Inclusive Lectern

Final Project Report

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Abstract

A lectern is an essential piece of equipment for almost all speeches and presentations. They come in many forms and range in degree of professionalism depending on the occasion. Lecterns not only hold a presenter's notes, a microphone, or other presentation aids, they provide a structure for a presenter that can bolster their confidence during a presentation. As such, it is important that all presenters have a lectern available to them. Unfortunately this is not always the case due to lectern accessibility limitations. This problem inspired the Cal Poly Disability Resource Center to request a lectern that satisfies the *Least Restrictive Environment* criterion by creating a system that can accommodate the needs of all people, with and without disabilities. It should make the individual as independent as possible with as few adaptations possible, while maintaining a high level of functionality and grandeur. The purpose of this project is to design, build, and test a lectern that can be used at Cal Poly San Luis Obispo for presentation at various location around campus. This report details the entire design process that was used to develop the final concept: design, build, and test. The main function of the final lectern design that allows it to accommodate the widest range of users is its height adjustability. It can adjust to heights ranging from approximately 26 to 52 in. Additional features designed to accommodate the needs of the user include an adjustable worksurface and a roll-on pressure pad actuation system.

1. Introduction

California Polytechnic State University San Luis Obispo (Cal Poly), in the heart of the California Central Coast, is home to over 24,000 students, faculty and staff. As is typical of any university, there are frequently presentations, which vary in topic, duration, location, audience, formality, and presentation aids. One thing that almost all of these presentations have in common is a lectern - a stand that serves as a support for the notes or books of a speaker. The intrinsic value of a lectern is that it creates an air of gravitas that helps to convey the importance of the speaker and the topic.

Each year, the San Luis Obispo County Community Foundation hosts the Paul Wolff Accessibility Advocacy Awards to honor "individuals, organizations, and businesses within San Luis Obispo County [that] make exemplary contributions of time, energy and talents toward the creation of a barrier-free community for people with disabilities" [1]. It was at the 2015 ceremony that John Lee, an Assistive Technology Specialist for the Cal Poly Disability Resource Center (DRC) and the sponsor of this project, discovered an accessibility need that has previously been unmet. During the awards presentation, Mr. Lee noticed that standing presenters were able to use the lectern provided, whereas presenters using wheelchairs were unable to because it was too tall and not adjustable. Mr. Lee introduced this problem to the Cal Poly Mechanical Engineering Department in the form of a senior project. The completed lectern is set to be used in the 2016 Paul Wolff Accessibility Advocacy Awards on May 22, 2016; and after will be available to the Cal Poly community through the DRC.

The project's main requirement is to develop a lectern that creates the Least Restrictive Environment (LRE) for users with various needs, while still maintaining a professional appearance. The Least Restrictive Environment makes the individual as independent as possible by requiring the fewest adaptations possible. In order for the lectern to be deemed inclusive, it must comply with specific Americans with Disabilities Act (ADA) requirements such as: reach distance, wheelchair width clearance, workstation height, toe and knee depth, and height clearance. These requirements serve as a basic set of necessities that will drive the design this project.

Problem Definition

Speakers need an adjustable lectern that creates the Least Restrictive Environment while maintaining functionality and grandeur. As such, we will design a lectern to accommodate the needs of the widest range of individuals that is easily adjustable; wheelchair accessible; and meets or exceeds the features of current, less inclusive lecterns.

2. Background

As stated in the Problem Definition, the lectern needs to be designed to accommodate the widest range of individuals. This includes wheelchair users, people that might find seeing over a standard lectern difficult, or those who find the worksurface to be at an unfavorable height. Adjustable furniture has already been developed for numerous applications; therefore, a study of current adjustable lecterns and height adjustment methods was conducted to better understand possible solutions. First, a standard lectern often used during presentations can be seen in Figure 1. Data from lectern manufacturer AmpliVox shows that for 12 different fixed height lectern models, the average height is 46 in [2]. With the 47 in and 45 in average eye heights for males and female wheelchair users, respectively, according to a University of Buffalo anthropometric database for wheelchair users, it can be seen how this podium can pose challenges to users [3]. A wheelchair user would find the lectern of little use because they cannot be seen from behind it. A typical solution to this problem is to have the wheelchair user present beside the lectern, or make accommodations for a shorter table to be present. In the event a wheelchair user attempts to use the lectern, the presenter is forced to reach to an inconvenient, uncomfortable height and speak without seeing the audience.

Figure 1. A classic lectern

There are currently adjustable lecterns available on the market; however, all of these fail to either create the LRE or maintain a high level of grandeur and professionalism. The adjustable lecterns that maintain a professional appearance often are limited to approximately 10 in of vertical range. These lecterns are designed for standing users or wheelchair users, not both. Figure 2 shows one of the most common designs for a standard adjustable lectern. These lecterns are simple, inherently inexpensive, and are found in many classrooms. The manually adjustable lectern allows the presenter to operate while standing or sitting because the height adjusts from

30-44 in. This style of lectern is an example of a lectern that is adjustable, but lacks the professionalism desired by a keynote speaker or awards ceremony.

Figure 2. A basic, inexpensive, and common adjustable lectern style

The few lecterns currently on the market that do adjust to appropriate heights for a person using a wheelchair, as dictated by ADA standards, are bulky, heavy, expensive, limited in vertical adjustment, and do not provide the appropriate air of gravitas. One example of a lectern that satisfies wheelchair inclusivity is shown in Figure 3. One key parameter seen in Figure 3 for designing to meet the needs of a wheelchair user is the width. The lectern must be wide enough to allow the user to approach unobstructed and use the worksurface comfortably. The bulky appearance adds difficulty in meeting the aesthetic appeal of grand lecterns, but is necessary to provide adequate privacy to wheelchair users.

Figure 3. ADA compliant lectern with height adjustability

After reviewing the existing lecterns, there is an evident need for a lectern that is: light, visually appealing, ADA compliant, affordable, and capable of adjustment heights to suit both standing users, and those using wheelchairs. For these, or any lectern to receive ADA compliancy, the lectern must meet some basic, geometric requirements. The ADA guidelines present a list of clearances that must be met in order to properly accommodate people in a wheelchair. The dimensions are shown in Figure 4 and specifically define knee depth, knee height, toe height, overall width, and overall depth dimensions. Finally, the guidelines present some mobility data that outlines maximum horizontal and vertical reach a wheelchair user has depending on the obstacle they are navigating. This information is useful for determining the ergonomics of an inclusive device and how the user interface will need to be located.

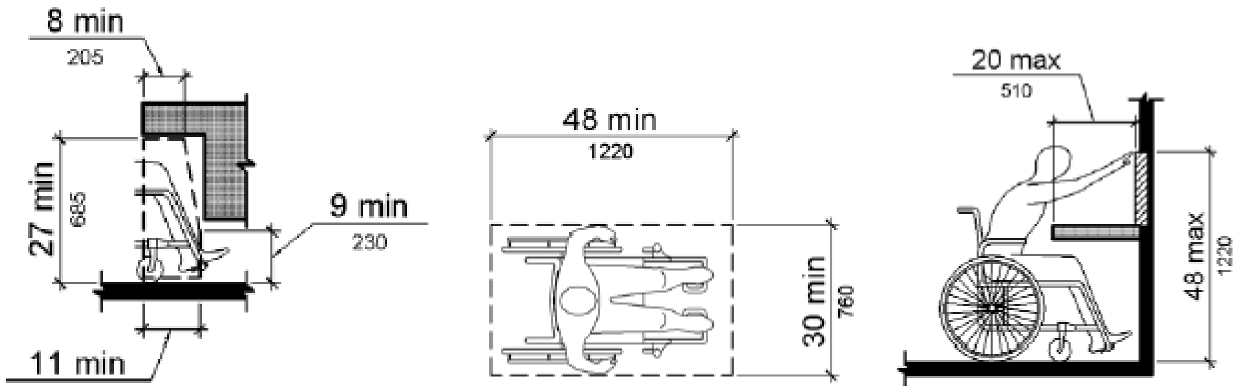


Figure 4. Various ADA guidleine governing dimensions

In addition to the ADA guidelines, we found a study conducted by the University at Buffalo that gathered anthropometric data for 121 wheelchair users. The subjects of the study we both male and female, and measurements of both manual and powered wheelchair users were gathered. The information will be used in the detail design to aid in determining the overall height of the lectern at the lowered state that allows for the presenter to still be seen by an audience. Finally, the measurements that record the arm rest and foot rest positions will be essential for the placement of the user controls.

Aside from the aesthetics and inclusivity of the designs discussed above, the adjustment method is an important feature of an inclusive product. Therefore, research was conducted in regards to the method of height adjustment. Two of the most prominent forms of vertical adjustment include the lead screw and linear actuators. Lead screws are commonly used for 3-D printer vertical adjustment, and linear actuators are found in adjustable computer table legs. These automated designs provide easy adjustment, at the cost of required power, increased weight, and overall system complexity.

Furthermore, passive lowering techniques, such as a spring damper systems, have also been considered for height adjustment. These systems are commonly seen in office chairs and would lower under the lecterns own weight, but would require manual adjustment from the user to raise it. Figure 5 is an example of an adjustable lectern that operates on this principle. It uses a foot actuated hydraulic to raise the lectern. The user can lower the lectern by stepping on the foot pedal, and pressing the top surface down. The lectern in Figure 4 was available to our team and we found that while it is easy to use, the height adjustment range is limited and it does not achieve the desired aesthetic.

Figure 5. A foot-operated hydraulic lectern from Displays2Go

In addition to lecterns, there is other furniture on the market that currently feature automated adjustment. Most of these systems are adjustable for ergonomic purposes, and do not design for an inclusive product. The Ergosource desk shown in Figure 6 uses guided linear actuators to raise and lower the worksurface at the push of a button. Our team has researched similar desks and found that this method of raising and lowering is fast, quiet, and easy to use.

Figure 6. An adjustable desk by Ergosource

3. Objectives

The goal of our team is to design and build a lectern to accommodate the widest range of people that is easily adjustable, wheelchair accessible, and meets or exceeds the features of current less-inclusive lecterns. To address the problem detailed in the problem definition, our team plans to design with the most inclusivity and LRE in mind. With regard to the required adjustability, our goal is to allow for adjustment, but prevent the mechanism from pinching or trapping the user. To allow for full control during the presentation, another goal is to integrate audio and visual systems such that the speakers can control the entire presentation by themselves. Finally, our team aims to create a product that preserves the grand aesthetic of lecterns such that the lectern will complement the reverence of the speaker.

Customer Requirements

Below is a brief list of important customer requirements defined by the sponsor.

- Adjustable in height
- Wheelchair friendly
- Maneuverable
- Include standard features of a presentation lectern
- Maximize independence of user

Our team translated all the requirements and other specifics defined by John Lee into measurable engineering specifications. The engineering specifications will drive the product design and be the metric used to evaluate the product in the development and testing phases of the project.

Quality Function Deployment

The Quality Function Deployment (QFD) is the tool our team used to translate the customer requirements outlined by John Lee to the engineering specifications to which our team will design. The product of QFD is known as the House of Quality, which can be found in Appendix A. Inside the *house* are various weighting systems that evaluate the customer's requirement against who the requirement affects, how they can be designed and quantified, and current related products. The *house* is constructed to facilitate the comparisons and output values that identify the importance of each engineering specification. The far left column contains the 'Whats' of the project in the form of customer requirements such as "adjustable." The top row contains the 'Hows,' which are the engineering specifications that translate the qualitative requirements into quantifiable specifications. For example, an engineering requirement of "28-52 in" would be defined for the customer requirement of "height adjustable." The center section of the house addresses how many and to what degree each customer requirement and engineering specification relate. Outlining this section are the Competitive Assessment rows and columns that evaluate how existing products meet the requirements and specifications listed in the previous sections. Finally, each requirement is weighted to effectively order the importance and identify how it relates to the specifications. When completed the normalized weight in the bottom row ranks the importance of each engineering requirement based on an extensive evaluation of the customer requirements.

Engineering Specifications

The main function of the QFD, described in the previous section, is to develop the engineering specifications for the project. The specifications are the most important aspect of this report because as engineering students, our team will design the product to be tested against these metrics. Without proper definition of the specifications, time and resources can be wasted designing the wrong product.

In addition to creating a House of Quality, the compliance method of verification was implemented for a detailed study of the engineering specification. A compliance table was created to summarize the engineering specifications, the metrics associated with them, and the manner in which they will be tested or verified. The requirement and tolerance columns contain nominal values or boundaries for each specification. The compliance column addresses how the important specifications will be verified. The four methods used include Analysis (A), Test (T), Similarity to Existing Designs (S), and Inspection (I). Analysis refers to verification of a specification through engineering modeling, calculation, and analysis. Testing specifications provides verification through a physical test of the product, or component of the product. Similarity to Existing Design is a rare, subjective comparison to existing technology, or standards. Inspection is verification by visual assessment. Finally, the risk column defines the feasibility that each specification will be verified in the final design. Risk is measured in high (H), medium (M), and low (L). For example a high risk item is unlikely to be integrated in the final product.

Table 1. Compliance Matrix

Spec #	Specification	Requirement or Target	Tolerance	Risk	Compliance
1	Table Height Range [in]	28-52	1	L	T
2	Table Horizontal Range [in]	12	2	L	T
3	Audio Pickup Range [in]	16	Min	L	T
4	Controller Distance to WC Arm	6	Max	L	T
5	People to Relocate [#]	2	Max	L	T
6	Steps to Store [#]	3	2	H	T
7	ADA Knee Clearance [in]	27	Min	L	I
8	ADA Depth [in]	25	Max	L	I
9	ADA Width [in]	30	Min	L	I
10	Storage Area [in^2]	9x12	Min	M	I
11	Audio/Visual Ports	HDMI, VGA, 3.5mm	Min	L	I, S
12	Power Rating @ $120V_{AC}$ [W]	800	Min	M	A,T
13	Adjustment Sound Level [Db]	60	Max	M	T,S
14	No. People Like Look [%]	75	Min	L	T,S
15	No. of Sharp Edges & Pinch Pts. [#]	0	Max	L	T,I
16	Vertical Tipping Corner Force [lb]	350	Min	L	A,T
17	Horizontal Tipping Force [lb]	200	Min	L	A,T
18	Price [$]	1000	Max	L	I

The first six requirements address the functionality of the lectern. In order to be inclusive, the lectern shall be able to adjust both vertically and horizontally to accommodate those using a wheelchair as well as those who are not. It will be important to allow the user to control the height adjustment, and for microphone reception and ADA compliancy to be maintained throughout the adjustment range. The lectern will be the only one of its kind on campus so it must be mobile enough to move between buildings and easy to store.

The ADA compliancy is the key spatial requirement and many of the geometric guidelines are referenced in the 2010 ADA Standards for Accessible Design [4]. Other spatial requirements, such as a storage shelf for papers or personal items, will be required to adhere to the guidelines.

The technical requirements are specification numbers 11-13. The lectern will require power for operation of personal electronic devices and depending on the means used for adjustment, any electric motors or pumps. Additionally, to preserve the functionality of modern lecterns, multiple audio and visual connections are required to aid presentations.

Due to the adjustability, safety during operation is a large concern. For this reason, the design will avoid pinch points that can injure the user, avoid adjustment mechanisms that may trap the user, and have a smooth finish on the corners and edges. Furthermore, analysis will be required to assure stability of the lectern when bearing weight on the corners and edges.

There is one high-risk specification on the compliance matrix: the number of steps to store the lectern. If the lectern will have mechanisms that allow it to fold up for storage, ideally it would take less than 3 steps to be fully collapsed. However, when considering that there will also be a mechanism to raise and lower, we anticipate that this goal will be difficult to achieve. The ability to fold up for storage is of less importance than the height adjustability, so the design should not be over-complicated to accommodate this.

Finally, the aesthetic of the final product is of utmost importance. The final product shall have a professional finish, precise craftsmanship, and include the Cal Poly seal. Ultimately, the success of the solution will be judged by the compliance with the specification in Table 1, and they will be the basis of the testing plan once a design is selected and constructed.

4. Design Development

The project will be executed in three distinct phases: design, build, and test. These main phases will guide the design process from a simple problem statement to a final, functioning lectern. At the Preliminary Design Review (PDR), the project is in the middle of the design phase. The design development to this point will be explained in detail throughout the section, followed by the method of approach for the remainder of the project.

Idea Generation

The first step taken to develop a solution was ideation. First, we held a 20 minute brainstorming session where any ideas related to a lectern or vertical adjustment were recorded on a sticky note and added to the idea wall, shown in Figure 7. The results showed that the ideas generated could be separated in three categories: frame, adjustment, and aesthetic. Using these categories, we transferred the ideas into the morphological attributes list where the ideas were categorized and all possible combinations were discussed. For example, one idea from the frame category was selected, then an adjustment method that could be integrated with the given frame was selected. Finally, an aesthetic was selected that fit with the two previous attributes. That combination defined one possible concept to be further considered.

Figure 7. Idea generation through group brainstorming using sticky notes

Additionally, similar products are currently on the market so a method known as SCAMPER was used to see how the products could be modified into a solution for our problem statement. SCAMPER is an acronym that guides a set of questions to apply to an existing solution: Substitute, Combine, Adapt, Modify, Put to other uses, Eliminate, Reverse. This method produced two main concepts that were considered with two others from the morphological attribute list that were further developed in the prototyping exercise.

Prototyping

With the selection process narrowed to five main ideas, a prototyping session was conducted. The goal of the prototyping was to validate the feasibility and functionality of the top concepts. Another consequence of the prototyping was it exposed design sticking points that had to be resolved on the fly to create functioning models. The session revealed four top designs which are shown in Figure 7: three telescoping elements, square nesting boxes, chamfered nesting boxes, mechanical linkage adjustment. These four concepts were proven to work at the simplest level and were then considered for preliminary design through basic analysis and modeling.

The first major conclusion from this prototyping process was that the three telescoping element design, the model on the far left of Figure 7, was much more aesthetically pleasing. This design appears much less bulky than the other three. The other decision was not to proceed with the mechanical linkage system, because housing the linkages in an aesthetically pleasing manner would prove too difficult.

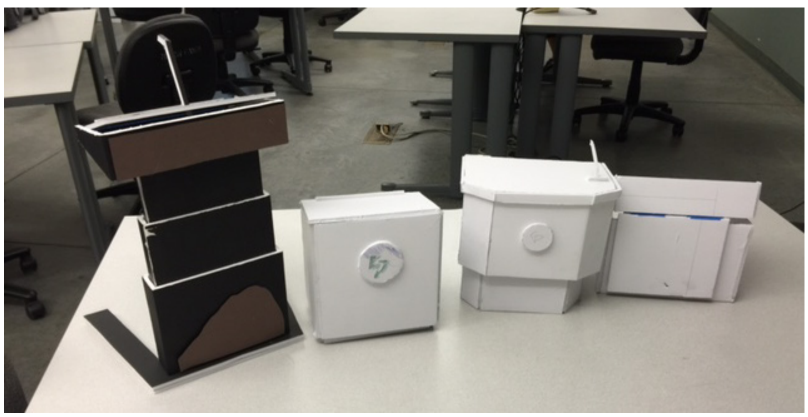


Figure 8. Top four designs from foamcore prototyping session

Idea Development – Adjustment Method

Off-the Shelf System

Many companies produce ergonomic, height adjustable worksurfaces to satisfy the physical demands of its users. Telescoping legs, like the one shown in Figure 9, are often used because it allows for maximum height adjustability, while providing a strong and stable platform to work from. Since the legs are designed using three shorter segments the worksurface is capable of achieving lower heights than a two-segment system and still has the functionality to extend to the upper range of heights. For example, the Workrite adjustable table shown in Figure 9 has a vertical height range from 22 in to 48 in. This type of system could be integrated into a lectern to satisfy the specification for height adjustability.

Figure 9. Telescoping leg of adjustable height workstation from Workrite

These systems have been proven for numerous height adjustable tables and desks, and present additional benefits that beyond just the range of height adjustment. The legs also provide the main support for the worksurface of the lectern. The use of these two legs prevents the need for additional guides to ensure stability and functionality. It is critical in the design of the lectern to create the LRE and minimizing the space needed for the mechanical system allows for more room for the user. Inclosing the lift mechanism in the legs prevents exposure to moving parts, thus reducing the possibility of damage and eliminated potential pinch points. A concept for integrating the cascading legs in a lectern is shown in Figure 10.

Figure 10. 3-D model of off-the-shelf system at various height positions

The cascading leg system allows for a unique solution to address how the body of the lectern will move as the lectern adjusts height. Figure 11 shows how the privacy panels that shield the user's legs from the audience retract behind one another.

Figure 11. Motion of privacy panels through adjustment range

The legs are powered by a series of linear actuators, or hydraulic cylinders. Linear actuators allow for quiet, reliable, and precise adjustment of the lectern. By using two actuators in series in each leg, actuators with a smaller stroke can be used as opposed to a single larger unit. There are currently complete systems on the market that integrate the controls, either mechanical or electric, with the actuators.

While this system provides a solution to meeting the customer requirements, there are a few potential issues that need further consideration. This system creates numerous moving parts and critical component interactions, which can cause issues with reliability and functionality if not executed properly. Additionally, off-the-shelf systems are typically expensive and this may create issue with staying under the project budget.

Lead Screws and Linear Actuators

A lead screw, also known as a power screw, is a mechanism used to transmit rotary motion into linear motion. They come in a variety of thread profiles, diameters, pitches, and lengths. Examples of some of the combinations are shown in Figure 12. Due to their versatility, their applications include: benchtop vices, 3-D printers, front doors of airplanes, and countless other systems. The screw rotates about a fixed axis and the pitch angle causes the nut to travel linearly. The system may be configured such that either the screw or nut is fixed while the other is attached to the component to be moved.

Figure 12. Lead screw examples from Stock Drive Products/Sterling Instrument

This design proposes using a lead screw, powered by a motor, to accommodate height adjustment of the lectern. Lead screws provide a simple system that is easy to package, therefore, it could be easily integrated into an aesthetic concept. For example, Figure 13 demonstrates how the system could be mounted in a nested box design. The lead screw would be attached to the upper section of the lectern and would drive through a fixed member of the lower section, as shown.

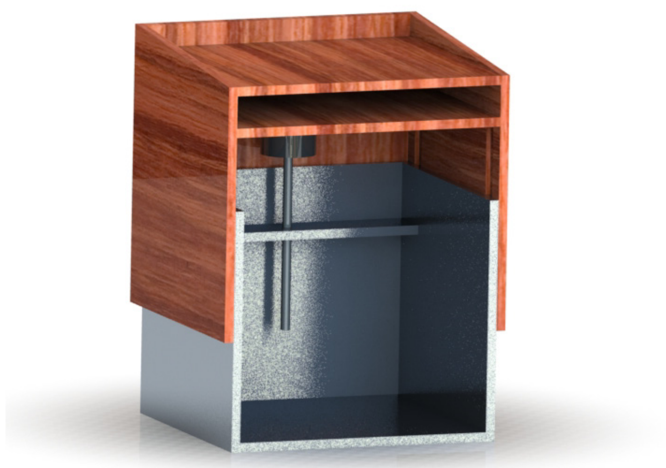


Figure 13. Concept rendering of the lead screw design

Figure 14 illustrates another necessary feature for the proposed lead screw design. With a large piece of furniture, having only one attachment point yields unstable adjustment. Therefore, hidden grooves, two on each side, act as linear guides for the vertical motion to ensure stability and eliminate slop between the two sections. The lower section would be fitted with a roller to ensure smooth and quite interaction between the two sections during adjustment.

Figure 14. Detail of the guide rails

As with any design solution, there are anticipated trade-offs for using a lead screw. The first benefit is lead screws are a common, off-the-shelf part so there are nearly unlimited sizes at low cost. Additionally, lead screws are inherently self-locking, so in the event that the power is disconnected it will remain at the current height. Finally, they are designed and sized using simple analysis, provide precise motion, and provide smooth and quiet adjustment. The main disadvantage of lead screws is their inefficiency. An ACME lead screw has a typical efficiency between 30-50%. Therefore, a lot of the input power is lost as friction on the threads, which in turn wears the threads quickly and wastes energy.

A linear actuator is a mechanical system that creates motion in a straight line. They are usually powered by a motor connected to a mechanical component that converts rotary motion into linear motion. Such components include: lead screws, jack screws, roller screws, rack and pinions, chain drives, belt drives, cam and followers, and many more. A ball screw linear actuator is shown in Figure 15. Hydraulic and pneumatic actuators are also common.

A linear actuator system accomplishes essentially the same motion as a lead screw, but is simpler to implement. Sizing a linear actuator is based around desired stroke length, bore diameters, and actuation speeds. They come prepackaged, with sizes and electrical components already engineered. The design of a lead screw system involves sizing the lead screw and nut, as well as a motor, shafting coupling, and possible gear reduction. Both systems would require guide rails on the sides for stability.

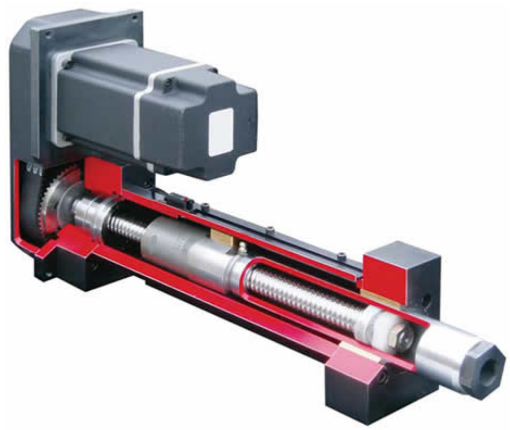


Figure 15. Ball screw linear actuator from Kuroda Jena Tec Inc

Mechanical Linkage

The mechanical linkage solution was developed to provide a manual option for raising and lowering the worksurface of the inclusive lectern. The linkage is a standard 6-bar linkage that operates through a 65° range to provide various heights. The linkage modeled in Figure 16 was designed with equal length linkages such that it keeps the worksurface at the same operating angle throughout the entire range of heights. Finally, with the maximum knee depth clearance for ADA compliance at 25 in [2], the lectern shown in Figure 16 is adjustable from 27 in to 44 in.

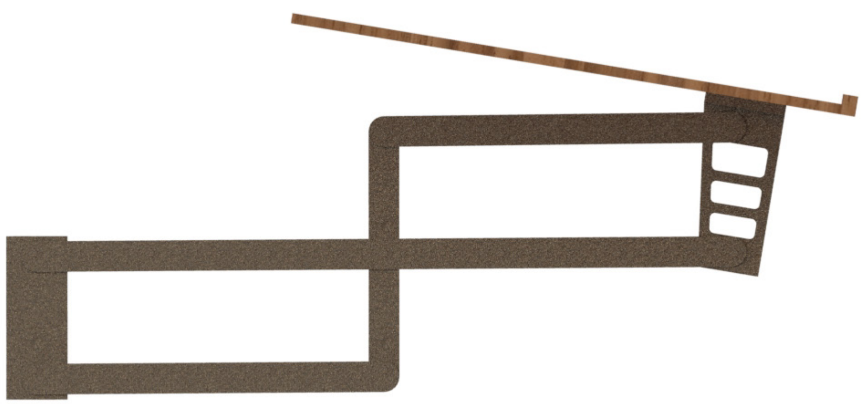


Figure 16. Equal length, parallel motion 6-bar linkage

The feature that sets the mechanical linkage design apart from the other options is the width changes in conjunction with the height. At the lowered state, the lectern is the widest to allow for knee clearance as outlined in the ADA guidelines for wheelchair users [2]. The additional width for wheelchair clearance is not required for standing users; therefore, the lectern becomes narrower as the worksurface is raised. Figure 17 provides a visual of the lectern at both extrema.

Figure 17. Mechanical linkage solution in fully collapsed and fully extended positions

The weight of the mechanical linkage system is another benefit. The system is much lighter because there is no need for motors, inverters, and controllers that are required for automated adjustment methods. Also, many of the other options are a fixed width, but this option can be made narrower to allow for better storage. Next, the desired angle of the worksurface is independent of the motion as shown; however, by lengthening the topmost link, a variable angle worksurface may be achieved. This may be beneficial to provide less obstruction when the lectern is in the lowered state.

The main drawback of the mechanical linkage system is the aesthetic. Since the motion is two-dimensional, it is difficult to maintain a professional look throughout the range. The main sticking point are the sides of the lectern. Preliminary design revealed that it would be easy to implement paneling that would provide a given aesthetic at the extrema, but at intermediate locations the paneling looks out of place. Additionally, the manual system provides challenges for the adjustment. The adjustment would require an air spring, or similar device, to assist with the adjustment, but it is still a physical event that may not allow the adjustment aspect of the lectern to be inclusive.

Gas Spring

The final method of height adjustment considered for the inclusive lectern is the use of a gas spring with vertical guide rails. A gas spring works through a piston compressing pressurized nitrogen gas in a cylinder to create a “spring” force. This design gained inspiration from the use of gas springs in adjustable computer chairs, and is operated in a similar manner. The gas spring would be sized so the force exerted by the spring would be slightly less than the weight of the supported podium, so when the adjustment lever is activated by the user, the podium lowers in a controlled descent. The lever is then released when the workstation height lowers to the desired level. The lectern would have to be manually raised if the user desired a larger work station height, with assistance provided by the air spring. The air spring system is modeled in Figure 18.

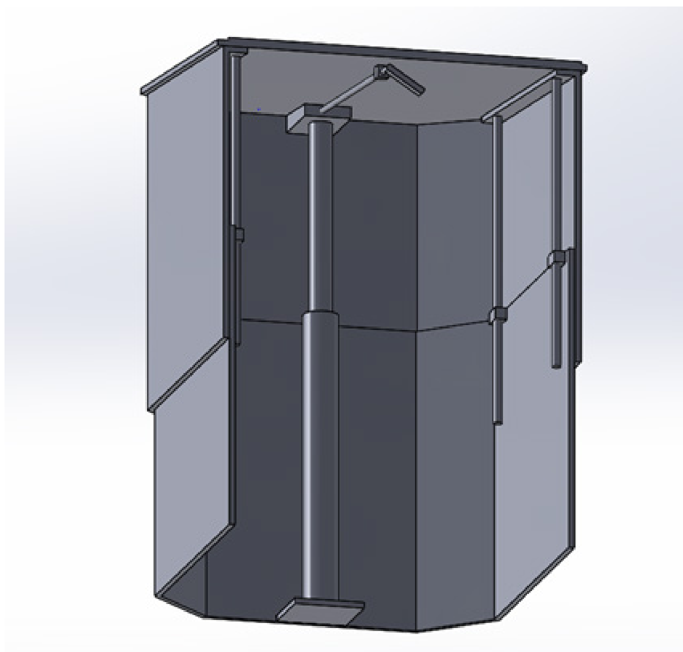


Figure 18. Gas spring adjustment concept

The gas spring method of height adjustment has many distinct benefits and drawbacks when compared to other methods of actuation. Due to the passive nature of the system, the benefits of this system include: simple to operate, simple to design, and inexpensive parts. As described before, this design only requires one lever to operate, and would be intuitive to operate due to its similarity to gas spring systems in office chairs. To avoid any confusion in operation, a basic set of instructions would be displayed on the inner wall of the lectern. This system also requires no motors, control systems, or power sources to operate which results in a simple design process; only an initial spring force sizing and bucking analysis would be needed. Without a motor and control system, this design would be much less expensive than automated alternatives. Finally the compact nature of this design also allows it to be implemented into a variety of different aesthetic designs.

Though it provides most of the benefits in the form of simplicity, the major drawback of this system is the lack of automation. Even though the lectern lowers slowly under its own weight, having to physically raise the worksurface drastically reduces inclusivity. The lack of an automated control system also poses a danger of the work station being lowered too far, to the point where it could make contact with the user's legs when seated in a wheelchair and create a trap.

Idea Selection

The QFD study, described in the Objectives section, showed the aesthetic of the lectern was an important factor of the design, but form would have to follow function since the vertical adjustment is the most crucial specification. This was further supported during research and prototyping; it will be more practical to develop an aesthetic appeal around a skeleton of a lectern, rather than designing a complicated mechanism to match an artistic look. With this in mind, the weighted decision matrix in Figure 19 was used to identify the best solution for height adjustment.

For the evaluation of the four methods, the off-the-shelf method was used as the datum, or standard, against which all other methods were compared. The other methods were evaluated and scored as (-), (S), (+), which define the method as worse than, the same as, or better than the off-the-shelf solution, respectively. The off-the-shelf solution may come in many forms, but the design used for the evaluation is the Workrite Sierra HX adjustable frame system. For this solution, the structure and the control system would be provided and the majority of the effort would focus on system integration and packaging.

The mechanical linkage setup requires compromises to be implemented. The simplicity of the system allows for a low cost, lightweight solution, but has inherent downfalls due to the need for manual operation and difficulties with aesthetic integration. These factors combine to give this solution the lowest score, which categorizes it as a poor solution.

The evaluation of the gas spring is the same as the mechanical linkage because it is also a passive system with a manual controller. However, the gas spring is not considered for final design due to safety reasons that are unable to be quantified in the Pugh matrix in Figure 19. Since the spring's working fluid is a gas, the spring is compressible to a small degree in the static position. Therefore, the mechanism does not provide adequate rigidity should someone lean on it. Furthermore, the spring would be integrated such that the lectern would lower slowly under its own weight and require slight user assistance during raising. As a result, in the event of a failure, the user could be trapped and injured as the system finds equilibrium in the lowered state.

Specification	 Off-the-Shelf	 Linkage & Damper	 Linear Actuation System	 Gas Spring
Packaging		-	-	+
Cost		+	+	+
Ease of Manufacturing	D	-	-	-
Automated	A	-	S	-
Control System	T	-	S	-
Noise	U	+	S	S
Weight	M	+	S	S
Ease of Use		S	S	S
Safety		-	S	-
Sum (+)	0	3	1	2
Sum (-)	0	5	2	5
Sum (±)	0	-2	-1	-3

Figure 19. Pugh matrix comparing height adjustment methods

As discussed in the previous section, the lead screw and linear actuator design is a system that would require a design from individual components including: the driving mechanism, guiderails, and control system. As a result, these systems do not provide a better solution to manufacturing or packaging. This is simply due to the fact that the system would have to be constructed from individual components, whereas the off-the-shelf product is plug-and-play. However, an off-the-shelf system is significantly more expensive than a linear actuator or lead screw. Ultimately, both the systems operate in the same exact way, but the cost of the off-the-shelf system exceeds the budget for the project and limits the packaging ability. Therefore, the linear actuator or lead screw proves to be a superior solution.

When determining the general shape of the podium, two main designs were considered: closed sides, versus open sides. The first design is a lectern composed of two nesting boxes, as shown in Figure 20, which uses a top box that slides vertically over the stationary bottom box during height adjustment. The main benefit of this design is the added privacy of the sides for a person using a wheelchair. The second main design is a work station supported by a single column of telescoping sections. An example of this design can be seen in Figure 21. This design has no sides, which allows a greater inclusivity at the cost of less privacy for the user's lower body.

Figure 20. Closed side general shape

Figure 21. Open side general shape

After consultation with our project sponsor, it was decided that the greater inclusivity of the open side design takes precedence over the added privacy of the nesting boxes. Without the physical restriction of the sides, the lectern can accommodate a wider variety of wheelchair styles. The open side design also has the distinct advantages of being lighter, easier to transport, having less potential pinch points near the user's legs, and being less visually bulky when compared to the closed side design.

For designs of lecterns with open sides, we considered a design with two cascading sections, in addition to the three section design shown in Figure 22. Two telescoping elements may make the design and construction of the lectern simpler, but the three elements design creates more visual intrigue and opportunity for a more sophisticated appearance. Therefore, the three stage adjustment will best achieve the desired aesthetic.

Preliminary Design

The Idea Selection phase reveals the linear actuation system as the best method for the height adjustment. Implementing a completely custom actuation system allows the greatest flexibility for integration with the final aesthetic. This system will allow the user to easily adjust the height of the lectern, while providing the desired professional appearance.

The final design will also include additional smaller features that will need to be considered in addition to the general shape and adjustment methods presented in the previous section. For example, there is a need to develop an adjustment mechanism for the worksurface. Depending on the user's needs, the worksurface may require a greater angle to accommodate limited motion of the head and neck. Furthermore, in an effort to design for inclusivity, control buttons will be integrated into the bottom of the lectern. An application of this type of system is shown in Figure 22. These buttons will be integrated to allow users in a wheelchair to control the height of the lectern with the foot plate of a wheelchair.

Figure 22. Foot activated elevator button

After selecting the height adjustment method, a decision on the aesthetic could be confirmed. When considering the aesthetic selection, it was important to remember the professionalism and grandeur that is expected from the customer. To achieve this, we selected a simple design with clean lines and a luxurious finish. The design features the telescoping three section adjustment and open sides as noted in the previous discussion. The inlaid frosted glass and seal give the design a touch that is unique to Cal Poly by adding a modern touch to a traditional piece. Finally, the aesthetic is married with the linear actuation method in a way that hides the moving parts to create the safest environment for the users.

Figure 23. Preliminary design

This system was validated through simple calculations to show that the lift mechanism can raise the weight of the lectern, along with additional lifting weight, without compromising the performance. For the proposed design in Figure 23, the weight of the upper section is roughly 65 lb. The adjustable furniture from our research is typically rated at 250 lb. Therefore, to meet this standard, we would need to specify a linear actuation device that could lift over 315 lb. This is sufficient because unlike a workstation, the typical load for to be raise on a lectern may include a textbook, laptop, binder, and water bottle in a worst case scenario.

As seen in the QFD in the Objectives section, the height adjustment is the most important specification of the design. This specification was quantified such that the lectern could adjust from a lowered position that satisfies the ADA clearance guidelines to a fully raised position suitable for a 6’6” person standing up. The minimum allowable worksurface height from the ADA guidelines is 27 in [4]. With that fixed dimension, the next decision was to determine the maximum frontal height so the user could still see and be seen from behind the lectern during a presentation. A preliminary study with an adjustable lectern showed that having the front edge level with the pectoral region of the user would allow the user to been seen by an audience on the floor level when the speaker is on a stage. This is a rough dimension for the PDR, but will be confirmed with testing using a wheelchair prior to the final design.

The construction of the lectern will begin with a skeleton that integrates the linear actuation system into a base and raises a platform. This will allow the lectern to function at the basic level and will allow for testing of the system by loading with weights and cycling the system. Once the functionality of the system is confirmed, constructing the aesthetic components that cover the mechanism will begin.

5. Description of Final Design

This section contains a detailed description of the final design of the Inclusive Lectern. Each of the major subsystems of the lectern, including the actuation system, base, top, cascading panels, human interface, and electrical will be addressed. Figure 24 below shows all major subsystems of the lectern in an exploded view.

Figure 24. Isometric view of lectern

The main geometry shown in Figure 24 was heavily influenced by the ADA guidelines that dictated the engineering specifications in Section 3. The final lectern design has the capabilities of achieving heights from 26-1/2 in to 52 in at the base of the worksurface. This range meets the height range defined in Specification #1 of Table 1, in the Objective section, to allow for comfortable use by the 95th percentile of both standing and wheel chair users. Additionally, viewed from the side profile, the lectern has an accessible depth of 20 in throughout the range of aforementioned heights, and a total depth less than 36 in to ensure clearance through a standard doorway. With a projected weight of 150 lb, it is capable of being moved safely by two individuals with the aid of a dolly.

The following detailed sections focus on the selection and justification for the design of the respective section. The justification will address how the selection meets the engineering specifications and customer requirements, and will include analysis, comparison, and explanatory figures. Detailed engineering drawings, a bill of materials, and data sheets are provided in Appendices B, C, and D, respectively.

Actuation System

The actuation system that will be used to adjust the lectern height are the legs from a commercial adjustable height desk. In the preliminary design phases, this option was given serious consideration and was ruled the best actuation method available based on the functionality of the complete system. However, given the project budget, it was deemed too expensive and an alternative to a lead screw actuation method. Since that decision, we received support from Cal Poly who donated an adjustable height workstation to the project; solving the budget constraint that eliminated this method originally.

Figure 25. Actuating table legs

The adjustable workstation that was donated is a Workrite Sierra HXL adjustable table. The table system included two, telescoping legs that are electronically activated through a control box and user interface board. The legs used are more specifically Okin ID21 Lifting Columns. The legs are rated for a 1.6 ips lifting rate, 250 lb load capacity, and 25.59 in stroke length which qualifies their use in our project to meet the specifications without having to design a custom lift system. The use of the commercial lifting system provides an automated system that is easy to use, safe, lightweight, quiet, and reliable. This allowed resources to be devoted to other systems of the lectern.

The Okin ID21 legs, and auxiliary bracketry, require slight modification to be integrated into the final design of the lectern. Figure 26 shows the major components of the leg design.

Figure 26. Collapsed leg assembly

The collapsed height of each of the legs, free-standing, is 21.875 in with a fully extended height of 47.75 in. While the legs provide the necessary adjustability in height, modifications are required to make sure that the adjustability was in the desired range of heights for the lectern. First, to satisfy ADA requirements, the minimum height of a workstation is 27 in. Therefore, modifications were required to ensure a wheelchair user does not get trapped during adjustment. To accomplish this, an aluminum 2 x 3 in cross member will be installed at the top of the legs to offset the worksurface. This provides additional height, while increasing the lateral stability of the leg system. Figure 27 shows the hardware used to attach the crossbar to the legs; this includes the attachment of the modified brackets from the original workstation that will be used to attach the top of the lectern to the legs.

