Low idle speed	:	600 ± 50
	- Speed at maximum torque	:	1550 ± 50
	- Rated speed	:	2200
	- Rated speed for field operation	:	1650
	Location	:	Behind the grain tank
	Mounting	:	On M.S. channel section frame.
3.2.1	**Cylinder & Cylinder Head:**		
	Number	:	Six
	Disposition	:	Vertical, inline
	Bore/stroke, (mm)	:	107.2/120.7
	Capacity as specified by the applicant, (cc)	:	6536
	Compression ratio	:	16.1 : 1
	Type of cylinder head	:	Monoblock
	Type of cylinder liners	:	Wet
	Type of combustion chamber	:	Direct injection (Open cavity on piston crown)
	Arrangement of valves	:	Overhead, Inline
	Valve clearance (cold):		
	- Inlet valve, (mm)	:	0.508
	- Exhaust valve, (mm)	:	0.508
3.2.2	**Fuel System:**		
	Type of fuel feed system	:	Gravity and Force feed
3.2.2.1	**Fuel tank:**		
	Capacity, (l)	:	367
	Location	:	On RHS side of combine
	Provision for draining of sediments / water	:	Provided
	Material of fuel tank	:	M. S. Sheet Metal
3.2.2.2	**Fuel feed pump:**		
	Make	:	BOSCH, India
	Model/Group combination No	:	FP/KE22AD280/2 9 440 030 002
	Type	:	Plunger
	Location	:	On Fuel injection pump
	Provision for draining of sediments / water	:	Metallic sediment bowl provided
	Method of drive	:	Through FIP camshaft
3.2.2.3	**Fuel filters:**		
	Make	:	BOSCH, India
	Model/Group combination No	:	F 002 H20 114
	Number(s)	:	Two (Primary and Secondary)
	Type of elements	:	Primary – Cloth Secondary -- paper
	Capacity of final stage filter, (l)	:	0.95
3.2.2.4	**Injection pump:**		
	Make	:	BOSCH, India
	Model/Group Combination No.	:	F 002 AOZ 400 PES 6A100D 320RS 3520

Sl. No.	Original Mass Before Test (g)	Mass After 30.1 Hour of test (g)	Loss of Mass	Percent wear (%)
b)	Peg teeth of concave			
1.	210.1	209.6	0.5	0.23
2.	222.0	221.2	0.8	0.36
3.	212.2	211.9	0.3	0.14
4.	217.9	216.5	1.4	0.64
5.	216.2	215.4	0.8	0.37
6.	224.0	223.2	0.8	0.35
7.	219.2	218.7	0.5	0.22
8.	217.7	217.0	0.7	0.32
9.	211.3	210.7	0.6	0.28

18. SUMMARY OF OBSERVATIONS. COMMENTS AND RECOMMENDATIONS

18.1 Engine performance Test :

Brake Power , (kW)	Crankshaft torque, (Nm)	Engine Speed, (rpm)	Fuel consumption (l/h)	Fuel consumption (kg/h)	Fuel consumption Specific, (kg/ kWh)	Specific energy, (kWh/l)
1	2	3	4	5	6	7
Test –A : Varying Speed tests:						
a)Maximum power and fuel consumption						
66.49	288.6	2200	20.94	17.52	0.264	3.18
55.73	332.6	1600	16.14	13.51	0.242	3.45**
65.92	286.2	2200	20.65	17.28	0.262	3.19*
b) Power at rated engine speed (rpm):						
66.49	288.6	2200	20.94	17.52	0.264	3.18
32.58	188.5	1650	9.70	8.12	0.249	3.36**
65.92	286.2	2200	20.65	17.28	0.262	3.19*
c)Maximum torque:						
46.74	318.8	1400	13.56	11.35	0.243	3.45
50.77	334.3	1450	14.37	12.03	0.237	3.53**
47.29	311.5	1450	13.75	11.51	0.243	3.44*
Test- B: Maximum power – Two hours:						
66.49	288.6	2200	20.94	17.52	0.264	3.18
53.68	320.4	1600	15.47	12.95	0.241	3.47**
Five hour rating test: Engine loaded to 90% of maximum power :						
62.08	258.0	2298	19.46	16.29	0.262	3.19*

*Under high ambient conditions.
** Under part throttle setting as recommended for field work

Remarks

I) The maximum power output of the engine at 2 hour maximum power test was observed as 66.49 kW against the declared value of 81.0 kW, which is 17.9% lower. It should be looked for necessary corrective action

II) The maximum power output of the engine after adjusting the no loat engine speed as per recommendation of manufacture for field work was observed as 55.73 kW against the declared value of 62, which is 10.1% lower. It should be looked for necessary corrective action

III) The specific fuel consumption corresponding to maximum power at full throttle & setting recommended for field was measured as 0.264 & 0.242 kg/kWh.

