



uOttawa

GNG 2101

**Design Project User and Product Manual**

**Roll n' Row User Manual**

Submitted by:

RollNRow A2.5

Qingyun Yang, 300220139

Alec Bazinet, 300261019

Luis Monroy 300243770

Joshua Rose, 300294730

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University of Ottawa

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## List of Acronyms and Glossary

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**Table 1. Acronyms**

<b>Acronym</b>	<b>Definition</b>
ARM	Adaptive rowing machine for people with disabilities,
C2R	Concept2 Rower, it is a brand that the client uses.
ERG	An ergometer is a tool designed to measure the work accomplished.
RMAE	Rowing Machine Adaptability Equipment
ADJ	Adjustable

**Table 2. Glossary**

<b>Term</b>	<b>Acronym</b>	<b>Definition</b>
Adaptability	ARM	The capability of rowing machine to be adjusted or customized to meet individual user preferences and needs.
Modular Design	MD	A design that allows users to add, remove, or rearrange components.

# 1 Introduction

Welcome to the Roll n' Row User and Product Manual. This document is your comprehensive guide for the Roll n' Row system, providing information on setup, usage, troubleshooting, and maintenance. Designed for wheelchair users, Roll n' Row offers a versatile solution for upper body workouts.

In this manual, our goal is to empower users with the knowledge and skills required to effectively utilize the Roll n' Row system. Clear instructions and insights are provided to ensure a seamless user experience from initial setup to ongoing maintenance.

The document is structured to cater to various user needs, covering an overview of the product, detailed setup instructions, guidance on system usage, troubleshooting tips, product documentation, and concluding with key learnings and future recommendations.

Roll n' Row addresses the limitations of existing gym equipment for wheelchair users by providing a unique solution that focuses on both strength training and cardio workouts. The manual is designed for a diverse audience, including wheelchair users, caregivers or assistants, maintenance personnel, and support teams.

Users are encouraged to follow safety cautions and warnings outlined in the manual. For immediate safety concerns or emergency assistance, contact information is provided. Privacy considerations are minimal, as the manual does not involve personal data.

Thank you for choosing Roll n' Row – your partner in accessible and effective upper body exercise!

## 2 Overview

This product offers upper body exercise opportunities. Typically, wheelchair-accessible exercise equipment found in gyms tends to emphasize strength training while overlooking cardio workouts and a wider range of motion. This is where Roll n' Row comes into play. Our product surpasses many of our competitors due to three critical advantages: user-friendly design, compatibility with a variety of wheelchairs, and a compact form factor.



Figure 1 : Roll n' Row



Figure 2 : Roll n' Row in action

## **2.1 Cautions & Warnings**

Please ensure that the pin is fully inserted through the height adjustment mechanism before using the rowing machine.

Do not bend the main arm away from the wooden base.

## **3 Getting started**

The rower assist equipment should arrive with all parts pre-assembled. The main components consist of three parts: a pin, an upper arm with knee support and handle holder, and a base with the main arm.

To assemble it, please follow these steps:

1. Place the base on the floor.
2. Insert the joint from the rowing machine into the joint holder (the red part).
3. Insert the upper arm into the main arm, ensuring that the height adjustment hole is aligned.
4. Insert the pin all the way through to lock the height position and secure the joint.

### **3.1 Configuration Considerations**

No additional tools are required for assembly. The product is designed for easy assembly without the need for specialized equipment.

### **3.2 User Access Considerations**

This product is designed to be used by both motorized and non-motorized wheelchair users. The three height options are designed to work with most common wheelchairs, however; users in a specialty or uncommon chair may not have their knees lined up perfectly with the pads. In this case, the product still can be used safely.