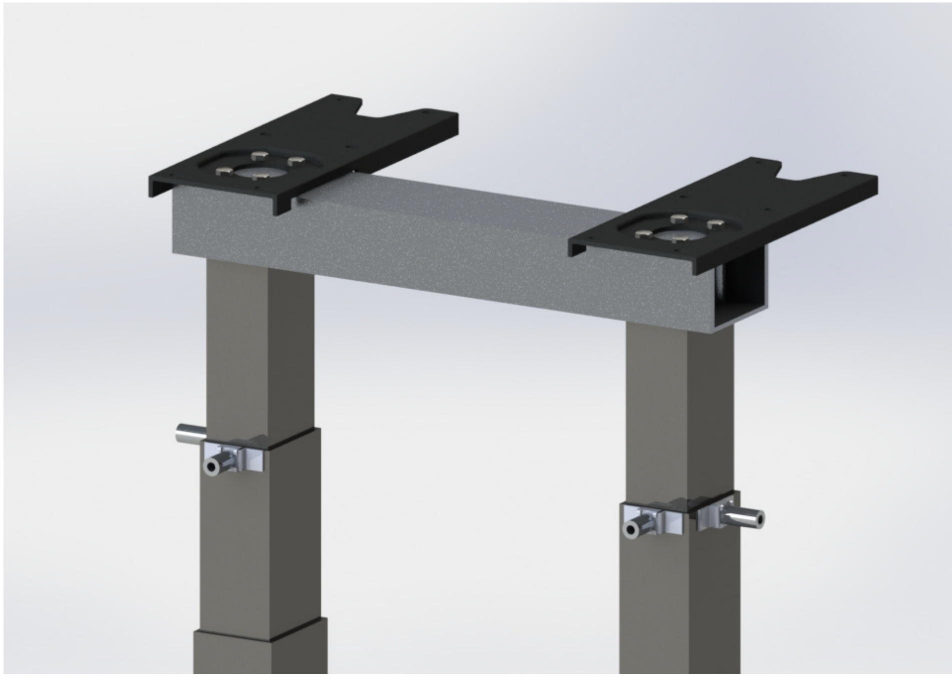


Figure 27. Upper support cross member

The pre-existing four-bolt pattern in the top of each leg will be used along with M6-1.0 x 65mm hex bolts to attach the crossbar and mounting plates to the top of the legs.

The bottom segment of each leg will have 1 in removed to allow clearance for the hardware used to mount the middle panel of the cascading panels. This is due to the nesting nature of the fully collapsed position where the middle segment of the leg sits flush with the bottom segment of the leg. To avoid limiting the full functionality of the legs the material removal is required for the legs to operate without obstruction. Other independent systems were explored, but none would achieve the functionality that was desired, especially with minimum modifications to the existing legs. The hardware that will be used to attach the middle section of the cascading panels will be addressed in the Cascading Covers section. This modification is shown in Figure 28, where the left leg is modified, and the right is a leg in stock configuration to allow for comparison.

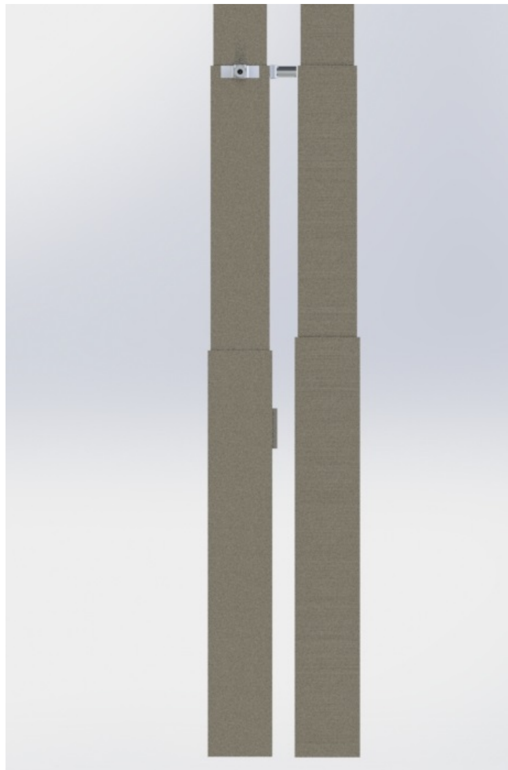


Figure 28. Modified, and unmodified legs

A major concern with removing an inch of material from the bottom segment of the legs is the stability of the legs. In the fully extended position, there is 6 in of overlap between the bottom and middle segments. After disassembling the legs down to the lead screw, we were able to verify the system would remain stable with the remaining 5 inch overlap.

Base

The base consists of a 6061 aluminum subframe wrapped in aesthetic wood paneling. Figure 29 shows the completed base design.

The aluminum subframe consists of a rectangular 4 x 3 in rectangular tube, two 1.5 x 3 in rectangular tubes, and a 3 x 1.5 in c-channel. Figure 30 shows how these elements are combined to create the subframe, and base of the lectern. The connections will be welded together to ensure a strong foundation for the lectern and a permanent joint. The 4 x 3 in tube will serve as the mounting surface for the actuation system described above. Similar to the top of the leg, the existing 4-bolt pattern in the base of the adjusting leg will be leverage to mount the legs to the base. Evaluating the bending moment at the bolt pattern location showed that the four bolts on the bottom of each leg are strong enough to withstand the worst case scenario loading. However, custom bracketry for the legs will be attached to the base to provide additional support to resist the moment acting at the joint. These are shown protruding vertically from the base in Figure 30, and will be constructed from .100 in aluminum sheet metal. Finally, the non-mounting holes throughout the subframe are included to enable routing of the electrical components.

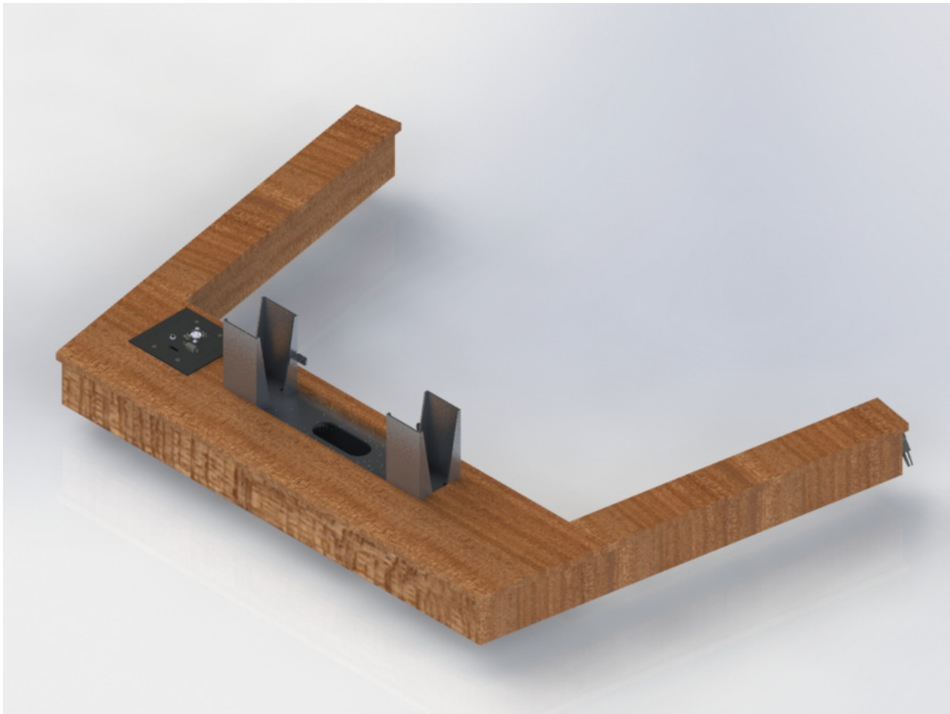


Figure 29. Base assembly

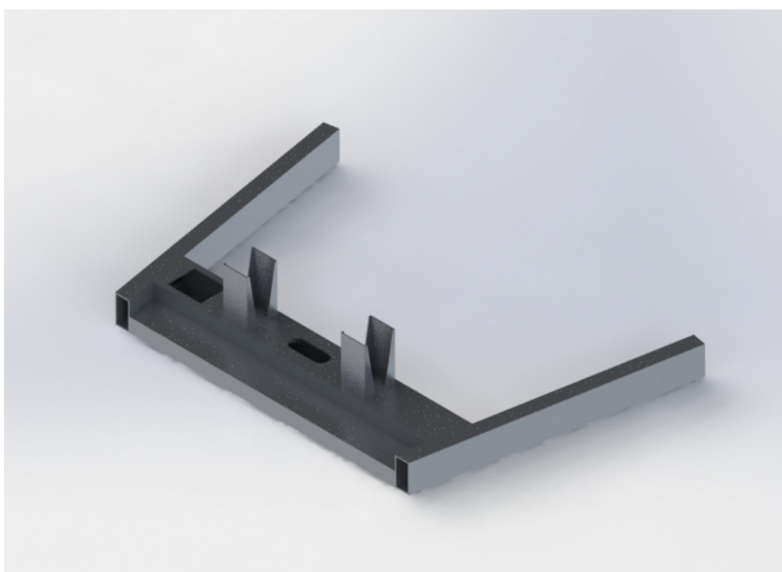


Figure 30. Aluminum subframe

In addition to providing support to resist forward tipping of the lectern, the c-channel is included to extend the front edge of the base for aesthetic reasons. This allows the base to extend farther forward than the front face of the top cover front panel. Aesthetically, we believe this creates a more proportional lectern and portrays a more balanced base. Figure 31 shows the front edge of the base extending past the top front panel.

Figure 31. Base extension past cascading panels

The wood panels surrounding the base will be 1/2 in thick and the top will be 3/4 in thick. The top will consist of three pieces to allow for easier manufacturing and allow the use of cheaper, but higher quality, hardwood in lieu of plywood. The top cover will extend 1/2 in over the sides of the base to add dimension to the structure for an aesthetic touch. The wood panels will be attached to the aluminum using an adhesive specifically designed to join metal and wood; 3-M DP100 epoxy. Since the aluminum subframe carries the entire load of the lectern, the wood serves only an aesthetic purpose and the adhesive will be enough to carry the expected load imparted on the wood.

Nylon feet will be placed each of the four corners of the base as shown in Figure 32. The purpose of the feet is three-fold: they will raise the lectern slightly off the ground to protect the base, allow for fine adjustment of the level, and protect the ground when the lectern is moved.

Figure 32. Feet and frame clearance

There was notable consideration put into including casters on the base of the lectern to increase the mobility of the lectern; however, they also presented numerous drawbacks. Adding casters to the base would significantly increase the size of the base because they demand significant vertical room for operation. Additionally, during use, the lectern needs to be securely in place. While some casters have a locking ability, we did not feel this was sufficient. Additionally, locking casters would require access to switch on and off. This would greatly detract from the aesthetic appeal of the lectern. The combination of these major drawbacks led us to believe casters would not benefit the overall design. Instead, additional equipment, such as a furniture dolly could be used to aid in moving the lectern. The inclusion of the nylon leveling mounts will allow for access of such equipment.

Initial designs of the base had it constructed primarily out of 2 x 4 in wood lumber. When reviewing the design of the lectern with professional wood worker, we were advised against building the structural components of the base out of wood. It is the tendency of the wood lumber to bow and twist over time. In high stress components, such as the extending support legs, this especially critical to try and prevent. To ensure a quality lectern that will last years, aluminum will provide a strong foundation capable of withstanding the loads seen by the lectern.

Top

The desk of the lectern will serve as the main worksurface for the user, as well as house many of the necessary electrical components of the lectern. The plan view of the Top, in Figure 33, highlights many of the elements housed in the top. The side panels of the desk will be constructed out of three 3/4 in solid wood panels and surround a piece of 3/4 in cabinet grade plywood. The side panels will be mitered and due to the relatively short joint, use the biscuit joinery method; creating a seamless corner. The side panels will be connected to the plywood base using a dado joint with wood glue. A shelf will be recessed within the side panels, parallel to the base, to provide the user a flat surface that can be used during a presentation.

Figure 33. Desk assembly

One of the main features of the top of the lectern is a worksurface that adjusts from an angle of 12 to 37°. The adjustability allows the largest number of users to use the worksurface in the most comfortable position possible. For example, a presenter that uses a wheelchair, cannot lean over the worksurface as much as a standing user and consequently would like the angle of the worksurface increased. This does compromise the viewing of the presenter, but is a tradeoff that we would like the presenter to have the ability to make. The adjustment of the worksurface is done through a linear actuator connected to a rocker switch, Figure 34, consistent with the hand controls used to raise and lower the lectern. This will allow the user to easily and reliably adjust the worksurface.

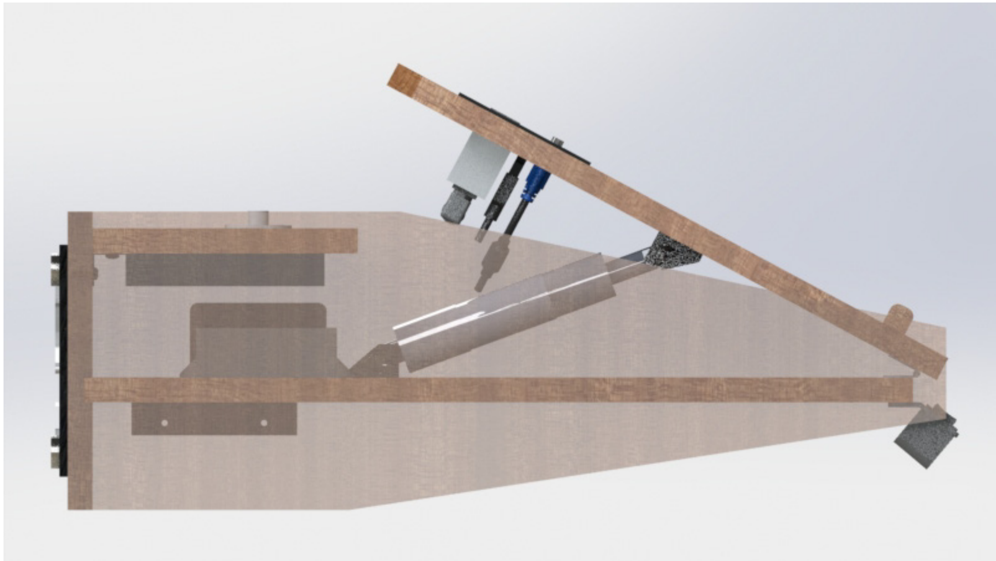


Figure 34. Worksurface linear actuator

In order to hide the linear actuator, and other components stored in the top of the lectern, a set of nesting panels made of black perforated metal will be installed on the underside of the worksurface. As the worksurface articulates, these panels will follow the motion and rotate to hide the inside of the desk. The operation of these panels is shown in Figure 35. A short piece of cable will trigger the motion of the second panel as the worksurface increases in angle.

Figure 35. Concealment panels

The top of the lectern will be secured to the legs through the brackets that came with the original adjustable workstation. The brackets will be modified to suit our lectern design. The connection will be made with six 1/4-20 button head fasteners per leg, as seen in Figure 36. This will ensure a strong connection, and the button head fasteners will prevent sharp edges in the user space.

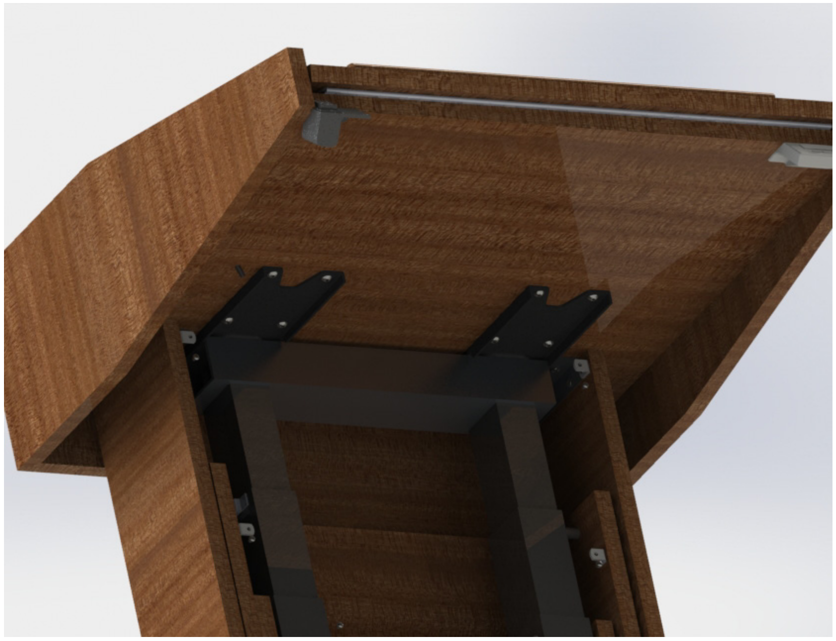


Figure 36. Main actuator top attachment method

Further explanation of the elements integrated into the top of the lectern will be discussed in one of the following sections.

Cascading Covers

A key feature in maintaining the aesthetic appeal of lectern, as it adjust, is the series of three cascading covers. They are designed to match the actuation motion of the legs. This will provide a nice aesthetic when at any height throughout the range, and serve as privacy panels for the user of the lectern.

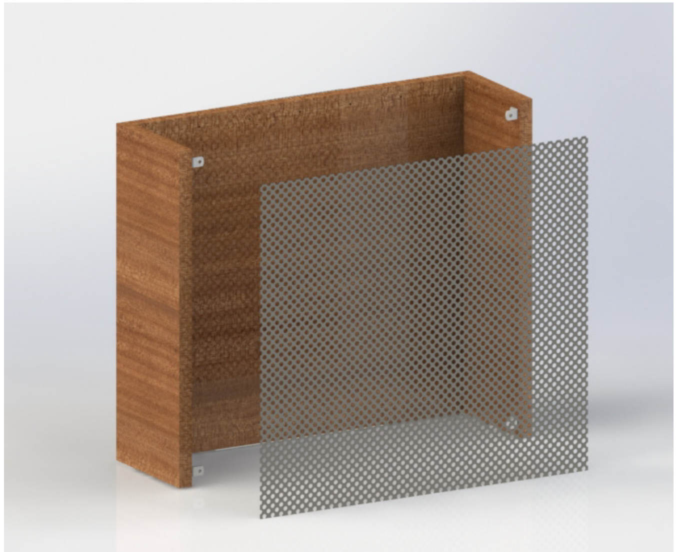


Figure 37. Cascading cover with exploded access panel

Each cover consists of wood panels on the front and two sides, and a sheet of black perforated aluminum to close the back, seen in Figure 37. The wood panels will be constructed from 3/4 in, cabinet grade plywood and connected with a lock miter joint. This type of joint, Figure 38, is a common wood joint that ensures a strong, and seamless, connection between the panels. Since the joint is not structural, and the covers do not bear load, the aesthetic finish of the joint is of utmost importance. This makes the lock miter the proper selection because lock miter, when cut on a routing table, will space and align the joint naturally. The black perforated metal will be connected to the panels by brackets, flush mounted on the backside; removable to access the legs and electronics.

Figure 38. Lock miter joint

Each of the cover successively gets larger as they move up the lectern: bottom, middle, and top. This allows the panels to collapse behind one another without interference. The bottom panel will mount directly to the bottom element of the leg through existing mounting blocks on the bottom section of the legs, as shown in Figure 39.

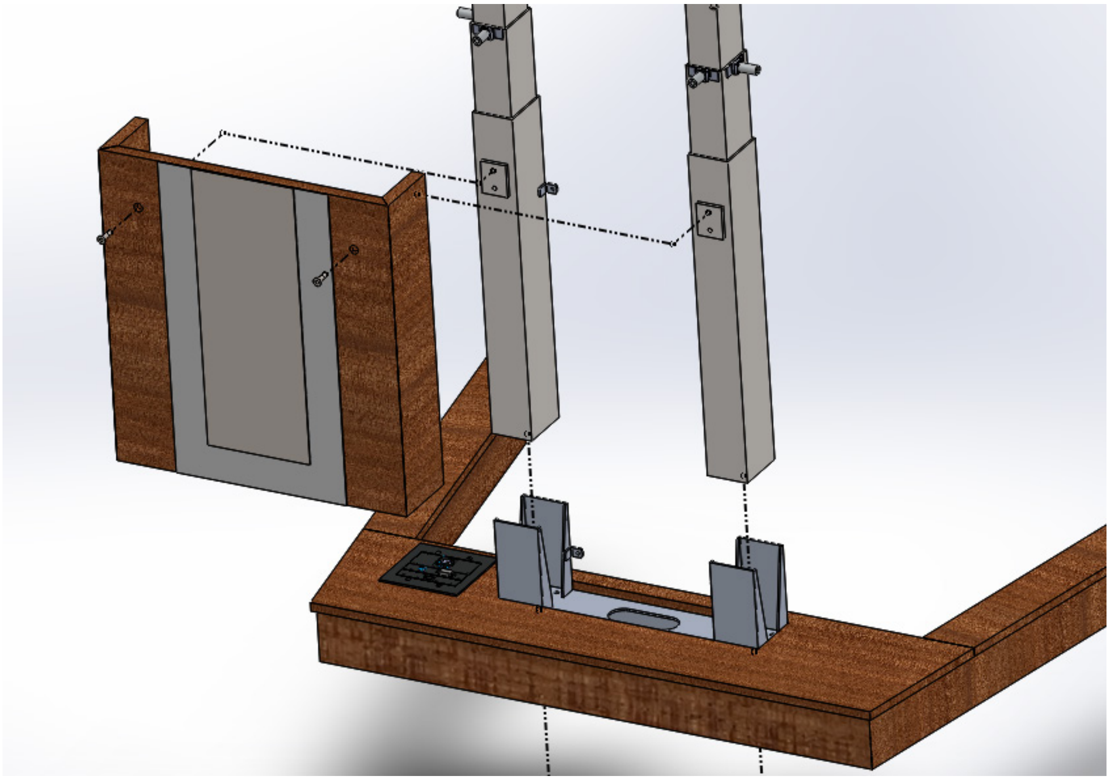


Figure 39. Mounting of bottom panel to legs

The attachment of the middle panel to the legs was not as trivial because of the nesting design of the legs. In order to achieve the cascading effect with the front panels, the middle panel has to directly mount to the middle housing of the legs. However, in the fully collapsed position, there is no surface area for mounting the panel. As discussed in the Actuation System section, an inch of material must be removed from the bottom leg housing to allow for mounting hardware clearance. Weld nuts will be the method used to attach the middle cover to the legs. The weld nuts will be permanently attached to the legs using high strength (metal to metal) epoxy. Epoxy was chosen for the permanent attachment over a welding process because it is a more forgiving process, and avoids disassembly of the intricate mechanism within the legs. Welding would require the legs to be complete dismantled. We had taken the legs completely apart once before and it was challenging to return them to the original working heights, and maintain synchronization. Additionally, not welding will ensure we preserve the electrical components within the leg. The attachment locations of the weld nuts are shown in Figure 40, along with the weld nut spacers.

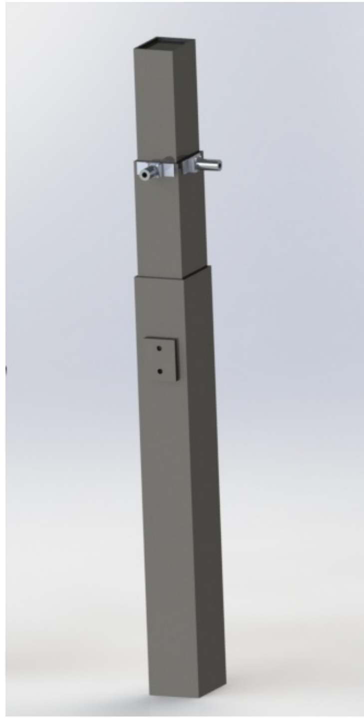


Figure 40. Location of weld nuts

The middle panel is attached to the weld nuts using 1/4-20 countersunk bolts through the exterior of the panels, as shown in Figure 41. The top cover length and the location of the bolts are carefully selected to ensure the bolt heads are not exposed as the lectern raises. Lastly, for the middle cover, metal spacers will ensure proper clearance around the bottom panel.

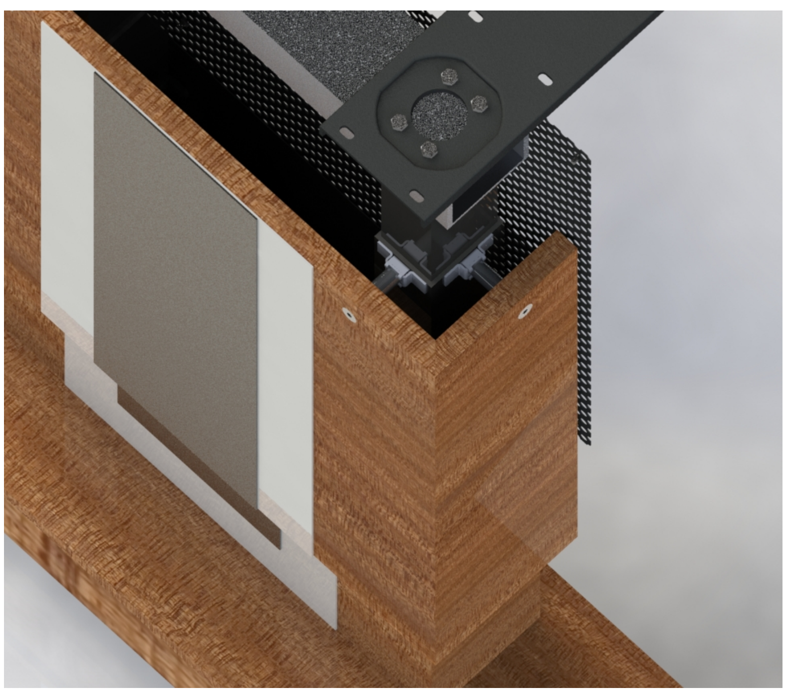


Figure 41. Attachment of middle panel to legs

The top cascading cover will attach directly to the top of the lectern through a set of angle brackets, as shown in Figure 42. The locations of the angle brackets are selected to ensure clearance around the middle cover and allow room for cable routing through the base of the desk section. Additional details about the top section will be discussed in the following section.

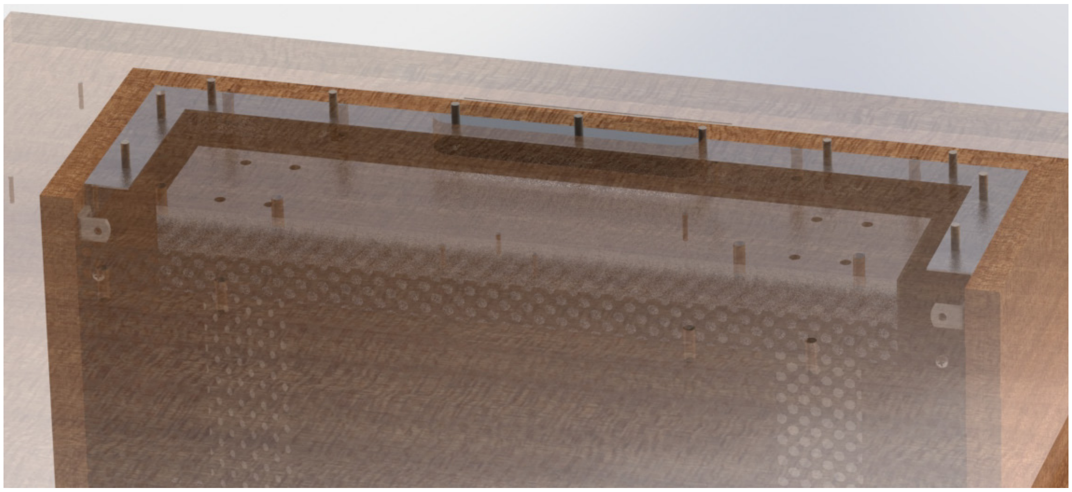


Figure 42. Attachment of top panel

In the construction and assembly of these panels, it is critical to maintain proper tolerance to ensure proper functionality without obstruction. For example, since the covers are mounted only at the top and cantilevered, they are subject to deflection when the lectern moves suddenly. To address this, felt pads will be installed between all critical surfaces to help maintain needed clearances and prevent damage to the surface finish of the wood.

Human Interfacing

The human factors of the lectern are a critical consideration that drives the design of the lectern. A beautiful lectern is meaningless if it blocks the view of the speaker, is not easy to use, or does not accommodate people with a diverse group of needs and abilities. Careful consideration was given during the design of user interaction components to address these concerns.

The first aspect of the human interfacing is the ability of the speaker and audience to connect. The audience should be able to see the speaker regardless of the configuration of the presentation room. For instance, there should be a clear view of the presenter whether the stage is 1 ft tall, or 3 ft tall, and the ability to see the presenter should be should be unaffected by the how far the audience is away from the stage. In accordance with these goals, the lectern should be at a height that is comfortable for the user. Consequently, determining the geometry of the lectern is a multiple degree of freedom problem. The variables of this system are illustrated in Figure 43 and values for these variables were gathered from anthropometric data and geometry specified by ADA guidelines. With this information, we determined the maximum lectern heights at different stage configurations, and therefore determine an appropriate height for the front edge of the lectern.

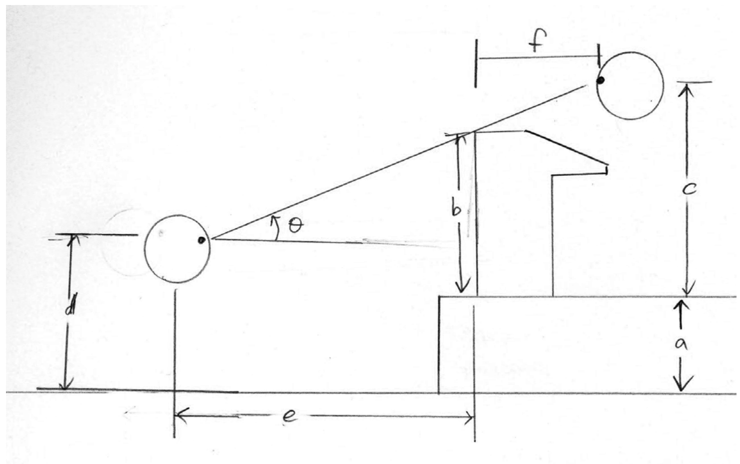


Figure 43. Sketch of the audience and speaker viewing angles

Figure 44 is a plot of the maximum front panel height as a function of the distance from the audience to the stage and the height of the stage. Anthropometric data for a 50th percentile woman using a wheelchair was used to determine the eye-height of the speaker. The eye height of audience members is assumed to be that of a 1st percentile woman, sitting in a typical chair. Using anthropometric height data for women lends itself to more conservative calculations than using the data for men. The desired front edge height – measured from the bottom of the worksurface - is an approximation, assuming the user would want the height of the worksurface to be at pectoral level. The pectoral level assumption was determined through internal testing of standing lecterns at Cal Poly. The intersection of the desired front edge height and the various stage height curves is used as an indication of the feasibility of that front edge height. For this analysis, the desired front edge height was 7.21 in; we used this to determine the design height of our front edge, 6.5 in.

Another important design motivator is that it must be easy to use the lectern. While an instruction manual will be provided, the user should not have to read it to understand which buttons to press to produce the desired output. To this end, all human interaction components (including buttons, switches, pressure pads, and audio/video ports) will be clearly labeled with what they operate. Images, rather than words, will be used as instruction, where possible. This is to prevent a language barrier between the lectern components and the user. An example of such a pictorial is seen in Figure 45, a rendering of the angle adjustment control switch.

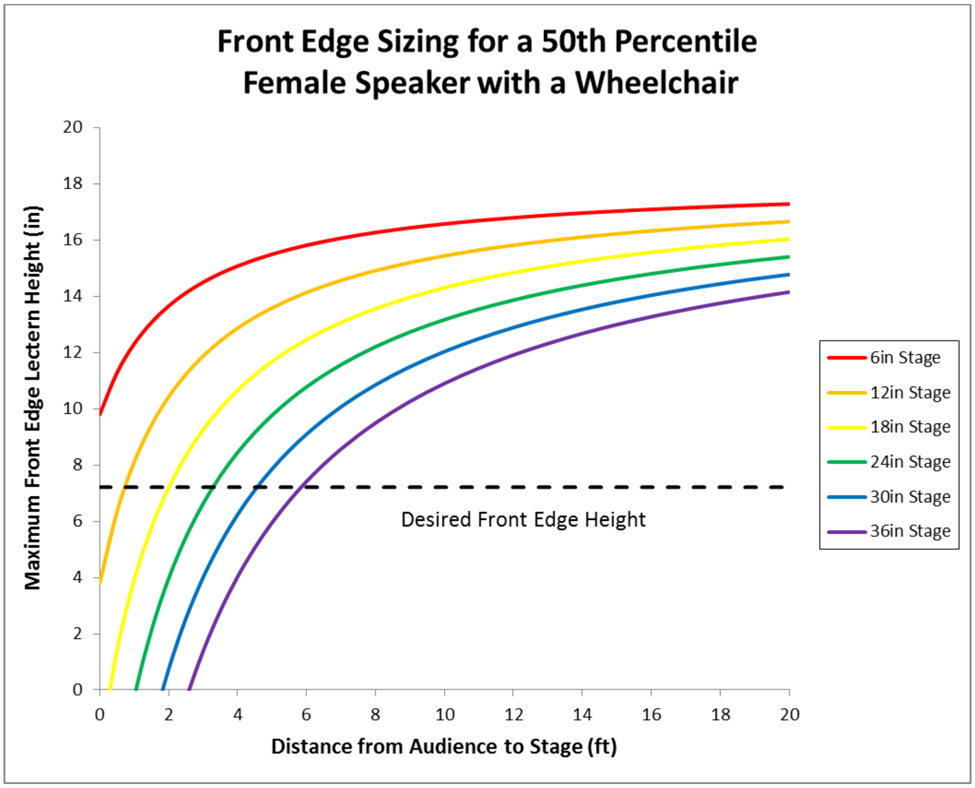


Figure 44. Front edge sizing analysis curves

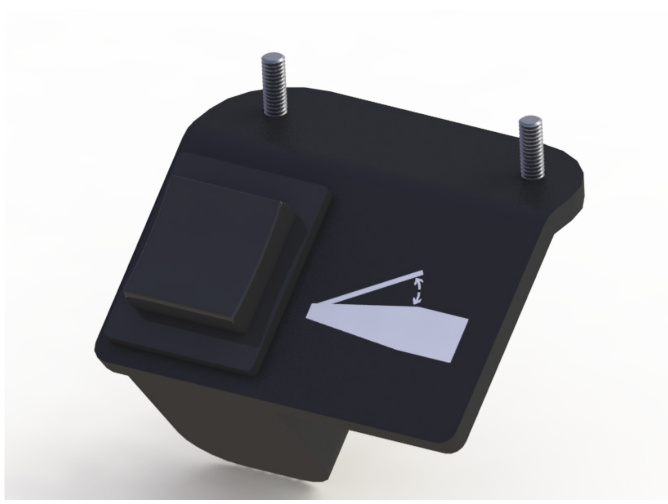


Figure 45. Angle adjustment control switch, demonstrating the use of pictorals

When designing for inclusivity, one of the key considerations we had was maximizing the independence of users with electric wheelchairs. If the lectern was controlled solely with hand-button controls, a speaker with paralysis or limited arm and hand movement would not be able to adjust the height. Therefore, we sought out a method to control the height, without the use of hands. Ultimately we decided on pressure pad switches, placed on the right and left sides of the lectern, which the user could roll their wheelchair onto. The placement of these pads is shown in Figure 46.

Figure 46. Location of foot control pressure pads

These pressure switches are 10 x 17 in, which serves as a large target for users who might not have fine position control. Their size improves visibility, and would prevent standing presenters from accidentally stepping on the pads. As illustrated in Figure 47, the pressure pads will have graphics with arrows painted on them to indicate which direction they move the worksurface. The right pad will raise the surface, and the left pad will lower it. The switch wiring will be spliced into the wiring of the hand controls, allowing for the same functionality regardless of which is used; this is detailed further in the wiring section.

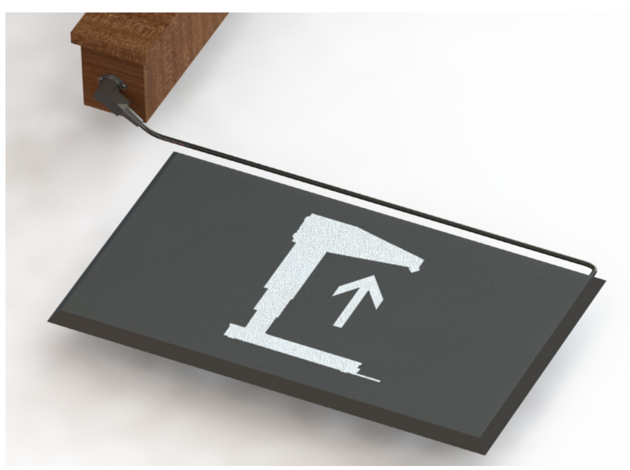


Figure 47. Foot control pressure pad graphics

Audio/Visual

The ultimate goal of the lectern is to design a system that can seamlessly integrate into any setting it needs to be used. This means having the capability of connecting to any room and provide the user all the functionality that they would demand during a presentation. We met with the ITS Classroom Technologies department at Cal Poly to learn what the typical accommodations for a user are and to get a better understanding of available products that could be integrated into the lectern.

The lectern will provide the user audio and visual connection through the use of either an HDMI port or the combination of VGA and 3.5mm audio port. These are the most widely used option and through the use of user-supplied adaptors, almost all devices can be connected. Connectivity for a microphone will also be integrated into the lectern. In speaking with the ITS Classroom Technologies Department, the microphone is a variable dependent on the setting. While wireless microphones are common, the ability to connect a gooseneck microphone to the lectern is needed. A XLR-3 port, the most common connection for microphones, will be provided in the case a wired microphone is used.

Products from Extron Electronics are going to be used to integrate the audiovisual connections into the lectern. Extron products are currently used by Cal Poly, and offer the ability to change the type of connections as technology evolves. The product consists of universal mounting frames with various numbers of slots to allow for various adaptor plates. At the top worksurface, the user will be supplied with a HDMI, VGA, and 3.5 mm audio port in addition to two 120V plugs for power. A XLR-3 port will be installed on the shelf of the top to allow for microphone connection. The various connections on the worksurface will feed through the lectern to another receptacle on the base of the lectern. Images and further information regarding plates and connectivity are detailed in the wiring subsection.

Wiring

Selecting electrical components and developing the wiring layout and is an important part of the design stage. We took careful consideration to ensure that the lectern is safe, reliable, and operates effortlessly. All potential electrical hazards have been mitigated by not having any exposed wiring. System and wiring diagrams are provided in Appendix E.

The Workrite hand control module that operates controller for the table we were given is shown in Appendix B. It features a digital read out that displays the height of the worksurface. To the right of the display are up and down buttons; below the display are three programmable preset buttons, and a reset button. This control module has a 7-pin DIN cable that connects to the controller. Input requests are processed in the controller which outputs commands to the two linear actuators via an 8-pin DIN cable.

Figure 48. CAD model of Workrite height adjustment control module

Controlling the height of the lectern with pressure pad switches, supplemental to the manufacturer's hand controls, is most feasible by splicing the pressure pad wires with the hand control wires. This necessitated us mapping the pin output of the hand control module, to determine what each wire does. We used a digital multimeter to measure which wires had electrical potential while pressing different buttons. A schematic of the pin out is provided in Figure 49, along with the results from our test presented in Table 2.

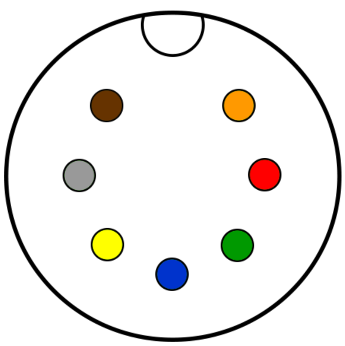


Figure 49. 7-pin DIN connector wire colors

Table 2. 7-Pin DIN pin out mapping

Wire Color	Effect
Black	Ground
Orange	5V whenever any button pressed
Red	5V when legs are raising
Green	5V when legs are lowering
Blue	5V when preset 1 is pressed
Yellow	5V when preset 2 is pressed
Grey	Unknown
Brown	Unknown

We concluded that we can raise the lectern by shorting the red and orange wires, and lower the lectern by shorting the green and orange wires. Using this information, we sketched a schematic of the electric circuit that will raise or lower the lectern with pressure switches or hand-buttons independently of each other. An excerpt of the final layout is shown in Appendix E along with the full circuit available on the Height Control Detail Schematic.

The pressure pads we have selected are Single-Pole Single-Throw Normally Open (SPST NO) momentary switches. Wires for these pads are soldered to 3-pin DIN connectors. They plug into the base of the lectern and can be seen in Figure 46. The orange wires in these cables are soldered together, and connect to a 3-pin DIN female at the splitter box.

The splitter box is a 3-D printed box which features a 3-pin DIN input for the pressure pad signals, a 7-pin DIN input for the hand control modules, and a 7-pin DIN output which sends the combined signal to the controller. Spliced wires will be soldered together and covered with heat-shrink tubing. The box serves three purposes: making cable management for the splice wires easier, providing an electrically insulated enclosure for the wires, and ensuring that the user could not have any contact with exposed wires. Note that all wire bundles will be surrounded with heat-shrink tubing, and the splitter box is located inside the worksurface. There is virtually no chance that the user will contact these wires.

