



INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai 400076.

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TECHNICAL SPECIFICATIONS FOR “BACKPACK ROVER VERSION 2”

Following are the technical specifications for a Backpack Remotely Operated Vehicle (hereafter referred to as BPRover2) which must be fabricated and supplied to IIT Bombay. The overall design philosophy must be based on robustness (ability to work in dirty environment like mud, dirt and rocky terrain with minimum maintenance).

1. Wheels

1.1 The BPRover2 needs to run on wheels of sufficient resilience and toughness which will allow it to be used in off-road environment. These wheels must be designed (or selected) such that they offer sufficient traction both on hard ground and on soft ground (e.g. mud) and on ramps.

1.2 Six wheels must be attached to the chassis of the BPRover2 in a rocker bogie configuration. The approximate design of such a configuration has been shown in Figure 1. The final design must be finalized after consulting with IIT Bombay.

1.3 It must be possible by the user to replace the wheels with reasonable ease after they have worn off.

1.4 It must be possible to move the left and right wheels in opposite directions simultaneously in order to achieve almost zero turning radius rotating capability about the centre of BPRover2's body.

2. Speed

A speed of at least 1.5 km/hour must be achieved by the BPRover2 on level ground.

3. Dimensions

Approximate dimensions of the bounding box of the BPRover2 with the arm in a folded (most compact) configuration may be 1000 mm X 500 mm X 500 mm. These are approximate dimensions (Figure 1). The exact dimension must be decided upon by discussing the design with IIT Bombay. A BPRover2 with a smaller bounding box will be appreciated.

4. Arm and gripper

An approximate design of the arm with the gripper has been given in Figure 1. The detailed design of the arm and the gripper will be shared with the fabricator after the order has been placed. The final design of arm and the gripper must be decided upon by discussing the design with IIT Bombay.

5. Object Retrieval Capability

The arm and gripper must be designed to lift an object of weight 2 kg.

6. Weight

The total weight of the BPRover2 with the arm, gripper and body mounted cameras (mentioned in section 1.9) must not exceed 20 kg. This is a strict limit. A BPRover2 with lower weight will be appreciated.

7. Ramp Negotiation

The BPRover2 must be able to climb up and down a 30 degree ramp with and without a 2 kg object held by the gripper.

8. Step Negotiation

8.1 The BPRover2 must be able to climb over an obstacle of 150 mm height with and without a 2 Kg object which is being retrieved.

8.2 Optional but preferable: Ability to negotiate an obstacle of 200 mm height.

9. Body Mounted Cameras

9.1 One camera must be mounted on the body of the BPRover2 looking towards the front. This must be a camera with auto focus, image stabilization and low light capability. The field of view of this camera must include the gripper in its act of picking up an object from the ground and lifting it. The entire gripper must be in the field of view of this camera.

9.2 If the view of the path in front of the BPRover2 is blocked by an object being picked up by the arm and gripper, then an additional front facing camera will need to be mounted on the body of BPRover2 in such a position that the path in front of the BPRover2 is visible in this second camera.

9.3 One camera must be mounted on the body of the BPRover2 looking towards the back. This must be with auto focus, image stabilization and low light capability. The field of view of this camera must include the back edge of the body of BPRover2.

9.4 A front facing thermal imaging camera must be mounted on the rover. This camera will be supplied by IIT Bombay to the fabricator.

9.5 The body mounted cameras mentioned in 9.1, 9.2 and 9.3 must be made shock proof (perhaps with additional shock absorption attachments) so as to withstand off-road running conditions.

9.6 The video feed from these four cameras must be available at the base station (section 11.2). Provision to record these video feeds must be available at the base station.

9.7. The video feedback system must be interchangeable with the video feedback system currently installed in the 70 kg and 140 kg rovers in IIT Bombay.

10. Actuator Capability

10.1 All the actuators for BPRover2 ground motion (travel), arm and gripper must have the capability and controls for inching (start-stop), forward and reverse motion.

10.2 All these actuators must conform to IP54 rating.

11. Remote Control

11.1 Wireless control over all the actuators must be possible from a distance of 500 m outside line of sight behind multiple concrete walls and foliage. There must be no delay in signal when the vehicle is moving.

11.2 The remote control must be achievable from a base station which is as compact and ergonomic as possible.

11.3 The software for controlling the actuators must be intuitive. It is preferable to have separate buttons or joysticks for separate actuators as much as possible. This is because control of different actuators with the same motion of the same button or joystick increases the time to shift from one actuator control to another. Separate buttons or joysticks also allow multiple actuators to be controlled simultaneously. However, use of intuitive software for simultaneous control of multiple actuators can be explored after discussing the design with IIT Bombay. Small inching motion must be possible with both arm motors and vehicle motors. Control with joystick may help in achieving small inching motion of all the motors.

