Operator’s Manual

The L.A.D.

Team 16: Joshua Aferzon, Michael Chen, Matthew Desch

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Client: Ronald Hiller, Ashford CT 06278
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Safety Instructions

• Always cover the L.A.D. with a tarp or canvas before and after use to prevent environmental damage
• Always store the L.A.D. in an upright position with the hydraulic pump at its lowest setting
• Do not tamper with any components or internal mechanisms on the L.A.D.
• Do not place a load exceeding 350lbs. on the L.A.D.
• Always strap in the seatbelts during use
• Always activate either 4 or all 5 brakes on the L.A.D. before use
• Move the L.A.D. slowly to prevent accidental tipping
• Do not shift weight excessively to prevent accidental tipping
• Do not use in slippery conditions
• Extend the bridge carefully to prevent damage to either the internal seat mechanism or the bridge attachment
• Do not lift the L.A.D. off of the ground for any reason
Parts and Accessories

- Medical Grade Wheels

- Base
• Base/Hydraulic Pump Attachment

• Hydraulic Pump
• Hydraulic Pump/Seat Attachment

• Seat
  o Lower Plate
- Upper Plate

- Final Seat
• Safety Rails

• Bridge
• Lawnmower Attachment

• Seatbelts
  o L.A.D. Seatbelt
- Lawnmower Seatbelt

- Removable safety pin

- Overall Device
Features

- Reliable medical grade wheels for mobility with quick-lock braking system
- Powerful hydraulic pump for lifting and lowering client
- Comfortable cushioning on seat and back support
- Durable outdoor fabric upholstery
- Two sets of seatbelts for safety
- Extendable bridge from L.A.D. to lawnmower
- Permanent lawnmower attachment built into casing
- Easy-to-use hydraulic pump handle
- Tough and durable carbon steel framed seat with full 360° rotation capabilities
1 INTRODUCTION

1.1 Device Overview
By examining the L.A.D. from a top-down perspective, one can see how simple in design the device really is. Beginning anteriorly, the device’s safety bars are welded to the seat base for back support. These bars were framed with thin planks of wood, and cushioned throughout. Below the cushioned and upholstered safety bars lie the seatbelt, which the user can fasten while being displaced by the hydraulic pump. The seatbelt sits on the L.A.D. seat, which has been cushioned with not one, but two layers of egg-crate bed foaming. Like the safety bars, the seat is covered with the same fabric. A figure of both the upholstered and cushioned safety bars and seat can be viewed below.

Figure 1. Upholstered/Cushioned Safety Bars Seat  Figure 2. Upholstered/Cushioned Seat
Under all the cushioning and fabric exists another wooden frame which was attached to the metal skeleton via Velcro. This frame’s purpose was to provide a material to staple the fabric into after cushioning was laid in position. Inside the seat complex is where the connection bridge is housed. This bridge has metal tracks welded to its bottom, which coincide with acrylic wheels that roll on the lower seat plate, which represent the bridge sliding mechanism. In addition, wooden “stoppers” (not shown below) were adhered to the lower seat plate to keep the wheels in place.

Moving posteriorly, one can observe the seat/pump connector, which was fashioned in the machine shop to connect the seat plate to the pump. Inside this piece sits a shoulder bolt, which allows the entire seat to swivel without loosening itself. The hydraulic pump itself consists of a plastic housing, which protects a stainless steel piston which performs the mechanical lifting. Attached to the pump is a metal lever with a rubber grip, which can be pushed down by foot very easily.

Another connector was manufactured in the machine shop to attach the bottom of the pump to the base. Custom screws (with bolts) fasten these two pieces together. The last two device components are the 5-star base and medical grade wheels. The base was extracted by a common office chair, while the wheels were ordered from a casting company and installed in place of the stock wheels. These wheels each have a depressible brake installed on them, which effectively lock each wheel in place if so desired.
1.2  Operation Instructions
By following the set of directions below, one can easily and safely use the L.A.D. to transfer
themselves from an electric wheelchair to a riding lawnmower, without the usage of their legs.