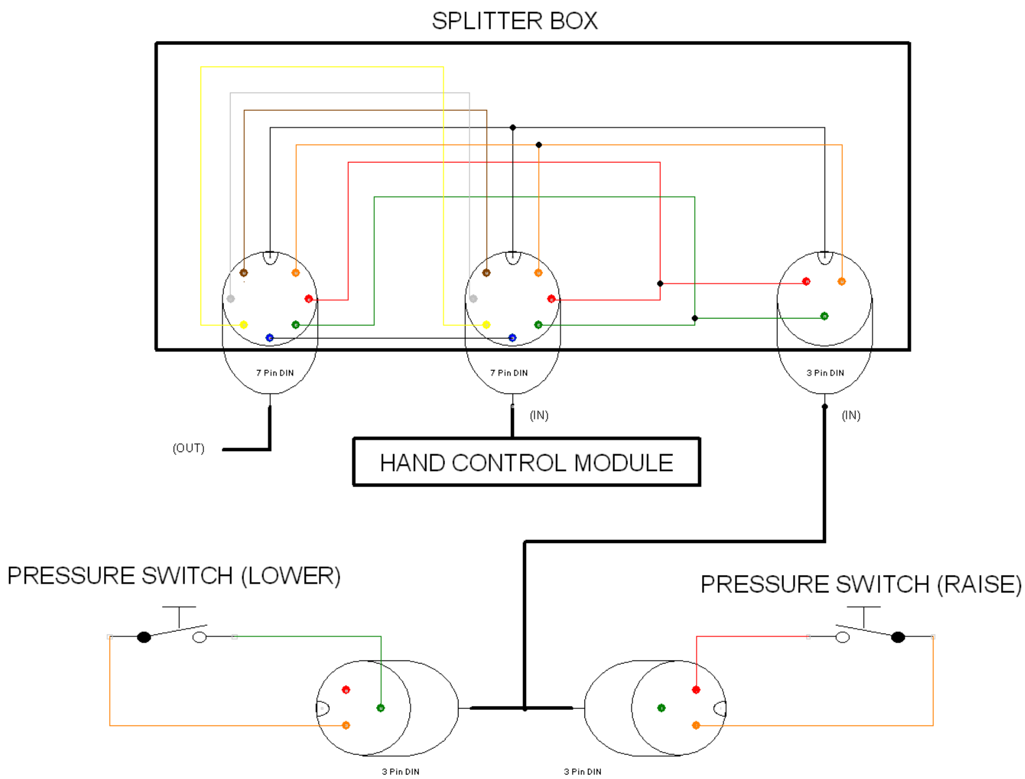


Figure 50. Wiring diagram for the supplementary height controls

The linear actuator used to adjust the angle of the worksurface is rated for 12 VDC at 7 A. We have specified an AC-DC converter that supplies the actuator with 12 VDC at 5 A. A Double-Pole Double-Throw (DPDT) momentary rocker switch allows us to raise and lower the linear actuator with just one switch. The schematic for this system is shown in Figure 51. The rocker switch will be mounted in a 3-D printed housing, on the bottom front edge of the worksurface, opposite (left) of the height adjustment hand controls. Figure 52 provides a visual of the location of the hand controls.

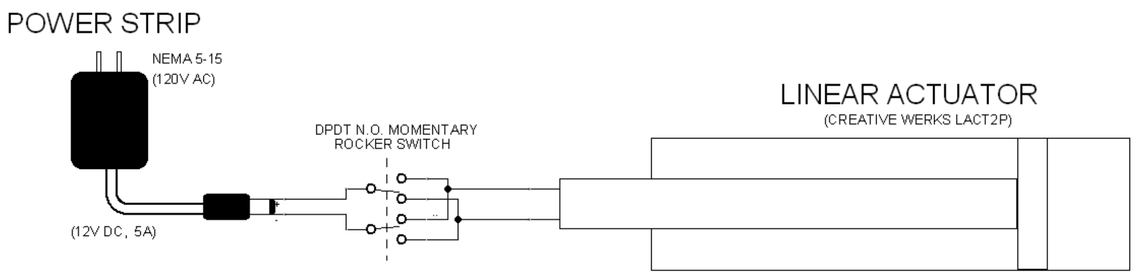


Figure 51. Linear actuator circuit with DPDT NO switch wiring

Figure 52. Hand control mounting locations.
Blue: angle adjustment. Red: height adjustment

The lectern features standard audio/visual accommodations. On the worksurface, there is a panel which has HDMI, VGA, and 3.5 mm ports. Also on this panel are two, NEMA 5-15P sockets which provide the presenter with 120 VAC. A rendering of this panel is in Figure 53. Also included on the top of the worksurface is a shock-absorbing threaded microphone mount that connects to a 3-pin XLR cable. All the audio and visual cables are connected to another plate, mounted at the base of the lectern. This allows the user to connect their computer to the top of the lectern, and connect the base of the lectern to the wall, rather than running one long cable from the wall to the top of the lectern.

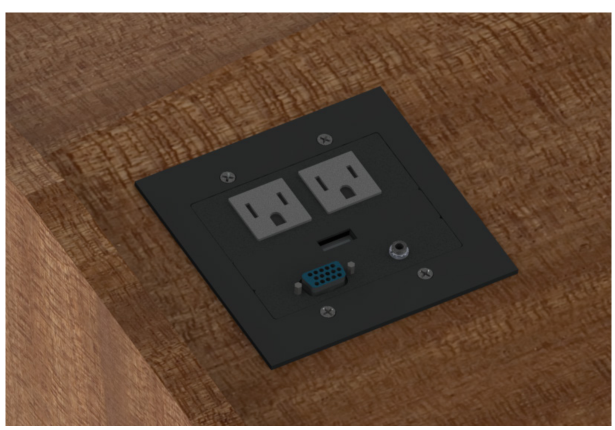


Figure 53. Rendering of the AV panel on the desk

All of the powered devices – the controller, the angle adjustment linear actuator, and the speaker's power outlets – are plugged into one main power strip that is housed inside the bottom panel of the lectern. Figure 54 is a rendering of the power strip mounting location. Using regular NEMA 5-15P plugs would not work, due to the limited clearance (1.6 in) between the power strip and the access panel. Therefore we have specified low-profile plugs that can rotate 360°. The power strip has a circuit breaking current of 15 A, to prevent damage to devices in the event of a short.

Figure 54. Power strip mounting location

The power strip connects to a male NEMA 5-15P flanged outlet that is mounted flush to the bottom, right side of the lectern (as shown in Figure 55). The purpose of this is for easy access to connect and disconnect an extension cord to power the lectern. An overall summary schematic of the power connections is shown in Figure 56, and in Appendix H.

Figure 55. Main power plug location

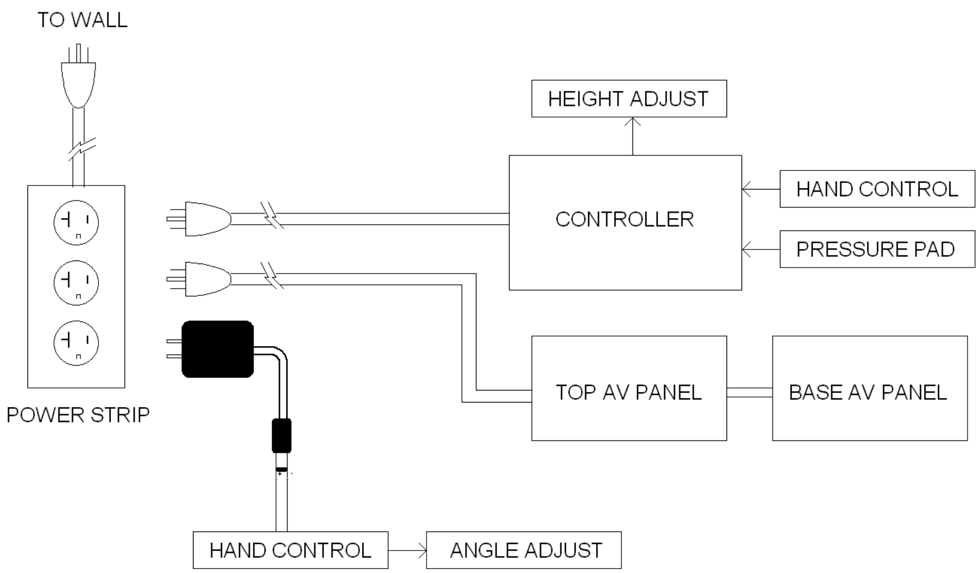


Figure 56. Overall electrical schematic

Aesthetic

A major element of the overall lectern design is aesthetic. From the onset of the design process, emphasis was placed on designing a system that has a high level of grandeur, while maintaining functionality. This influenced the selection of materials and embellishments of the lectern.

The wood components of the lectern are going to be made of mahogany. Mahogany is a common wood used in furniture fabrication for its strength and durability, as well as its straight grain that is free of voids and pockets. It also does not shrink, swell, or warp as much as other similar woods. While mahogany is more expensive than other hard woods, the quality of product is worth the added expense.

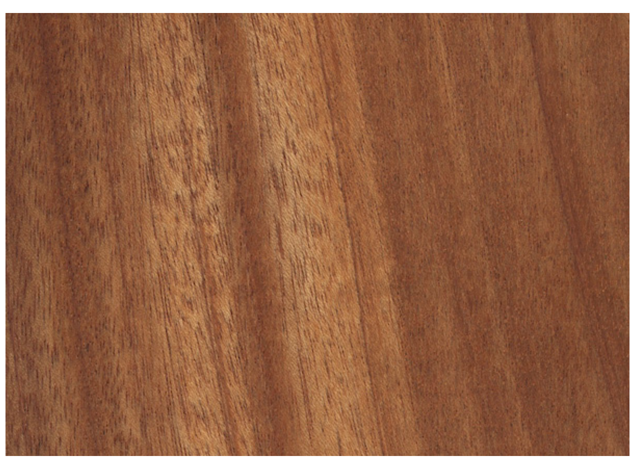


Figure 57. Sample of African Mahogany to show color and grain

After discussion of surface treatment options with a woodworking expert, it was decided that the wood be treated with boiled linseed oil, to both visually accent the color and fill the grain pores. An example of the finish want to achieve is shown in Figure 57.

Since the lectern is designed for use at Cal Poly, it was a customer requirement to include aesthetic elements that represent the dynamic of the university. With this in mind, we worked to develop an aesthetic concept that exudes a Cal Poly *feel*, while remaining understated so that it does not take away attention from the presenter. The front face on the top of the lectern will contain a plaque with the Cal Poly, San Luis Obispo logo extruded across it as shown in Figure 58. The dark background will be made from a piece of aluminum and coated black. The Cal Poly logo will be made of 1/8 in white acrylic cut out using a laser cutter. Aluminum embellishments will be added at each of the four corner of the plaque.

Figure 58. Top embellishment

The cascading covers of the lectern create large blank surfaces that demand an embellishment. Since the covers cascade as the lectern adjusts it height, the embellishment needed to look appealing at all heights. This this limited design possibilities, however, we were able to generate a simple yet elegant design that accents the podium and user. This design is shown in Figure 59. An inner brushed stainless steel strip will be accented by a broader white acrylic strip. The white acrylic will accent the Cal Poly logo and the brushed stainless steel will be accented by the round metal embellishments on the top.

Figure 59. Embellishment on cascading panels

The aesthetic of the lectern delivers a professional appearance, while providing a look that ties into the modern, polytechnic focus of the university. It remains understated so that it does not detract focus from the presenter, yet adds tasteful elements that breakup the wood components of the lectern.

6. Design Analysis

Safety Considerations

Due to the amount of human interaction with the lectern, many safety concerns have been addressed and resolved throughout the design process to prevent placing the lectern user in a hazardous situation. The major sources of potential injury that were addressed, include: crush hazards, pinch points, improper use, and mechanical failure.

As with many pieces of furniture, the lectern creates a potential crush hazard to the user in the case of it tipping. In designing the lectern, it was important to keep the center of gravity in a location that is effectively compensated by the base. The 3-D model allowed us to estimate the center of gravity to be just two inches to the presenter's side of the lectern. As shown by the calculations performed in the Design Analysis section, under reasonable conditions, the lectern is not under threat of tipping.

By adding the feature of adjustability to the lectern, we are creating another potential crush hazard for the user; this is especially hazardous to presenters that are wheelchair users. They place themselves in a position, where during lectern use, a portion of their body may be under the top of the lectern. All switches for any actuation on the lectern are momentary, stopping actuation when the button is released. Under normal operation, this prevents the lectern from lowering too far and trapping a user. With a speed of 1.6 in/s, the user is able to fine tune the height without In the case of mechanical malfunction, the lectern could potentially lower on the user before they are able to move free. The lifting columns we are integrating into the design to provide actuation have a built in feature that stops movement if an obstacle is present. In the case of body part, the actuation will stops before causing serious harm to the user.

The cascading panels have the potential to create many potential pinch points during actuation. To prevent this hazard, the panels are spaced far enough apart to allow clearance for actuation, but close enough to prevent the threat of pinching a finger, for example. Additionally, with the controls near the base of the worksurface, the cascading panels do not pose a threat to the user during operation. During all maintenance, unplugging the lectern from its power source will prevent the threat of accidental adjustment.

While the floor level pressure pads switches are designed to allow users with limited dexterity to operate the lectern, they also create a threat of accidental actuation. By placing the pressure pads on the sides of the lectern, not underneath or behind, the probability of accidental, unwanted adjustment is greatly reduced. Unfortunately, the additional actuation poses a potential problem, however, the mats are removable. When not being used, a simple 3 pin DIN connector may be disconnected and the mats may be stored outside of the usable area. This speaks to the idea that the switch mats will only be used in certain situation; when a presenter who does not have extremity dexterity is using the lectern. In situations where the switch mats are used, greater care will have to be taken when moving around the lectern.

Maintenance & Repair

Since the lectern is designed for use on a regular basis, it has to be easily maintained and repaired in the case something breaks. Throughout the design process, there was a heavy emphasis placed on creating a system that allows for access to all critical systems. A majority of the components used on the lectern are off-the-shelf parts that could be easily replaced. All part numbers and suppliers will be supplied with the documentation of the lectern and can be found in Appendix C. Detailed assemblies, engineering drawings, and product specification sheet will also provide additional information on specific systems of the lectern.

The actuation system for the lectern is a complex mechanical system with built-in features that prevent use that would damage the internal components. There are numerous potential faults that can trigger the controller to freeze the motion of the legs. In order to reset the system, there are specific procedures that have to be followed. The manufacturer has outlined these procedures and information on how to access them will be provided with the lectern.

Numerous design features allow for easy access to all the subsystems of the lectern. The back panels on each of the cascading covers can be removed. This allows for access to the legs and wiring running from the base to the top. The aluminum subframe provides passages to route the wiring with the ability to replace the wire in the case of a failure. Many of the electrical components for the lectern will be housed in the top; raising the worksurface to its highest position allows for easy access to all the components.

Human Factors

After sizing each section of the lectern, a speaker-visibility analysis was conducted, similar to that used to size the panels (Figure 43 and Figure 44), in the human interfacing subsection of the final design description. In this analysis, we calculated the maximum lectern height, according to different staging and speaker conditions. A plot for the 50th percentile female using a wheelchair is in **Error! Reference source not found.**. The desired front edge height is based on the approximate pectoral height of the speaker, and shows at what height the lectern would be most comfortable. The minimum lectern height is the distance from the floor to the top of the lectern, with the actuators as low as they can go. The goal is to have the different stage height curves above the desired front edge height. Naturally, this is impossible at certain combinations of stage height and audience distance. However, this can be used to as a feasibility assessment. As an example, consider the case with a 3 ft stage. In order for the speaker to have the lectern at a comfortable height, and for the audience to still be able to see her (and vice versa), the minimum audience distance is only 6 ft. This validates our design decisions, because for a fairly high stage, the audience would have to be unreasonably close for the speaker to be unable to have the lectern at a comfortable height.

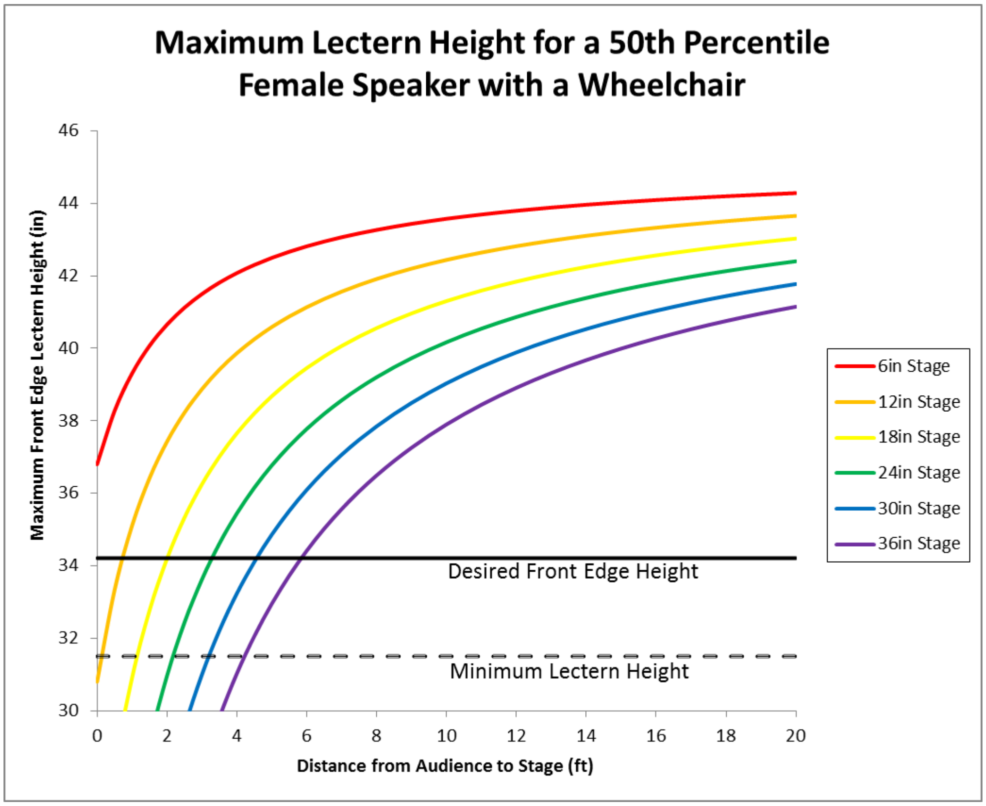


Figure 60. Speaker visibility analysis for a 50th percentile female user

Note that this study, and the study from **Error! Reference source not found.** were both based on the anthropometric data for the 50th Percentile female wheelchair user. To assess how inclusive our lectern design is, we then considered a 5th Percentile female wheelchair user. This subsequent analysis is shown in **Error! Reference source not found.**.

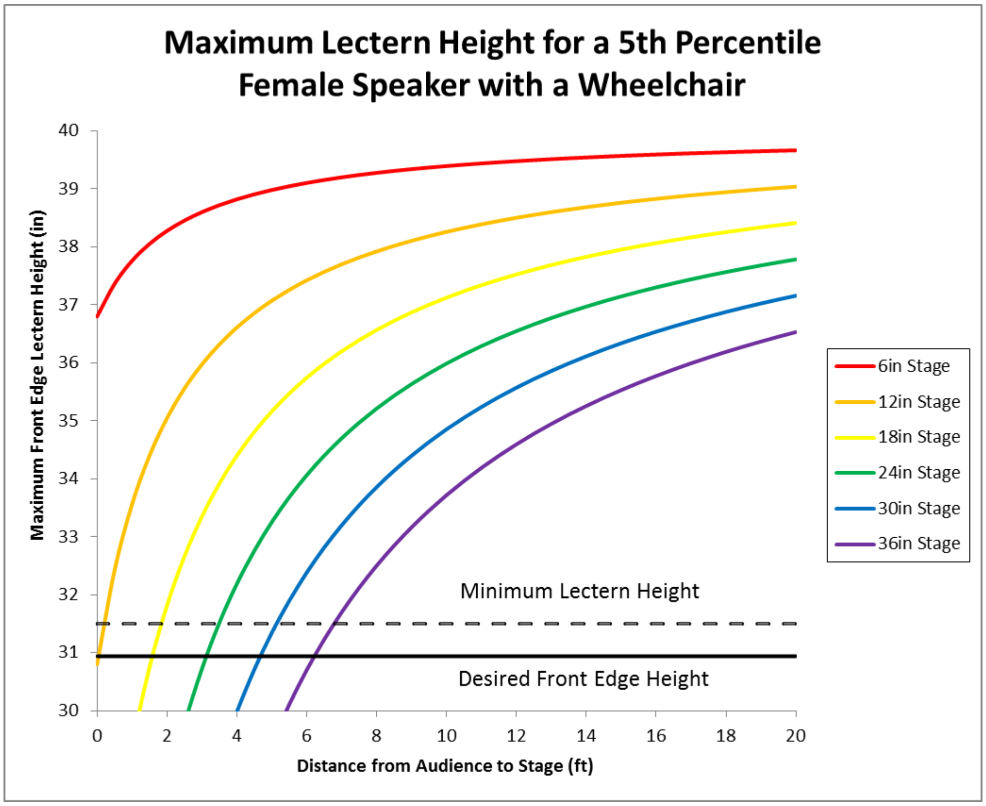


Figure 61. Speaker visibility analysis for a 5th percentile female user

Note that in this situation, the intersection of the desired front edge height and the various stage height curves still produces reasonable results for the minimum audience distance. However, the desired stage height is actually lower than our minimum lectern height. This does not compromise the inclusivity of our design, because the difference between the minimum lectern height and the desired height is only 1/2 in. Considering the assumptions, approximations, and statistical data that went into this analysis, 1/2 in is within an acceptable range.

Cost Analysis

For the design that has been described to this point, we have sourced the part and created a bill of materials to evaluate the cost to make the lectern. **Error! Reference source not found.** shows the budget breakdown by subsystem. The full cost breakdown can be found in the Bill of Materials in Appendix C. The total of $2200 is a greater than the allotted budget for the project and will need to be addressed during the part, and raw material, procurement phase. The bill of materials in Appendix C is a thorough accumulation of all possible parts, tooling, and overhead that will be expected during construction. As a result, the budget stated is a conservative estimate and will likely only reduce. In an attempt to reduce the cost, a study will be performed to source the materials in the most efficient way possible; with respect to cut plans and shipping. Another action to minimize cost is we will perform a large majority of the labor ourselves using Cal Poly's machine shop resources. The cost is also significantly affected by the inclusivity of the lectern. For example, the switch mats that allow for floor level actuation are $120 each, and the linear actuator to allow worksurface adjustment exceeds $150. The most significant costs include: the switch mats, the worksurface linear actuator, lumber, metal tubing, and shipping and taxes.

Table 3. Simplified budget breakdown

Subsystem	Value	Distribution
Base	$ 742.84	33.8%
Actuation	$ 70.56	3.2%
Covers	$ 326.66	14.9%
Desk	$ 530.83	24.2%
Tooling	$ 125.29	5.7%
Shipping/Taxes	$ 399.30	18.2%
Total	**$ 2,195.48**	

7. Product Realization

This following section provides an overview of the manufacturing process for the lectern. The manufacturing process was broken down based on the major tasks: subframe and legs, carpentry, hardware review, finishing, aesthetic, and final assembly. A brief description for each of these tasks is provided. The majority of the manufacturing was completed for the Hardware Review on April 28th. This provided sufficient time to make needed modifications and complete testing for use at the Global Accessibility Awareness Day kickoff event on May 18th and the Paul Wolff Awards on May 22nd. A detailed timeline can be found in the Gantt attached in Appendix F. Additionally, the poster created for Senior Design Expo, which summarizes the project, can be found in Appendix G.

Manufacturing

With the parts and materials on order, we created a day-by-day build plan for every week of Spring Quarter, which outlined every part and subsystem that we were going to manufacture. The schedule was largely dictated by our bottom-up build plan for the main lectern construction. For example, the aluminum subframe was the first part assembly to be manufactured so that all other subsystems could be added to the foundation. The other governing factor was the shop availability. The Hangar has a greater collection of metal working tools, therefore, we staggered the wood construction and metal construction accordingly to utilize the Hanger and Mustang 60, respectively. This proved successful, as it caused us to think critically about when and where we were going to do each task, and allowed us to see a path to completion.

Subframe and Legs

The aluminum subframe was the first subsystem to be fabricated since it serves the foundation for the entire lectern. It was critical that the subframe follows tight tolerances because any errors at this stage would propagate throughout the lectern. Once the subframe was completed, the legs were attached to create the main structural skeleton of the lectern.

The components of the subframe were prepared for assembly at the Cal Poly machine shops, both Mustang 60 and the Hanger. This involved cutting the raw material to length and various milling operations to create cutouts to allow hardware access during assembly and routing of the wiring harness. One of the most critical features on the subframe are the holes for mounting the legs. These had to be extremely precise to ensure proper spacing and alignment of the legs. This was completed using a mill to ensure accuracy and yield clean results. Once all the parts were ready, an experienced welder was contracted to weld all the components together. Figure 62 shows the completed subframe.

Figure 62. Fully Welded Aluminum Subframe

Once the subframe was completed, the legs were prepared for assembly. This included fitting the rectangular cross member spacer at the top of the legs, shortening of the bottom leg segment, modifying the brackets that will attach the top to the legs, and removing preexisting mounting hardware. With this complete, the legs were then attached to the subframe. Once all the elements were square and in place, the vertical leg supports were welded to the subframe. The vertical supports were first tack welded to the subframe with the legs in place to ensure proper fit. Finish welds were performed with the legs removed to prevent damage.

Once the main structure of the lectern was complete, attention was transferred to construction of the wood elements of the lectern.

Carpentry

The woodworking was the most time consuming step in the manufacturing process. Since the final appearance of the lectern was of major concern, great care and detail was taken to ensure high quality craftsmanship. The machine shops on campus have numerous tools that were used for this step: table saw, router table, planer, jointer, sanders, and drill presses. These tools allowed us to create the joints and special features required for the final assembly of the lectern. Figure 63 shows the raw lumber being planed from a stock size of ¾ in. to ½ in. for use on the sides of the base.

Figure 63. Planing boards to 1/2" for sides of base

Before beginning construction on the major wood components, test pieces were made to ensure proper execution. This allowed us to practice the various woodworking techniques to reduce the likelihood of damaging the expensive African mahogany wood. For example, the lock miter joinery was tested on scrap pieces of plywood to ensure proper alignment of the router bit and fence. This was critical to achieving a perfect seam. Additionally, due to our team's limited experience with woodworking, we consulted woodworking experts regarding the best methods to achieve our desired results. Maintaining precise tolerances on the wood panels was challenging, but essential to achieving the desired aesthetic. Throughout the process of manufacturing the wood panels, extensive test fitting and minor adjustments were made to ensure proper fit and finish. For instance, the wood panels that surround the subframe were all cut and fit before any of the pieces were attached to ensure clean lines at the joints. Through these techniques, we were able to produce a high quality final product.

The wood for the subframe was first planed to size then cut to length. It was then dry-fit around the subframe before being attached it using 3M DP100 epoxy. This epoxy sets within five minutes, so we had to act quickly to align all the parts properly and clamp them together. Figure 64 shows the wood being clamped to the base as the glue set. The final base covered with all the wood panels attached is shown in Figure 65.

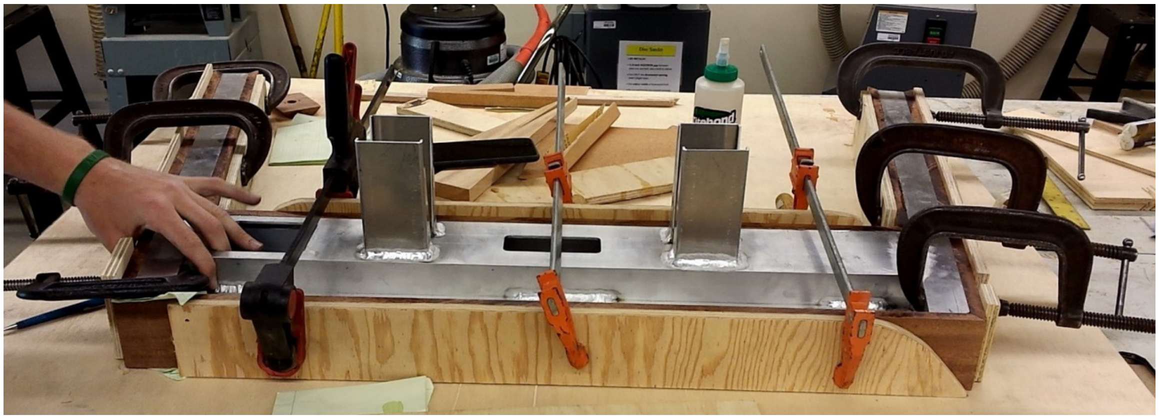


Figure 64. Epoxying wood to the Metal Base

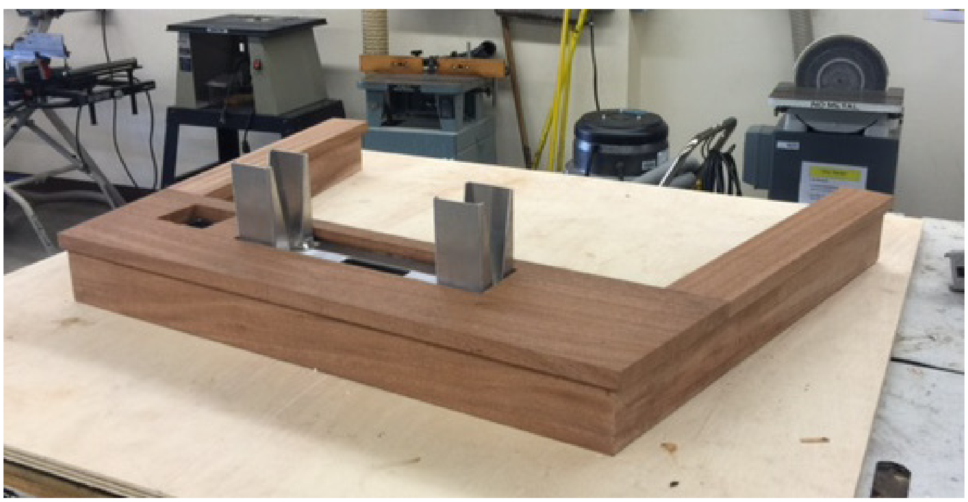


Figure 65. Metal Base covered with wood panels

After the wood for the base was completed, the construction of the middle panels were constructed. The three cascading covers began as a 4’ x 8’ sheet of cabinet grade plywood. Three 21 in. tall segments were cut. Each of these segments contained the front and two sides for one of the three covers. Special attention was paid to the alignment of each piece during construction to maintain a continuous grain pattern. The next step was to cut the lock miter joints to connect the two sidepieces of the cover to the front. Figure 66 shows the setup of the router table to cut the lock miter joints. A custom fence was constructed to support the pieces as they were cut. After careful tuning using test pieces, the perfect alignment was achieved.

Figure 66. Router table setup for cutting of lock miter joint

The final covers are shown in Figure 67. The figure shows the alignment of each of the panels and the lock miter joint holding the sides to the front. Wood glue was used to hold the pieces together.

Figure 67. Cascading covers and close-up of lock miter joints

The top of the lectern was constructed next. Each of the panels were cut to size before a dado joint was cut in the front and sides to allow for a piece of plywood to slide in and hold them together. Figure 68 shows the dado joints cut into the panels of the top. The details in the sides were cut, along with the miters before it was all glued together. The shelf was then fit and attached to complete the mockup of the desk portion of the lectern.

Figure 68. Dado joint used to hold top of lectern together

The worksurface of the lectern was constructed by laminating five 3-1/2 in. boards with 1/4 in. spacers between them. It was difficult to source solid mahogany wide enough to make the worksurface out of a single piece of wood and we did not like the exposed edge that using plywood would leave. The laminated worksurface ended up adding to the overall aesthetic of the lectern and provided a unique touch.

Electrical

As previously mentioned, much of the manufacturing was conducted in parallel. By working on the electrical components at the same time as the wood and metal framework, we were able to complete separate systems and test them individually.

First, we 3-D printed the original actuation signal splitter, which took the form of a box with two inputs and one output. The 3-pin and 7-pin DIN connectors were soldered together inside of the box. The box, shown in Figure 64, was completed on the same day that we fixed the wood paneling to the subframe. However, as discussed further in the design verification section, the connections inside the splitter box were poor. This caused the control system to short-circuit, and did not successfully raise and lower the legs. After troubleshooting, we decided the best option was to replace the splitter box with a custom Y-connector cable, which had the same functionality. This was completed in the following weeks.

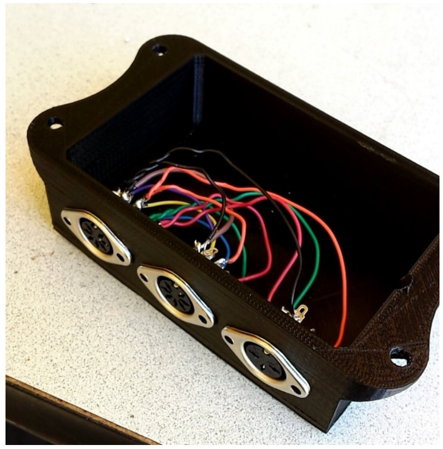


Figure 69. Signal Splitter Box Completion

The remaining wiring on the lectern was completed without complications. This included the floormat DIN connectors, the AV connections, the power connections, and the linear actuator that changes the worksurface angle. However, after installing the angle adjustment linear actuator, we realized that it was permanently fixed inside the worksurface, which we did not want. This was remedied by adding quick disconnects for the power supply and the switch, which raises and lowers it. This allowed us to do all the finishing work (including paint) with the inside of the worksurface completely empty.

When the wiring of the individual electrical systems were completed, and the individual systems were tested and deemed operational, the wiring had to be consolidated. Due to vertical actuation of the lectern, the wiring had to be packages in such a way as to not tangle during adjustment. The wires were consolidated, and housed in two electrical looms. The loom was slightly longer than the height of the fully extended lectern, as to not stress the connections in the maximum height setting, and coiled into an "S" shape in the lectern's lowers position to prevent tangling, as seen in Figure 65. As a cost saving measure, we made use of a retractable key ring to direct the upper portion of the wiring harness into the proper-coiled position.

Figure 70. Wiring Housing in Lowest Lectern Height

Hardware Review

The majority of the manufacturing had to be completed by the Hardware Review. This was to ensure we were on schedule to complete the lectern by May 18th. For the review, the major components of the lectern were assembled to ensure proper functionality before moving on to the finishing process; the top was mounted to the legs and the cascading covers were attached. The lectern, as presented for the Hardware Review, can be seen in Figure 66.

Figure 71. Mocked-up lectern for Hardware Review prior to finishing and wiring.

Finishing

Great care was taken during the preparation of the wood components for finishing. This preparation was critical to allowing us to achieve a quality final product with a professional grade finish. Significant time was devoted to sanding out all imperfection and making sure all the visible joints had clean lines. Sanding was completed in stages, moving from a low grit sand paper for major material removal to a high grit sand paper for final detailing.

After sanding, one coat of stain, Zar's Teak Natural, was applied to all the exterior wood surfaces. Figure 72 shows the wood components as they were prepared and laid out for staining. Following the staining, the first coat of clear coat was applied. We noticed inconsistency within the clear coat where some areas of the wood absorbed more readily than others. Even though the clear coat had a satin finish, the clear coat left a finish we felt was too glossy. It detracted from the natural look that we desired. To remedy both of these issues, we prepared the lectern with steel wool and applied another coat of clear. Spots were touched up by lightly sanding with steel wool again. This gave it a smooth and bright finis that complimented the natural beauty of the wood. The interior surfaces of the cascading panels, and the bottom piece of wood used for the desk were painted black to allow the assembly hardware to blend in.

Figure 72. Preparation of wood components for finishing

The finishing process included painting all the metal components: bracketry, access panels, exposed metal on the base, and washer plates. A textured semi-gloss black spray paint was used. This complemented the appearance of the wood elements and blended seamlessly with the Extron equipment.

Final Aesthetic

The aesthetics of the lectern were very much an experimental process. Many of the ideas discussed in the CDR, and modeled in Solidworks, turned out to overcomplicate the visuals of the lectern, making it appear busy. The major simplification undertaken was eliminating the acrylic and stainless steel accents on the front of the cascading elements. It was decided that the wood façade of the cascading elements gave a more classic, warm, and elegant feel to the lectern.

The workstation aesthetic design also changed from CDR. Initial experimentation with laser engraving white acrylic proved that the size of the Cal Poly logo we wanted to implement was too large for the facilities available in our machine shop. Once it was decided that it was necessary to contract the workstation plaque out, we decided that waterjet cut stainless steel over an acrylic background would provide an appealing visual, and give it a unique Cal Poly touch; the actual product can be seen in Figure 67.

Figure 73. Final Workstation Plaque Design

Final Assembly

The final step in the manufacturing process was final assembly. In this step, final paintwork was completed, the top and cascading panels were attached to the frame for the final time, the access panels we constructed, wiring was run, all the electrical and audiovisual components were installed, and final adjustments were made.

Final Product

The culmination of the construction outlined above was the final Inclusive Lectern that features a 26” vertical range, high quality African Mahogany construction, and standard presentation AV connectivity; as shown in Figure 68.

Figure 74. Completed Lectern

The lectern is unique in its ability to lower to 25.5 in. of clearance and extend to 51.5 in. of clearance at the maximum. 25.5 in. dips below the ADA standard, therefore, not only can this lectern accommodate presenters that use a wheelchair, there is the ability to allow a child presenter to use the lectern as well. Similarly, the extended range on the top side will allow users up to 6’-8” to use the podium without the need to hunch over. This extension overcomes the typical limited ranges in which ADA lecterns currently on the market operate. Two pictures showing the lectern at about an inch above its lowest height are shown in Figure 75.

Figure 75. The Lectern Slightly Above its Lowest Height

The worksurface features AV connectivity, HDMI, VGA, and 3.5mm audio, and two power outlets for presenter's phones and computers. It can change in angle from 12-38°, which is controlled by a clearly labeled momentary switch. This allows users in wheelchairs or those who cannot move their neck, who have the lectern at a lower height, to more easily read their notes. There is also a connection for a gooseneck microphone at the center of the top of the lectern. All of these features are shown in Figures 76 and 77.

Figure 76. Features of the Worksurface

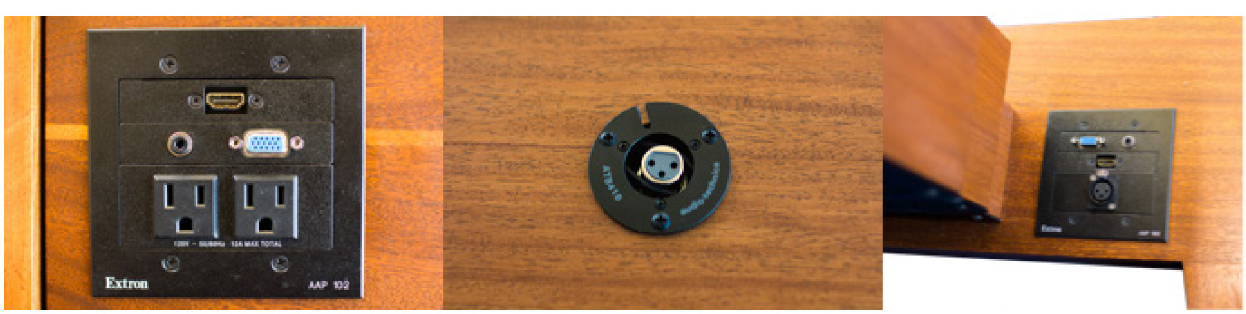


Figure 77. AV connectivity at the top of lectern (left and middle) and at the base (right)

The lectern also features the open sided design and floor mats in an effort for further inclusivity. The open sided design can be noted by the slim design and tight tolerances of the nesting covers that make up the front of the lectern. The slim design maximizes the space behind the lectern for easier access by presenters that use wheelchair. Additionally, the floor mats are an adjustment feature that is unique to this lectern. This creates a second height adjustment option for presenters that do not have the dexterity to use the hand control mounted to the bottom of the worksurface. The hand controls used to adjust the height of the lectern and the worksurface angle are shown in Figure 78. Adding the floor mats captures the essence of inclusivity and is a distinguishing factor on the Inclusive Lectern. The floormats are shown in detail in Figure 79.

Figure 78. Hands Controls: Worksurface angle (left), Height Adjustment (right)

Figure 79. Finished Floormats for Height Adjustment

Power for the lectern is provided by the male three-prong power outlet on the right side of the base of the lectern. This is shown in Figure 79. A common extension cord is used as the connection between the lectern and an AC power supply. Since the power cord disconnects, it can be easily removed for storage and transportation of the lectern.

Figure 80.Lectern power source

Provided in Appendix I are instruction manuals for the recommended transportation and setup procedure for the lectern. It is important that these procedures are thoroughly understood to maintain the functionality of the lectern. In the case an issue does arise, a troubleshooting guide has also been provided in Appendix I with solutions for common problems that may occur.

Cost Estimation

The total cost for the development of the lectern was greater than the original price estimate in the design process. Design modifications and unforeseen issues that arose in the manufacturing process forced us to purchase more raw material, additional hardware, necessary tooling, and numerous other items to complete the project. The final expenditure for the project is highlighted in Table 4.

Table 4. Summary of final lectern expenditure

Subsystem	Projected Cost	Distribution	Actual Cost	Distribution	Error in Cost
Electrical	$ 1,175.20	54%	$ 1,575.43	50%	34%
Lumber	$ 208.50	9%	$ 256.17	8%	23%
Metal	$ 513.26	23%	$ 339.41	11%	-34%
Hardware	$ 107.28	5%	$ 307.33	10%	186%
Tooling	$ 117.96	5%	$ 304.01	10%	158%
Finish	$ 73.28	3%	$ 388.62	12%	430%
Total	$ 2,195.48	-	$ 3,170.97	-	44%

The largest portion of the budget was consumed by the electrical subsystem. While this was not initially expected, the functionality needed to maximize the inclusivity of the lectern required numerous electrical components. The electrical subsystem consists of the linear actuator for worksurface adjustment, AV connectivity, and foot control integration. Each of these systems contained big-ticket items that drove up cost: compact linear actuator, floor switch mats, and AV interface boards. The Extron components used for the AV connectivity of the lectern cost significantly more than initially estimated. These components were chosen to make sure the lectern integrated seamlessly with the existing systems at Cal Poly as they largely use Extron components. Moving forward, an easy way to reduce the cost of the electrical subsystem would be to manufacture the connectivity plates ourselves. They are relatively simple to manufacture and could save several hundred dollars.