11.4 The base station must be capable of displaying live feed from the body mounted front and rear facing cameras simultaneously. Provision for data storage of these video feed must be provided as mentioned in section 9.6.

12. Battery

12.1 All the actuators must draw power from a rechargeable on-board battery.

12.2 The battery must be capable of lasting for 3 hours of continuous operation of the BPRover2. This is likely to include 1.5 hour of ground motion (forward, backward and turning) and 1.5 hour of movement of multiple actuators of the arm and gripper.

12.3 Re-charging of the battery must be possible without detaching any component (including battery or cover of battery compartment) from the BPRover2. It is preferable to have the battery charging port at a position where it will be easily accessible but does not get soiled during off road running (e.g. through mud).

12.4 It must be possible to assess the remaining charge of the battery through an indicator which is a part of the BPRover2.

13. Temperature Range

The BPRover2 must be capable of working at temperatures ranging from minus 5 degrees Celsius to plus 50 degrees Celsius for extended periods.

14. Local Sourcing of Components

An attempt must be made to source the components locally. Imported components must be avoided as much as possible, without compromising quality and robustness.

15. Prior experience in fabricating rovers

The fabricator must have prior experience in fabricating rovers (with arms for object manipulation) of different weight categories.

16. Prior experience in fabricating rovers with interchangeable components

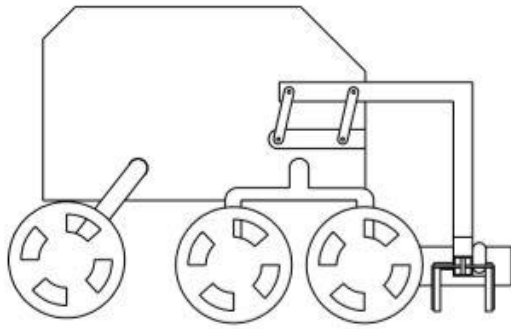
The fabricator must have prior experience in fabricating rovers of different weight categories in which critical components were interchangeable. Some such critical components include arm, gripper and video feedback systems.

The final design of BPRover2 must be shared with IIT Bombay and the approval of IIT Bombay must be taken before fabrication.

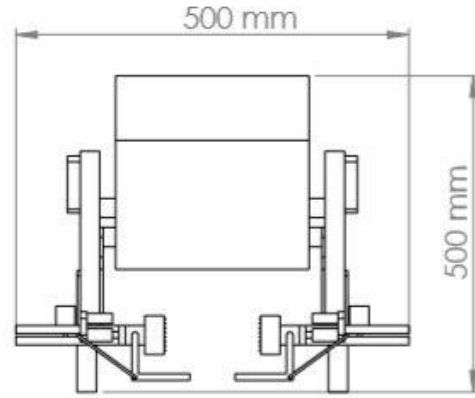
An operating manual must be provided with detailed instructions for use. Complete drawing of all the components must be provided.

Delivery Period : Within 365 Days from the date of purchase order

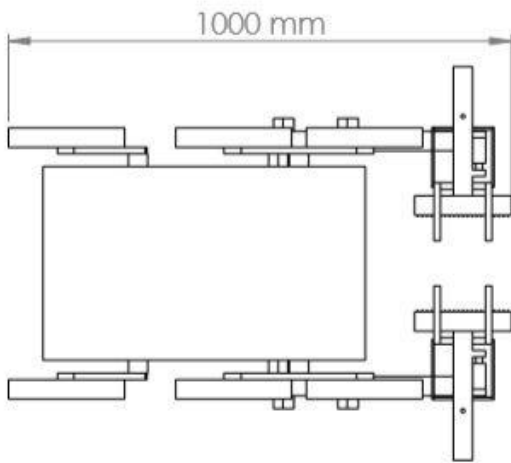
Warranty : One year from the date of successful installation/commissioning of equipment.



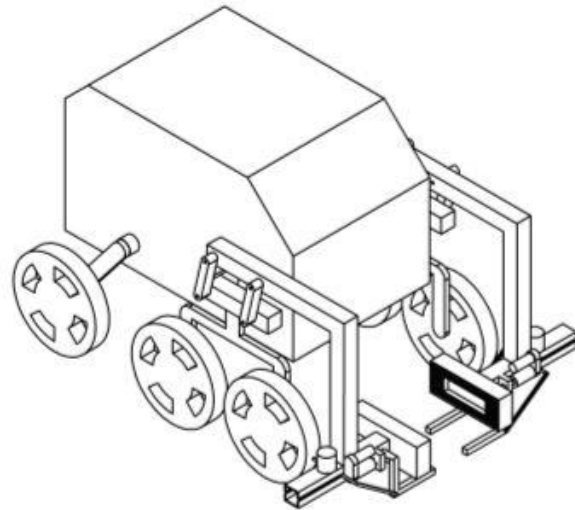
Front view



Left hand side view



Top view



Isometric view

Figure 1: Draft drawings of BPRover2