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Studies on general test of multi-crop thresher for wheat crop

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Abstract

The Research was carried out in the laboratory of Farm Machinery and Power Collage of Technology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, for general testing of multi crop thresher on wheat crop, RAMSONS IMPEX made thresher.

The testing was carried out as per the IS: 6284:1985 test codes. The various tests i.e. Checking of Specifications, Checking for Material of Construction, Visual Observations and Provisions of Adjustments, Checking of Safety Provision and Pre-test observation which comes under the general test were carried out. It is observed that during the pre-test observation the parameters like grain crop ratio, moisture content of straw and grain, shaft speed...etc. were found within the specific limits as per standard.

All the specifications were found to be equal with the specifications provided by manufacturer. The performance of the thresher was found to be satisfactory, but still there is need of upgradation in some parameters like safety cover of prime mover and transmission, feed rate adjustment, minimize knocking and rattling sound, slippage of belt, repair of transport wheel, frequent clogging, rise in bearing temperature and the provision of hitching arrangement. There is also need for checking the overall performance during short and long run test.

Keywords: Multi-crop thresher testing, wheat crop threshing performance, farm machinery laboratory analysis

Introduction

In India the mechanization of agriculture is increasing with very high rate. Agricultural mechanization implies the use of various power sources and improved farm tools and equipment, with a view to reduce the drudgery of the human beings and draught animals, enhance the cropping intensity, precision and timelines of efficiency of utilization of various crop inputs and reduce the losses at different stages of crop production. The end objective of farm mechanization is to enhance the overall productivity and production with the lowest cost of production. The contribution of agricultural mechanization has been well recognized in enhancing the production together with irrigation, biological and chemical inputs of high yielding seed varieties, fertilizers, pesticides and mechanical energy. Indian Green Revolution is regarded as one of the greatest achievements of the 20th century. It has been adopted in India on a large scale benefiting both small, medium and large size farms.

Threshing of agricultural crop is one of the important sectors under mechanization. The thresher of agriculture crop is general carried out by manually and by thresher. A threshing machine or thresher is a piece of farm equipment that threshes grain that is it removes the seeds from the stalks and husks. Mechanization of this process removed a substantial amount of drudgery from farm labour. Thresher machine is used for separating wheat, peas, soybeans other small grain seed crops from their chaff and straw. Primitive threshing methods involved beating by hand with a flail or trampling by animal hooves.

India is the second largest producer of wheat in the world, with production hovering around 68-75 million tons for past few years. The latest estimated demand for wheat production for the year 2020 is approximately 87.5 million tons, or about 13 million to more than the record production of 75 million tons harvested in crop season 1999-2000. Since 2000, India has struggled to match that record production figure and thus, faces a critical challenge in maintaining food security in the face of its growing population.

The current major challenges facing future wheat production in India are increasing heat stress; dwindling water supplies for irrigation; a growing threat of new virulence of diseases such as wheat rusts (yellow, brown, and black) and leaf blight; continuous adoption of rice-wheat systems on around 11 million hectares; changes in urbanization patterns and demand for better quality wheat.

Machines contain hazards of different nature and exposure to those hazards can result in injuries or deaths. Safety of machinery considers the ability of a machine to perform its intended function during its life cycle where risk has been adequately reduced. The principles of machine safety, risk assessment and risk reduction are covered in international standards, national standards, regulations and other literature. Moving parts of machinery still cause many serious injuries and fatalities. The main causes are easy access to moving parts of machinery, lack of safeguarding, absence of lockout procedures, inexperience of workers, bypassing safeguards, lack of risk assessment, lack of supervision, poor machinery design, unsafe working methods, no clear instructions to workers on how to intervene safely on machinery as well as modifications to machinery and to control systems. Prevention strategies are also proposed based on the findings and on the literature. (Chinniah, 2015) ^[1].

Keeping the above point in view the present study was conducted for various general test of multicrop thresher for wheat crop.

Material and Methods

The research was carried out in the Laboratory of Farm Machinery and Power, Collage of Technology at Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. The research station is situated at Lat. 29.084926° Long. 77.698467°. The research was carried for general testing of power operated multi crop thresher on wheat crop. A RAMSON IMPEX made (RI-916) multi crop thresher of 2Hp electric motor operated was purchased for the Laboratory of Farm Machinery and Power.

