Operator’s Manual
Multifunction Table

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Important Safety Instructions

General Warnings

- Some assembly is required and all instructions should be read first before use
- Ensure that the hand knob is fully tightened before loading anything on the table top
- Ensure that the table is properly attached to the wheelchair at all three points
- Make sure all adjustment screws are tightened with no movement of the brackets
- Beware of fingers during movement of table to prevent pinching
- Use only two 9 volt batteries in the controller
- Do not open or tamper with the electrical control box
- Keep all electrical components away from water to avoid risk of shock
- Move table top slowly to avoid injury
- Do not load the table top with more than 10 lbs while moving
- Do not load the table top with more than 25 lbs while stationary
- Inspect the system regularly for broken or defective parts and discontinue use immediately if there is a problem
- Replace missing hardware immediately when noticed
Parts and Accessories

- Detachable support plug bracket (3)

- Adjustable attachment arm (3)

- Central support clamp
• Strap clamp (2)

• Outer upright support

• Inner upright support

• Bottom end cap
• Linear actuator/spring system
- Linear actuator spacers
- Top swivel support cap
- Small swivel screw
• Table top (a)
• Table frame (b)
• Support rod (c)

• Hand knob

• Flip up ledge
- Upper paper support

- Linear actuator controller
Features

- Customized table designed to fit on several standard wheelchairs
- Automated vertical adjustment of table top
- Sliding horizontal adjustment of attachment arms
- Able to tilt table top forwards for reading
- Storage compartment
- Flip-up ledge and upper paper support to hold books and papers
- Quick disassembly
- Table detaches when not in use
- Swivel table top allows access to seat and can be locked in place
- Movable controller always within reach
- Preset limits of motion prevent injury while lowering table
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1. Introduction

1.1 General Overview of Device

The multifunction table was designed to the specifications of the client so that it would be compatible with the wheelchair and would perform the required functions. The final multifunction table is able to store items inside a small compartment, hold books and papers in a reading position, and be raised and lowered automatically. It is fully adjustable which allows the user to fit it to them and allows for future growth. Another important feature is that it quickly detaches from the wheelchair, leaving only small mounting brackets. This means that the table can be taken off when it is not being used and allows for easier mobility, but can avoids the hassle of clamping it back on the chair.

The table consists of an upright support and the table top which can be set in several positions for use. The upright support is made of two telescoping tubes that are raised by a linear actuator located on the inside. An electrical controller holds two 9V batteries that can be placed in any convenient place and raises and lowers the table with a simple button. The top of the upright support has the swivel bracket that allows the table top to rotate and the small swivel screw locks the table in place. The table frame supports the weight of any load placed on the table top and it connected to the support rod which is inserted through a hole in the top swivel cap. The hand knob tightens the support rod and prevents the table top from tilting forwards. The table top can lift upwards to reveal a small storage compartment and a flip up ledge can be found along the front edge of the table. A rubber band and clips along the edges of the table top will hold papers and books in a reading position. The entire table is attached to the wheelchair using three attachment arms that can adjust the horizontal position of the table. The attachment arms are connected to support plugs that are bolted to the chair, allowing the table to be easily removed when not in use. Only the three small support plugs would remain on the wheelchair and the attachment arms are easily slide onto them and secured with a bolt. Figure 1 below shows the multifunction table mounted to the client’s new wheelchair.

![Figure 1- Multifunction table mounted on wheelchair](attachment:image.png)
The multifunction table comes in three parts that need to be assembled before use. The support plug brackets need to be bolted to the wheelchair at three places that are in a vertical line along the left side of the wheelchair. Once these are fastened, the upright support needs to be attached to the plugs through the use of the attachment arms. The attachment arms can be loosened and slide up or down the outer upright support to find the correct positioning, and then tightened to prevent movement. Once the arms have been bolted to the support plugs, the table top and frame can be attached to the swivel top bracket by inserting the support rod through the hole and tightening the hand knob. Only slight adjustments are needed after the table has been set up.