### 3.3 Accessing/setting up the System

1. Remove the pin and line up the attachment bar of the rower with the red receiving slot

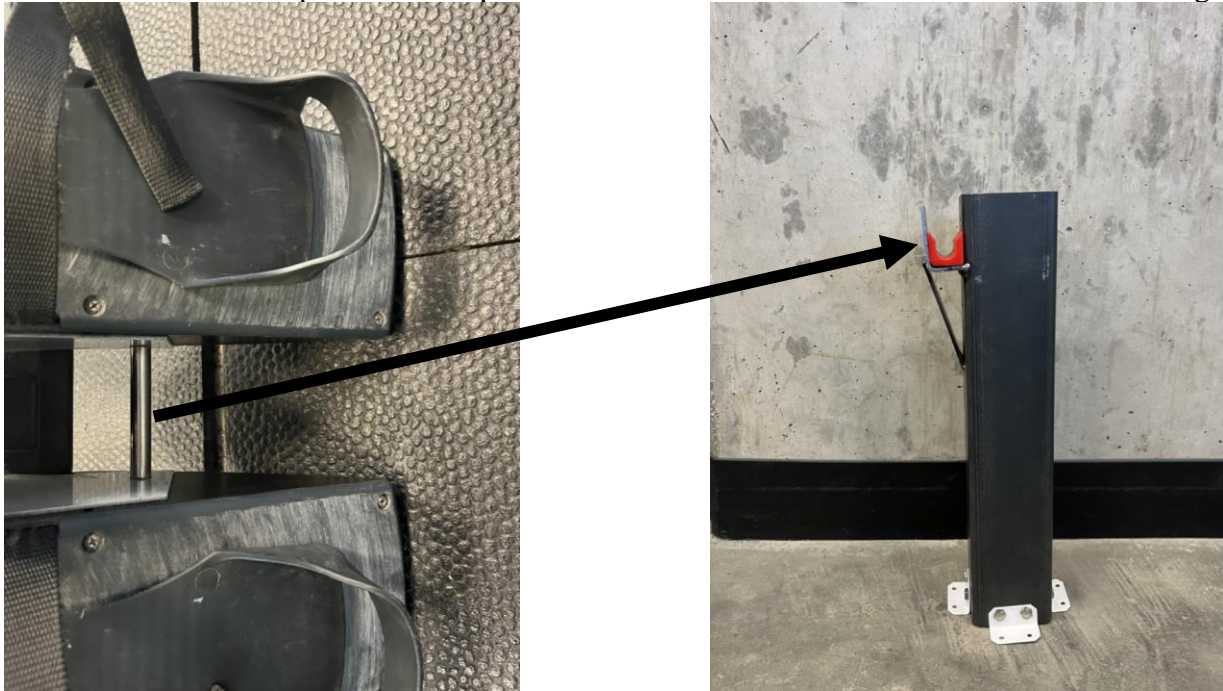


Figure 3 : Attachment bar connection

2. Push the bar into the slot with some force to ensure it is all the way in
3. Raise the inner section to the desired height and secure it with the pin. Ensure the pin goes all the way through.

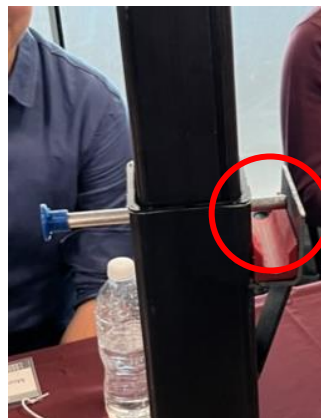


Figure 4 : Pin insertion

4. Pull the rower handles forward and place it in the hooks.



Figure 5 : Handle hook

### 3.4 System Organization & Navigation

Our product is made from two main parts. An inner telescopic portion which attaches to the wooden base and has the mounting point for the rower, and an outer telescopic portion which has the knee rest.



Figure 6 : Outer telescopic portion with the attachment point



Figure 7 : Inner telescopic portion which goes inside the outer portion. The three holes are for the three different heights and are secured with the pin.

