

# ***DM100 Series***

## **Disk Manager**

### **Manual**



***PUSHCORP, INC.***

**Dallas, Texas**

**DO NOT USE LUBRICATED AIR.**

**This device requires a dry, non-lubricated 100 psi (6.9 bar) minimum air supply filtered to 5  $\mu\text{m}$  and a 0.3 micron oil mist separator.**

**Non-compliance with these requirements will void the manufacturer's warranty.**

**(See Section 4.4)**

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## **1.0 Limited Warranty**

### **Duration:**

One year from date of delivery to the original purchaser.

### **Who gives this warranty (warrantor):**

*PushCorp, Inc.*

Telephone: (972) 840-0208

Corporate Address:

P. O. Box 181915

Dallas, Texas 75218

Shipping Address:

3001 W Kingsley Rd

Garland, Texas 75041

### **Who receives this warranty (purchaser):**

The original purchaser (other than for purposes of resale) of the *PushCorp, Inc.* product

### **What products are covered by this warranty:**

Any *PushCorp, Inc.* DM100 Disk Manager or DM100 Disk Manager accessory supplied or manufactured by the Warrantor.

### **What is covered under this warranty:**

Defects in material and/or workmanship which occur within the duration of the warranty period.

### **What is NOT covered in this warranty:**

- A. IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO ONE YEAR FROM THE DATE OF ORIGINAL PURCHASE. Some states do not allow limitations on how long an implied warranty lasts, so the above limitations may not apply to you.
- B. ANY INCIDENTAL, INDIRECT, OR CONSEQUENTIAL LOSS, DAMAGE or EXPENSE THAT MAY RESULT FROM ANY DEFECT, FAILURE, MALFUNCTION OF THE *PUSHCORP, INC.* PRODUCT. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you.
- C. Any failure that results from an accident, purchaser's abuse, neglect, unauthorized repair or failure to operate the products in accordance with the instructions provided in the owner's manual(s) supplied with the product.

**Responsibilities of the Warrantor under this warranty:**

Repair or replace, at Warrantor's option, products or components which have failed within the duration of the warranty period.

**Responsibilities of the purchaser under this warranty:**

- A. Deliver or ship the *PushCorp, Inc.* product or component to PushCorp, Inc. Service Center, Dallas, TX. Freight and insurance costs, if any, must be borne by the purchaser.
- B. Use reasonable care in the operation and maintenance of the product as described in the owner's manual(s).

**When warrantor will perform repair or replacement under this warranty:**

Repair or replacement will be scheduled and serviced according to the normal work flow at the service center, and depending on the availability of replacement parts. Purchasers requiring quicker repair may receive such with payment of a *PushCorp, Inc.* predetermined expediting fee.

This Limited Warranty gives you specific legal rights and you may also have other rights which vary from state to state.

## 2.0 General Overview

The *PushCorp, Inc. DM100 Series* Disk Manager provides a flexible means to store and automatically change a wide variety of abrasive disk media. The Disk Manager is capable of storing 30 Disk Assemblies with diameters ranging from 4 to 7 inches. The machine is also capable of handling many different media types, from thin coated abrasive products to relatively thick buffing pads.

The *DM100 Series* is designed to be used in a robotic surface finishing workcell. Typically such a cell is equipped with an industrial robot, and an attached force control device and motor for grinding, surface finishing or buffing. The Disk Manager system uses a DC100-1 Disk Collet attached to the motor shaft to capture and release the Disk Assemblies. The Disk Collet is passive in that it does not require any electrical, hydraulic or pneumatic connections to maintain a grip on the Disk Shaft. To accomplish this, the PushCorp DC100-1 Disk Collet uses high force springs and a machine tool collet to clamp the Disk Shaft with over 25 lb-ft of holding torque. No external connections means that the Disk Collet may be quickly attached to almost any type of electric or pneumatic motor.

To execute a Disk change, the robot moves to a single taught Docking Point. The Disk Manager verifies that the robot is in the correct position with a proximity sensor located at the Docking Point. Upon receiving an *In Position* signal from the Disk Manager, the robot signals the Disk Manager to change Disk Assemblies.

The Disk Assembly change cycle is executed by a small gripper first grasping the Disk Shaft on the spent Disk Assembly. With the Disk Shaft captured, two pneumatic actuators are pressurized to over 230 psi thereby clamping the Disk Collet with over 1600 pounds of force. This force compresses the internal Disk Collet springs and releases the Disk Shaft. The gripper is now free to gently lower the spent Disk Assembly to the Horizontal Shuttle Belts where it is carried away while a fresh Disk Assembly is simultaneously moved into position underneath the Disk Collet. To insert the fresh Disk Assembly, the gripper lowers and grasps the Disk Shaft and then raises to insert it into the Disk Collet. Finally, when sensors indicate that the Disk Shaft is fully inserted, the Clamping Bar is released and the Disk Shaft is securely captured in the Disk Collet completing the Disk Assembly change cycle. While the fresh Disk Assembly is being used by the robot, another fresh Disk Assembly is transferred from the Tower onto the Horizontal Shuttle Belts and into position, ready for the next Disk Assembly change.

The Tower handles up to 30 Disk Assemblies in specially designed Belt Profiles on the Tower Belt. The Tower Belt is easy to load and the Belt Profiles are pliable enough to prevent personal injury. If the Tower Belt should become jammed, a built-in slip clutch will protect the machine and operator personnel. The Disk Manager is capable of detecting an empty Tower Belt condition and will notify the operator with a pilot lamp and a signal output. The Disk Manager is designed so that the Tower can be positioned outside the robot workspace so that the Disk Manager can be safely loaded at any time without interrupting the operation of the manufacturing process.

## 3.0 Installation

### 3.1 Installing the Base Unit

The Base Unit must be placed where the robot can easily reach the Docking Point, and the Disk Assemblies can be loaded without entering the workspace. The *PushCorp* Disk Manager must be rigidly attached to the floor to maintain a fixed robot Docking Point. The Base Unit has four large mounting holes located on the Base Feet (see Figure 1). The machine requires four ½ inch diameter bolts with appropriate washers. The unit should be leveled to facilitate teaching the Docking Point and aligning the Tower. The Base Unit can be leveled by inserting shims under the Base Feet.

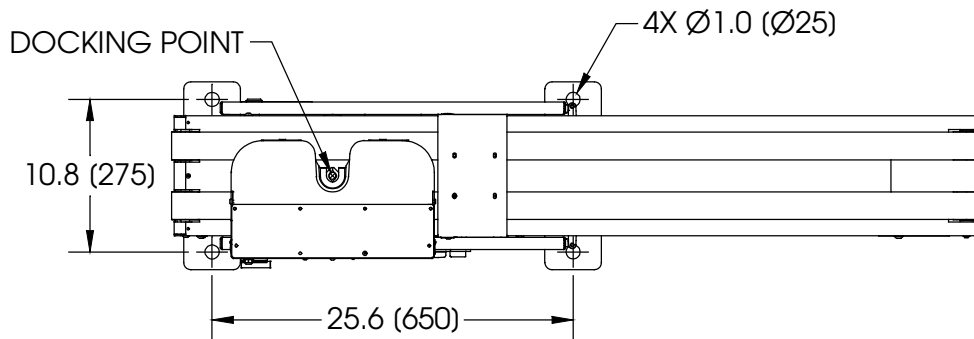


Figure 1. Base Unit installation holes

### 3.2 Pneumatic Connection

The *DM100 Series* requires a dry, non-lubricated 100 psi air supply filtered to 5 microns. Failure to provide supply air to these specifications will void any warranty repairs concerning pneumatic components. Additionally, a minimum 100 psi air pressure must be maintained to provide sufficient clamping force. Excessively low or high air pressure will prevent the unit from performing within published specifications. The Disk Manager requires approximately 2 CFM per Disk Change.

If water condensation is a problem in the air supply system, an air dryer can be used. *PushCorp* recommends an ambient dryer. Moisture inside the Disk Manager will cause premature failure which will not be covered under warranty.

The single pneumatic connection to the DM100 is a ¼ inch NPT nipple, see Figure 2 for location. Before connecting the pneumatic Supply Line to the Disk Manager purge the line to remove any contaminants. The Supply Line can now be connected to the nipple. Charge the system with compressed air and verify that there are no air leaks. If a minimum air pressure of 100 PSI cannot be achieved, then an auxiliary air compressor or booster pump with at least 2 CFM must be installed.

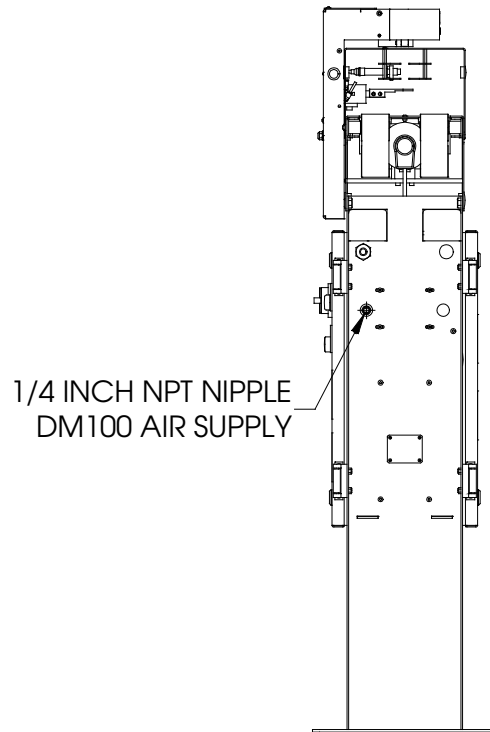


Figure 2. DM100 Air Supply

**NOTE: Cover or plug the nipple any time the Supply Line is not connected to keep contaminants from entering the pneumatic system.**

### 3.3 Electrical And Communication Line Connections

Once the Base Unit is secured and the pneumatic connection is complete, the electrical power and communications control lines can be connected. Figure 3. shows the location of the terminal blocks on the bottom of the back panel inside the Base Unit.