A few simple tools are needed to set up the table properly but they should be able to be found easily. A pair of pliers or a 0.25 inch wrench is needed to tighten the hex head bolts clamping the support plug brackets and on the strap clamps. A flat head screwdriver is needed to adjust the four screws in the central support clamp. These are the only tools necessary to properly set up the table, since the other bolts and knobs can be hand tightened. Optional tools include a Philips screwdriver to loosen the screws holding the swivel top bracket on if it needs to be removed. If the support rod does not easily slide in to the swivel top bracket hole, it can be tapped in with a small hammer.

1.2 Step by Step Instructions on How to Use Device

1.2.1 Setup
1. Remove bolts holding the attachment arms to the support plug brackets
2. Loosen bolts on the clamp of the support plug and fasten to left side of the wheelchair along armrest and angle them forward slightly
3. Repeat for all 3 support plug brackets so they are in a vertical line down the side of the chair and ensure that the bolts are properly tightened. Figure 2 shows the positioning for the attachment clamps.
4. Slip the attachment arms onto the support plugs and insert the bolts into the holes to secure them in place

Figure 2- Attachment points of multifunction table
5. Make sure the longer attachment arm is used on the lowest point which is located further under the chair
6. Adjust the attachment arms so that the pipe sections are parallel to the arm rest top
7. Loosen the strap clamps and central support clamp and slide the upright support into them
8. Adjust the clamps to the appropriate height and tighten each bolt
9. Insert the support rod through the hole in the top swivel cap so that the flat face matches up with the table frame
10. Screw the hand knob onto the end of the support rod and tighten fully
11. Loosen the small swivel screw to adjust the proper angle and then retighten
12. Loosen the three screws on the attachment arms and adjust the rods forwards or backwards to the proper distance
13. Tighten all screws and test table for sturdiness

1.2.2 Use
1. Loosen the swivel screw and push the table to allow access to the wheelchair seat
2. Sit down and pull the table into place, then tighten the swivel screw
3. Use the controller to raise and lower the table top
4. Loosen the hand knob slightly to angle the table top forwards and then tighten
5. Raise the lid at the front edge to access the storage compartment
6. Open the lid and flip up the front ledge to support a book
7. Close the lid with the ledge open and then adjust the top strap to hold the book in place
8. Once adjusted, the entire table can be removed from the chair by removing the bolts holding the attachment arms to the support plugs. Only the support plugs will remain on the wheelchair for future use.
9. To replace the batteries, slide open the small cover on the front of the electrical control box and unhook the two batteries
2. Maintenance

A limited amount of maintenance is needed for the proper function of the multifunction table.

- The linear actuator is powered by two 9V batteries found in the controller box that will need to be replaced periodically.
- The table top can be washed with soap and water but should be detached from the electrical components.
- The upright supports should be wiped down periodically with a damp rag to remove dirt.
- If liquid is spilled on the upright support, wipe it dry with a clean towel to prevent it from rusting.
- No lubrication is necessary for any moving parts.
- Regular inspection of the screws, attachment points, and seams is recommended to ensure everything is stable.
3. Technical Description

The multifunction table is composed of several parts that function to provide stability and support for the table top. Figure 3 below illustrates the variety of parts that were machined to the specifications required. All of the parts used in the design were machined specifically for the multifunction table.

![Diagram](image)

<table>
<thead>
<tr>
<th>PARTS LIST</th>
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<tbody>
<tr>
<td>ITEM</td>
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</table>

Some small changes were made in the final design to improve on the original design. These changes included using three attachment points instead of only one, and reducing the length of the support rod. The actual attachment system was also altered to allow for a more universal and user friendly design. These changes allowed for the table to be better secured so that it is more stable and to make it more adjustable. The final design and the components used have been described below.

