



**SSCH-3737 Tejas (Brand Name - SHAKTIMAN,  
SELF PROPELLED SUGARCANE HARVESTER**



सत्यमेव जयते

भारत सरकार

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

GOVERNMENT OF INDIA

MINISTRY OF AGRICULTURE AND FARMERS WELFARE

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

केन्द्रीय कृषि मशीनरी प्रशिक्षण एवं परीक्षण संस्थान

ट्रैक्टर नगर, बुदनी (म.प्र.) ४६६ ४४५

**CENTRAL FARM MACHINERY TRAINING & TESTING INSTITUTE**

(An ISO : 9001 - 2008 Certified Institute)

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Comb-63/1621/2017

SSCH-3737 Tejas (Brand Name- SHAKTIMAN), SELF PROPELLED  
SUGARCANE HARVESTER – Commercial (Variant)



Applicant : M/s Tirth Agro Technology Pvt. Ltd.,  
Near Hotel Krishna Park, NH-27, Vavdi,  
Dist- Rajkot (Gujarat)  
Pin code - 360 004

Manufacturer : M/s Tirth Agro Technology Pvt. Ltd.  
"SHAKTIMAN", Survey No.-108/1,  
Plot No.B, NH-27, Nr. Bharudi Toll Plaza  
Bhunava (Village), Taluka- Gondal,  
Dist- Rajkot (Gujarat)  
Pin code-360 311

|             |                                    |            |
|-------------|------------------------------------|------------|
| Month: July | Test Report No. Comb- 63/1621/2017 | Year: 2017 |
|-------------|------------------------------------|------------|



GOVERNMENT OF INDIA  
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|                       |   |  |
|-----------------------|---|--|
| Type of test          | : | COMMERCIAL (Variant)   |
| Test code / procedure | : | IS:8122 (Part-II):2000 (Reaffirmed 2011), IS:15806:2008 & test procedure as agreed between applicant & testing authority |
| Period of test        | : | May, 2017 to June, 2017  |
| Test Report No        | : | Comb-63/1621/2017  |
| Month & Year          | : | July, 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 selected 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 a Variant test report and, should be read in conjunction with the Test Report of base model i.e. "SSCH-3737 (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester bearing No. Comb-61/1482/2015, March, 2015.

#### SELECTED CONVERSIONS

| SELECTED CONVERSIONS |                       |                                | ABBREVIATIONS |                                    |
|----------------------|-----------------------|--------------------------------|---------------|------------------------------------|
| S. No                | Units                 | Conversion Factor              |               |                                    |
| 1                    | <b>Force:</b>         |                                | apa           | As per applicant                   |
|                      | 1 kgf                 | 9.80665 N                      | TDC           | Top Dead Centre                    |
|                      |                       | 2.20462 lbf                    |               | IS                                 |
| 2                    | <b>Power:</b>         |                                | LHS/RHS       | Left Hand Side/<br>Right Hand Side |
|                      | 1 hp                  | 1.01387metric hp (Ps)          | Hg.           | Mercury                            |
|                      |                       | 745.7 W                        | Temp.         | Temperature                        |
|                      | 1 Ps                  | 735.5 W                        | N.R.          | Not recorded                       |
|                      | 1 kW                  | 1.35962 Ps                     | rpm           | Revolutions per minute             |
| 3                    | <b>Pressure:</b>      |                                | O.D/I.D       | Outer diameter/<br>Inner diameter  |
|                      | 1 psi                 | 6.895 kPa                      | N.A.          | Not available/<br>Not applicable   |
|                      | 1 kgf/cm <sup>2</sup> | 98.067 kPa = 735.56 mm of Hg   | PTO           | Power take-off                     |
|                      | 1 bar                 | 100 kPa = 10 N/cm <sup>2</sup> | R.H.          | Relative Humidity                  |
|                      | 1 mm of Hg            | 1.3332 m-bar                   | Min./Max.     | Minimum / Maximum                  |
|                      |                       |                                | L x W x T     | Length x Width x Thickness         |



|                   |   |   |
|-------------------|---|---|
| Name of Machine   | : | Sugarcane Harvester   |
| Type              | : | Self propelled, four wheeled, two wheel drive, sugarcane harvester with de-topper and chopper mechanism (provided with double crop divider)   |
| Make and Model    | : | Tirth Agro Technology Privet Limited,<br>SSCH-3737 Tejas (Brand name- Shaktiman)  |
| Manufactured by   | : | M/s Tirth Agro Technology Pvt. Ltd.<br>"SHAKTIMAN", Survey No.-108/1,<br>Plot No.B, NH-27, Nr. Bharudi Toll Plaza<br>Bhunava (Village), Taluka- Gondal,<br>Dist- Rajkot (Gujarat)<br>Pin code-360 311 |
| Test Requested by | : | M/s Tirth Agro Technology Pvt. Ltd.,<br>Near Hotel Krishna Park, NH-27,<br>Vavdi, Dist- Rajkot (Gujarat)<br>Pin code-360 004  |
| Test Conducted by | : | Government Of India,<br>Central Farm Machinery Training and Testing Institute,<br>Tractor Nagar Budni – 466445 (M.P.) India   |



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## 1. SCOPE OF TEST

The Sugarcane Harvester "SSCH-3737 Tejas (Brand Name- SHAKTIMAN)", is a self propelled machine used for harvesting the sugarcane crop with mechanism for cutting cane in billets, extractor to remove trash, leaves and dirt from the cane and the elevator conveyor system to delivers the cane billets to hydraulic assisted tipping trailer i.e. infielder.

The "SSCH-3737 (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester had undergone "Initial Commercial Test" at this Institute and a test report No. Comb-61/1482/2015, was released in March, 2015. Now the applicant has submitted an application vide letter No. TIRTH/NP/TEST/2017-18/06 dated 02/03/2017 for testing of "SSCH-3737 Tejas (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester as a Variant of "SSCH-3737 (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester.

The applicant having enclosed a list of following differences in the technical specifications between "SSCH-3737 (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester and "SSCH-3737 Tejas (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester and requested to test the "SSCH-3737 Tejas (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester as a variant of "SSCH-3737 (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester".

The major features of Base model and Variant model are listed below:

| S. No. | Parameters                                | Base Model<br>(Test Report No.<br>Comb-61/1482/2015)   | Variant Model  |
|--------|---|--|--|
| 1      | 2   | 3  | 4  |
| 1.     | Model of sugarcane harvester              | SSCH-3737<br>(Brand Name - SHAKTIMAN)  | SSCH-3737 Tejas<br>(Brand Name - SHAKTIMAN)  |
| 2.     | Type of sugarcane harvester               | Self propelled, four wheeled, two wheel drive, sugarcane harvester with topper and chopper mechanism (provided with double crop divider) | Self propelled, four wheeled, two wheel drive, sugarcane harvester with topper and chopper mechanism (provided with double crop divider) |
| 3.     | <b>Prime mover:</b>                       |  |  |
|        | Make                                      | M/s. Tata- Cummins Ltd.  | M/s. Volvo Penta   |
|        | Model                                     | B 5.9173C 31   | TAD551VE   |
|        | Maximum speed at no load                  | 2550 ± 100   | 2400±100   |
|        | Rated speed                               | 2500 ± 50  | 2200±50  |
|        | Rated Engine speed for Field operation    | 2500 ± 50 (No load)<br>2400 + 50/-150 (On load)  | 2200 ± 50 (No load)<br>2200 ± 50 (On load)   |
|        | Low idle speed                            | 800 ± 50   | 700±50   |
|        | Engine speed at max torque                | Not specified  | 1400   |
|        | Max. declared power, kW (hp)              | 128 (174)  | 129 (175.4)  |
|        | Maximum torque, Nm                        | 650  | 810  |
| 4.     | <b>Cylinder:</b>                          |  |  |
|        | Number                                    | Six  | Four   |
|        | Bore/Stroke, mm                           | 102 / 120  | 110 / 135  |
|        | Capacity, cm <sup>3</sup>                 | 5883   | 5132   |
|        | Compression ratio                         | 18:1   | 17.5:1   |
|        | Type of cylinder liners                   | Wet, replaceable   | Dry, replaceable   |
|        | Type of head                              | Individual   | Monoblock  |
|        | Type of combustion chamber                | Direct combustion, Re-entrant cavity on piston crown   | Piston combustion chamber (apa)  |
|        | <b>Valve clearance in cold / hot, mm:</b> |  |  |
|        | Inlet                                     | 0.25/0.25  | 0.20   |
|        | Exhaust                                   | 0.50/0.50  | 0.20   |



| 1   | 2   | 3  | 4  |
|-----|---|--|--|
| 5.  | Type of fuel injection pump   | Inline plunger   | Common rail (Electronic)                               |
| 6.  | Effective size of charge air cooler, mm                                 | 500 x 545 x 60   | 585 x 445 x 136  |
| 7.  | Size of impeller of water pump, mm                                      |  |  |
|     | Diameter  | 82.3   | 117  |
|     | No. of guide Vanes  | 07   | 07   |
| 8.  | Dia. of cooling fan, mm   | 720  | 615  |
| 9.  | <b>Radiator:</b>  |  |  |
|     | Effective size of radiator, mm  | 740 x 650 x 60   | 830 x 585 x 115  |
|     | No. of tubes on radiator  | 35, Vertical   | 64, Horizontal   |
|     | Radiator cap pressure kPa (kg/cm <sup>2</sup> )                         | 48.3 (0.49)  | 75 (0.76)  |
|     | Bare radiator capacity, l   | 12.9   | 16.3   |
|     | Total coolant capacity, l   | 28.6   | 38.05  |
| 10. | <b>Range of forward speeds, (kmph):</b>                                 |  |  |
|     | - At full throttle  | 15.86  | 13.63  |
|     | - At rated engine speed   | 12.50  | 11.51  |
| 11. | <b>Exhaust System:</b>  |  |  |
|     | (Position of silencer outlet w.r.t SIP, mm)                             |  |  |
|     | -Vertical   | 850  | 1555   |
|     | -Longitudinal   | 1290   | 995  |
|     | -Lateral  | 310 (RHS)  | 120 (LHS)  |
|     | <b>Size of Muffler, (mm):</b>   |  |  |
|     | -Length   | 850  | 620  |
|     | -Diameter   | 283  | 261  |
| 12. | <b>Turbocharger:</b>  |  |  |
|     | Number of blades on turbine wheel / compressor fan                      | 12 / 07  | 09 / 10  |
| 13. | <b>Hydraulic oil cooler:</b>  |  |  |
|     | -No of Tubes  | 28   | 34   |
|     | -Effective Area, mm   | 565 x 415 x 40   | 490 x 487 x 60   |
|     | Capacity of Hydraulic tank (l)  | 120.5  | 130.0  |
| 14. | <b>Topper assembly:</b>   |  |  |
|     | Cutting height from GL, mm  |  |  |
|     | Minimum   | 1060   | 800  |
|     | Maximum   | 3990   | 3230   |
| 15. | <b>Elevator:</b>  |  |  |
|     | Total area of sieve, (m <sup>2</sup> )                                  | 2.02   | 2.80   |
|     | Horizontal reach, mm (Min. / Max.)                                      | 3640 / 4695  | 2180 / 3085  |
|     | Clearance height, mm (Min. / Max.)                                      | 1850 / 2640  | 2390 / 3350  |
|     | Range of vertical movement at top of elevator from GL, mm (Min. / Max.) | 2790 / 4280  | 3340 / 4590  |
|     | Range of horizontal swing towards LHS and RHS from centre of machine    | 84 degree and 80 degree                                | 82.5 degree / 82.5 degree                              |
|     | Arrangement of levelling / controlling elevator feed                    | 15 nos. chains of 10 link hanged on extractor fan bowl | 15 nos. chains of 08 link hanged on extractor fan bowl |



| 1        | 2  | 3                        | 4                           |                    |                        |
|----------|--|--------------------------|-----------------------------|--------------------|------------------------|
| 16.      | Extractor fan:   |                          |                             |                    |                        |
|          | Working Diameter   | Ø 880                    | 850 Ø                       |                    |                        |
|          | Opening area of Extractor unit, m <sup>2</sup>                 | 0.732                    | 0.556                       |                    |                        |
| 17.      | Speed corresponding to rated engine speed for field work, rpm: |                          |                             |                    |                        |
|          |  | Base model @ 2500 rpm    | Variant model @ 2200 rpm    |                    |                        |
|          | Topper assembly knife blade                                    | 1344                     | 1340                        |                    |                        |
|          | Crop divider<br>Inner side /Outside                            | 162/162                  | 140 / 140                   |                    |                        |
|          | Knock down roller  | 80                       | 70                          |                    |                        |
|          | Finned roller  | 80                       | 84                          |                    |                        |
|          | Base cutter  | 558                      | 481                         |                    |                        |
|          | Butt lift roller   | 82                       | 80                          |                    |                        |
|          | Feed rollers<br>LHS / RHS                                      | 103 / 83                 | 103 / 81                    |                    |                        |
|          | Chopper drum   | 495                      | 507                         |                    |                        |
|          | Elevator   | 210                      | 211                         |                    |                        |
|          | Extractor fan  | 2292                     | 10 to 2250 (Variable speed) |                    |                        |
|          | 18.  | Over all dimensions, mm: |                             |                    |                        |
|          |  | Transport position       | Field Working position      | Transport position | Field Working position |
| - Length |  | 11620                    | 6560                        | 10510              | 6540                   |
| - Width  |  | 2505                     | 5632                        | 2480               | 5085                   |
| - Height |  | 3590                     | 4335                        | 3760               | 4650                   |
| 19.      | Mass of sugarcane harvester:                                   | 8340                     | 8730                        |                    |                        |

Subsequent to the examination of the case in light as per draft DOCUMENT NO. 26-1/2016-1111TEST/SH/CFMTTI/2017 and vide Office Memorandum No. 13-10/1999-M&T (I&P) dated 21.04.2016 above "SSCH-3737 Tejas (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester is considered as a variant of "SSCH-3737 (Brand Name - SHAKTIMAN)" Self Propelled Sugarcane Harvester". The following tests were considered to be carried out:

- Specifications checking in full
- Nominal speed test
- Engine performance test full
- Noise level measurement at bystander position & at operator's ear level
- Mechanical Vibration at various assemblies / sub-assemblies

## 2. METHOD OF SELECTION

The machine was directly submitted for test by the applicant. Hence, the method of selection is not known.





## 3. FUEL AND LUBRICANTS

1.1 Fuel : The high speed diesel oil, having specific gravity of 0.836 at 15°C was used during the engine test.

## 1.2 Lubricants:

| S. No. | Particulars  | As recommended by the applicant | As used during the test   |
|--------|--|---------------------------------|---|
| 1      | Engine oil   | VDS-3 OIL – 15W-40              | The original lubricants filled in systems were not changed during the test. |
| 2      | Hydraulic system oil   | Enklo 68                        |   |
| 3      | Main cutter gear box, chopping device gear box, rear wheel hub oil | HP Gear Oil XP 85W140           |   |
| 4      | Grease   | SKF LGMT 2                      | M.P Grease  |

## 4. ESSENTIAL TESTS

## 4.1 SPECIFICATIONS

## 4.1.1 General:

Base modelVariant model

|         |                                |   |  |
|---------|--------------------------------|---|--|
| 4.1.1.1 | Name & Address of manufacturer | : | M/s Tirth Agro Technology Pvt. Ltd, "SHAKTIMAN", Survey No.-108/1, Plot No.B, NH-27, Nr. Bharudi Toll Plaza Bhunava (Village), Taluka- Gondal, Dist- Rajkot (Gujarat) Pin code-360 311 |
|         | Make                           | : | Tirth Agro Technology Privet Limited   |
|         | Model                          | : | SSCH-3737   SSCH-3737 Tejas  |
|         | Brand name                     | : | Shaktiman   Shaktiman  |
|         | Type                           | : | Self propelled, four wheeled, two wheel drive, sugarcane harvester with topper and chopper mechanism (provided with double crop divider)   |
|         | Year of manufacture            | : | 2014 (November 2014)   February, 2016  |
|         | Serial Number / Chassis No.    | : | 14K0000009 / TATSCH373714K0000009   16B0000047 / TATSCH373716B0000047  |

## 4.1.2 Prime mover :

|  |   |  |  |
|--|---|--|--|
| Make                                   | : | M/s. Tata- Cummins Ltd.  | M/s. Volvo Penta                           |
| Model                                  | : | B 5.9173C 31   | TAD551VE                                   |
| Type                                   | : | Four stroke, Turbo charged, intercooled, Direct injection, Diesel engine |  |
| Serial Number                          | : | 41F84169936  | 7005308375                                 |
| Compliance with emission norms         | : | BS-III   | BS-III                                     |
| Maximum speed at no load               | : | 2550 ± 100   | 2400±100                                   |
| Engine max power, kW (hp)              | : | 128 (174)  | 129 (175.4)                                |
| Rated speed                            | : | 2500 ± 50  | 2200±50                                    |
| Rated Engine speed for Field operation | : | 2500 ± 50 (No load)<br>2400 + 50/-150 (On load)                          | 2200 ± 50 (No load)<br>2200 ± 50 (On load) |
| Rated Engine speed for Road operation  | : | 2000   | 2000                                       |
| Low idle speed                         | : | 800 ± 50   | 700±50                                     |
| Engine speed at max torque             | : | Not specified  | 1400                                       |
| Maximum torque, Nm (apa)               | : | 850  | 810  |



|                |  | <u>Base model</u>  | <u>Variant model</u>                                |
|----------------|--|--|---|
| <b>4.1.3</b>   | <b>Cylinder &amp; Cylinder Head:</b>       |  |   |
|                | Number                                     | : Six  | Four  |
|                | Disposition                                | : Vertical, inline   | Vertical, inline                                    |
|                | Bore/Stroke, mm                            | : 102 / 120  | 110 / 135   |
|                | Capacity, cm <sup>3</sup>                  | : 5883   | 5132  |
|                | Compression ratio                          | : 18:1   | 17.5:1  |
|                | Arrangement of valves                      | : Overhead, inline   | Overhead, inline                                    |
|                | Type of cylinder liners                    | : Wet, replaceable   | Dry, replaceable                                    |
|                | Type of head                               | : Individual   | Monoblock   |
|                | Type of combustion chamber                 | : Direct combustion, Re-entrant cavity on piston crown   | Piston combustion chamber (apa)                     |
|                | No. of valve                               | : 24 (4 per cylinder)  | 16 (04 valves per cylinder)                         |
|                | <b>Valve clearance in cold / hot,mm:</b>   |  |   |
|                | Inlet                                      | : 0.25/0.25  | 0.20  |
|                | Exhaust                                    | : 0.50/0.50  | 0.20  |
| <b>4.1.4</b>   | <b>Fuel System:</b>                        |  |   |
|                | Type of fuel system                        | :  | Force feed  |
| <b>4.1.4.1</b> | <b>Fuel Tank:</b>                          |  |   |
|                | Capacity(l)                                | : 208  | 210 (apa)   |
|                | Location                                   | : At rear side of main chassis assembly  |   |
|                | Material of construction                   | :  | Not provided  |
|                | Provision for draining of sediment / water | :  | Provided  |
| <b>4.1.4.2</b> | <b>Water Separator:</b>                    |  |   |
|                | Make                                       | : Donaldson  | Volvo   |
|                | Model/Part No                              | : P558000  | 21538975  |
|                | Type                                       | : Spin on replaceable paper element filter with bowl at base having arrangement for draining of water. |   |
|                | Number                                     | : One  | One   |
|                | Location                                   | : On rear side of engine, inside pump room.  | On LHS of engine                                    |
| <b>4.1.4.3</b> | <b>Fuel Feed Pump:</b>                     |  |   |
|                | Make                                       | : Bosch, India   | Denso corporation (apa)                             |
|                | Type                                       | : Plunger  | Push button type                                    |
|                | Type No. /Group combination No.            | : F002 A50 023   | Not available                                       |
|                | Provision of sediment bowl                 | : Not provided   | Provided  |
|                | Method of drive                            | : Through timing gear  | Not applicable                                      |
|                | Number (s)                                 | : One  | Two (one on water separator and one on fuel filter) |
| <b>4.1.4.4</b> | <b>Fuel Filter:</b>                        |  |   |
|                | Make                                       | : Fleetguard   | Volvo   |
|                | Type                                       | : Replaceable spin on  | Cartridge, Replaceable spin on                      |
|                | Model/Group. Combination No                | : 3931063  | 22296404  |
|                | Number                                     | : Two  | One   |
|                | Type of element                            | : Paper  | Paper   |
|                | Capacity of fuel filter, (l)               | : 0.3 / 0.6 (Primary / Secondary)  | 1.0 (apa)   |