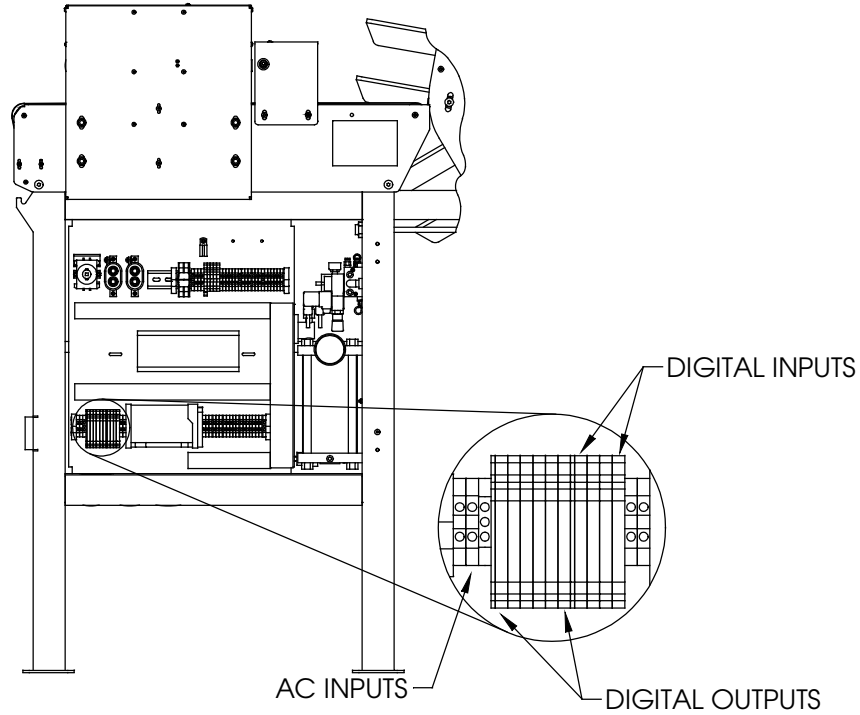


Figure 3. Location of Electrical and Communication Connections

The electrical power connections are made according to Table 1.

Terminal	Connection
L1	120 VAC Line, 200W
N	120 VAC Neutral
⏏	Earth Ground

Table 1. Electrical Connections

The digital I/O connections are wired according to Table 2.

Terminal	Connection
1	Ready Output
2	Cycle Complete Output
3	In Position Output
4	Empty Output
5	Error Output
6	Output Common
7	Start Input
8	Stop Input
9	Change Disk Input
10	Input Common

Table 2. Communications Control Connections

**NOTE: Do not power the Disk Manager up until the Tower has been installed and connected.**

The Communications Control Connections take the form of dry contact closures and relay coils for DM100 outputs and inputs respectively. The schematics in Figures 4 and 5. illustrate how these connections are made.

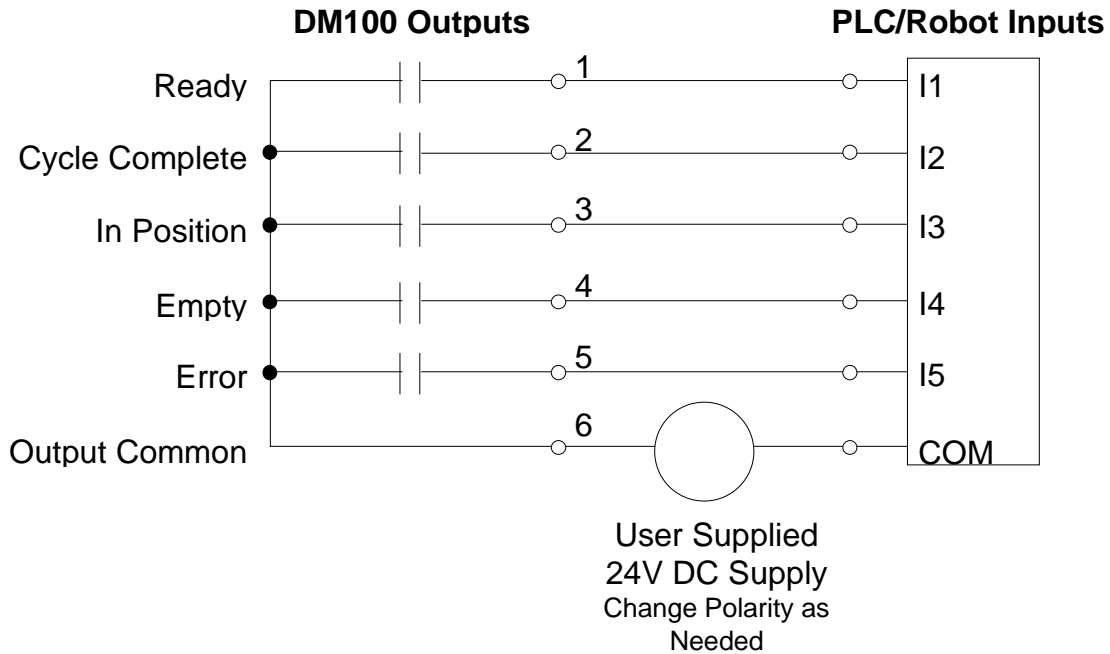


Figure 4. DM100 Output Wiring Schematic

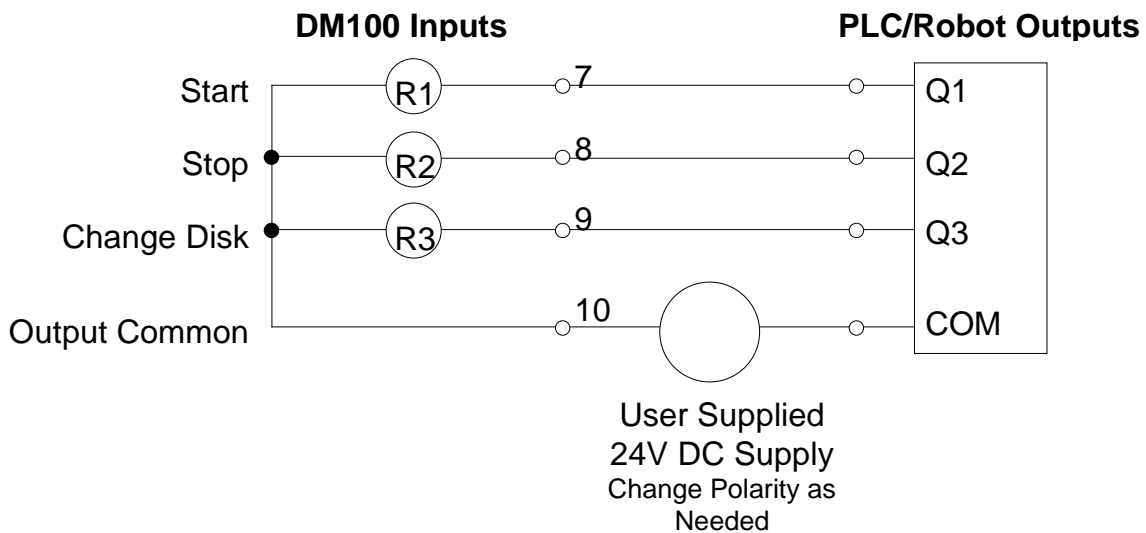


Figure 5. DM100 Input Wiring Schematic

### 3.4 Installing the Tower

**WARNING: Do NOT attach the Tower until the Base Unit is securely fastened. Failure to do so could cause the Tower to tip over and result in personal injury.**

**NOTE: Make sure that all electrical and pneumatic connections are completed prior to installing the Tower.**

**WARNING: Do NOT remove both of the fasteners (one on each side) that hold the Mounting Flanges or Tower Legs to the Tower. Removal of both the fasteners will allow the spacer standoff to fall out of position. The Tower must be disassembled to reposition the standoff.**

#### 3.4.1 DM100-1 Standard Disk Manager

The Tower of the Standard Disk Manager rests on the Base Arms and the Tower Legs. Care must be taken when attaching the Tower to the Base Unit to ensure the proper alignment of the Belt Profiles between the Shuttle Belts. Incorrect positioning of the Tower can cause the Tower Belt to jam. If the Tower Belt does jam, a built-in slip-clutch will disengage the motor. The slip-clutch will automatically engage the Tower Motor once the jam condition is corrected.

To attach the Tower to the Base Unit, follow the procedure below:

1. Place the Tower upright on the Base Arms. The Mounting Flanges rest on top of the Base Arms (see Figure 6.)
2. Position the Tower so that the Belt Profiles are between the two Shuttle Belts as shown in Figure 6. The Mounting Holes and the holes on the Base Arms should be aligned. The Tower should not contact the Shuttle Belts.
3. Place the (4) four 3/8 inch diameter fasteners and locknuts through the Mounting Flange and Base Arm holes and lightly tighten the locknuts.
4. Place (2) two 1/2 inch diameter fasteners and washers through the Mounting Holes in the Tower Feet to secure the Tower. The Tower Legs are vertically adjustable via the (4) four 3/8 inch fasteners securing the Tower Legs to the Tower. All Tower Leg fasteners should be lightly tightened. Make sure that the Tower is plumb. Shim under the Tower Feet if necessary.
5. Insert the Control Cable Connector into the Control Socket on the Tower. The Control Cable Connector and Control Socket are keyed so that they must be clocked correctly to engage. Once the Control Cable Connector is fully inserted, tighten the interface cable lock ring by rotating it clockwise.
6. Insert the Power Cable Connector into the Power Socket on the Tower. The Power Cable Connector and Power Socket are keyed so that they must be clocked correctly to engage. Once the Power Cable Connector is fully inserted, tighten the interface cable lock ring by rotating it clockwise.
7. The Disk Manager can now be powered up.

8. Use the *Start* and *Stop* buttons located on the Tower to jog a Belt Profile into a position between the Shuttle Belts. Align the Tower so that the Belt Profiles are centered between the Shuttle Belts as shown below in Figure 6. Care should be taken not to jam the Tower Belt. If the Tower Belt does jam, press the *Stop* button and realign the Tower to the Base Unit.
9. Press the *Start* button to allow the Tower Belt to make one complete revolution. Check that none of the Belt Profiles contact the Shuttle Belts or Base Unit at any time. The Tower must not be positioned closer than 1/8 inch from the Shuttle Belts to prevent interference during operation.
10. Tighten the (10) ten fasteners.

