TRUCK MOUNTED STREET VACUUM CLEANER (T-MSVC)

USER MANUAL

National Institute of Technology, Tiruchirappalli

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1. Introduction

The Truck Mounted Street Vacuum Cleaner (T-MSVC) is an indigenously designed and developed by the students of National Institute of Technology, Tiruchirappalli, (NITT) Tamil Nadu, India, to help Trichy Corporation and other government agencies to maintain the streets and roads of the towns and cities clean in a quick and efficient manner. This cleaning system is mounted on any mini-truck and used to clean streets.

This is a user-friendly street vacuum cleaning system that permits the user to clear garbage and plastic wastes off the roads. Majority of the garbage includes leaves, plastic bottles, plastic covers and wrappers, sand and dust particles and organic waste. It becomes a cumbersome task for corporation sweepers to remove such wastes manually and without the aid of any devices. Hence, this product serves the purpose of clearing wastes from the roads with ease through its unique vacuum system that enables the user to sway the inlet hose to collect the garbage. Human effort is drastically reduced by the help of the ergonomic design of the hose's handle.

2. How to Start and Use T-MSVC

2.1 SAFETY

General warnings before starting the machine

- Before use, be sure everyone using this unit reads and understands all safety instructions and other information contained in this manual.
- Ensure no one is near the exhaust of impeller
- Ensure exhaust pipe of the engine is free
- Ensure nothing hinders the coupling belt of engine and impeller
- Ensure nothing unnecessary is near the inlet of the hose
- Ensure there isn't any leak between the joints of each components
- Check the fuel level
- Check whether the ratchet clamps are fitted firmly to the L-angles attached to bin and lid.
- Avoid any unnecessary bends in the hose pipes.
- Ensure all the bolts and nuts on the eye adapter, exhaust adapter and impeller-engine mount are tightly fastened.
- Keep long hair and loose clothing away from openings and moving parts.

GENERAL SAFETY INSTRUCTIONS FOR THE PRODUCT

- USE ONLY identical replacement parts. See instructions and specifications for exact component details and servicing of appliances.
- STORE IDLE TOOLS. When not in use, the unit should be stored in a dry, high or locked-up place - out of reach of children.

- DO NOT switch on the impeller after disassembling all the components.
- DO NOT get in contact with engine during/after running to avoid burns.
- DO NOT use this system in damaged conditions.
- DO NOT move the system from its position on the truck while the engine and impeller are still running.
- DO NOT pick up anything that is burning or smoking, such as cigarettes, matches or hot ashes.
- DO NOT attempt to repair the blower/vac. To assure product safety and reliability, repairs, maintenance, and adjustments should be performed by authorized service persons, always using exact replacement parts.
- DO NOT expose to rain, do not use on wet surfaces.
- DO NOT allow individuals to operate the machine if they are tired, taking prescription medication, or are under the influence drugs or alcohol.
- ALWAYS keep the hose pipes away from heated surfaces to prevent damage.
- KEEP CHILDREN, BYSTANDERS AND ANIMALS AWAY from the work area a minimum of 5 meters when starting or operating the tool. Do not blow debris in directions of bystanders.
- Dismantling of the system must be performed with utmost care as per the procedure prescribed in the manual.
- The gasoline must be poured carefully into the fuel tank without spillage.
  Exhaust gas from engine will be hot and must be passed to the environment with proper ventilation.

WARNING:

I. Cut Hazard. Turn off and wait until fan stops or at least 10 seconds before removing the hose pipes.
II. When approaching an operator of the machine, be careful not to startle or distract the operator, which may cause an unsafe situation. Carefully call his attention and confirm that the operator STOPS/KEEPS IT AWAY the machine prior to approaching them.

CAUTION:

I. Do not refuel the engine while it is hot or running.
II. MUST TURN OFF THE ENGINE before trying to replace the Garbage Can/Bin.
III. Replace the bin after 3/4th of bin is filled with trash, otherwise it may result in clogging of the impeller.

2.2 STARTING T-MSVC

- Check if you have enough petrol/gasoline in the tank, located above the engine. If not, fill the tank with unleaded petrol first.
- Check to see if the Lid assembly is securely placed and locked on top of the large garbage bin.