|                |  | <u>Base model</u>  | <u>Variant model</u>  |
|----------------|--|--|---|
| <b>4.1.4.3</b> | <b>Fuel Injection Pump:</b>                        |  |   |
|                | Make   | : Bosch, India   | Volvo   |
|                | Model/Group combination No                         | : 460 426 522, VE<br>6/12F1250R1172, 5290979                             | HP3, 2260, 02S, 00044   |
|                | Type   | : Rotary   | 02 cylinder rotary<br>electronic pump   |
|                | Serial Number                                      | : 45407028   | 22251132  |
|                | Method of drive                                    | : Through timing gear  | Through timing gears  |
| <b>4.1.4.5</b> | <b>Fuel Injectors:</b>                             |  |   |
|                | Make   | : Bosch, India   | Denso   |
|                | Model/Group combination No. /<br>Part No./ Sr. No. | : F002 C7Z 008 (Holder<br>Number)<br>DL LA 153 P 2134 (Nozzle<br>Number) | G3SAM (apa) 21785960<br>1240, 09S508663   |
|                | Type/ No. of hole                                  | : Multi holes (Five holes)   | Electronically operated /<br>Multi holes (Seven<br>holes)   |
|                | Injection opening pressure, Mpa,<br>apa            | : Not specified  | Not specified   |
|                | Injection timing, apa                              | : Not specified  | Dataset 22431305,<br>sugarcane harvester<br>has electronic governed<br>engine, it has an<br>"Electronic Control Unit"<br>that governs the fuel<br>injection and timing. It is<br>programmed with<br>software ID 22431305. |
| <b>4.1.4.7</b> | <b>Firing order</b>                                | : 1-5-3-6-2-4  | 1-3-4-2   |
|                | <b>Governor:</b>                                   | <b>Provided</b>  | <b>Not provided</b>   |
|                | Make   | : Bosch, India   | --  |
|                | Model/Group combination No.                        | : Inbuilt with fuel injection<br>pump                                    | --  |
|                | Type   | : Mechanical, centrifugal,<br>variable speed                             | --  |
|                | Governed range of engine speed,<br>rpm             | : 750 to 2650  | 650 to 2500   |
|                | Rated engine speed, rpm                            | : 2250 to 2500 (on load)   | 2200 ± 50 (on load)   |
|                | <b>ECU Unit</b>                                    | : <b>Not provided</b>  | provided  |
|                | Make   | : --   | alu   |
|                | Identification number                              | : --   | AISI8Cu 3.5   |
|                | Function   | : --   | It acts as governor<br>which governs the fuel<br>injection and timing.  |
| <b>4.1.5</b>   | <b>Air Intake system</b>                           |  |   |
| <b>4.1.5.1</b> | <b>Pre-cleaner:</b>                                |  |   |
|                | Make   | : Not provided   | Donaldson   |
|                | Type   | : Turbine  | Spin on,<br>non – transparent   |
|                | Number   | : One  |   |
|                | Location   | : On the top of main air cleaner intake tube                             |   |
| <b>4.1.5.2</b> | <b>Air Cleaner:</b>                                |  |   |
|                | Make   | : Fleetguard   | Donaldson   |
|                | Type   | : Dry (Dual cartridge)   |   |
|                | Number   | : One  |   |
|                | Location   | : On the LHS of harvester<br>above pump chamber                          | On RHS top of air<br>intercooler and radiator<br>housing  |



|   | Base model  |                   | Variant model   |                   |
|---|---|-------------------|---|-------------------|
|   | Primary element   | Secondary element | Primary element   | Secondary element |
| <b>Details of filter element</b>                              |   |                   |   |                   |
| - Size ,OD/ID, (mm)   | 254.7/145   | 144.8/127         | 245/155   | 145/115           |
| - Length, (mm)  | 445   | 405               | 515   | 480               |
| - Type  | Cellulose fibre paper   |                   | Cellulose fibre paper   |                   |
| Range of suction pressure at max. Power, kPa (observed)       | 2.0 to 2.1  |                   | 4.2 to 4.3  |                   |
| Maintenance Indicator   | The air restriction provided at outlet of air cleaner   |                   |   |                   |
| Cleaning interval   | Based on dust indicator (apa)   |                   |   |                   |
| Service/ maintenance schedule                                 | 1) Replace primary filter element and safety element only when restriction indicator's signal, 1000 hours or one year whichever is earlier. |                   | Check and clean daily or when air filter blockage indicator indicates or Check and clean after every 250 hour of operation. |                   |
|   | 2) After each 500 hours, simulate restriction pointer is functioning correctly.   |                   | Change after every 2500 hours of operation.   |                   |
| <b>4.1.3 Exhaust System</b>                                   |   |                   |   |                   |
| Make  | Not specified   |                   | Donaldson   |                   |
| Type of silencer  | Updraft, cylindrical  |                   | Updraft, cylindrical  |                   |
| <b>Position of silencer outlet with respect to SIP, (mm):</b> |   |                   |   |                   |
| - Vertical  | 850   |                   | 1555  |                   |
| - Longitudinal  | 1290  |                   | 995   |                   |
| - Lateral   | 310 (RHS)   |                   | 120 (LHS)   |                   |
| <b>Size of Muffler, (mm):</b>                                 |   |                   |   |                   |
| - Length  | 850   |                   | 620   |                   |
| - Diameter  | 283   |                   | 261   |                   |
| Range of exhaust gas pressure at max power, kPa (observed)    | 126.4 to 128.8  |                   | Not recorded  |                   |
| Location  | Behind the cabin  |                   |   |                   |
| Provision of spark arresting device/any other device          | Not provided  |                   |   |                   |
| <b>4.1.3.1 Details of turbocharger</b>                        |   |                   |   |                   |
| Make  | Holset  |                   | Not provided  |                   |
| Model   | HX35W   |                   | Not provided  |                   |
| Number of fan/ wheels   | Two, one for turbine and one for compressor   |                   |   |                   |
| Number of blades  |   |                   |   |                   |
| Turbine wheel   | 12  |                   | 09  |                   |
| Compressor fan  | 07  |                   | 10  |                   |
| Method of drive   | Exhaust gas driven turbo charger  |                   |   |                   |
| Means of lubrication  | Force feed, through main gallery on oil filter mounting.  |                   |   |                   |
| Serial No.  | D1405216058   |                   | 2405154-01, 002552  |                   |
| <b>4.1.3.2 Exhaust Gas Recirculation System (if any)</b>      | None  |                   | None  |                   |



|   | <u>Base model</u>  | <u>Variant model</u>   |
|---|--|--|
| <b>4.1.1 Intercooler/Charge Air cooler</b>                    |  |  |
| Type  | : Tube type heat exchanger, cooling with forced air                              | : Horizontal, tube type heat exchanger, cooling with forced air        |
| Make  | : Not available  | : Not available  |
| Model   | : Not available  | : Not available  |
| No. of Tubes  | : 28   | : 28   |
| Effective size, mm  | : 500 x 545 x 60   | : 585 x 445 x 136  |
| Material of construction                                      | : Aluminium  | : Aluminium  |
| Location  | : Mounted in M.S. frame above radiator, in front of engine                       | : Mounted in M.S. frame above radiator, in front of engine             |
| <b>4.1.2 Lubrication System</b>                               |  |  |
| Type  | : Pressurized oil lubrication  | : Pressurized oil lubrication  |
| Type of oil pump  | : Gear type  | : Gear type  |
| Method of drive   | : Through timing gear  | : Through timing gear  |
| Oil sump capacity, l  | : 15.50  | : 14.0   |
| Total lub. oil capacity, l                                    | : 16.40  | : 16.0   |
| <b>4.1.2.1 Oil filters</b>                                    |  |  |
| Type of oil filters   | : Spin on (replaceable)  | : Spin on (replaceable)  |
| Make and Model Number.  | : Fleetguard, LF 9028  | : Volvo  |
| Location  | : One  | : One  |
| Oil filter capacity, l  | : On LHS of engine   | : On LHS of engine   |
| Relief valve pressure setting, kpa (kg/cm <sup>2</sup> ), apa | : 0.5  | : 2.0  |
| Minimum permissible pressure, kPa (kg/cm <sup>2</sup> ), apa  | : Not available  | : 420 (4.28)   |
| Method of oil cooling   | : Not available  | : 150 (1.52)   |
| <b>Details of oil cooler</b>                                  |  |  |
| Type  | : Oil cooler provided  | : Oil cooler provided  |
| Make  | : Plate type heat exchanger  | : Plate type heat exchanger  |
| Lubrication oil change period, apa                            | : Nor provided   | : Nor provided   |
|   | : Change after every 225 to 250 hour or within three month whichever is earlier. | : Check lever daily and change after every 250 hour of operation.      |
| <b>4.1.3 Cooling system:</b>                                  |  |  |
| Type  | : Pressurised, forced circulation of coolant                                     | : Pressurised, forced circulation of coolant                           |
| Coolant recommended   | : Fleetguard, Premixed (50:50 ratio)   | : Coolant VCS ready mixed  |
| <b>4.1.3.1 Water pump:</b>                                    |  |  |
| Make  | : Concentric, USA  | : TBK Volvo  |
| Type  | : Centrifugal, seven metallic vanes, semi open impeller                          | : Centrifugal  |
| Size of impeller, mm  |  |  |
| Diameter  | : 82.3   | : 117  |
| No. of guide Vanes  | : 07   | : 07   |
| Method of drive   | : Through crank shaft pulley by flat belt common to fan and alternator           | : Through crank shaft pulley by flat belt common to fan and alternator |
| <b>4.1.3.2 Details of fan:</b>                                |  |  |
| Type  | : Blower type with auto cleaning facility  | : Blower type with auto cleaning facility                              |
| No. of blades & material                                      | : 06, plastic blades mounted on aluminium hub                                    | : 06, plastic blades mounted on aluminium hub                          |
| Dia. of fan, mm   | : 720  | : 615  |
| Mean of temperature control                                   | : One thermostal valve provided  | : One thermostal valve provided  |



|                 |   | <u>Base model</u>   |         | <u>Variant model</u>   |         |
|-----------------|---|---|---------|--|---------|
| <b>4.1.1</b>    | <b>Radiator:</b>                            |   |         |  |         |
|                 | Make  | Not available   |         |  |         |
|                 | Effective Size of radiator, mm              | Effective   | Overall | Effective  | Overall |
|                 | Height                                      | 740   | 920     | 830  | 845     |
|                 | Width                                       | 650   | 685     | 585  | 750     |
|                 | Thickness                                   | 60  | 85      | 115  | 115     |
|                 | No. of tubes                                | 35, Vertical  |         | 64, Horizontal   |         |
|                 | Material of radiator core                   | Aluminium   |         |  |         |
|                 | Type of radiator cap                        | Pressurized   |         |  |         |
|                 | Radiator cap pressure kPa                   | 48.3  |         | 75   |         |
|                 | Type of thermostat (apa)                    | Wax type  |         |  |         |
|                 | Temperature setting (apa), °C:              |   |         |  |         |
|                 | Opening starts                              |   |         | 85   |         |
|                 | Complete opening                            | 83  |         | 85   |         |
|                 |   | 95  |         | 95   |         |
|                 | Bare radiator capacity, (l)                 | 12.9  |         | 16.3   |         |
|                 | Total coolant capacity, (l)                 | 28.6  |         | 38.05  |         |
|                 | Grill cleaning                              | Manual / auto cleaning by reversing fan direction with help of oil flow |         |  |         |
|                 | Coolant reservoir                           | Brass reservoir is provided, above radiator mounting frame              |         | Plastic reservoir is provided, above radiator mounting frame           |         |
|                 | Capacity of coolant reservoir, (l)          | 9.80  |         | 9.55   |         |
|                 | Method of mounting                          | Bolted with rubber pad on mounting frame                                |         |  |         |
|                 | Means of grill cleaning                     | Manual  |         |  |         |
| <b>4.1.11</b>   | <b>Details of Hydraulic oil cooler:</b>     |   |         |  |         |
|                 | Make  | Not provided  |         |  |         |
|                 | Type  | Tube with fins type heat exchanger, cooled with forced air              |         | Horizontal, Tube with fins type heat exchanger, cooled with forced air |         |
|                 | Model/part no                               | 3526  |         | 539003000831 / TA20703BO   |         |
|                 | No of Tubes                                 | 28  |         | 34   |         |
|                 | Effective Area, mm                          | 565 x 415 x 40  |         | 490 x 487 x 60   |         |
|                 | Material of construction                    | Aluminium   |         |  |         |
|                 | Location                                    | Mounting above the radiator in M.S frame, in front of radiator          |         |  |         |
| <b>4.1.11</b>   | <b>Electrical System:</b>                   |   |         |  |         |
| <b>4.1.11.1</b> | <b>Starting System:</b>                     |   |         |  |         |
|                 | Type  | Electrical 24 V, DC   |         |  |         |
|                 | Any aid for cold starting                   | None  |         |  |         |
|                 | Any other device provided for easy starting | None  |         |  |         |
| <b>4.1.11.2</b> | <b>Battery</b>                              |   |         |  |         |
|                 | Make and Model                              | Amaron & HCV700 H29R  |         | AMRON & BL1000RMF  |         |
|                 | Number and type                             | Two, lead acid  |         |  |         |
|                 | Capacity and rating                         | 12V, 100 Ah at 20 hour discharge rating                                 |         |  |         |
|                 | Location                                    | Bake side of radiator in engine mounting assembly                       |         | On LHS of top of engine mounting assembly, rear of cabin               |         |



|                 |                              | <u>Base model</u>  | <u>Variant model</u>   |
|-----------------|------------------------------|--|--|
| <b>4.1.11.3</b> | <b>Starter Motor:</b>        |  |  |
|                 | Make                         | : Lucas TVS  |  |
|                 | Type                         | : Pre-engaging, solenoid operated                                      |  |
|                 | Model/ Group combination no. | : 7M14   |  |
|                 | Capacity and rating          | : 24 V   | : 24 V & 5.5 kW  |
|                 | Sl. No.                      | : 26925237B  | : 90P55 (apa)  |
|                 | Location                     | : On RHS of engine   |  |
| <b>4.1.11.4</b> | <b>Alternator:</b>           |  |  |
|                 | Make                         | : Lucas TVS  | : Melco (apa)  |
|                 | Model                        | : SA 45  | : Not provided   |
|                 | Model/Group combination no.  | : Not provided   | : Not provided   |
|                 | S. No.                       | : 26215921   | : Not provided   |
|                 | Output rating                | : 24 V, 90 Amp   | : 24V, 110 Amp (apa)   |
|                 | Location                     | : On RHS of engine   |  |
|                 | Method of drive              | : Through crankshaft pulley by a cogged "V" belt common to water pump. | : Through crankshaft pulley by a flat belt common to water pump. |
| <b>4.1.11.5</b> | <b>Voltage Regulator:</b>    |  |  |
|                 | Make                         | : Not provided   | : Not provided   |
|                 | Type                         | : Inbuilt in alternator  | : Inbuilt with alternator  |
|                 | Capacity                     | : 24 V   | : 24 V   |

**4.1.11.6 Details of Lights:**

| Description                              | No. & capacity of bulb | Height above ground to the centre of beam (mm) | Size of beam (mm) | Distance from centre of the beam to outside edge of harvester (mm) LHS/ RHS |
|--|------------------------|--|-------------------|---|
| 1  | 2                      | 3  | 4                 | 5   |
| <b>Base model</b>                        |                        |  |                   |   |
| <b>Front Lights:</b>                     |                        |  |                   |   |
| Head Lights                              | 02, 24V, 75/70W        | 2830   | 140 Ø             | 805   |
| Parking lights                           | 02, 24V, 4W            | 2830   | 140 Ø             | 805   |
| Turn cum hazard indicator light          | 02, 24V, 21W           | 2710   | 148 x 52          | 802   |
| Field working lights                     | 01, 24V, 55W           | 3070   | 130 x 70          | 1252  |
| Reflector (White)                        | 2                      | 2140   | 80 x 55           | 770   |
| <b>Rear Lights:</b>                      |                        |  |                   |   |
| Brake light                              | 02, 24V, 21W           | 1550   | 100 x 120         | 742   |
| Turn cum hazard indicator light          | 02, 24V, 21W           | 1550   | 100 x 120         | 507   |
| Trail cum parking light                  | 02, 24V, 10W           | 1575   | 120 x 40          | 625   |
| Reverse light & Registration plate light | 02, 24V, 21W           | 1520   | 115 x 50          | 625   |
| Registration plate light                 | 01, 24V, 5W            | 1400   | 35 Ø              | 235   |



| 1                                       | 2                | 3           | 4         | 5         |
|---|------------------|-------------|-----------|-----------|
| <b>Variant model</b>                    |                  |             |           |           |
| <b>Front Lights:</b>                    |                  |             |           |           |
| Head Light                              | 02, 24V, 100/90W | 3020        | 130 Ø     | 830       |
| Turn cum hazard indicator light         | 02, 24V, 21W     | 2910        | 50 x 145  | 830       |
| Front working lights                    | 01, 24V, 70W     | 3240        | 130 x 75  | 1240      |
| Reflector (White)                       | 02               | 1810        | 60 x 90   | 775       |
| Reflector (front side mirror)           | 02               | 1300        | 60 x 90   | 260       |
| <b>Rear Lights:</b>                     |                  |             |           |           |
| Turn cum hazard indicator light         | 02, 24V, 21W     | 1470        | 100 x 120 | 505       |
| Fuel cum parking light                  | 02, 24V, 21W     | 1440        | 50 x 120  | 485       |
| Reverse light                           | 02, 24V, 10W     | 1500        | 40 x 125  | 485       |
| Functional lights                       | 02, 24V, 10      | 1470        | 100 x 120 | 550       |
| Cabin rear light                        | 02, 24V, 70W     | 3240        | 100 Ø     | 830       |
| Reflector-Red (mount with RCL assembly) | 02               | 1440        | 50 x 120  | 485       |
| Reflector (Amber)                       | 02               | 1560        | 60 x 90   | 900       |
| <b>Back light:</b>                      |                  |             |           |           |
| Elevator light                          | 02, 24V, 70W     | 3040        | 100 Ø     | 535       |
| Turn cum hazard indicator light         | 02, 24V, 21W     | 3280        | 65 x 95   | 510       |
| Reverse light                           | 02, 24V, 10W     | 3230        | 65 x 65   | 510       |
| Reflector (Red & Amber)                 | 02 & 02          | 2600 & 1790 | 60 x 90   | 505 & 485 |

**4.1.11.7 Reverse Warning Alarm:**

|          |   |                    |
|----------|---|--------------------|
| Make     | : | Vaishno            |
| Number   | : | One                |
| Capacity | : | 24 V, DC           |
| Location | : | Inside engine hood |

Above the engine on inside the top of bird cage

**4.1.11.8 Horn:**

|          |   |   |
|----------|---|---|
| Make     | : | Hella   |
| Type     | : | 12V, 2B, Electromagnetically vibrated diaphragm |
| Number   | : | One   |
| Location | : | Above the engine cover                          |

Roos  
24V, 2B,  
Electromagnetically vibrated diaphragm  
Two  
Above the engine on inside the top of bird cage

**4.1.11.9 Circuit breaker**

|          |   |   |
|----------|---|---|
| Location | : | On panel board, in front of operator          |
| Capacity | : | 20 A, 250V AC/50V DC                          |
| Number   | : | 06 (Six)   5A, 10A, 15A & 20A<br>15 (Fifteen) |





**4.1.11.10 Details of other electrical Accessories: on Base and Variant Model**

- i) Transmission/traction neutral switch
- ii) Safety switch-cut electrical connection when high coolant temperature, low engine oil pressure and low hydraulic oil level
- iii) Battery cut off - for cutting electrical connections when sugarcane harvester is not in operation
- iv) Emergency stop button provided on control panel on front top RHS of cabin to protect machine in case of any emergency

**4.1.11.11 GPRS Control : on Base & Variant model**

GPRS module is provided on control panel for giving machine information to machine owner by connection to monitoring and controlling system on web supervisor (<http://websupervisor.Comp.cz>) or to PC tools. This module is capable of sending alarm SMS based on setting in SMS / Email set point group. This system required electrical voltage unit 24 V DC, antenna and SIM card. To activate, it required 1 no. SIM card. Insert SIM card in GPSR unit and install the programme. Once programme is installed and system activated, owner of machine will start getting below mentioned information by SMS depending on settings. SMS message can be sent to maximum two mobile users. After that machine owner will start getting the below mentioned information:-

1. Engine radiator water temperature
2. Engine oil pressure
3. Hydraulic oil temperature
4. Hydraulic oil level
5. Fuel (Diesel) level
6. Easily traceable the geographical location of machine
7. Easily traceable the working hours of machine

**4.1.12 Wheel Equipments:**

**4.1.12.1 Driving wheels:**

|  | <u>Base model</u>                          | <u>Variant model</u>                           |
|--|--|--|
| Make   | : BKT                                      | BKT AT -625                                    |
| Type   | : Pneumatic, Nylon, Traction (Radial Tyre) | Pneumatic, Traction, Tubeless                  |
| Location   | : On rear of harvester                     |  |
| Number, size & Ply rating  | : Two, 16.9-28, 12 PR                      |  |
| Recommended tyre pressure, kPa   | : 224                                      |  |
| Maximum permissible loading capacity of each tyre at 260 kPa pressure, (kgf) | : 3550 (As marked on tyre)                 |  |
| Track width, mm  | : 1460                                     | 1455   |
| Make and size of rim   | : BWPL & W 15 x 28                         | Not provided & 28 x W15L 0416HQ                |
| Standard ballast, if any   | : 114 kg on each side (38 kg of 3 weight)  | 109.2 on each wheel side (36.4 kg of 3 weight) |