IV) The back-up torque of the engine was measured as 10.5 % and 4.3 % at full throttle and setting recommended for field operation. The backup torque at setting recommended for field is observed on lower side. It should be looked in for necessary corrective action

V) The maximum smoke density was recorded as 0.18 m^{-1} Which is within specified limit.

VI) The maximum temperature of engine oil was observed as 147 degree Celsius against the declared value of 130 ^{0}c, which is on higher side and undesirable. It should be looked into for necessary corrective action.

18.2 Turning Ability:
The radius of turning cycle of LHS and RHS was observed satisfactory.

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

18.4 Braking Performance:

1. The mean deceleration and stopping distance corresponding to 276 N pedal force was measured as 2.82 m/sec^2 & 8.4 m respectively, performance is in line with the IS 12207 – 1987.
2. The performance of the parking brake was found satisfactory.

18.5 Mechanical Vibration:
The amplitude of mechanical vibration of components marked as (*) in the chapter 13 of this report are on higher side. This calls for providing suitable remedial measure to dampen the vibration in order to improve the operator's comfort and services life of various component and sub assemblies.

18.6 Noise Measurement:
i) The ambient noise emitted by the machine was measured as 87 db (A).
ii) The noise at driver's ear level was measured as 94 db (A) which is within limit when compared to warming levels of 98 db (A).

18.7 Air cleaner oil pull over test:
The maximum oil pulls over was measured as 0.13 % Which is normal.

18.8 Field Test:

18.8.1 Summary of field test:
The result of the field test is summarized below.

Sl. No.	Observation	Wheat Harvesting	Paddy Harvesting
1.	Speed of operations, kmph	3.33 to 4.52	1.74 to 1.82
2.	Area covered (ha/h)	0.865 to 1.279	0.314 to 0.392
3.	Fuel consumption: -(l/h) -(l/ha)	 6.95 to 9.27 6.35 to 8.35	 8.90 to 9.92 24.08 to 31.59
4.	Crop throughput (t/ha)	3.62 to 14.55	7.46 to 11.41
5.	Grain breakage in main grain outlet (%)	1.41 to 2.03	0.30 to 1.31
6.	Header losses (%)	0.08 to 1.39	0.41 to 2.08
7.	Total non-collectable losses (%)	0.105 to 1.93	1.35 to 2.29
8.	Total collectable losses (%0	0.28 to 1.26	2.76 to 3.40
9.	Total processing losses (%)	1.97 to 4.21	3.72 to 5.90
10.	Threshing efficiency (%)	98.34 to 99.69	96.30 to 97.00
11.	Cleaning efficiency (%)	96.3 to 99.43	95.40 to 99.40

18.8.2 Wheat Harvesting:

i) The grain breakage in all the varieties tested was measured as 1.41 to 2.03 % which is considered to be normal.

ii) The total non-collectable losses ranged from 0.105 to 1.93 % which is considered to be normal.

iii) The total processing losses ranged from 1.97 to 4.21 % which is considered to be on higher side.

iv) The threshing efficiency ranged from 98.34 to 99.69 % which is considered to be normal.

v) The cleaning efficiency ranged from 96.3 to 99.43 % which is considered to be normal.

Necessary improvements to brining header losses are. required to be incorporated

18.8.3 Paddy Harvesting:

i) The grain breakage range from 0.30 to 1.31 % which is considered to be normal.

ii) The total non-collectable losses ranged from 1.35 to 2.29 % which is considered to be normal

iii) The total processing losses ranged from 3.72 to 5.90 % which is considered to be higher side.

iv) The threshing efficiency ranged from 96.30 to 97.00 % which is considered to be on lower side.

v) The cleaning efficiency ranged from 95.40 to 99.4 % which is considered to be normal.