1.2.1  To begin operation, the user must first roll the device up to the lawnmower, making sure
that the brakes on each wheel are disengaged to allow effortless mobility. At this point, it is
essential that one of the “legs” of the 5-star base is positioned correctly behind the blades of the
lawnmower. This way, the bridge can be correctly aligned with the lawnmower attachment. The
figure below illustrates this positioning.

![Figure 5. Device Wheel Positioning](image)

1.2.2  Once the device is correctly positioned, the brakes on each wheel should be engaged by
stepping on them and locking them into place (accomplished by someone other than the user). It
is suggested, but not required, that the brakes on all five wheels are locked into place before
usage.
1.2.3 Next, the user will be able to remove the metal pin that is held inside the left lawnmower arm. Removing this pin will allow the user to swing the arm down in the forward direction so that it will not be in the way during transfer.

![Figure 6. Safety Pin Removal and Arm Positioning](image)

1.2.4 With the user’s wheelchair positioned to the left of the device, the device seat will be allowed to be lowered to the correct height of the wheelchair by simply depressing the hydraulic pump lever (by foot) until at the desired height. Then, the user will be able to slide from wheelchair to device easily.

1.2.5 Once transferred from the wheelchair to the L.A.D., the user should secure himself by fastening the seatbelt that has been installed in the device. With the user’s back flush with the safety bars, the device can be raised.

1.2.6 The same person who locked the wheels into place should also be in charge of pumping up the user in the L.A.D. by foot. The hydraulic pump vertically displaces the device seat best when the lever is pumped in short strokes. As the user begins to reach the desired height, he should slide the bridge out of the seat housing with his right hand, approximately a quarter of the way. The bridge should NEVER be pulled out entirely. Once the bridge appears to hover over
the lawnmower attachment by approximately an inch, pumping should cease. A visual of this process can be viewed below.

Figure 7. Vertical Displacement of the Device
1.2.7 Next, the device should be lowered slightly (with the user still seated) until the bridge is level and rests on the lawnmower attachment. This can be accomplished by pushing the pump lever as far as possible and holding it in position—caution should be taken as to not allow the pump to decline too much.

Figure 8. Bridge Placement
1.2.8 After both the user and whoever is assisting him have assured that the bridge is pulled out to the length of the lawnmower attachment, the seatbelt in the L.A.D. can be unfastened. At this time, the user should slide himself across the bridge using his upper body, until seated in the lawnmower chair. For increased safety, a second seatbelt has been installed in the lawnmower itself, which can be fastened here.

1.2.9 At this time, usage of the L.A.D. is complete. Once seated in the lawnmower chair, the user can take the same pin that he removed in 1.2.3 and place it back into the lawnmower arm to maintain functionality. Finally, the device can be easily rolled away from the lawnmower by following these easy steps:

- Depress the hydraulic pump lever 5 times to raise the bridge slightly above the attachment so the paint isn’t scratched upon retracting the bridge.
- Push the bridge back into the seat housing until it makes contact with the back of the device.
- Depress the hydraulic pump lever once again to return the L.A.D. seat to the shortest height possible.
- Roll device to desired location.

1.2.10 After the user has mowed his lawn, he will need to dismount the lawnmower and reenter the L.A.D. before getting into his wheelchair. To do this, steps 1.2.2—1.2.8 should be repeated in the opposite direction, beginning with the removal of the metal pin from the lawnmower arm.

1.2.11 After the L.A.D. is done being used, it should be covered with a plastic tarp (provided) and kept in a dry place (preferably a shed or garage).
2 Maintenance

A main goal of constructing this device was to keep maintenance at a minimum. In order to do so, electrical components were removed, and the overall design was kept simplistic to allow for maximum functionality with minimum complexity. Therefore any maintenance necessary is simple to carry out.

2.1 Mechanical
The mechanical maintenance portion will be separated into separate components for each component of the device.