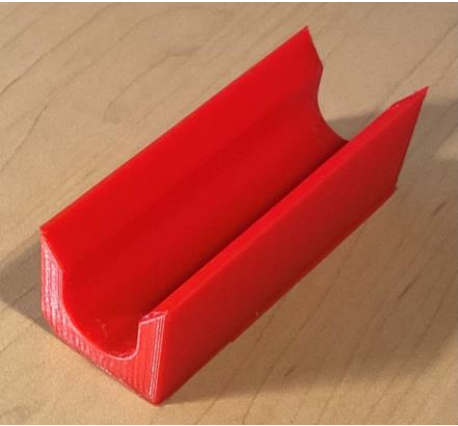


Figure 8 : Receiving slot for the rowing machine which sits in the outer telescopic portion.

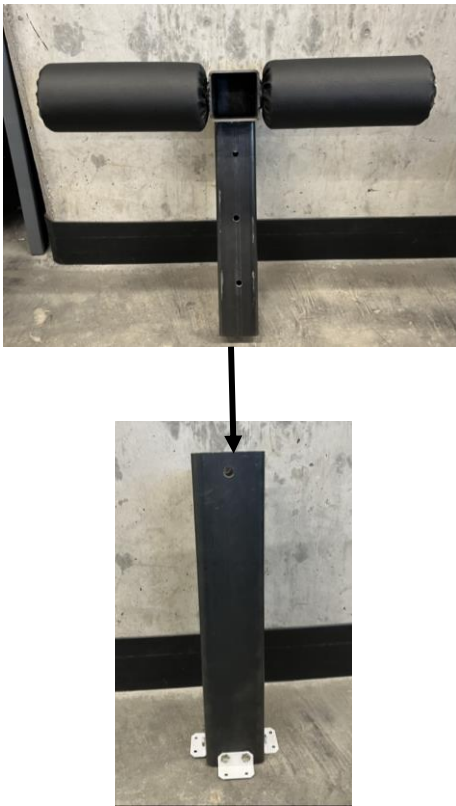


Figure 9 : Inner and outer telescoping parts

### **3.5 Exiting the System**

To exit the system, simply remove the rower handles from the hooks, fully remove the pin and lift the rower up and out.

## **4 Using the System**

In this section, we'll explore how to effectively utilize the Roll n' Row system. The following subsections provide detailed instructions for key features.

## 4.1 Height Adjustment

- The height of the upper arm can be adjusted to accommodate different user preferences and wheelchair sizes.
- Locate the height adjustment hole on the upper arm.
- Insert the pin through the desired height hole and ensure it is locked securely.



Figure 10 : Different height adjustments

## 4.2 Rowing Exercise

- Sit in your wheelchair and position it appropriately.
- Grasp the handle with both hands.
- Perform rowing motions by pushing and pulling the handle towards and away from you.



Figure 11 : Rowing exercise.

## **5 Troubleshooting & Support**

If the pin becomes stuck, attempt to remove the blue stabilizer piece around the connection point of the upper arm and base. Then, insert it back in and try again.

If anything breaks or if the equipment is not functioning correctly, please contact MakerLab via email. We will respond to your inquiry as soon as possible.

### **5.1 Error Messages or Behaviors**

#### **Misalignment of the Upper Arm**

Error/Behavior:

- The upper arm is not aligned properly with the main arm.

Cause:

- Misalignment during assembly or adjustment.

Corrective Action:

- Reassemble the upper arm, ensuring proper alignment.
- Check the height adjustment and reinsert the pin if necessary.

#### **Unstable Base**

Error/Behavior:

- The base feels wobbly during use.

Cause:

- Improper placement or uneven flooring.

Corrective Action:

- Reposition the base on a flat and stable surface.
- Ensure all joints and connections are securely locked.

#### **Excessive Noise**

Error/Behavior:

- Unusual or excessive noise during rowing.

Cause:

- Loose components or friction between parts.

Corrective Action:

- Check all connections and joints for tightness.

Lubricate moving parts if necessary.

- If noise persists, inspect for wear and contact customer support.

## 5.2 Maintenance

### Check Joints and Connections

Frequency: Every two weeks.

Procedure:

- Inspect all joints and connections for tightness and proper alignment.
- Tighten any loose bolts or screws.
- Ensure that the base is securely placed on a stable surface.

### Inspect Height Adjustment Mechanism

Frequency: Monthly.