Necessary improvements are required to be incorporated to reduce the total processing losses and to improve cleaning and threshing by the applicant.

18.8.4 Harvesting of any other crops:
The performance of combine to harvest the wheat paddy crop was evaluated as the same were recommended by the applicant.

18.9 Ease of operation and safety provision:

i) The controls provided around the operator are within easy reach. But not labeled with symbols as per Indian standard. Therefore it is recommended that the symbol as per the requirement of IS: 6283-1998 may be provided.

ii) Caution notice and safe operating instructions should be provided on machine.

iii) The horizontal and vertical adjustments is not provided in operator's seat, it should be provided

iv) The design of stone trap need to be modified for easy cleaning.

v) Slip clutch/ safety devices in knife drive, crop auger and threshing drum drive are considered essential from safety point of view, which needs to be provided.

vi) The mechanical arrangement for adjusting the reel speed through provided, needs to be modified such that the same could be controlled from operator's position.

vii) The first aid box should be provided.

18.10 Assessment of Wear:

i) The discard limit for engine components i.e. piston and valve spring have not been specified by the applicant. It is therefore not possible to ascertain their wear with reference to discard limit.

ii) The transmission gears and components wear found in normal working condition.

iii) The timing gears, clutch lining, release bearing were found in normal working condition.

iv) The condition of the component of brake, hydraulic system and steering system was observed to be normal.

v) The condition of the bearing, chains, sprockets and belts was observed to be normal.

vi) The component of starter motor and alternator were found in normal working condition.

vii) The rate of wear of rasp bar and peg teeth of threshing cylinder & concave were observed to be normal.

18.11 Hardness and chemical composition:
The hardness & chemical composition of knife blade does not conform to IS.it should be incorporated at production level.

18.12 Maintenance / service problems:
No noticeable maintenance / service problem was observed during the course of test at this institute.

18.13 Labeling plate of combine:
The Labeling plate is provided on the combine harvester on LHS of operator's platform.

18.14 Literature supplied with the machine:
The following literatures were supplied with the machine for reference during testing and these where found adequate. However, it need to be modified and updated in accordance with IS: 8132-1983. The literature may also bring out in hindi and other regional languages.

i) Operation Manual, Aman 955

ii) Operator Manual for Genset /Industrial/Marine engines of Ashok Leyland.

iii) Service Manual, genset/Industrial/Marine engines, 370/400/402 from Ashok Leyland

18.15 General Observations

i) As per technical specification submitted, the type of air cleaner is specified as oil bath , whereas on combine, combination of dry and wet (oil bath) type of air cleaner is observed. The specifications should be to be updated accordingly.

ii) Maintenance interval/change period for dry elements is not specified in literature supplied as well as technical specifications. It may be specified and literature should be updated accordingly.

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

Sr. No.		Characteristics	Requirement	Declared	Observed	Remark
1	2	3	4	5	6	7
1	**Prime mover performance**					
	i)	Max. power (absolute) Average max. power observed during 2 hrs. Max. power test in natural ambient condition kW	It should not be less than 5% of the declared valve.	81.0	66.49	**Does not conform**
	ii)	Max. power observed during test after adjusting the no load engine speed as per recommendation of the manufacturer for field work, kw	Max. Power observed must not be less than 5% of declared value.	62.0	53.58	**Does not conform**
	iii)	Power at rated engine speed, kw (Ps)	The observed value must not be less than 5% of the declared value by the applicant.	81.0	66.49	**Does not conform**
	iv)	Specific fuel consumption g/ kwh.	The average value during 2 hr. max. Power test must be within ±5% of the declared value by applicant/manufacturer.	264	312	**Does not conform**
	v)	Max. Smoke density (bosch no.) at 80% load between the speed at max. Power & 55% of speed at max. Or 1000rpm whichever is higher should be observed as per CMVR rule.	For tractor:- 5.2 bosh no. or 75 hartridge For engine:- Free deceleration or natural aspirated or turbo charges 65 hartridge	---	0.9 Hartridge unit (0.18 m^{-1})	Conform
	vi)	Max. crank shaft torque, (N-m) observed during the test after no load engine speed is adjusted as per manufacture's recommendation for field work	It must not be less than 8% of declare value of manufacturer.	390	334.3	**Does not conform**
	vii)	**Back up torque, %**	7% min.	7 %	10.5 %	Conforms
	viii)	Max. Operating temp. to be declared by manufacturer	engine oil coolant	130 130	147 112	**Does not conform** Conforms
	ix)	Lubrication oil consumption, g/kwh	1% of SFC at max. Power during high ambient condition.	2.62	Not observed	Unascertain--able
2.	**Brake Performance**					
	i)	Max. stopping distance at a force equal to or less than 600 N on break pedal, m	10 m or s≤0.15v +v^2/130 v=speed corresponding to 80% of design max. Speed, kmph.	10 m	8.4 (cold)	conforms
	ii)	Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec^2	≤ 600N.	---	276	conforms