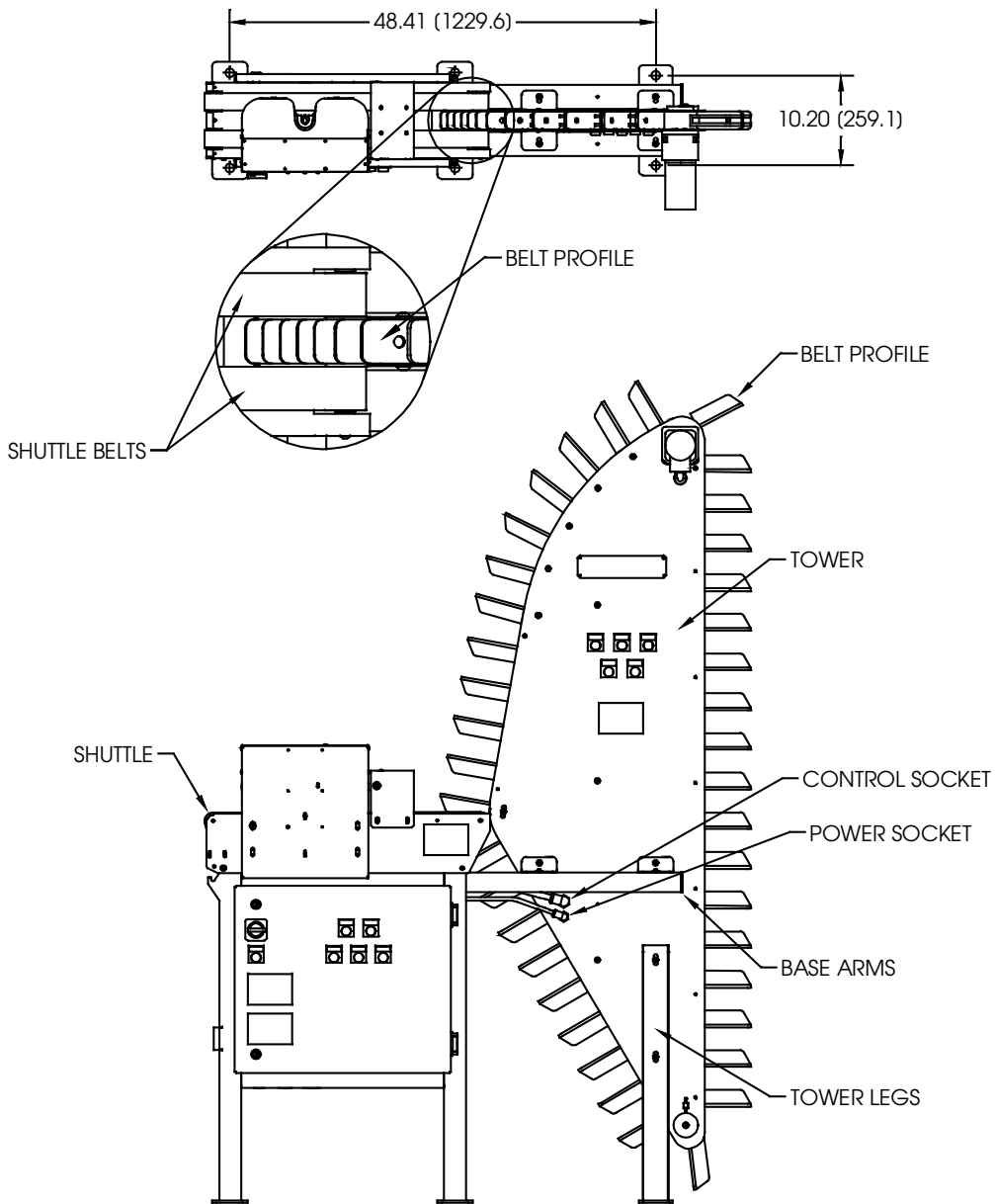


Figure 6. Standard Disk Manager

### 3.4.2 DM100-2 Stretched Disk Manager

The Tower for the Stretched Disk Manager mounts to the floor with the Tower Legs. Care must be taken when attaching the Tower to the Base Unit to ensure the proper alignment of the Belt Profiles between the Shuttle Belts. Incorrect positioning of the Tower can cause the Tower Belt to jam. If the Tower Belt does jam, a built-in slip-clutch will disengage the Tower Belt from the motor. The slip-clutch will automatically engage the Tower Motor once the jam condition is corrected.

To install the Tower, follow the procedure below:

1. Place the Tower upright on the Tower Legs.
2. Position the Tower so that the Belt Profiles are between the two Shuttle Belts as shown in Figure 7. The Tower should not contact the Shuttle Belts.
3. Use (6) six ½ inch diameter fasteners and washers. Place the fasteners through the Mounting Holes in the Tower Feet to secure the Tower. The fasteners should be lightly tightened. Make sure that the Tower is plumb. Shim under the Tower Feet if necessary.
4. Insert the Control Cable Connector into the Control Socket on the Tower. The Control Cable Connector and Control Socket are keyed so that they must be clocked correctly to engage. Once the Control Cable Connector is fully inserted, tighten the interface cable lock ring by rotating it clockwise.
5. Insert the Power Cable Connector into the Power Socket on the Tower. The Power Cable Connector and Power Socket are keyed so that they must be clocked correctly to engage. Once the Power Cable Connector is fully inserted, tighten the interface cable lock ring by rotating it clockwise.
6. The Disk Manager can now be powered up.
7. Use the *Start* and *Stop* buttons located on the Tower to jog a Belt Profile into a position between the Shuttle Belts. Align the Tower so that the Belt Profiles are centered between the Shuttle Belts as shown below in Figure 7. Care should be taken not to jam the Tower Belt. If the Tower Belt does jam, press the *Stop* button and reposition the Tower.
8. Press the *Start* button to allow the Tower Belt to make one complete revolution. Check that none of the Belt Profiles contact the Shuttle Belts or Base Unit at any time. The Tower must not be positioned closer than 1/8 inch from the Shuttle Belts to prevent interference during operation.
9. Tighten the (6) six ½ inch fasteners that secure the Tower Legs.
10. Use two 3/8 inch fasteners and locknuts (included) to attach the Tower Stabilizers to the mounting holes located under the Shuttle.

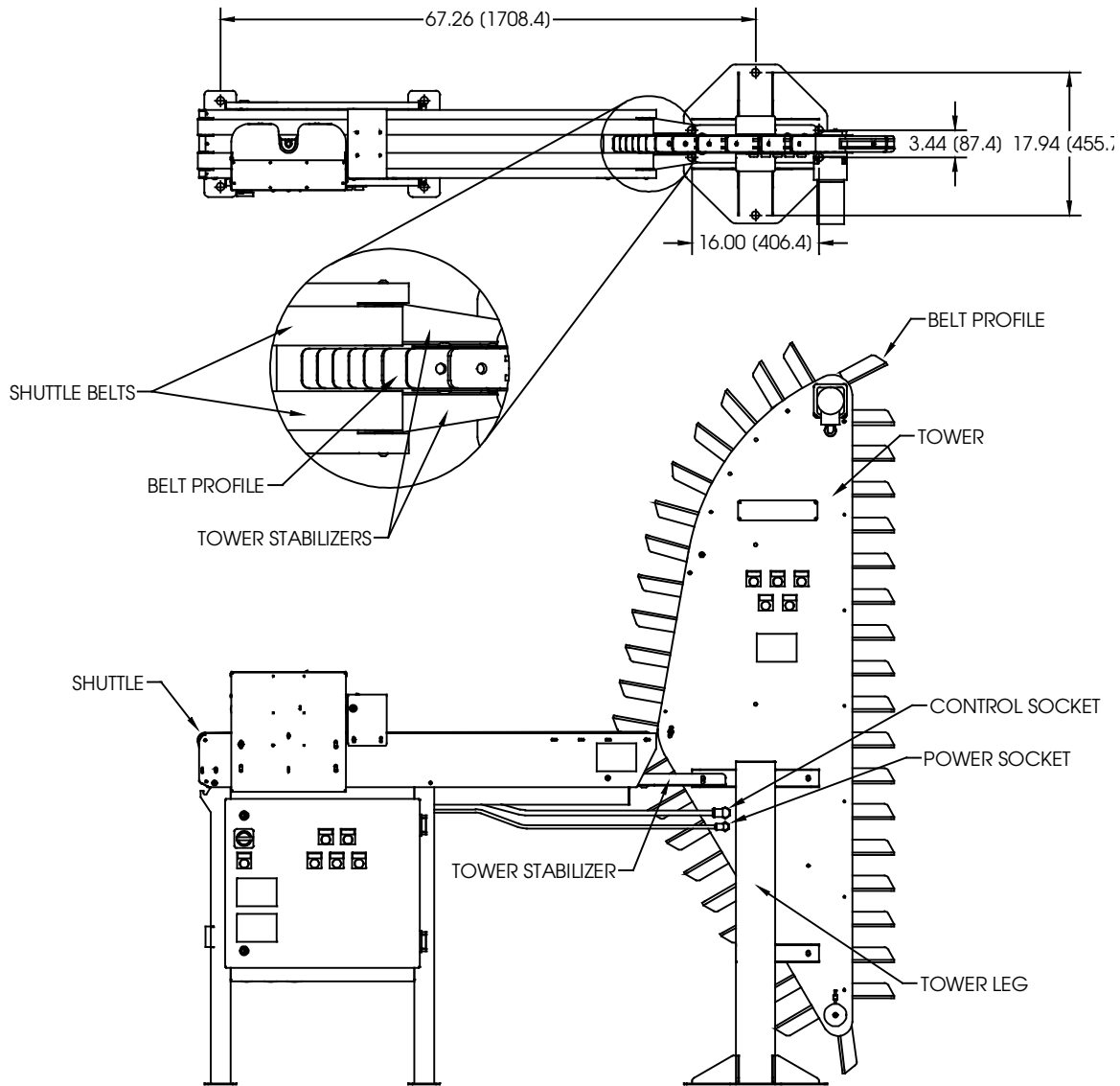


Figure 7. Stretched Disk Manager

### 3.5 Mechanical Adjustments

#### 3.5.1 Disk Shaft Dimensions

The length of the Disk Shafts is dependent on the media and backup pad being used. The Disk Manager can handle a wide variety of media and therefore must have a means to accommodate for the variation. Changing the length of the shafts allows a single gripping height for all media. It is critical that the overall height of the Disk Assembly remain constant for the Disk Manager to operate properly. The hex and thread portions of the Disk Shaft are varied to maintain the overall assembled height. The Disk Assembly including, the media, and Disk Shaft height must be 4 inches (approximately) so that the Tower can effectively store and consistently invert the Disk Assembly. The dimensions of the Disk Shaft are shown in Figure 8, since the user may want to make additional shafts for different media.