The general testing of the thresher was carried out as per the IS: 6284:1985 ^[3] code. The following standard procedure was followed for various tests:



Plate 1: Multi-crop Wheat Thresher

Pre Test Observation

Determination of Grain-Crop Ratio

The five samples of the crop each weight 1Kg was taken and the grain was separated manually for each sample. The mass of grain and straw separated for each sample and average value of five sample was determined in percentage.

Moisture Content (Grain and Straw)

The grain and straw sample were tested for moisture content as in accordance with IS: 4333(Part 2)-1947 and IS: 7897-1975 ^[4] respectively.

Running-in and Preliminary Adjustments

Before commencing the tests, the thresher was run for one hour as per the instructions of the manufacturer. The adjustments for the speed of different shaft, concave clearance, speed of prime mover, screen slope...etc., shall be done as per manufacturer's recommendations.

General Test

Checking of Specifications

General

- Make
- Model
- Type
- Year of manufacture

Power Unit

- Type of prime mover,
- Recommended power, kW (Hp)
- Type of drive

Crops to be threshed

- Main crop
- Other crops

Main Drive

- Type
- Directly coupled
- Belt drive
- Chain drive
- Gear drive
- Size of belt/chain/gear
- Size of pulley/sprocket
- Diameter of main shaft
- Recommended speed of main drive, rev/min

Threshing Unit

- Type
- Diameter
- Width
- Recommended speed
- Number and type of bearings
- Number and size of beaters/projections/bars

Concave

- Type
- Diameter or width
- Length
- Concave clearance range
- Constructional feature
- Method of fixing
- Angle of sliding pan

Sieve

- a) Type
- b) Number
- c) Total length and width
- d) Effective length and width
- e) Number of holes per cm²
- f) Size of hole
- g) Sieve clearance
- h) Screen slope range
- i) Method of mounting

Shaker

- a) Type
- b) Number of strokes per minute
- c) Drive
- d) Number and type of bearings

Blower

- a) Number
- b) Type
- c) Number of blades
- d) Size of blades
- e) Diameter
- f) Recommended speed
- g) Provision for changing air displacement
- h) Size of inlet opening
- i) Size of outlet opening
- j) Drive
- k) Number and type of bearing

Crop Feeding

- a) Type
- b) Method of feeding
- c) Height and location of feeding system
- d) Size of feeding chute

Transport

- a) Type
- b) Number of wheels
- c) Size of wheels
- d) Wheel bearing
- e) Type of towing arrangement

Flywheel

- a) Number
- b) Size

Overall Dimensions

- a) Length
- b) Width
- c) Height
- d) Ground clearance

Checking for Material of Construction

The material of the following components was checked and recorded.

- a) Frame
- b) Feeding system
- c) Threshing unit
- d) Drum
- e) Beater/projection/bar
- f) Concave
- g) Blower
- h) Main shaft

- i) Blower shaft
- j) Flywheel
- k) Sieve
- l) Shaker
- m) Elevator
- n) Transport wheel
- o) Pulleys
- p) Sliding pan
- q) Others

Visual Observation and Provision of Adjustment

The following observations and adjustments were checked and recorded during the test:

Observations

- a) Adequacy of marking of inlet and outlets
- b) Adequacy of marking of direction of rotation of threshing unit
- c) Adequacy of protection of bearings against the ingress of dust
- d) Adequacy of safety arrangements, especially at moving points and at inlet
- e) Provision for lubrication of moving parts
- f) Provision for belt tightening
- g) Provision for transportation
- h) Provision for easy changing of components requiring frequent replacement
- i) Provision for easy replacement and cleaning of screens
- j) Provision for anti-corrosive coatings
- k) Balancing of threshing unit
- l) Welding of seams
- m) Tightness of bolts and nuts and other fasteners
- n) Other observations

Provision for Adjustments

- a) Feed rate
- b) Concave clearance
- c) Speed
- d) Screen slope
- e) Sieve clearance
- f) Air displacement

Checking of Safety Provision

The safety provision was checked as per IS: 9129-1979 ^[6] and IS: 9020-1979 ^[5] as below:

General

In case the prime mover is mounted on the thresher, a protective cover shall be provided to prevent it from dust or straw falling on it.

Presence of any sharp corners and protruding fasteners.

Guards (IS: 9020-1979) ^[5]

Guards shall be provided to prevent accidental contact of persons or parts of clothing being caught in the transmission system.

Guards shall be designed in such a way not to hinder in any adjustments, servicing and operation.