1	2	3	4	5	6	7
	iii)	Whether parking brake is effective at a force of 600 N at foot pedal or 400 N at hand and lever	Yes or No.	Yes	Provided	Conforms
3.	**Mechanical Vibration**					
	i)	Operator's platform	120µm max.	–	120	Conforms
	ii)	Steering wheel	150µm max.	–	260	**Does not conforms**
	iii)	Seat with driver seated	120µm max.	–	120	Conforms
4.	**Air cleaner oil pull over**					
	i)	Max. oil pull over in % age when tested in accordance with IS:8122 pt(II) – 2000	0.25% max.	0.25	0.13	conforms
5.	**Noise Measurement**					
	i)	Max. ambient noise emitted by combine db(A)	88 dB (A) as per CMVR	–	87	Conforms
	ii)	Max. noise at operator's ear level db(B)	98 dB (A) as per CMVR.	–	94	Conforms
6.	**Discard Limit**					
	i)	Cylinder bore diameter	Should not exceed the values declared by the manufacture	107.546	107.25 to 107.26	Conforms
	ii)	Piston diameter	-do-	106.85	107.038 to 107.062	Conforms
	iii)	Ring end gap	-do-	2.032	0.30 to 0.60	Conforms
	iv)	Ring groove clearance	-do-	0.254	0.043 to 0.064	Conforms
	v)	Diametrical clearance and axial clearance of main bearing	-do-	0.178 0.356	0.066 to 0.107 0.13	Conforms
	vi)	Diametrical clearance and axial clearance of big end bearings	-do-	0.178 0.356	0.018 to 0.941 0.12	Conforms
	Vii)	Thickness of brake lining	-do-	Up to rivet head	9.18 to 11.80	Conforms
	viii)	Thickness of clutch plate	-do-	Up to rivet head	2.11 to 2.30	Conforms

1	2	3	4	5	6	7
7.	**Field Performance**					
	i)	Suitability for crops	Wheat & paddy essential	Wheat & paddy	Suitable Wheat & paddy	Conforms
	ii)	Grain breakage in grain tank	≤ 2.5%	–	Wheat -1.41 to 2.03 % (Avg. 1.912 %) Paddy – 0.30 to 1.31 % (Avg. 0.715 %)	Conforms Conforms
	iii)	Non collectable	≤ 2.5% for wheat, paddy & gram ≤ 4.0% for soybean	–	Wheat- 0.105 to 1.93 % (Avg. – 0.742 %) Paddy-1.35 to 2.29 (Avg. 1.898 %)	Conforms Conforms
	iv)	Threshing efficiency	≥ 98% wheat & paddy	–	Wheat- 98.34 to 99.69 % (Avg. 99.11 %) Paddy- 96.30 to 97.00 % (Avg. 96.57%)	Conforms **Does not conforms**
	v)	Cleaning efficiency	≥ 96% wheat & paddy	–	Wheat-94.03 to 99.43% (Avg. –97.34 %) Paddy-95.40 to 99.40 (Avg. 97.10 %)	Conforms Conforms
8.	**Safety requirement**					
	i)	Guards against all moving per	Essential	–	Provided	Conforms
	ii)	Lighting arrangement Head light Parking light Indication Reverse gear Brake Number plate	Essential as per CMVR	—	Provided as per CMVR report no. CMVR/Comb.27 /335/2009-2010 dated 16.02.2010	Conforms
	iii)	Grain tank cover	Essential	–	Provided	Conforms
	iv)	Spark arrester in engine's exhaust	Essential	–	Provided	Conforms
	v)	Stone trap before concave	Essential	–	Provided	Conforms