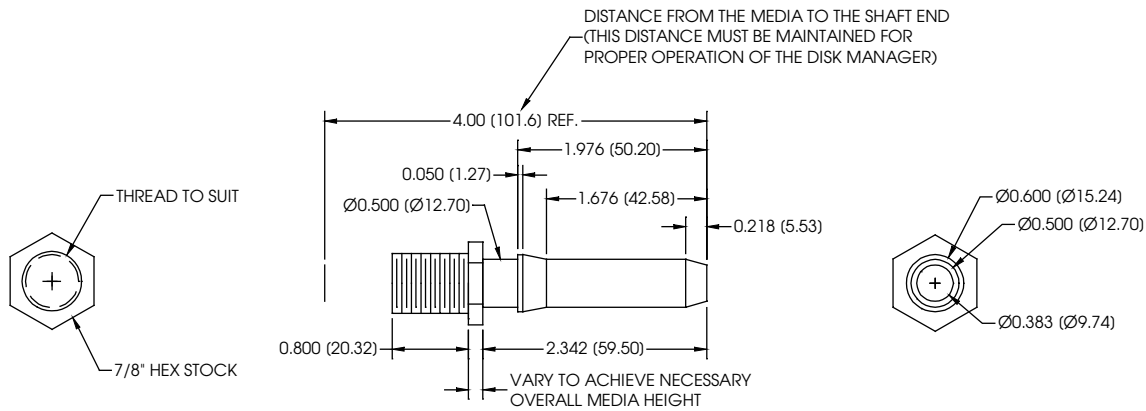


Figure 8. Disk Shaft dimensions

### 3.5.2 Disk Ready Station Adjustments

The *Disk Ready Station* is located over the Shuttle Belts just prior to the Clamping Head. This station shown in Figure 9. serves two purposes. First the proximity sensor indicates that a Disk Assembly is in position and ready to be shuttled underneath the Docking Point. Second, the Guide Brackets serve to ensure that the Disk Assembly is centered on the Shuttle Belts. The position of the Disk Ready Sensor and the Guide Brackets are set at the factory, and in general should not require adjustment. However there are situations that could arise where the Disk Ready Station may need adjustment:

- The Shuttle Belts do not stop, even as a Disk Assembly passes through the Disk Ready Station
- The Disk Assembly leaves the Disk Ready Station significantly off center and can not be captured by the Gripper Fingers

If the Disk Assembly is passing through the Disk Ready Station without stopping, the Disk Ready Sensor may need adjustment. The Disk Ready Sensor is located inside the Disk Ready Station cover and a small red LED Indicator on the Sensor will illuminate when it is triggered.

First place a metallic object (a screwdriver works well) against the sensor element. If the LED Indicator does not light then the Disk Ready Sensor or Sensor Wire is bad and must be replaced. If the LED Indicator does light then the sensor needs position re-adjustment according to the following procedure:

1. Loosen the Disk Ready Sensor Adjustment Lock Nut which holds the Sensor shown in Figure 9.
2. Position the Disk Ready Sensor by rotating it until the end of the sensor is within 0.020 to 0.040 inch of the edge of the sheet metal Guide Brackets.
3. While holding the Sensor to prevent rotation, tighten the Disk Ready Sensor Adjustment Lock Nut to secure the Sensor.

4. With the power on, place a Disk Shaft in front of the Disk Ready Sensor. The red LED Indicator at the base should be lit. If not, then repeat steps 1-3 bringing the sensor closer to the Disk Shaft (without making contact).

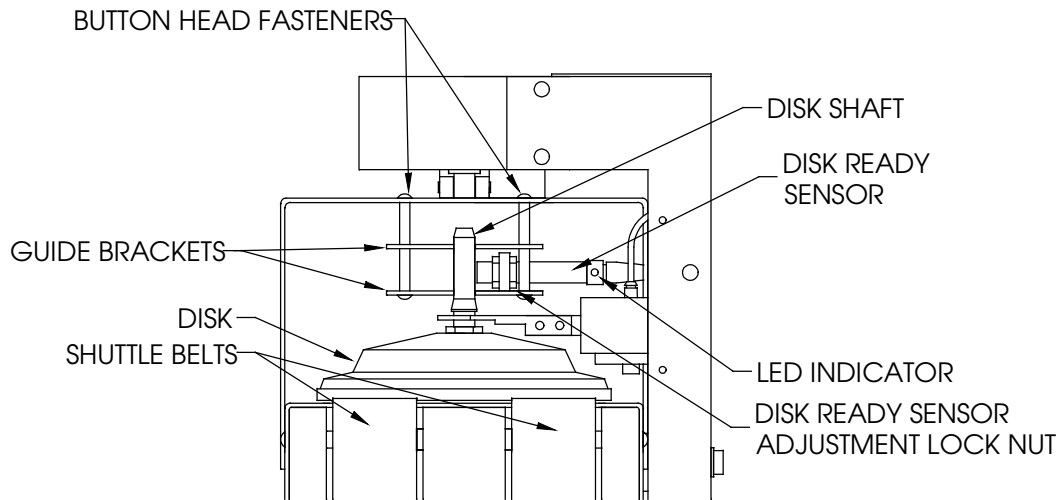


Figure 9. Disk Ready Station

If the Disk Assembly leaves the station significantly off center or does not pass close enough to the Sensor, the Guide Brackets require adjustment.

To perform the Guide Bracket Adjustment follow the procedure below:

1. Loosen the Button Head Fasteners located on top of the Disk Ready Station (see Figure 9). This will allow the Guide Brackets to move laterally in the slotted holes of the Disk Ready Bracket.
2. Position the Guide Brackets so that the Disk Assembly leaves the station centered in relation to the Pickup Point. Also there must be a gap between the Disk Shaft and Guide Brackets large enough to prevent the Disk Shaft from binding in the station. The gap must not be too large or the Disk Shaft could be out of Disk Ready Sensor range.
3. Tighten the Button Head Fasteners that hold the Guide Brackets in place. With a Disk Assembly in the Tower, cycle the Disk Manager by pressing the *Start* button. The Disk Assembly should enter the Disk Ready Station without binding, and the Proximity Sensor should detect the Disk Shaft, stopping the Shuttle Belts.
4. Press the *Change Disk* button to cause the Disk Assembly to pass completely through the Disk Ready Station.

Setting the height of the Disk Ready Station:

1. Check the height of the Disk Ready Station to ensure that both of the Guide Brackets are aligned with the straight portion of the Disk Shaft (as shown in Figure 9), and not on the tapered end.

2. If the upper or lower Guide Brackets are not both aligned with the straight portion of the shaft, loosen but do not remove the (4) four Disk Ready Station Height Adjustment Screws as shown in Figure 10.
3. Raise or lower the Disk Ready Station to set the Guide Brackets on the non-tapered portion of the Disk Shaft.
4. Tighten the Disk Ready Station Height Adjustment Screws to secure the position of the Disk Ready Station.

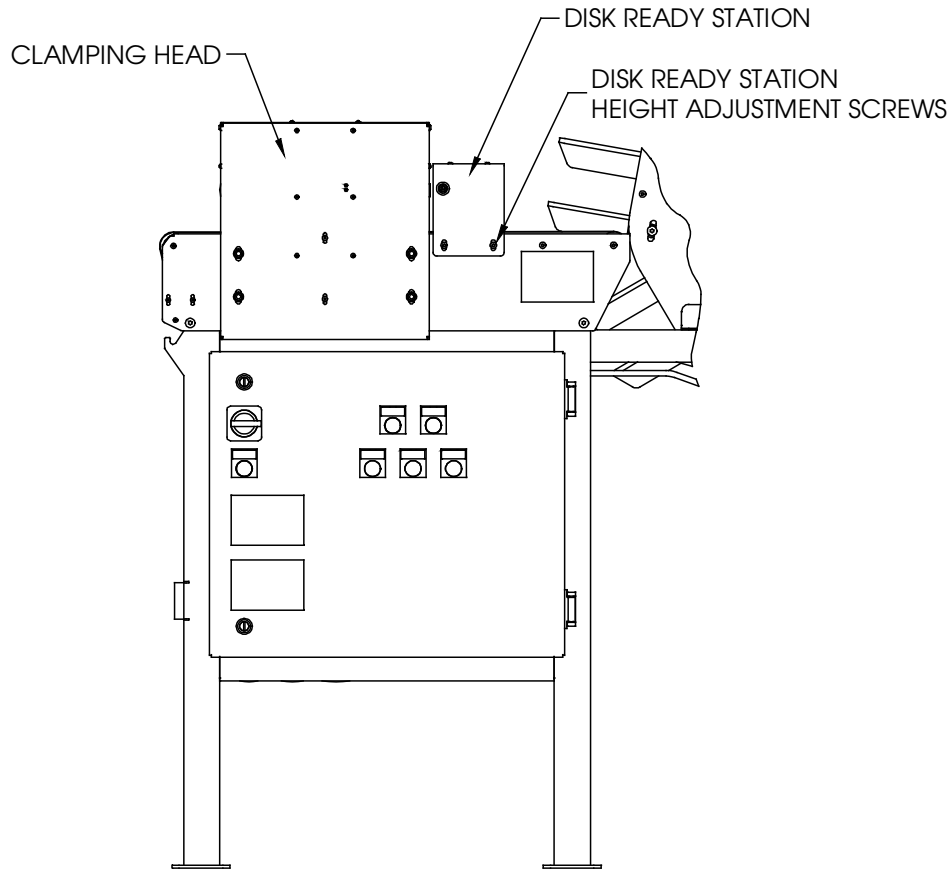


Figure 10. Disk Ready Station Height adjustment

### 3.5.3 In Position Sensor Adjustment

The In Position Sensor is used to detect when the DC100 Disk Collet has fully entered the Docking Point and is ready to be clamped. The In Position Sensor is located in the Clamping Head shown in Figure 11. The In Position Sensor is set at the factory and should not require adjustment. However, there are situations which could arise that require it to be adjusted or replaced.

When the Disk Collet is properly docked and the In Position lamp is not lit, there are two possible reasons:

- The In Position Sensor is bad
- The In Position Sensor needs adjustment

To determine if the In Position Sensor is bad perform the following procedure:

1. Remove the (8) eight Clamping Head Cover Fasteners and Clamping Head Cover Plate from the top of the Clamping Head Frame.
2. Place a metallic object (such as a screwdriver blade) over the In Position Sensor Head, shown in Figure 11.
3. Observe to see if the red LED Indicator located on the sensor illuminates. If it does not illuminate then the In Position Sensor and/or sensor cable are bad and must be replaced. If it does light then proceed with the following adjustment procedure.

