



# USER MANUAL

## Compressed Air Source Connection



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*Culturing Cells in a Mechanically Active Environment™*  
Flexcell International Corporation • 2730 Tucker Street, Suite 200 • Burlington, NC 27215  
800-728-3714 • (919) 732-1591 • FAX: (919) 732-5196 • [www.flexcellint.com](http://www.flexcellint.com)

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## INTRODUCTION

### COMPRESSED AIR SOURCE REQUIREMENTS FOR THE FX-6000™ TENSION SYSTEM

Optimizing performance on the FX-6000™ Tension System requires a compressed air source able to maintain a free air flowrate of 5.7 cfm (161 L/min) at 100 kPa (14.5 psi). The system can be used with the following configurations:

- **Equibiaxial strain** (with cylindrical Loading Stations™),
- **Unconstrained distension** (without Loading Stations™),
- **Uniaxial strain** (with Arctangle® Loading Stations™).

### EQUIBIAXIAL STRAIN

The equibiaxial strain configuration uses a BioFlex® plate with 6 cylindrical loading posts situated in a Loading Station™ such that the membrane translates across the lubricated planar surface of the loading posts. Distension of the membrane in this way results in equibiaxial strain to the area of the membrane over a loading post. The vacuum requirement to produce a maximum strain of 23% on the BioFlex® membrane in this configuration is -90 kPa. To operate the FX-6000™ Tension System in this configuration, a compressor is required that will provide the following minimum specifications:

**Maximum Pressure: +90 kPa (13.1 psi)**  
**Minimum Free Airflow Rate: 5.7 cfm (161 L/min)**

### UNCONSTRAINED DISTENSION

The unconstrained distension configuration uses the BioFlex® plate without loading posts in Loading Stations™ such that the BioFlex® membrane deforms freely downward.

Distension of the membrane in this way results in a non-uniform strain profile on the membrane that is maximal at the periphery and minimal at the center. The vacuum requirement to produce a maximum strain of 34% on the BioFlex® membrane in this configuration is only -30 kPa. To operate the FX-6000™ Tension System in this configuration, a compressor is required that will provide the following minimum specifications:

**Maximum Pressure: +30 kPa (4.4 psi)**  
**Minimum Free Airflow Rate: 1.3 cfm (37 L/min)**

### UNIAXIAL STRAIN

The uniaxial strain configuration uses the UniFlex® plate, the linear Tissue Train® plate or the trapezoidal Tissue Train® plate with the Arctangle® Loading Stations™ such that the membrane deforms over the top, planar surface of the loading posts in Loading Station™ only at the east and west poles. Distension of the membrane in this way results in uniaxial strain to the area of the membrane over the Arctangle™ loading posts in a Loading Station™. The vacuum requirement to produce a maximum strain of 12% on the UniFlex® membrane in this configuration is -90 kPa. The vacuum requirement to produce a maximum strain of 20% on the either Tissue Train® membrane in this configuration is -90 kPa. To operate the FX-6000™ Tension System in this configuration, a compressor is required that will provide the following minimum specifications:

**Maximum Vacuum: +90 kPa (13.1 psi)**  
**Minimum Free Airflow Rate: 5.7 cfm (161 L/min)**



## IN-HOUSE COMPRESSED AIR SYSTEMS

If an in-house compressed air system is being used in the laboratory, the system capabilities must be known to determine if it is sufficient to operate the FX-6000™ Tension System in the desired configuration. The maximum pressure and free airflow rate of the compressor generated by the in-house air compressor will likely be greater than that required by the FX-6000™, and will therefore require proper air regulation. However, because in-house compressed air is often shared among labs, neither the maximum pressure level nor airflow rate available are certain to be stable at all times.

If access of equipment to measure the capabilities of the in-house compressed air system is unavailable, the FX-6000™ can be safely tested by connecting it to a pressure-regulated outlet. The performance of the unit can be noted with respect to the house compressor to determine if it will be effective enough for experimental purposes. The maximum pressure of the in-house compressor can be tested by programming a regimen with the following parameters: **Sine wave, 0-23% elongation, 0.25 Hz, DC% = 50, 10 cycles.**

This regimen should be run with standard *FLEX IN* and *FLEX OUT* tubing lengths and a BioFlex® baseplate with four culture plates in place and four 25 mm cylindrical Loading Stations™. Adjust the compressed air outlet regulator to approximately +90 kPa and start the regimen. If the actual output minimum % elongation is less than 0.50%, then the in-house air compressor is providing enough positive pressure to run the unit at its maximum capability.