**4.1.12.2 Steering wheels:**

|  |                            |                             |
|--|----------------------------|-----------------------------|
| Make   | : BKT                      | BKT Implement – AW 702      |
| Type   | : Pneumatic, Nylon, Ribbed | Pneumatic, Ribbed, Tubeless |
| Location   | : On front of harvester    |                             |
| Number, size & Ply rating  | : Two, 10.5/65-16, 14 PR   |                             |
| Recommended tyre pressure, kpa   | : 309                      |                             |
| Maximum permissible loading capacity of each tyre at 300 kPa pressure, (kgf) | : 1360 (As marked on tyre) |                             |
| Track width (mm)   | : 1595                     | 1600                        |
| Make and size of rim   | : BWPL & W 8L x 16         | 16 x W8 0615HQ              |

**4.1.13 Wheel base (mm)**

|        |      |
|--------|------|
| : 2215 | 2200 |
|--------|------|



|          |   | <u>Base model</u>   | <u>Variant model</u>  |
|----------|---|---|---|
| 4.1.14   | Transmission System:                                |   |   |
|          | Type  | : Hydrostatics (IVT), oil flow from two variable discharge axial piston hydraulic pumps to control valves and hydraulic motors for individual final reduction unit at wheel, travel speed is controlled by hand lever, provided at the front of operator' seat. |   |
|          | Make  | : EATON, Mexico   |   |
|          | Model   | : 78461-RAM-04<br>72400-RAT-04 and 72400-RFC-04   | : 78461-RAM-04  |
|          | Serial No   | : 120907RSP2049 (RHS) and 120907RSP1034 (LHS)   | : 120820RSP1042   |
|          | Method of drive                                     | : Driven through engine flywheel by main hydraulic pump   |   |
|          | No. of speeds                                       | : Infinite Variable Transmission  |   |
|          | Method of Control                                   | : By a hand operated traction lever provided on LHS of steering wheel for forward and reverse movement with parking / neutral position at mid point.  |   |
| 4.1.15   | Final driver:                                       |   |   |
|          | Make  | : Bonfiglioli, Made in India  |   |
|          | Type  | : Planetary rear reduction  |   |
|          | Reduction ratio gear box output shaft to wheel axle | : 35 : 1  |   |
|          | Location  | : On chassis at rear wheel  | : On chassis, centre of both rear wheels                              |
|          | Power Input :                                       |   |   |
|          | Make  | : Rexroth, Turkey   |   |
|          | Model/Type  | : A2FE45/61W-VZL100   |   |
|          | Serial Number                                       | : 12376663  | : 12984691  |
|          | Oil capacity, l                                     | : 1.40  | : 1.20 (apa)  |
|          | Oil changing period, (apa)                          | : First change after 50 hours and subsequently after every 250 hours.   |   |
| 4.1.16   | Brakes:   |   |   |
| 4.1.16.1 | Service Brake:                                      |   |   |
|          | Make  | : Bonfiglioli   |   |
|          | Type  | : Wet, hydraulic assisted, multi disc type  | : Bonfiglioli (apa)<br>Wet, hydraulic assisted, multi disc type (apa) |
|          | Size of brake disc, mm                              |   |   |
|          | -Inner dia  | : 94.70   | : 94.70 (apa)   |
|          | -Outer dia  | : 129.0   | : 129.0 (apa)   |
|          | Area of lining per wheel, cm <sup>2</sup>           | : 3376.7  | : 3376.7 (apa)  |
|          | No. of disc per wheel                               | : 07  | : 07 (apa)  |
|          | Location  | : Inside  | : Inside (apa)  |
|          | Thickness of disc, mm                               | : 2.81 to 2.89  | : 2.81 to 2.89 (apa)  |
|          | Method of operation                                 | : Primary control by hand operator traction lever and secondary control by independent foot pedal operation.  |   |
| 4.1.16.2 | Parking brake:                                      | : The harvester remains in parking condition when the traction lever is in neutral condition.   |   |
| 4.1.16   | Steering System:                                    |   |   |
|          | Make and Model                                      | : EATON, Brazil   |   |
|          | Type  | : Hydrostatic   |   |
|          | Pump  | : Gear type   |   |
|          | Method of operation                                 | : A hydrostatic unit provided which actuates double acting cylinder at front wheel at king pin for turning  | : Manually through steering control wheel                             |



|  | <u>Base model</u>   | <u>Variant model</u>                                      |
|--|---|---|
| Outer diameter of steering control wheel, mm | 300   | 295   |
| Location                                     | In front of operator, inside cabin  | In front of operator's seat, inside the cabin             |
| <b>Hydraulic System:</b>                     |   |   |
| <b>Pump:</b>                                 |   |   |
| <b>Main Hydraulic Pump:</b>                  |   |   |
| Type   |   | External gear   |
| Make   |   | Permco, china   |
| Model/PT. No.                                | 1124 23 1236  | 1117231507  |
| Serial No.                                   | TKG 04724   | MJ-03877  |
| Number and their locations                   | One, On LHS of engine flywheel in between slip clutch and tandem pump   |   |
| Drive  | From engine flywheel  |   |
| Function                                     | To generate flow to drive the hydraulic motors for driving base cutter, chopper rollers, feed rollers, knockdown roller, finned roller, butt lift roller, crop dividers and extractor fan   |   |
| <b>Tandem hydraulic pump:</b>                |   |   |
| Make   | Eaton, Mexico   |   |
| Type   | Piston  | Axial, piston pump  |
| Model/Pl. No                                 |   | 78461-RAM-04  |
| Serial No.                                   | 120907RSP2049,<br>120907RSP1034   | 120820RSP1042   |
| Drive  | Through engine flywheel via main hydraulic pump shaft   |   |
| Number and Location                          | Two, LHS, after main hydraulic pump   |   |
| Function                                     | To transmit hydraulic power to rear wheels separately   |   |
| <b>Auxiliary pump:</b>                       |   |   |
| Make   | Permco, China   |   |
| Type   | External gear   |   |
| Model / Pl. No / Serial No.                  | Not available   | 592C-A0040  |
| Drive  | Through timing gear of engine   | Through engine's flywheel gear                            |
| Number and Location                          | Three segment, on LHS of engine   | One but has three segments, on front of engine's flywheel |
| Function                                     | i) First segment provide hydraulic fluid flow to steering and hydraulic cylinder<br>ii) Second segment provide hydraulic fluid flow to elevator drive motor<br>iii) Third segment provide hydraulic fluid flow to topper motors             |   |
| <b>Flow divider:</b>                         |   |   |
| Make   | Permco, China   |   |
| Type   | External gear   |   |
| Model/Pl. No                                 | LZ-0577-1   | 1915083741  |
| Serial No.                                   | Not available   | JB40  |
| Drive  | Through main hydraulic pump   |   |
| Number and Location                          | Three segment, on LHS inside the pump housing   | One but has three segments above tandem hydraulic pump    |
| Function                                     | i) First segment provide hydraulic fluid flow to base cutter, crop divider and rollers motors<br>ii) Second segment provide hydraulic fluid flow to Extractor fan motor<br>iii) Third segment provide hydraulic fluid flow to chopper motor |   |



|  |   | <u>Base model</u>  | <u>Variant model</u>   |      |
|--|---|--|--|------|
| 22.17.2  | <b>Hydraulic Tank:</b>                                |  |  |      |
|  | Type  | Trapezoidal  | MS box   |      |
|  | Location  | LHS of operator, behind pumps housing  | Behind pump housing above LHS rear wheel   |      |
|  | Capacity of Hydraulic tank(l)                         | 120.5  | 130.0 (apa)  |      |
|  | Provision of breather                                 |  | Provided   |      |
|  | Provision for oil level indication                    |  | Provided, one at front and another at rear (show oil level and temperature) with cut-off sensor.                                 |      |
|  | Recommended grade of lubricating oil                  | ENKLO 68   | Enklo 68   |      |
|  | Hydraulic oil changing period. (apa)                  | After every 2500 hours   | check oil level daily and maintained oil level if required   |      |
|  | 22.17.3   | <b>Hydraulic filter:</b>   |  |      |
|  |   | Number   |  | Four |
| Type and their location                          |   | One strainer at suction inside hydraulic tank, two paper elements at suction line and two paper elements on return line. | Spin on throw away & 02 on suction line, 02 on return line   |      |
| Any indication for servicing of hydraulic filter |   |  | Vacuum gauge at suction filter and pressure gauge at the return line filters with colour code indication (Green, yellow and red) |      |
| 22.17.4  | <b>Hydraulic Cylinders, their type and locations:</b> |  |  |      |
|  | Topper up-down  |  | One, double acting, at topper mounting arm   |      |
|  | Drop divider up-down                                  |  | Two, double acting, at LHS and RHS   |      |
|  | Base cutter level indicator                           |  | Two, LHS and RHS, single acting  |      |
|  | Base cutter level adjustment cylinder                 |  | Two, double acting, at LHS and RHS front wheel steering linkage  |      |
|  | Steering Cylinder                                     |  | Two, double acting, at Front wheel, LHS and RHS  |      |
|  | Elevator slew cylinder                                |  | Two, double acting, below chopper unit   |      |
|  | Elevator up-down cylinder                             |  | Two, double acting, at elevator LHS and RHS  |      |
|  | Bin flap  |  | One, double acting, at the end of elevator outlet  |      |
|  | Total no of cylinder                                  |  | 14   |      |
| 22.18  | <b>Topper assembly: (Refer Fig. 7)</b>                |  |  |      |
|  | Function  |  | To cut top vegetative portion of sugar cane at natural breaking point  |      |
|  | Type  |  | Single cutting disc type   |      |
|  | No. of disc unit                                      |  | One  |      |
|  | <b>Details of Cutting disc:</b>                       |  |  |      |
|  | No of cutting blades per disc                         |  | Four   |      |
|  | Size of cutting blade, mm                             |  |  |      |
|  | Height  | 81.5   | 80.4   |      |
|  | Width at top  | 18.5   | 18.8   |      |
|  | Width at base   | 77.0   | 76.0   |      |
| Method of mounting of cutting blade              |   | Assembled/ fixed with two hex head (Allen) Bolts on the periphery of disc  |  |      |
| Method of drive                                  |   | Hydraulic motor (Reversible)   |  |      |
| <b>Details of Gathering disc</b>                 |   | N.A.   |  |      |
| <b>Details of Hydraulic motors:</b>              |   |  |  |      |
| <b>Cutting Disc Motor:</b>                       |   |  |  |      |
| Make   |   | Permco, China  |  |      |
| Model/pt no                                      | M3100A783 A DUR 07-32                                 | 1213071361 (TA06853B0)   |  |      |
| Serial No  | TKG 04754   | LF1100   |  |      |
| Location   |   | Above the cutting unit   |  |      |

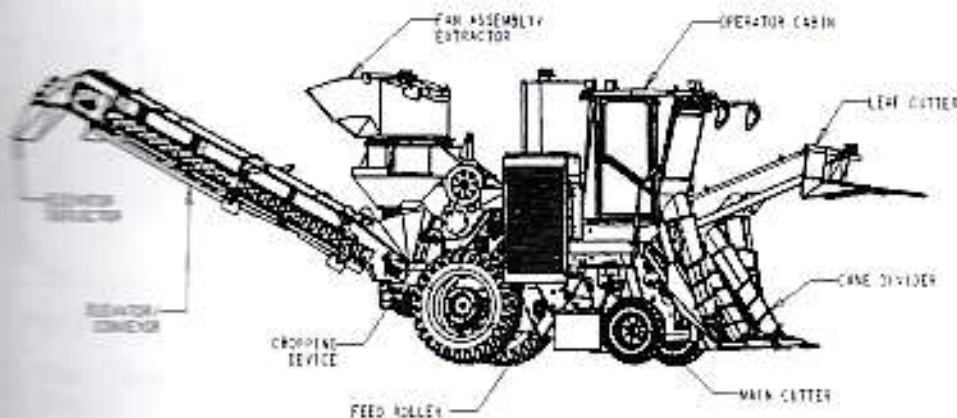


Fig 1. Machine Components

| Details of movement of knife blade:                                   | Base model  | Variant model         |
|---|---|-----------------------|
| speed corresponding rated engine speed for field work, rpm            | 1344 @ 2500 rpm   | 1340 @ 2200 rpm (apa) |
| Arrangement of speed variation, if any                                |   | None                  |
| Arrangement of vertical movement of de topper arm                     | A double acting hydraulic cylinder is provided and controlled by finger tip lever on RHS of steering wheel inside the cabin |                       |
| Cutting height from GL, mm  |   |                       |
| Minimum   | 1060  | 800                   |
| Maximum   | 3990  | 3230                  |
| Arrangement of laterally swing movement of de topper arm              |   | None                  |
| Range of lateral movement, mm   |   | N.A.                  |
| Any Arrangement for locking the de topper assembly in raised position |   | None                  |
| Drive Safety if any   | Relief valve bank at LHS, below the cabin   |                       |

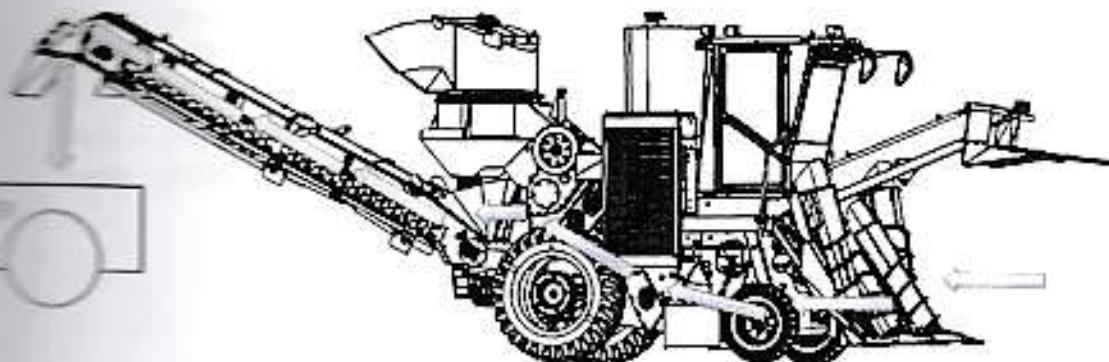


Fig 2. Crop Flow Diagram

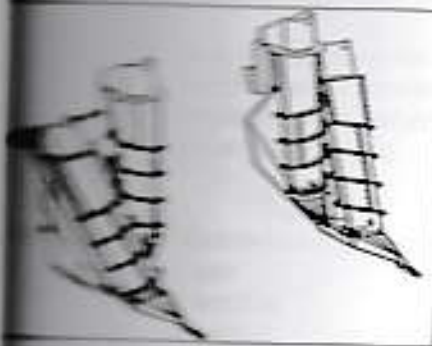


Fig 3. Crop Dividers

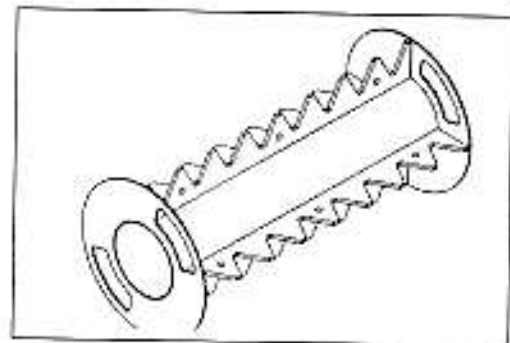


Fig 4. Knockdown Roller

|  |   |  |                         |
|--|---|--|-------------------------|
| <b>Crop divider: (Refer fig. 3)</b>                        |   | <b>Base model</b>  | <b>Variant model</b>    |
| Type   | : | Inclined, conical dual spiral screw  |                         |
| No of crop divider   | : | Four (two on each side)  |                         |
| Function   | : | Outer crop divider separate cane of other row and inner crop divider gathers the harvesting row cane into machine. |                         |
| Spacing of crop divider shoe, mm                           | : | 1090(fixed)  | 1105 (fixed)            |
| Size   |   |  |                         |
| length   | : | 1320   | 1310                    |
| Diameter   | : | 820 (Top) & 670 Bottom   | 340 (Top), 200 (Bottom) |
| Pitch  | : | 235  | 230                     |
| Range of vertical movement from GL, mm                     | : | 0 to 265   | 0 to 445                |
| Method of vertical height adjustment, mm                   | : | 80   | 100                     |
| Lateral movement if any                                    |   | None   |                         |
| <b>Direction of rotation</b>                               |   |  |                         |
| Inner crop divider (LHS / RHS)                             | : | Clockwise / Anticlockwise  |                         |
| Outer crop divider (LHS / RHS)                             | : | Anticlockwise / Clockwise  |                         |
| Speed corresponding rated engine speed for field work, rpm |   |  |                         |
| Inner side crop divider                                    |   |  |                         |
| Outside crop divider                                       | : | 162 @ 2500 rpm   | 140 @ 2200 (apa)        |
|  | : | 162 @ 2500 rpm   | 140 @ 2200 (apa)        |
| Method of drive  | : | Hydraulic motor (Reversible)   |                         |
| <b>Details of Hydraulic motors:</b>                        |   | <b>LHS</b>   | <b>RHS</b>              |
| Make   | : | EATON  | EATON                   |
| Model/Part no  | : | 104-3358-006, F02414   | 104-3358-006, F02414    |
| Serial No  | : | 3878, 3870   | 3845, 3863              |
|  |   |  | 1497S08615              |
|  |   |  | 5014T146                |
|  |   |  | 15                      |
| Location   | : | On the top, separate motor at top for each roller  |                         |
| Method of mounting   | : | Mounted with hydraulic motor at top and roller/ball bearing at bottom  |                         |
| Safety mechanism   | : | Safety warnings and symbols are provided   |                         |

SSCH-3737 Tejas (Brand Name- SHAKTIMAN), SELF PROPELLED SUGARCANE HARVESTER – Commercial (Variant)



|  | Base model   | Variant model              |                           |             |
|--|--|----------------------------|---------------------------|-------------|
| Any Arrangement for locking the sugarcane harvester header assembly in raised position | None   |                            |                           |             |
| Drive Safety if any  | Hydraulic relief valve bank mounted below cabin on LHS foot rest |                            |                           |             |
| <b>Knockdown Roller: (Refer fig. 4)</b>  |  |                            |                           |             |
| Type   | Height adjustable cylindrical with comb plate                    |                            |                           |             |
| Function   | To guide cane towards finned roller and base cutter              |                            |                           |             |
| Number   | One  |                            |                           |             |
| Size, mm   |  |                            |                           |             |
| Overall Length   | 725  | 725                        |                           |             |
| Overall dia.   | 340  | 340                        |                           |             |
| No. of rows of combs and their arrangement   | Four, on the periphery of cylinder                               |                            |                           |             |
| Size of comb, mm   |  |                            |                           |             |
| Height   | 56   | 60                         |                           |             |
| Base width   | 72   | 90                         |                           |             |
| Pitch  | 90   | 90                         |                           |             |
| Total height from base   | 83   | 83                         |                           |             |
| Spacing and number   | 90 degree apart & 9 nos. on each row                             |                            |                           |             |
| Method of drive  | Hydraulic motors (Two reversible)                                |                            |                           |             |
| <b>Details of Hydraulic motors:</b>  |  |                            |                           |             |
|  | LHS  | RHS                        | LHS                       | RHS         |
| Make   | EATON  |                            | EATON                     |             |
| Model/pt no  | F02414, 104-3358-006, 3896                                       | F02414, 104-3358-006, 3848 | 104-3358-006              |             |
| Serial No  | 12960,WF1 7, 4A06  | 12960,WF22, 4A06           | 1482 S 008615             | 5008 T14615 |
| Location   | On LHS and RHS of roller   |                            |                           |             |
| Speed corresponding rated engine speed for field work, rpm                             | 80 @ 2500  |                            | 70 @ 2200 rpm (apa)       |             |
| Method of vertical and horizontal Adjustment   | Mechanical, 4 mounting steps are provided                        |                            |                           |             |
| Method of mounting   | On main chassis with hydraulic motor shaft and flang             |                            |                           |             |
| Drive safety if any  | Hydraulic relief valve bank mounted below cabin on LHS foot rest |                            |                           |             |
| <b>Finned Roller: (Refer Fig.5)</b>  |  |                            |                           |             |
| Type   | Fixed, finned rollers with 4 fins on the periphery               |                            |                           |             |
| Function   | To feed the cane towards base cutter                             |                            |                           |             |
| Number   | One  |                            |                           |             |
| Size, mm   |  |                            |                           |             |
| Overall Length   | 760  |                            | 755                       |             |
| Overall Dia.   | 407  |                            | 415                       |             |
| No. of rows of combs and their arrangement   | Four, 90 degree apart on the periphery of cylinder               |                            |                           |             |
| Size of comb, mm   |  |                            |                           |             |
| Height   | 20, 67, 102  |                            | 102, 64.5, 59, 20.2, 20.5 |             |
| Pitch  | 36   |                            | -, 75.6, 76.1, 410, 36.8  |             |
| Number   | 18,8,4   |                            | 1, 5, 3, 2, 8             |             |
| Number of row (s)  | Four   |                            |                           |             |
| Details of drive   | Hydraulic motors (Two reversible)                                |                            |                           |             |



| Details of Hydraulic motors:                               | Base model   |                      | Variant model   |      |
|--|--|----------------------|-----------------|------|
|  | LHS  | RHS                  | LHS             | RHS  |
| Make :   | E.T.N  |                      | EATON           |      |
| Model/pt no :  | 104-3358-006, F02414   | 104-3358-006, F02114 | 104-3358-006    |      |
| Serial No :  | 3927   | 3934                 | 3893            | 5163 |
| Location :   | On LHS and RHS side roller                                       |                      |                 |      |
| Speed corresponding rated engine speed for field work, rpm | 80 @ 2500 (apa)  |                      | 84 @ 2200 (apa) |      |
| Method of vertical and horizontal adjustment               | None   |                      |                 |      |
| Vertical movement from GL, mm                              | None   |                      |                 |      |
| Horizontal movement, mm                                    | None   |                      |                 |      |
| Method of mounting   | Mounted with hydraulic motor on both side                        |                      |                 |      |
| Drive safety if any  | Hydraulic relief valve bank mounted below cabin on LHS foot rest |                      |                 |      |