Even with the large budget influence of the electrical system, the hardware, tooling, and finishing sections had a greater impact on the project going over budget. The underestimation of the costs in this area served as a learning experience in project management and product development. For example, the tooling costs were overhead that we did not account for and assumed would be provided by the student shops on campus. The hardware cost discrepancy has a lot to do with inexperience with woodworking and understanding preferred methods of attaching. Also, some hardware material was used for mocking up jigs and first time fitments of the lectern. Finally, the finishing was simply underestimated. We knew the importance of the aesthetic, however, did not understand the tooling and consumables associated with creating a professional finish.

The final note regarding the excessive cost is the prototype nature of the project. At the conclusion of the manufacturing process, there was a surplus of left over material. These materials would be fully utilized in a production scenario. For example, the paints, stains, and adhesives were all left only partially used. Also, if additional lecterns were to be built, the overhead would decrease as the needed tooling would already be purchased, and there would be a better understanding of all the exact parts required. The Bill of Materials provided in Appendix C still provided a good estimate for the cost of the lectern.

8. Design Verification

Due to the nature of this project, design verification took place at two times: during manufacturing and after final assembly. A majority of the design verification took place during the manufacturing process because the functionality of each subsystem has to be confirmed so it would not hinder subsequent manufacturing. For example, proper functionality of the leg actuation system was tested before finishing and final assembly. The second phase of design verification was to be completed with the lectern as a final product. Due to test failures during the manufacturing process, a few of the design verification tests could not be completed. The following sections outline the tests that were completed and describe the additional tests that need to be completed. The completed DVP&R can be found in Appendix H.

Metal to Metal Adhesive

A test of the Loctite 243 structural adhesive, used to bond a set of weld nuts to the actuator housing, was necessary to verify that the bonded surfaces between the weld nut and the actuator housing have sufficient shear strength to support the Middle Cover. To simulate the assembled configuration, we bonded a weld nut to large section of sheet metal and secured the fixture in a vise. Then, using a bolt tightly fastened in the weld nut, we hanged ten pounds weight from a strap, as seen in Figure 72. The load simulated four times the load each weld nut carries during normal operation. The test was conducted without failure, failure only occurred when a large impact load was subjected directly to the head of the bolt.

Figure 81. Weld nut test configuration with ten pound load

Leg Actuation

With the lectern completely constructed, but before finishing, the lectern successfully traveled over the full range of the leg actuators. This confirmed the feasibility of the design and the project could move into the finishing process.

Height Adjustment Range

When functioning properly, the lectern adjusted from a height of 25.5 in to a height 51.5 in. This range of heights satisfies the engineering specification for height adjustability from to 28 in to 52 in. While the upper limit of heights fell short by 0.5 in, the critical heights are for the lower limit and the final product still satisfies the customer requirements.

Height Actuation Speed

The vertical actuation speed of the lectern was tested by measuring the time it took to ascend from its lowest height to the upper most position. Several runs were completed and all the results agreed with the 1.6 in/sec actuation speed provided by the manufacturer. The additional weight from the components of the lectern did not affect the actuation speed. This is to be expected as this weight added from the lectern mirrored the weight of the tabletop that was originally designed for attachment with the legs.

Electrical

The majority of the electrical system was original from the manufacturer, however, two subsystems required validation.

The first was the floor mat control system that tapped into the existing wiring harness to override the stock hand controls. The initial design included a 3-D printed splitter box that housed the junction of the foot controls and the stock harness. After multiple attempts at soldering the wiring between the plugs inside the box, it was determined that there was either a short, or one plug was damaged, because the box only worked intermittently. The splitter design was then abandoned, for a simpler Y-branched cable that combined both hand controller, and floor pad signals into in the controller input. The Y-branched cable fixed the short in the system and allowed the hand controls and floor controls to work in parallel.

The second system was the adjustable worksurface wiring. This system is independent of the stock wiring harness and only includes a 12V power supply, the linear actuator, and a momentary switch. The two-wire system passed the validation testing easily, but did reveal the need for quick disconnect connectors for modularity. These quick disconnectors were added, and allow for the removal of the angle controls if necessary.

Wood Finishing

The wood finishing testing was a subjective test based on the opinion of other senior project members, faculty, and members of the community. With an understanding that all individuals have different furniture style preferences, we set the goal at a 75% approval rating. Our testing was conducted with 100% approval.

Speaker Visibility

A modified speaker visibility test was conducted at two events where the speaker and the audience were on the same level. The adjustability allowed the presenter to select a comfortable lectern height and at that height, all audience members attending the event were able to see the presenter. Unfortunately, due to issues that arose regarding the functionality of the adjustment actuators, more thorough design evaluation could not be conducted. These issues will be discussed in great detail in Section 9 of this report. Thorough testing would require the speaker's visibility to be evaluated at four separate heights, both standing, then sitting. It is important to verify that the front row of the audience can see the speaker with the lectern adjusted to a comfortable height. This test requires testing time at Chumash, a wheelchair, and four individuals of variable height.

Tipping

Despite not being able to conduct the full range of tests to understand the susceptibility of tipping for the lectern, based on the brief use of the lectern, it proved to handle typical use without posing any danger. This issue was discussed throughout the design process and preemptive measures were taken to and maximize the force required tip the lectern. However, due to the typical design of lecterns in general, there is an inherent stability issue with many lecterns. Once the full functionality of the lectern is restored, testing needs to be conducted to quantify the lecterns susceptibility to tipping.

9. Recommendations

After the testing and validation outlined in Section 9, initial operation of the completed lectern unveiled two procedural flaws that led to the failure of the telescoping legs.

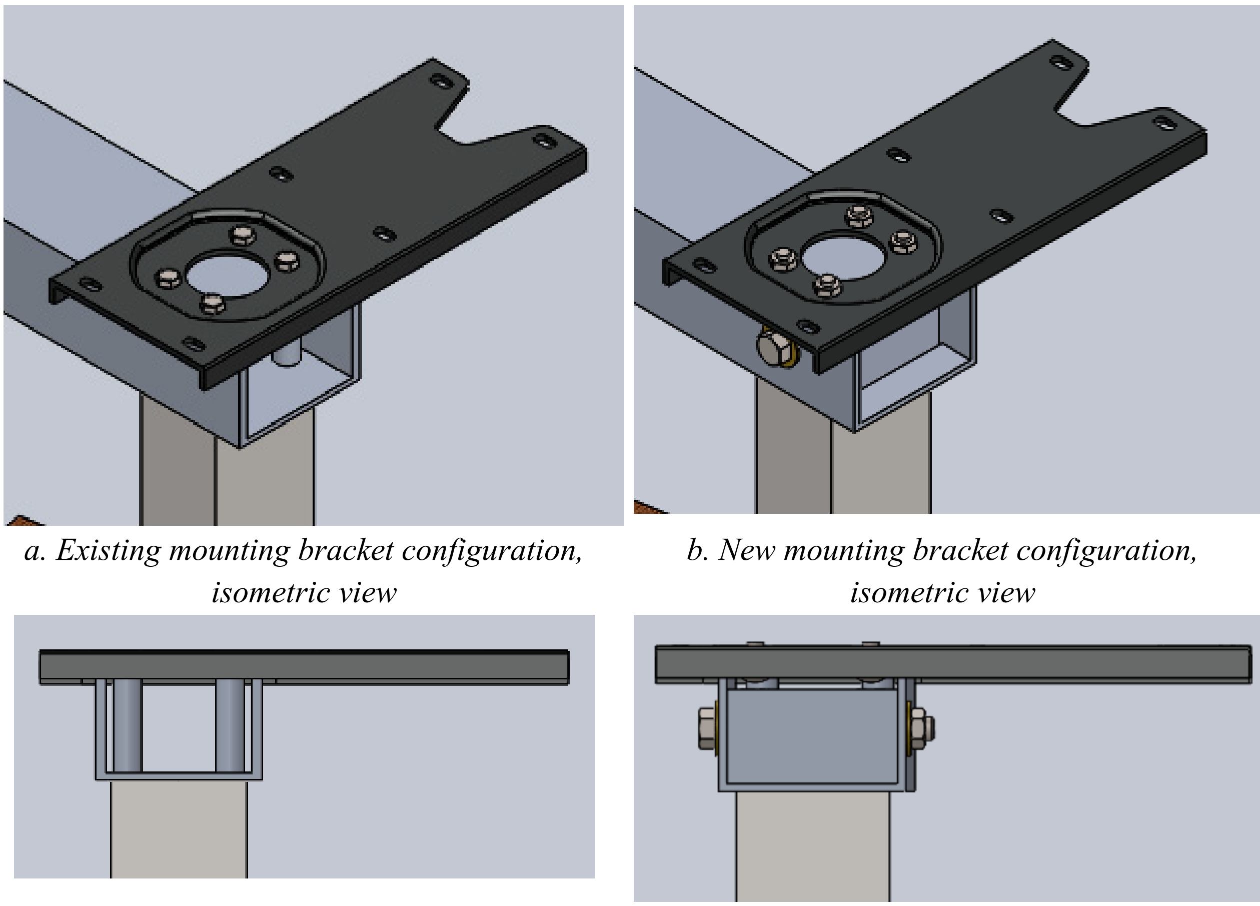
First, improper testing of the wiring caused the legs to be adjusted without the controller recording the change in height. As a result, the controller read a height that was 5 inches lower than the actual height. Therefore, when the legs were extended, the control system did not recognize the end of the travel had been reached and consequently, the legs overextended and broke internal components.

Second, performing the initialization of the legs when they were connected through the cross member at the top of each leg caused the legs to bind up and again break internal components. The damage that occurred from the two examples above caused the legs to be torn completely apart. The lead screw nut form the first failure was salvaged with permanent epoxy, while the coupler that failed in the second example was 3-D printed and re-installed. The result of the two failures above was a change in methodology regarding the initialization of the legs and the assembly of the lectern.

The initialization procedure causes the legs to move independently to the absolute lowest position; they do not always move at the same rate or from the same height. Therefore, initialization is only to be done when the legs are completely removed from the lectern. After initialization, the legs can be inserted into the base, and assembly may be completed.

This method was successful in allowing the legs to remain functioning once the lectern was fully assembled. However, after a limited number of cycles, or transportation across campus, the legs continued to fail, a total of three times while completely assembled. The failure continued to take place in the coupler that couples the electric motor within the leg to the largest lead screw in the leg.

Further consideration of the design revealed an over constrained adjustment system. The two, independent telescoping legs were fixed – zero degrees of freedom – both at the top and bottom. Therefore, any uneven loading, or failed synchronization translated to the lead screw system within the legs binding. Although the lectern supports less load than the table the legs were designed for, the constraints were much different. The table legs were fixed to the table top at the top, but were independent at the bottom, allowing some slack in the system. As a result, we decided to redesign the cross member to unconstrain two degrees of freedom. To do so, we created an adapter that attaches to the existing bolt pattern at the top of each leg with a hole through the middle, perpendicular to the speaker, to fit a pinned connection. This configuration of the cross member will allow for a slightly uneven legs without transmitting the misalignment to the lead screw systems.



a. Existing mounting bracket configuration, isometric view

b. New mounting bracket configuration, isometric view

c. Existing mounting bracket configuration, side view

d. New mounting bracket configuration, side view

Figure 82. Comparison of the two mounting configurations

Unfortunately, the legs had become too damaged through the three previous failures and are now inoperable. Therefore, the redesign has yet to be tested and evaluated as a solution to the leg failures. We believe the redesign that implements the pinned joint will greatly improve the operation of the legs and increase the longevity. As a result, the parts shown in Figure 82. Comparison of the two mounting configurations have been manufactured and it is our recommendation to find a new set of legs to replace the failed set currently in the lectern. With this switch, the lectern will become fully operational and continue use in events across campus. Instructions for disassembly of the lectern, and the installation of the new legs can be found in Appendix I.

10. Conclusion

This report outlines the entire design process that was used to develop an Inclusive Lectern for use by the Cal Poly Disability Resource Center. From the ideation process to manufacturing, a detailed account of each phase of the process has been provided. It is the hope that this document can be used as a reference for future individuals interested in creating similar items that can be used to help solve issues surrounding inclusivity for all.

Despite not being in full working at the conclusion of this project, the lectern was well received by engineering faculty, fellow students, and most importantly the local community of disability awareness activists. Everyone marveled at the quality woodwork, attention to detail, and the elegant stainless steel Cal Poly logo. The lectern received praise for its inclusivity, as well as its simple, intuitive controls.

From a business perspective, many people were talking about the possibility mass-production, and marketing the lecterns. Someone knowledgeable about inclusive furniture suggested that a lectern such as ours would sell for $10,000. We took this comment with a little skepticism, but it is not unreasonable. One of the less discussed challenges that communities with disabilities face is that inclusive furniture and fixtures are expensive. For instance, the ADA podium mentioned at the beginning of this report, which is less inclusive and less elegant than ours, costs $4,400.

Another common topic at the various on-campus events was that the design could be shared and replicated through the California State University system, or even statewide/nationwide. Each lectern would be unique, handcrafted following our plans, with the institution's logo water jetted onto stainless steel just like the Cal Poly logo is on ours. There is even the opportunity for each institution to have the option to modify the design to best suit their needs. This idea is definitely possible. Our original lectern would serve as a prototype, and perhaps a future senior project team can further develop and improve on our design to create a product that is mass manufacture-able and more reliable.

The problem that our lectern attempts to solve is not unique to Cal Poly. Thankfully, more attention is being brought to the issue of accessibility and inclusivity. Through events like the Global Accessibility Awareness Day, people are being made more aware of the difficulties faced by people with disabilities. As a team, we are grateful to have worked on a senior project, which can directly help people. It has provided us with insight into human factors we were previously unfamiliar with, and provided us with a new design mantra, "make inclusivity a forethought, not an afterthought." We are hopeful that one day our lectern – or a lectern similar to ours – will be the standard everywhere, simply a lectern.

11. References

[1] San Luis Obispo County Community Foundation. *Paul Wolff Accessibility Advocacy Award.* 2015. Web. 13 October 2015.

[2] "Non Sound Lecterns." Catalog. AmpliVox. 2015. PDF file.

[3] Paquet, Victor, and Feathers, David. "An anthropometric study of manual and powered wheelchair users." *International Journal of Industrial Ergonomics* 33 (2004): 191–204. PDF file.

[4] Department of Justice. "2010 ADA Standards for Accessible Design." 15 September 2010. *Information and Technical Assistance on the Americans with Disabilities Act.* PDF file.

Appendix A: House of Quality

Engineering Specifications [Hows]		Engineering Specification Targets	1 Adjustable Height	2 Adjustable Extension	3 Volume Capture	4 Adjustment Possible from Wheelchair	5 Manueverable between Locations	6 Easy Storage (fold, collapse)	7 Wheelchair Accessible	8 Shelf for Storage	9 Usable w/ or w/o Powersource	10 Connectivity for AV	11 Power Source for auxilary electronics	12 Quiet Height Adjustment	13 "Air of Gravitas"	14 No Sharp Edges or Pinch Points	15 Stable Workstation	16 Low Budget	Absolute Weight	Normalized Weight
A	Table Height Range	28-52 [in]	9				3	3			3				3	3	3		105	6%
B	Table Extension Range	12 [in]		9	3	3		3			3				1	3	9		143	8%
C	Audio Pickup Range	16 [in]	9	9	9	3						1	3		3				176	10%
D	Controller Distance to WC Arm	6 [in]				9													54	3%
E	People to Relocate	2 [#]					9	3											21	1%
F	Steps to Store	3 [steps]						9											9	1%
G	ADA Knee Clearance	Min. 27 [in]	9	3		9			9	9					3				180	11%
G	ADA Depth	Max. 25 [in]	3	9		9			9	1					3				150	9%
G	ADA Width	Min. 3 [in]	3	9		9			9	3					3				156	9%
H	Storage Area	9x12 [in^2]								9									27	2%
I	Manual Override/Option	Yes									9								36	2%
J	Audio/Visual Ports	HDMI, VGA, 3.5mm										9	9		1				86	5%
K	Power Rating	800 [W]	3								3		9		1				68	4%
L	Adjustment Sound Level	60 [dB]	9	9										9					108	6%
M	No. People Like Look	75 [%]													9				45	3%
N	No. of Sharp Edges & Pinch Pts.	0 [#]	9	9			9	1								9			127	8%
O	Vertical Tipping Force	350 [lb]															9		45	3%
O	Horizontal Tipping Force	350 [lb]															9		45	3%
P	Price	$1,000	9	3								3	3					9	111	7%
	Customer Importance		5	4	5	3	2	1	3	3	4	5	4	3	5	3	5	3		
	Absolute Weight		315	240	60	126	42	19	81	66	72	65	96	27	135	45	150	27		
	Normalized Weight		20%	15%	4%	8%	3%	1%	5%	4%	5%	4%	6%	2%	9%	3%	10%	2%		

Customer Requirements [Whats]; Prioritized Customer Requirements; Prioritized Engineering Specifications

Appendix B: Inclusive Lectern Engineering Drawing Set

Let ED represent "Engineering Drawing" and DS represent "Data Sheet"

0.0.0 – Lectern Assembly	ED
0.1.1 – HDMI Cable	DS
0.1.2 – VGA Cable	DS
0.1.3 – Audio Panel Mount Cable	DS
0.1.4 – XLR Cable	DS
0.1.5 – 12V Power Supply	DS
0.1.6 – Shrink Wrap	DS
0.1.7 – Foot Control Wire	DS
1.0.0 – Base Assembly	
1.1.0A – Aluminum Subframe Assembly	ED
1.1.0M – Aluminum Subframe Manufacturing	ED
1.1.1 – Cross Member	ED
1.1.2 – Okin Leg Support	ED
1.1.3 – U-Channel	ED
1.1.4L – Leg – Left	ED
1.1.4R – Leg – Right	ED
1.1.5 – Leveling Mount	DS
1.1.6 – Angle Bracket	ED
1.2.1 – Cross Member Inside Panel	ED
1.2.2 – Cross Member Outside Panel	ED
1.2.3 – Leg Inside Panel	ED
1.2.4L – Leg Outside Side Panel – Left	ED
1.2.4R – Leg Outside Side Panel – Right	ED
1.2.5 – Leg End Cap	ED
1.2.6 – Cross Member Top Panel	ED
1.2.7 – Leg Top Panel	ED
1.3.0 – AV Panel – Lower	ED
1.3.1 – AV Mounting Frame	ED
1.3.2 – HDMI Plate	DS
1.3.3 – VGA_Stereo Plate	DS
1.3.4 – XLR Plate	DS

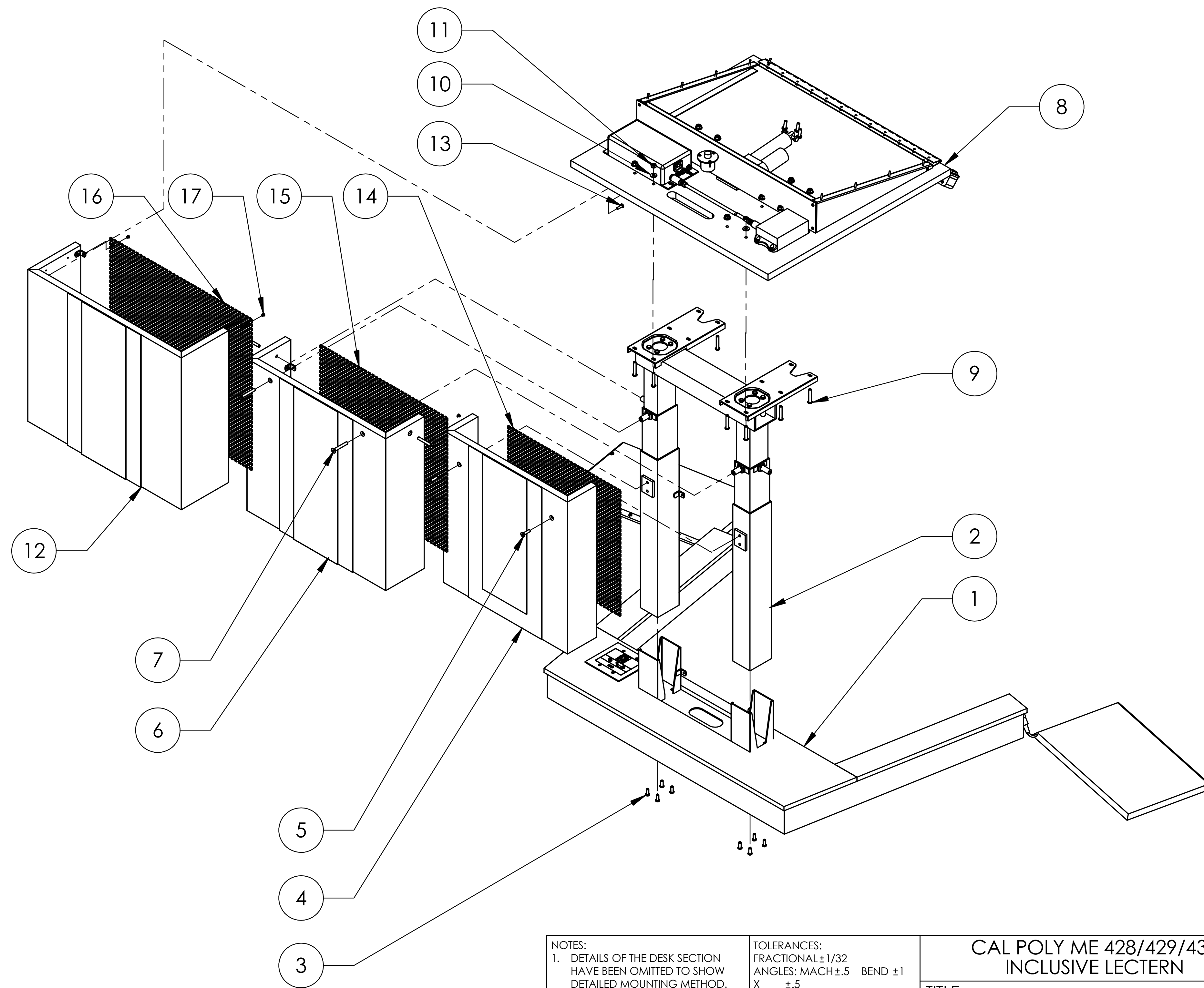
1.4.1 – AC Outlet Male Port	DS
1.4.2 – 3 Pin DIN Female Socket	DS
1.4.3 – 3 Pin DIN Male Angle	DS
1.4.4 – Switch Mat	DS
1.5.1 – Panel Adhesive	DS
2.0.0 – Actuation Assembly	ED
2.1.0 – Telescoping Leg	DS
2.2.1 – TL Mounting Tube	ED
2.2.2L – TL Mounting Bracket – Left	ED
2.2.2R – TL Mounting Bracket – Right	ED
2.2.3 – TL Mounting Spacer	ED
2.3.1 – Weld Nut	DS
2.3.2 – Weld Nut Spacer – Side	ED
2.3.3 – Weld Nut Spacer – Front	ED
2.3.4 – Angle Bracket (Copy of 1.1.6)	ED
3.0.0 – Bottom Cover	ED
3.1.1 – Bottom Panel – Front	ED
3.1.2 – Bottom Panel – Side	ED
3.1.3 – Bottom Panel – Access	ED
3.1.4 – Power Strip	DS
3.1.5 – Power Supply – Linear Actuator	DS
3.2.1 – Bottom Acrylic Strip	ED
3.2.2 – Bottom Metal Strip	ED
4.0.0 – Bottom Cover	ED
4.1.1 – Middle Panel – Front	ED
4.1.2L – Middle Panel – Left	ED
4.1.2R – Middle Panel – Right	ED
4.1.3 – Bottom Panel – Access	ED
4.1.4 – Angle Bracket	DS

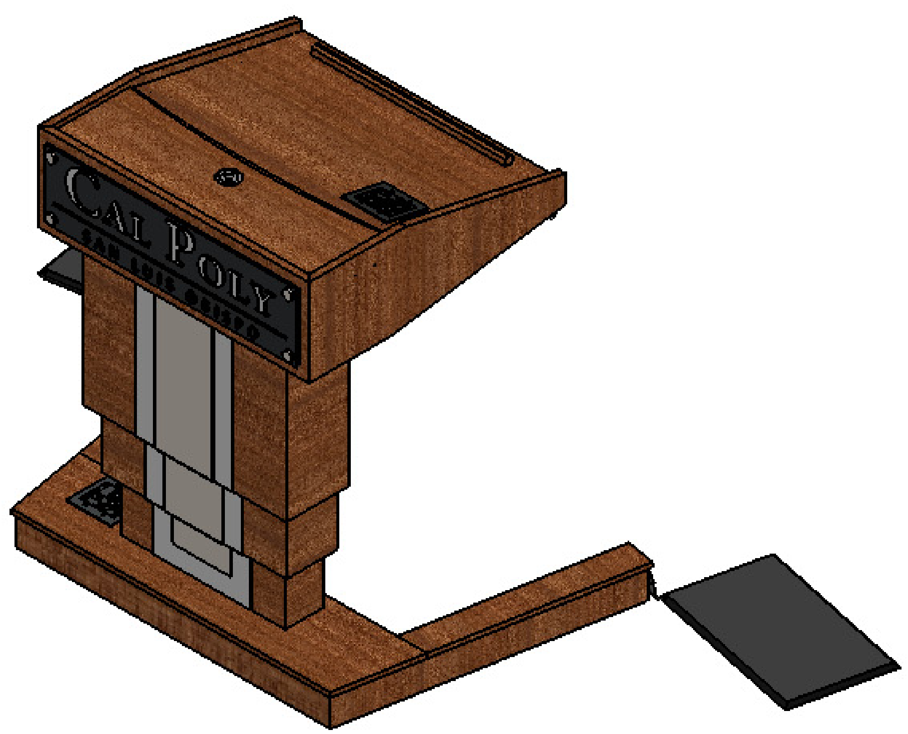
4.2.1 – Acrylic Strip	ED
4.2.2 – Acrylic End	ED
4.2.3 – Metal Strip	ED
5.0.0 – Bottom Cover	ED
5.1.1 – Bottom Panel – Front	ED
5.1.2L – Bottom Panel – Left	ED
5.1.2R – Bottom Panel – Right	ED
5.1.3 – Bottom Panel – Access	ED
5.1.4 – Angle Bracket (Copy of 4.1.4)	DS
5.2.1 – Acrylic Strip	ED
5.2.2 – Acrylic End	ED
5.2.3 – Metal Strip	ED
6.0.0 – Desk Assembly	ED
6.1.1 – Base	ED
6.1.3 – Panel – Front	ED
6.1.4L – Panel – Left	ED
6.1.4R – Panel – Right	ED
6.1.5 – Shelf	ED
6.1.6 – Shelf Mount	ED
6.1.7 – Top Cover Mount – Front	ED
6.1.8L – Top Cover Mount – Left	ED
6.1.8R – Top Cover Mount – Right	ED
6.2.0 – Logo Assembly	ED
6.2.1 – Logo Plate	ED
6.2.2 – Logo Letters	ED
6.2.3 – Logo Posts	ED
6.3.1 – Controller	DS
6.3.2 – Controller Remote	DS
6.4.0 – Splitter Assembly	ED
6.4.1 – Splitter Housing	ED
6.4.2 – 3 Pin DIN Female Socket	DS
6.4.3 – 7 Pin DIN Female Socket	DS

6.4.4 – 7 Pin DIN Male to Wire	DS
6.4.5 – 7 Pin DIN Male Straight	DS
6.5.1 – Worksurface	ED
6.5.2 – Worksurface Stop	ED
6.5.3 – Piano Hinge	DS
6.6.0 – AV Panel – Worksurface	ED
6.6.1 – AV Mounting Frame (Copy of 1.3.1)	ED
6.6.2 – US Outlet Plate	DS
6.6.3 – HDMI Plate (Copy of 1.3.2)	DS
6.6.4 – VGA_Stereo Plate (Copy of 1.3.3)	DS
6.6.5 – XLR Shock Mount	DS
6.6.6 – XLR Female Adapter	DS
6.7.1 – Clevis	ED
6.7.2 – Linear Actuator	DS
6.7.3 – Linear Actuator Switch Housing	ED
6.7.4 – Linear Actuator Switch	ED
6.8.1L – Upper Worksurface Panel – Left	ED
6.8.1R – Upper Worksurface Panel – Right	ED
6.8.2L – Upper Worksurface Panel – Left	ED
6.8.2R – Upper Worksurface Panel – Right	ED
6.8.3 – Upper Worksurface Panel – Front	ED
6.8.4 – Lower Worksurface Panel – Front	ED

See attached sheets corresponding to list above.

ITEM NO.	PART NUMBER	Default/ QTY.
1	1.0.0 - Base Assembly	1
2	2.0.0 - Actuation	1
3	M6-1.0 X 13mm Socket Cap Bolt	8
4	3.0.0 - Bottom Cover	1
5	M6-1.0 x 25mm CSK Bolt	2
6	4.0.0 - Middle Cover	1
7	1/4-20 x 1-7/8 CSK Bolt	4
8	6.0.0 - Desk	1
9	1/4-20 x 1-1/2 Button Head Bolt	12
10	1/4 Washer	12
11	1/4-20 Full Nylock Nut	12
12	5.0.0 - Top Cover	1
13	#10 x 5/8 Wood Screw	11
14	3.1.3 - Bottom Panel - Access	1
15	4.1.3 - Middle Panel - Access	1
16	5.1.3 - Top Panel - Access	1
17	#6-32 x 3/16 Pan Head Machine Screw	12





FOR REFERENCE ONLY

NOTES:
1. DETAILS OF THE DESK SECTION HAVE BEEN OMITTED TO SHOW DETAILED MOUNTING METHOD. FOR ADDITIONAL DESK INFORMATION REFER TO 6.0.0.

TOLERANCES:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

LECTERN ASSEMBLY

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

SIZE B | DWG. NO. 0.0.0 | REV -

SCALE: 1:12 | UNITS: INCHES | SHEET 1 OF 1

GE 6 Foot HDMI Cable - Black (24111)

details

Get that amazing HD video and audio with the GE 6 Foot HDMI Cable - Black (24111).This is an HDMI to HDMI, male to male, connection so you can hook up your home theater components, game consoles and more. Imagine how your home viewing and game experience will change with the quality of HD through this simple GE HDMI Cable.

Features: Nickel-Plated Connectors
Cable/Cord Length: 6.000L
Connection 1 Type: HDMI
Connection 1 Gender: Male
Connection 2 Type: HDMI
Connection 2 Gender: Male
Data Transfer Rate: Up to 10.2 Gbps
Maximum Resolution: 1080p
Cable Application: Video, Gaming, Audio
Warranty Description: 1 Year Limited Manufacturer Warranty

0.1.1 - HDMI Cable

The V7 6' VGA HDDB15 Male to Male Cable, HDDB15, is an effective extension or replacement cord for your computer monitor. It features nickel-plated connectors for superior conduction power and long-lasting durability. It has a black PVC jacketed cable so it also provides efficient insulation and reduces the interference from other signals, letting you enjoy superior performance at all times. This VGA extension cable is RoHS-compliant as it does not use hazardous levels of any heavy metals in its construction. It comes with 6' of cable to allow you plenty of length for connecting nearly anywhere. Make sure your monitor is secure and ready to use with this VGA monitor extension cable. The simple style will blend in with your other cables and accessories. It is a great choice for using in the home, classroom or office due to its quality components and enhanced design.

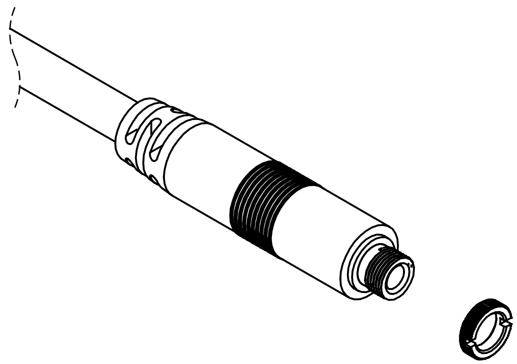
V7 6' VGA HDDB15 Male to Male Extension Cable:

Read more

Specifications

Type:	VGA cable
Color:	Black
Length:	6 ft
Compliant Standards:	RoHS
Model No.:	V7N2VGA-06F-BLK
Shipping Weight (in pounds):	0.35
Product in Inches (L x W x H):	11.8 x 9.9 x 0.7

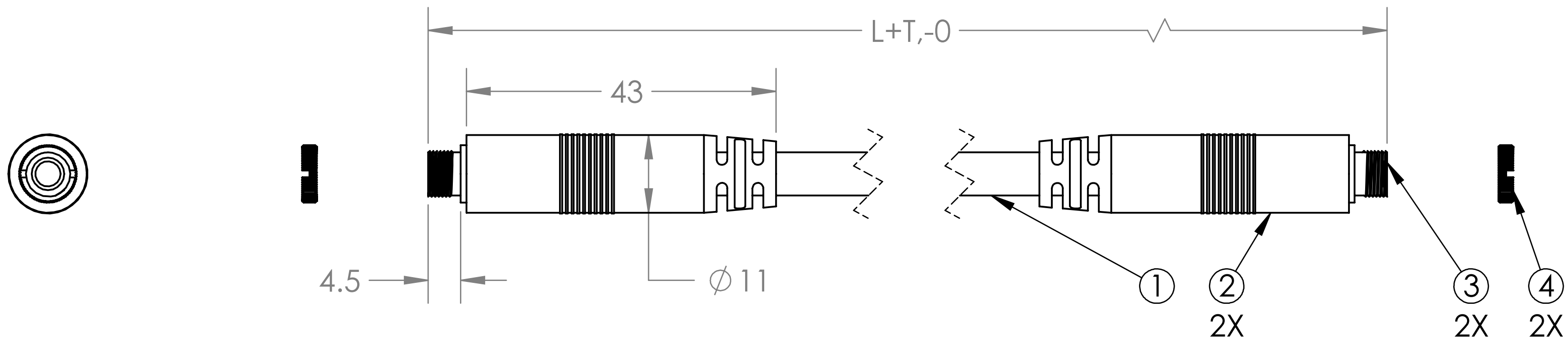
0.1.2 - VGA Cable



QTY	DESCRIPTION	COLOR	MATL	ITEM #
1	Wire: UL VW-1 Type CL2, 24 AWG*2C + AL/MY + DW, RoHS	Black	PVC	1
2	Overmold with strain relief	Black	PVC	2
2	Stereo 3.5mm Female, Threaded M6x0.5		Nickel-plated	3
2	Nut: M6x0.5mm, 2mm thick, assembled in place		Nickel-plated	4

NOTES:

- Packed with clear polybag individually
- Packed with clear polybag by 10



0.1.3 - AUDIO PANEL MOUNT CABLE

COMPLIANCES

REACH (EC 1907/2006)
ROHS (2011/65/EU)

PROPRIETARY AND CONFIDENTIAL

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P/N	L	T
1223-01C	305	25
1223-02C	610	50
1223-03C	915	50
1223-04C	1220	50
1223-06C	1830	100
1223-10C	3050	100
1223-15C	4575	150
1223-20C	6100	150
1223-25C	7620	150
1223-50C	15240	760

LENGTH TABLE

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE mm
STANDARD TOL ± 0.3

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	BNM	02/10/15
CHECKED	NWC	03/05/15
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

DATAPRO

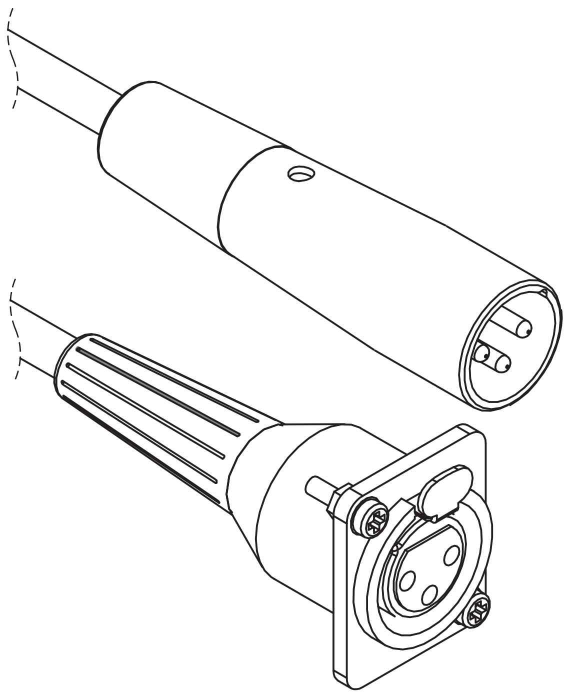
TITLE:

DUAL PANEL-MOUNT
STEREO F/F

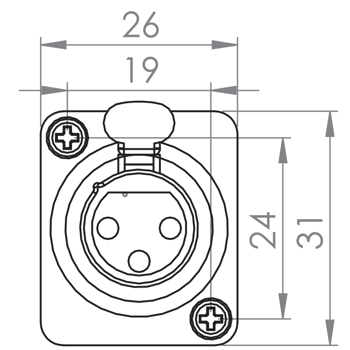
SIZE A | DWG. NO. 1223 | REV 4

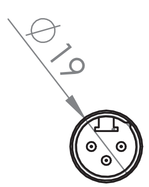
SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

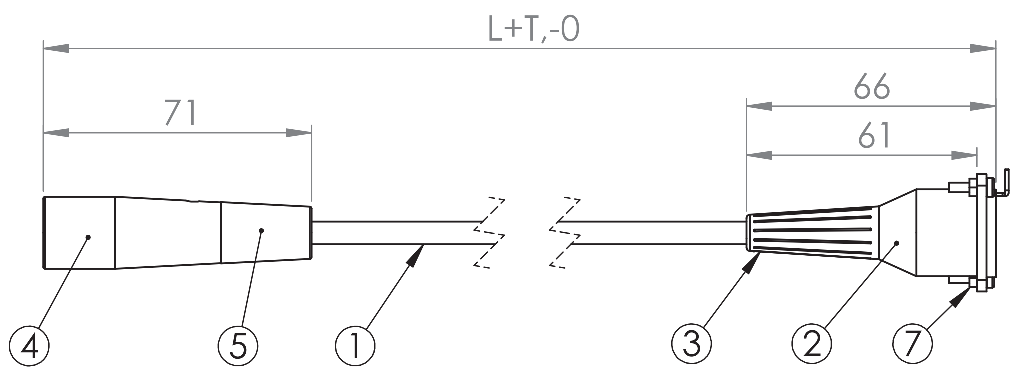
5 4 3 2 1

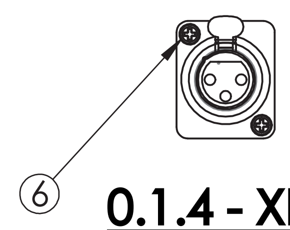


QTY	DESCRIPTION	COLOR	MATL	ITEM #
1	Wire: UL VW-1, 24AWG x 2C + AL/MY + DW + Jacket	Black	PVC	1
1	Connector: XLR 3-Pin Female Panel-Mount with Release Tab	Black		2
1	Plastic Strain Relief	Black	PVC	3
1	Connector: XLR 3-Pin Male			4
1	Plastic Strain Relief	Black	PVC	5
2	Screw, pan-head, UNC #4-40, 5/16" (8mm) thread, 0.3925" (12 mm) length		Zinc Plated	6
2	Hex nut, UNC #4-40, 1/16" (2mm) thick		Zinc Plated	7









0.1.4 - XLR CABLE

COMPLIANCES

ROHS (2011/65/EU)

P/N	L	T
1231-01C	305	25
1231-02C	610	50
1231-03C	915	50
1231-06C	1830	100

LENGTH TABLE

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE

STANDARD TOL ± 0.3

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	BNM	06/02/15
CHECKED	NWC	06/08/15
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

DATAPRO

TITLE:

XLR PANEL-MOUNT FEMALE EXTENSION

SIZE	DWG. NO.	REV
A	1231	2

SCALE: 1:2 WEIGHT: SHEET 1 OF 1

5 4 3 2 1

TNT electron

NEW 12 Volt Fully Regulated Power Supply-5Amp Standard Adapter Power

Email to a Friend
Be the first to review this product

Availability: Out of stock

$8.99

Quick Overview

- 2 Volt 5 Amp DC Power Supply Adapter (60 Watts) - Standard
- High quality power adapter
- Input:100/240 Volts AC 50-60 Hz. Output: 12V DC 5 Amp (12V, 5A)
- Connector Size: 5.5mm (Outside barrel) x 2.1mm (Inside Barrel). Center: Positive.

MORE VIEWS

Product Description | Product Tags

High Quality 12V 5A DC Power Supply Adapter for any device that requires stable DC power. Examples: Audio and Video Devices, Digital Media, Hard Drives, Computer Peripherals, Amplifiers, Satellite Radio receivers, and many more. This adapter will protect your valuable electronics against spikes and dips in power, and will shut itself off if the power supply becomes unstable. It can be reset by being unplugged and replugged in. It is vastly superior to cheap look alike power supply adapters and normally retails for $40.00. Connector Size: 5.5mm (Outside barrel) x 2.1mm (Inside Barrel) Center: Positive.

- 12 Volt 5 Amp DC Power Supply Adapter (60 Watts) - Standard
- High quality power adapter
- Input:100/240 Volts AC 50-60 Hz. Output: 12V DC 5 Amp (12V, 5A)
- Connector Size: 5.5mm (Outside barrel) x 2.1mm (Inside Barrel). Center: Positive.