Procedure:

- Check the height adjustment mechanism for smooth operation.
- Ensure that the pin locks securely into the chosen height position.

### Clean the Product

Frequency: Every three months.

Procedure:

- Wipe down the entire product with a clean, damp cloth.
- Remove any dust or debris from joints and moving parts.
- Allow the product to dry thoroughly.

### Check for Unusual Noises

Frequency: As needed.

Procedure:

- If users notice any unusual noises during operation, inspect the product for loose components or friction.
- Address and resolve any issues promptly.

## 5.3 Support

**Note: All contact information is fictitious and shouldn't be contacted.**

### Emergency Assistance:

In the case of a security incident or immediate safety concern, contact the Emergency Response Team immediately.

Emergency Contact:

Name: Emergency Response Team

Phone: 1-800-123-4567

Email: [emergency@rollnrow.com](mailto:emergency@rollnrow.com)

## **System Support:**

For general issues, contact the Support Team via email or phone with a detailed description of the problem.

### Help Desk Support:

Name: Support Team

Email: [support@rollnrow.com](mailto:support@rollnrow.com)

Phone: 1-888-765-4321

For production-related issues, contact the Production Support Team via email or phone.

### Production Support:

Name: Production Support Team

Email: [production-support@rollnrow.com](mailto:production-support@rollnrow.com)

Phone: 1-877-987-6543

## **Reporting Security Incidents:**

If you suspect a security incident, immediately contact the Emergency Response Team at [emergency@rollnrow.com](mailto:emergency@rollnrow.com) or 1-800-123-4567.

Provide detailed information about the incident, including date, time, and a description of the event.

### Security Incident Handling:

#### Initial Reporting:

- Report any security incidents to the Emergency Response Team immediately.
- Provide as much detail as possible about the incident.

#### Response Time:

- The Emergency Response Team will acknowledge receipt of the report within 24 hours.

#### Investigation:

- The team will conduct a thorough investigation into the security incident.

#### Resolution and Communication:

- Once the incident is resolved, affected users will be notified, and preventive measures may be implemented.



Follow-Up:

- The team will conduct a follow-up to ensure that the issue is fully resolved and to implement any necessary improvements to prevent future incidents.

## **6 Product Documentation**

The development of the Roll n' Row prototype was driven by a commitment to durability, stability, and user comfort. This section delves into the materials and considerations that shaped the design, providing insight into our meticulous manufacturing process.

### **6.1 Materials and Considerations**

The design of the Roll n' Row prototype prioritized durability, stability, and user comfort. Most of the products are constructed from steel to meet industry standards and maintain cost-effectiveness. After considering various materials, including stainless steel, aluminum, plastic, and wood, we opted for stainless steel due to its exceptional strength, corrosion resistance, and stability.

The final design incorporates a combination of square and round tubes for structural integrity and an L-shaped configuration for enhanced stability. The base plate, however, is crafted from wood to minimize weight while ensuring stability. This strategic choice contributes to the overall user-friendly design of the Roll n' Row system.

### **6.2 Manufacturing Process**

The manufacturing process involved precision cutting, welding, and 3D printing. All joints are welded to guarantee strength and durability. 3D printed pieces serve as endcaps and the attachment slot for the rower, providing both functionality and ease of assembly. The professionally sourced padding used for the knee rests ensures user comfort and adherence to industry standards.

### **6.3 Subsystem 1 - Base**

The wooden base plate serves as the foundation for the Roll n' Row system, providing a flat and stable surface for users. Crafted from wood to minimize weight, the base plate is strategically attached to the outer telescoping part using brackets, screws, and bolts. This design choice adds to the overall user-friendly nature of the Roll n' Row system, making it easy to assemble and disassemble.