Guards shall be capable of withstanding specified load.

Feeding System

Type

Details of the system (in accordance with (IS: 9129-1979) ^[6]

Cautionary notices (IS: 9020-1979) ^[5]

Any other provision

code. During general tests the specification checked and data observed are as follows:

Results and Discussion: The multi crop thresher made of RAMSON IMPEX was tested in the Laboratory of Farm Machinery and Power, Collage of Technology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, according to the IS:6284: 1985 ^[3]

Pre Test Observations

The pre-test observations were taken before starting the test and the various parameters were observed as shown in table 1.

Table 1: Parameters observed at pre-test observation

S.N.	Particular	Observations
1	Grain-Crop Ratio	1:3
2	Moisture Content in Straw	7.20%
3	Moisture Content in Grain	9.20%
4	Speed of Shaft	750 RPM
5	Concave Clearance	15 mm
6	Speed of Prime mover	1450 RPM
7	Screen Slope	20°

It is clear from the table that the grain crop ratio was found to be 1:3 while the moisture content for straw and grain was observed with the specific range as per the standard. The speed of the shaft and the prime mover were found as 750 and 1440 RPM respectively. The screen slope was found to be 20°. It is clear from the above data that the pre test observation was recorded within the specific range as per standard.

General Test

Under the general test the various steps were followed i.e. checking of specification, checking of material visual observation provision for adjustment and checking for safety provision. The data recorded and observed during the various steps is shown in table 3, 4, 5 and 6 respectively.

Specifications of Thresher

Table 2: Specifications of thresher recorded at the general test

S. No.	Particular	Description
1	General	
	a) Make	Ramson Impex
	b) Model	RI-916
	c) Type	Drum Type
	d) Year of manufacture	2022
2	Power Unit	
	a) Type of prime mover,	Electric Motor
	b) Recommended power	2Hp
	c) Type of drive	Belt Drive
3	Crops to be Threshed	
	a) Main crop	Wheat, Paddy
	b) Other crops	Cereals
4	Main Drive	
	a) Type	Belt Drive
	b) Size of belt/chain/gear	1364 mm
	c) Size of pulley/sprocket	125 mm
	d) Diameter of main shaft	45 mm
	e) Recommended speed of main drive	1440 RPM
5	Threshing Unit	
	a) Type	Spike Tooth
	b) Diameter	686 mm
	c) Width	356 mm
	d) Recommended speed	750 RPM
	e) Number and type of bearings	2 and Ball Bearing
6		
	Concave	
	a) Type	Bar Type
	b) Diameter or width	600 mm
	c) Length	330 mm
	d) Concave clearance range	15 mm
	e) Constructional feature	No
	f) Method of fixing	Nut Bolt
7		
	Sieve	
	a) Type	Round
	b) Number	2
	c) Total length and width	510 x 450 mm
	d) Effective length and width	450 x 400 mm
	e) Number of holes per cm ²	2 holes/cm ²

	f) Size of hole	5 mm
	g) Sieve clearance	15 mm
	h) Screen slope range	20°
	i) Method of mounting	Nut Bolt
8	Shaker	
	a) Type	Crank and Link Mechanism
	b) Number of strokes per minute	450
	c) Drive	Belt Drive
	d) Number and type of bearings	5 and Bush Bearing
9	Blower	
	a) Number	1
	b) Type	Fan Type
	c) Number of blades	4
	d) Size of blades	210 x 125 mm
	e) Diameter	600 mm
	f) Recommended Speed	750 rpm
	g) Provision for changing air displacement	Yes
	h) Size of inlet opening	230 mm
	i) Size of outlet opening	155 x 150 mm
	j) Drive	Mounted on Main Shaft
10	Crop Feeding	
	a) Type	Hopper
	b) Method of feeding	Manual
	c) Height and location of feeding system	1200 / 1530 mm
11	Transport	
	a) Type	Wheel
	b) Number of wheels	4
	c) Size of wheels	180 mm
	d) Wheel bearing	No
	e) Type of towing arrangement	No
12	Flywheel	
	a) Number	1
	b) Size (Día)	500 mm
13	Overall Dimensions	
	a) Length	1130 mm
	b) Width	880 mm
	c) Height	1470 mm
	d) Ground clearance	190 mm

It is clear from the above table that all the specifications i.e. general, power unit, crop to be threshed, main drive, threshing unit, concave, sieve, shaker, blower, crop feeding, transport, fly wheel and overall dimensions were observed as per the specification provided by the manufacturer.