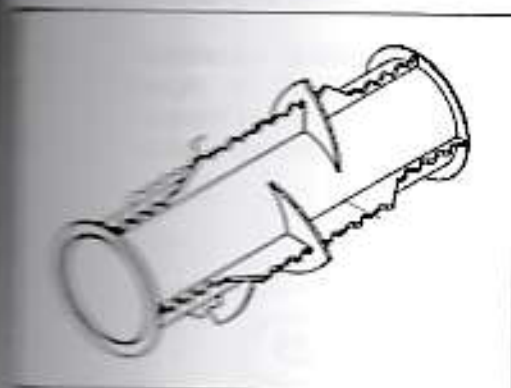


Fig 5. Finned Roller

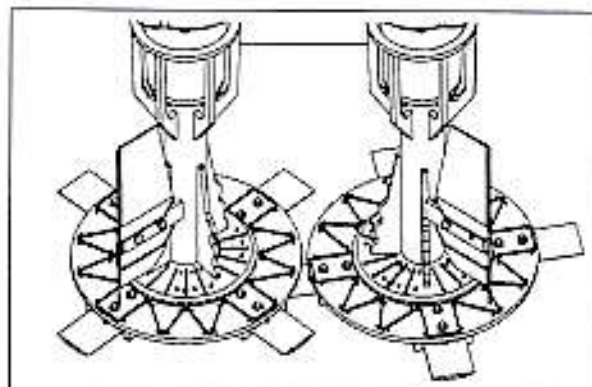


Fig 6. Base Cutter

| Base Cutter assembly (Refer fig. 6):                       |   | Base model  | Variant model    |
|--|---|---|------------------|
| Type   | : | Single row, rotating disc type  |                  |
| No of Disc   | : | Two   |                  |
| Tilt angle of disc   | : | 18 degree   | 17.5 degree      |
| Arrangement for changing disc angle                        | : | None  |                  |
| Number, type of blades and their arrangement               | : | Eight, Reversible straight blades, Four on each disc  |                  |
| Size of blades, mm   |   | Refer (fig. 10)   |                  |
| Length   | : | 268   | 269.8            |
| Width  | : | 89.5  | 89.6             |
| Thickness  | : | 6.0   | 6.1              |
| Cutting width, mm  |   |   |                  |
| Without blade  | : | 978   | 990              |
| With blade   | : | 1119  | 1110             |
| Speed corresponding rated engine speed for field work, rpm | : | 558 @ 2500  | 481 @ 2200 (apa) |
| Arrangement for speed variation, if any                    | : | None  |                  |
| Arrangement for reversal of rotation                       | : | Provided  |                  |
| Arrangement of cutting height adjustment                   | : | Suspension cylinder, double acting, at LHS and RHS wheel, actuates with hand lever at control panel |                  |





|  | <u>Base model</u>  | <u>Variant model</u>              |
|--|--|-----------------------------------|
| Range of height adjustment from (L, mm)  | 0 to 208   | 0 to 205                          |
| Method of mounting of Base cutter assembly   | Base cutter disc are mounted on output shafts from the base cutter gear box  |                                   |
| Details of drive   | Hydraulic motors (One reversible)  |                                   |
| <b>Details of Hydraulic motors:</b>  |  |                                   |
| Make   | Permco, China  |                                   |
| Model/pt no  | TKG04743, LZ-0577-10, 82-0576  | 1215 072 740 (TA0685530)          |
| Serial No  | SDE C101, SDEC071  |                                   |
| Location   | On top of base cutter gear box   |                                   |
| <b>Details of Gearbox:</b>   |  |                                   |
| Make   | Not Provided   | Shaktiman (apa)                   |
| Type   | Spur gear reduction  | Helical gear reduction (apa)      |
| Reduction ratio  | 2.60:1   | 2.60 : 1 (apa)                    |
| Oil Capacity (l) and grade   | 6.0, 85W140  | 6.0 (apa) & HP Gear Oil XP 85W140 |
| Oil changing period, apa   | First change after 50 hours of use, subsequent after every 250 hours.  |                                   |
| Mechanism to indicate the cutting height of base cutter to the operator inside the cabin | Provided, a transparent oil pipe is provided in cabin with scale, the oil level changes with movement of level gauge cylinder. |                                   |
| Safety mechanism, if any   | Rubber flange provided on LHS and RHS of base cutter disc. Hydraulic relief valve mounted below cabin on LHS foot rest.        |                                   |

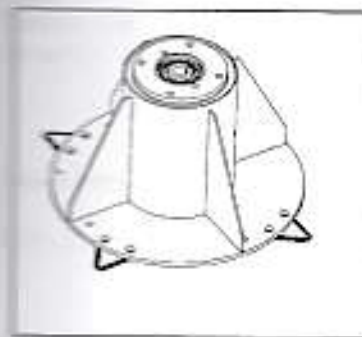


Fig 7. Topper

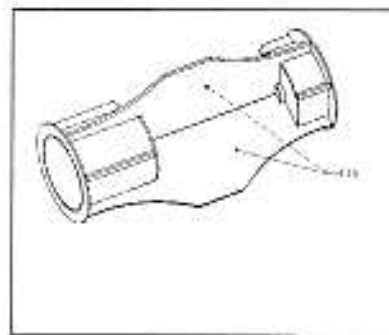


Fig 8. Butt Lift Roller

Butt lift roller: (Refer fig. 8)

|  | <u>Base model</u>   | <u>Variant model</u>          |
|--|---|-------------------------------|
| Type   | Paddle type with circumferential V- Shaped groves of constant width |                               |
| Function   | To move the harvested sugarcane towards feed roller assembly        |                               |
| Size, mm   |   |                               |
| Length   | 580   | 580                           |
| Dia.   | 212.8 (Roller) / 328 (Paddle)                                       | 211.9 (Roller) / 322 (Paddle) |
| Speed corresponding rated engine speed for field work, rpm | 82 @ 2500 rpm (apa)   | 80 @ 2200 rpm (apa)           |
| Adjustment, if any   | None  |                               |
| Details of drive   | One, reversible   |                               |
| <b>Details of Hydraulic motors:</b>                        |   |                               |
| Make   | EATON   |                               |
| Model/pt no  | 104-3279-006, F02414  | 104-327S-006                  |



|   |           | <u>Base model</u>  | <u>Variant model</u>              |                        |                       |
|---|-----------|--|-----------------------------------|------------------------|-----------------------|
|   | Serial No | : 4297, 12960WF224A03  | 3522 S02615                       |                        |                       |
|   | Location  | : On LHS of roller   |                                   |                        |                       |
| Method of mounting  |           | : Flange with hydraulic motor at one side and on a bearing at another side   |                                   |                        |                       |
| Details of bearing  |           | : 1NAGE45-KRR-B-AS2  | INAGYE 45-KTI-B, A82/V-BRAZIL K96 |                        |                       |
| Any drive safety mechanism                                    |           | : Hydraulic relief valve mounted on rear of hydraulic tank   |                                   |                        |                       |
| <b>2.24 Feed rollers (Refer Fig. 12)</b>                      |           |  |                                   |                        |                       |
| Type  |           | : Ms sheet metal roller with corrugation (eight nos.) on the periphery of each roller (Upper roller floating type and Lower roller fixed type) |                                   |                        |                       |
| Function  |           | : To convey harvested cane toward chopper unit   |                                   |                        |                       |
| Number  |           | : Eight (4 pairs)  |                                   |                        |                       |
| Size, mm  |           | Top  | Bottom                            | Top                    | Bottom                |
| Overall Length  |           | : 548  | : 575                             | : 551                  | : 578                 |
| Overall Dia.  |           | : 215  | : 218                             | : 212                  | : 213                 |
| Speed corresponding to rated engine speed for field work, rpm |           | : 103 @ 2500 rpm   | : 83 @ 2500 rpm                   | : 103 @ 2200 rpm (apa) | : 81 @ 2200 rpm (apa) |
| Details of drive  |           | : Ten hydraulic motors, one each for every roller except two motors are provided for each lower first and last roller                          |                                   |                        |                       |
| <b>Details of Hydraulic motors:</b>                           |           |  |                                   |                        |                       |
| Make  |           | : EATON  |                                   |                        |                       |
| Model/pt no   |           | : 104-3279-006   | 104-3279-006                      |                        |                       |
| Serial No   |           | : 7654, 4090, 4085, 4092, 1586, 7641, 4352, 4104, 4117 and one no.(not available)  | 3543 S02615 (first one)           |                        |                       |
| Adjustment, if any  |           | : Upper roller are cradle mounted to adjust throat height automatically according to feed  |                                   |                        |                       |
| Method of mounting  |           | : With bearing on one side and hydraulic motor at another side, except roller having motor on both side  |                                   |                        |                       |
| Any drive safety mechanism                                    |           | : Hydraulic relief valve (main) mounted on hydraulic tank inside main pump housing at LHS.   |                                   |                        |                       |



Fig 10. Base Cutter Blade

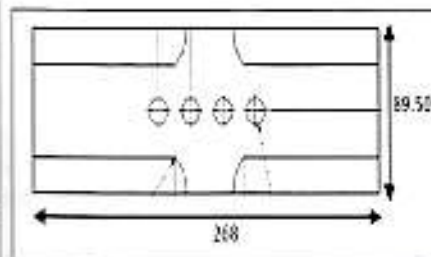


Fig 10. Base Cutter Blade

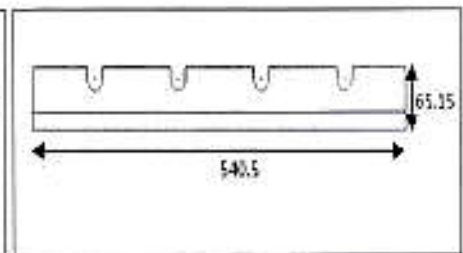


Fig 11. Chopper Blade

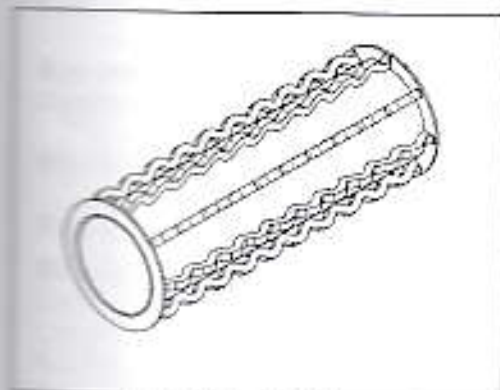


Fig 12. Feed Roller

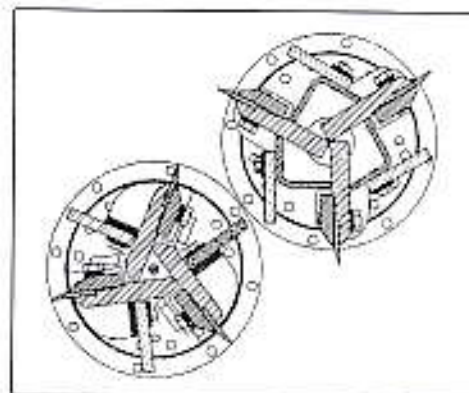


Fig 13. Chopper Drum

**Chopper drum assembly (Refer Fig. 13):**

|  | <u>Base model</u>  | <u>Variant model</u>  |
|--|--|---|
| Type   | MS sheet roller with blade mounting arrangement on its periphery   |   |
| No. of drum per chopper unit   | Two  |   |
| Size of drum , mm  |  |   |
| Working Dia.   | 285  | 287   |
| Width  | 579  | 580   |
| Type of blade  | Straight with plain sharp cutting edge   |   |
| Arrangement of blades  | Right angle to the direction of movement of cane   |   |
| Size, mm   |  |   |
| Length   | 540.5  | 540.5   |
| Width  | 65.2   | 66.0  |
| Thickness  | 8.0  | 8.1   |
| No. of blades and spacing, mm  | Three on each drum at 120 degree apart   |   |
| Type of drive  | Through hydraulic motor for each drum  |   |
| <b>Details of Hydraulic motors:</b>  |  |   |
| Make   | EATON  |   |
| Model/pt no  | 112-1080-006   | 112 1060 006  |
| Serial No  | 8535, 8536   | 183S14115 (Lower),<br>1331S05015 (Upper)  |
| Location   | On LHS of drum   |   |
| Method of mounting   | Flange on drum with four nos. Balls and gear on other side of drum for gearbox unit.   |   |
| Chopper gearbox oil capacity (l) and recommended grade                       | 5.0, 85W140  | 5.0 (apa), HP Gear Oil XP 85W140  |
| Oil change period  | Check oil level daily and change period was not specified in the manual  | Check oil level daily, first change after 50 hours and subsequently after 250 hours of operation. |
| Balancing flywheel size, mm  | 500 Ø  | 500 Ø   |
| Speed corresponding rated engine speed for field work, rpm                   | 495 @ 2500 rpm   | 507 @ 2200 rpm (apa)  |
| Any method of reversal direction movement                                    | Provided   |   |
| Method of speed variation  | None   |   |
| Drive safety mechanism   | Flywheel with slip clutch is provided and Hydraulic relief valve mounted on rear of hydraulic tank inside pump housing at LHS. |   |
| Method of adjustment of cutting clearance and its range of adjustment in, mm | One slot for advance or retard of blade with respect to fixed drum blade is provided.  |   |



|      |   | <u>Base model</u>  | <u>Variant model</u>                              |
|------|---|--|---|
| 2.26 | Deflector Plate:  | MS sheet deflector is provided to adjust deflection of chopped sugar cane billets towards the elevator bowl.                   |   |
|      | Size, mm  | 581 x 250 x 3  | 580 x 250 x 3                                     |
|      | Location  | At the outlet of chopper   |   |
| 2.27 | Elevator Bowl   | MS sheet bowl is provided at lower end of the elevator below the extractor fan housing.  |   |
|      | Shape   | Conical  |   |
| 2.28 | Elevator:   |  |   |
|      | Type  | Chain and metallic pad type vertical conveyor  |   |
|      | Length, mm  | 4575   | 4590  |
|      | Number of pads/elevator flight                            | 19   | 19  |
|      | Size of pads/elevator flight, mm                          | 556 x 100 x 3  | 560 x 100 x 3                                     |
|      | Spacing between the pads, mm                              | 508  | 506   |
|      | Type of chain   | Hollow pin roller  |   |
|      | Size of chain, mm   |  |   |
|      | Total length  | 9650   | 9690  |
|      | No. of roller   | 190  | 190   |
|      | No of link  | 190  | 190   |
|      | Roller Dia.   | 38.10  | 38.05   |
|      | Pitch   | 50.80  | 51.0  |
|      | Method of tensioning the chain                            | By tightening the adjusting nut bolts provided at top of elevator bearing housing  |   |
|      | Type of drive   | Through hydraulic motor to the shaft with sprocket at upper end.   |   |
|      | Details of Hydraulic motors:                              |  |   |
|      | Make  | EATON  |   |
|      | Model/pt no   | 103-1012-012,<br>140109M050017   | 103-1012-012                                      |
|      | Location  | At upper shaft of the elevator on RHS  |   |
|      | Elevator drive safety                                     | Hydraulic relief valve mounted at LHS, below cabin   |   |
|      | Mounting  | Mounted on frame with bracket on upper end at RHS  |   |
|      | Elevator sieve/separating grato:                          |  |   |
|      | Type  | Metallic sieve with opening of 13 mm x 35 mm size  | Metallic sieve with opening of 12 mm x 40 mm size |
|      | Total area of sieve, ( m <sup>2</sup> )                   | 2.02   | 2.80  |
|      | Horizontal reach, mm                                      |  |   |
|      | Minimum   | 3640   | 2180  |
|      | Maximum   | 4695   | 3085  |
|      | Discharge height above ground level, mm                   |  |   |
|      | Min.  | 2945   | 2960  |
|      | Max   | 4275   | 4280  |
|      | Clearance height, mm                                      |  |   |
|      | Min.  | 1850   | 2390  |
|      | Max   | 2640   | 3350  |
|      | Method of vertical movement of elevator                   | By two double hydraulic cylinders fitted with elevator and mounting strap along with roller chain to hood.                     |   |
|      | Range of vertical movement at top of elevator from GL, mm |  |   |
|      | Minimum   | 2790   | 3340  |
|      | Maximum   | 4280   | 4590  |
|      | Method of horizontal swing movement                       | By two double acting hydraulic cylinder (slew cylinder) at rear of the chassis controlled by foot pedal below operator's seat. |   |



|  | <u>Base model</u>  | <u>Variant model</u>  |
|--|--|---|
| Range of horizontal swing  | : 84 degree and 80 degree from the centre of machine towards LHS and RHS of harvester.   | : 82.5 degree from the centre of machine towards LHS and RHS of harvester (apa) |
| Provision to see continuous operation of elevator from operator seat | : Rear view mirror and transparent glass doors are provided.   |   |
| Speed corresponding rated engine speed for field work, rpm           | : 210 @ 2500 rpm   | : 211 @ 2200 rpm (apa)  |
| Arrangement of levelling/ controlling elevator feed                  | : 15 nos chains of 10 link hanged on extractor fan bowl  | : 15 nos chains of 08 link hanged on extractor fan bowl                         |
| Drive safety mechanism, if any                                       | : Hydraulic relief valve provided in seven racine valve unit at RHS, below cabin   |   |
| <b>Bin Flap:</b>   |  |   |
| Type   | : Metallic inclined plate type   |   |
| Size, mm   |  |   |
| Length   | : 770  | : 765   |
| Width  | : 510  | : 500   |
| Thickness  | : 3.0  | : 3.0   |
| Adjustment if any  | : The position of flap can be adjusted with the double acting hydraulic cylinder at upper end.   |   |
| <b>Extractor fan:</b>  |  |   |
| Type   | : Suction fan  |   |
| Number and their location  | : One, above elevator bowl   |   |
| Working Diameter   | : Ø 880  | : 850 Ø   |
| No. of blades  | : Three  |   |
| Size of fan blade, mm  |  |   |
| Length   | : 328  | : 330   |
| Width  | : 225  | : 230   |
| Thickness  | : 6.51   | : 5.06  |
| Clearing area of Extractor unit, m <sup>2</sup>                      | : 0.732  | : 0.556   |
| Type of drive  | : By hydraulic motor mounted at top of extractor hood  |   |
| <b>Details of Hydraulic motors:</b>                                  |  |   |
| Make   | : Permco, China  |   |
| Model/pt no  | : YZ-0592, KKC 04 PH   | : 1215071117CTA06854 B0   |
| Location   | : At the top of fabricated structure in centre position  |   |
| Fan speed corresponding to rated engine speed for field work, rpm    | : 2292   | : 10 to 2250 (Variable speed)   |
| Arrangement of speed variation                                       | : None   | : A lever is provided on cabin to vary speed of extractor fan.                  |
| Arrangement for changing direction of extractor outlet               | : The mechanical linkage and stopper with elevator for the direction of outlet of extractor fan changes with movement of the elevator. |   |
| Range of movement of extractor outlet from centre of harvester       | : 23 degree / 230 mm from central pin  | : 23 degree / 230 mm from central pin (apa)                                     |
| Method of mounting   | : Inside the enclosed circular housing above the elevator bowl with outlet at upper side of fan with hood.                             |   |
| Any drive safety mechanism   | : Hydraulic relief valve block at near air cleaner.  |   |