0.1.5 - 12V POWER SUPPLY

1.5mm Diameter Heat Shrinkable Tube Shrink Tubing

Market Price: $8.99
Model Number : a12072700ux0158

Suitable for various electric insulation and bonding of cables and connectors and widely applied for connecting or end-handling, electric wire, insulating and harness of electric wire, corrosion-proof of metallic rods or tubes, and antenna protection.

Description:

- Suitable for various electric insulation and bonding of cables and connectors and widely applied for connecting or end-handling, electric wire, insulating and harness of electric wire, corrosion-proof of metallic rods or tubes, and antenna protection.
- Very thin wall tubing good protection for temperature sensitive components.
- Low shrink temp improves production efficiency.
- Fast, safe, secure way to wrap wiring harnesses.

Product Name	Heat Shrinkable Tube
Material	Polyolefin
Rated Voltage	600V
Temperature Level	125C
Flammability	VW-1
Diameter	1.5mm / 0.059" (Before Shrinking) 0.75mm / 0.029" (After Shrinking)
Shrink Ratio	2:1
Length (Approx.)	6M / 19.6Ft
Color	Blue
Weight	19g
Package Content	1 x Heat Shrinkable Tube

Click to open expanded view

by Coleman Cable

Coleman Cable 18/3 Thermostat Wire • 18 Gauge 3 Conductor • 20 foot

Be the first to review this item

Price: $13.15 & **FREE Shipping**

In Stock.

Estimated Delivery Date: Friday, Feb. 12 when you choose Two-Day Shipping at checkout.
Ships from and sold by AirstarSupply.

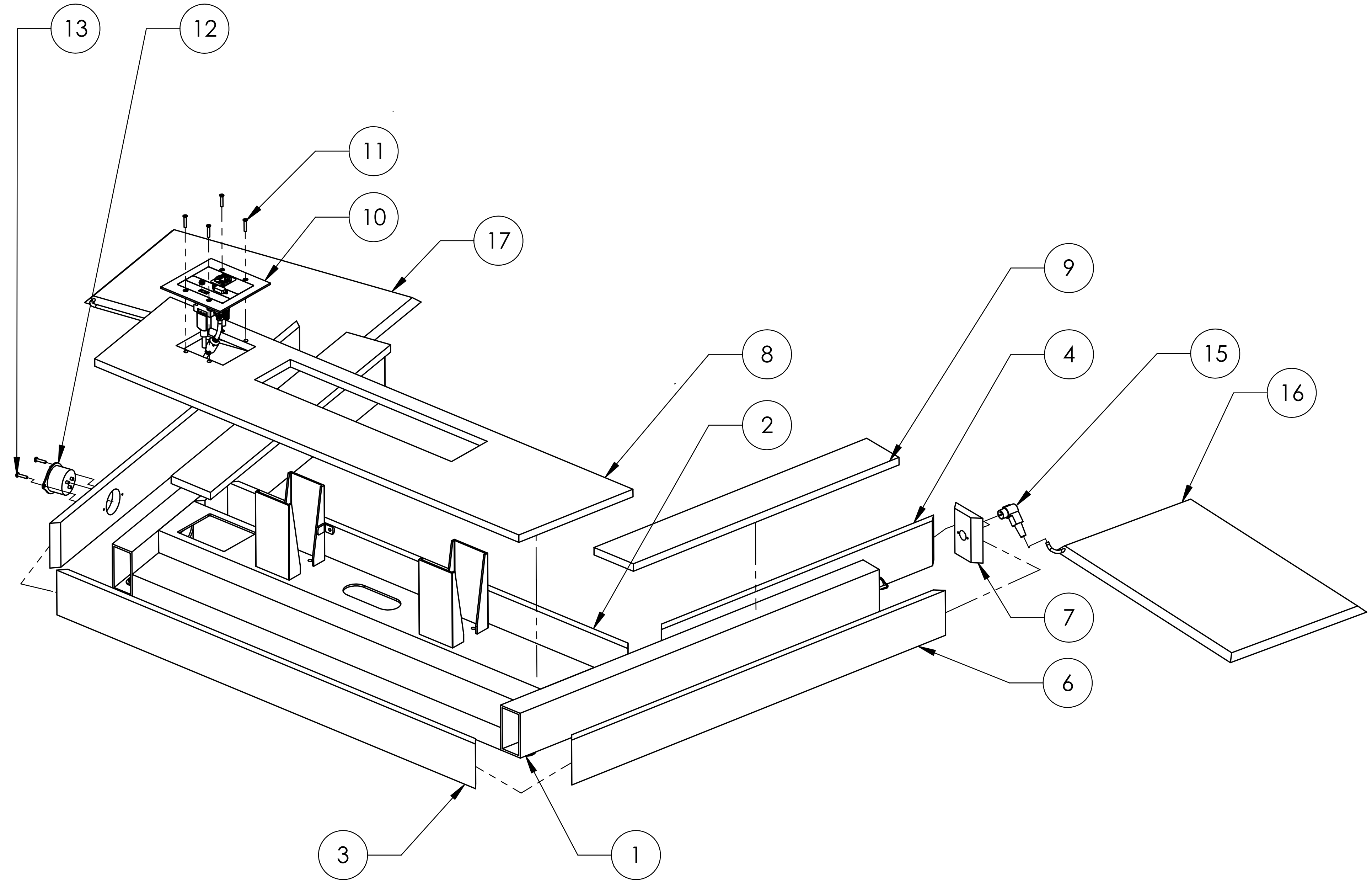
2 new from $13.15

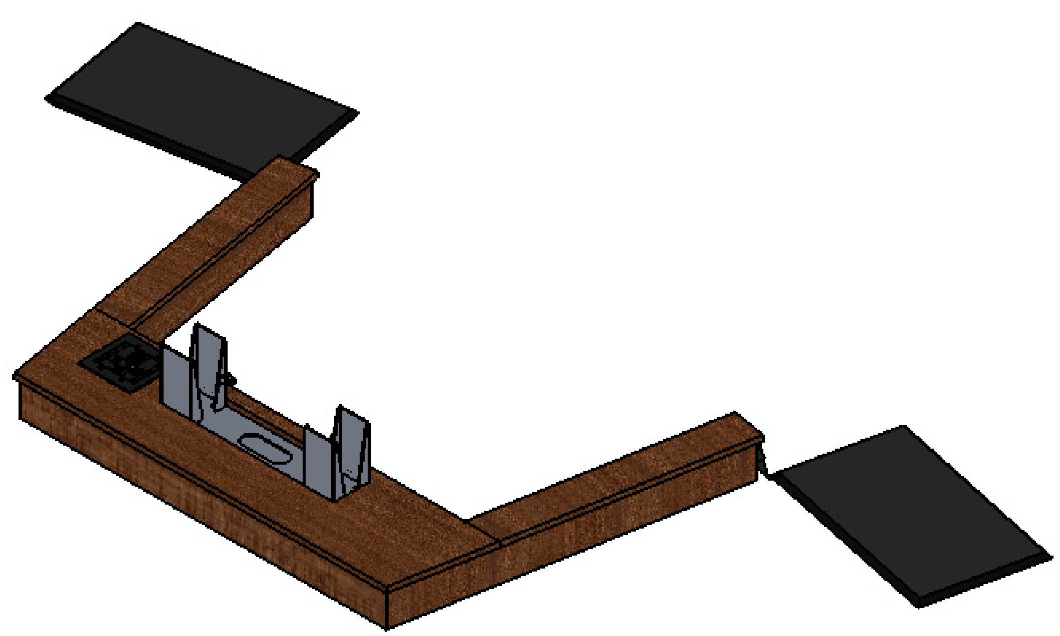
Specifications for this item

Brand Name	Coleman Cable
Item Weight	1 pounds
Material Type	Copper
Number of Items	1
Part Number	18/3_StatWire_20ft
Shape	Round
UNSPSC Code	26121500

0.1.7 - FOOT CONTROL WIRE

ITEM NO.	PART NUMBER	QTY.
1	1.1.0 - Aluminum Subframe	1
2	1.2.1 - Cross Member Inside Panel	1
3	1.2.2 - Cross Member Outside Panel	1
4	1.2.3 - Leg Inside Side Panel	2
5	1.2.4R - Leg Outside Panel - Right	1
6	1.2.4L - Leg Outside Panel - Left	1
7	1.2.5 - Leg End Cap	2
8	1.2.6 - Cross Member Top Panel	1
9	1.2.7 - Leg Top Cover	2
10	1.3.0 - AV Panel - Lower	1
11	#6 x 5/8 Flat Head A3 Wood Screw	4
12	1.4.1 - AC Outlet Male Port	1
13	#6 x 5/8 Pan Head A3 Wood Screw	6
14	1.4.2 - 3 Pin DIN Female Socket	2
15	1.4.3 - 3 Pin DIN Male 90	2
16	1.4.4L - Switch Mat - Left	1
17	1.4.4R - Switch Mat - Right	1





FOR REFERENCE ONLY

NOTES:

TOLERANCES:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

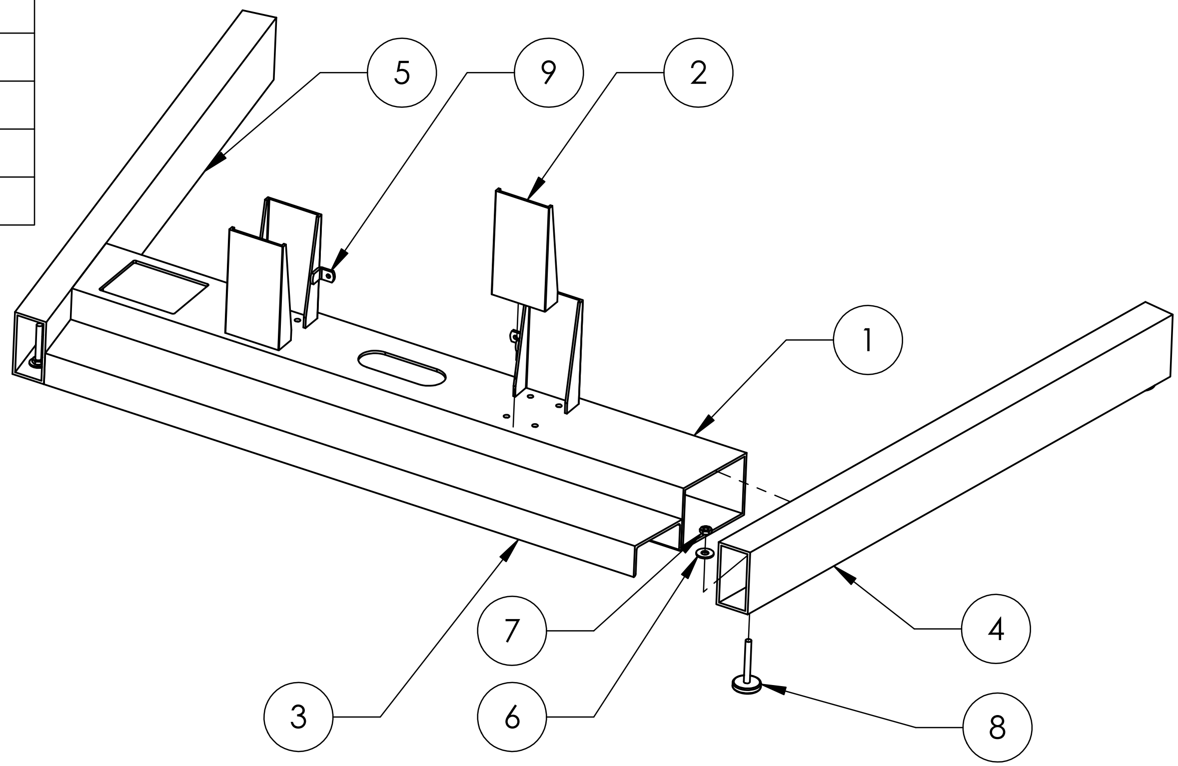
TITLE:

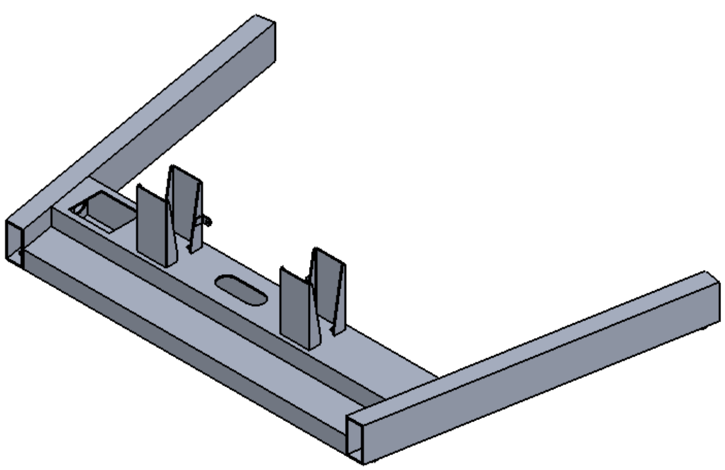
BASE ASSEMBLY

SIZE **B** | DWG. NO. 1.0.0 | REV -

SCALE: 1:8 | UNITS: INCHES | SHEET 1 OF 1

ITEM NO.	PART NUMBER	QTY.
1	1.1.1 - Cross Member	1
2	1.1.2 - Okin Leg Supports	4
3	1.1.3 - U-Channel	1
4	1.1.4L - Leg - Left	1
5	1.1.4R - Leg - Right	1
6	1/4" Washer	4
7	1/4-20 Hex Jam Nut	4
8	1.1.5 - Leveling Mount	4
9	1.1.6 - Angle Bracket	2





FOR REFERENCE ONLY

NOTES:
1. REFER TO 1.1.1M FOR ADDITIONAL CONSTRUCTION AND ASSEMBLY INFORMATION.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

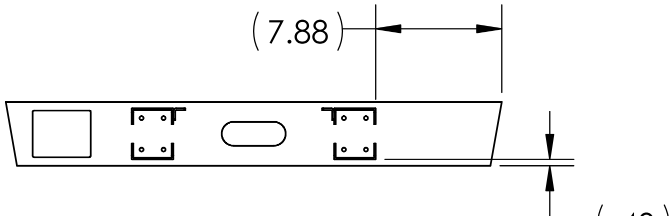
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

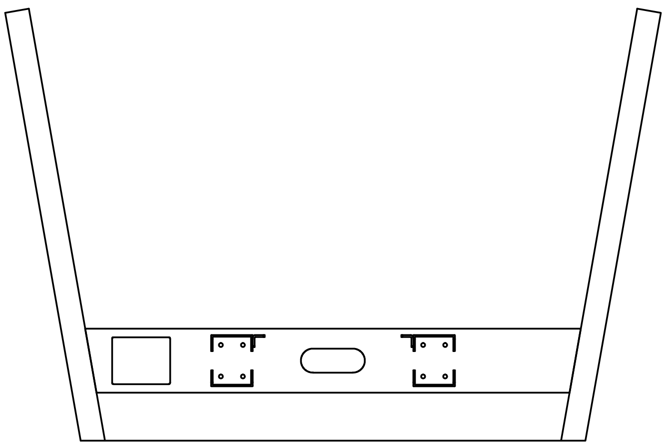
ALUMINUM SUBFRAME ASSEMBLY

SIZE: A | DWG. NO. 1.1.0A | REV -

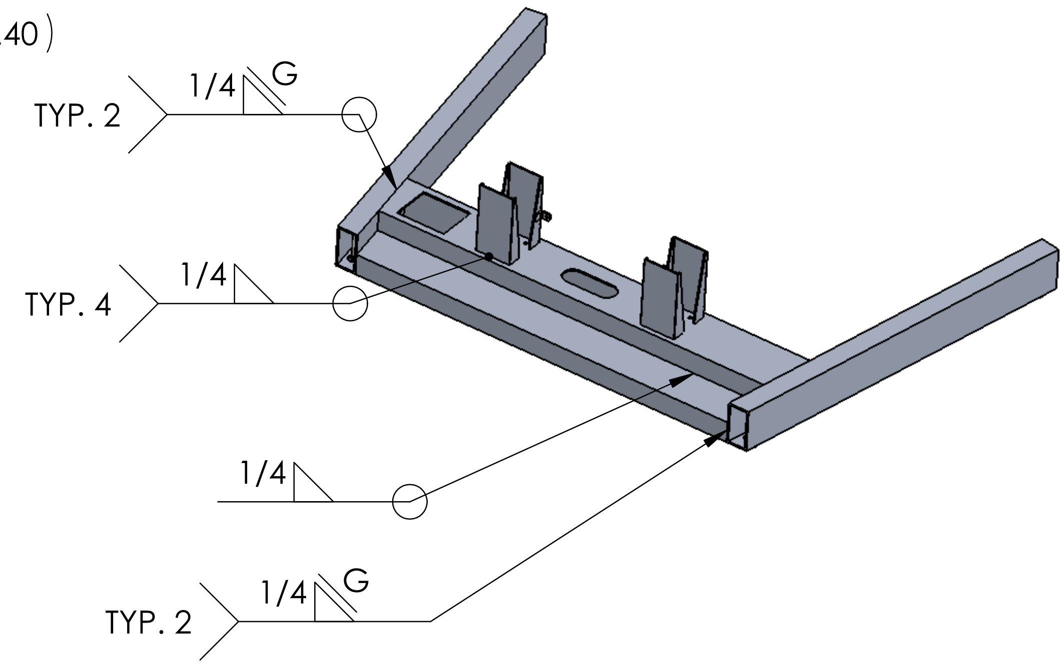
SCALE: 1:8 | UNITS: INCHES | SHEET 1 OF 1



PROCESS #1



PROCESS #2



SPECIFICATIONS

NOTES:
1. GTAW PROCESS SHALL BE USED FOR ALL WELDS.
2. USE 4043 ALUMINUM WELDING ROD, OR EQUIVALENT.
3. LOCATE SUPPORT BRACKETS IN PROCESS #1 BY TACKING WITH ACTUATION LEGS IN PLACE.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:
ALUMINUM SUBFRAME MANUFACTURING

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

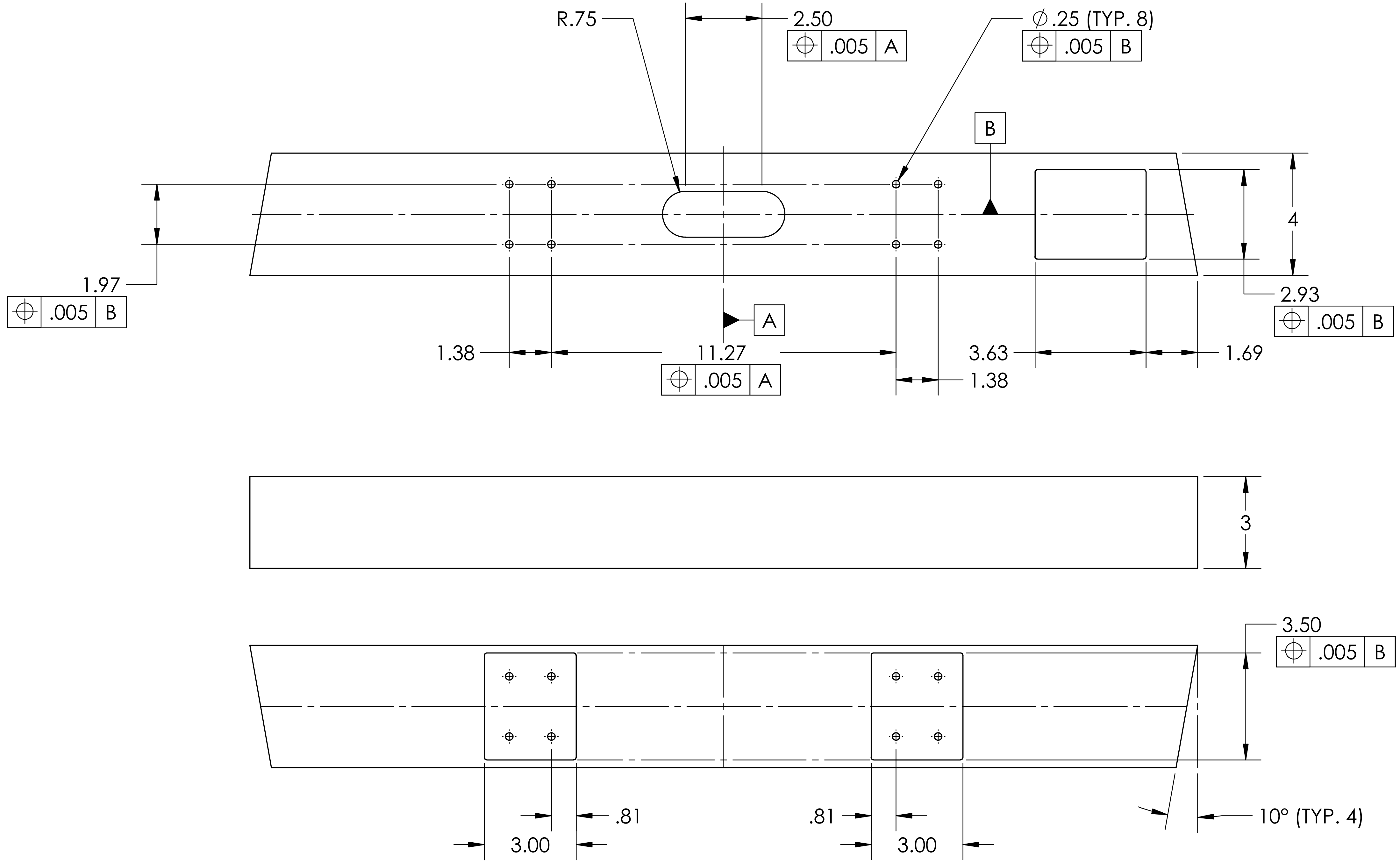
MATERIAL: 6061-T6

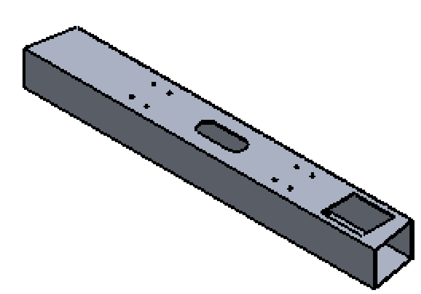
FINISH: UNFINISHED

DO NOT SCALE DRAWING

SIZE: **A**
DWG. NO. 1.1.0M
REV -

SCALE: 1:12
UNITS: INCHES
SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. STOCK RECTANGULAR TUBE
2. 'D' LETTERED DRILL BIT FOR CLEARANCE HOLE

TOLERANCES:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

CROSS MEMBER

PROPRIETARY AND CONFIDENTIAL

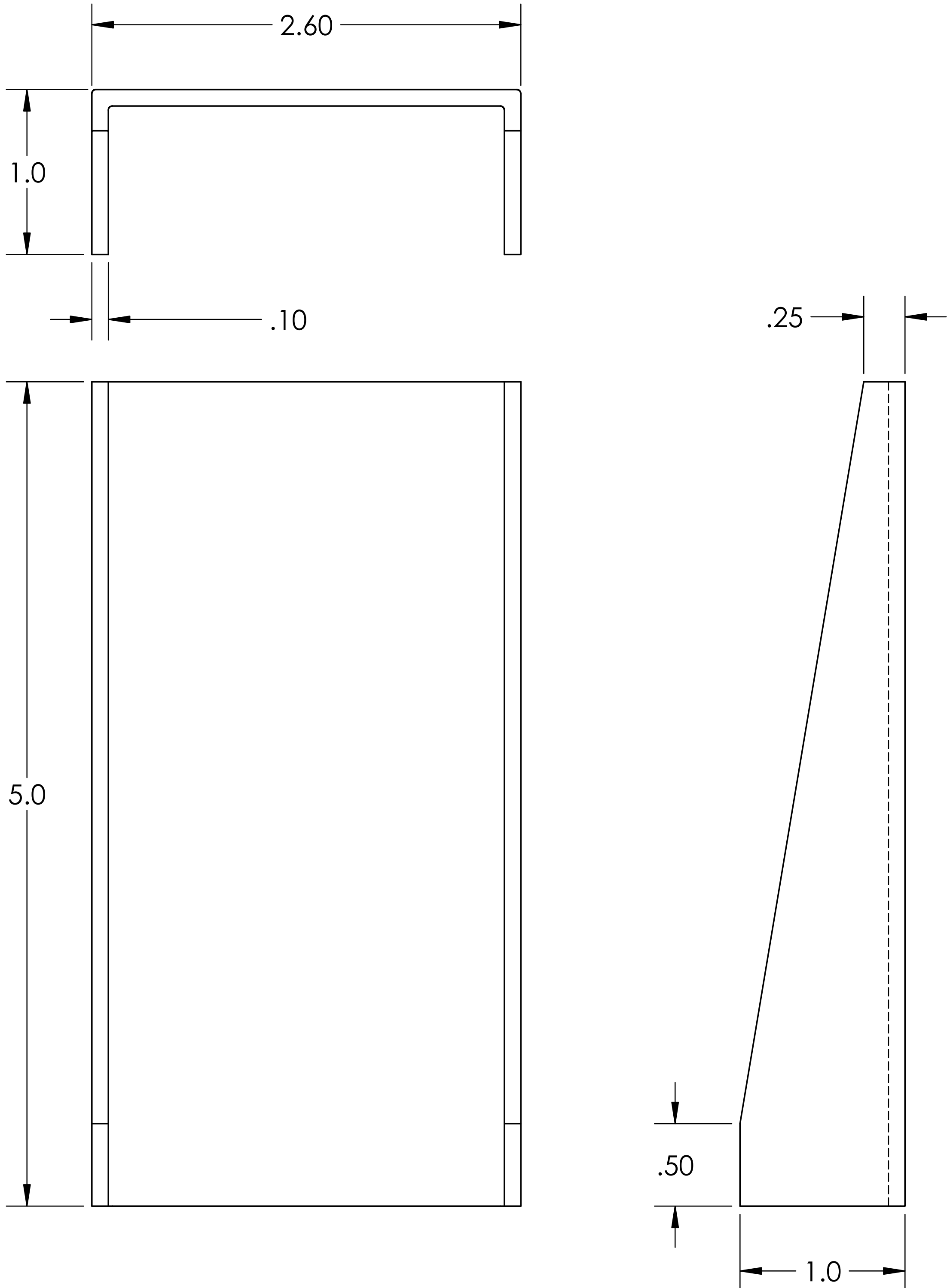
INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

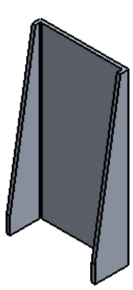
MATERIAL	6061-T6
FINISH	UNFINISHED

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
B	1.1.1	-

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

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TOLERANCES, UON:
FRACTIONAL ±1/32
ANGULAR: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

MATERIAL
6061-T6

FINISH
UNFINISHED

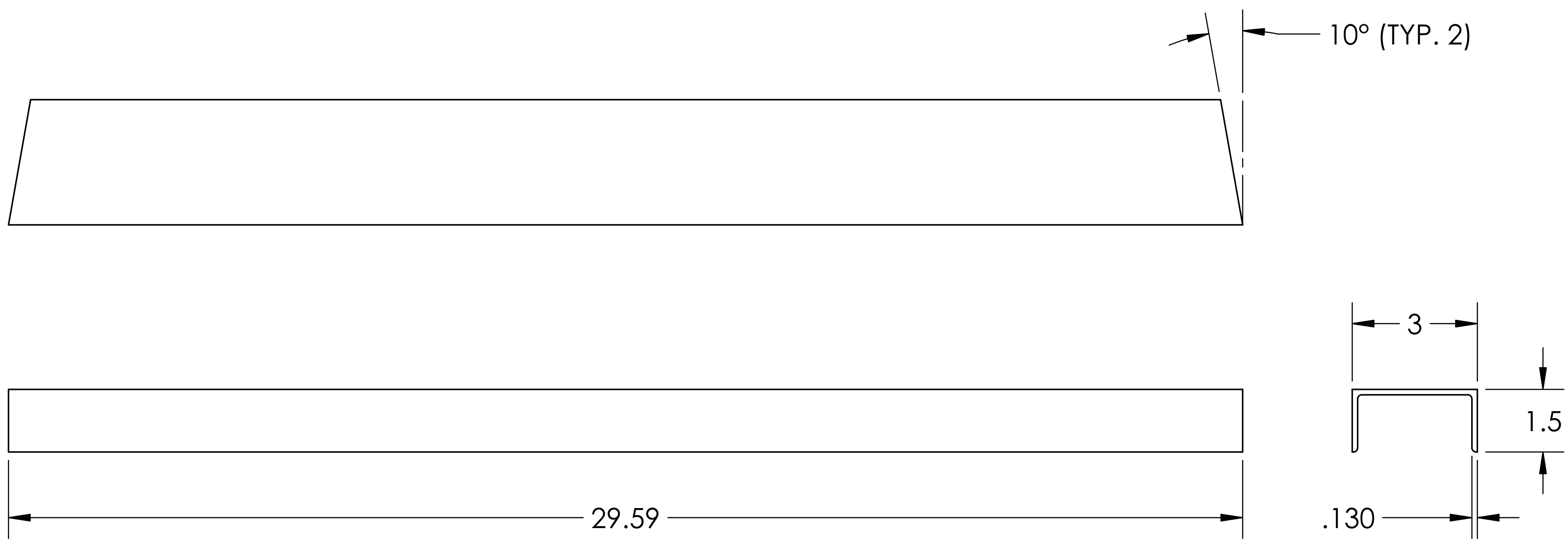
DO NOT SCALE DRAWING

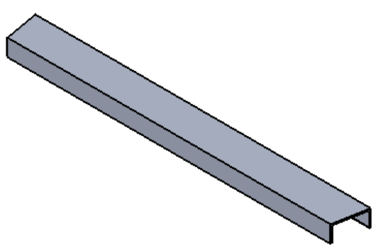
CAL POLY ME428/429/430
INCLUSIVE LECTERN

TITLE:
OKIN LEG SUPPORT

SIZE A | DWG. NO. 1.1.2 | REV. -

SCALE:1:1 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. STOCK U-CHANNEL

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

U-CHANNEL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

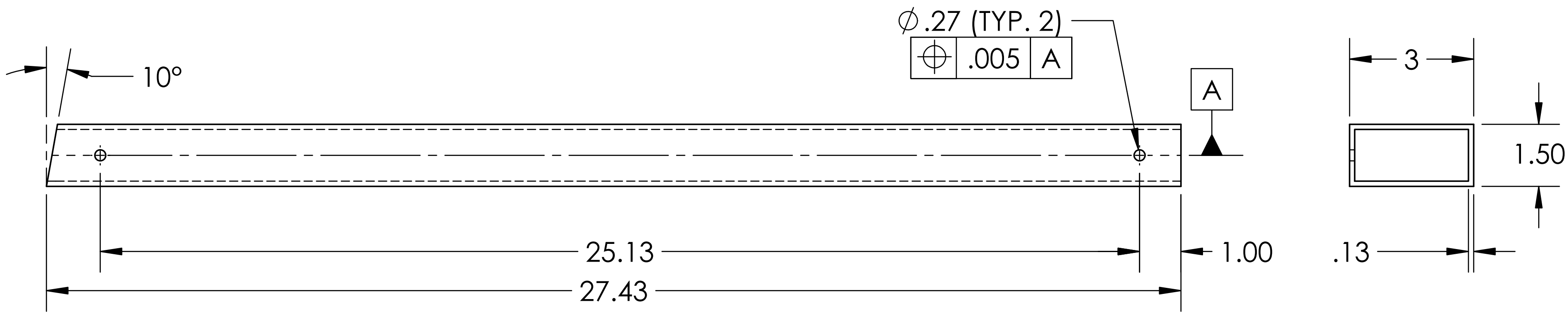
MATERIAL: 6061-T6

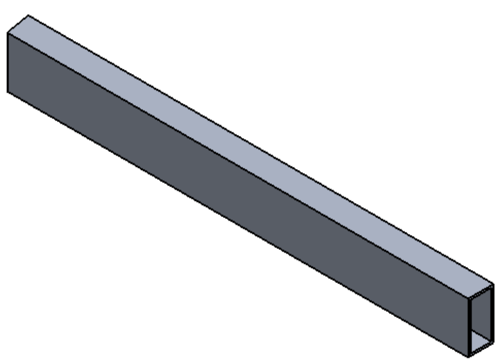
FINISH: UNFINISHED

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
A	1.1.3	-

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. STOCK RECTANGULAR TUBE
2. 17/64 CLEARANCE HOLE

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

LEG - LEFT

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

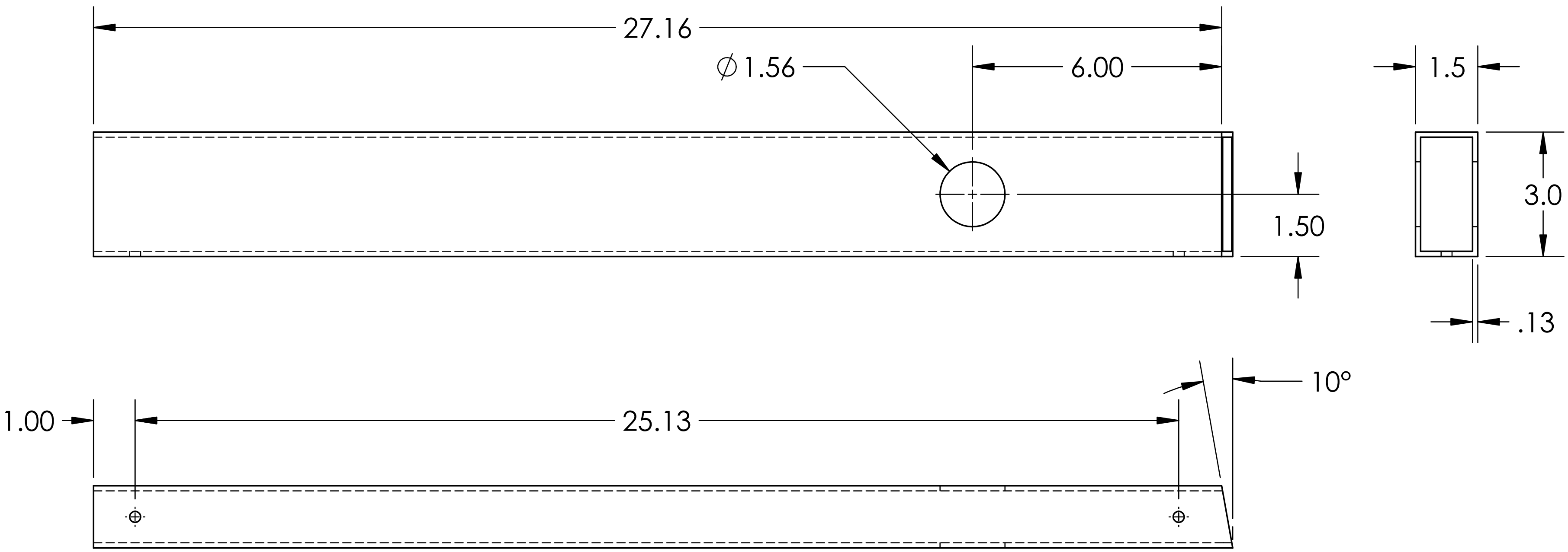
MATERIAL: 6061-T6

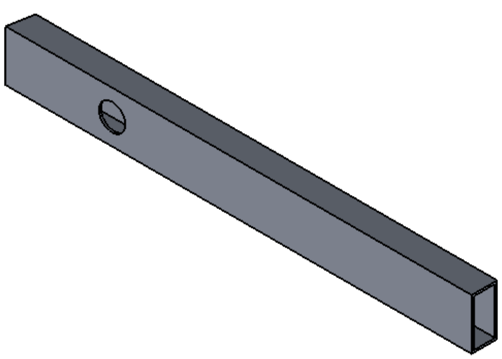
FINISH: UNFINISHED

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
A	1.1.4L	-

SCALE: 1:4	UNITS: INCHES	SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. STOCK RECTANGULAR TUBE
2. 17/64 CLEARANCE HOLE

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

LEG - RIGHT

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL 6061-T6

FINISH UNFINISHED

DO NOT SCALE DRAWING

SIZE A | DWG. NO. 1.1.4R | REV -

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1

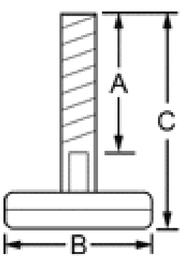
McMASTER-CARR® OVER 555,000 PRODUCTS
(562) 692-5911
(562) 695-2323 (fax)
la.sales@mcmaster.com
Text 75930

High-Cap Leveling Mount with Zinc-Plated Steel Stud

1/4"-20 x 1-1/2" Thread Length, 1-3/16" Base Diameter

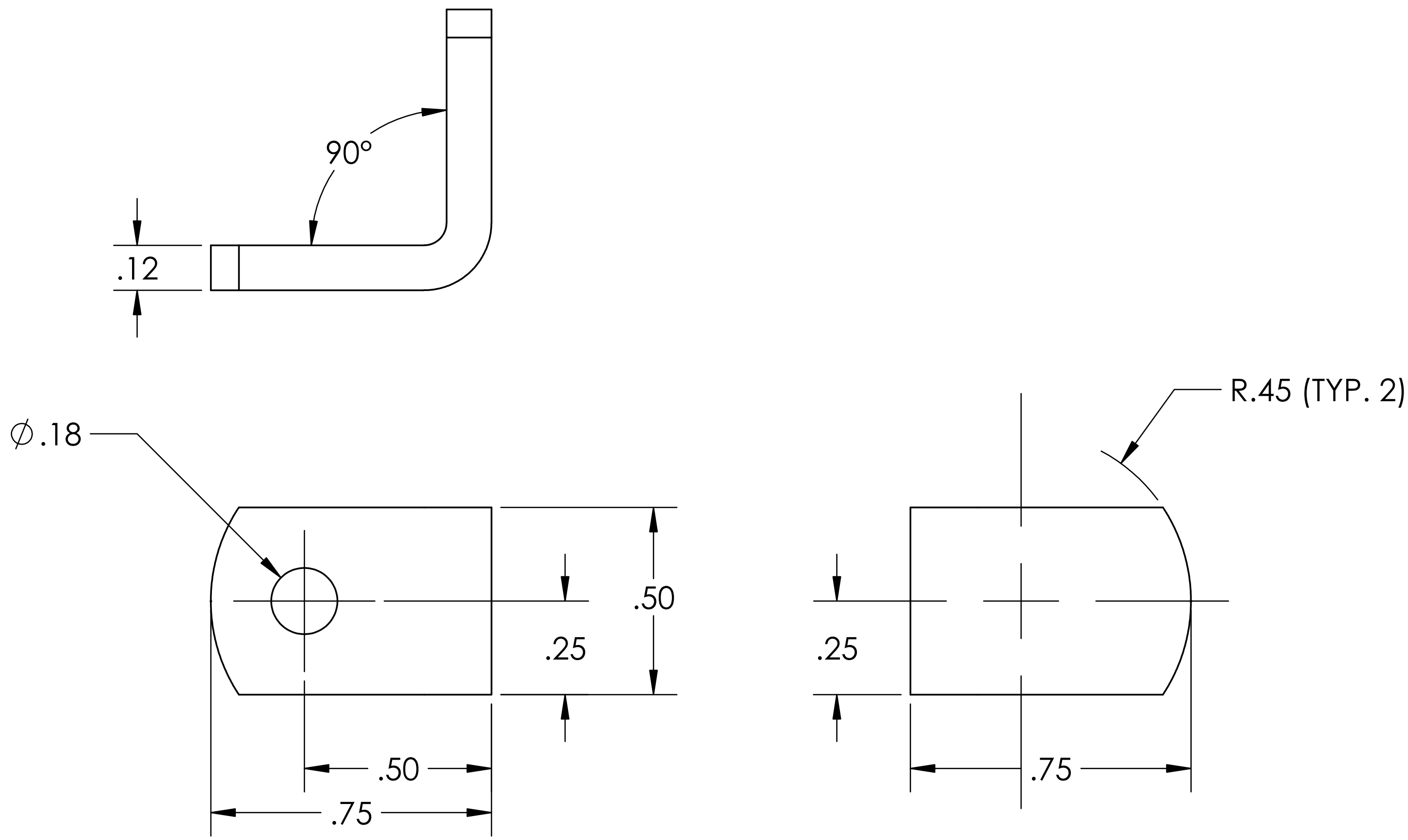
In stock
$2.05 Each
62805K32

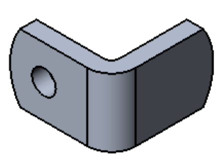
Thread	
Size	1/4"-20
Length (A)	1 1/2"
Capacity per Mount	250 lbs.
Base Diameter (B)	1 3/16"
Overall Height (C)	2 1/4"
Additional Specifications	Inch (8) High Capacity with Zinc-Plated Steel Stud (-20° to 170°F)
RoHS	Compliant



(8) High Capacity—Choose from zinc-plated steel and stainless steel stud. Base is same as stud material on top with a white, nonmarring plastic bottom.