- The support plugs consist of 0.75 inch square plugs that clamp to 1 inch diameter upright tubes on the wheelchair. The plugs are secured by tightening two 0.25 inch diameter screws.
- The attachment arms fit around the support plugs and are held in place by a bolt. The round pipe section is held in the sleeve by a small adjustment screw which allows the length of the arm to be adjusted to the user.
- The central clamp has four screws that can be tightened around the upright support with a spacer in between. The spacer serves to protect the upright support from marring during tightening of the screws.
- Two strap clamps wrap around the upright support and can be tightened with the bolt that holds it to the pipe sections of the attachment arms.
- The upright support consists of a 3 inch diameter outer support and a 2.5 inch diameter inner support, separated by strips of Delrin plastic to prevent binding.
- A 12V, 2A Firgelli Mini Linear Actuator powers the movement of the table top with the help of a spring. This allows the table to be raised and lowered a maximum of 12 inches.
- A 9 inch long spring was added to the top of the linear actuator to improve the ability of the table top to raise while loaded.
- Six screws hold the top swivel cap on the end of the inner upright support and can be removed if needed. The swivel cap has a 0.5 inch hole through the center that holds the support rod which is clamped by the hand knob on the left side.
- The table frame is welded at the corners as well as using corner brackets to increase the strength. The table bottom is held on by small L brackets that were riveted on and a thin layer of foam padding covers the inside of the storage compartment.
- The table top is hinged at the back and has a cutout at the front that allows the flip up ledge to be opened. Two clips attached by a rubber band are fastened on the edges of the top and can be used to hold paper or a book in place.
- The electrical controller box has a toggle switch which makes the table to go up or down depending on the direction it has been pressed. It also has a battery compartment to hold two 9 volt batteries to power the linear actuator.

The Firgelli mini linear actuator used to power the multifunction table is capable of raising and lowering a load of 15 pounds 12 inches. The dimensions of the linear actuator have been provided in Figure 4 below in case it needs to be replaced in the future. The top swivel cap can be removed, the bolts removed from the ends, and the spacers taken out to replace the motorized component.

![Figure 4- Firgelli Mini Linear Actuator](image.png)
There are several screws and bolts that are used in the multifunction table that may need to be replaced if they are lost or broken. The following table has a list of the hardware that has been used and where they go if they get mixed up. These can be found at any hardware store but may need to be cut shorter to prevent them from sticking too far out of the table. The seams of most of the multifunction table have been welded to ensure increased durability and rivets were used whenever possible. Constant evaluation of each part of the table is recommended to determine if a bolt is missing or needs to be replaced.

Table 1 - Inventory of replaceable hardware

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Size</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hex Head Bolt</td>
<td>0.25 in. dia., 2.5 in. long</td>
<td>Support plugs, arms, strap clamps</td>
</tr>
<tr>
<td>Flat Head Screw</td>
<td>10-32, 1 in. long</td>
<td>Central support clamp, swivel top</td>
</tr>
<tr>
<td>Flat Head Screw</td>
<td>8-32, 3 in. long</td>
<td>Linear Actuator attachments</td>
</tr>
<tr>
<td>Flat Head Screw</td>
<td>10-32, 0.25 in. long</td>
<td>Hinges along table top</td>
</tr>
<tr>
<td>Set Screw</td>
<td>8-32, 0.2 in long</td>
<td>Attachment arms</td>
</tr>
<tr>
<td>Large Nut</td>
<td>0.5 in. dia.</td>
<td>Support rod</td>
</tr>
</tbody>
</table>
4. Troubleshooting

Movement

- If the table does not rise when the up button is pressed, take objects out of table compartment and gently push it upwards while pressing the up button.
- If it continues to not move or moves very slowly while unloaded, replace the batteries.
- If it does not close fully, a small amount of pressure may be applied downwards on the top swivel bracket.
- If there is a lot of movement and slack in the table, make sure all bolts and the hand knob is fully tightened.

Fitting

- If the attachment arms do not match up with the support plugs, loosen the clamp bolts and readjust the arms to fit properly.
- If the table is too close to the user, loosen the small screws on the attachment arms and slide the pipe section forwards until it is in the correct position.
- If the table top frame hits the armrest when in the down position, loosen the bolts on the clamps and slide the outer upright support upwards until there is enough clearance.
- If the support plugs do not fit around wheelchair frame, make sure they are angled forwards at approximately a 30 degree angle and use a wrench to tighten fully.