2.3 Starting the engine:

- When starting a cold engine, push the choke lever. If re-starting a warm engine, leave the choke in the (RUN) position.
- Ensure that the switch to the ignition system is turned on. This switch can be located on the front of the engine on the top.
- Set the throttle valve to the required RPM level. (Recommended RPM: 1700)
- Pull the cord with a smooth accelerating motion to start the engine.
- Once the engine is running, slowly push the choke lever back to the RUN position.
- Point and Hold the nozzle of the hose towards trash to be picked up. The T-MSVC will start sucking the trash and collect it in garbage bin. (If the garbage is not sucked in, please check the Lid assembly again to make sure it is tightly locked in on the Garbage Bin).

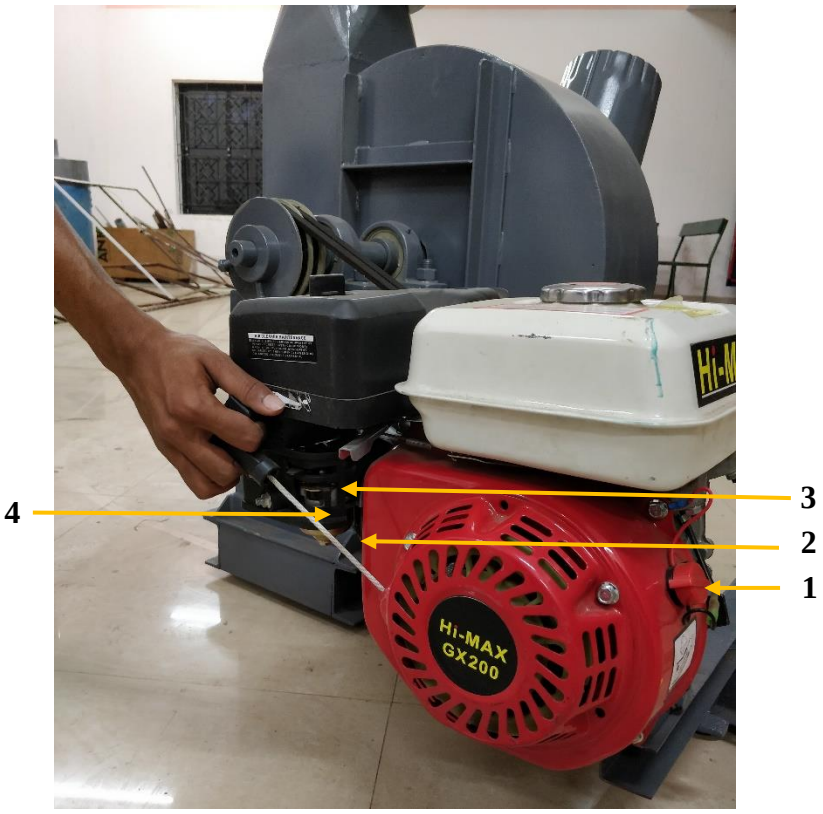


Fig.1. Cord/Rope in ready position in engine.

1 : Engine Knob to turn ON/OFF
2 : Cord to crank the engine
3 : Choke lever
4 : RPM lever

2.3 Switching OFF the engine:

- After the operation is complete, turn the engine knob to the OFF position.

3. Functionality and Unique features

Fig.2. T-MSVC system

1 - Engine
2 - Impeller
3 - Impeller Exhaust
4 - Handle(garbage inlet)
5 - Lid Assembly
6 - 8'' Flexible Hose Connector
7 - Garbage Bin
8 - Irwin Ratchet Clamp
9 - 5'' Flexible Hose

Functionality:

- **Independent module**

The Truck Mountable Street Suction cleaner is an independent module that can be used in any TATA Ace trucks. The module can be easily shifted from one truck to another with minimum labour and ease

- **Inbuilt Engine and Impeller**

The module comes with an inbuilt engine to drive the Impeller. The engine and the impeller are coupled using belt drive. The base of the system is fit with rubber bushes to arrest the vibrations of the prime mover.

- **Flexible hose and miter bends**

Flexible PVC hose is used to connect the Impeller eye to the LID and the handle. The hose provides enough flexibility for the user to move around and for shifting the lid from bin to bin.

Miter bends are provided at different angled to avoid Kinks in the hose and to reduce the suction lose. The hose is fixed using hose clamps that makes it air tight.

