

Project Title: Cell Culture Incubation Housing

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Function: To develop a cell culture incubation chamber with interchangeable culture plates that is compatible with the Olympus IX71 microscope. This incubation chamber must be able to maintain an internal environment of 37°C, 5% CO₂ and 95-100% over long durations for time course experiments, without compromising the integrity of the microscopes optics or functionality.

Client Requirements

- Internal Environment: 37°C, 5% CO₂, 95-100% humidity
- Little to no temperature gradient
- Easy to assemble and remove
- Housing cannot interfere with optics (transparent)
- Housing doesn't impede microscope function
- Compatible with different cell culture plates
- Compatible with automatic stage
- Cannot allow evaporation
- Condensation cannot interfere with optics

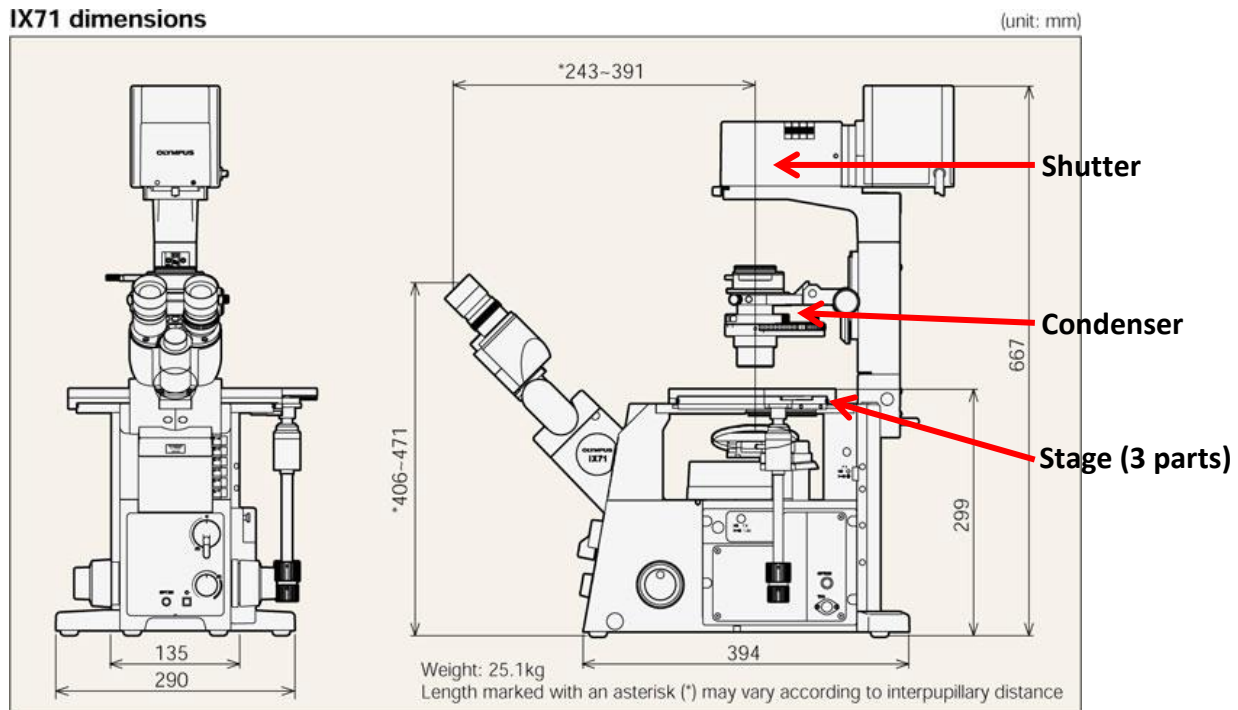
Design Requirements:

1.) Physical and Operational Characteristics

- Performance Requirements:** The incubation chamber must be able to maintain 37°C, 5% CO₂, 95-100% humidity for hours or days for time course experiments, without the formation of a temperature gradient; these environmental conditions cannot damage the optics of the microscope. When the housing is attached, the microscope must remain fully functional. Also, the housing must prevent condensation build-up on a wide variety of cell culture plates as well as the microscopes optics.
- Safety:** The incubation chamber will contain a warming device that will heat the cultures to 37°C, but a malfunction in the heating regulation system could lead to much higher temperatures that could damage the cells, microscope, or even the lab technician. Our microscope housing may be used to image pathogenic strains of cells.
- Accuracy and Reliability:** The cell culture housing must maintain an internal temperature of 37±1°C, a CO₂ concentration of 5±.5%, and humidity between 95-100%. The housing should allow for accurate and reproducible measurements of the microscope that are close or identical to the accuracy and reliability achieved without the housing.

- d. **Life in Service:** The device must be able to be used for up to 1 week while maintaining the environmental constraints previously discussed. The microscope housing should be reusable for different cell culture experiments.
- e. **Operating Environment:** This device will be used by a skilled lab technician and should only experience the environmental conditions previously discussed as well as the environment of the lab, which will be well controlled.
- f. **Ergonomics:** The microscope housing must be easy to assemble, disassemble and store.
- g. **Size:**

IX71 dimensions



IX71 Inverted Microscope overall

dimensions http://www.olympusamerica.com/seg_section/product.asp?product=1023&p=72

Stage

- Fixed Bottom Plate: 240mm(X) x 232mm(Y)
- Middle Plate: 260mm(X) x 180mm(Y), Translates 25mm forward and 25mm backwards from the center point of the stage
- Top Plate: 260mm(X) x 200mm(Y)
 - This excludes the irregularity that juts out at the upper right corner of the stage; this extension measures 42mm(X) x 85mm(Y)
 - Also has a 110mm diameter hole in the center for the stage insert plate
 - Translates to the left 25mm and to the right 25mm from the center of the stage

Working Space

- The distance from the bottom of the shutter to the top of the stage is 232mm
 - The condenser extends out 210mm from the back of the neck of the microscope; it is 107.5mm tall and 110mm wide (measuring from the front)
 - Assuming the effective working space is the area of the top plate of the stage all the way up to the bottom of the shutter, then the dimensions of this area are 260mm(X) x 200mm(Y) x 232mm(Z).
 - These measurements exclude the volume of the condenser as it will most likely be contained within our housing.
- h. **Weight:** Excluding external humidifiers, heat sources or CO₂ tanks, our device should be light enough to carry.
- i. **Materials:** The materials used must be biologically compatible, transparent, water resistant and non-corrosive. The materials should also be able to withstand the expected temperatures range.

2.) Production Characteristics

- a. **Quantity:** 1
- b. **Target Product Cost:** Between \$100-\$200

3.) Miscellaneous

- a. **Customer:** Our client wants a cost-effective design and would prefer that our product cost about \$100 dollars, but we are allowed to spend up to \$200; however, if we came up with a superior design that is outside of this price range, he would consider funding that design. Our client would also prefer if we designed a system that is compatible with non-mixed (100%) CO₂ tanks. The design must be compatible with different cell culture plate shapes and sizes. One of our main goals our client had for this project is to prevent condensation from interfering with microscope readings. Ideally, our microscope housing should be compatible with an automatic stage.
- b. **Competition:** There are many other designs similar to ours on the market. The following is a list of website links that correspond to another companies competing product:
- http://spectraservices.com/Merchant2/merchant.mvc?Screen=PROD&Product_Code=THSS&Category_Code=EC

- http://www.autom8.com/brain_slice_bsc1.html
- <http://www.20-20tech.com/inc-2000.html>
- <http://www.olympusconfocal.com/resources/specimenchambers.html>
- <http://biosciencetools.com/catalog/Closed.htm>