To perform the In Position Sensor Adjustment follow the procedure below:

1. Loosen the In Position Sensor Lock Nut.
2. Rotate the sensor until the Sensor Head is flush with the exterior surface of the Clamping Head.
3. Manually or robotically move the DC100 Disk Collet into the Docking Point of the Clamping Head.
4. With the power on, check that the red LED Indicator on the In Position Sensor is lit. If not, rotate the Sensor until the red LED Indicator comes on without the In Position Sensor Head contacting the Disk Collet. Do not extend the In Position Sensor any further than is necessary, or damage could occur from contacting the Disk Collet. When the red LED Indicator is on, the *In Position* front panel indicator should also be lit.
5. Tighten the In Position Sensor Lock Nut against the Clamping Head.
6. Install the Clamping Head Cover Plate and associated Fasteners.

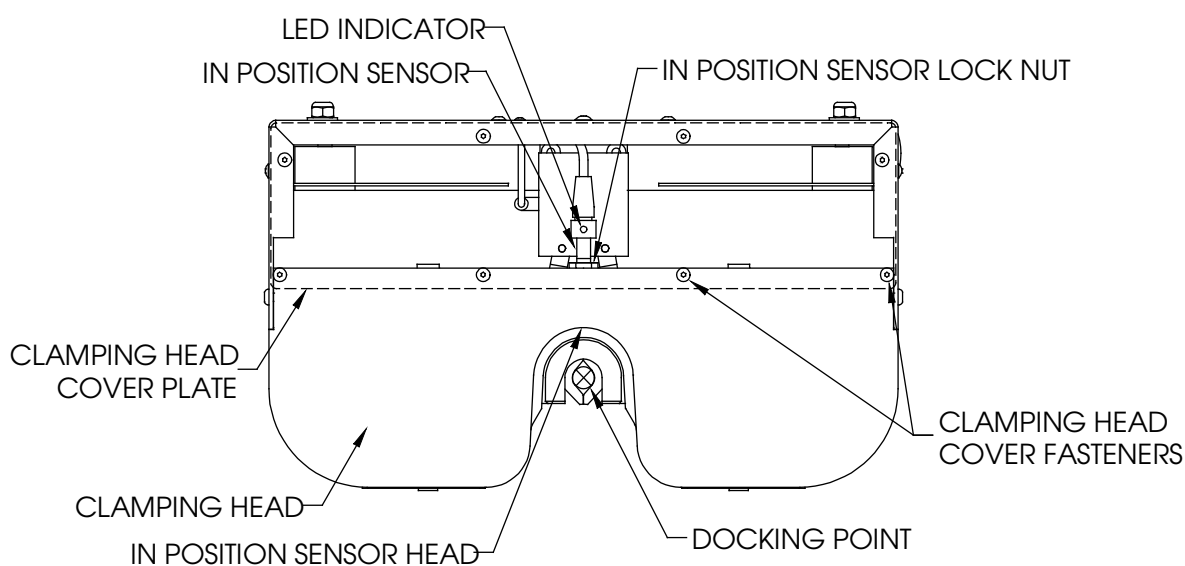


Figure 11. In Position Sensor adjustment

### 3.5.4 Clamping Head Frame Adjustments

The Clamping Head Frame Adjustment is used to raise and lower the Gripper Finger Pickup Height. The Pickup Height can change if a different media or backup pad is used. The Clamping Head Frame is mounted to the Shuttle with rubber isolation mounts that provide compliance for robot docking. The Clamping Head Frame is set at the factory and should not require field adjustment. However, situations could arise which would require the unit to be adjusted.

**CAUTION: If the Clamping Head Frame is adjusted, then it will be necessary to re-teach the robot Docking Point.**

To perform the Clamping Head Frame Adjustment follow the procedure below:

1. Turn off the supply air to the Disk Manager.
2. With the air supply off, the Gripper Fingers will fall to the Disk Pickup Point.
3. Manually place a Disk on the Shuttle Belt directly under the Docking Point.
4. Loosen the (4) four Clamping Head Frame Lock Nuts on the back of the Clamping Head Frame (Figure 12) enough to allow it to move along the vertical slots.
5. Move the Clamping Head Frame so that the Gripper Fingers, on the lowered Gripper Slide, will contact the Disk Shaft Pickup Point. The Gripper Fingers should be centered between the hex and tapered portion of the shaft.
6. Make sure that the Clamping Head Frame is level. This means that the amount of vertical adjustment slot showing is the same on both sides of the Clamping Head Frame. The gap between the Shuttle and the Clamping Head Frame should be approximately 0.100 in. (2.5 mm). Additional adjustment nuts are located inside the Clamping Head Frame to set the gap. Tighten the (4) four Clamping Head Frame Lock Nuts to secure the position of the Clamping Head Frame.

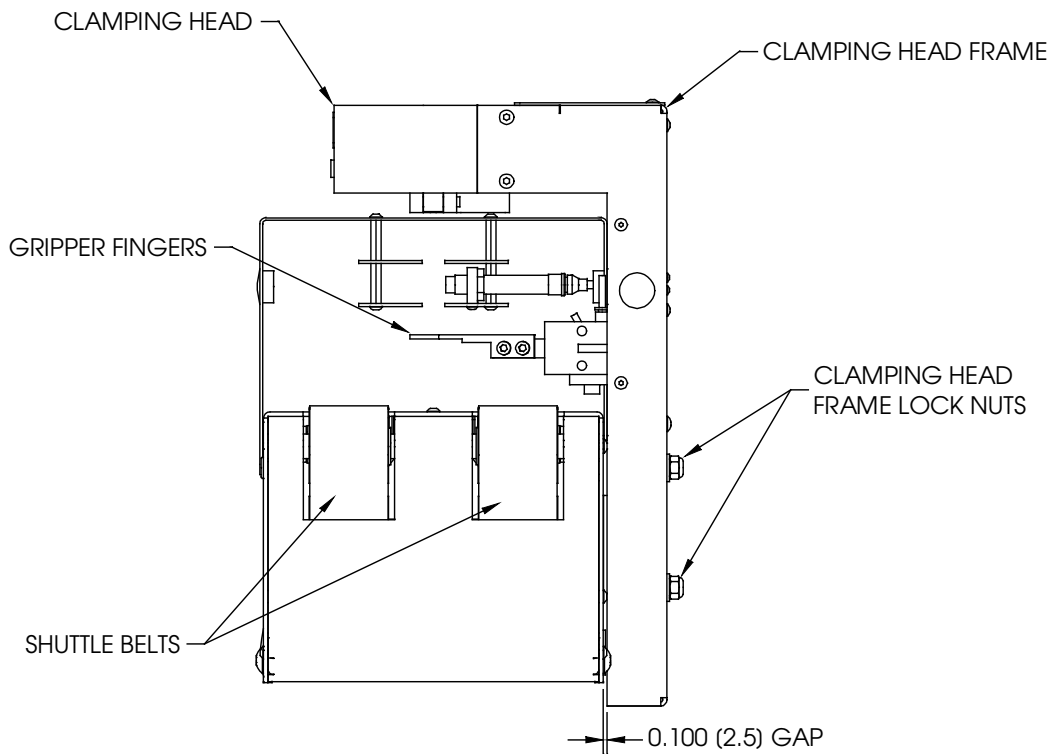


Figure 12. Clamping Head Frame Adjustment

### 3.5.5 Gripper Finger Adjustments

The position of the Gripper Fingers are set at the factory and should not require field adjustment. However, there are situations which could occur where the Gripper Fingers will need adjustment. Adjustment of the Gripper Fingers is critical in the operation of the Disk Manager. Accurate alignment of the Gripper Fingers will ensure the correct insertion and removal of the Disk Shaft from the DC100 Disk Collet. To facilitate this adjustment, PushCorp recommends the use of a Gripper Alignment Fixture, PushCorp ASM000098, (GAF100-1 shown in Figure 13). The GAF100-1 can be obtained from the factory. Setting the Gripper Fingers without the GAF100-1 is not advised.

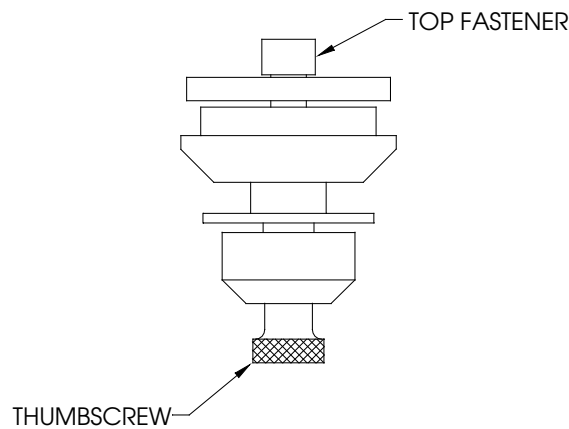


Figure 13. Gripper Alignment Fixture

To perform the Gripper Finger Adjustment follow the procedure below:

1. Turn the Disk Manager power on and the supply air on.
2. Press the *Clamp* button located on the front door of the Disk Manager. The *Clamped* indicator should now be illuminated.
3. Place the GAF100-1 into the Clamping Head, as shown in Figure 14, and tighten the Top Fastener (5/16 hex key).