1	2	3	4	5	6	7
	vi)	Rear view mirror	Essential	–	Provided	Conforms
	vii)	Slip clutch at following driver – Cutting platform Under shout conveyor drive Grain & tailing elevator	Essential	–	 Provided Provided Not Provided	 Conform Conform **Does not conforms**
	viii)	Anti slip surfaces at operator platform & ladder & proper gripping for the control levers.	Essential	–	Provided	Conforms
	ix)	Working clearance around the controls	Essential 70 mm, min		Provided	Conforms
	x)	Labeling of control gauge	Essential		Provided	Conforms
9.	**Material of construction:**					
	i)	Guard should conforms to IS: 6024- 1983	The guard (except ledger plate) shall be manufactured from malleable iron casting (Is: 2108-1977), steel casting (Is: 1030-1947) or steel forging (IS: 2004-1978)	Not Specified	C= 0.462 Si=0.363 S=0.036 P=0.061	Unascertainable as the limit of the elements as observed are not specified in the relevant code.
	ii)	Knife blade As per IS: 6025-1982	It must have chemical composition as C= 0.70-0.95% Mn= 0.30-0.50%	------	C=0.373 Si=0.282 S=0.027 P=0.036	**Does not conforms** Not ascertain
	iii)	Knife back Must meet the requirement of IS: 10378-1982	The knife back shall be manufactured from carbon steel having minimum carbon content of 0.35%		Not observed	Not ascertain
10		**Labeling of combine harvester**				
		It should conforms to IS: 10273-1987	Essential, It should Mention make & Model, Engine No. Chassis No., Year of manufacture, power & SFC of engine	-----	Provided	Conforms
11.		**Break down (Critical major & minor):**				
			Essential as per IS: - annexure A1, A2, A3	----	None	Conforms

TESTING AUTHORITY:

G.R.AMBALKAR
AGRICULTURAL ENGINEER

P.K.VERMA
SENIOR AGRICULTURAL ENGINEER

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DIRECTOR

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20. APPLICANT'S COMMENTS

Para No.	Our Reference	Applicant's comments
20.1	15.4 (i) & 18.9 (i)	The symbols will be provided on production model.
20.2	15.4 (i),(iii) & 18.9 (i),(iii)	It will be provided on machine in future.
20.3	18.9 (iv)	It is under study and necessary modification will be incorporated.
20.4	15.4 (iv) &,18.9 (v)	It is under development and will be provided in future.
20.5	18.9 (vi)	Study and develop necessary arrangement.
20.6	18.1 & 18.10	This is taken up with engine manufacturer for necessary corrective action.
20.7	18.14	It will be develop and updated.
20.8	18.8.2 & 18.8.3	Corrective measures will be taken.
20.9	18.11	It has been reported to vender and corrective measures are being taken.

Appendix-1

Combine Run Hours During Test

A	Laboratory Tests:	Hours
1.	Running-in	10.1
2.	Engine Performance test	20.4
3.	Radius of turning space & turning circle	0.3
4.	Location of center of Gravity	0.2
5.	Visibility test	0.0
6.	Brake performance Test	1.0
7.	Noise measurement	1.0
8.	Mechanical vibration Test	0.5
9.	Air cleaner oil pull over test	3.8
10.	Header Lifting Test	1.0
11	Nominal speed test	2.0
B	**Field Test:**	
1.	Wheat Harvesting	51.3
2	Paddy Harvesting	25.1
C.	Miscellaneous test and other run hours including ideal run, transportation, trails and preparation for test	18.4
TOTAL		135.9

Appendix-II

OBSERVATION SHEET FOR FIELD TESTING (WHEAT HARVESTING)