2.1.1 Tarp cover
The tarp used for the device is made from tough material that resists ripping and is water proof. In the case that the tarp gets dirty simply spread out the tarp on a clean area such as grass and rinse off with a standard garden hose. Allow to dry naturally. Periodically wash the tarp to remove dirt or staining. Otherwise the tarp requires no maintenance at all. Keep the device covered under the tarp whenever not in use in any season.

2.1.2 Fabric
The fabric covering used for the L.A.D is also made from tough water proof material. To remove dirt and maintain a beautiful shine, periodically wipe the fabric with a dry cotton cloth and rubbing alcohol. Allow to air dry; overall prevent saturating the seat in water or leaving out in the rain.

2.1.3 Bridge
In order to maintain ease of use and smooth bridge contraction and withdrawal, periodically apply a spray-on lubricant to the sides of the bridges where the bridge meets the metal support columns on the side of the LAD. In addition clean the bridge with a wet cotton cloth once every mowing season or as necessary.

2.1.4 Pump
The hydraulic pump is a self-sustained system and requires no maintenance to continue functionality. However generally do not put excessive force on the pump handle and use as directed.

2.1.5 Base
Clean the wheeled base once every mowing season or as necessary with a wet cotton cleaning cloth.

2.1.6 Wheels
Clean wheels periodically according to section 2.2.3. In addition apply a lubricant to the wheel axel at the end of every mowing season.
2.2  Environmental

2.2.1  Paint
All paint on the LAD is waterproof. In addition both enamel and polymer coating have been applied to the paint to prevent rusting and chipping respectively. To maintain color intensity, avoid prolonged sun exposure and keep covered with tarp when not in use. The paint can be cleaned with a wet cotton cleaning cloth. Do not submerge this device for long periods of time in water. Every 2 to 3 years it is suggestible to reapply a protected spray on enamel coating to all painted areas.

2.2.2  Cloth
The cloth covering is waterproof and should also resist fading. If the chair and cushions are submerged in water for any reason first cover the seat with a dry cloth. Then allow to dry outside in the sunlight or using a blow-dryer to dry the inner cushion.

2.2.3  Wheels
To clean the fiber-glass wheels simply angle a standard garden hose to clean any mud or dirt trapped between the wheels and wheel base; use a small brush to clean any remaining dirt off the wheels if necessary.

2.2.4  Tarp Cover
The tarp cover is made to withstand any whether conditions. After operation make sure to cover the L.A.D under the tarp and weight the tarp down.

2.2.5  Seasonal Storage
The L.A.D is capable of handling very low temperatures. However for winter storage is it suggestible to store the L.A.D indoors. After the winter season test the pump before use. If the pump is stuck, slowly depress the pump handle to loosen the pumping mechanism and hydraulic fluid. Always mount the L.A.D when fully lowered at first, especially after a long period of disuse to make sure it is safe and no low temperature related damage has been caused. During the summer time, keep the L.A.D covered when not in use and try to keep in a dry area away from swimming pools and lawn sprinklers.
3 Technical Description

The overall function of the device is to elevate the client from a lower position at wheelchair seat level to the height of the lawnmower. The main components are utilized in a multi-step process that can be operated by both the user and an assistant in a straightforward fashion. All components are permanently secured and should be used in the proper order.

3.1 Medical Grade Wheels

A total of 5 medical grade wheels are installed on the L.A.D. They include a polymer-glass fiber exterior casing to provide wear resistance and maximum tensile strength. The wheels feature a polypropylene core with thermoplastic elastomer tread to provide heat resistance and traction. The wheels are the source of the L.A.D.’s maneuverability and allow a full two degrees of rotation. They also function as weight distributors by separating device load into 5 distinct contact points with the ground surface. During use, the wheels can be locked with the braking mechanism to prevent migration while the client is operating the L.A.D.
3.2 Base

The base is a 5-star stainless steel support structure used in many standard piston-operated chair designs. The arms are hollow to minimize the weight, and are angulated to the floor to minimize stress at the central axis. The base is connected to the piston via an attachment piece that is supported through the base opening.