- **LID System**

The LID has been designed to form a primary chamber prior to the impeller when it is air-sealed with the garbage bin. The chamber behaves as a cyclone separator to ensure the garbage doesn't reach the impeller. A liner is provided to ensure this.

- **Ratchet clamp and rubber gasket**

The LID and the garbage bins are provided with rubber gasket padding to ensure an Air tight chamber when sealed together. 3 unique ratchet clamps are provided at 120 degrees on the lid to clamp the lid with the bin. The LID can be changed from one bin to another when the bins are filled with the garbage.

- **The handle**

It has been ergonomically designed to allow the user to manoeuvre the handle with ease and comfort with minimum effort. The weight of the handle is distributed to the ground through the castor wheel on the bottom which also acts as a pivot for the handle.

Unique Features:

- It can achieve an average suction rate of more than 550 cfm at a constant 1600 revolutions of the impeller per minute.
- The model is the first of its kind to incorporate the existing garbage bins into its working to form an air sealed primary storage chamber
- The Lid system has been cleverly designed with a liner to transform the primary storage chamber into a cyclone separator to separate the garbage from entering the impeller.
- The ratchet clamp and the handle have been designed ergonomically
- The product requires minimum maintenance. All subcomponents of the model are easily accessible by the user.
- The model serves as an improvement for the current practice of garbage collection as it drastically reduces the labour intense process of collecting the garbage in these bins.
- The Product proves to be effective for nearly 80% of all types of garbage frequently collected including water bottles. Food packets etc.
- It is the cheapest model available amongst all the other various models of Truck Mounted Street suction cleaners available in the market.
- Provided with protection to withstand harsh weather conditions.
- Requires only 1 man to operate the system.
- Can be used for up to 8 hrs continuously on a full tank with a capacity of 4 litres.

4. Specifications

	PART	SPECS
1	**ENGINE**	6 HP, Hi-MAX GX200
	RPM	1700
	Starter	Pull start
	Fuel Capacity	4L
	Oil Capacity	100mL
2	**IMPELLER**	6 HP
	Speed	1700 RPM
	Weight	30 kg
	Suction	550 CFM
	Inlet dia	5 in
	Outlet dia	8 in
3	**Connecting Hose**	PVC Corrugated, VV Hitech
	Inner Diameter	5 in , 8 in
	Length	3.5 m , 1m
4	**BIN**	PVC
	Height	3 ft
	Diameter	2 ft
	Capacity	280 L
5	**RATCHET CLAMPS**	Irwin Quick-grip Mini-clamp
	Maximum Extension	6 in
	Clamping force	140 lbs
6	**HOSE CLAMP**	Stainless Steel
	Diameter	5", 8"
7	**FILTER**	Fine mesh 4x4 mm^2

5. Parts replacement details

Description of the part	Where to buy from (address/contact information)
Hose & hose clamps	VV Hitech Innovations India Private Limited Ph: 91-422-2530534 , 9952401293
Lid assembly	Samsudeen Tinker Works Ph: 9360209468
Garbage bin	Samsudeen Tinker Works Ph: 9360209468
Engine	J.S.Traders Ph: 9597596231, 9442869882
Impeller	M Bakul&Co 115, Linghi Chetty St, Parry's Corner, George Town, Chennai, TamilNadu, 600001 Ph: 044-2522 8513
Irwin Ratchet Clamps	CRG & Co. 26/1, 10th Floor, Brigade World Trade Center, Dr. Rajkumar Road, Bangalore - 560055
Castor wheel & Fasteners	MKS Raja corporation Thanjavur Thuvakudi Road Trichy-620015
Rubber stopper and Gasket	Suresh Auto Stores Thiruverumbur Trichy - 620014 Ph: 9976103442