Test No.	Date of test	Variety of crop	Height of plants (cm)	Length of ear head (cm)	No. of grains per ear head	Plant Population (No of tillers/m2)	Straw grain ratio	Moisture (%)		Atmospheric conditions at the time of test		
								Grain	Straw	Amb. Temp (°c)	R.H (%)	Pressure, kPa
1.	2	3	4	5	6	7	8	9	10	11	12	13
1	31.03.11	Lok-1	40 to 74	7 to 11	10 to 43	98 to 95	1.47	11.8	36.50	37	60	96.9
2.	02.04.11	GW-322	64 to 85	5 to 10	22 to 48	246 to 291	1.03	12.7	37.20	38	60	97.0
3.	04.04.2011	GW-322	52 to 90	6 to 10	17 to 53	270 to 316	1.30	12.9	26.58	36	57	96.7
4.	05.04.11	GW-322	55 to 83	7 to 10	23 to 40	261 to 239	0.91	12.4	40.9	33	63	96.7
5.	05.04.11 (evening)	GW-322	63 to 97	7 to 10	39 to 65	201 to 230	0.99	11.9	27.9	36	50	96.7
6.	06.04.11	GW-322	69 to 78	5 to 10	20 to 53	266 to 236	1.27	13.2	27.7	32	56	96.9
7.	06.04.11 (evening)	GW-322	58 to 89	5 to 10	39 to 78	375 to 340	0.88	12.2	39.6	34	56	96.8
8.	07.047.11	GW-322	67 to 90	5 to 8	17 to 45	288 to 281	1.12	13.6	44.00	38	51	97.0
9.	07.04.11 (evening)	GW-322	70 to 83	5 to 10	19 to 43	232 to 255	1.21	13.2	30.8	32	59	96.9
10.	08.04.11	GW-322	58 to 88	5 to 10	27 to 55	363 to 330	1.02	13.6	12.2	36	53	96.6

Appendix - III

FIELD TEST DATA ANALYSIS SHEET (WHEAT HARVESTING)

Test No.	Date of test	Duration of test (hr.)	Speed of operat-ion (kmph)	Width of cut (m)	Rate of work		Through put		Fuel consumption		Pre-harvest loss (kg/ha)	Crop straw/ Grain ratio (SKH/ GKH)	Crop through put (t/h)	Grain Breakage in Main outlet (%) (a)
					Area covered (ha/hr.)	Grain output (Kg/h.)	Clean Grain (kg/h) GKH	Straw (kg/h) SKH	(l/h)	(l/ha)				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	31.03.11	5.85	4.16	4.08	1.190	1438.3	1463.2	2157.7	7.82	6.57	11.30	1.47	3.62	2.03
2.	02.04.11	8.40	4.52	3.94	1.138	5339.9	5379.6	5567.3	7.89	6.94	14.0	1.034	10.95	2.80
3.	04.04.11	9.27	4.43	4.05	1.106	6281.5	6302.1	8248.7	7.62	6.86	4.25	1.3	14.55	1.70
4.	05.04.11	4.47	4.19	4.15	1.036	3684.8	3743.0	3403.4	8.58	8.28	6.75	0.91	7.45	1.81
5.	05.04.11 (evening)	5.38	4.40	4.08	1.279	5605.6	5638.3	5584.0	9.27	7.23	19.25	0.99	11.22	2.05
6.	06.04.11	6.72	4.39	3.92	0.840	4951.9	4998.5	6397.0	7.56	6.35	33.50	1.27	11.39	1.80
7.	06.04.11 (evening)	4.15	4.26	3.99	0.960	7103.6	7139.0	6335.2	8.70	8.35	18.50	0.887	13.47	2.05
8.	07.047.11	3.90	3.33	3.98	1.078	4487.9	4492.7	5039.8	6.95	6.40	16.75	1.12	9.53	1.83
9.	07.04.11 (evening)	2.57	3.37	3.97	0.865	4606.7	4632.1	5644.6	NR	NR	25.20	1.21	10.27	1.64
10.	08.04.11	4.62	3.36	4.10	0.978	4060.7	4079.5	4180.3	8.04	8.20	11.25	1.02	8.25	1.41

Contd. Appendix-III

FIELD TEST DATA ANALYSIS SHEET (WHEAT HARVESTING)