Figure 12 : Base Subsystem

### 6.3.1 Equipment list

#### Materials

- 1- 3" x 3" x 0.125" Square Steel Tube
- 1- 3/4' ply wood
- 4 - 3/4' x 1- 3/4' Braces
- 8 – 7 x 1/2' screws
- 8 – Bolts and nuts
- Plastic filament

#### Tools/Equipment

- Metal cutting bandsaw
- MIG Welding machine
- Mill
- Wrenches
- Screwdriver
- 3D printer

### 6.3.2 Assembly Instructions

1. Drill holes on the 3-inch square tube according to the provided measurements.
2. Cut a small L-shaped steel piece from the second 3-inch square tube.

3. Weld the steel piece to the back of the first square tube.
4. Use 3D printing to create the designed joint holder piece.
5. Insert the holder piece into the location of the steel piece.
6. Drill two holes on each side on the bottom of the main tube.
7. Securely attach the brace to the bottom of the tube using these 8 holes and screws.
8. Securely screw the braces into the wood to ensure a stable connection of the base.

## 6.4 Subsystem 2 – Upper Arm

The upper arm subsystem of the Roll n' Row prototype is a crucial element responsible for providing a comfortable experience for users. This subsystem is predominantly made of steel, with the exception of the foam knee rests. The steel portion is composed of square and circular tubes, strategically designed to optimize strength, stability, and user comfort.



Figure 13 : Upper Arm Subsystem

### 6.4.1 Equipment list

#### Materials

- 1 - 2.5" x 2.5" x 0.125" Square Steel Tube
- 1 – 1.05" OD x 0.850" ID x 0.100" Wall
- 2 – Foam Knee Restes

#### Tools/Equipment

- Metal cutting bandsaw
- MIG Welding Machine
- Mill

### 6.4.2 Instructions

1. Cut a 2.5-inch square tube with a 45-degree angle cut on one end of the 3/4-inch square tube.
2. Take the longer part of the cut tube and drill three holes as per the provided measurements.
3. Weld these two sub-tubes together at the 45-degree cut, forming an 'L' shape.
4. Cut the round tube to the specified measurements.
5. Weld the round tube on two sides of the front edge of the 'L' shaped semi-finished product.
6. Insert the two foot pads onto the round tube.

## 6.5 Subsystem 3 – Pin

The third subsystem of the Roll n' Row prototype is a simple yet crucial element that contributes to the user-friendly design and functionality of the system. This subsystem consists of an aluminum pin with a 3D printed handle, serving as a versatile and secure height adjustment mechanism.



Figure 14 : Pin Subsystem

### 6.5.1 Equipment list

#### Materials

- 1- Aluminium rod
- Plastic filament

#### Tools/Equipment

- Metal cutting bandsaw
- Lathe
- 3D Printer

### 6.5.2 Assembly Instructions

1. Cut a 1/4-inch metal stick to the desired length.
2. Use a lathe to round the tip of the metal stick.
3. 3D print a handle for the pin.
4. Attach the rounded end of the metal stick to the handle.

## 6.6 Testing & Validation

Throughout the design and construction phases of the Roll n' Row prototype, rigorous testing was conducted to validate and optimize key performance metrics. The team focused on assessing the Height Range, Setup/Takedown Time, Weight, Base Size, and Comfort to ensure the product's effectiveness and user satisfaction. Height range testing involved validating the adjustability of the upper arm to accommodate diverse user preferences and wheelchair sizes. Setup and takedown time were meticulously measured to guarantee a swift and efficient assembly process. Weight considerations were assessed to meet industry standards for portability and user convenience. Base size testing ensured the stability and footprint of the system, while comfort evaluations aimed at enhancing the user experience during workouts. These comprehensive tests and assessments were integral to refining the Roll n' Row prototype, aligning it with high-quality standards and user expectations.