6. Setting up the product

6.1 Parts:

1

2

3

4

5

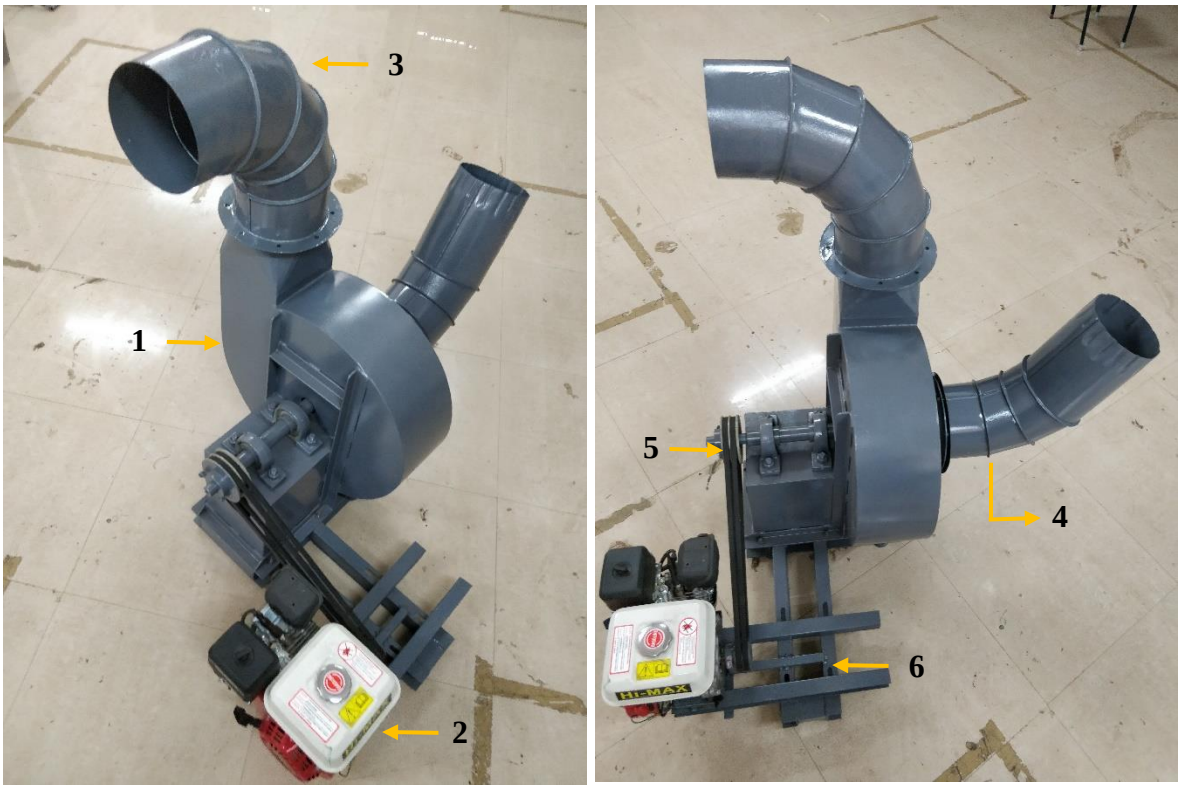
6

7

1) **Irwin ratchet clamp:** used to hold the lid and bin tightly to avoid air leakage
2) **Hose clamp:** used to tightly fit the hoses to the respective pipes
3) **Castor wheel:** assist in easy maneuvering of the handle
4) **Rubber sheet:** acts as a gasket for attaching the exhaust and eye adapters to the impeller
5) **Filter:** to prevent large sized particles from getting sucked into the impeller
6) **Hose pipe (5" inch):** inlet hose connected to the handle maneuvered by the user
7) **Hose pipe (8" inch):** connecting eye adapter to the lid

6.2 <u>Sub-Assemblies:</u>

1. Impeller – Engine assembly



1) **Impeller:** rotating component creating suction
2) **Engine:** power source for the impeller
3) **Impeller exhaust adapter:** directing the exhaust air from impeller exit
4) **Impeller eye adapter:** guiding the hose from lid to impeller eye
5) **Coupling Belt:** to transmit the power from engine to impeller
6) **Mount for engine:** common rigid base for engine and impeller

2. Bin - Lid assembly


1


2


3


4


5


6

1) **Lid:** guides the garbage into the bin
2) **Bin:** stores the garbage
3) **Using Ratchet Clamp:**
   Firstly, loosen the clamp by pressing the release lever (Fig.3)
   Secondly place the rubber pads on the L-angles of the lid and bin (Fig.4)
   Finally, tighten it (Fig.5)
6) bin and lid are assembled