The airflow rate of the in-house compressor can be tested by programming a regimen with the following parameters: **Sine wave, 0-15% elongation, 1.0 Hz, DC% = 50, 20 cycles.**

This regimen should be run with standard *FLEX IN* and *FLEX OUT* tubing lengths and a BioFlex® baseplate with four culture plates in place and four 25 mm cylindrical Loading Stations™. Adjust the compressed air outlet regulator to approximately +90 kPa and start the regimen. If the actual output minimum % elongation is less than 0.50%, then the in-house air compressor is providing enough airflow to run the unit at its maximum capability.

If the output minimum % elongation is higher than 0.50%, then the in-house air compressor is going to be a limitation in the performance of the FX-6000™. This will only be a problem if the combination of % elongation and frequency that is desired for particular experiments is unachievable. Using the FX-6000™ with an air compressor system that does not allow the FX-6000™ to run at its maximum capability will not damage the unit. The FX-6000™ will adjust to make the best possible use of the compressed air that is being provided.

If there are questions about the operation of the FX-6000™ Tension System with the in-house compressed air system, call Flexcell® and ask to speak with a technical service representative.



## CONNECTING IN-HOUSE COMPRESSED AIR SYSTEMS TO THE FX-6000™ TENSION SYSTEM

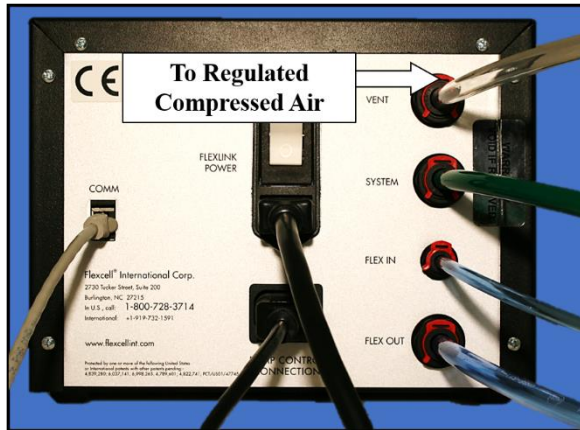
### GENERAL INFORMATION

The FX-6000™ Tension System has a single connection for the compressed air source. This connection port is located on the back of the FX6K™ Tension FlexLink® and is labeled **VENT** as shown in Figure 1.

All of the following compressed air source configurations will need a single source line coming from a pressure regulator to the **VENT** port on the back of the FlexLink®. The **VENT** port requires tubing dimensions of  $\frac{3}{8}$ " (9.5 mm) outer diameter by  $\frac{1}{4}$ " (6.4 mm) inner diameter. Flexcell® recommends the  $\frac{3}{8}$ " clear tubing that is provided with the FX-6000™ Tension System.

install the provided pressure regulator, it is recommended to have a union joint with a 90° elbow installed on the end of the air-line to allow removal the piping past the shutoff valve. The pressure regulator will connect to a  $\frac{1}{4}$ " NPT threaded male fitting.

Each FX-6000™ Tension System will require a dedicated regulator for the compressed air connection. If there is only one FX-6000™ Tension System, only the primary regulator rated to 80 CFM will be required (see Figure 2).



**Figure 1.** FX-6000 FlexLink® back panel.

### COMPRESSED AIR REGULATOR SETUP

If your facility has a central in-house air compressor, speak to the building manager or plumbing technician to drop a compressed air-line into the location of FlexLink® operation. The line will require a shutoff valve within reachable distance to open or close the line. The air-line should be securely offset approximately 2-3" from the wall. To



**Figure 2.** Single FX-6000 regulator setup

For additional FX-6000™ Tension FlexLinks, an additional secondary regulator rated to 14 CFM will be required for each FlexLink (see Figure 3). The primary regulator should be connected to the pneumatic air line that provides direct access to the in-house air compressor. Once the position and layout of the regulator(s) are determined, use a 5/16" drill bit to make holes for the wall anchors. Mount the regulators to the wall with the provided wall anchors and mounting screws.