Hence, it is clear from data that the machine was designed precisely and accurately.

Material of Construction

Table 3: Material of various components of thresher

S. No.	Component	Material
1	Frame	Mild steel
2	Feeding system	Mild steel
3	Threshing unit	Mild steel
4	Drum	Mild steel
5	Beater/projection/bar	High carbon steel
6	Concave	Mild steel
7	Blower	Mild steel
8	Main shaft	Mild steel
9	Blower shaft	Mild steel
10	Flywheel	Cast iron
11	Sieve	Mild steel
12	Shaker	Mild steel
14	Transport wheel	Rubber
15	Pulleys	Cast iron
16	Sliding pan	Mild steel

Material of various components of thresher observed is shown in Table 3. The material of construction of various parts like frame, feeding system, threshing unit etc. were analyzed and it was found that beater / projection, bar were made up of high carbon steel while the transport wheel and

pulleys were made up of rubber and cast iron respectively. The other remaining parts as shown in table are made up of mild steel.

Visual Observation and Provision of Adjustment

Table 4: Visual observation and provision of adjustment

S. No	Particular	Remark
1	Observations	Yes
	a) Adequacy of marking of inlet and outlets	Yes
	b) Adequacy of marking of direction of rotation of threshing unit	Yes
	c) Adequacy of protection of bearings against the ingress of dust	Yes
	d) Adequacy of safety arrangements, especially at moving points and at inlet	Yes
	e) Provision for lubrication of moving parts	Yes
	f) Provision for belt tightening	Yes
	g) Provision for transportation	Yes
	h) Provision for easy changing of components requiring frequent replacement	Yes
	i) Provision for easy replacement and cleaning of screens	Yes
	j) Provision for anti-corrosive coatings	Yes
	k) Balancing of threshing unit	Yes
	l) Welding of seams	Yes
	m) Tightness of bolts and nuts and other fasteners	Yes
2	Provision for Adjustments	
	a) Feed rate	No
	b) Concave clearance	Yes
	c) Speed	Yes
	d) Screen slope	Yes
	e) Sieve clearance	Yes
	f) Air displacement	Yes

It is clear from the table-4 that all the observations recorded like adequacy of making of inlet and outlet, provision of lubrication, provision for belt tightening ... etc. were on positive side. Also, the observation were recorded for the various adjustment like concave clearance, speed, screen

slope, sieve clearance, and air displacement were provided on machine except the feed rate adjustment.

Checking of Safety Provision

Table 5: Checking of safety provision

S. No	Particular	Remark
1	General	
	a) In case the prime mover is mounted on the thresher, a protective cover shall be provided to prevent it from dust or straw falling on it.	No
	b) Presence of any sharp corners and protruding fasteners.	No
2	Guards	
	a) Guards shall be provided to prevent accidental contact of persons or parts of clothing being caught in the transmission system.	No
	b) Guards shall be designed in such a way not to hinder in any adjustments, servicing and operation.	Yes
	c) Guards shall be capable of withstanding specified load.	yes
3	Feeding System	
	a) Type	Manual

It is very necessary to have the safety measures on the machine for the safety working of the operator. The above table-5 shows the provision of safety provide on thresher from which it is clear that the guards were placed on proper places having the capability of carry the load.

But it is found that there were no any kind of guards provided over the prime mover and transmission system. It is also observed that there was manual type feeding system over the thresher.



Plate 2: Inspection of safety provision

Summary and Conclusion

The various test were carried out on the wheat crop of variety HD-3086 i.e. pre observation test, test at no load, test at load (short duration) and analyses of sample were carried out for the checking specifications and pretest observation. It was observed that all the specifications were found to be equal to the specifications provided by the manufacture. Moisture content of crop during the test was found within the specific range as per IS: 6284: 1985 ^[3] code. The material of construction was found to be properly use as per the requirement. The various types of provisions and adjustments were provided except the feed rate adjustment. Some safety was not provided on the thresher like prime mover and transmission system covers. During visual observation the performance were found to be satisfactory except the knocking, rattling sound, slippage of belt, transport wheel damage, frequent clogging, and rise in bearing temperature.

It is concluded from the test that the specification and observations were found to be satisfactory but still there are some necessary changes that must be require like provision of safety, repair of transport wheel, feed rate adjustment which is necessary to update for future use.

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