3. Handle assembly

6.3 Setting up Procedure

- The belts must be tightened on to the pulleys of the engine and the impeller
- The impeller must be lubricated using oil by pouring it through the oil ports.
- Outlet and inlet manifolds should be fastened to the impeller outlet and impeller eye respectively using fasteners with gasket in between them.
- The assembly is placed on the Vehicle.
- The impeller to lid hose must be clamped to the inlet manifold using a 8” Hose clamp
- The other end of the impeller to lid hose must be clamped to the outlet of the Lid using a 8” Hose Clamp.
- The filter must be attached to the inner tubular setup in the lid
- The lid must be placed on the brim of the bin such that the angles coincide.
- The bin and lid need to be clamped using the ratchet clamps until there is no visible gap between the lid and the bin.
- The bin is placed on the Vehicle such that the Lid inlet faces the rear side of the vehicle.
- The handle to lid hose must be clamped to the inlet of the lid using a 5” hose clamp
- The other side of the hose is clamped to the handle using a 5” hose clamp.

7. Operating procedure

7.1 Filling Petrol:

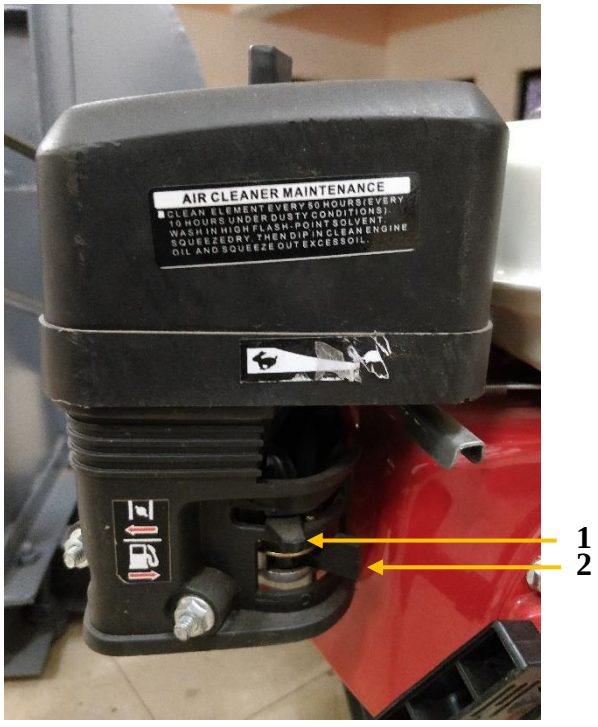
- Remove the cap located on top of the engine by unscrewing it.
- Fill the required amount of petrol, preferably through a funnel, to avoid spillage.
- Close the cap tightly to prevent any leakage.

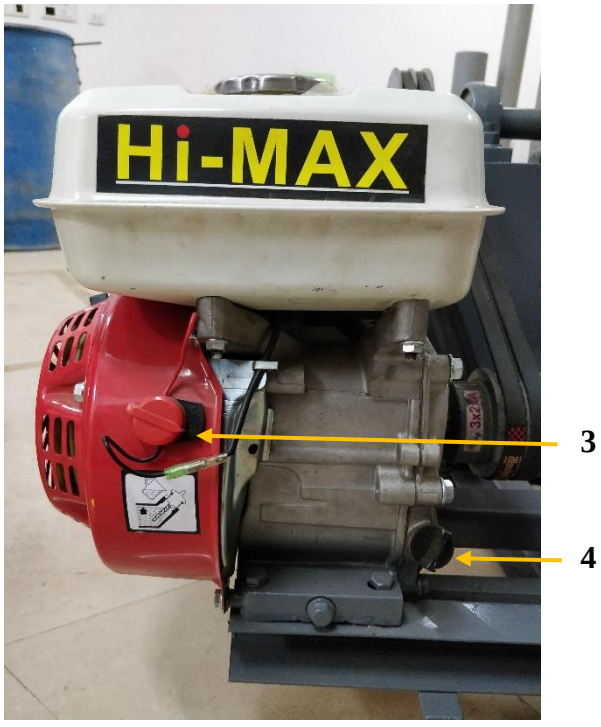
CAUTION: Do not refuel the engine while it is hot or running.

7.2 Starting the engine:

- When starting a cold engine, push the choke lever (CHOKE). If re-starting a warm engine, leave the choke in the (RUN) position.
- Ensure that the switch to the ignition system is turned on. This switch can be located on the front of the engine on the top.
- Set the throttle valve to the required RPM level. (**Recommended**: 1700 RPM – can be calibrated using **tachometer**)
- Pull the cord with a smooth accelerating motion to start the engine.
- Once the engine is running, slowly push the choke lever back to the RUN position.