**Figure 3A.** Regulator setup for 2 FX-6000 FlexLinks



**Figure 3B.** Regulator setup for 3 FX-6000 FlexLinks



**Figure 3C.** Regulator setup for 4 FX-6000 FlexLinks

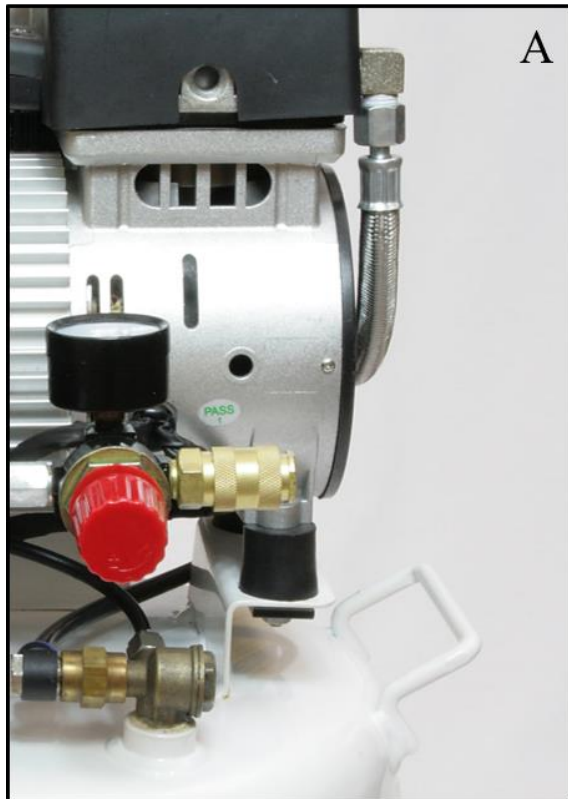
There are 25 mL of color indicating desiccant beads included within the primary regulator. The desiccant beads will act as an indicator of air dryness coming from the air compressor. If the beads begin to turn pink after extensive use of compressed air, contact the appropriate department to make sure the air compressor dryer is functioning properly. Rotate the collection bulb to the left to remove the bulb and the desiccant beads. The saturated beads can be regenerated in an oven set to 120 °C (250 °F) for 1-2 hours. Once the beads have turned blue, refill and replace the collection bulb on the regulator.



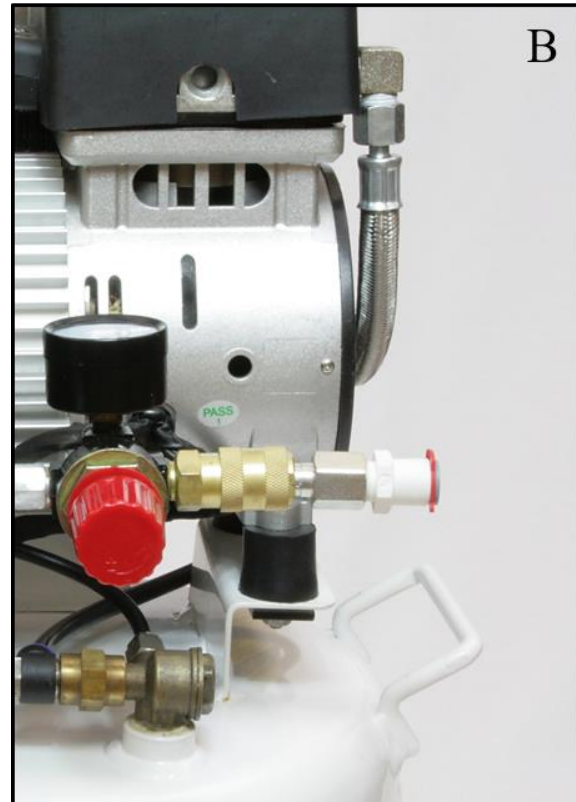


## SETTING UP THE CALIFORNIA AIR TOOLS COMPRESSOR

Carefully remove the compressor from the shipping box and attach the provided rubber feet with nuts to the base of the unit. Push the zinc coupling into the outlet port until the brass ring locks forward (Figure 4A, 4B). Pull on the zinc coupling to make sure it is securely connected. Connect one end of the clear 3/8" tubing from the Tubing and Adapter Kit to the push-to-connect fitting on the zinc coupling (Figure 4C). Cut the 3/8" tubing to the required length to reach the VENT port of the FX-6000 (keep this length as short as possible).