|   | <u>Base model</u>   | <u>Variant Model</u> |
|---|---------------------|----------------------|
| <b>Operators controls and instrumentation:</b>  |                     |                      |
| 3) Main switch (key turn type)  | Provided            | Provided             |
| 4) Digital control panel multifunction's  | Provided            | Provided             |
| 5) AC on and blower speed control switch  | Provided            | Provided             |
| 6) Circuit breaker  | Provided            | Provided             |
| 7) Digital run hour meter   | Provided            | --                   |
| 8) Digital run hour cum speedometer   | --                  | Provided             |
| 9) Front light high/low switch  | Provided            | Provided             |
| 10) Rear light switch   | Provided            | Provided             |
| 11) Front light (working light) ON/OFF switch   | Provided            | Provided             |
| 12) Wasing indicator  | Provided            | Provided             |
| 13) Wipper indicator  | Provided            | --                   |
| 14) Wiper switch  | --                  | Provided             |
| 15) Radiator cleaning fan indicator   | Provided            | Provided             |
| 16) Cabin fan indicator   | Provided            | --                   |
| 17) Cabin fan switch  | --                  | Provided             |
| 18) Extractor fan indicator   | Provided            | --                   |
| 19) Extractor fan switch  | --                  | Provided             |
| 20) Extractor fan speed control switch  | <b>Not provided</b> | Provided             |
| 21) Praking light indicator   | Provided            | --                   |
| 22) Praking light switch  | --                  | Provided             |
| 23) Working light ON indicator  | Provided            | --                   |
| 24) Dash board light  | Provided            | --                   |
| 25) Working light switch + Dashboard light "ON"   | --                  | Provided             |
| 26) Cabin light   | Provided            | --                   |
| 27) Cabin light (LED) with switch   | --                  | Provided             |
| 28) Main cutter pressure gauge (0-400 bar)  | Provided            | Provided             |
| 29) Chopping device pressure gauge (0-400 bar)  | Provided            | Provided             |
| 30) Steering control wheel  | Provided            | Provided             |
| 31) Height suspension up/down lever   | Provided            | Provided             |
| 32) Height suspension up/down oil level tube  | <b>Not provided</b> | Provided             |
| 33) Topper up/down lever  | Provided            | Provided             |
| 34) Right crop divider position control lever (lower-rise)  | Provided            | Provided             |
| 35) Left crop divider position control lever (lower-rise)   | Provided            | Provided             |
| 36) Elevator position control lever (lower-rise)  | Provided            | Provided             |
| 37) Elevator left/right turn (pivot) pedal  | Provided            | Provided             |
| 38) Bin flap position control lever (open –close)   | Provided            | Provided             |
| 39) Throttle control lever (red)  | Provided            | Provided             |
| 40) Traction lever with horn push button (forward-parking and reverse position)   | Provided            | Provided             |
| 41) Function drive lever – ( crop divider, knockdown roller, finned roller, base cutter, butt lift roller, feed rollers and chopper) (forward direction-off- reverse direction) | Provided            | Provided             |
| 42) Topper drive lever (clockwise-off-anticlockwise)  | Provided            | Provided             |
| 43) Elevator drive lever (forward-off-reverse)  | Provided            | Provided             |
| 44) Elevator slew control pedal   | Provided            | Provided             |
| 45) Hydraulic oil temperature gauge (60-100 °C)   | <b>Not provided</b> | Provided             |
| 46) Water temperature gauge (40 –120°C)   | <b>Not provided</b> | Provided             |
| 47) Engine oil pressure gauge (0-10 bar)  | <b>Not provided</b> | Provided             |
| 48) Fuel level gauge (full-empty)   | <b>Not provided</b> | Provided             |
| 49) Fuse box  | <b>Not provided</b> | Provided             |



|               |  | <u>Base model</u>                        | <u>Variant model</u>                       |
|---------------|--|--|--|
| <b>1.11</b>   | <b>Operators' cabin</b>                    |  |  |
|               | Make                                       | : Not available                          | Durasafe Tempered-ST (TAC No. 80458)       |
|               | Model                                      | : Not available                          | Not available                              |
|               | Size, mm                                   | : 1100 x 1470                            | 1080 x 1490                                |
|               | Height of operator's platform, mm          | : 1300                                   | 1450                                       |
|               | Cabin cooling / heating arrangement        | : Provided only cooling arrangement      |  |
| <b>1.12</b>   | <b>Operator's seat</b>                     |  |  |
|               | Make                                       | : Not available                          |  |
|               | Model                                      | : Not available                          |  |
|               | Type                                       | : Cushioned                              | Cushioned seat with backrest and seat belt |
|               | Type of suspension                         | : Helical spring                         | 02, Helical coil springs                   |
|               | Type of dampening                          | : Helical spring                         | 01, Hydraulic shock absorber               |
|               | Adjustments provided, mm                   |  |  |
|               | -Longitudinal                              | : Nil                                    | ±55  |
|               | -Vertical                                  | : Nil                                    | Nil  |
|               | -Backrest                                  | : Nil                                    | Nil  |
|               | -Mass, kg                                  | : Nil                                    | 50 to 120                                  |
| <b>1.13</b>   | <b>Details of air conditioning System:</b> | <u>Base model</u>                        | <u>Variant model (apa)</u>                 |
| <b>1.13.1</b> | <b>Compressor</b>                          |  |  |
|               | Make                                       | : Pael                                   | Top Leader                                 |
|               | Model No.                                  | : N.A.                                   | DLCP24-Y3                                  |
|               | Serial No.                                 | : 0516704480                             | NA   |
|               | Refrigerant                                | : R134a                                  | R134a                                      |
|               | Location                                   | : LHS of engine at front                 | On top of operator's cabin                 |
|               | Drive                                      | : From fan pulley by cogged V belt       | Electrical                                 |
| <b>1.13.2</b> | <b>Condenser Unit:</b>                     |  |  |
|               | Make                                       | : Pael                                   | Top Leader                                 |
|               | Model                                      | : N.A.                                   | NA   |
|               | Number                                     | : 2                                      | 02   |
|               | No. of blades                              | : Each fan having 10 plastic blade       | Each fan having 5 plastic blade            |
|               | Size, mm                                   | : Ø 300                                  | Ø 200                                      |
|               | Capacity                                   | : 24V                                    | 24 V                                       |
|               | Condenser:                                 |  |  |
|               | Size, mm                                   | : 735 x 350 x 48                         | 450 x 254 x 57                             |
|               | Location                                   | : Above the engine, inside engine case   | On top of operator's cabin                 |
| <b>1.13.3</b> | <b>Evaporator Blower Unit</b>              |  |  |
|               | <b>Evaporator:</b>                         |  |  |
|               | Type                                       | : Copper tube type with fins             | Copper tube type with fins                 |
|               | Size, mm                                   | : 130 x 130 x 40                         | 435 x 310 x 38                             |
|               | <b>Blower:</b>                             |  |  |
|               | Make                                       | : Sanden                                 | Top leader                                 |
|               | Model/Type                                 | : CV1152-40123                           | ZHF281301                                  |
|               | Number of blower                           | : 3                                      | 1  |
|               | Size, mm                                   |  |  |
|               | Diameter                                   | : 50                                     | 100  |
|               | Length                                     | : 143                                    | 100  |
|               | Location                                   | : In the cabin, above the steering wheel | Inside the cabin above operator's seat     |



**Provision for safety and comfort of operator**

Conformity with IS 12343 : 1998 (reaffirmed 2009):

Operator's seat meets the requirements of IS 12343 : 1998 **except the following:**

| <u>Base model</u>   | <u>Variant model</u>  |
|---|---|
| i) Length of seat.  | i) Length of seat.  |
| ii) Longitudinal adjustment forward and rearward from the mid position. | ii) Width of seat   |
| iii) Vertical adjustment upward and downward from the mid position      | iii) Longitudinal distance from seat index point to centre of clutch and accelerator pedal. |
|   | iv) Vertical distance from seat index point to centre of clutch and accelerator pedal.      |
|   | v) Longitudinal distance from seat index point to centre of steering control wheel.         |

Safety cabs and gates meets the requirements of IS 12343 : 1998 **except the following:**

|                    |                                    |
|--------------------|------------------------------------|
| i) Emergency exit. | i) Emergency exit is not provided. |
|--------------------|------------------------------------|

Conformity with IS 12239 (Part 1) : 1996 (reaffirmed 2012):

Operator's work place meets the requirements of IS 12239 (Part 1): 1996 **except the following:**

|   |  |
|---|--|
| i) Vertical retainers at both sides of foot steps are not provided. | i) Vertical retainers at both sides of foot steps are not provided.                    |
| ii) Spark arrester has not been provided in the exhaust system.     | ii) Height of 1" step from ground is 640 mm against the maximum requirement of 550 mm. |
|   | iii) Spark arrester has not been provided in the exhaust system.                       |

Conformity with IS 12239 (Part 2) : 1999 (reaffirmed 2009):

Meets the requirements of IS 12239 (Part 2) : 1999 **except the following:**

|                        |  |
|------------------------|--|
| Meets the requirements | i) Rear wheel or tracks are not covered.   |
|                        | ii) Working clearance around control levers are less than the minimum requirement. |

Conformity with IS: 6283 (Part-1 & 2)-2006 & 2007(Re-affirmed in March, 2009):

Controls are identifiable with symbols as per IS: 6283 (Part-1 & 2)-2006 & 2007. **except the following:**

|                        |   |
|------------------------|---|
| Meets the requirements | i) Symbol on starting switch is not provided.                                 |
|                        | ii) Symbol for speed range (fast - slow) on hand accelerator is not provided. |

Conformity with IS:8133-1983 (Re-affirmed in March, 2009):

Location and movement of various controls meets the requirement of IS: 8133- 1983: (Re-affirmed March 2009) on both **Base and Variant model.**

Conformity with IS: 14683 – 1999 (Re-affirmed in March, 2009) :

Lighting meets the requirements of IS: 14683 – 1999 on both **Base and Variant model.**

**Labelling of the Harvester:**

The labelling plate is riveted on LHS of harvester chassis, below the batter box. Provides the following information

|                      |   |                                 |
|----------------------|---|---------------------------------|
| Manufacturer         | : | Tirth Agro Technology Pvt. Ltd. |
| Make and Model       | : | Shaktiman & SSCH-3737 Tejas     |
| Max Engine Power, hp | : | <b>Not provided</b>             |
| Engine Sr. No.       | : | 7005308375                      |
| Chassis No           | : | TATSCH373716B0000047            |
| Year of manufacture  | : | February, 2016                  |

**Overall dimension of harvester, mm**

|                  | <u>Base model</u>                   |                               | <u>Variant model</u>                |                               |
|------------------|-------------------------------------|-------------------------------|-------------------------------------|-------------------------------|
|                  | <u>Transport position</u>           | <u>Field Working position</u> | <u>Transport position</u>           | <u>Field Working position</u> |
| Length           | 11620                               | 6560*                         | 10510                               | 6540                          |
| Height           | 2505                                | 5632                          | 2480                                | 5085                          |
| Wheelbase        | 3590                                | 4335                          | 3760                                | 4650                          |
| Ground clearance | 206 (at base cutter in up position) | --                            | 190 (at base cutter in up position) | --                            |





**Mass:**

Mass of harvester with :  
coolant, fuel, lubricants full  
and 75 kg mass on the  
operator's seat, (kgs)

|       |        |      |
|-------|--------|------|
| Total | : 8340 | 8730 |
| Front | : 2030 | 2320 |
| Rear  | : 6310 | 6410 |

**Total number of lubricating points:**

|                               |   |     |
|-------------------------------|---|-----|
| Grease Nipples / grease holes | : | 59  |
| Greasing cups                 | : | Nil |
| Oiling                        | : | Nil |

**Colour of Harvester:**

|   |   |        |
|---|---|--------|
| Cabin and Radiator door, and bird cage          | : | Black  |
| Wheel rim                                       | : | Silver |
| Chassis, lower sheet metal, header and elevator | : | Orange |

**4.2. RUNNING-IN**

The Harvester was run-in nil hours in sugarcane harvesting prior to start of the field test as per the recommendation of the manufacturer.

**4.3 SPEED TEST**

**Forward Travel Speed:**

The harvester is equipped with variable speed hydrostatic transmission so the test was conducted as per IS: 10274- 1993 (Reaffirmed 1997) Method of determination of maximum travel speed). So the distance of 100 meters and time recorded for two successive test drive in opposite direction as given below:-

| Sl. No. | Lever position | Travelling Speed, kmph         |                                |                                |               |
|---------|----------------|--------------------------------|--------------------------------|--------------------------------|---------------|
|         |                | Base model                     | Variant model                  | Base model                     | Variant model |
|         |                | At an engine speed of 2525 rpm | At an engine speed of 2390 rpm | At an engine speed of 2000 rpm |               |
| 1.      | Forward        | 15.83                          | 13.61                          | 12.48                          | 11.53         |
| 2.      | Forward        | 15.89                          | 13.63                          | 12.50                          | 11.55         |
| 3.      | Forward        | 15.81                          | 13.64                          | 12.52                          | 11.51         |
| 4.      | Forward        | 15.89                          | 13.64                          | 12.50                          | 11.46         |
|         | Average -      | 15.86                          | 13.63                          | 12.50                          | 11.51         |

**Nominal Speed: Variant Model**

| Sl. No. | No. of engine revolutions for one revolution of driving wheel | Nominal speed at engine speed of fitted with 16.9-28 tyre size of 670 mm radius index, (kmph) respectively. |                                |                                      |  |
|---------|---|---|--------------------------------|--------------------------------------|--|
|         |   | At an engine speed of 2000 rpm  | At an engine speed of 2200 rpm | At an rated engine speed of 2000 rpm | At an engine speed of 2200 rpm recommended for field work. |
| n       | 2   | 3   | 4                              | 5                                    |  |
| Forward | 44.27   | 44.22   | 11.41                          | 12.56                                |  |
| Reverse | 42.26   | 42.42   | 11.95                          | 13.09                                |  |



## 4. ENGINE PERFORMANCE TEST

4.4.1 The engine performance test was conducted in accordance with Para 5.4 of IS: 8122 (Part-II)-2000 for evaluating its performance under natural and high ambient condition.

|   | <u>Base model</u>          | <u>Variant model</u>     |
|---|----------------------------|--------------------------|
| Date(s) test                            | 14.03.2015 &<br>16.03.2015 | 02.06.2017 to 06.06.2017 |
| Engine run prior to start of test (apa) | 81.4                       | 386.3                    |
| Type of dynamometer bench used          | Eddy current, SAJ AG 250   |                          |

4.4.2 Engine was mounted on the test bed with radiator mounting frame and hydraulic pump fitted as installed on the harvester and coupled with dynamometer.

4.4.3 Prior to starting of the tests no adjustments were done on engine, the tests were carried out on the prevalent settings of governor control fuel pump etc.

4.4.4 The result of the full load & varying speed, two hour maximum power and part load tests under natural ambient and full load & varying speed and five-hour engine rating tests high ambient condition conducted on the engine are in tabulated in **Table-2** and are graphically represented in Fig. 14, 15 and 16. The result of the 5 hour rating test is tabulated in **Table-3**.

Table-2

| Brake Power kW                                | Crankshaft torque, Nm | Engine speed (rpm) | Fuel consumption |       |                  | Specific energy, kWh/l |
|---|-----------------------|--------------------|------------------|-------|------------------|------------------------|
|   |                       |                    | l/h              | kg/h  | Specific, kg/kWh |                        |
| 1   | 2                     | 3                  | 4                | 5     | 6                | 7                      |
| <b>TEST - A: Varying Speed Test:</b>          |                       |                    |                  |       |                  |                        |
| <b>a) Maximum power and fuel consumption:</b> |                       |                    |                  |       |                  |                        |
| <u>Base model</u>                             |                       |                    |                  |       |                  |                        |
| 115.3   | 524.2                 | 2100               | 34.99            | 29.26 | 0.254            | 3.30                   |
| 107.2   | 487.6                 | 2100               | 33.85            | 28.30 | 0.264            | 3.17 *                 |
| <u>Variant model</u>                          |                       |                    |                  |       |                  |                        |
| 126.2   | 560.4                 | 2150               | 38.40            | 32.10 | 0.254            | 3.29                   |
| 125.4   | 557.0                 | 2150               | 38.25            | 32.40 | 0.258            | 3.28 *                 |
| <b>b) Power at rated engine speed:</b>        |                       |                    |                  |       |                  |                        |
| <u>Base model: (2400±50/-150 rpm)</u>         |                       |                    |                  |       |                  |                        |
| 112.1   | 475.9                 | 2250               | 35.86            | 29.98 | 0.262            | 3.19                   |
| 104.8   | 445.0                 | 2250               | 34.31            | 28.68 | 0.274            | 3.05 *                 |
| <u>Variant model: (2200 ± 50 rpm)</u>         |                       |                    |                  |       |                  |                        |
| 126.2   | 560.4                 | 2150               | 38.40            | 32.10 | 0.254            | 3.29                   |
| 125.4   | 557.0                 | 2150               | 38.25            | 32.40 | 0.258            | 3.28*                  |
| <b>c) Maximum torque</b>                      |                       |                    |                  |       |                  |                        |
| <u>Base model</u>                             |                       |                    |                  |       |                  |                        |
| 96.5  | 635.8                 | 1450               | 26.61            | 22.24 | 0.230            | 3.42                   |
| 94.0  | 544.1                 | 1650               | 27.37            | 22.88 | 0.243            | 3.43 *                 |
| <u>Variant model</u>                          |                       |                    |                  |       |                  |                        |
| 116.9   | 797.2                 | 1400               | 31.62            | 26.43 | 0.226            | 3.69                   |
| 116.0   | 791.1                 | 1400               | 31.79            | 26.58 | 0.229            | 3.65 *                 |
| <b>TEST - B: Maximum power – Two hours:</b>   |                       |                    |                  |       |                  |                        |
| <u>Base model</u>                             |                       |                    |                  |       |                  |                        |
| 115.3   | 524.2                 | 2100               | 34.99            | 29.26 | 0.254            | 3.30                   |
| <u>Variant model</u>                          |                       |                    |                  |       |                  |                        |
| 126.2   | 560.4                 | 2150               | 38.40            | 32.10 | 0.254            | 3.29                   |



|   | 2    | 3     | 4     | 5      | 6    | 7 |
|---|------|-------|-------|--------|------|---|
| <b>Part loads:</b>                            |      |       |       |        |      |   |
| <b>Load corresponding to maximum power:</b>   |      |       |       |        |      |   |
| 524.2   | 2100 | 34.99 | 29.26 | 0.254  | 3.30 |   |
| 560.4   | 2150 | 38.40 | 32.10 | 0.254  | 3.29 |   |
| <b>90% of load obtained at maximum power:</b> |      |       |       |        |      |   |
| 446.0   | 2328 | 34.95 | 29.22 | 0.269  | 3.11 |   |
| 476.0   | 2298 | 35.41 | 29.61 | 0.258  | 3.24 |   |
| <b>75% of load defined in (ii):</b>           |      |       |       |        |      |   |
| 335.0   | 2394 | 30.21 | 25.25 | 0.301  | 2.78 |   |
| 357.0   | 2351 | 29.78 | 24.90 | 0.284  | 2.95 |   |
| <b>60% of load defined in (ii):</b>           |      |       |       |        |      |   |
| 223.0   | 2480 | 23.42 | 19.58 | 0.338  | 2.47 |   |
| 238.0   | 2398 | 23.72 | 19.83 | 0.332  | 2.52 |   |
| <b>45% of load defined in (ii):</b>           |      |       |       |        |      |   |
| 112.0   | 2565 | 15.91 | 13.30 | 0.443  | 1.89 |   |
| 119.0   | 2445 | 16.12 | 13.48 | 0.442  | 1.89 |   |
| <b>Unloaded:</b>                              |      |       |       |        |      |   |
| 3.0   | 2637 | 10.00 | 8.36  | 10.450 | 0.08 |   |
| 4.0   | 2486 | 10.07 | 8.42  | 8.096  | 0.10 |   |

**FIVE HOURS ENGINE RATING TEST\***

**Table-3**

| Time of the day   | Engine braking power, kW | Crank-shaft torque, N-m | Engine speed (rpm) | Fuel consumption |              |                 | Specific Energy kWh/l |
|---|--------------------------|-------------------------|--------------------|------------------|--------------|-----------------|-----------------------|
|   |                          |                         |                    | l/h              | kg/h         | Specific kg/kWh |                       |
| 2   | 3                        | 4                       | 5                  | 6                | 7            | 8               | 9                     |
| <b>a) Test started and engine loaded to 90% of maximum power:</b> |                          |                         |                    |                  |              |                 |                       |
| 102.8   | 439.0                    | 2237                    | 33.56              | 28.06            | 0.273        | 3.06            |                       |
| 103.5   | 439.0                    | 2252                    | 33.75              | 28.21            | 0.270        | 3.07            |                       |
| 104.5   | 439.0                    | 2274                    | 33.57              | 28.06            | 0.268        | 3.11            |                       |
| 104.4   | 439.0                    | 2270                    | 33.73              | 28.20            | 0.270        | 3.09            |                       |
| 104.4   | 439.0                    | 2270                    | 33.66              | 28.14            | 0.270        | 3.10            |                       |
| 103.9   | 439.0                    | 2261                    | 33.67              | 28.15            | 0.271        | 3.09            |                       |
| 103.9   | 439.0                    | 2260                    | 33.64              | 28.13            | 0.271        | 3.09            |                       |
| 104.0   | 439.0                    | 2263                    | 33.73              | 28.19            | 0.271        | 3.08            |                       |
| <b>Average</b>  | <b>103.9</b>             | <b>439.0</b>            | <b>2261</b>        | <b>33.66</b>     | <b>28.14</b> | <b>0.271</b>    | <b>3.09</b>           |

Under high ambient conditions:

SSCH-3737 Tejas (Brand Name- SHAKTIMAN), SELF PROPELLED SUGARCANE HARVESTER - Commercial (Variant)