**NOTE: Be sure that the GAF100-1 is pushed in completely and firmly seated in the Clamping Head. Failure to do so will cause all subsequent adjustments to be incorrect.**

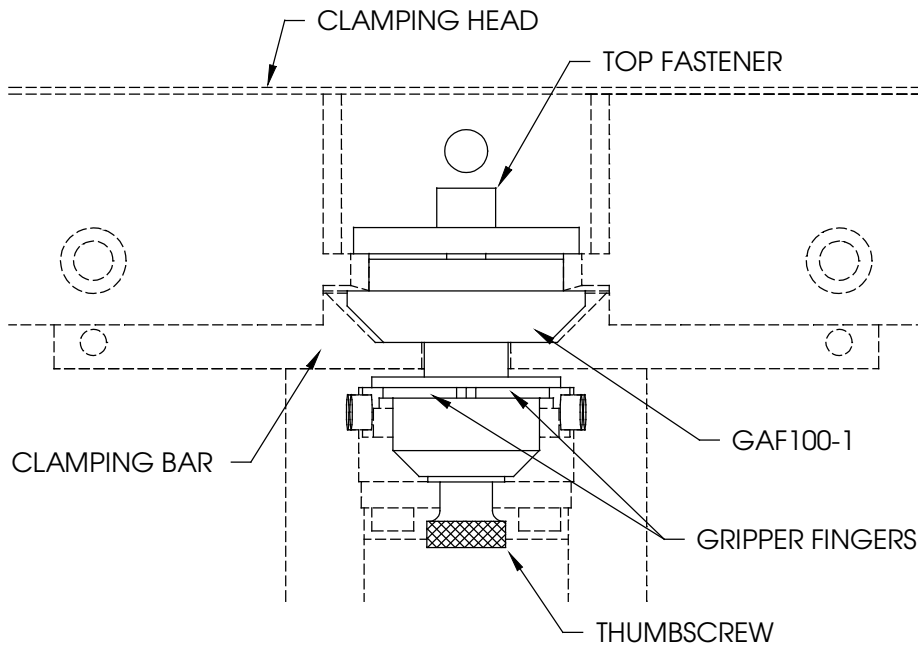


Figure 14. Clamping Head and GAF100-1

4. Turn the supply air off.
5. Loosen the (2) two metric M5x.8 Gripper Slide Adjustment Screws located on the back of the Clamping Head Frame (shown in Figure 15). Move the Gripper Slide up to the top of the slots in the Clamping Head Frame and tighten the M5x.8 Gripper Slide Adjustment Screws to hold the Gripper Slide in place.
6. Loosen but do not remove the (4) four M5X.8 Gripper Finger Fasteners and the (2) two M6x1 Gipper Body Fasteners as shown in Figure 16. Loosen the fasteners only enough to allow movement of the Gripper Fingers and Gripper Body.
7. Manually raise the Gripper Slide and close the Gripper Fingers around the GAF100-1. While holding the Gripper Fingers tightly together around the GAF100-1, tighten the Thumbscrew to secure them in place, see Figure 14.

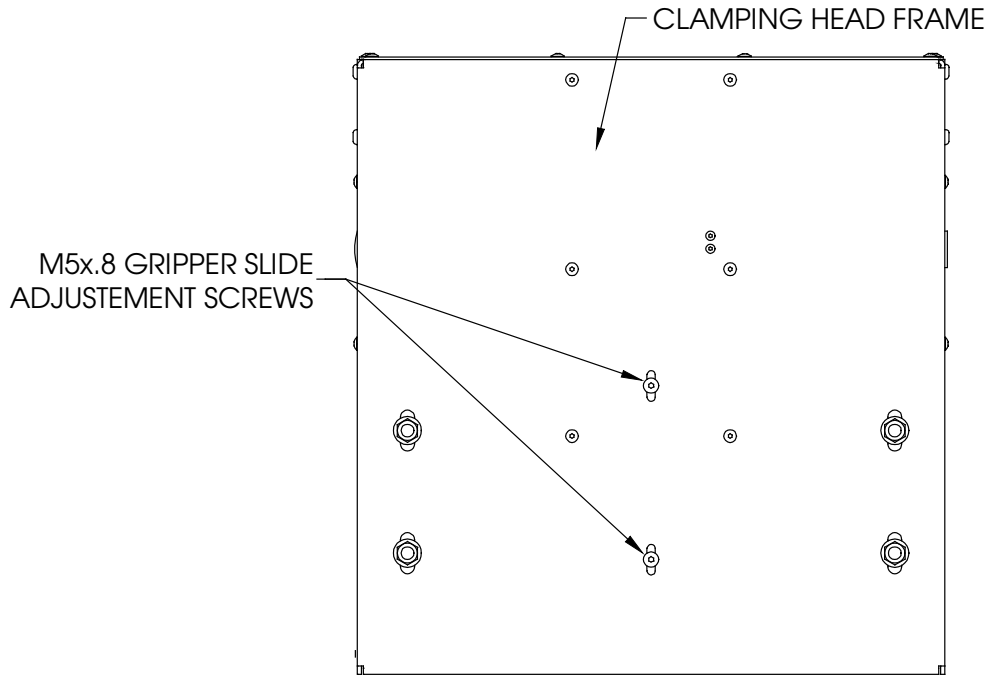


Figure 15. Gripper Slide Adjustment

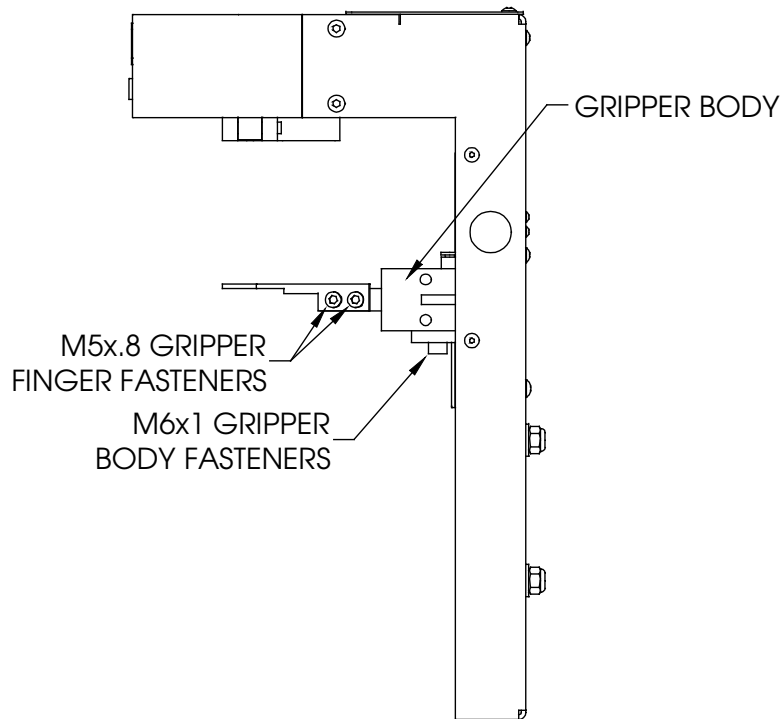


Figure 16. Gripper Finger Adjustment

8. Turn the supply air on. The Gripper Slide should be pushing up on the Gripper Fingers and Gripper Body.
9. Tighten the (2) two Gripper Body Fasteners to secure the Gripper Body in place on the Gripper Slide.
10. Tighten the (4) four Gripper Finger Fasteners to secure the Gripper Fingers to the Gripper Body.
11. The Gripper Fingers should now be set parallel and centered to the Clamping Head. Loosen the (2) two Gripper Slide Adjustment Screws located on the Clamping Head Frame and allow the air pressure to move the slide to the fully extended position. The fully extended position can be verified by observing that the top slide proximity sensor LED located on the side of the Gripper Slide is lit.
12. Tighten the Gripper Slide Adjustment Screws to set the position of the Gripper Slide.
13. Loosen the Thumbscrew to release the Gripper Fingers from the GAF100-1. The Gripper Fingers will open when the Thumbscrew is loosened. Loosen the Top Fastener and remove the GAF100-1 from the Clamping Head.
14. Press the *Unclamp* button located on the front door of the Disk Manager. The *Clamped* indicator should be off.
15. The Gripper Finger Adjustment is now complete. The Disk Manager may require a Clamping Head Frame Adjustment if the Disk Pickup Point is no longer between the hex and tapered portions of the Disk Shaft (see Section 3.5.4, Clamping Head Frame Adjustment).
16. Manually cycle the Disk Manager to verify proper operation.

### **3.5.6 Drop Off Pulley Adjustment**

The position of the Drop Off pulley is set at the factory and should not require field adjustment. If the Drop Off Pulley is out of position, the Disk Assembly may drag on the Belt Profiles as the Shuttle Belts transfer the Disk Assembly from the Tower Belt to the Disk Ready Station. If the Drop Off Pulley is considerably out of position, the Disk Assembly exiting the Tower could jam between the Tower Belt and the Shuttle Belts. There are several situations which would require the adjustment of the Drop Off Pulley:

- The Tower position has been adjusted
- The Disk Assembly are dragging on the Belt Profiles

To adjust the Drop Off Pulley, follow the procedure below:

1. Loosen but do not remove the (2) two Drop Off Pulley Fasteners (shown in Figure 17) to allow the Drop Off Pulley to move within the Adjustment Slot.
2. With the *Power* on, jog the Tower Belt with the *Start* and *Stop* buttons (shown in Figure 20) to position a Belt Profile on the Drop Off Pulley.
3. Position the Drop Off Pulley within the Adjustment Slot such that the top surface of the Belt Profile is in the same plane as the Shuttle Belts.

4. Tighten the Drop Off Pulley Fasteners.
5. Adjusting the Drop Off Pulley may require re-adjustment of the Tower Belt, see Section 3.5.7.

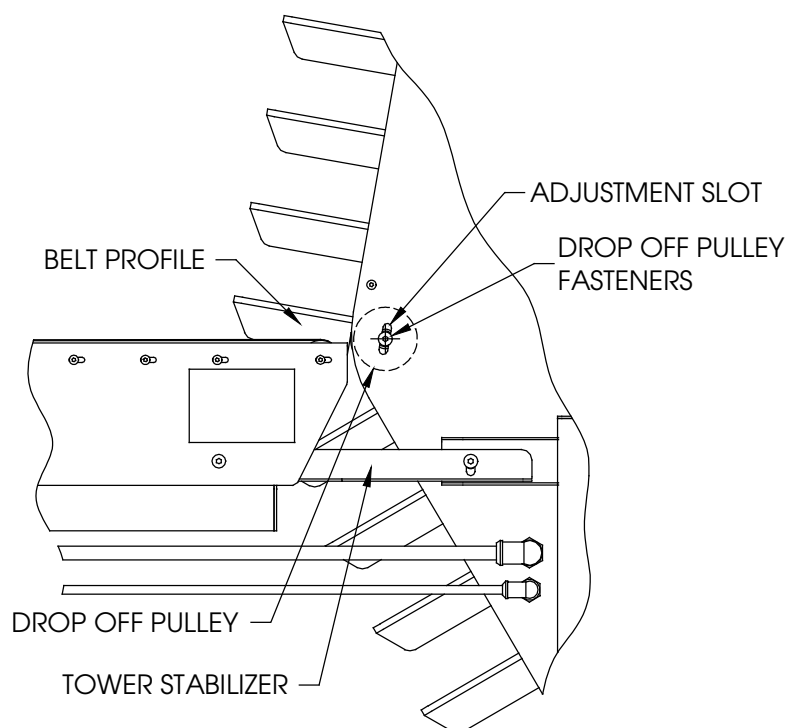


Figure 17. Drop Off Pulley Adjustment

### 3.5.7 Tower Belt Tension Adjustment

The tension on the Tower Belt is set at the factory and should not require field adjustment. However, there are several situations which would require the adjustment of the Tower Belt:

- The Tower Belt has stretched
- The Drop-Off Pulley has been adjusted
- The Tower has been disassembled for service.