**Figure 4A.** Brass Compressor Outlet



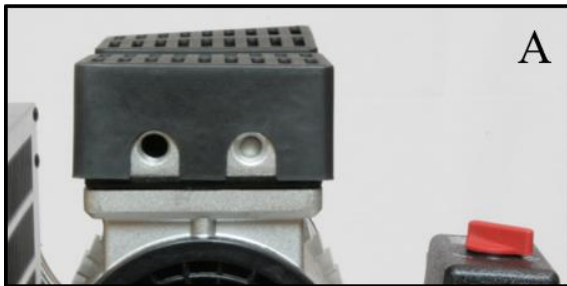
**Figure 4B.** Compressor Outlet with Zinc Coupling





**Figure 4C.** Compressor Outlet with Zinc Coupling and 3/8" Clear Tubing

Push the rigid black tubing into the air intake filter and thread the air intake filter to the air intake port (Figure 5).



**Figure 5A.** Compressor Inlet Port (left opening)



**Figure 5B.** Compressor Inlet Port with attached Air Filter

Use a rubber plug with two openings to guide the drain tubing from the air-drying tower into a reservoir (such as an Erlenmeyer flask, see Figure 6). Connect the provided tubing extender to the filter drain. Use a rubber plug with two openings to guide the extended drain tubing from the filter into a reservoir (Figure 6).



**Figure 6A.** Drain tubing segments from drying tower and filter bulb

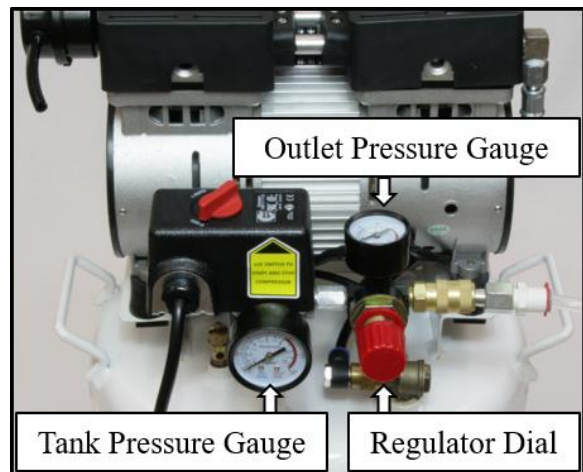


**Figure 6B.** Extended drain tubing segment from filter bulb



**Figure 6C.** Drain tubing segments fed into reservoir flasks

Plug the power cord into a 110 V outlet. Make sure the regulator dial is completely rotated counter-clockwise and turn the red power switch to Auto (Figure 7). The compressor motor should turn on and begin pressurizing the tank. Watch the tank pressure gauge and make sure the motor turns off when the tank reaches 125 psi. Slowly rotate the regulator dial clockwise to allow air to flow from the outlet. Adjust the regulator until the outlet pressure gauge reads approximately 10 psi. The compressor is now setup for operation with the FX-6000.



**Figure 7.** Pressure gauges and regulator dial



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## PHYSICAL SPECIFICATIONS

### Primary regulator

(Item# 4ZK92):      Size (with fittings), L x W x H: 4.5" x 3.5" x 10.0" (11.43 x 8.89 x 25.40 cm)  
Power Requirements:      None  
Weight (unit only):      2.0 lbs. (0.91 kg)

### Secondary regulator

(Item# 4ZK76):      Size (with fittings), L x W x H: 4.0" x 3.5" x 6.5" (10.16 x 8.89 x 16.51 cm)  
Power Requirements:      None  
Weight (unit only):      0.5 lbs. (0.23 kg)

### California Air Tools 1.0 Hp Ultra Quiet & Oil-Free with Air Dryer and Aftercooler

(Item# 10010DC):      Size (unit only), L x W x H: 16" x 23" x 32" (40.6 x 58.4 x 81.3 cm)  
Power Requirements:      110 volts, 60 Hz  
Weight (unit only):      75 lbs. (34.0 kg)  
Running volume:      60 decibels