Test No.	Total collectable losses-s Unthr-shed from main outlet (%) (B)	Loss due to combine, percent by mass										Total losses (%) (A+B)	Thresh-ing efficien-cy (%)	Cleani-ng efficie-ncy (%)	Proces-sing losses (15+16 +a+b) (%)
		Non collectable losses (%)(c)													
		Straw outlet (Rake)				Sieve(Shoe)				Header loss (c)	Total (B) (a+b+c)				
		Thresh-ed (a)	Unthre-shed (b)	Broken (c)	Total (A) (a+b+c)	Thresh-ed (1)	Unthre-shed (2)	Broken (3)	Total (b) (1+2+3)						
	16	17	0.18	19	20	21	22	23	24	25	26	27	28	29	30
1	1.22	0.02	0.059	0.0014	0.080	0.135	0.306	0.001	0.44	1.30	1.82	3.04	98.34	96.30	3.77
2	1.26	0.07	0.018	0.0029	0.090	0.038	0.023	0.003	0.064	0.58	0.73	1.99	98.40	96.97	4.21
3	0.85	0.097	0.022	0.004	0.123	0.027	0.004	0.001	0.032	0.168	0.32	1.17	99.11	97.57	2.70
4	0.72	0.08	0.026	0.004	0.11	0.032	0.13	0.002	0.047	1.39	1.54	2.26	99.22	99.43	2.68
5	0.51	0.151	0.001	0.002	0.154	0.086	0.0031	0.001	0.090	0.33	0.57	1.08	99.47	96.70	2.80
6	0.73	0.416	0.01	0.010	0.43	0.10	0.002	0.013	0.115	0.36	0.84	1.57	99.25	98.93	3.07
7	0.74	0.14	0.023	0.005	0.16	0.019	0.0021	0.002	0.0023	0.29	0.47	1.21	99.23	98.23	2.97
8	0.28	0.10	0.004	0.001	0.015	0.006	0.004	0.0004	0.010	0.08	0.105	0.38	99.69	94.03	2.13
9	1.00	0.22	0.012	0.0102	0.24	0.05	0.007	0.0102	0.067	0.25	0.56	1.56	98.95	94.67	2.94
10	0.47	0.0152	0.003	0.0004	0.018	0.010	0.067	0.0025	0.079	0.36	0.46	0.93	99.45	98.60	1.97

Appendix-IV

OBSERVATION SHEET FOR FIELD TESTING (PADDY HARVESTING)

Test No.	Date of test	Variety of crop	Height of plants (cm)	Length of ear head (cm)	No. of grains per ear head	Plant Population (No of tillers/m2)	Straw grain ratio	Moisture (%)		Atmospheric conditions at the time of test		
								Grain	Straw	Amb. Temp (°c)	R.H (%)	Pressure, kPa
1.	2	3	4	5	6	7	8	9	10	11	12	13
1.	03.11.11	POOSA BASHMATI	112 to 130	28 to 37	165 to 236	370 to 400	2.26	24 to 26.	81	34	67	96.7
2.	04.11.11	POOSA BASHMATI	110 to 137	25 to 31	90 to 150	300 to 380	4.00	22 to 25	82	32	67	96.8
3.	05.11.11	POOSA BASHMATI	108 to 120	20 to 28	160 to 200	410 to 430	3.40	23	83	36	53	96.8
4.	12.11.11	POOSA BASHMATI	110 to 130	24 to 32	160 to 200	470 to 510	3.60	24	82	37	50	96.6
5.	14.11.11	POOSA BASHMATI	127 to 135	28 to 32	165 to 190	390 to 414	3.26	22	83	38	45	96.7

Appendix - V

FIELD TEST DATA ANALYSIS SHEET (PADDY HARVESTING)

Test No.	Date of test	Duration of test (hr.)	Speed of operation (kmph)	Width of cut (m)	Rate of work		Through put		Fuel consumption		Pre-harvest loss (kg/ha)	Crop straw/ Grain ratio (SKH/ GKH)	Crop through put (t/h)	Grain breakage in Main outlet (%) (a)
					Area covered (ha/hr.)	Grain output (Kg/h.)	Clean Grain (kg/h) GKH	Straw (kg/h) SKH	(l/h)	(l/ha)				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	03.11.11	6.00	1.82	3.99	0.314	2385.0	2416.0	5464.9	9.92	31.59	10.0	2.26	7.88	0.755
2.	04.11.11	5.63	1.79	3.98	0.332	1431.4	1463.2	5990.6	8.90	26.80	73.0	4.00	7.45	1.310
3.	05.11.11	4.87	1.74	3.99	0.392	1910.4	1940.7	6605.2	9.44	24.08	35.0	3.40	8.55	0.410
4.	12.11.11	6.53	1.82	4.00	0.336	2293.2	2342.9	8511.8	9.24	27.5	19.5	3.60	10.85	0.800
5.	14.11.11	6.48	1.79	3.98	0.348	2661.1	2720.0	8873.6	9.62	27.64	28.0	3.26	11.59	0.300