To adjust the Tower Belt tension follow the procedure below:

1. Unload all Disk Assemblies from the Tower Belt.
2. Loosen the (2) two Tower Belt Locking Screws (7/32 Hex Key), shown in Figure 18, that hold the Tensioning Pulley in place. Rotate both of the screws  $\frac{1}{4}$  turn.
3. Ensure that the Tower Belt is correctly seated on all the pulleys. The teeth must be engaged on all the toothed pulleys. This can be accomplished by starting the Tower Motor while tightening the Tower Belt.

4. To tighten the Tower Belt, rotate the Tensioning Screws (1/8 Hex Key) so that the Tensioning Pulley moves down. The Tensioning Screws must be rotated equally to maintain the alignment of the Tensioning Pulley.
5. Stop the Tower Motor. The tension is correctly set when the Tower Belt is pulled horizontally at the midpoint of the load side and is flush with the edge of the sheet metal.
6. To check for Tensioning Pulley alignment, a measurement can be taken from the Tension Bar to the Adjustment Ring. The distance on both sides should be equal.
7. Tighten the (2) two Tower Belt Locking Screws to lock the Tensioning Pulley.

**NOTE: Do not over-tighten the Tower Belt. This can bend the Tower sheet metal.**

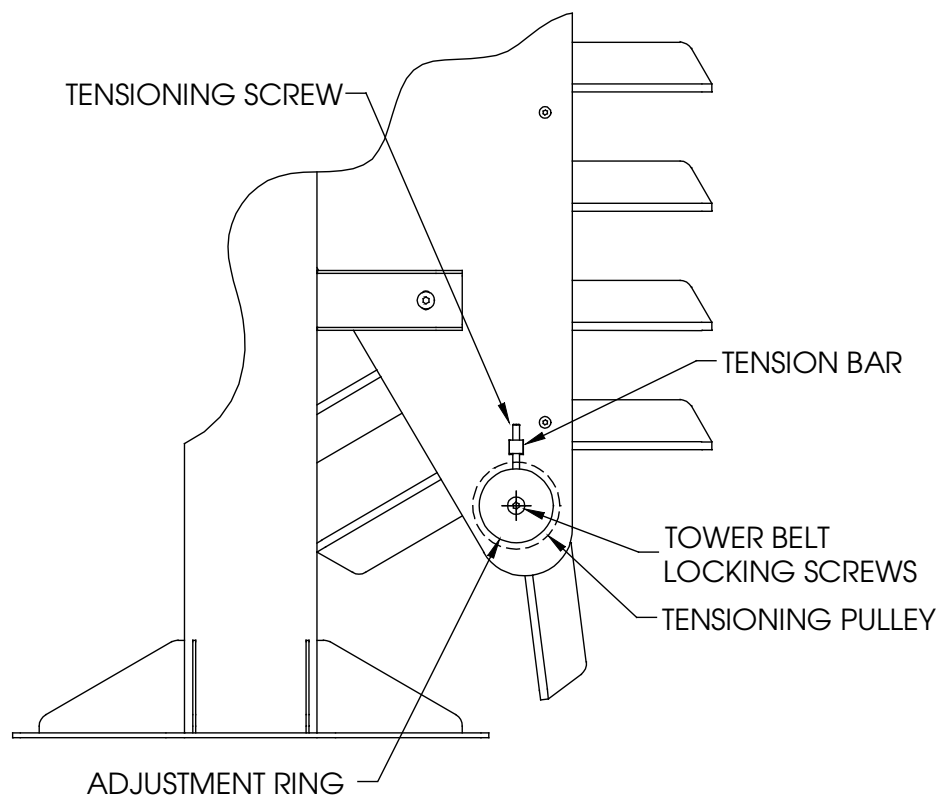


Figure 18. Tower Belt adjustment

### 3.5.8 Shuttle Belts Tension Adjustment

The Shuttle Belts transport the Disk Assembly from the Tower to the Docking Point and from the Docking Point to the spent Disk container. The two Shuttle Belts are tightened with the same mechanism and cannot be adjusted separately. The Shuttle Belts tension is set at the factory and should not require field adjustment. However, there are conditions that may require their adjustment:

- The Shuttle Belts have stretched

The Shuttle Belts tension is adjusted by following the procedure below:

1. Remove the (5) five (3/32 Hex) Motor Guard Screws shown in Figure 19 that hold the Shuttle Motor Guard. Remove the Shuttle Motor Guard.
2. Loosen the (4) four Shuttle Belt (3/32 Hex) Adjustment Screws. This will allow the Shuttle Motor Bracket to move in the vertical adjustment slots in the Shuttle.
3. Ensure that both of the Shuttle Belts are correctly seated on all the pulleys. The "V" on the Shuttle Belts must ride in the grooves in the pulleys, and the teeth must be engaged on all the pulleys.
4. The Shuttle Belts tension are set by moving the Shuttle Motor Bracket vertically. This may require the use of a leverage device (i.e., a screwdriver) to provide sufficient belt tension. A good pry point is between the Idler Shaft and the Motor Gear Box Housing. The Shuttle Belt tension should be set such that the Shuttle Belts can be lifted approximately 1/4 inch above the Shuttle at their midpoint.
5. Tighten the four Shuttle Belt Adjustment Screws to secure the Shuttle Motor Bracket.
6. Replace the Shuttle Motor Guard and the five Motor Guard Screws.

**NOTE: Do not over tighten the Shuttle Belts.**

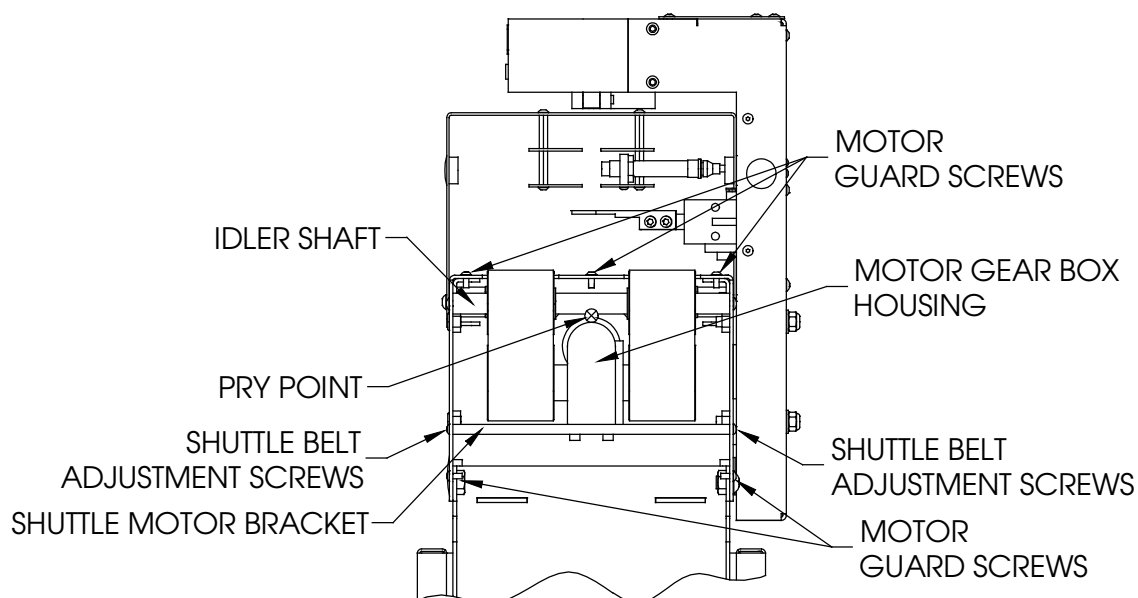


Figure 19. Shuttle Belts Adjustment

## 4.0 Operations

### 4.1 Teaching the Docking Point

The first step in performing a Disk Assembly change is for the robot to maneuver the Disk Collet to the Docking Point in the Clamping Head. To accomplish this the robot needs to be taught two points: the Docking Point, and an Approach Point roughly six to eight inches away from the Clamping Head. To teach these points, it is easier to first teach the Docking Point and then teach the Approach Point by simply backing out of the Clamping Head.

**NOTE: If using a PushCorp Active Force Device (AFD) in conjunction with the Disk Manager, ensure that the AFD is in the *Active* mode (i.e., extended) while docking. This prevents any clamping loads from being transferred to the robot.**

Aligning the Disk Manager with one of the Cartesian axes of the robot greatly simplifies the programming. Position the Disk Collet vertically with the Disk below the Collet. Bring the robot with the Disk Collet to within several inches of the Disk Manager. Position the Disk Collet so that the groove in the Disk Collet corresponds to the shoulder of the Docking Point. Jog the robot so that the Disk Collet moves to the Docking Point in the Clamping Head. Ensure that the Disk Collet is centered laterally by checking the clearance on either side. If the Disk Collet is not centered, the Disk Collet will contact the Clamping Head and will rotate as it moves toward the Docking Point. If the Disk Collet rotates, jog the robot to re-center the Disk Collet within the Clamping Head.

The vertical position of the Disk Collet must also be maintained while jogging into the Docking Point. There should be a clearance gap between the Disk Collet and the top surface of the shoulder of the Docking Point. It is important that the vertical approach be based on the top level surface (not the bottom tapered surface) of the shoulder.

When the Disk Collet is completely seated into the Docking Point, the *In Position* indicator will illuminate. Teach this point to the robot.

The Approach Point can now be taught by simply jogging the Disk Collet out of the Clamping Head 4 to 5 inches making sure not to change the vertical position of the Disk Collet.

### 4.2 Loading and Initializing the Disk Manager

The control buttons and indicators for the Disk Manager are shown in Figure 20.