SSCH-3737 Tejas (Brand Name- SHAKTIMAN), SELF PROPELLED SUGARCANE HARVESTER - Commercial (Variant)



| 2   | 3     | 4     | 5    | 6     | 7     | 8     | 9    |
|---|-------|-------|------|-------|-------|-------|------|
| <b>Engine loaded to its maximum power</b> |       |       |      |       |       |       |      |
| 210                                       | 118.9 | 502   | 2262 | 36.97 | 30.91 | 0.260 | 3.22 |
| 2140                                      | 118.9 | 502   | 2261 | 36.92 | 30.86 | 0.260 | 3.22 |
| 210                                       | 118.9 | 502   | 2262 | 36.89 | 30.84 | 0.259 | 3.22 |
| 2140                                      | 118.9 | 502   | 2263 | 36.90 | 30.85 | 0.259 | 3.22 |
| 210                                       | 118.9 | 502   | 2261 | 36.89 | 30.84 | 0.259 | 3.22 |
| 2140                                      | 118.9 | 502   | 2262 | 36.96 | 30.90 | 0.260 | 3.22 |
| 210                                       | 118.9 | 502   | 2262 | 36.98 | 30.91 | 0.260 | 3.22 |
| 2140                                      | 118.9 | 502   | 2261 | 36.96 | 30.90 | 0.260 | 3.22 |
| Average                                   | 118.9 | 502   | 2262 | 36.93 | 30.88 | 0.260 | 3.22 |
| <b>Engine loaded to its maximum power</b> |       |       |      |       |       |       |      |
| 1800                                      | 106.4 | 483.6 | 2100 | 33.27 | 27.81 | 0.262 | 3.20 |
| 1840                                      | 106.7 | 485.3 | 2100 | 33.34 | 27.87 | 0.261 | 3.20 |
| 1800                                      | 107.1 | 487.2 | 2100 | 33.39 | 27.92 | 0.261 | 3.21 |
| 1840                                      | 107.1 | 486.9 | 2100 | 33.37 | 27.90 | 0.261 | 3.21 |
| Average                                   | 106.8 | 485.8 | 2100 | 33.34 | 27.88 | 0.261 | 3.20 |
| <b>Engine loaded to its maximum power</b> |       |       |      |       |       |       |      |
| 2100                                      | 125.3 | 556.5 | 2150 | 38.75 | 32.39 | 0.258 | 3.23 |
| 2140                                      | 125.4 | 557.0 | 2150 | 38.75 | 32.39 | 0.258 | 3.24 |
| 2100                                      | 125.5 | 557.5 | 2150 | 38.75 | 32.40 | 0.258 | 3.24 |
| 2140                                      | 125.4 | 556.8 | 2150 | 37.79 | 32.43 | 0.259 | 3.32 |
| Average                                   | 125.4 | 557.0 | 2150 | 38.51 | 32.40 | 0.258 | 3.26 |

at high ambient condition.

| Parameters                             | Base model                      |                |  | Variant model                   |              |  |
|--|---------------------------------|----------------|--|---------------------------------|--------------|--|
|  | Natural ambient (full throttle) | High ambient   | Five hours rating test at High ambient | Natural ambient (full throttle) | High ambient | Five hours rating test at High ambient |
| Maximum engine speed (rpm)             | 2637                            | 2630           | --                                     | 2486                            | 2489         | --                                     |
| Maximum torque at max. rpm (Nm)        | 524.2                           | 487.6          | --                                     | 560.4                           | 557.0        | --                                     |
| Maximum torque (Nm)                    | 635.8                           | 544.1          | --                                     | 797.2                           | 791.1        | --                                     |
| Maximum rpm (%)                        | 21.3                            | 11.6           | --                                     | 42.3                            | 42.0         | --                                     |
| <b>Typical atmospheric conditions:</b> |                                 |                |  |                                 |              |  |
| Temperature (°C)                       | 20 to 24                        | 42 to 44       | 42 to 45                               | 28 to 32                        | 41 to 44     | 41 to 43                               |
| Relative humidity (%)                  | 99.0 to 99.4                    | 100.1 to 100.3 | 99.8 to 100.0                          | 99.3 to 99.4                    | 98.6 to 99.0 | 99.2 to 99.6                           |
| Wind speed (km/h)                      | 63 to 70                        | 30 to 34       | 24 to 30                               | 58 to 78                        | NR           | 32 to 79                               |
| Wind direction (°)                     |                                 |                |  |                                 |              |  |
| Wind speed (km/h)                      | 103                             | 109            | 115                                    | 104                             | 121          | 113                                    |
| Wind direction (°)                     | 91                              | 102            | 104                                    | 88                              | 102          | 93                                     |
| Wind speed (km/h)                      | 46                              | 59             | 58                                     | 42                              | 52           | 50                                     |
| Wind direction (°)                     | 21                              | 38             | 42                                     | 32                              | 48           | 47                                     |
| Wind speed (km/h)                      | 676                             | 693            | 693                                    | 734                             | 767          | 725                                    |
| Wind direction (°)                     |                                 |                |  |                                 |              |  |
| Wind speed (km/h)                      | 2.0 to 2.1                      | 0.8 to 2.6     | 2.6 to 2.9                             | 4.2 to 4.3                      | 4.1          | 4.1 to 4.2                             |
| Wind direction (°)                     | 126.4 to 128.8                  | 44.3 to 137.7  | 125.5 to 139.5                         | NR                              | NR           | NR                                     |
| Maximum lift coefficient (m)           | 1.18                            | --             | --                                     | 0.25                            | --           | --                                     |
| <b>Consumptions</b>                    |                                 |                |  |                                 |              |  |
| Fuel (g/h)                             | --                              | --             | 0.212                                  | --                              | --           | 0.408                                  |
| Water (kg/h)                           | --                              | --             | 2.45                                   | --                              | --           | Nil                                    |

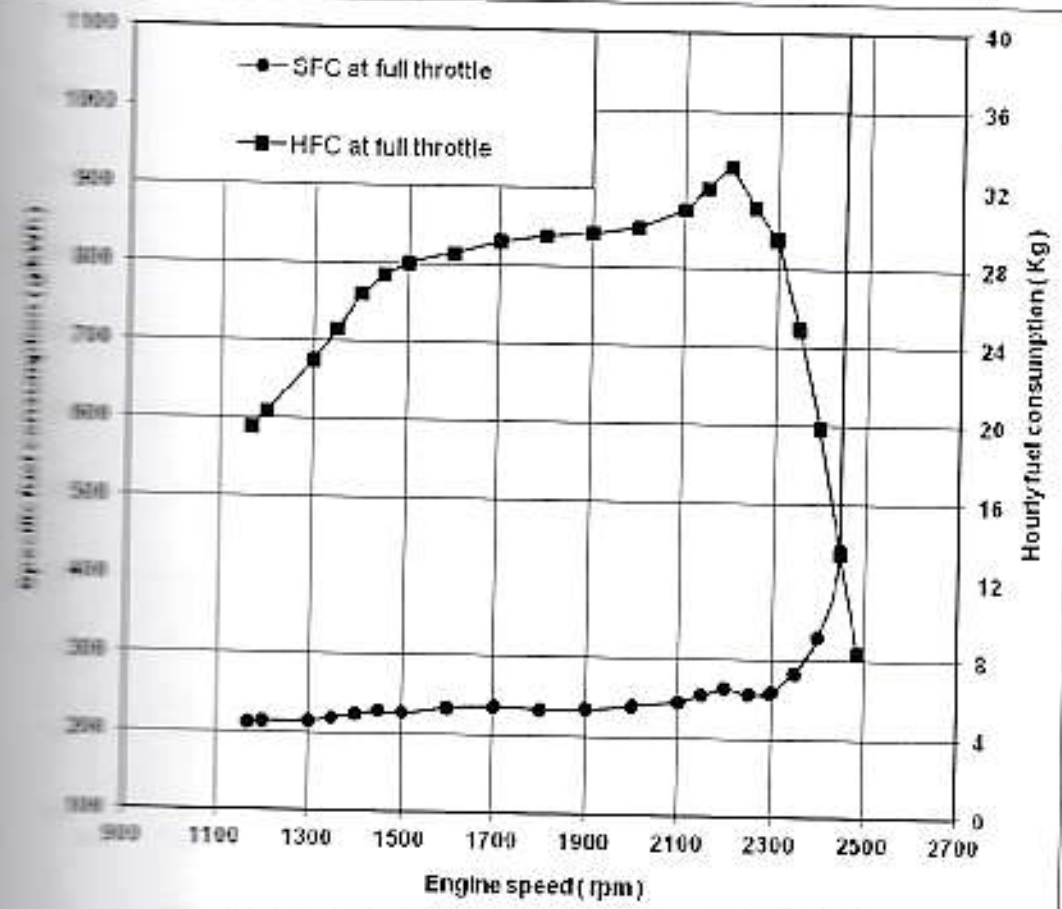
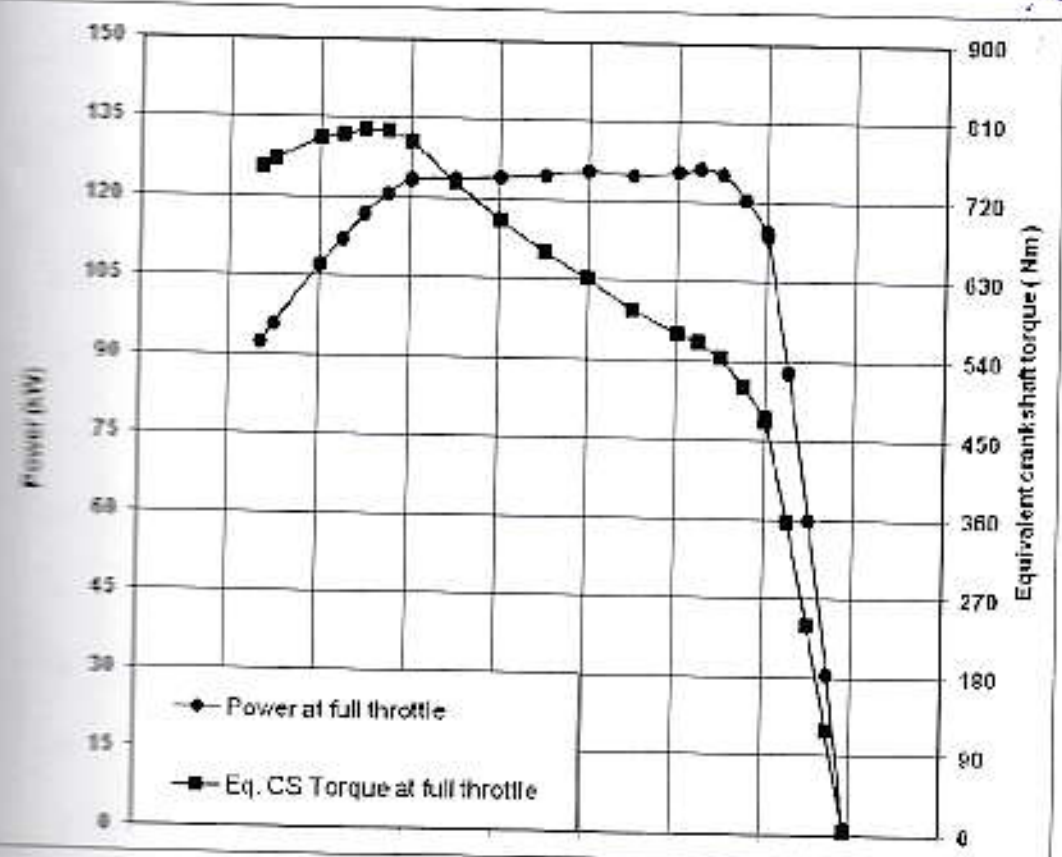


Fig. 14: ENGINE PERFORMANCE CHARACTERISTICS (Natural Ambient)

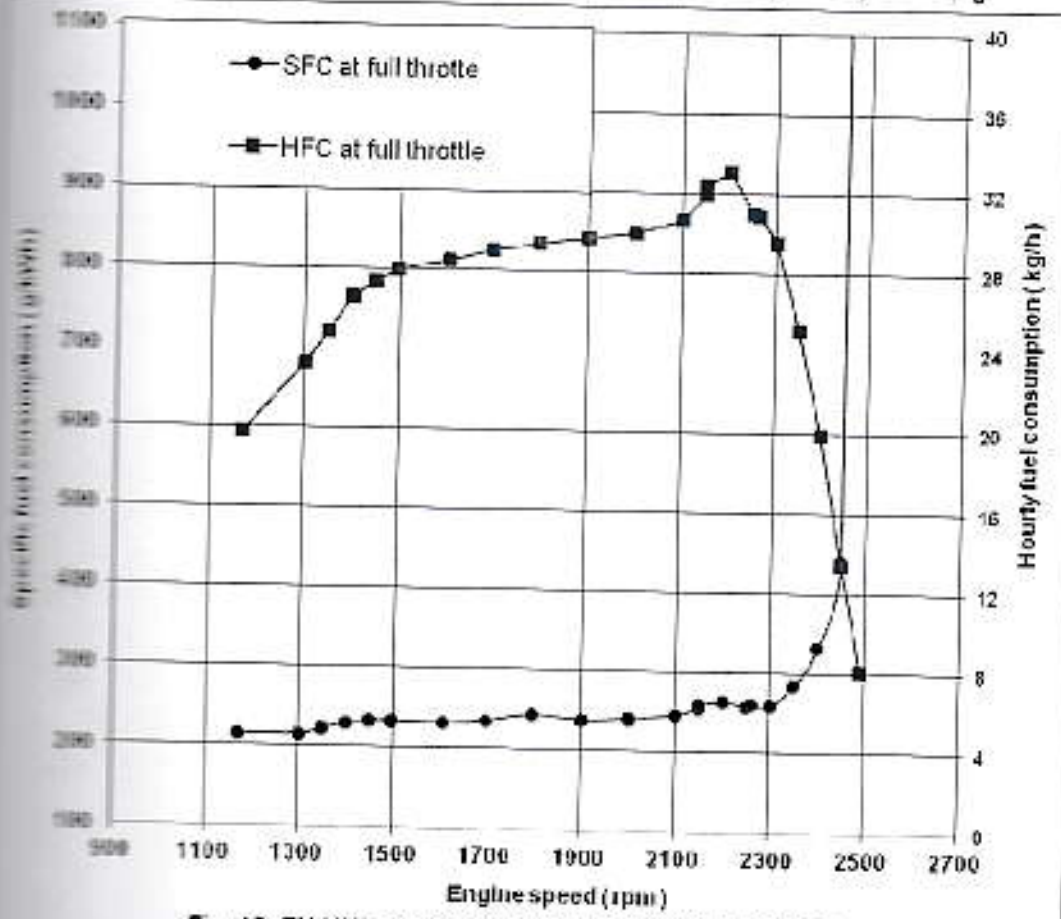
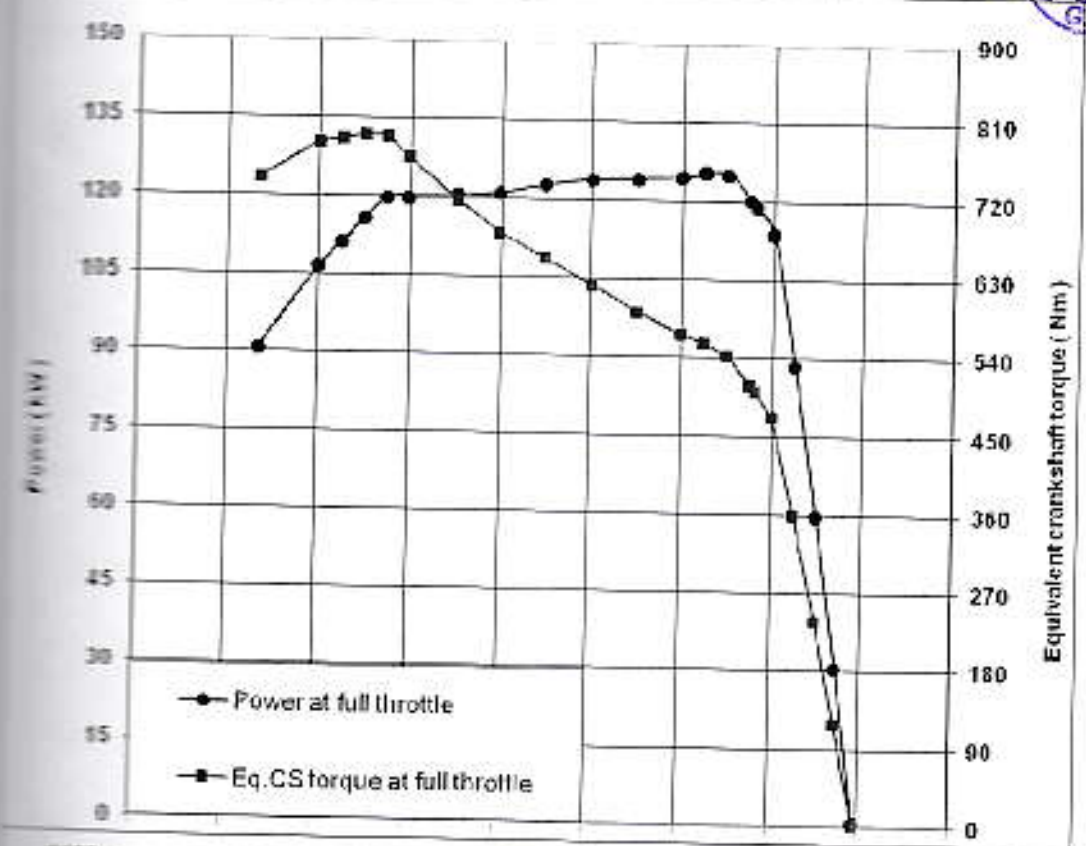


Fig. 15: ENGINE PERFORMANCE CHARACTERISTICS (High Ambient)

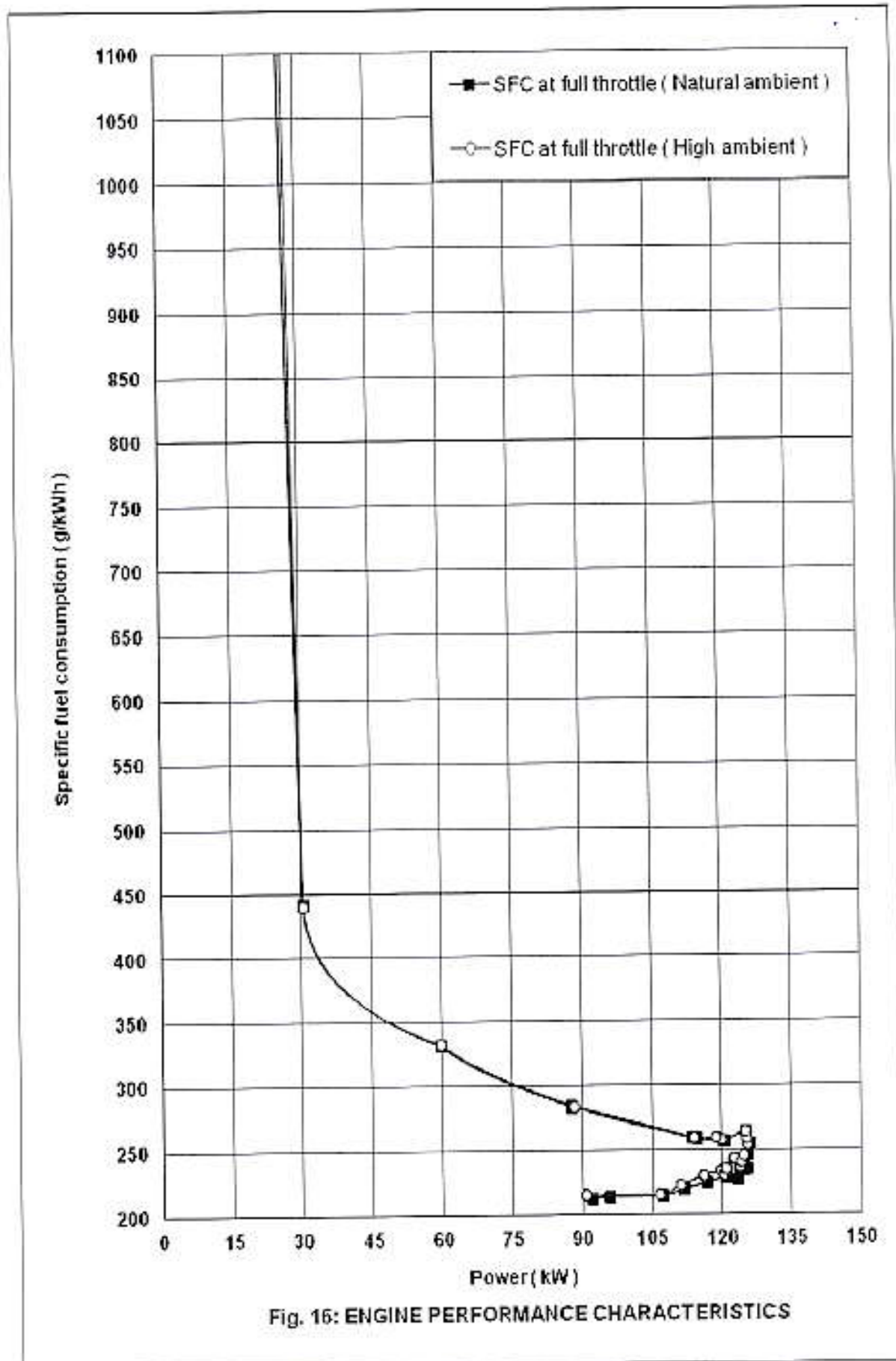


Fig. 16: ENGINE PERFORMANCE CHARACTERISTICS



## 4.5 MECHANICAL VIBRATION TEST

The amplitude of mechanical vibration on various assemblies/ components of the harvester were recorded by running the machine under the stationary condition at engine speed recommended for field operation on a level concrete surface and without load with all systems working. The base cutter and crop divider height was maintained at 150 mm above ground level. The amplitude of vibration was measured in horizontal and vertical positions of the accelerometer and the results are represented as below.