3.3 Base/Hydraulic Pump Attachment
The base attachment is custom fashioned from aluminum alloy. The inferior component is driven into the base opening and pressure locked. The superior component is mated to the bottom end of the hydraulic pump and secured with four sets of bolts.

3.4 Hydraulic Pump

The hydraulic piston is an ISO-approved industrial grade pump. Under normal conditions the pump has a capacity of above 450lbs, which allows a client weight of up to 375lb within reasonable safety levels. The piston is the only interactive component of the device (excluding the brakes), and can be operated by pumping the handle with several short rapid strokes. This should elevate the client to a suitable height with minimal effort. The piston may then be lowered by completely compressing the handle and holding for several seconds.
3.5 Hydraulic Pump/Seat Attachment

The seat attachment is custom fabricated from aluminum alloy. The inferior component encapsulates the head of the piston and can be secured with a safety pin if necessary. The superior component is mated to the base of the seat and is constructed from a wider diameter material for extra support.

3.6 Seat

- 3.6.1 Lower Plate
3.6.2 Upper Plate

The lower plate of the seat is cut from high-durability carbon steel. Four supports were welded to the outer edges of the base to support the upper plate (not shown in image). The seat mechanism consists of two axel systems fashioned from carbon steel rods and four acrylic wheels. The wheels spin when in contact with the bridge component thus allowing movement. Four corner joints were then welded to the supports for primary fixation to the upper plate. Several bolts were

3.6.3 Final Seat

The lower plate of the seat is cut from high-durability carbon steel. Four supports were welded to the outer edges of the base to support the upper plate (not shown in image). The seat mechanism consists of two axel systems fashioned from carbon steel rods and four acrylic wheels. The wheels spin when in contact with the bridge component thus allowing movement. Four corner joints were then welded to the supports for primary fixation to the upper plate. Several bolts were
then driven through the upper plate into the supports to complete the seat construction. Afterwards, the metal framework was cushioned and upholstered.

3.7 Safety Rails

The safety rails are constructed from four carbon steel rod structures. Two were used for primary support along the perimeter and were welded to the seat. The other two were implemented as fasteners along the top and middle regions of the safety rail system. The fasteners were cushioned and the entire component was upholstered with durable exterior fabric.

3.8 Bridge

The bridge is constructed from high-strength carbon steel. The main structure is a rectangular element which is strengthened by four support beams. The support beams are located on the
underside of the bridge and function as wheel housings to allow bridge extension to the
lawnmower attachment.

3.9 Lawnmower Attachment

The lawnmower attachment is completely fashioned from wood and custom-fit to the structure of
the lawnmower’s cup-holder. The attachment is secured with bolts and wood screws along with a
thin aluminum plate to prevent deformation of the plastic framing under high stresses. The top of
the component functions as a receiving terminal for the bridge, which can be withdrawn from the
seat housing and rested on the lawnmower attachment. The client may then proceed to transfer
himself/herself to the lawnmower seat from the L.A.D.

3.10 Seatbelts

• 3.10.1 L.A.D. Seatbelt
3.10.2 Lawnmower Seatbelt

Two sets of standard seatbelts were installed in the device for extra security. The first pair is located on the L.A.D. so the client may strap himself/herself in during use. The second pair is connected to the lawnmower via the plastic casing so that the client may safely operate the vehicle.

4 TROUBLESHOOTING

Although our team does not envision any complications coming about in the future, it is important to recognize any potential problems so they can be addressed if need be. This section outlines several troubleshooting techniques, from a bottom-top perspective.

4.1 Dislodgement of One of the Medical Grade Wheels
The custom-ordered wheels that were implemented in this device are very securely inserted into the device base. During installation, a compressor was used to mechanically force each wheel into a bolt hole. In the event that one of the wheels becomes dislocated from the 5-star base, reinstalling it is a very easy process. At the top of each wheel exists a metal bolt that is used for attachment. To reinstall, position the device on its side and align the wheel bolt mentioned above with the corresponding bolt hole in the 5-star metal frame. With a mallet or hammer, tap the wheel back into place until the top of the wheel bolt is flush with the base frame.