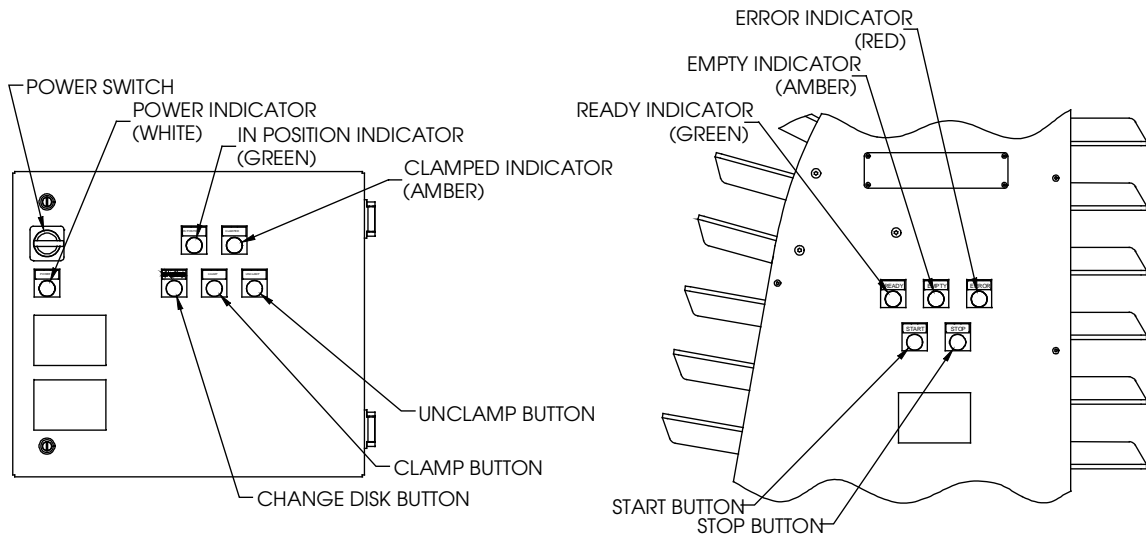


Figure 20. Disk Manager manual controls

To load the Disk Manager, insert the Disk Assembly, shaft first, into the hole in the Belt Profiles attached to the Tower Belt as shown in Figure 21. Disk Assemblies must be loaded from the bottom to the top of the Tower Belt.

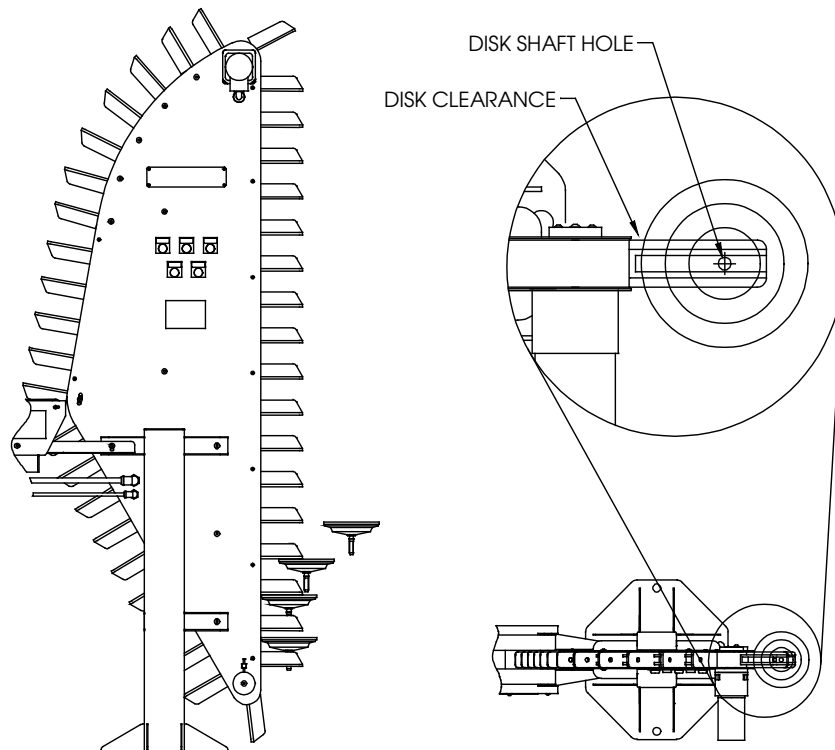


Figure 21. Loading the Disk Manager

To load and initialize the Disk Manager, first turn the *Power* on. The Disk Manager *Empty* light will illuminate to indicate an *Empty* condition. Load the Tower Belt to a comfortable height then press the *Start* button located on the Tower. When the lowest Disk Assembly has risen to eye level, press the *Stop* button located on the Tower. Load the remaining Belt Profiles on the Tower Belt and then press the *Start* button. The Tower Belt will run until a Disk Assembly circulates around to the Disk Ready Station. When a Disk Assembly is in the *Ready* position both belts will stop and the *Ready* lamp will illuminate indicating that the Disk Manager is ready to change a Disk Assembly. At this time more Disk Assemblies may be added to fill the remaining empty Belt Profiles on the Tower Belt. Disk Assemblies can be loaded onto the Tower Belt at any time during operation.

**NOTE: The *Start* button will NOT operate if the DC100-1 Disk Collet is docked in the Clamping Head with the *In Position* indicator illuminated. The DC100-1 Disk Collet must be removed before the *Start* button will initialize the Disk Manager. This feature eliminates the potential for a jam at the Docking Point.**

### 4.3 Changing a Disk Assembly Manually

Before changing a Disk Assembly, visually ensure that the Disk Manager's *Ready* indicator is illuminated. If the *Ready* Indicator is not illuminated, follow the instructions to initialize the Disk Manager in Section 4.2. With the Disk Manager indicating *Ready*, move the DC100-1 Disk Collet to the Docking Point in the Clamping Head. The Base Unit control panel *In Position* indicator should now be illuminated. If not, the Docking Point is incorrect and must be re-taught. The *Change Disk* button located on the Base Unit control panel can now be pressed to initiate the Disk Assembly change cycle.

During the change cycle the Gripper Fingers close, grasping the Disk Shaft. Then the Clamping Head actuates releasing the Disk Shaft from the Disk Collet. The Disk Assembly is then removed and lowered onto the Shuttle Belts. The spent Disk Assembly is shuttled out into a Spent Disk Container while, at the same time, a fresh Disk Assembly is shuttled underneath the Clamping Head. This fresh Disk Assembly is then inserted into the DC100-1 and the Clamping Head released. The Gripper Fingers open and the DC100-1 may then be removed. When the Change Cycle is complete, another Disk Assembly is indexed to the Disk Ready Station. If a Disk Assembly is not detected at the Disk Ready Station, the Disk Manager belts will stop after one complete Tower Belt revolution and the *Empty* indicator located on the Tower will illuminate. To correct this situation load more Disk Assemblies according to Section 4.1.

### 4.4 Changing a Disk Assembly Automatically

The Disk Assembly changing process can be completed automatically by using the digital interface connections. The PushCorp Disk Manager can be run by the robot controller or a dedicated workcell controller. There are ten digital connections, (6) six outputs and (4) four inputs. The outputs are *Ready*, *Common*, *Cycle Complete*, *In Position*, *Empty*, *Error*, and *Clamped*. The inputs are *Change Disk*, *Start*, *Stop*, and *Common*. These controls function identically to their associated lights and buttons. Section 3.3 explains how the digital interface lines are connected to the controller.

Before docking with the Disk Manager the robot should check for a *Ready* signal. If a *Ready* signal is not present the robot should wait. Once a *Ready* signal is received the robot can move the DC100-1 Disk Collet to the Docking Point. The *In Position* signal will come on if the robot has docked properly. If the *In Position* signal is not on, the Disk Collet is not fully in the Clamping Head and the Docking Point must be re-taught (Section 4.1).

With the robot docked and the *In Position* signal on, the robot controller will send the *Change Disk* signal to the Disk Manager. The spent Disk Assembly will be removed from the Disk Collet and a new Disk Assembly will be inserted. At the end of the *Change Disk* cycle, the Disk Manager will send either a *Cycle Complete* or an *Error* signal. The *Cycle Complete* signal means that the robot can exit the Docking Point. If an *Error* signal is present, the Disk Assembly change was not completed correctly and the Disk Manager must be cleared and re-initialized (Section 4.1).

**NOTE:** If using a PushCorp Active Force Device (AFD) in conjunction with the Disk Manager, ensure that the AFD is in the *Active* mode (i.e., *extended*) while docking. This prevents any clamping loads from being transferred to the robot.

**WARNING:** The grinding motor must not be spinning during the Disk Change cycle.

#### 4.5 Recovering from Errors

The Disk Manager has sensors and timers which monitor the operation of the device. Failure to remove or fully insert a Disk Shaft will result in an *Error* signal. The Disk Change cycle will immediately stop and the *Error* indicator located on the Tower will illuminate.

To recover from the error, the problematic Disk Assembly must be manually removed from the DC100-1 Disk Collet. To facilitate this, it may be necessary to manually clamp and unclamp the Disk Collet via the buttons located on the Base Unit control panel. Once the Disk Assembly is cleared and the Disk Collet removed, press the *Start* button on the Tower control panel to re-initialize the Disk Manager. Remember the Disk Collet must be removed from the Clamping Head before the *Ready* light and signal will activate. The *Ready* indicator will illuminate when a fresh Disk Assembly reaches the Disk Ready Station indicating the Disk Manager is prepared for a Disk Change Cycle.

Removing or inserting a Disk Assembly is a very reliable operation of the Disk Manager. If an error occurs there will be a reason. First check the Disk Shaft for wear or burrs. Make sure the Disk Shaft is screwed completely into the Disk, and that the media is not raising or lowering the Pickup Point. If the Disk and Disk Shaft are correct, then check the insertion of the Disk Shaft into the Disk Collet by doing a Manual Disk Change. Misalignment can be corrected by readjusting the Gripper Fingers (see Section 3.5.5).

Another potential problem is that the Clamping Head is not clamping the Disk Collet with enough force to open the Disk Collet. This can be checked by placing the DC100-1 Disk Collet in the Docking Point and manually clamping. Take a Disk Assembly and insert the Disk Shaft into the Disk Collet. If the Disk Shaft does not easily slide in and out of the Disk Collet check the booster pressure. The booster pressure must be greater than

230 psi to disengage the Disk Collet. The Booster High Pressure Gauge is located inside the Base Unit.

**NOTE:** The Disk Manager will **NOT** indicate *Ready* and will not allow a Disk change if the Clamping Head is *Clamped*. Unclamping the Clamping Head will allow the *Ready* Indicator to illuminate.

## 5.0 Specifications

### Electrical:

Supply: 110 - 120 VAC, 60 Hz, 100 W

Interface: Standard 24 VDC Digital

Control lines:

*Inputs:* Start, Stop, Change Disk, Common

*Outputs:* Ready, Cycle Complete, In Position, Empty, Error, Common

### Mechanical:

Footprint: 17" x 63"  
(456mm x 1708mm)

Height: 95 in. (2407mm)

Pneumatic Supply: Dry, 5µm filtered, Non-lubricated, 100 psi (6.9 Bar) min.

Storage Capacity: 30 Disk Assemblies