| Sl. No. | Location                            |           | Vibration (microns) |      |
|---------|-------------------------------------|-----------|---------------------|------|
|         |                                     |           | HD                  | VD   |
| 1.      | Foot rest                           | LHS       | 10                  | 20   |
|         |                                     | RHS       | 20                  | 20   |
| 2.      | Main drive engaging lever           |           | 30                  | 30   |
| 3.      | Topper drive lever                  |           | 20                  | 30   |
| 4.      | Brake pedal                         | LHS       | 10                  | 20   |
|         |                                     | RHS       | 30                  | 20   |
| 5.      | Elevator drive lever chain          |           | 40                  | 40   |
| 6.      | Reverse / Forward lever             |           | 30                  | 40   |
| 7.      | Steering Control wheel              |           | 40                  | 30   |
| 8.      | Seat                                | Back Rest | 30                  | 30   |
|         |                                     | Bottom    | 30                  | 20   |
| 9.      | Hand accelerator lever              |           | 20                  | 20   |
| 10.     | Base cutter height adjusting lever  |           | 40                  | 30   |
| 11.     | Topper height adjusting lever       |           | 20                  | 20   |
| 12.     | Crop divider height adjusting lever | LHS       | 20                  | 30   |
|         |                                     | RHS       | 10                  | 20   |
| 13.     | Elevator height adjusting lever     |           | 20                  | 20   |
| 14.     | Bin flap lever                      |           | 20                  | 30   |
| 15.     | Elevator left right position pedal  | LHS       | 20                  | 30   |
|         |                                     | RHS       | 30                  | 30   |
| 16.     | Dash board                          |           | 20                  | 30   |
| 17.     | Door latch leaver                   | LHS       | 20                  | 20   |
|         |                                     | RHS       | 20                  | 20   |
| 18.     | Battery base                        |           | 70                  | 110* |
| 19.     | Head light                          | LHS       | 30                  | 60   |
|         |                                     | RHS       | 40                  | 30   |
| 20.     | Back light                          | LHS       | 40                  | 30   |
|         |                                     | RHS       | 30                  | 40   |
| 21.     | Parking light                       | LHS       | 80                  | 70   |
|         |                                     | RHS       | 120*                | 110* |
| 22.     | Signal or indicator light of cabin  | LHS       | 40                  | 30   |
|         |                                     | RHS       | 40                  | 40   |
| 23.     | Top work light (on top of cabin)    |           | 30                  | 30   |
| 24.     | Elevator top work light             | LHS       | 90                  | 170* |
|         |                                     | RHS       | 100                 | 250* |
| 25.     | Elevator indicator & reverse light  | LHS       | 160*                | 140* |
|         |                                     | RHS       | 130*                | 60   |





## 4.6 NOISE MEASUREMENT

|         |   |   |            |
|---------|---|---|------------|
|         | Date(s) of test   | : | 17.05.2017 |
| 4.6.1   | <b>Measurement of ambient noise emitted by the harvester at bystander position:</b> |   |            |
| 4.6.1.1 | <b>Atmospheric conditions:</b>  |   |            |
|         | Atmospheric temperature, °C   | : | 40         |
|         | Relative humidity, %  | : | 21         |
|         | Atmospheric pressure, kPa (mm of Hg)  | : | 97.8       |
|         | Wind velocity, m/sec.   | : | 2.0 to 3.1 |
| 4.6.1.2 | <b>Location of microphone:</b>  |   |            |
|         | Height of microphone above ground level, m  | : | 1.20       |
|         | Distance of microphone from line of travel, m                                       | : | 7.50       |
|         | Background Noise level dB(A)  | : | 52         |
| 4.6.1.3 | <b>Test Results:</b>  |   |            |
|         | Travelling speed before acceleration, kmph  | : | 10.26      |
|         | Max. noise level, dB(A)   | : | 92         |
| 4.6.2   | <b>Noise at operator's ear level:</b>   |   |            |
|         | Atmospheric temperature, °C   | : | 42         |
|         | Relative humidity, %  | : | 15         |
|         | Atmospheric pressure, kPa (mm of Hg)  | : | 97.3       |
|         | Wind velocity, m/sec.   | : | 2.1        |
|         | Height of microphone from the foot board, mm  | : | 72         |
|         | Back ground noise level dB(A)   | : | 54         |
|         | Noise level at max. travel speed inside cabin (13.63 kmph), dB(A)                   | : | 83         |

## 5. OTHER APPLICABLE TESTS

--None--

## 6. DEFECTS, ADJUSTMENTS, BREAKDOWNS AND REPAIRS

| Sr. No | DEFECTS, ADJUSTMENTS, BREAKDOWNS AND REPAIRS  | Harvester run hours |
|--------|---|---------------------|
| 1      | During engine performance test under natural ambient condition leakage of diesel from water separator was observed. There after "M-seal" was used to prevent leakage.                                       | 8.45                |
| 2      | During engine performance test under high ambient condition leakage of coolant from expansion flask hose was observed. There after hose was tighten by new clamed of same specification to prevent leakage. | 15.6                |



## 7. COMPARISON BETWEEN BASE MODEL AND VARIANT MODEL

| Sl. No. | Clause No. | Features  | Observation on base model<br>(Comb-61/1482/2015,<br>March, 2015) | Observation on variant model | Remarks                |                          |           |
|---------|------------|---|--|------------------------------|------------------------|--------------------------|-----------|
| 1       | 2          | 3   | 4  | 5                            | 6                      |                          |           |
| 1.      | i)         | <b>Air cleaner:</b>                               |  |                              |                        |                          |           |
|         |            | <b>Details of filter element</b>                  | <b>Primary element</b>   | <b>Secondary element</b>     | <b>Primary element</b> | <b>Secondary element</b> |           |
|         |            | - Size, OD/ID, (mm)                               | 255 / 145  | 145/ 127                     | 245 / 155              | 145 / 115                | No Change |
|         |            | - Length, (mm)                                    | 445  | 405                          | 515                    | 480                      | Changed   |
|         |            | -Range of suction pressure at maximum power (kPa) | 2.0 to 2.1   |                              | 4.2 to 4.3             |                          | Changed   |
| 2.      | ii)        | <b>Exhaust system:</b>                            |  |                              |                        |                          |           |
|         |            | a)  | Position of silencer outlet w.r.t SIP, mm                        |                              |                        |                          |           |
|         |            |   | -Vertical  | 850                          | 1555                   | Changed                  |           |
|         |            |   | -Longitudinal  | 1290                         | 995                    | Changed                  |           |
|         |            |   | -Lateral   | 310 (RHS)                    | 120 (LHS)              | Changed                  |           |
|         |            | b)  | <b>Size of Muffler, (mm):</b>                                    |                              |                        |                          |           |
|         |            |   | -Length  | 850                          | 620                    | Changed                  |           |
|         |            |   | -Diameter  | 283                          | 261                    | Changed                  |           |
|         |            | c)  | Provision of spark arresting device / any other device           |                              | Not provided           | Not provided             | No Change |
| 4.      | iv)        | <b>Range of speeds, (kmph):</b>                   |  |                              |                        |                          |           |
|         |            | - At full throttle                                | 15.86  | 13.63                        | Changed                |                          |           |
|         |            | - At rated engine speed                           | 12.50  | 11.51                        | Changed                |                          |           |
|         |            | Additional no. of speed                           | None   | None                         | No change              |                          |           |
| 5.      | v)         | <b>Fitment of accessories:</b>                    |  |                              |                        |                          |           |
|         |            | - Expansion tank                                  | Provided   | Provided                     | No change              |                          |           |
|         |            | - Additional hydraulic pump                       | None   | None                         | No change              |                          |           |
|         |            | - Air compressor                                  | None   | None                         | No change              |                          |           |
|         |            | Size of impeller of water pump, mm                |  |                              | Changed                |                          |           |
|         |            | Diameter  | 82.3   | 117                          |                        |                          |           |
|         |            | No. of guide Vanes                                | 07   | 07                           |                        |                          |           |
|         |            | Dia. of cooling fan, mm                           | 720  | 615                          | Changed                |                          |           |
|         |            | - Radiator  | Provided   | Provided                     | No change              |                          |           |
|         |            | Effective size of radiator, mm                    | 740 x 650 x 60   | 830 x 585 x 115              | Changed                |                          |           |
|         |            | No. of tubes on radiator                          | 35, Vertical   | 64, Horizontal               | Changed                |                          |           |
|         |            | Radiator cap pressure kPa (kgf/cm <sup>2</sup> )  | 48.3 (0.49)  | 75 (0.76)                    | Changed                |                          |           |
|         |            | Bare radiator capacity, l                         | 12.9   | 16.3                         | Changed                |                          |           |
|         |            | Total coolant capacity, l                         | 28.6   | 38.05                        | Changed                |                          |           |
|         |            | - Oil cooler                                      | Provided   | Provided                     | No change              |                          |           |
|         |            | - Charge air cooler                               | Provided   | Provided                     | No change              |                          |           |
|         |            | Effective size of charge air cooler, mm           | 500 x 545 x 60   | 585 x 445 x 136              | Changed                |                          |           |



|     | 2   | 3  | 4   | 5  | 6         |
|-----|---|--|---|--|-----------|
|     |   | -Hydraulic oil cooler  | Provided  | Provided                                       | No change |
|     |   | No of Tubes  | 28  | 34   | Changed   |
|     |   | Effective Area, mm   | 565 x 415 x 40                                  | 490 x 487 x 60                                 | Changed   |
|     | vi)   | <b>Brake system:</b>   |   |  |           |
|     |   | Type   | Wet, hydraulic assisted, multi disc type        | Wet, hydraulic assisted, multi disc type (apa) | No Change |
|     |   | Area of lining per wheel, cm <sup>2</sup>                                    | 3376.7  | 3376.7   | No Change |
|     |   | No. of disc per wheel  | 07  | 07   | No Change |
|     | vii)  | <b>Type of drive:</b>  |   |  |           |
|     |   |  | 2WD   | 2WD  | No Change |
|     | viii)   | <b>Rear Final Reduction:</b>   |   |  |           |
|     |   | Reduction ratio gear box output shaft to wheel axle                          | 35 : 1  | 35 : 1   | No change |
|     |   | Oil capacity, l  | 1.40  | 1.20 (apa)                                     | Changed   |
|     | ix)   | <b>Type of fuel Injection pump:</b>  |   |  |           |
|     |   | Inline/Rotary/Common rail  | Inline plunger                                  | Common rail                                    | Changed   |
| 10. | <b>Change related to statutory/ regulatory requirements</b>                                   |  |   |  |           |
|     | a)  | Engine operating principle (spark / compression ignition, two / four stroke) | Compression Ignition, 4 stroke                  | Compression Ignition, 4 stroke                 | No change |
|     | b)  | Number & arrangement of cylinders  | Six & vertical inline                           | Four & vertical inline                         | Changed   |
|     | c)  | Maximum declared PTO power, (kW)   | 128.0   | 129.0  | Changed   |
|     | d)  | Maximum declared torque, Nm  | 650   | 810  | Changed   |
|     | e)  | Bore /stroke ,(mm)   | 102 / 120                                       | 110 / 135                                      | Changed   |
|     | d)  | Engine displacement (cc)   | 5883  | 5132   | Changed   |
|     | e)  | Rated engine speed (rpm)   | 2500 ± 50 (No load)<br>2400 + 50/-150 (On load) | 2200 ± 50 (No load)<br>2200 ± 50 (On load)     | Changed   |
|     | f)  | Low idle speed, rpm  | 800 ± 50  | 700±50   | Changed   |
|     | g)  | Naturally aspirated / turbo charged  | Turbo charged                                   | Turbo charged                                  | No change |
|     |   | -Number of blades on turbocharger turbine wheel /compressor fan              | 12 / 07   | 09 / 10  | Changed   |
| 11. | <b>Change related to ergonomics, safety comfort, and statutory / regulatory requirements:</b> |  |   |  |           |
|     | a)  | IS: 10273  | Conformed                                       | Does not conform                               | Changed   |
|     | b)  | IS:12343   | Did not conform                                 | Does not conform                               | No change |
|     | c)  | IS:12239 (Pt-I)  | Did not conform                                 | Does not conform                               | No change |
|     | d)  | IS:12239 (Pt-II)   | Did not conform                                 | Does not conform                               | No change |
|     | e)  | IS:8133  | Did not conform                                 | Does not conform                               | No change |
|     | f)  | IS: 6283   | Conformed                                       | Does not conform                               | Changed   |
|     | g)  | IS:14683   | Conformed                                       | Conforms                                       | No change |
| 12. | <b>Other changes:</b>   |  |   |  |           |
|     | a)  | Model/PT. No. Main Hydraulic Pump  | 1124 23 1236                                    | 1117231507                                     | Changed   |
|     | b)  | Type of Tandem hydraulic pump  | Piston  | Axial, piston pump                             | Changed   |
|     | c)  | Model/Pt. No of flow divider   | LZ-0577-1                                       | 1915083741                                     | Changed   |
|     |   | Capacity of Hydraulic tank (l)   | 120.5   | 130.0  | Changed   |



| 1 | 2  | 3   | 4                             | 5                                      | 6         |  |
|---|----|---|-------------------------------|--|-----------|--|
|   | d) | <b>Details of Topper assembly</b>               |                               |  |           |  |
|   |    | Size of cutting blade, mm                       |                               |  |           |  |
|   |    | Height  | 81.5                          | 80.4                                   | No Change |  |
|   |    | Width at top                                    | 18.5                          | 18.8                                   | No Change |  |
|   |    | Width at base                                   | 77.0                          | 76.0                                   | No Change |  |
|   |    | Model/pt no of hydraulic motors                 | M3100A783 A DUR 07-32         | 1213071361 (TA06853B0)                 | Changed   |  |
|   |    | Cutting height from GL, mm                      |                               |  |           |  |
|   |    | Minimum   | 1060                          | 800                                    | Changed   |  |
|   |    | Maximum   | 3990                          | 3230                                   | Changed   |  |
|   | e) | <b>Details of crop divider</b>                  |                               |  |           |  |
|   |    | Spacing of crop divider shoe, mm                | 1090(fixed)                   | 1105 (fixed)                           | No Change |  |
|   |    | Size length                                     | 1320                          | 1310                                   | No Change |  |
|   |    | Diameter  | 820 (Top) & 670 (Bottom)      | 340 (Top), 200 (Bottom)                | Changed   |  |
|   |    | Pitch   | 235                           | 230                                    | No Change |  |
|   |    | Range of vertical movement from GL, mm          | 0 to 265                      | 0 to 445                               | Changed   |  |
|   |    | Model/Part no of hydraulic motor of LHS and RHS | 104-3358-006, F02414          | 104-3358-006                           | Changed   |  |
|   | f) | <b>Detail of knock down roller:</b>             |                               |  |           |  |
|   |    | Size, mm  |                               |  |           |  |
|   |    | Overall Length                                  | 725                           | 725                                    | No change |  |
|   |    | Overall dia.                                    | 340                           | 340                                    |           |  |
|   |    | Size of comb, mm                                |                               |  |           |  |
|   |    | Height  | 56                            | 60                                     | No change |  |
|   |    | Base width                                      | 72                            | 90                                     | Changed   |  |
|   |    | Pitch   | 90                            | 90                                     | No change |  |
|   |    | Total height from base                          | 83                            | 83                                     | No change |  |
|   | g) | <b>Details of finned roller:</b>                |                               |  |           |  |
|   |    | Size, mm  |                               |  |           |  |
|   |    | Overall Length                                  | 760                           | 755                                    | No Change |  |
|   |    | Overall Diameter                                | 407                           | 415                                    |           |  |
|   |    | Size of comb, mm                                |                               |  |           |  |
|   |    | Height  | 20, 67, 102                   | 102, 64.5, 59, 20.2, 20.5              | Changed   |  |
|   |    | Pitch Number                                    | 36 18,8,4                     | -, 75.6, 76.1, 410, 36.8 1, 5, 3, 2, 8 |           |  |
|   | h) | <b>Base Cutter assembly:</b>                    |                               |  |           |  |
|   |    | Tilt angle of disc                              | 18 degree                     | 17.5 degree                            | Changed   |  |
|   |    | Size of blades, mm (L x W x T)                  | 268 x 89.5 x 6.0              | 269.8 x 89.6 x 6.1                     | No Change |  |
|   |    | Cutting width, mm                               |                               |  | No Change |  |
|   |    | Without blade                                   | 978                           | 990                                    |           |  |
|   |    | With blade                                      | 1119                          | 1110                                   |           |  |
|   |    | Model/pt no of hydraulic motor                  | TKG04743, LZ-0577-10, 82-0576 | 1215 072 740 (TA0685530)               | Changed   |  |
|   |    | Reduction ratio on gear box                     | 2.60:1                        | 2.60:1                                 | No Change |  |



| 1 | 2   | 3   | 4  | 5  | 6          |  |
|---|-----|---|--|--|------------|--|
|   | i). | <b>Details of butt lift roller:</b>   |  |  |            |  |
|   |     | Size, mm  | 580  | 580  | No Change  |  |
|   |     | Length<br>Dia.  | 212.8 (Roller) /<br>328 (Paddle)                             | 211.9 (Roller) /<br>322 (Paddle)                             |            |  |
|   |     | Model/pt no of hydraulic motor  | 104-3279-006, F02414   | 104-327S-006   | Changed    |  |
|   | j)  | <b>Details of feed rollers:</b>   |  |  |            |  |
|   |     | Number (s)  | Eight (4 pairs)  | Eight (4 pairs)  | No change  |  |
|   |     | Size, mm  | Top<br>Bottom  | Top<br>Bottom  |            |  |
|   |     | Overall Length  | 548<br>575   | 551<br>578   | No change  |  |
|   |     | Overall Dia.  | 215<br>218   | 212<br>213   | No change  |  |
|   | k)  | <b>Details of chopper drum assembly:</b>                                      |  |  |            |  |
|   |     | Size of drum , mm   | 285  | 287  | No Changed |  |
|   |     | Working Dia.<br>Width   | 579  | 580  |            |  |
|   |     | Size of blades, mm  | 540.5 x 65.2 x 8.0   | 540.5 x 66.0 x 8.1   | No change  |  |
|   |     | L x W x T   |  |  |            |  |
|   |     | Balancing flywheel size, mm   | 500 Ø  | 500 Ø  | No change  |  |
|   | l)  | <b>Details of elevator:</b>   |  |  |            |  |
|   |     | Length, mm  | 4575   | 4590   | No change  |  |
|   |     | Size of pads/elevator flight,<br>mm (L x W x T)                               | 556 x 100 x 3  | 560 x 100 x 3  | No change  |  |
|   |     | <b>Elevator sieve/separating grate:</b>                                       |  |  |            |  |
|   |     | Type  | Metallic sieve with<br>opening of 13 mm x 35<br>mm size      | Metallic sieve with<br>opening of 12 mm<br>x 40 mm size      | No change  |  |
|   |     | Total area of sieve, (m <sup>2</sup> )  | 2.02   | 2.80   | Changed    |  |
|   |     | Horizontal reach, mm<br>(Min. / Max.)   | 3640 / 4695  | 2180 / 3085  | Changed    |  |
|   |     | Discharge height above<br>ground level, mm, (Min. / Max.)                     | 2945 / 4275  | 2960 / 4280  | No change  |  |
|   |     | Clearance height, mm (Min. /<br>Max.)   | 1850 / 2640  | 2390 / 3350  | Changed    |  |
|   |     | Range of vertical movement at<br>top of elevator from GL, mm<br>(Min. / Max.) | 2790 / 4280  | 3340 / 4590  | Changed    |  |
|   |     | Range of horizontal swing<br>towards LHS and RHS from<br>centre of machine    | 84 degree and 80<br>degree                                   | 82.5 degree / 82.5<br>degree                                 | Changed    |  |
|   |     | Arrangement of levelling /<br>controlling elevator feed                       | 15 nos. chains of 10<br>link hanged on<br>extractor fan bowl | 15 nos. chains of<br>08 link hanged on<br>extractor fan bowl | Changed    |  |
|   | m)  | <b>Details of bin flap</b>  |  |  |            |  |
|   |     | Size, mm<br>(L x W x T)   | 770 x 510 x 3.0  | 765 x 500 x 3.0  | No change  |  |
|   | n)  | <b>Details of extractor fan:</b>  |  |  |            |  |
|   |     | Working Diameter  | Ø 880  | 850 Ø  | Changed    |  |
|   |     | Size of fan blade, mm<br>(L x W x T)  | 328 x 225 x 6.51   | 330 x 230 x 5.06   | No change  |  |
|   |     | Opening area of Extractor unit, m <sup>2</sup>                                | 0.732  | 0.556  | Changed    |  |
|   |     | Model/pt no of Hydraulic<br>motors  | YZ-0592, KKC 04 PH   | 1215071117CTA0<br>6854B0                                     | Changed    |  |



| 1 | 2         | 3   | 4  | 5   |           |  |
|---|-----------|---|--|---|-----------|--|
|   | <b>o)</b> | <b>Speed corresponding to rated engine speed for field work, rpm:</b> |  |   |           |  |
|   |           |   | <b>Base model<br/>@ 2500 rpm</b>   | <b>Variant model<br/>@ 2200 rpm</b>       |           |  |
|   |           | Topper assembly knife blade   | 1344   | 1340                                      | Changed   |  |
|   |           | Crop divider<br>Inner side /Outside                                   | 162/162  | 140 / 140                                 | Changed   |  |
|   |           | Knock down roller   | 80   | 70  | Changed   |  |
|   |           | Finned roller   | 80   | 84  | Changed   |  |
|   |           | Base cutter   | 558  | 481                                       | Changed   |  |
|   |           | Butt lift roller  | 82   | 80  | Changed   |  |
|   |           | Feed rollers<br>LHS / RHS   | 103 / 83   | 103 / 81                                  | Changed   |  |
|   |           | Chopper drum  | 495  | 507                                       | Changed   |  |
|   |           | Elevator  | 210  | 211                                       | Changed   |  |
|   |           | Extractor fan   | 2292   | 10 to 2250<br>(Variable speed)            | Changed   |  |
|   | <b>p)</b> | <b>Wheel equipments:</b>  |  |   |           |  |
|   |           | Track width of steered wheel,<br>mm                                   | 1595 (Std.),   | 1600 (std),                               | No change |  |
|   |           | Track width of drive wheel, mm  | 1460 (std.),   | 1455 (std.),                              | No change |  |
|   | <b>q)</b> | Wheel base (mm)   | 2215   | 2200                                      | No change |  |
|   | <b>r)</b> | <b>Over all dimensions, mm:</b>                                       |  |   |           |  |
|   |           |   | <b>Transport<br/>position</b>  | <b>Transport position</b>                 |           |  |
|   |           | - Length  | 11620  | 10510                                     | Changed   |  |
|   |           | - Width   | 2505   | 2480                                      | Changed   |  |
|   |           | - Height  | 3590   | 3760                                      | Changed   |  |
|   |           | Minimum ground clearance,<br>(mm)                                     | 206<br>(at base cutter<br>in up position)                                  | 190<br>(at base cutter in up<br>position) | Changed   |  |
|   | <b>s)</b> | <b>Sheet metal:</b>   |  |   |           |  |
|   |           | Style of bonnet & Fender  |  |   |           |  |
|   |           | - Colour  | Orange   | Orange                                    | No change |  |
|   |           | -Decals (Sticker)   | <b>SHAKTIMAN<br/>SSCH 3737</b>   | <b>SHAKTIMAN SSCH 3737<br/>Tejas</b>      | Changed   |  |
|   | <b>t)</b> | Mass of sugarcane harvester   | 8340   | 8730                                      | Changed   |  |
|   | <b>u)</b> | Details of air conditioning<br>system                                 | Various configuration between base and<br>variant model refer para 4.1.34. |   | Changed   |  |