**Table 3 : Target vs Final Specs**

Metric	Unit	Target Specs	Final Specs
Height range	Min - Max inch	16-28"	20-28"
Setup/takedown time	Seconds	<= 45 (With assistance)	<= 45 (With assistance)
Weight	kg	15-20	8
Base Size	in <sup>2</sup>	> 5 X 5	12' X 12'
Comfort	N/A	Yes	Yes
Total cost	\$	<=100	167

## 6.7 BOM (Bill of Materials)

Table 4 : BOM (Bill of Materials)

Description	Source	Quantity	Unit Price	Amount	Taxe
HOT ROLLED 44W SQUARE TUBE 2.500" x 2.500" x 0.125"	Metal Pros	2ft	9,88	\$19,76	\$2,54
HOT ROLLED 44W ROUND TUBE 1.050" OD x 0.850"ID x 0.100" WALL	Metal Pros	1.67 ft	3,85	\$6,43	\$5,22
HOT ROLLED 44W SQUARE TUBE 3.000" x 3.000" x 0.125"	Metal Pros	1.35 ft	12,38	\$16,53	
3/4-inch x 2 ft. x 4 ft. Spruce Handy Panel	Home Depot	1	31,47	\$31,47	\$5,20
3/4 Inch X1-3/4 Inch White Furniture Brace (4-Pack)	Home Depot	1	3,68	\$3,68	
7 x 1/2-inch Pan Head Square Drive Steel Shelf Bracket Screw, White, 18pcs	Home Depot	1	4,88	\$4,88	
Foam Foot Pads Rollers Set of a Pair (8"x4"x20mm)	Amazon	1	45,63	\$45,63	\$5,25
Cutting Fees	Metal Pros	4	3	\$12,00	N/A
Dilivery Fees	Metal Pros	1	8	\$8,00	N/A
Total BOM				\$166,59	

## 7 Conclusions and Recommendations for Future Work

In conclusion, the project has underscored the critical importance of foundational steps, particularly in understanding the business model and conducting problem analysis. This initial phase proved key in identifying root issues, enabling a targeted approach for effective solutions. Another vital lesson centered on benchmarking and market research, where insights into existing products, potential competitors, and industry standards were learned through meticulous benchmarking and specification analysis.

The project's ultimate takeaway lies in the significance of prototype testing and iteration. Prototypes not only provided accurate measurements for assessment and testing but also served to affirm initial design choices and uncover potential flaws.

Given additional time for project development, two crucial enhancements would have been pursued. First, the addition of hinges to the base, allowing clients to adjust them for a straight vertical position. This feature facilitates wall hanging, optimizing storage space. The second improvement involves refining the hooks on the handle for increased safety by reducing their size and minimizing sharp edges. These adjustments, although constrained by time, are recognized as essential for an even more refined and user-friendly final product.

## 8 Bibliography

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Adapt2Row: rowing on a Concept2 rowing machine from your wheelchair. GeroFitness. <https://gerofitness.nl/export/406-adapt2row.html>.

## APPENDICES

### 9 APPENDIX I: Design Files

This document is formulated based on the information contained in specific files available in our Makerrepo repository. For a more in-depth exploration of various stages of the project, we invite you to access the files through the provided link. The referenced documents within the repository, all titled "Project Deliverable," the project deliverables that were referenced when making of this user manual span from letter A to G. Deliverable A focuses on our team's approach to meeting preparation and project management. Deliverable B pertains to our business model, while Deliverable C encompasses problem definition and concept development. Deliverable D provides a detailed design and bill of materials. Project E delves into the specifics of Prototype 1, while Deliverable F covers design constraints and Prototype 2. Lastly, Deliverable G addresses additional considerations such as budgetary aspects and future revenue projections for the product. Accessing these files will provide a comprehensive understanding of the project.

[GNG2101-G2.5-RowPower | MakerRepo \(makerepo.com\)](https://www.makerepo.com/GNG2101-G2.5-RowPower)

**Table 5. Referenced Documents**

<b>Document Name</b>	<b>Document Location and/or URL</b>	<b>Issuance Date</b>
Project Deliverable A	Its location is in the link provided	10, 2023
Project Deliverable B	Its location is in the link provided	Dec 10, 2023
Project Deliverable C	Its location is in the link provided	Dec 10, 2023
Project Deliverable D	Its location is in the link provided	Dec 10, 2023
Project Deliverable E	Its location is in the link provided	Dec 10, 2023
Project Deliverable F	Its location is in the link provided	Dec 10, 2023
Project Deliverable G	Its location is in the link provided	Dec 10, 2023