CAUTION: When garbage gets stuck inside the hose, shut down the engine. This will enable the garbage to fall back down.





1 - Choke lever

2 – RPM lever

3 – Engine ON/OFF knob

4 - Oil level indicator

7.3 General Operation:

- The lid is placed on top of the garbage can by aligning the brackets of the lid with those of the garbage can.
- Once aligned, the ratchet clamps are then tightened to the brackets.
- Ensure all the hose pipes are secured tightly with the help of the hose clamps.
- Turn on the engine, following the procedure stated above.
- Use the handle of the inlet hose to guide it in the required direction as to collect the garbage.
- Once the garbage can gets filled, turn off the engine, and switch the lid to the other garbage can, and repeat steps 1-5.

7.4 Changing the garbage Can during operation:

- **TURN OFF** the engine FIRST.
- Remove the ratchet clamps.
- Take the lid off and place it on the other garbage can.
- Align the L brackets and secure the ratchet clamps.
- Start the engine once again.

NOTE: The garbage can must be changed every time the can gets full.

7.5 Stopping the engine

- Leave the hose at a proper place after ensuring that unnecessary materials won't go into the hose.
- Turn off the engine by turning the knob which is present at its side.

NOTE: Careful with the engine, exhaust chute will be very hot and never disturb the throttle valve which changes the RPM of engine.

7.6 Emergency stop

Learn to recognize the change in sounds when

- Overloaded
- Some foreign objects get struck at the filter mesh under the lid
- If it reaches the impeller and struck with the blades

NOTE: Stop the engine immediately by turning the knob on the engine to prevent serious damage to the machine.

7.7 Disposing the garbage collected

After turning off the engine,

- Remove the ratchet clamps.
- Dispose the garbage from the bin.
- Replace with the new bin.
- Align the brackets in the new bin with the lid.
- Attach the ratchet clamps and tighten it. (NEVER over-tighten it)

7.8 Operating safety

- Understand all the instructions and safety measures clearly.
- If a safety shield or cover is removed for any reason, it must be replaced before the machine is again operated.
- Before operating the machine, check over all pins, bolts, hose clamps, ratchet clamps and other connections to be sure all are securely in place. Replace any damaged or worn parts immediately.
- Keep all hydraulic lines, fittings free of leaks before using.
- When the use of hand tools is required to perform any part of assembly, installation, adjustment, maintaining, repairing, removal or moving, be sure the tools used are designed and recommended by the tool manufacturer for that specific task.
- Do not allow long hair, loose fitting clothing, or jewelry to be around moving parts.
- Always use two people to handle heavy, unwieldy components during assembly, installation, removal or moving.
- Place all controls in neutral, stop the engine, set park brake, remove the ignition key and wait for all moving parts to stop before servicing, adjusting, repairing or unplugging.
- Never put your hands inside the vacuum hose while the engine is running. Always stop the engine before cleaning the vacuum hose.
- Do not reach into blower openings when the engine is running.
- Clear the work area of objects which might be picked up and snagged or entangled in the impeller.
- Watch out for low branches, overhangs and wires that may catch on top of the collector while the vehicle is moving.
- Even though rubber bushes are present at the bottom of the impeller to avoid movement due to vibrations, there are chances for it to tip in case if vehicle moves over bumps. Slow down on turns and watch out for bumps
- Empty the bin after each use. Do not store any garbage collected in the bin.
- Do not allow anyone who is not familiar with the safety rules and operation instructions to use this machine.

7.9 Transport safety

- Abide by the state and local laws governing safety and movement of machinery on public roads.
- Plan the route and time to avoid heavy traffic.
- Turn into corners or go up or down hills only at low speed and at a gradual steering angle. Make certain that at least 20% of the tractor's weight is on the front wheels to maintain safe steerage. Slow down on rough or uneven surfaces.

7.10 Storage safety

- Store the machine in a covered place to avoid hot sun and rain.
- Do not store the garbage to the maximum height of the bin, else it will reach the impeller blades. Better to replace the bin after 3/4th of bin is occupied with trash.