## 8. SUMMARY OF OBSERVATIONS, COMMENTS AND RECOMMENDATIONS

### 8.1 Engine Performance Test:

| Engine Brake<br>power,<br>kW            | Crankshaft<br>torque, Nm | Engine<br>speed<br>(rpm) | Hourly fuel<br>consumption l/h | Specific fuel<br>consumption<br>kg/kwh | Specific energy,<br>kWh/l |
|---|--------------------------|--------------------------|--------------------------------|--|---------------------------|
| 1                                       | 2                        | 3                        | 4                              | 5                                      | 6                         |
| <b>i) Maximum power - 2 hours test:</b> |                          |                          |                                |  |                           |
| <b>Base model</b>                       |                          |                          |                                |  |                           |
| 115.3                                   | 524.2                    | 2100                     | 34.99                          | 0.254                                  | 3.30                      |
| <b>Variant model</b>                    |                          |                          |                                |  |                           |
| 126.2                                   | 560.4                    | 2150                     | 38.40                          | 0.254                                  | 3.29                      |



| 1  | 2     | 3    | 4     | 5     | 6      |
|--|-------|------|-------|-------|--------|
| <b>ii) Power at rated engine speed</b>           |       |      |       |       |        |
| <b>Base model (2400±50/-150 rpm)</b>             |       |      |       |       |        |
| 112.1  | 475.9 | 2250 | 35.86 | 0.262 | 3.19   |
| 104.8  | 445.0 | 2250 | 34.31 | 0.274 | 3.05 * |
| <b>Variant model (2200±50)</b>                   |       |      |       |       |        |
| 126.2  | 560.4 | 2150 | 38.40 | 0.254 | 3.29   |
| 125.4  | 557.0 | 2150 | 38.25 | 0.258 | 3.28 * |
| <b>iii) Maximum torque:</b>                      |       |      |       |       |        |
| <b>Base model</b>                                |       |      |       |       |        |
| 96.5   | 635.8 | 1450 | 26.61 | 0.230 | 3.42   |
| 94.0   | 544.1 | 1650 | 27.37 | 0.243 | 3.43 * |
| <b>Variant model</b>                             |       |      |       |       |        |
| 96.5   | 635.8 | 1450 | 26.61 | 0.230 | 3.42   |
| 94.0   | 544.1 | 1650 | 27.37 | 0.243 | 3.43 * |
| <b>iv) Five hour rating test:</b>                |       |      |       |       |        |
| <b>a) Engine loaded to 90% of maximum power:</b> |       |      |       |       |        |
| <b>Base model</b>                                |       |      |       |       |        |
| 103.9  | 439.0 | 2261 | 33.66 | 0.271 | 3.09 * |
| <b>Variant model</b>                             |       |      |       |       |        |
| 106.8  | 485.8 | 2100 | 33.34 | 0.261 | 3.20*  |
| <b>b) Maximum power:</b>                         |       |      |       |       |        |
| <b>Base model</b>                                |       |      |       |       |        |
| 106.8  | 485.8 | 2100 | 33.34 | 0.261 | 3.20 * |
| <b>Variant model</b>                             |       |      |       |       |        |
| 125.4  | 557.0 | 2150 | 38.25 | 0.258 | 3.28 * |

\* Under high ambient condition.

- The maximum power output of the engine was observed as **126.2 kW @ 2150 rpm** of engine at full throttle setting against the declaration of **129 kW**, which meets the requirements of IS: 15806-2008 with regard to tolerance.
- The specific fuel consumption corresponding to maximum power at full throttle setting measured as **0.254 kg/kwh**.
- The back-up torque of the engine was measured as **43.2 %** under natural ambient condition at full throttle.
- The maximum smoke density was recorded as **0.25 m<sup>-1</sup>**.
- The maximum temperature (°C) of engine oil, coolant and exhaust gas were observed as 121, 102 and 767 respectively.
- The lubricating oil & coolant consumption during five hours rating test were measured as **0.408 g/kwh (0.300 g/hph) & nil** of total coolant capacity respectively.
- During engine performance test governor hunting of 08 to 56 rpm and 09 to 52 rpm of engine speed was recorded between engine speeds of 1300 to 1900 rpm under natural and high ambient conditions respectively. This should be looked into for necessary corrective action during the design of fuel supply system of engine.

### 8.2 Mechanical Vibration:

The amplitude of mechanical vibration on various assemblies / subassemblies / components marked as (\*) in Chapter- 4.5 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.

### 8.3 Noise measurement:

The ambient noise emitted by the machine at bystander's position and operator's ear level was measured as **92 & 83 dB (A)** (inside cabin on gate closed condition) respectively. The noise level at bystander's position is on higher side and does not meets the requirement. This may be looked into for necessary corrective action.



| 1  | 2     | 3    | 4     | 5     | 6      |
|--|-------|------|-------|-------|--------|
| <b>ii) Power at rated engine speed</b>           |       |      |       |       |        |
| <b>Base model (2400±50/-150 rpm)</b>             |       |      |       |       |        |
| 112.1  | 475.9 | 2250 | 35.86 | 0.262 | 3.19   |
| 104.8  | 445.0 | 2250 | 34.31 | 0.274 | 3.05 * |
| <b>Variant model (2200±50)</b>                   |       |      |       |       |        |
| 126.2  | 560.4 | 2150 | 38.40 | 0.254 | 3.29   |
| 125.4  | 557.0 | 2150 | 38.25 | 0.258 | 3.28 * |
| <b>iii) Maximum torque:</b>                      |       |      |       |       |        |
| <b>Base model</b>                                |       |      |       |       |        |
| 96.5   | 635.8 | 1450 | 26.61 | 0.230 | 3.42   |
| 94.0   | 544.1 | 1650 | 27.37 | 0.243 | 3.43 * |
| <b>Variant model</b>                             |       |      |       |       |        |
| 96.5   | 635.8 | 1450 | 26.61 | 0.230 | 3.42   |
| 94.0   | 544.1 | 1650 | 27.37 | 0.243 | 3.43 * |
| <b>iv) Five hour rating test:</b>                |       |      |       |       |        |
| <b>a) Engine loaded to 90% of maximum power:</b> |       |      |       |       |        |
| <b>Base model</b>                                |       |      |       |       |        |
| 103.9  | 439.0 | 2261 | 33.66 | 0.271 | 3.09 * |
| <b>Variant model</b>                             |       |      |       |       |        |
| 106.8  | 485.8 | 2100 | 33.34 | 0.261 | 3.20*  |
| <b>b) Maximum power:</b>                         |       |      |       |       |        |
| <b>Base model</b>                                |       |      |       |       |        |
| 106.8  | 485.8 | 2100 | 33.34 | 0.261 | 3.20 * |
| <b>Variant model</b>                             |       |      |       |       |        |
| 125.4  | 557.0 | 2150 | 38.25 | 0.258 | 3.28 * |

\* Under high ambient condition.

- The maximum power output of the engine was observed as **126.2 kW @ 2150 rpm** of engine at full throttle setting against the declaration of **129 kW**, which meets the requirements of IS: 15806-2008 with regard to tolerance.
- The specific fuel consumption corresponding to maximum power at full throttle setting measured as **0.254 kg/kwh**.
- The back-up torque of the engine was measured as **43.2 %** under natural ambient condition at full throttle.
- The maximum smoke density was recorded as **0.25 m<sup>-1</sup>**.
- The maximum temperature (°C) of engine oil, coolant and exhaust gas were observed as 121, 102 and 767 respectively.
- The lubricating oil & coolant consumption during five hours rating test were measured as **0.408 g/kwh (0.300 g/hph) & nil** of total coolant capacity respectively.
- During engine performance test governor hunting of 08 to 56 rpm and 09 to 52 rpm of engine speed was recorded between engine speeds of 1300 to 1900 rpm under natural and high ambient conditions respectively. This should be looked into for necessary corrective action during the design of fuel supply system of engine.

### 8.2 Mechanical Vibration:

The amplitude of mechanical vibration on various assemblies / subassemblies / components marked as (\*) in Chapter- 4.5 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.

### 8.3 Noise measurement:

The ambient noise emitted by the machine at bystander's position and operator's ear level was measured as **92 & 83 dB (A)** (inside cabin on gate closed condition) respectively. The noise level at bystander's position is on higher side and does not meets the requirement. This may be looked into for necessary corrective action.



**8.4 Labelling of Sugarcane Harvester:**

On labelling plate of sugarcane harvester engine power and specific fuel consumption should be mentioned as per IS: 10273 – 1987 (Reaffirmed in 2004).

**8.5 Recommendation with regard to safety on sugarcane harvester**

The following requirements, inter-alia, may be considered for incorporation on the sugarcane harvester:

- i) Length and width of seat should be sufficient for comfortable seating.
- ii) Longitudinal and vertical distance from seat index point to centre of clutch and accelerator pedal should be as per relevant standard for easy handling of sugarcane harvester.
- iii) Longitudinal distance from seat index point to centre of steering control wheel should be sufficient for easy steerability.
- iv) Emergency exits should be provided to move towards outside the operator during any hazardous situation.
- v) Vertical retainers at both sides of foot steps should be provided to avoid the accidents.
- vi) Height of 1<sup>st</sup> step from ground should be less than maximum requirement of 550 mm for easy ascend.
- vii) Spark arrester should be provided in the exhaust system.
- viii) Rear wheel or tracks should be covered to avoid accidents.
- ix) Working clearance around control levers should be more than the minimum requirement of 70 mm for trouble-free operations.
- x) There should be arrangement for locking the sugarcane harvester header assembly in raised position to avoid accidents.

**8.6 Literature supplied with the Machine:**

The following literature were supplied in English with the machine for reference during testing and these were found adequate, however, it needs to be modified in Hindi and other regional language for the guidance of the users in accordance with IS :8132-1999.

- i) Operator's Manual cum Service Manual of Shaktiman 3737 Tejas sugarcane harvester.
- ii) Parts Catalogue of Shaktiman 3737 Tejas sugarcane harvester.

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

| S. No. | Characteristics   | Requirement   | Declared       |                | Observed         |                  | Remark   |
|--------|---|---|----------------|----------------|------------------|------------------|----------|
|        |   |   | Base model     | Variant model  | Base model       | Variant model    |          |
| 1      | 2   | 3   | 4              | 5              | 6                | 7                | 8        |
| 9.1    | <b>Prime mover performance:</b>   |   |                |                |                  |                  |          |
| 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 value.                                | 128            | 129            | 115.3            | 126.2            | Conforms |
| 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.                     | 128            | 129            | 115.3            | 126.2            | Conforms |
| iii)   | Power at rated engine speed, kW(Ps)   | The observed value must not be less than 5% of the declared value by the applicant. | 128<br>(174.0) | 129<br>(175.4) | 115.3<br>(156.8) | 126.2<br>(171.6) | Conforms |



| 1          | 2  | 3   | 4                     | 5                                   | 6     | 7     | 8                       |
|------------|--|---|-----------------------|-------------------------------------|-------|-------|-------------------------|
|            | iv) Specific fuel consumption, g/kWh.  | The average value during 2 hr. max. Power test must be within $\pm 5\%$ of the declared value by applicant/manufacturer.              | 242.9                 | 255                                 | 254   | 254   | Conforms                |
|            | v) Max. smoke density (bosch no.) at 80% load between the speed at max. power & 55% of speed at max. or 1000 rpm which ever is higher, should be observed as per CMVR rule | For tractor:-<br>5.2 bosh no. or 75 hartridge<br>For engine:-<br>Free deceleration or natural aspirated or turbo charges 65 hartridge | $3.25 \text{ m}^{-1}$ | $3.25 \text{ m}^{-1}$               | 1.18  | 0.25  | Conforms                |
|            | 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.   | 650                   | 810                                 | 635.8 | 797.2 | Conforms                |
|            | vii) Back up torque, %   | 7% min.   | 0.33                  | 44.64                               | 21.3  | 42.3  | Conforms                |
|            | viii) Maximum operating temperature (To be declared by manufacturer)   | i) Engine oil   | 127                   | 125                                 | 115   | 121   | Conforms                |
|            |  | ii) Coolant   | 107                   | 107                                 | 104   | 102   | Conforms                |
|            | ix) Lubrication oil consumption, g/kWh   | 1% of SFC at 5 hr. max. Power during high ambient condition.  | N.A (D)               | 0.05 % by volume at rated condition | 0.212 | 0.408 | Conforms                |
|            |  |   | 2.67 (R)              | 2.59 (R)                            |       |       |                         |
| <b>9.2</b> | <b>Mechanical vibration:</b>   |   |                       |                                     |       |       |                         |
|            | i) Operator's platform   | 120 $\mu\text{m}$ max.  | --                    | 115                                 | 30    | 20    | Conforms                |
|            | ii) Steering wheel   | 150 $\mu\text{m}$ max.  | --                    | 140                                 | 70    | 40    | Conforms                |
|            | iii) Seat with driver sealed   | 120 $\mu\text{m}$ max.  | --                    | 110                                 | 40    | 30    | Conforms                |
| <b>9.3</b> | <b>Noise measurement:</b>  |   |                       |                                     |       |       |                         |
|            | i) Max. ambient noise emitted by combine at bystander position dB (A)  | 88 dB (A) as per CMVR   | --                    | --                                  | 94    | 92    | <b>Does not Conform</b> |
|            | ii) Max. noise at operator's ear level dB (A)  | 96 dB (A) as per CMVR.  | --                    | --                                  | 88    | 83    | Conforms                |



| 1   | 2   | 3  | 4                     | 5                                   | 6  | 7            | 8                     |                  |
|-----|---|--|-----------------------|-------------------------------------|----|--------------|-----------------------|------------------|
| 9.4 | <b>Safety requirement</b>                       |  |                       |                                     |    |              |                       |                  |
|     | i)  | Guards against all moving per                                      | Essential             | -                                   | -- | Provided     | Provided              | Conforms         |
|     | ii)   | Lighting arrangement   | Essential as per CMVR | --                                  | -- | Provided     | Provided              | Conforms         |
|     |   | a) Head light  |                       |                                     |    |              |                       |                  |
|     |   | b) Parking light   |                       |                                     |    |              |                       |                  |
|     |   | c) Indication  |                       |                                     |    |              |                       |                  |
|     |   | d) Reverse gear  |                       |                                     |    |              |                       |                  |
|     |   | e) Brake   |                       |                                     |    |              |                       |                  |
|     |   | f) Chassis number  |                       |                                     |    |              |                       |                  |
|     | iii)  | Working clearance around the controls                              | Essential 70 mm, min. | --                                  | -- | Provided     | Not provided          | Does not conform |
|     | iv)   | Labelling of control gauge   | Essential             | --                                  |    | Not provided | Not provided          | Does not conform |
|     | v)  | Operator seat requirement  | Essential             | -                                   |    | Not provided | Not provided          | Does not conform |
|     | vi)   | Safety slip clutch arrangement for Chopper assembly                | -                     | -                                   |    | Provided     | Provided              | Conforms         |
|     | vii)  | Safety guard for operator cabin, sideways and backside of elevator | -                     | -                                   |    | Provided     | Provided              | Conforms         |
| 9.5 | <b>Labelling of sugarcane harvester</b>         |  |                       |                                     |    |              |                       |                  |
|     | 1)  | Make   | Essential             | It should conform to IS:102 73-1987 | -- | --           | Shaktiman             | Conforms         |
|     | 2)  | Model  | Essential             |                                     | -- | --           | SSCH-3737 Tejas       | Conforms         |
|     | 3)  | Year of manufacture  | Essential             |                                     | -- | --           | February, 2016        | Conforms         |
|     | 4)  | Engine number  | Essential             |                                     | -- | --           | 7005308375            | Conforms         |
|     | 5)  | Chassis number   | Essential             |                                     | -- | --           | TATSCH373716B000 0047 | Conforms         |
|     | 6)  | Declaration of Engine power, kW                                    | Essential             |                                     | -- | --           | Not available         | Does not conform |
|     | 7)  | Specific fuel consumption g/kWh (g/hph)                            | Essential             |                                     | -- | --           | Not available         | Does not conform |
| 9.6 | <b>Break down (critical, major &amp; minor)</b> |  |                       |                                     |    |              |                       |                  |
|     | Critical  | As per IS 15806-2008   | -                     |                                     |    |              | Nil                   | Conforms         |
|     | Major   |  |                       |                                     |    |              | Nil                   |                  |
|     | Minor   |  |                       |                                     |    |              | Nil                   |                  |

## 10. CITIZEN CHARTER



| Time frame for Testing & Evaluation as per Citizen Charter | Duration of Test                       | Whether the Test Report is released within the time frame given in Citizen Charter | Remarks |
|--|--|--|---------|
| 10 Months  | 02 Months<br>(May, 2017 to June, 2017) | Yes  | --      |

TEST CARRIED OUT AT C.F.M.T. &amp; T.I., BUDNI (M.P.), INDIA

TESTING AUTHORITY :

**RAJNEESH PATEL**  
AGRICULTURAL ENGINEER

**C.V. CHIMOTE**  
TEST ENGINEER

**Y.K. RAO**  
SENIOR AGRICULTURAL ENGINEER

**J.J.R. NARWARE**  
DIRECTOR

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

## 11. APPLICANT'S COMMENTS

| Para No. | Our Reference   | Applicant's comments  |
|----------|---|---|
| 11.1     | 4.1.35.1 (i), (ii), (iii), (iv) & (v)                             | We will look into the ergonomic aspects in-side the cabin and improve if required.  |
| 11.2     | 4.1.35.1 (i) Emergency exit                                       | Operator cabin access door provided on both sides which also works as emergency exits. Also on four sides cabin is fitted with glass, which can be easily broken and make exit. |
| 11.3     | Chapter 7, Sr. No. 11 (a), (b), (c), (d), (e) & (f)               | We will look into the ergonomics, safety comfort and statutory / regulatory requirements and improve if required.   |
| 11.4     | 8.2   | We will look into reducing vibration on "Battery base, Parking light, Elevator top work light, Elevator indicator & Reverse light", where vibration is more than safety limit.  |
| 11.5     | 8.4   | We will look into it and make necessary changes.  |
| 11.6     | 8.5, (i), (ii), (iii), (iv), (v), (vi), (vii), (viii), (ix) & (x) | We will look into it and make necessary changes for the safety of Sugarcane Harvester   |
| 11.7     | 8.6   | We will look into it and make necessary changes in future.  |
| 11.8     | 9.4 iii) iv) & v)   | We will look into it and make necessary changes in future.  |

Annexure-IHARVESTER RUN HOURS DURING TEST

| A. | LABORATORY TESTS:  | HOURS       |
|----|--|-------------|
| 1. | Running-in   | --          |
| 2. | Engine Performance test  | 17.3        |
| 3. | Mechanical vibration test  | 1.0         |
| 4. | RPM Checking   | 0.8         |
| 5. | Nominal speed test   | 1.0         |
| 6. | Noise measurement  | 3.0         |
| B. | Miscellaneous test and other run hours including idle run, transportation, trials and preparation for test | 6.8         |
|    | <b>TOTAL</b>   | <b>29.9</b> |