4.2 Seat/Pump Attachment Loosening
To allow the device to swivel and still remain secure, a shoulder bolt was implemented. In addition, a special washer was included underneath the bolt that is able to spin freely without loosening the bolt from attaching the seat to the pump. To ensure that loosening would not occur, a larger hole was bored into the lower seat plate so the washer could rest inside. Although highly
unlikely, this bolt could one day become loosened to the point where the device would need to be dissected to re-tighten the attachment. To accomplish this requires a very destructive process, so this should be a “last-resort” option. First, the fabric and cushioning would need to be removed from the entire seat area. Next, the bolts (and their corresponding nuts) would need to be unscrewed from the top plate, so that this plate (with the safety bars) could be lifted off of the bottom plate. Doing so would unveil the bridge wheels, axels, and the anterior of the shoulder bolt. Using a hex key of the correct size, this bolt can be easily tightened. It is recommended that the smallest amount of fabric and cushioning be removed to perform this task.

4.3 Bridge Removal

As stated previously in this manual, the bridge should only be extended to a maximum of three-fourths of its entire length in any situation. During normal usage, the bridge will only need to be extended approximately half of its length out of the seat housing. In the event that the bridge is completely removed from the device, it can be easily reinserted into place. To do so, the top of the bridge must be flush with the top seat plate. With a small amount of applied force, the bridge should slide all the way back into place with little effort required. The bridge wheels should not have to be aligned before reinsertion because they are secured in place by wooden stops, adhered to the lower seat plate by Velcro. If any of these stops were ever to come unattached, the bridge would need to be totally removed first, which would provide ample room for one to reach inside and reposition the dislodged stopper. On the ventral side of the bridge, 4 support bars (which also act as wheel tracks) have been welded for extra support. The width of these tracks are the exact width of the bridge wheels—once aligned correctly, sliding the bridge in and out of the housing should be quite effortless.

4.4 Lawnmower Attachment Loosening

The lawnmower attachment that was secured inside the preexisting cup holder of the riding lawn mower was fashioned out of wood and metal bolts. Although the red paint is covered with a coating of enamel, scratching will still occur with repeated usage. This will not affect the functionality of the device. However, aesthetics could be compromised if the paint is continually scratched. If one were to lift up the plastic shell of the lawnmower (from the back of the machine to reveal the gas tank), they would be able to observe a thin aluminum plate that is bolted to the underside of the lawnmower attachment. As the bridge rests on the attachment and weight is applied, these nuts and bolts will eventually loosen over time. To combat this process, one simply needs to tighten the nuts on these bolts occasionally. This can be accomplished by using an adjustable wrench.

4.5 Rusting/Paint Chipping on Metal Parts

With this device comes a plastic tarp that can be placed over it when it is not being used. This tarp is rain resistant, and will prevent moisture from affecting the device in any way. In addition, it is highly recommended that the L.A.D. is kept indoors, preferably a shed, when it is not being used. If this tarp is not implemented, rusting will likely occur on the metal exterior. If the rusting process becomes too sever, the paint covering some of the metal pieces could chip off as well.
Repainting would require the preexisting paint to be removed entirely, so covering the device with the tarp and ensuring no moisture can enter its environment is heavily encouraged.

4.6 Upholstery Rip or Tear

In the event that a rip or tear forms in the fabric, a patch will work to effectively cover the torn area. The rip can be mended by sewing the two frays together with thread as well.

4.7 Seatbelt Dislodgement

As stated earlier in this report, seatbelts were installed in both the L.A.D. and the lawnmower itself. The attachment mechanism is quite simple— they were fastened using nuts and bolts (like many of the previous parts described). If the attachment of these seatbelts becomes loosened or dislodged at any time, they can be tightened easily using an adjustable wrench.