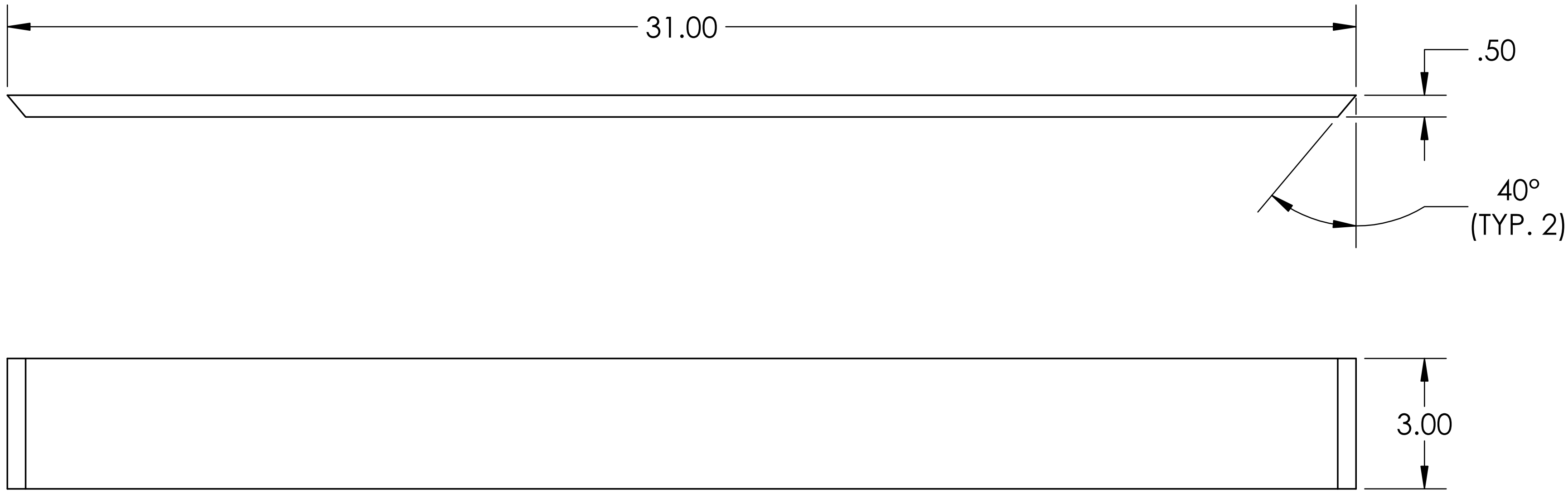
1.1.5 - LEVELING MOUNT

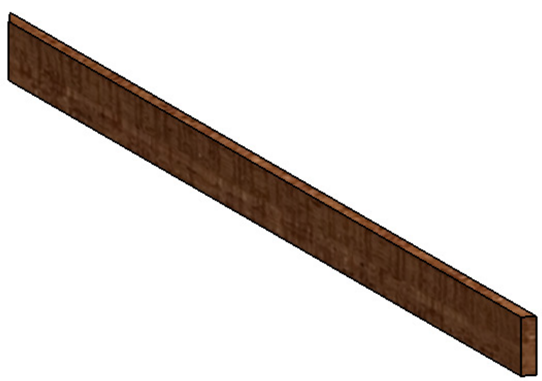




FOR REFERENCE ONLY

NOTES: 1.	TOLERANCES, UON: FRACTIONAL ±1/32 ANGLES: MACH ±.5 BEND ±1 X ±.5 .X ±.1 .XX ±.01 .XXX ±.005	CAL POLY ME 428/429/430 INCLUSIVE LECTERN TITLE: ANGLE BRACKET
PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.	INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B MATERIAL 6061 FINISH UNFINISHED DO NOT SCALE DRAWING	SIZE A | DWG. NO. 1.1.6 | REV - SCALE: 2:1 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

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INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

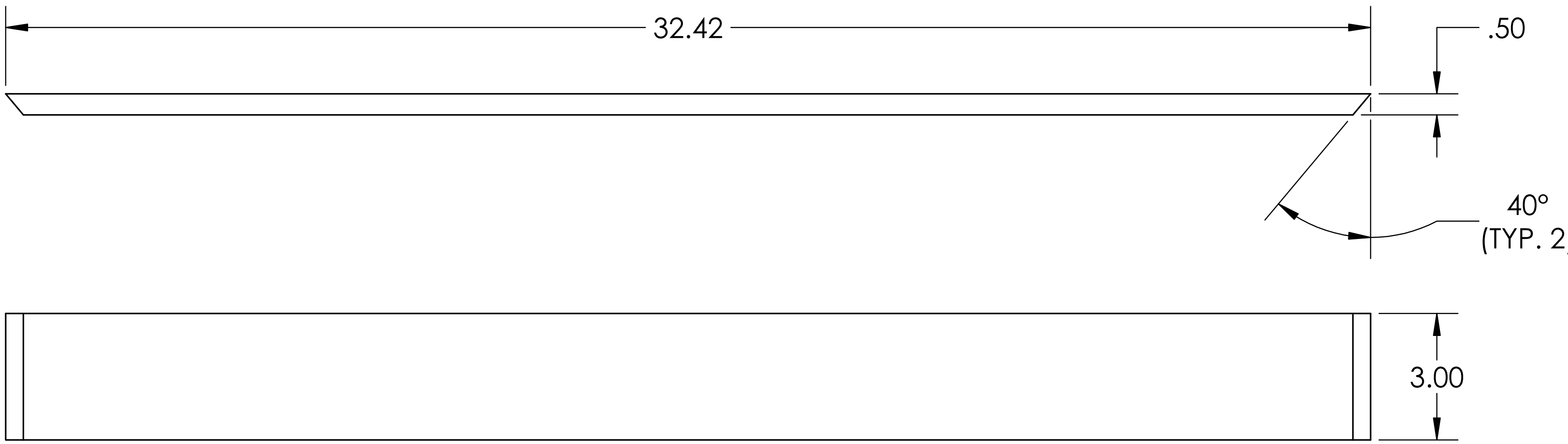
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

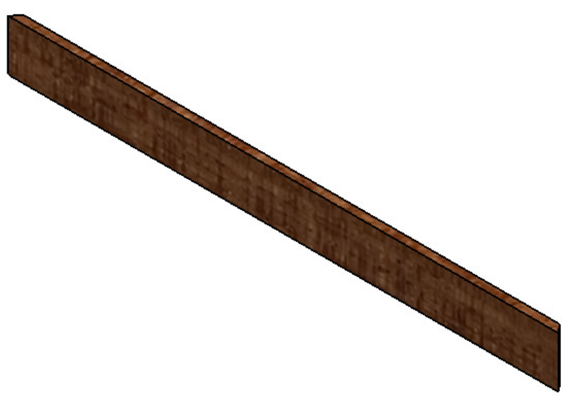
TITLE:

CROSS MEMBER INSIDE PANEL

SIZE	DWG. NO.	REV
A	1.2.1	-

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:

PROPRIETARY AND CONFIDENTIAL

TOLERANCES, UON:
FRACTIONAL ± 1/32
ANGLES: MACH ± .5 BEND ± 1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

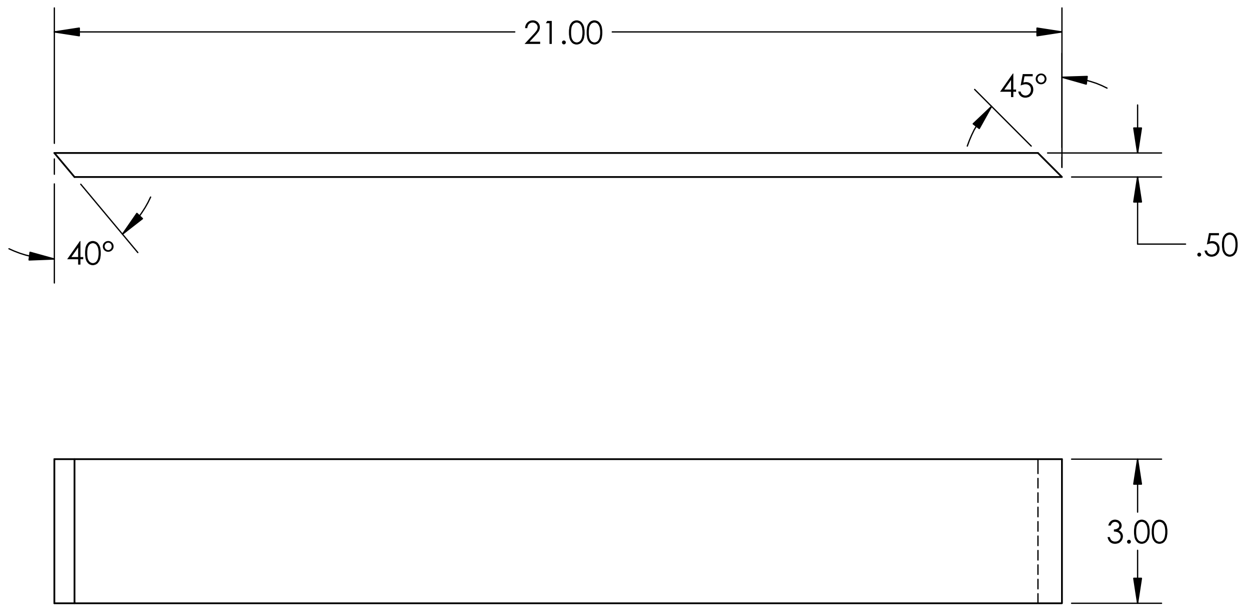
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

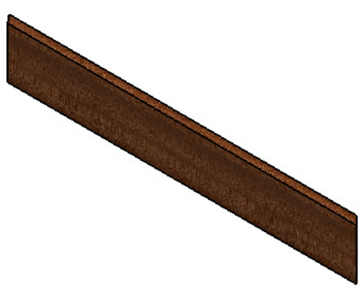
TITLE:

CROSS MEMBER OUTSIDE PANEL

SIZE	DWG. NO.	REV
A	1.2.2	-

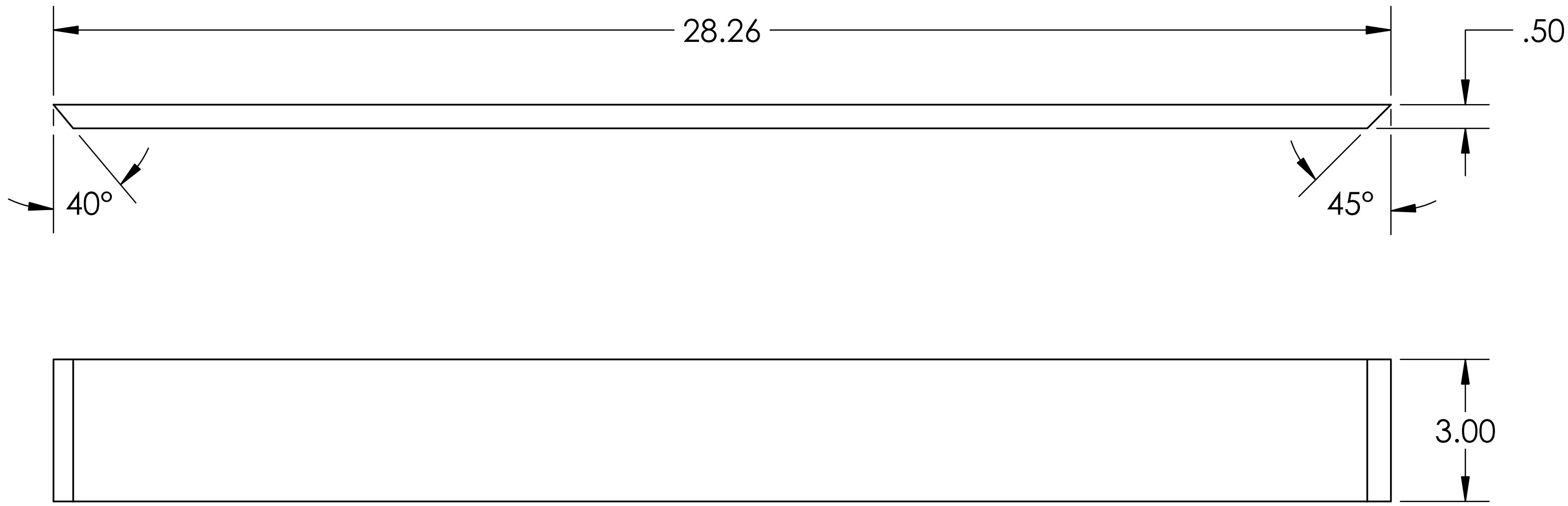
SCALE: 1:4	UNITS: INCHES	SHEET 1 OF 1

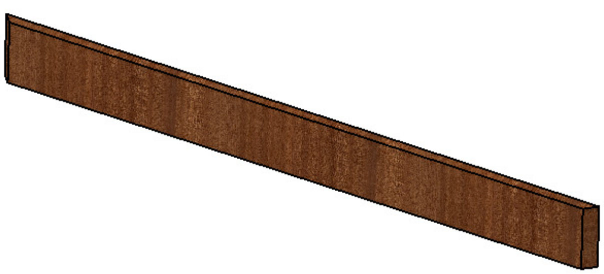




FOR REFERENCE ONLY

NOTES:	TOLERANCES, UON: FRACTIONAL ±1/32 ANGLES: MACH ±.5 BEND ±1 X ±.5 .X ±.1 .XX ±.01 .XXX ±.005	CAL POLY ME 428/429/430 INCLUSIVE LECTERN TITLE: LEG INSIDE PANEL
PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.	INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B MATERIAL: MAHOGANY FINISH: UNFINISHED DO NOT SCALE DRAWING	SIZE: A DWG. NO. 1.2.3 REV: - SCALE: 1:4 UNITS: INCHES SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

PROPRIETARY AND CONFIDENTIAL

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

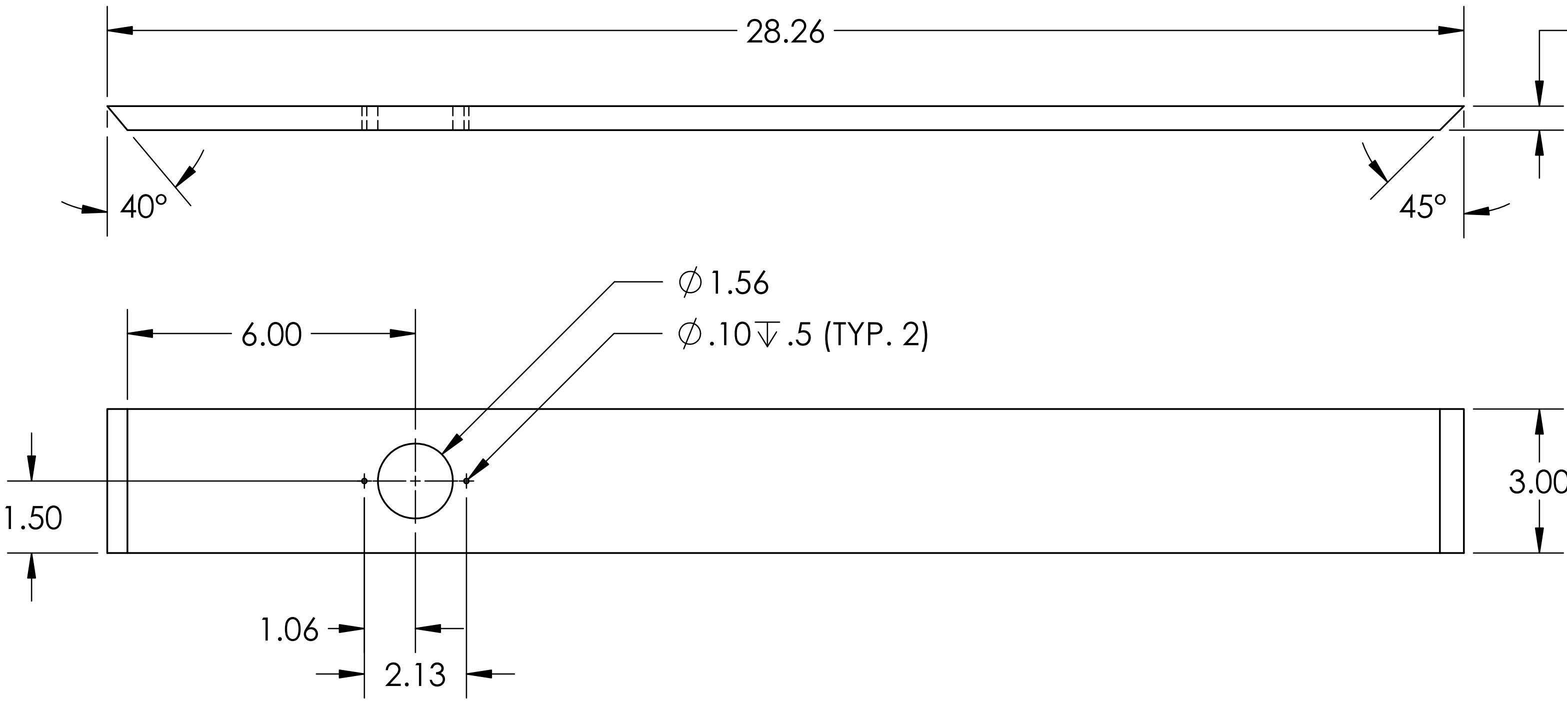
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

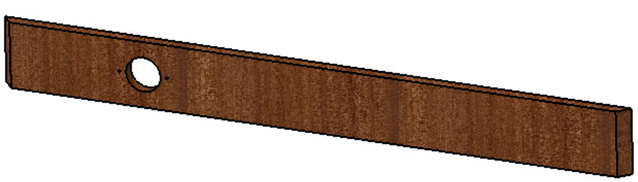
TITLE:

LEG OUTSIDE SIDE PANEL - LEFT

SIZE	DWG. NO.	REV
A	1.2.4L	-

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:

PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

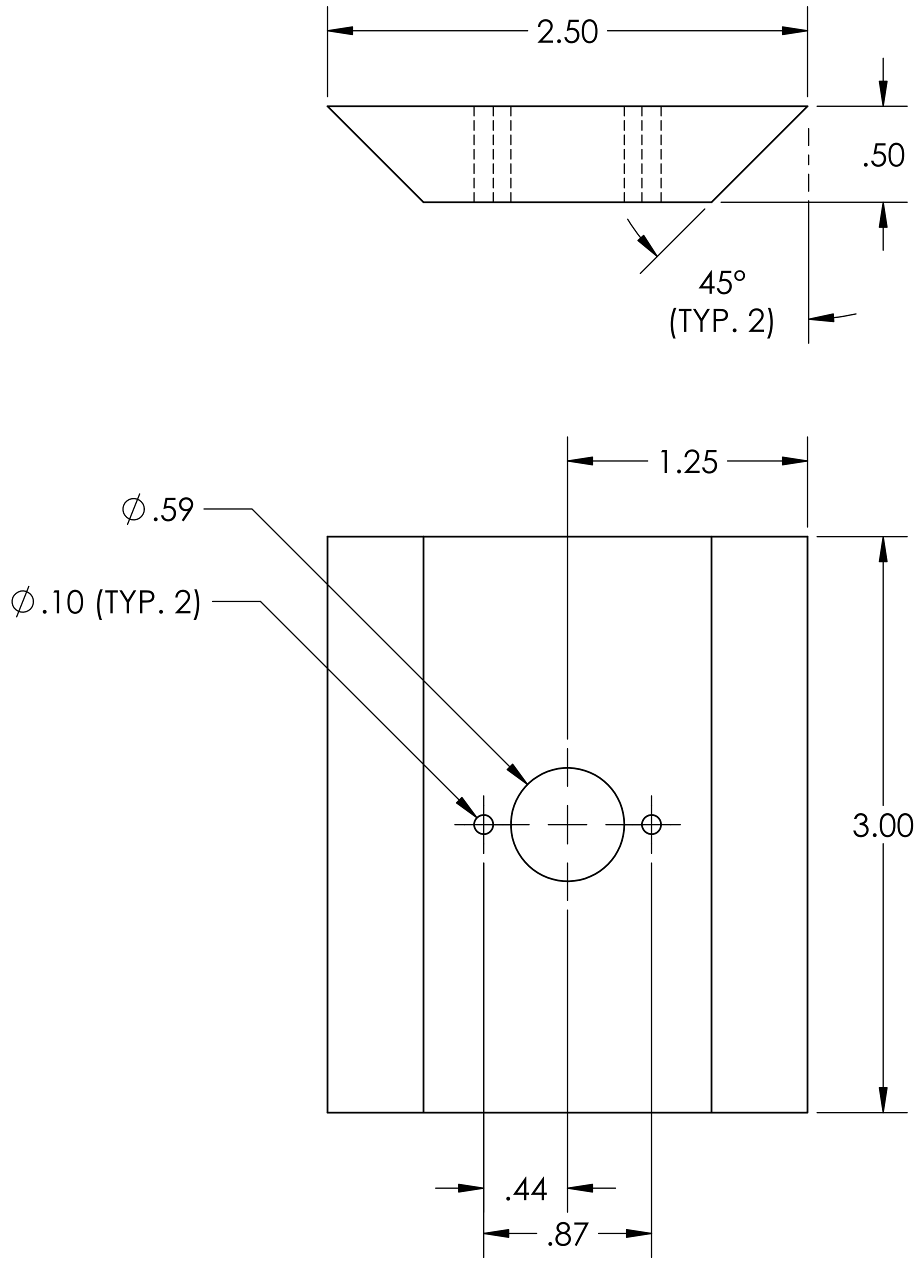
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

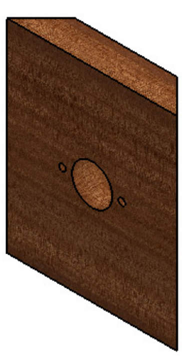
TITLE:

LEG OUTSIDE SIDE PANEL - RIGHT

SIZE: A | DWG. NO.: 1.2.4R | REV: -

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1



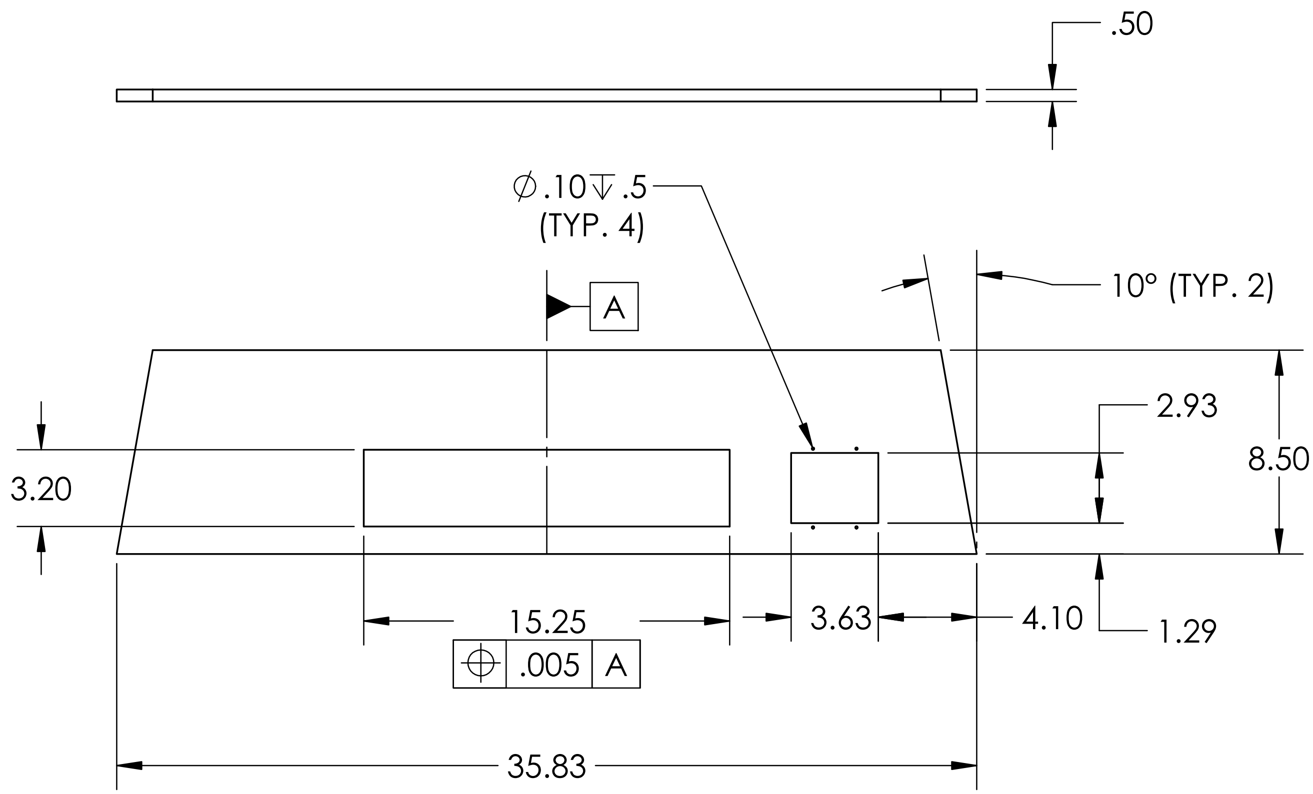


FOR REFERENCE ONLY

NOTES:	TOLERANCES, UON: FRACTIONAL ±1/32 ANGULAR: MACH ±.5 BEND ±1 X ±.5 .X ±.1 .XX ±.01 .XXX ±.005	CAL POLY ME428/429/430 INCLUSIVE LECTERN
PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.	MATERIAL: MAHOGANY FINISH: UNFINISHED DO NOT SCALE DRAWING	TITLE: LEG END CAP SIZE: A DWG. NO. 1.2.5 REV. - SCALE:1:1 UNITS: INCHES SHEET 1 OF 1

2 1

B



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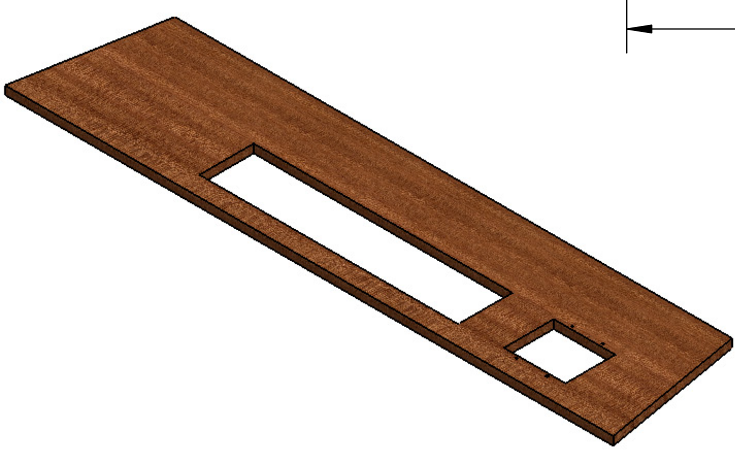


FOR REFERENCE ONLY

NOTES:
1. Ø.10 HOLE REPRESENTS PILOT TO LOCATE HARDWARE. REFER TO 1.1.0 FOR ADDITIONAL FASTENING INFORMATION.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:
CROSS MEMBER TOP PANEL

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

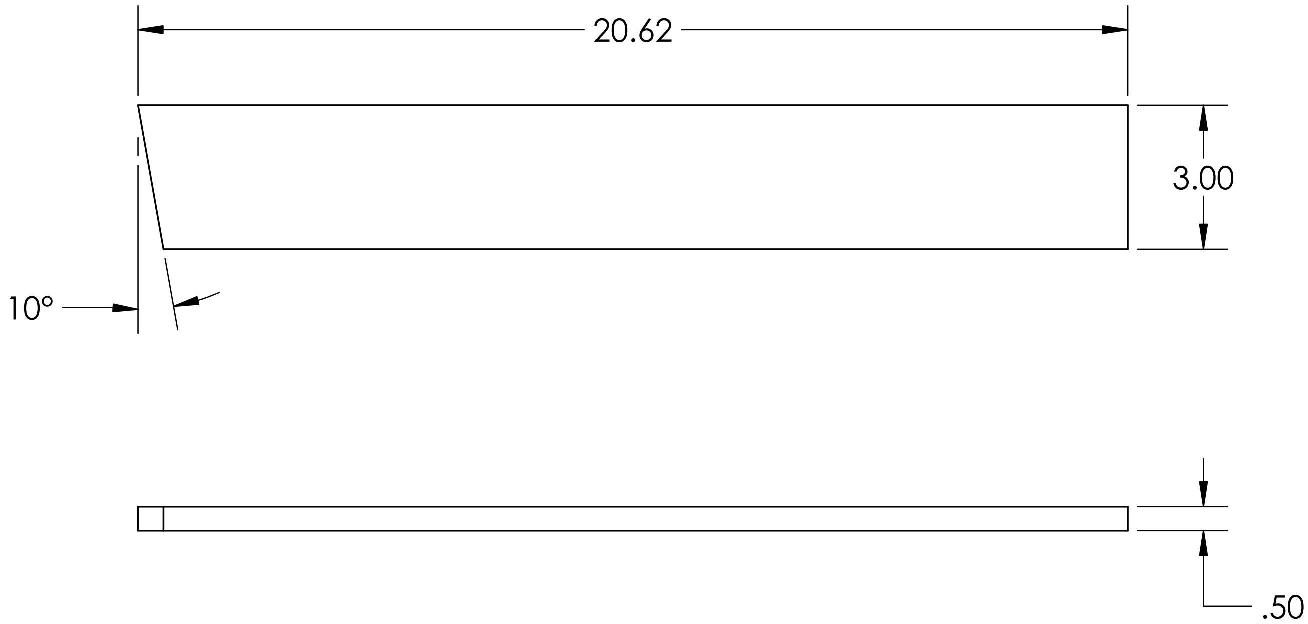
SIZE: A | DWG. NO.: 1.2.6 | REV: -

SCALE: 1:8 | UNITS: INCHES | SHEET 1 OF 1

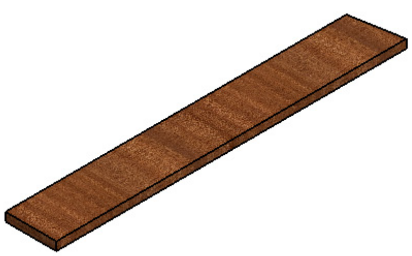
2 1

2 1

B B



A A



FOR REFERENCE ONLY

NOTES:

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

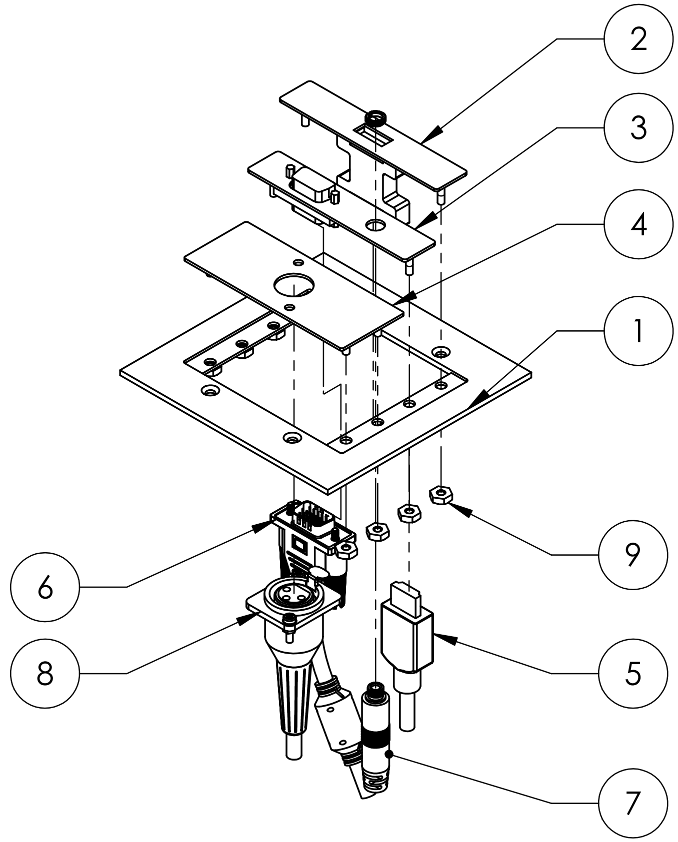
LEG TOP PANEL

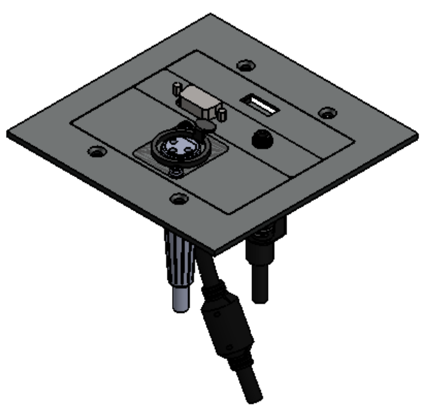
SIZE	DWG. NO.	REV
A	1.2.7	-

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1

2 1

ITEM NO.	PART NUMBER	QTY.
1	1.3.1 - AV Mounting Frame	1
2	1.3.2 - HDMI Plate	1
3	1.3.3 - VGA_Stereo Plate	1
4	1.3.4 - XLR Plate	1
5	0.1.1 - HDMI Cable End	1
6	0.1.2 - VGA Cable	1
7	0.1.3 - Audio Panel Mount Cable	1
8	0.1.4 - XLR Panel Mount Cable	1
9	#6-32 Jam Nut	8



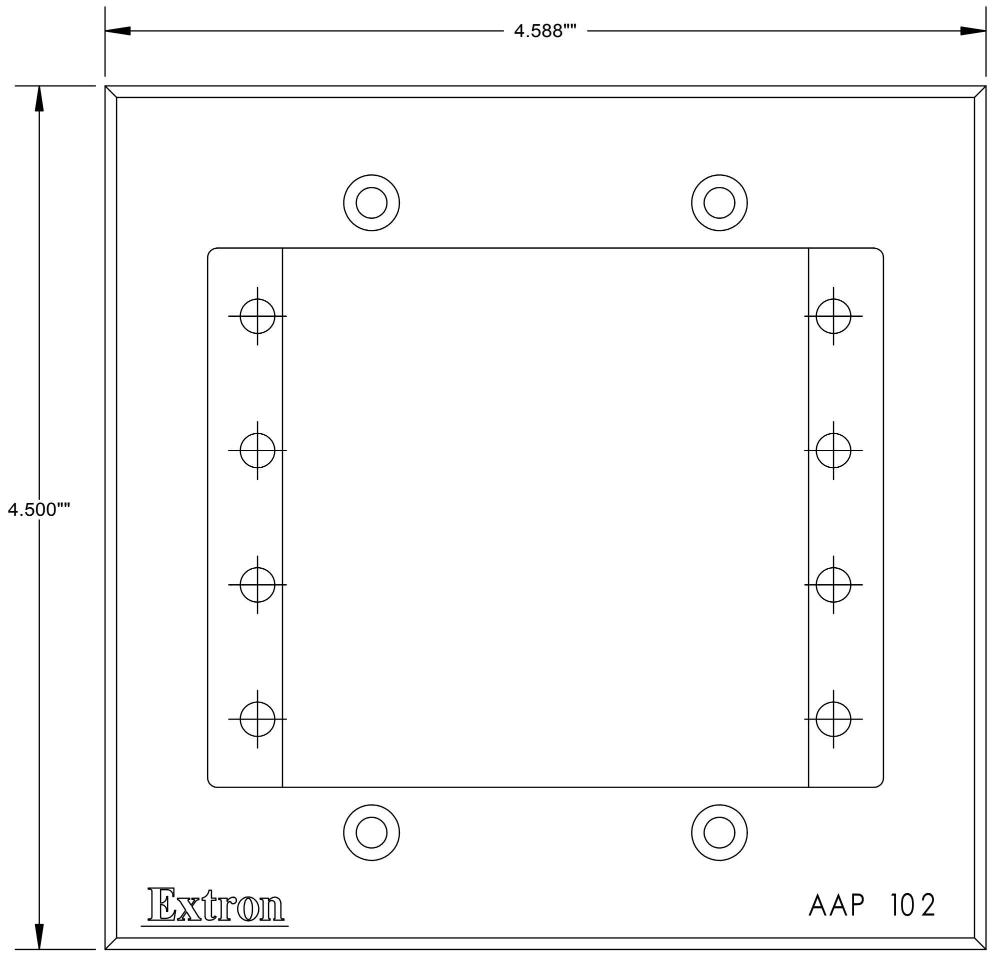


FOR REFERNCE ONLY

NOTES:	TOLERANCES, UON: FRACTIONAL ±1/32 ANGLES: MACH ±.5 BEND ±1 X ±.5 .X ±.1 .XX ±.01 .XXX ±.005	CAL POLY ME 428/429/430 INCLUSIVE LECTERN TITLE: AV PANEL - LOWER
PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.	INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B MATERIAL N/A FINISH N/A DO NOT SCALE DRAWING	SIZE A | DWG. NO. 1.3.0 | REV - SCALE: 1:3 | UNITS: INCHES | SHEET 1 OF 1

2 1

B B



A A

DRAWING IS DOWNLOADED FROM EXTRON ELECTRONICS RESOURCES AND IS PRESENTED IN THIS FORMAT FOR CONSISTENCY AND CLARITY.

NOTES:

TOLERANCES, UON:

PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF EXTRON ELECTRONIC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF EXTRON ELECTRONIC IS PROHIBITED.

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: N/A

FINISH: BLACK

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

AV MOUNTING FRAME

SIZE	DWG. NO.	REV
A	1.3.1	-

SCALE: NTS	UNITS: INCHES	SHEET 1 OF 1

2 1

Specifications — HDMI AAP

General

Temperature/humidity .... Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing
Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing

Rack mount .... Yes, with optional faceplate, and furniture/wall mountable with optional faceplates or AAP wall plates

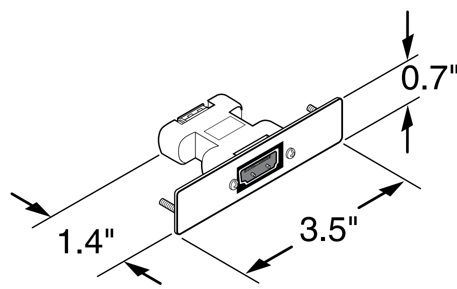
Enclosure type .... Metal

Connector type .... HDMI female

Enclosure dimensions

Faceplate............................. 0.7" H x 3.5" W x 0.1" D (1.8 cm H x 8.9 cm W x 0.3 cm D) (single space AAP plate)

Enclosure/connector .... 0.5" H x 1.3" W x 1.4" D (1.2 cm H x 3.3 cm W x 3.6 cm D)
(Depth excludes front connector. Allow at least 3.5" (8.9 cm) depth in the wall or furniture with the cables attached.)



Product weight .... 0.1 lbs (0.1 kg)

Shipping weight .... 1 lb (1 kg)

Vibration .... ISTA 1A in carton (International Safe Transit Association)

Warranty .... 3 years parts and labor

NOTE *Specifications are subject to change without notice.*

7.6-060209-D2-111512

1.3.2 - HDMI Plate

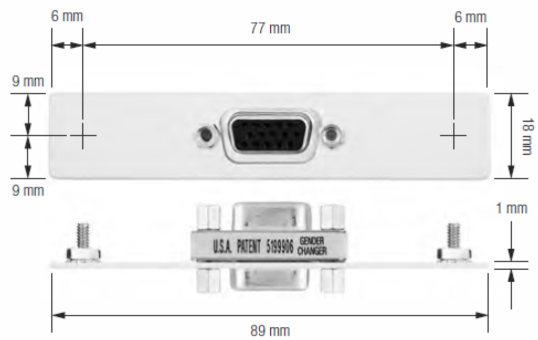
AAP - Architectural Adapter Plates

AV, Data, Power, and Control Connectivity for Wall Mount, Furniture Mount, and Floor Mount Applications

DESCRIPTION

Extron **Architectural Adapter Plates** are optional mounting plates that fit into designated AAP openings available on many Extron products. AAPs include pass-through connections and active modules as well as device control modules. There are also AAPs available with silk-screened labels for the most common signal types and blank AAPs to fill empty slots.

Custom engraving is available for an additional charge. See http://www.extron.com/engraving or contact your Extron Customer Support Representative.



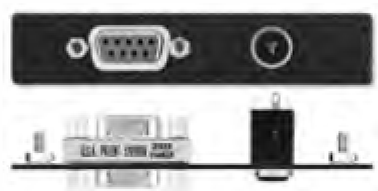
Control/Computer AAPs

One 9-pin D Female to Female Gender Changer, One 3.5 mm Stereo Mini Jack to Solder Tabs

Type: Barrel & Installation

Size: Single Space

COLOR	PART #
Black	70-102-13



1.3.3 - VGA_STEREO PLATE

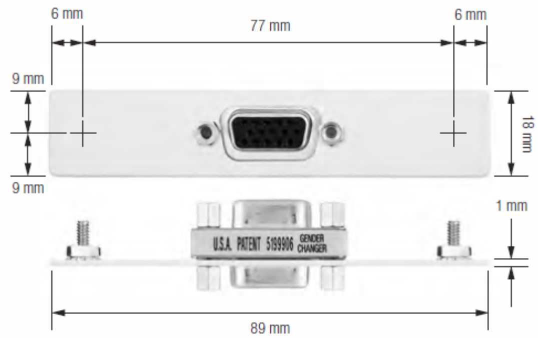
AAP - Architectural Adapter Plates

AV, Data, Power, and Control Connectivity for Wall Mount, Furniture Mount, and Floor Mount Applications

DESCRIPTION

Extron **Architectural Adapter Plates** are optional mounting plates that fit into designated AAP openings available on many Extron products. AAPs include pass-through connections and active modules as well as device control modules. There are also AAPs available with silk-screened labels for the most common signal types and blank AAPs to fill empty slots.

Custom engraving is available for an additional charge. See http://www.extron.com/engraving or contact your Extron Customer Support Representative.