7.11 Maintenance safety

- Make sure there is plenty of ventilation. Never operate the machine in a closed building. The exhaust fumes may cause asphyxiation.
- Always use protection devices such as eye, hand and hearing protectors, when performing any service or maintenance work.
- For the impeller and engine, replacement parts are necessary for periodic maintenance and servicing, genuine factory replacement parts must be used.
- Fire extinguisher and First aid kit should be readily accessible while performing maintenance.
- Periodically tighten all bolts, nuts and screws and check that all pins are properly installed to ensure machine working in a safe condition.

7.12 Tools Required for Maintenance and Repair

- Adjustable Wrench
- Flat head screwdrivers
- Double end spanner set

8. Maintenance and Storage

8.1 Regular Maintenance Checklist:

Procedure	Before Each Use	After Each Use	Periodic Check *(Interval as specified for each procedure)*
Check engine oil level	✓		
Check general equipment condition (like tight bolts, nuts, welds, etc.)	✓		
Check Hose for wear, holes, or abraded areas	✓		
Clean Engine Exterior & Cooling Fins	✓		
Empty the Collector		✓	
Clean Engine Air Filters			✓
Change Engine Oil			✓
Check Exterior of Impeller Housing for Wear	✓		
Replace Spark Plug			✓
Replace Engine Air Filters			✓

8.2 Lubrication:

The product was lubricated at the factory. The operator needs to provide engine lubrication and lubricate the necessary moving parts with grease periodically.

8.3 Removing and Replacing the engine oil:

- Check the oil and oil filter that is recommended by the engine manufacturer.
- Run your engine for about 5 minutes.
- Drain the old engine oil.
- Remove the oil filter and clean the filter compartment.
- Place the new oil filter.
- Add new engine oil.
- Start the engine and let it run for a few minutes.
- Check the engine oil level.

9.Troubleshooting

Problem	Possible Cause	Recommended Action
Bearing noise varying from a 'dry' rumble to a squeal	Improper greasing.	Check the bearings are packed with the correct grade and amount of grease.
	The bearings may be loose on the shaft or bearing support.	Tighten the bearing adaptor sleeve
	The bearings have not been properly tensioned	Re-tension as required
Rough lumpy sound	The bearings may have brinelled. Brinelling occurs when the fan is vibrated during transit or through ground vibration when stored. This causes the bearing to vibrate at a single point and therefore indenting the bearing race.	Replace the bearings.
Shaft seal squeal	The seals may have dried out.	The seals may require lubrication or may be misaligned.
Vibration	The impeller may be out of balance.	remove the impeller and balance.
	The shaft may be bent.	Replace shaft
	Impeller may be worn as a result of handling abrasive or corrosive materials	The impeller will have to be replaced.
	Material such as dust or grease could be sticking to the fan blades.	Clean the impeller blades
	The impeller blades may have been damaged	Depending on the level of damage the impeller may have to be replaced
	Vibration absorbing rubber padding may have worn out.	Replace rubber padding
Impeller excessively noisy	Impeller may be loose on the drive shaft.	Tighten the fixings.
	Impeller incorrectly mounted onto the shaft	Re-install the impeller onto the shaft

	Impeller not centred in the casing	Adjust to the correct position
	Bent drive shaft	Replace the shaft
	Shaft loose in bearings.	Tighten the bearing rings.
	Bearing loose on its support	Tighten the fixing bolts.
Damaged Impeller	Impeller bulging. The impeller is running above its recommended speed.	Replace the impeller but also check the engine speed.
Problems with Belt-drive	The belts are loose	Adjust the belts to the correct tension
	Belts are wearing out too quickly and/or the belts are too tight.	Adjust the belts to the correct tension. Also check the belts are a matched set, if they are not, replace the complete set.
	The belt may be the wrong cross-section for the pulley.	Check and replace the belts as necessary.
	The pulleys may be incorrectly aligned	Check the pulleys and realign as necessary.
Drop in suction/flowrate	clogging of air flow path	Check for clogs in the tubing and near the entry and exit from the bin
		Check for tears or leaks in the tubing
		Make sure all the clamps (hose clamps and ratchet clamps) are secured properly
Engine Related	Engine not starting	Check if the knob is in ON position.
		Check the petrol level.
		Apply the choke. (once engine is started, revert it to default position)
		Check the oil level (seizure)
		Check the exhaust air filter

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