Contd. Appendix-V

FIELD TEST DATA ANALYSIS (PADDY HARVESTING)

Test No.	Total collectable losses Unthr-shed from main outlet (%) (B)	Loss due to combine, percent by mass									Total losses (%) (A+B)	Threshing efficiency (%)	Cleaning efficiency (%)	Process-ing losses (15+16+a+b) (%)
		Non collectable losses (%)(c)												
		Straw outlet (Rake)				Sieve(Shoe)				Header loss (c)	Total (B) (a+b+c)			
		Thresh-ed (a)	Unthr-eshed (b)	Broken (c)	Total (a) (a+b+c)	Thres-hed (1)	Unthr-eshed (2)	Broken (3)	Total (b) (1+2+3)					
	16	17	0.18	19	20	21	22	23	24	25	26	27	28	29	30
1	2.76	0.19	0.26	0.001	0.451	0.15	0.190	Nil	0.340	0.56	1.35	4.11	96.87	95.40	4.30
2	2.95	0.06	0.02	0.012	0.092	0.06	0.030	0.024	0.114	2.08	2.29	5.24	97.00	99.40	4.46
3	3.11	0.07	0.07	0.003	0.143	0.05	0.004	0.010	0.060	1.37	1.57	4.68	96.80	97.20	3.72
4	3.40	0.38	0.48	0.040	0.900	0.58	0.224	Nil	0.800	0.14	2.11	5.51	95.90	98.00	5.90
5	3.07	0.65	0.50	0.030	1.800	0.13	0.070	0.001	0.201	0.79	2.17	5.24	96.30	95.50	4.75

pendix-VI

DETAILS OF GREASING & OILING POINTS.

(A)	Grease Nipples : to be greased after each working day	
S. No.	Location	No. of Grease Nipples
1.	Cutter bar drive	4
2.	Cutter platform auger	6
3.	Reel drive shaft	2
4.	Header unit drive shaft	2
5.	Under shaft conveyor bearing	4
6.	Threshing drum bearing	2
7.	Beater bearing	2
8.	Blower bearing	2
9.	Main variator pulley bearing and shaft	2
10.	Sieve shaker assemblies	6
11.	Grain elevator + Ear elevator + Unloading auger drive	18
12.	Straw walker bearing	14
13.	Tie rod ends	2
14.	King pin	2
15.	Clutch shaft	1
16.	Center pin	1
	Total:	**70**
(B)	**Oiling Point**	
1.	Reel	25
	Total:	25
(C)	**Greasing cups**	
1.	Rear wheel bearing	2
2.	Trailer wheel bearing	2
	Total:	**99**

APPENDIX- VII

SYMBOLS AND ABBRIVIATION

SYMBOLS:

SYMBOLS ASSIGNED TO BASIC SI UNIT

S.N.	PHYSICAL QUANTITY	NAME OF SI UNIT	SYMBOL
1	Length	Meter	m
		Millimeter	mm
2	Mass	Kilogram	kg
		Gram	g
		Tonne	t
3	Time	Second	s

II	SYMBOLS ASSIGNED TO SOME DERIVED UNIT		
S.N.	PHYSICAL QUANTITY	NAME OF SI UNIT	SYMBOL
1.	Area	Square centimeter	cm^2
		Square meter	m^2
		Hectare	ha
2	Speed / velocity	Meter per second	m/s
		Kilometer per hour	kmph
3	Pressure	Newton per square millimeter	N/mm^2
4	Time	Minute	min
		Hour	h
5	Volume	Cubic centimeter	cm^3
		Milliliter	ml
		Litre	l

ABBREVIATIONS:

As per applicant	:	apa	Clause	:	Cl
Degree	:	deg	Figure	:	Fig
Indian standard	:	IS	Kilowatt	:	kW
Number	:	No.	Not available	:	N.A.
Not Recorded	:	N. R.	Percent	:	%
Reference	:	Ref.	Revolutions per minute	:	rpm