One XLR 3-pin Female to Solder Cup - Neutrik

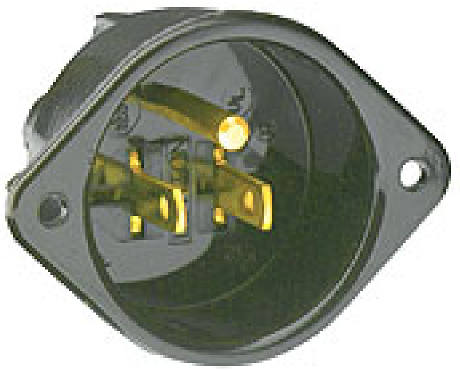
Type: Installation

Size: Double Space

COLOR	PART #
Black	70-103-11
White	70-103-21

1.3.4 - XLR PLATE

5239

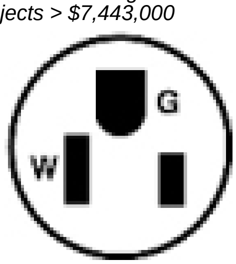


Color: Black

UPC Code: 07847722890

Country of Origin: Mexico - **Eligible for ARRA funded projects > $7,443,000*

NEMA: 5-15P



Straight Blade Wiring Devices

Brand Features

Leviton's commercial/industrial grade flanged wiring devices are available in 15A & 20A versions and feature heavy duty construction for many years of service life.

Item Description

15 Amp, 125 Volt, NEMA 5-15P, 2P, 3W, Flanged Inlet Receptacle, Straight Blade, Commercial Grade, Grounding, , , Back Wired, Thermoplastic Nylon Strap, - Black

Technical Information

Electrical Specifications

Grounding: Grounding

Amperage: 15 Amp

Voltage: 125 Volt

NEMA: 5-15P

Pole: 2

Wire: 3

Dielectric Voltage: Withstands 2000V per UL498

Current Interrupting: Certified for current interrupting at full rated current

Temperature Rise: Max 30C after 50 cycles OL at 150 percent rated current

Environmental Specifications

Flammability: Rated V-2 per UL94

Operating Temperature: -40C to 60C

Material Specifications

Face Material: Nylon

Body Material: Nylon

Strap Material: Thermoplastic Nylon

Color: Black

Mechanical Specifications

Terminal ID: Brass-Hot, Green-Ground, White-Neutral

Terminal Accom.: 18-12 AWG

Product ID: Ratings and NEMA I.D. permanently marked on device

Cord Range: .245 - .700

Termination: Back

Product Features

NEMA: 5-15P

Color: Black

Standards and Certifications

NEMA: WD-6

UL: 498

ANSI: C-73

UL: Listed

CSA C22.2 No. 42: File LR-406

NOM Certified: 057

1.4.1 - AC OUTLET MALE PORT

For more information, please visit the product page.

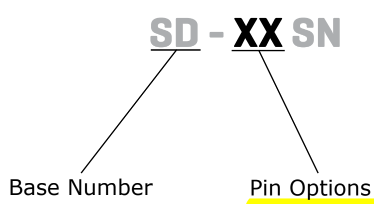
date 09/01/2015

SERIES: SD-XXSN | DESCRIPTION: STANDARD DIN CONNECTOR

FEATURES
- panel mount
- vertical
- shielded

RoHS

PART NUMBER KEY



30 = 3 pins
40 = 4 pins
50 = 5 pins
60 = 6 pins
70 = 7 pins
80 = 8 pins

SPECIFICATIONS

parameter	conditions/description	min	typ	max	units
rated input voltage			100 12		Vac Vdc
rated input current	at 100 Vac at 12 Vdc			1 2	A A
contact resistance				30	mΩ
insulation resistance	at 500 Vdc	100			MΩ
voltage withstand	for 1 minute			1,000	Vac
insertion force	SD-40SN all other models			6.5 4	kg kg
withdrawal force	SD-40SN all other models	1 1		5 3.5	kg kg
operating temperature		5		70	°C
life			5,000		cycles
flammability rating	UL94V-0				
RoHS	2011/65/EU				

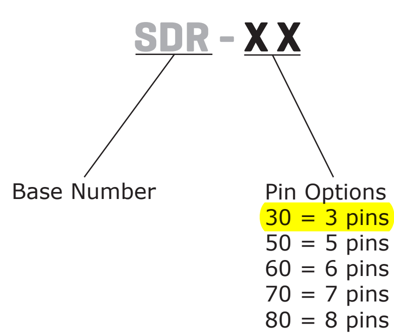
1.4.2 - 3 PIN DIN FEMALE SOCKET

SERIES: SDR | DESCRIPTION: STANDARD DIN CONNECTOR

FEATURES
- right angle
- metal bushing
- strain relief

RoHS

PART NUMBER KEY



SPECIFICATIONS

parameter	conditions/description	min	typ	max	units
rated input voltage			100		Vac
rated input current				1	A
contact resistance				30	mΩ
insulation resistance	at 500 Vdc	100			MΩ
voltage withstand	for 1 minute			250	Vac
operating temperature		-20		70	°C
life			5,000		cycles

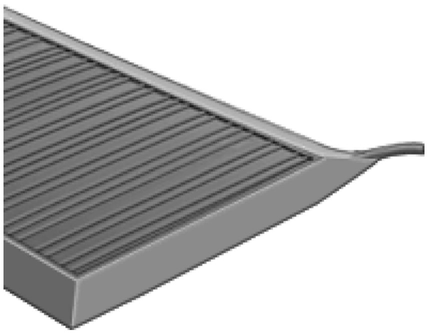
1.4.3 - 3 PIN DIN MALE 90

(562) 692-5911
(562) 695-2323 (fax)
la.sales@mcmaster.com
Text 75930

Switch Mat

10" x 17", Black

In stock
$117.74 Each
7351K61



Size	10" × 17"
Amp Rating	1 @ 24V AC/DC
Actuation Force	10-15 lbs.
Additional Specifications	Black

Step on these mats to open doors and perform other hands-free tasks (not intended for use as an emergency stop or safety control switch). Mats are made of durable molded vinyl. They're 3/8" thick and have a 6-ft. cord with two wire leads. All switch one circuit from off to on (SPST-NO) and spring back (momentary). Maximum capacity is 3,000 psi.

1.4.4 - SWITCH MAT

Typical Cured Properties

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

Physical	
Color	Clear
Hardness (ASTM D 2240) Shore D	65-70
Worklife[2]	3-4 minutes
Tack-free Time[3]	9-10 minutes
Time to Handling Strength[4]	20 min. @ 73°F (23°C)
Cure Time[5]	48 hrs. @ 73°F (23°C)
Elongation[6]	75%
Tensile Strength[6]	1850 psi

Thermal	
Weight Loss by Thermal Gravimetric Analysis (TGA)[7]	1% @ 116°C 5% @ 318°C
Thermal Coefficient of Expansion (TCE) by TMA[8] (x 10^{-6} units/unit/°C) Below Tg Above Tg	 93 (5-20°C range) 182 (40-140°C range)
Glass Transition Temperature (Tg) by DSC[9] Onset Mid-Point	 23°C 29°C
Thermal Conductivity[10] (@ 110°F on .250" samples) BTU - ft./ft.^{2} - hr. - °F) Cal./sec. - cm - °C Watt/m - °C	 .077 .32 x 10^{-3} .133
Thermal Shock Resistance[11] Potted Washer Olyphant Test (Test Method C-3174 + 100°C [air] to -50°C [liquid])	 Pass 5 cycles without cracking

Electrical	
Dielectric Constant @ 1 KHz @ 23°C (ASTM D 150)	6.6
Dissipation Factor @ 1 KHz @ 23°C (ASTM D 150)	0.06
Dielectric Strength (ASTM D 149) Sample Thickness Approx. 30 mil.	710 volts/mil
Volume Resistivity (ASTM D 257)	6.7 x 10^{11} ohm-cm

[2] Worklife determined using test method C-3180. Procedure involves periodically measuring a 2 gram mixed mass for self leveling and wetting properties. This time will also approximate the usable worklife in an 3M™ EPX™ Applicator mixing nozzle.

[3] Tack-free time determined per test method C-3173. Involves dispensing 0.5 gram amount of adhesive onto substrate and testing periodically for no adhesive transfer to metal spatula.

[4] Handling strength determined per test method C-3179. Time to handling strength taken to be that required to achieve a 50 psi overlap shear (OLS) strength using aluminum substrates.

[5] The cure time is defined as that time required for the adhesive to achieve a minimum of 80% of the ultimate strength as measured by aluminum-aluminum OLS.

[6] Tensile and Elongation. Used procedure in test method C-3094/ATSM D 882. Samples were 2 in. dumbbells with .0125 in. neck and .030 in. sample thickness. Separation rate was 2 inches per minute. Samples cured 2 hrs. RT plus 2 hrs. 160°F (71°C).

[7] Weight loss by TGA reported as that temperature at which 5% weight loss occurs by TGA in air at 5°C rise per minute per ASTM 1131-86.

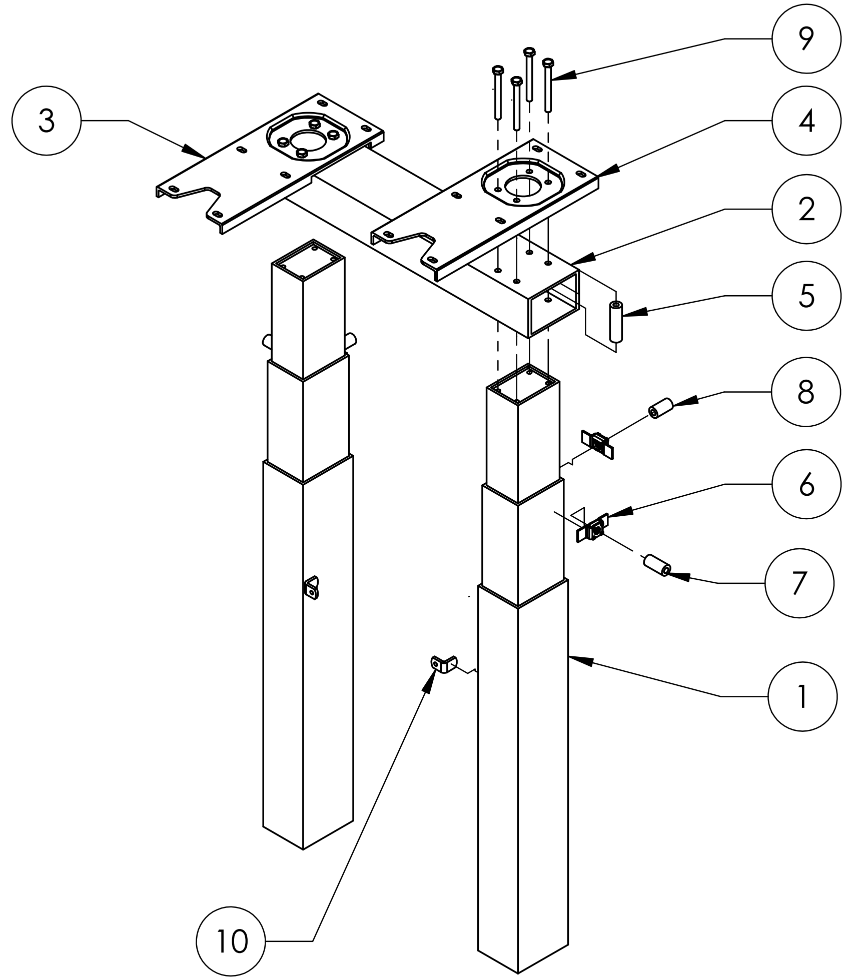
[8] TCE determined using TMA Analyzer using a heating rate of 10°C per minute. Second heat values given.

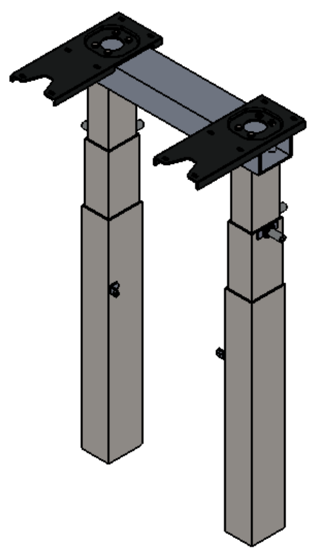
[9] Glass Transition Temperature (Tg) determined using DSC Analyzer with a heating rate of 20°C per minute. Second heat values given.

[10] Thermal conductivity determined using ASTM C177 and C-matic Instrument using 2 in. diameter samples.

[11] Thermal shock resistance run per test method C-3174. Involves potting a metal washer into a 2 in. x 0.5 in. thick section and cycling this test specimen to colder and colder temperatures.

ITEM NO.	PART NUMBER	QTY.
1	2.1.0 - Telescoping Leg - OkinID21	2
2	2.2.1 - TL Mounting Tube	1
3	2.2.2L - TL Mounting Bracket - Left	1
4	2.2.2R - TL Mounting Bracket - Right	1
5	2.2.3 - TL Mounting Spacer	8
6	2.3.1 - Weld Nut	4
7	2.3.2 - Weld Nut Spacer - Side	2
8	2.3.3 - Weld Nut SPacer - Front	2
9	M6-1.0 x 60 Hex Bolt	8
10	2.3.4 - Angle Bracket	2





FOR REFERENCE ONLY

NOTES:
1. WELD NUTS SHALL BE ATTACHED WITH ADHESIVE 1.5.1 IN DRAWING PACKAGE, OR EQUIVALENT.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

ACTUATION ASSEMBLY

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
A	2.0.0	-

SCALE: 1:8 | UNITS: INCHES | SHEET 1 OF 1

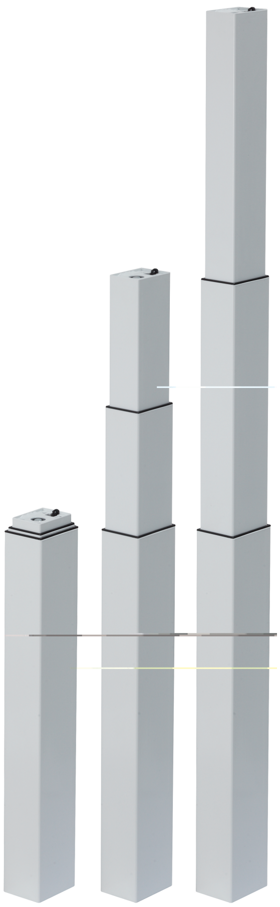
ID 21

A Phoenix Mecano Brand

Elegant and convenient electric table height adjustment. The ID 21 system comes without cross bar and without visible function hole in the profile. In addition, the middle profile is entrained.

- Load capacity: max. 800 N / 180 lbs push
- Adjustment speed: max. 38 mm (1.49")/sec. with and without load *
- Stroke length: 650 mm / 25.59"
- 3-part rectangular steel column, 2-stage telescopic upwards, inner profiles move outwards

* depending on drive configuration at constant 24/29 V DC without load



bedding

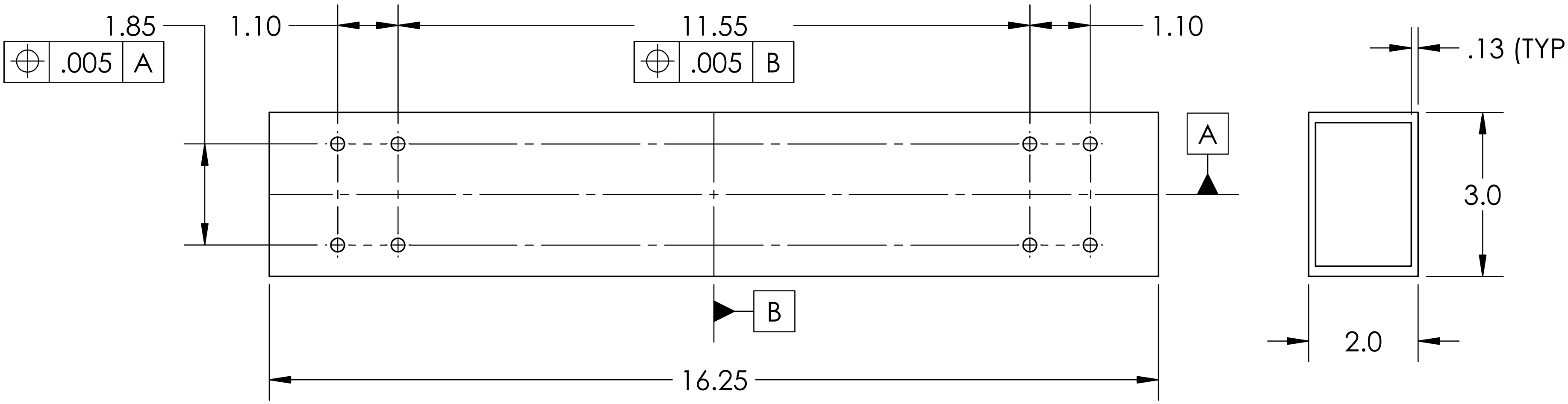
office

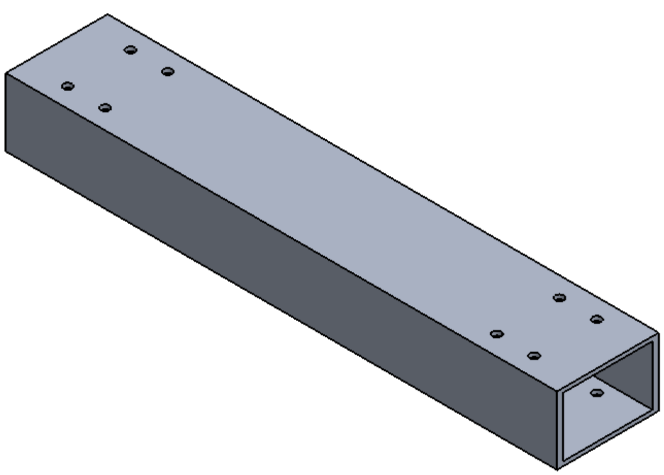
seating

2.1.0 - TELESCOPING LEG - OKIN_ID21

Note: Responsibility for OKIN products when used for specific applications and for adherence to the appropriate guidelines, standards and laws is borne by the manufacturer of the complete system into which OKIN products are fitted. We accept no liability for the correctness.

DewertOkin GmbH • Weststraße 1 • 32278 Kirchlengern
Phone: +49 (0)52 23 / 9 79 -0 • Fax: +49 (0)52 23 / 7 51 82 • Email: info@okin.de • Internet: http://www.okin.de





FOR REFERENCE ONLY

NOTES:
1. STOCK RECTANGULAR TUBE
2. 'D' LETTERED DRILL BIT FOR CLEARANCE HOLE

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

TL MOUNTING TUBE

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

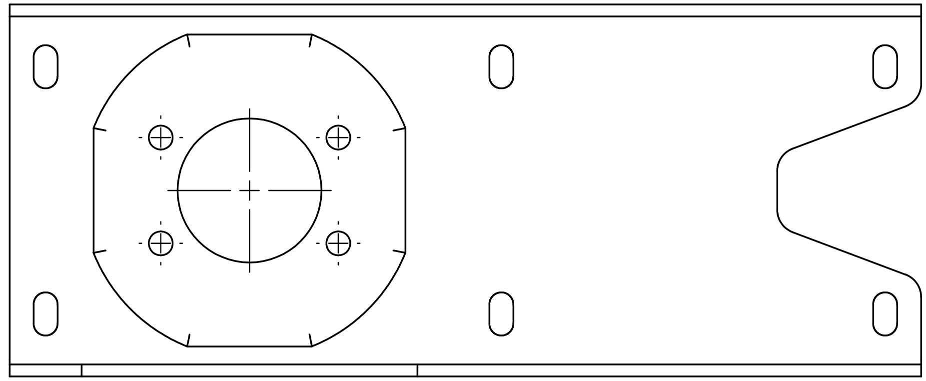
MATERIAL 6061-T6

FINISH UNFINISHED

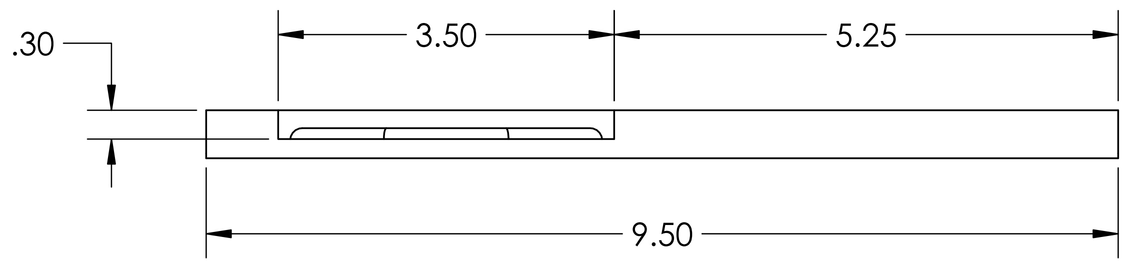
DO NOT SCALE DRAWING

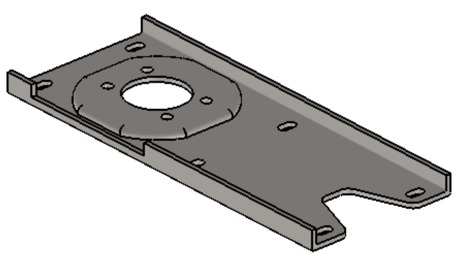
SIZE	DWG. NO.	REV
A	2.2.1	-

SCALE: 1:3 | UNITS: INCHES | SHEET 1 OF 1



FOR REFERENCE ONLY





FOR REFERENCE ONLY

NOTES:
1. EXISTING PART FROM WORKRITE SIERRA HXL MODEL. MODIFY ONLY DIMENSIONED FEATURES.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: EXISTING

FINISH: EXISTING

DO NOT SCALE DRAWING

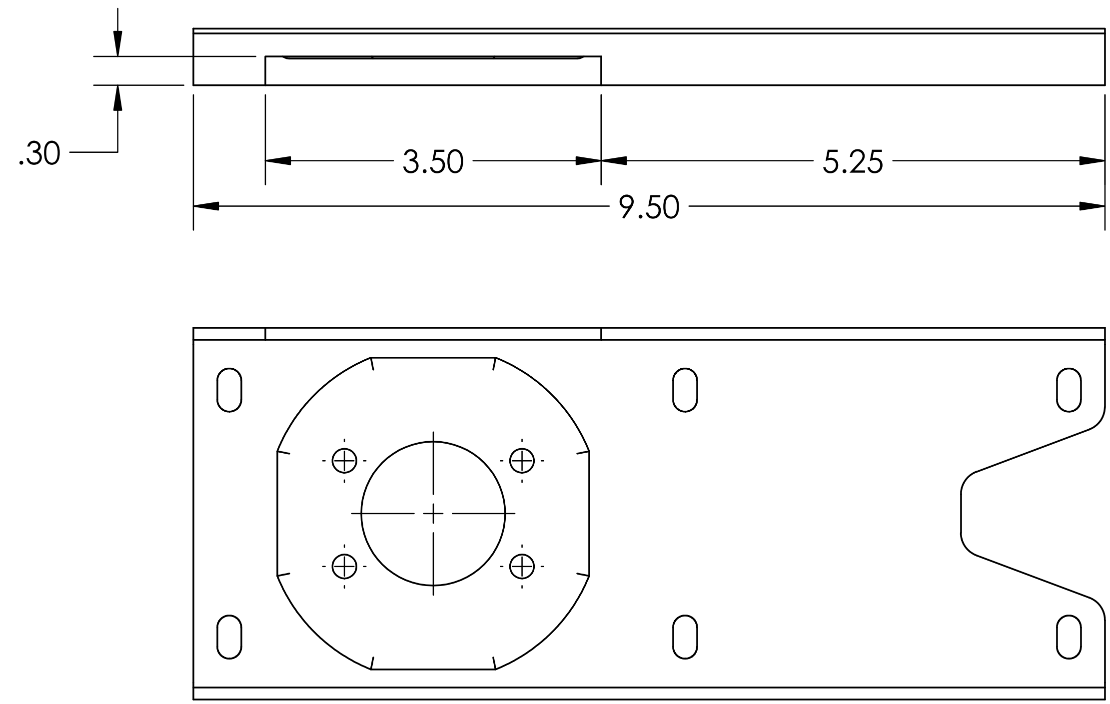
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

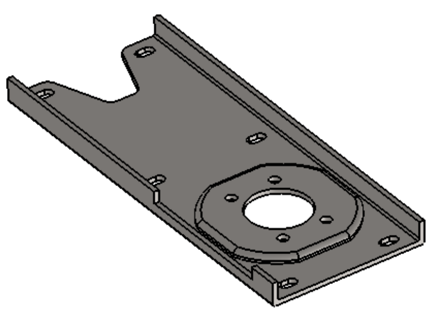
TL MOUNTING BRACKET - LEFT

SIZE	DWG. NO.	REV
A	2.2.2L	-

SCALE: 1:2	UNITS: INCHES	SHEET 1 OF 1



FOR REFERENCE ONLY



FOR REFERENCE ONLY

NOTES:
1. EXISTING PART FROM WORKRITE SEIRRA KXL MODEL. MODIFY ONLY DIMENSIONED FEATURES.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: EXISTING

FINISH: EXISTING

DO NOT SCALE DRAWING

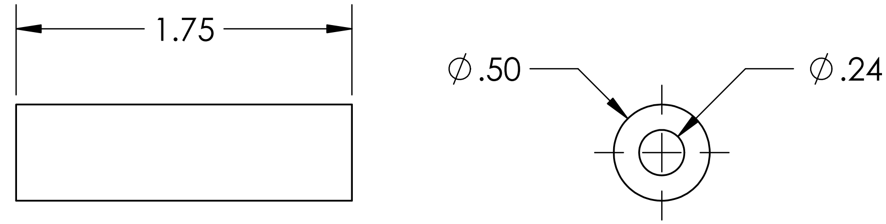
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

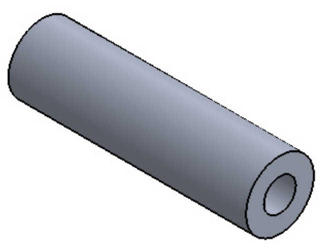
TITLE:

TL MOUNTING BRACKET - RIGHT

SIZE	DWG. NO.	REV
A	2.2.2R	-

SCALE: 1:2 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. STOCK ROUND BAR
2. 'D' LETTERED DRILL BIT FOR CLEARANCE HOLE

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: 6061-T6

FINISH: UNFINISHED

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

TL MOUNTING SPACER

SIZE	DWG. NO.	REV
A	2.2.3	-

SCALE: 2:1	UNITS: INCHES	SHEET 1 OF 1

(562) 692-5911
(562) 695-2323 (fax)
la.sales@mcmaster.com
Text 75930

Steel Easy-Align Weld Nut

with Steel Retainer, 1/4"-20 Thread Size

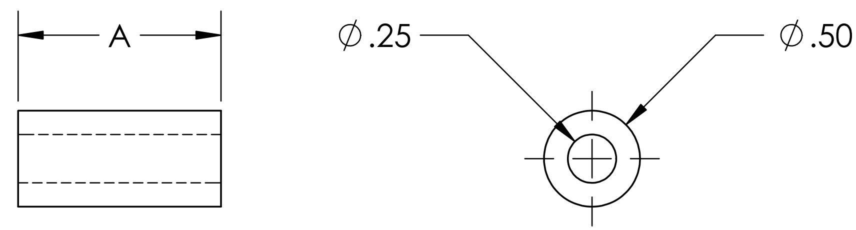
In stock
$15.81 per pack of 20
90955A112

Material	Steel
Finish	Uncoated
Thread Direction	Right Hand
Thread Size	1/4"-20
Base	
Length	1 3/4"
Width	9/16"
Thickness	1/16"
Overall Height	7/16"

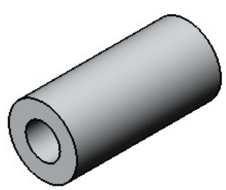
Often referred to as floating weld nuts, the nut floats within a retainer for easy alignment and installation of screws, bolts, and threaded rod. You can also punch holes in the flanges and secure them with rivets. Inch sizes have a Class 2B thread fit.

Uncoated steel nuts with steel retainer are C1008-C1010 steel. Weld them to steel parts.

2.3.1 - WELD NUT



CONFIGURATION	WELD NUT LOCATION	'A' DIM
2.3.2	SIDE	1.057
2.3.3	FRONT	.907



FOR REFERENCE ONLY

NOTES:
1.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL
6061-T6

FINISH
UNFINISHED

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

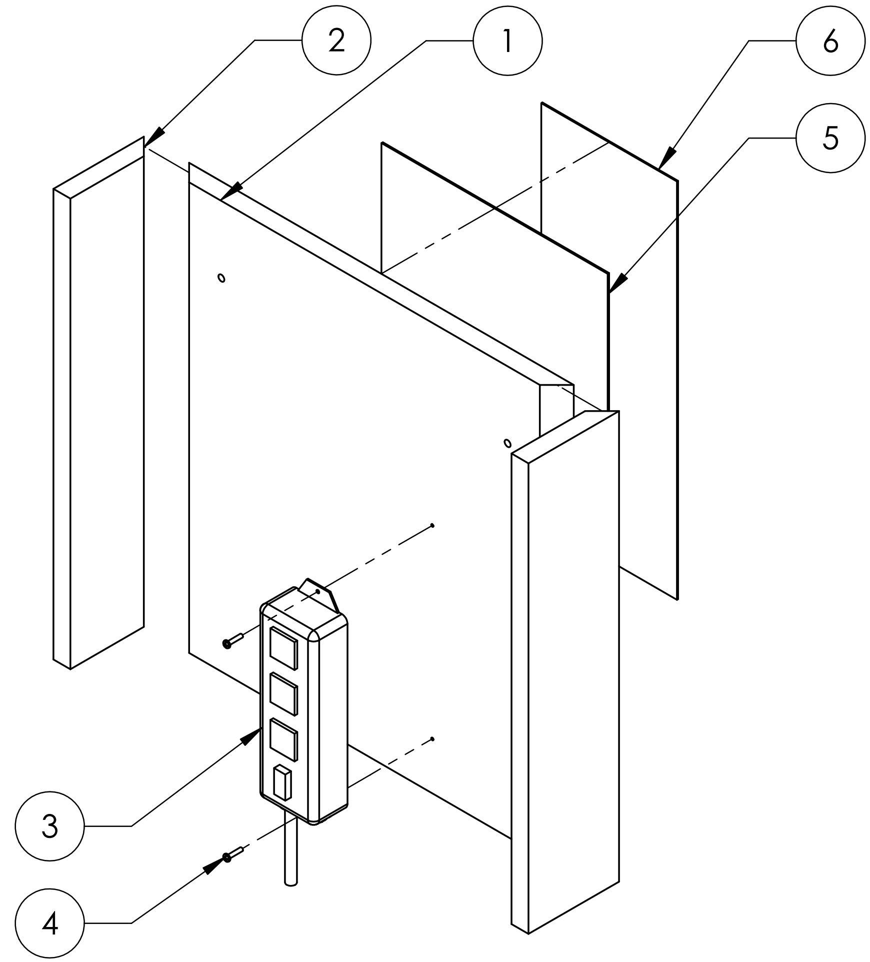
TITLE:

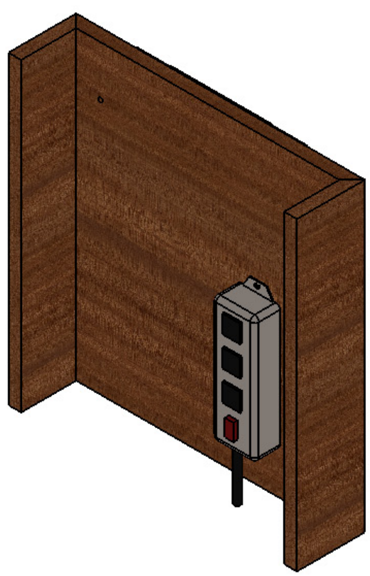
WELD NUT SPACER

SIZE **A** | DWG. NO. 2.3.X | REV -

SCALE: 1:1 | UNITS: INCHES | SHEET 1 OF 1

ITEM NO.	PART NUMBER	QTY.
1	3.1.1 - Bottom Panel - Front	1
2	3.1.2 - Bottom Panel - Side	2
3	3.1.4 - Power Strip	1
4	#6 X 5/8 Pan Head Screw	2
5	3.2.1 - Bottom Acrylic Strip	1
6	3.2.2 - Bottom Metal Strip	1





FOR REFERENCE ONLY

NOTES:
1. PERFORM PANEL CONNECTION SHOWN USING LOCK MITER JOINT. NO OTHER JOINT SHALL BE PERMITTED UNLESS APPROVED BY IL TEAM MEMBER.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

BOTTOM COVER

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

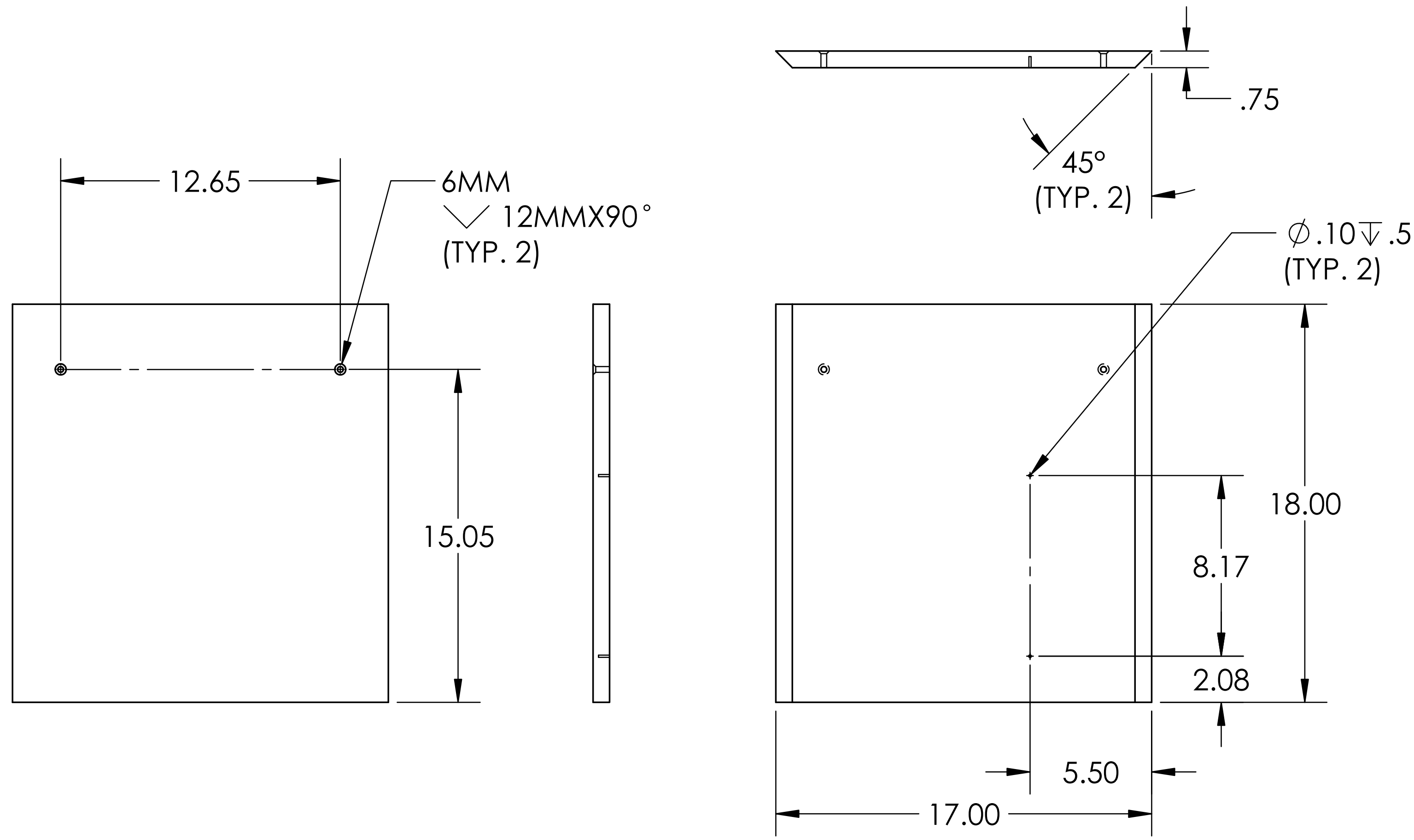
MATERIAL N/A

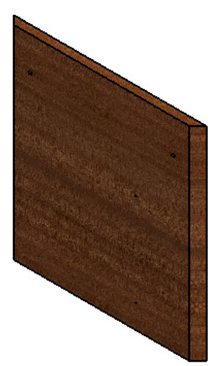
FINISH N/A

DO NOT SCALE DRAWING

SIZE A | DWG. NO. 3.0.0 | REV -

SCALE: 1:6 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. CUT ANGLE USING LOCK MITER BIT. COORDINATE GRAIN DIRECTION TO MAINTAIN CONSISTENT, HORIZONTAL PATTERN.
2. ALL ⌀.10 HOLE REP. PILOT HOLES FOR MOUNTING HARDWARE.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

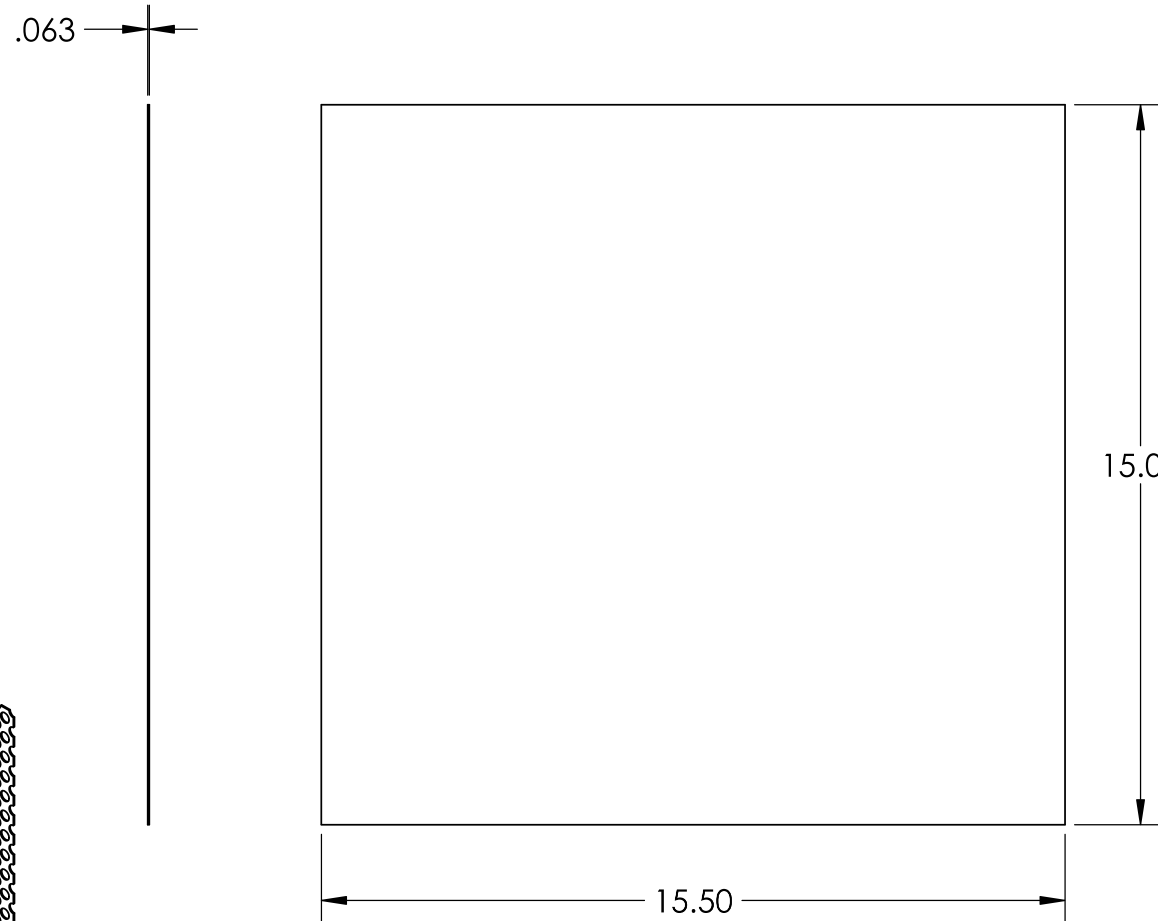
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

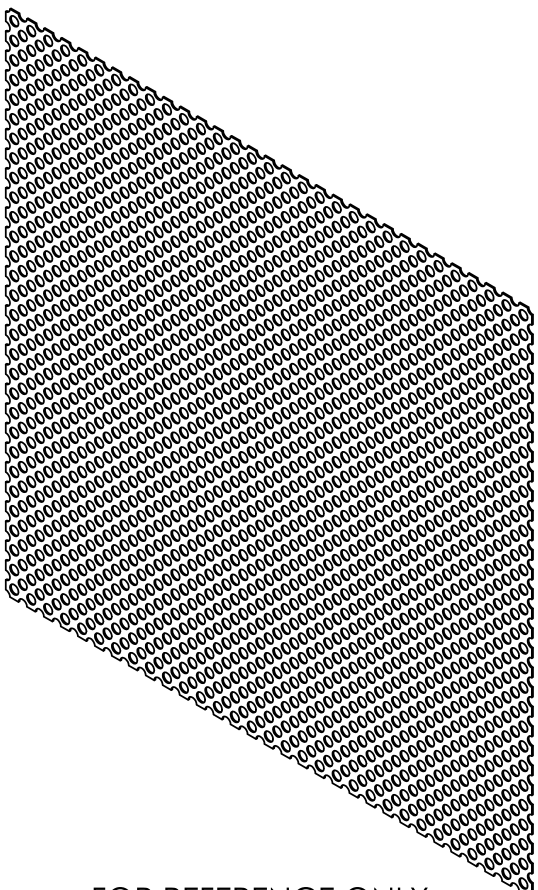
TITLE:

BOTTOM PANEL - FRONT

SIZE	DWG. NO.	REV
A	3.1.1	-

SCALE: 1:8 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. PART SHALL BE CONSTRUCTED FROM PERFORATED SHEET, Ø.1875 HOLES AND .25 SPACING.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: 6061

FINISH: BLACK POWDERCOAT

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

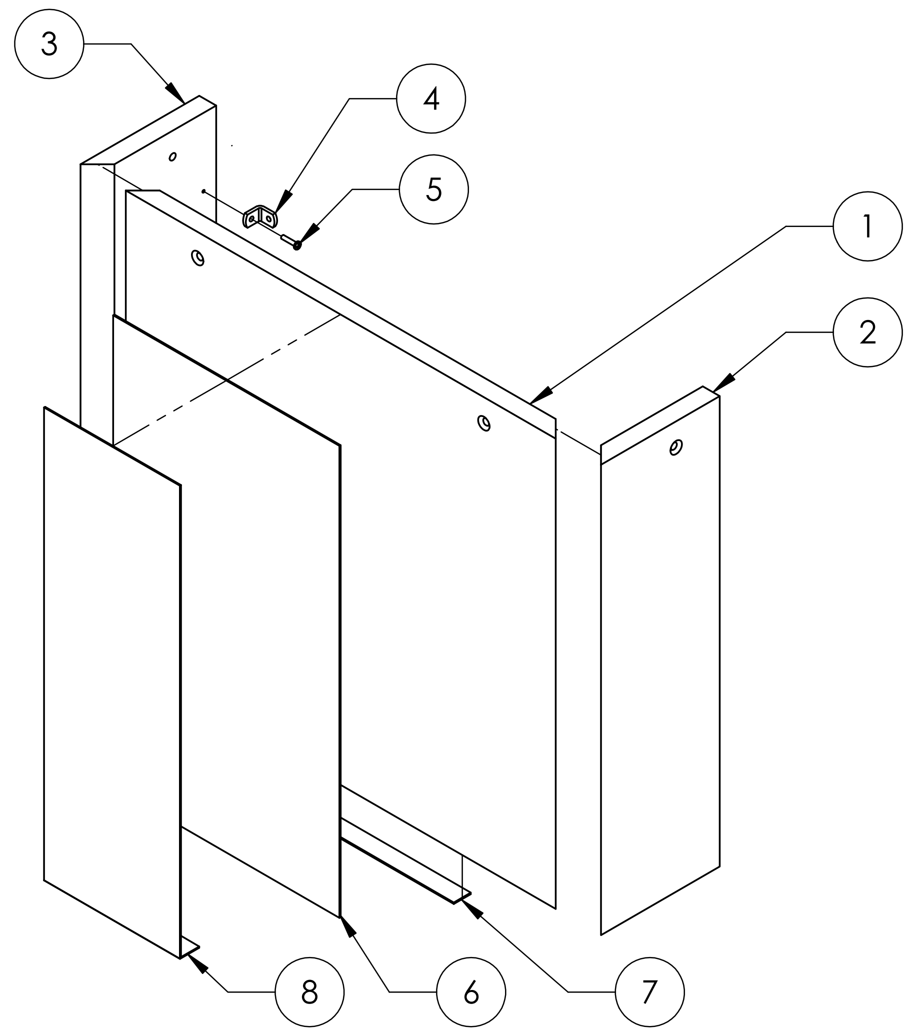
TITLE:

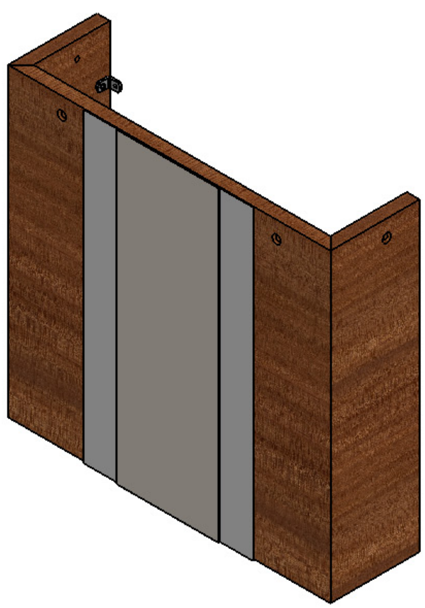
BOTTOM PANEL - ACCESS

SIZE: A
DWG. NO.: 3.1.3
REV: -

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1

ITEM NO.	PART NUMBER	QTY.
1	4.1.1 - Middle Panel - Front	1
2	4.1.2L - Middle Panel - Left	1
3	4.1.2R - Middle Panel - Right	1
4	4.1.4 - Angle Bracket	4
5	#6 x 5/8 Pan Head Screw	4
6	4.2.1 - Acrylic Strip	1
7	4.2.2 - Acrylic End	1
8	4.2.3 - Metal Strip	1





FOR REFERENCE ONLY

NOTES:
1. PERFORM PANEL CONNECTION SHOWN USING LOCK MITER JOINT. NO OTHER JOINT SHALL BE PERMITTED UNLESS APPROVED BY IL TEAM MEMBER.
2. ATTACH ACRYLIC AND METAL STRIPS WITH ADHESIVE, P/N 1.5.1

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

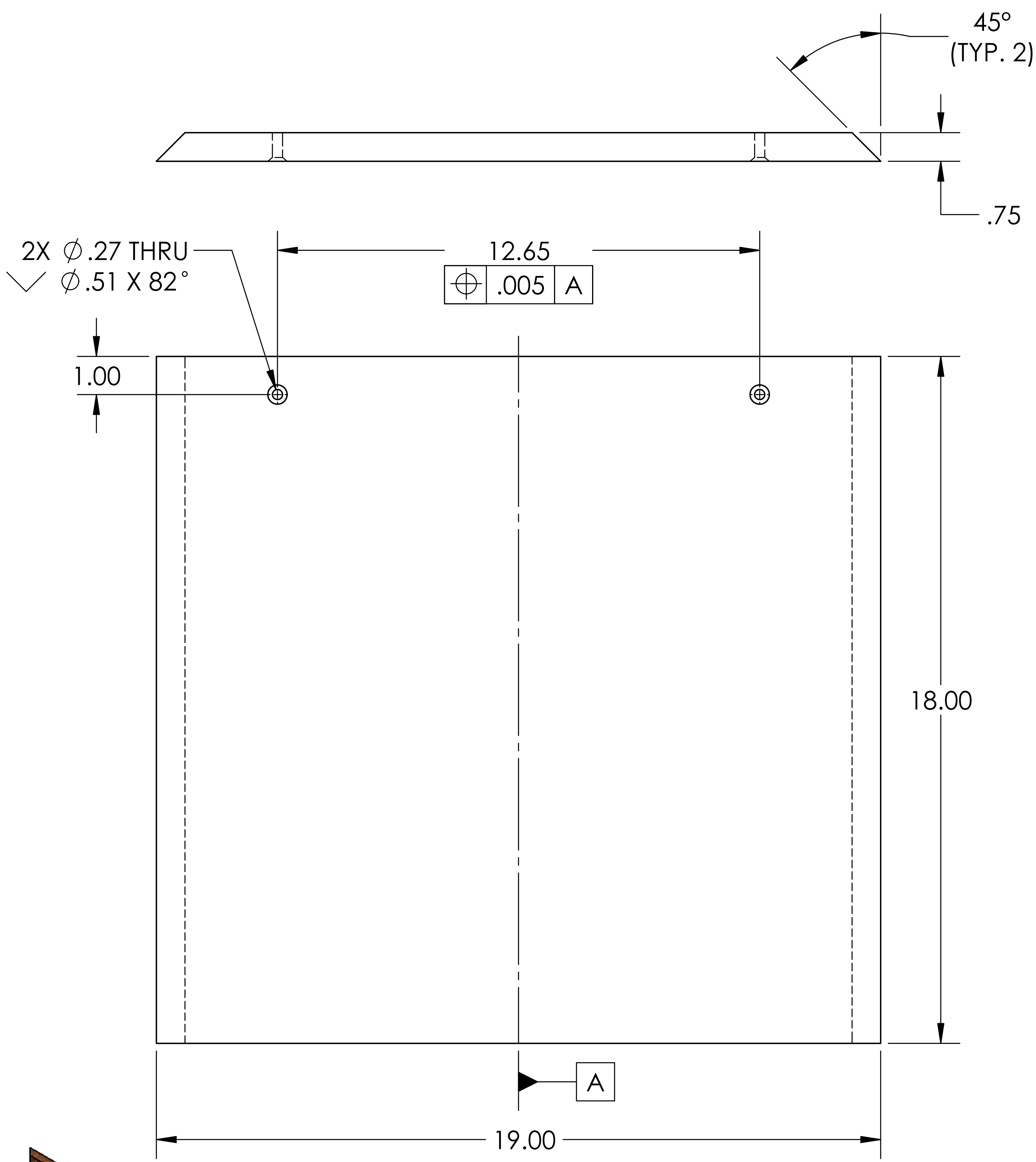
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

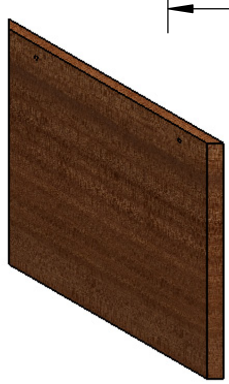
TITLE:

MIDDLE COVER

SIZE	DWG. NO.	REV
A	4.0.0	-

SCALE: 1:6 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. ANGLE SHALL BE CUT WITH LOCK MITER ROUTER BIT.

PROPRIETARY AND CONFIDENTIAL

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGULAR: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

MATERIAL
MAHOGANY

FINISH
UNFINISHED

DO NOT SCALE DRAWING

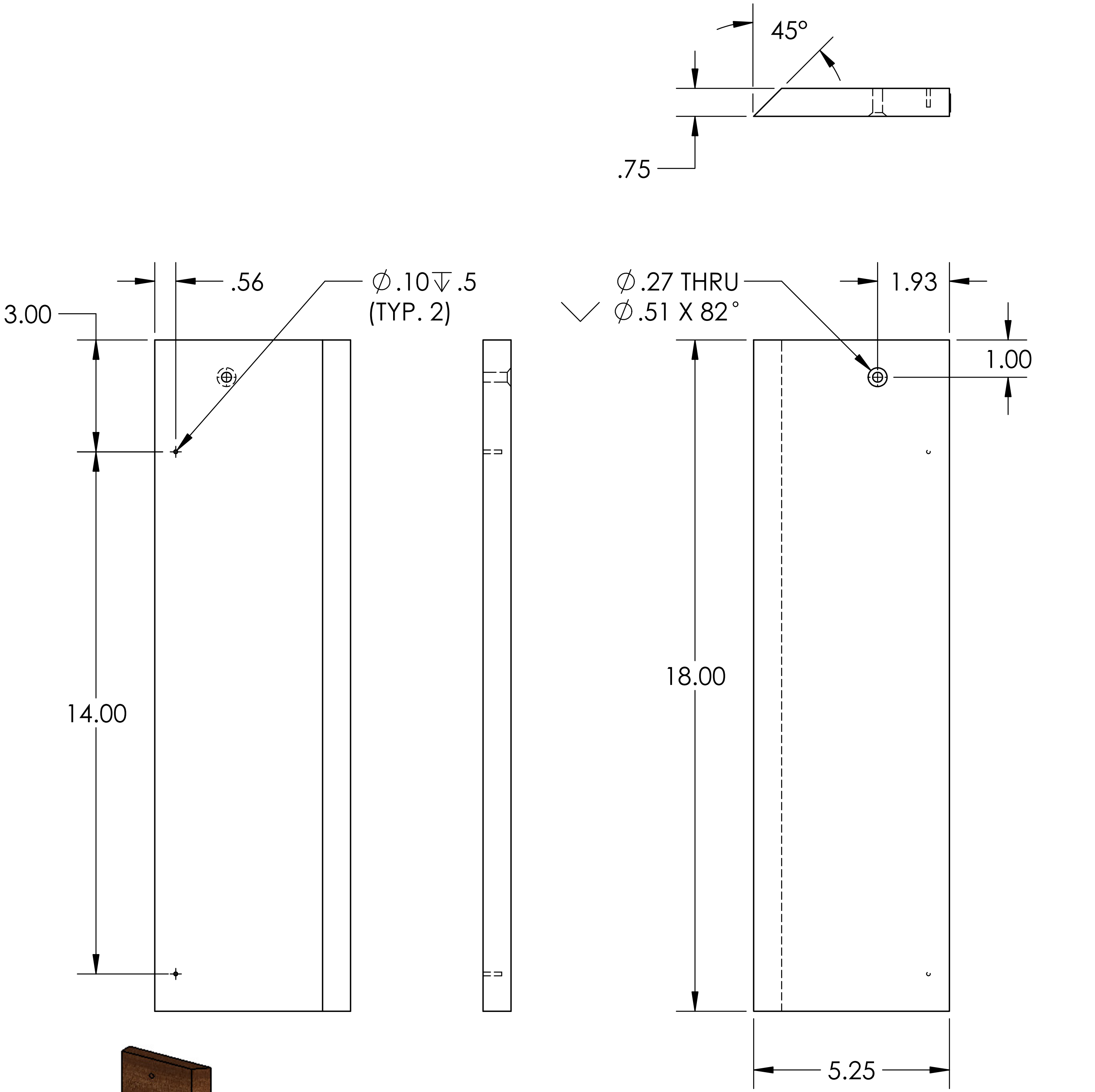
CAL POLY ME428/429/430
INCLUSIVE LECTERN

TITLE:

MIDDLE PANEL - FRONT

SIZE A | DWG. NO. 4.1.1 | REV. -

SCALE:1:4 | UNITS: INCHES | SHEET 1 OF 1



FOR REFERENCE ONLY

NOTES:
1. ANGLE SHALL BE CUT WITH LOCK MITER ROUTER BIT.

PROPRIETARY AND CONFIDENTIAL

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGULAR: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

MATERIAL
MAHOGANY

FINISH
UNFINISHED

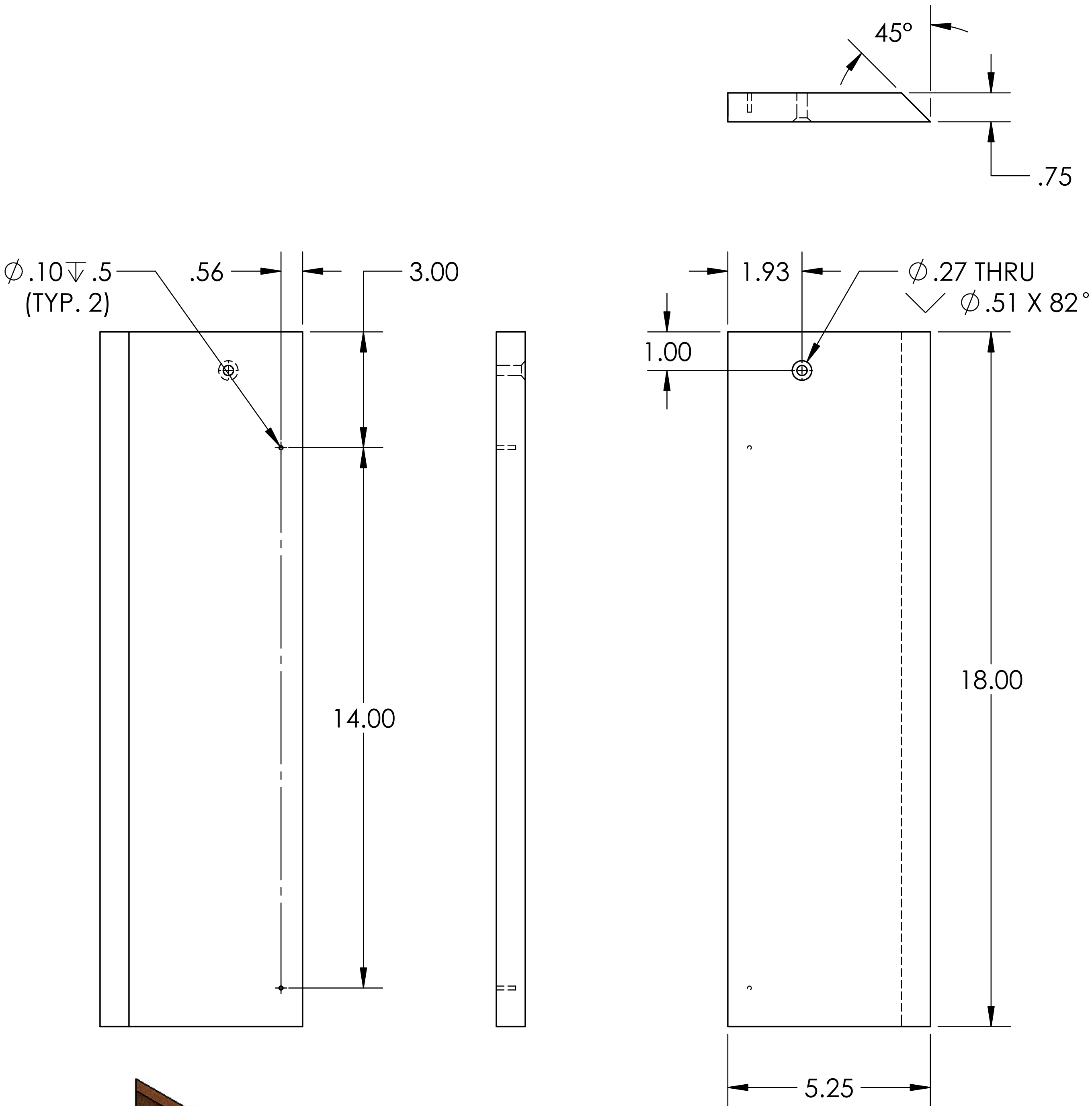
DO NOT SCALE DRAWING

CAL POLY ME428/429/430
INCLUSIVE LECTERN

TITLE:
MIDDLE PANEL - LEFT

SIZE A | DWG. NO. 4.1.2L | REV. -

SCALE:1:4 | UNITS: INCHES | SHEET 1 OF 1



FOR REFERENCE ONLY

NOTES:
1. ANGLE SHALL BE CUT WITH LOCK MITER ROUTER BIT.

PROPRIETARY AND CONFIDENTIAL

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGULAR: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

MATERIAL
MAHOGANY

FINISH
UNFINISHED

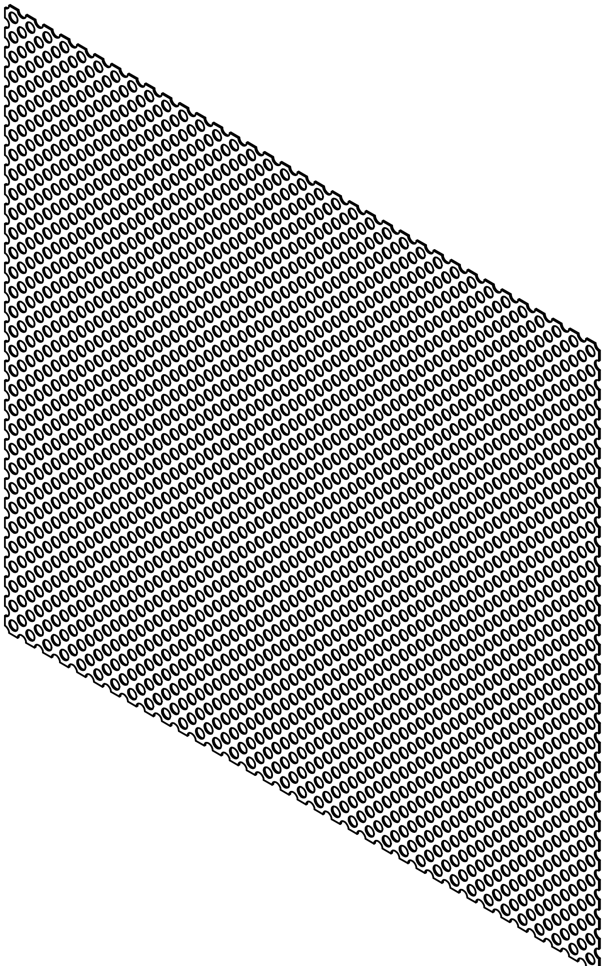
DO NOT SCALE DRAWING

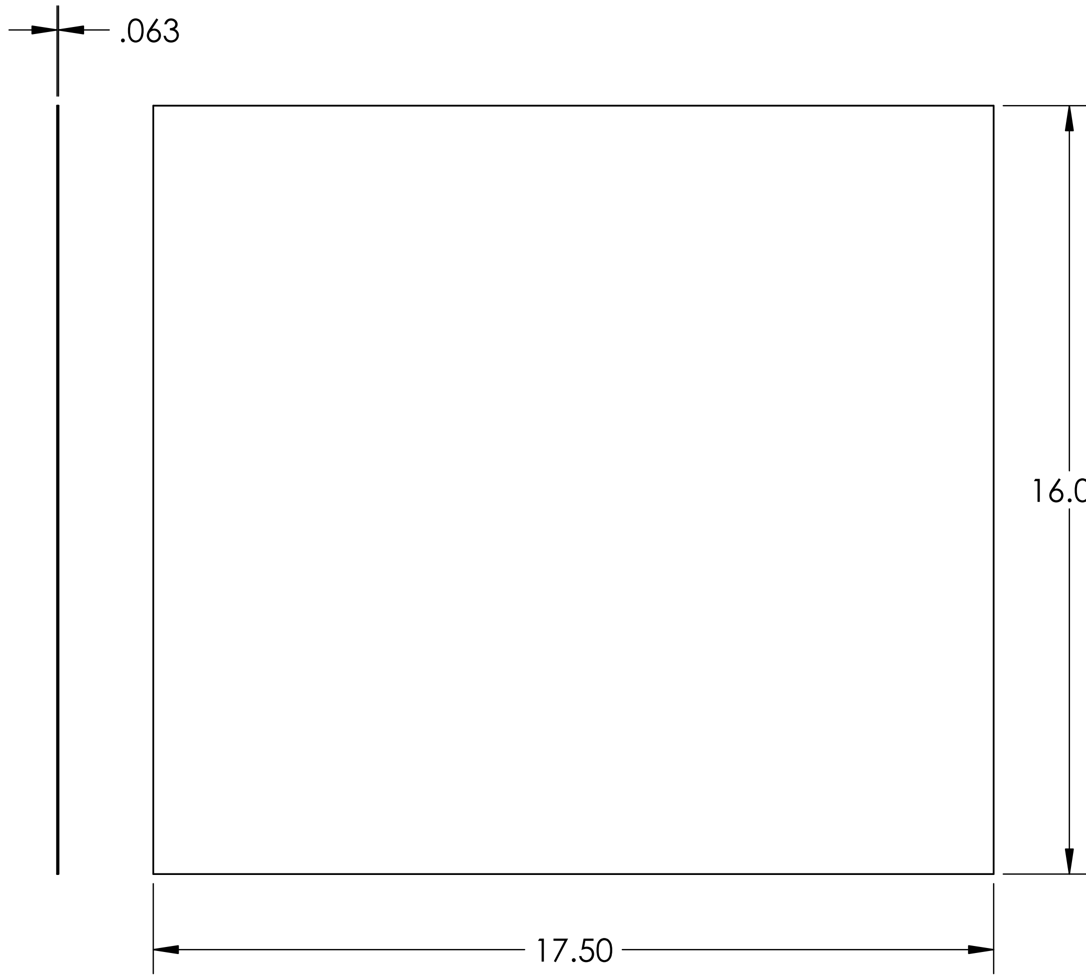
CAL POLY ME428/429/430
INCLUSIVE LECTERN

TITLE:

MIDDLE PANEL - RIGHT

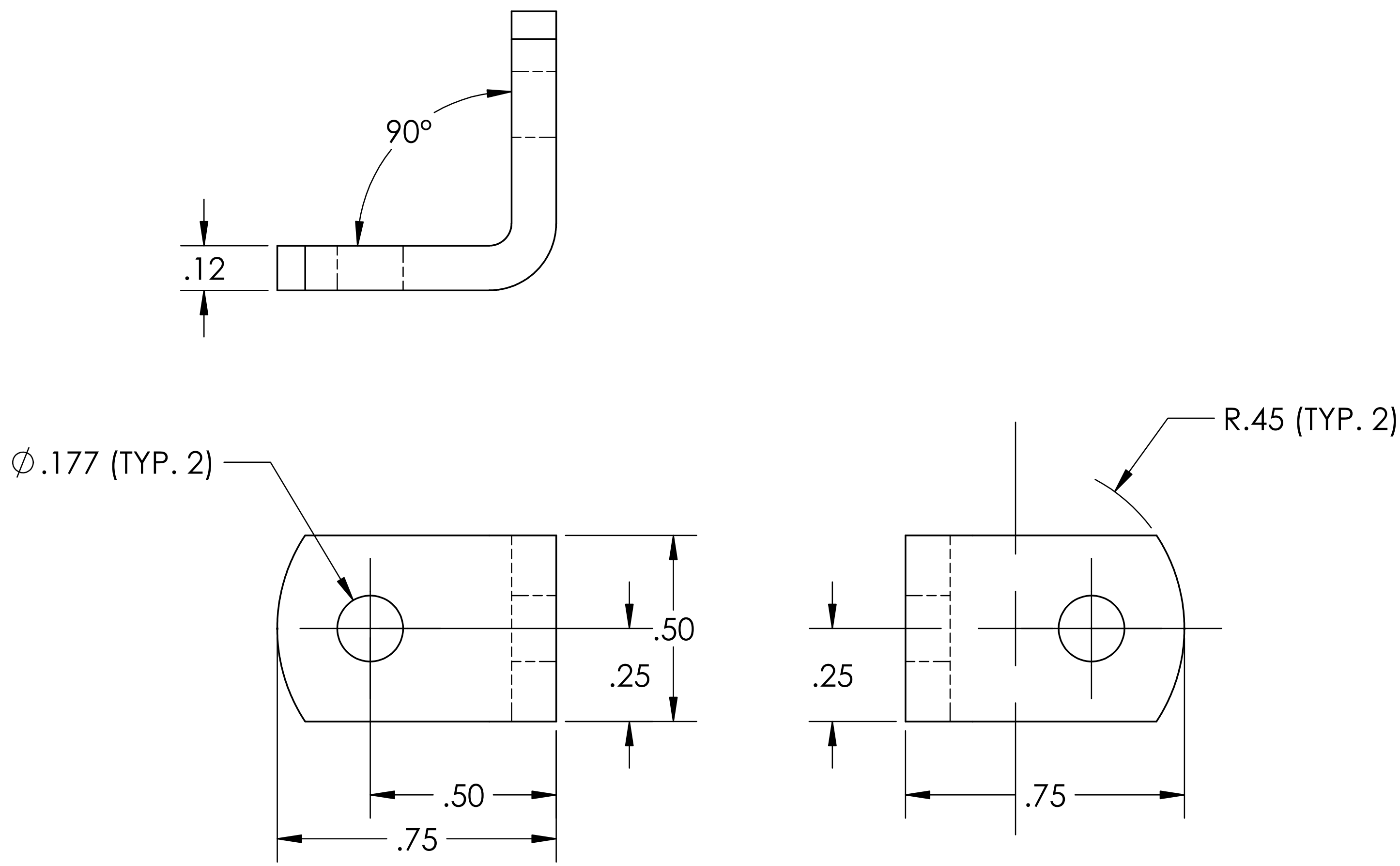
SIZE	DWG. NO.	REV.
A	4.1.2R	-
SCALE:1:4	UNITS: INCHES	SHEET 1 OF 1

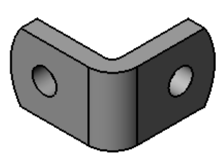




FOR REFERENCE ONLY

NOTES: 1. CONSTRUCT PART FROM PERFORATED SHEET METAL, Ø.1875 AND .25 SPACING OC.	TOLERANCES, UON: FRACTIONAL ±1/32 ANGLES: MACH ±.5 BEND ±1 X ±.5 .X ±.1 .XX ±.01 .XXX ±.005	CAL POLY ME 428/429/430 INCLUSIVE LECTERN
		TITLE: MIDDLE PANEL - ACCESS
PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.	INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B MATERIAL 6061 FINISH BLACK POWDERCOAT DO NOT SCALE DRAWING	SIZE A / DWG. NO. 4.1.3 / REV - SCALE: 1:4 / UNITS: INCHES / SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1.

PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: 6061

FINISH: UNFINISHED

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

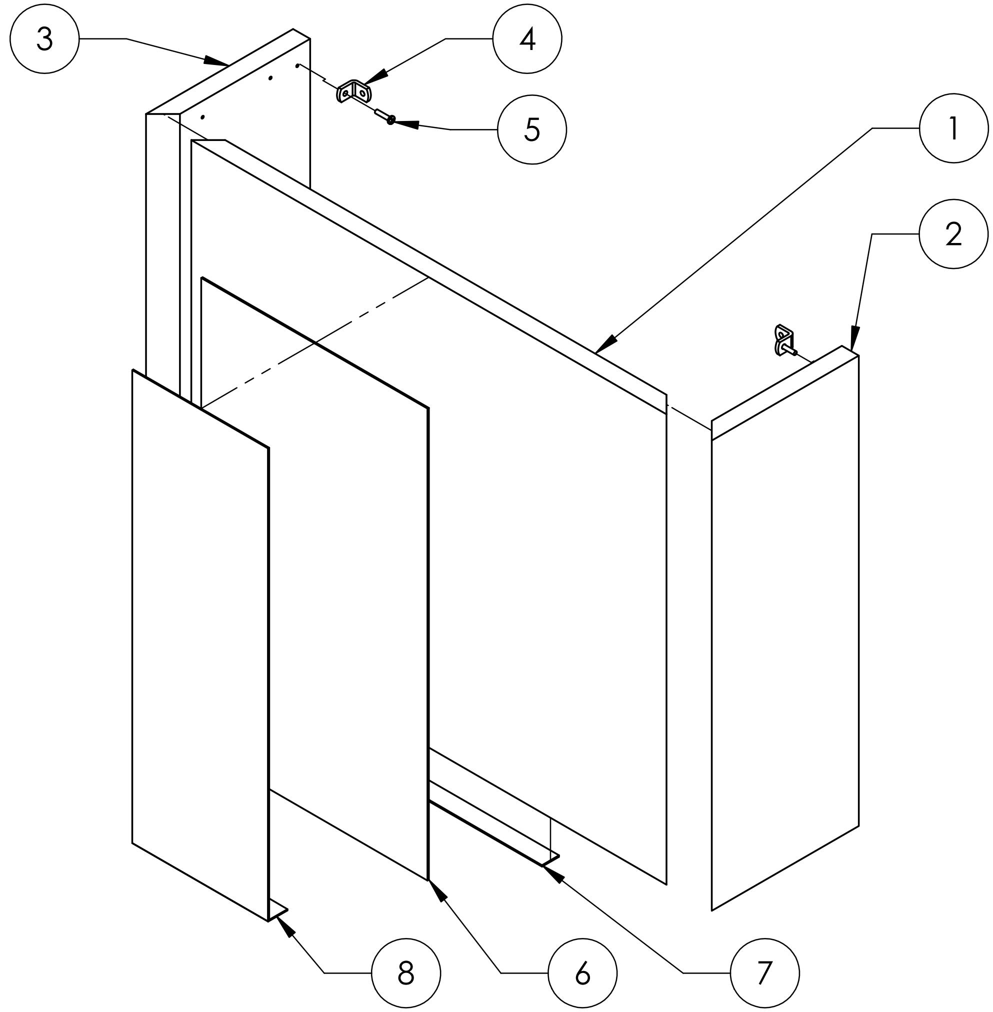
TITLE:

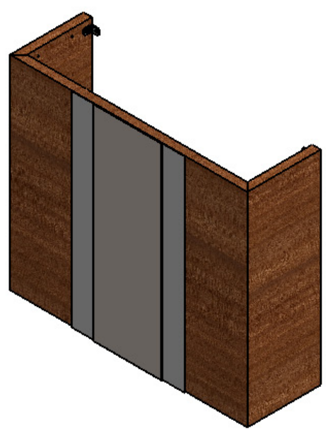
ANGLE BRACKET

SIZE	DWG. NO.	REV
A	4.1.4	-

SCALE: 2:1	UNITS: INCHES	SHEET 1 OF 1

ITEM NO.	PART NUMBER	QTY.
1	5.1.1 - Top Panel - Front	1
2	5.1.2L - Top Panel - Left	1
3	5.1.2R - Top Panel - Right	1
4	5.1.4 - Angle Bracket	4
5	#6 x 5/8 Pan Head Screw	4
6	5.2.1 - Acrylic Strip	1
7	5.2.2 - Acrylic End	1
8	5.2.3 - Metal Strip	1





FOR REFERENCE ONLY

NOTES:
1. PERFORM PANEL CONNECTION SHOWN USING LOCK MITER JOINT. NO OTHER JOINT SHALL BE PERMITTED UNLESS APPROVED BY IL TEAM MEMBER.
2. ACRYLIC AND METAL STRIPS SHALL BE ATTACHED WITH ADHESIVE, P/N 1.5.1.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

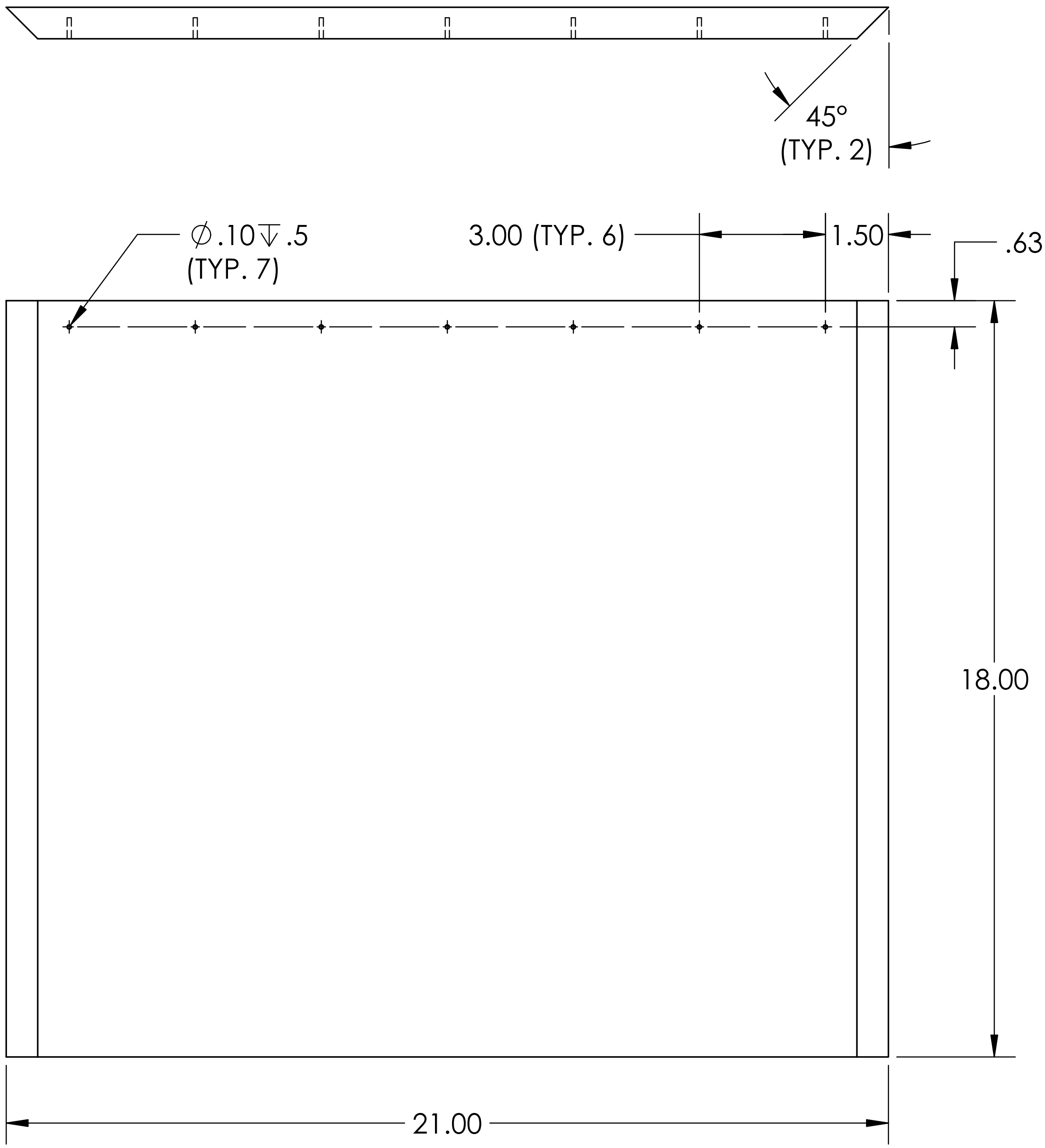
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

TOP COVER

SIZE	DWG. NO.	REV
A	5.0.0	-

SCALE: 1:6 | UNITS: INCHES | SHEET 1 OF 1



FOR REFERENCE ONLY

NOTES:
1. ANGLE SHALL BE CUT WITH LOCK MITER ROUTER BIT.

PROPRIETARY AND CONFIDENTIAL

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGULAR: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

MATERIAL
MAHOGANY

FINISH
UNFINISHED

DO NOT SCALE DRAWING

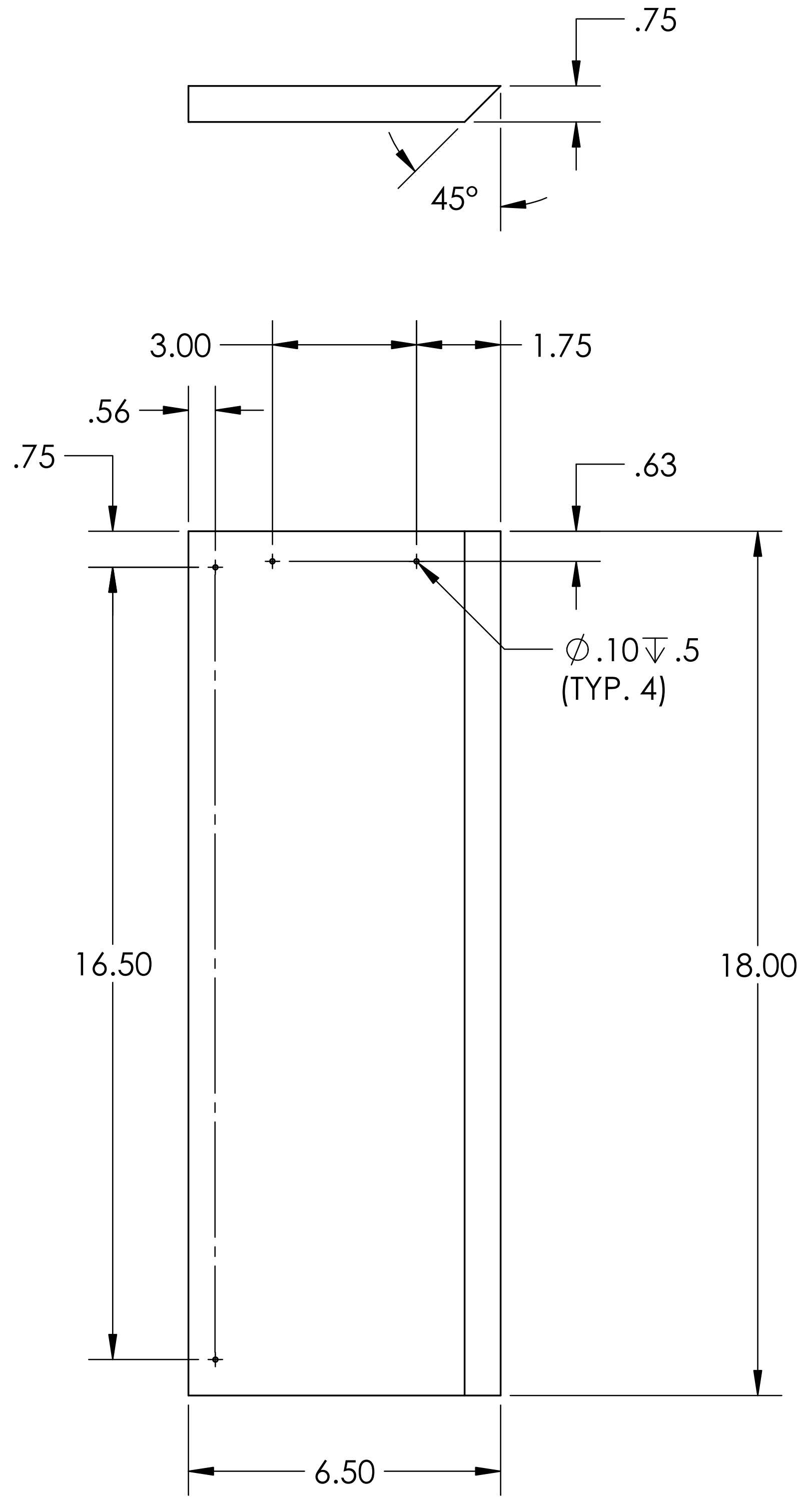
CAL POLY ME428/429/430
INCLUSIVE LECTERN

TITLE:

TOP PANEL - FRONT

SIZE	DWG. NO.	REV.
A	5.1.1	-

SCALE:1:4	UNITS: INCHES	SHEET 1 OF 1



FOR REFERENCE ONLY

NOTES:
1. ANGLE SHALL BE CUT WITH LOCK MITER ROUTER BIT.
2. ∅.10 HOLE REPRESENT PILOT TO LOCATE HARDWARE.

PROPRIETARY AND CONFIDENTIAL

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGULAR: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

MATERIAL
MAHOGANY

FINISH
UNFINISHED

DO NOT SCALE DRAWING

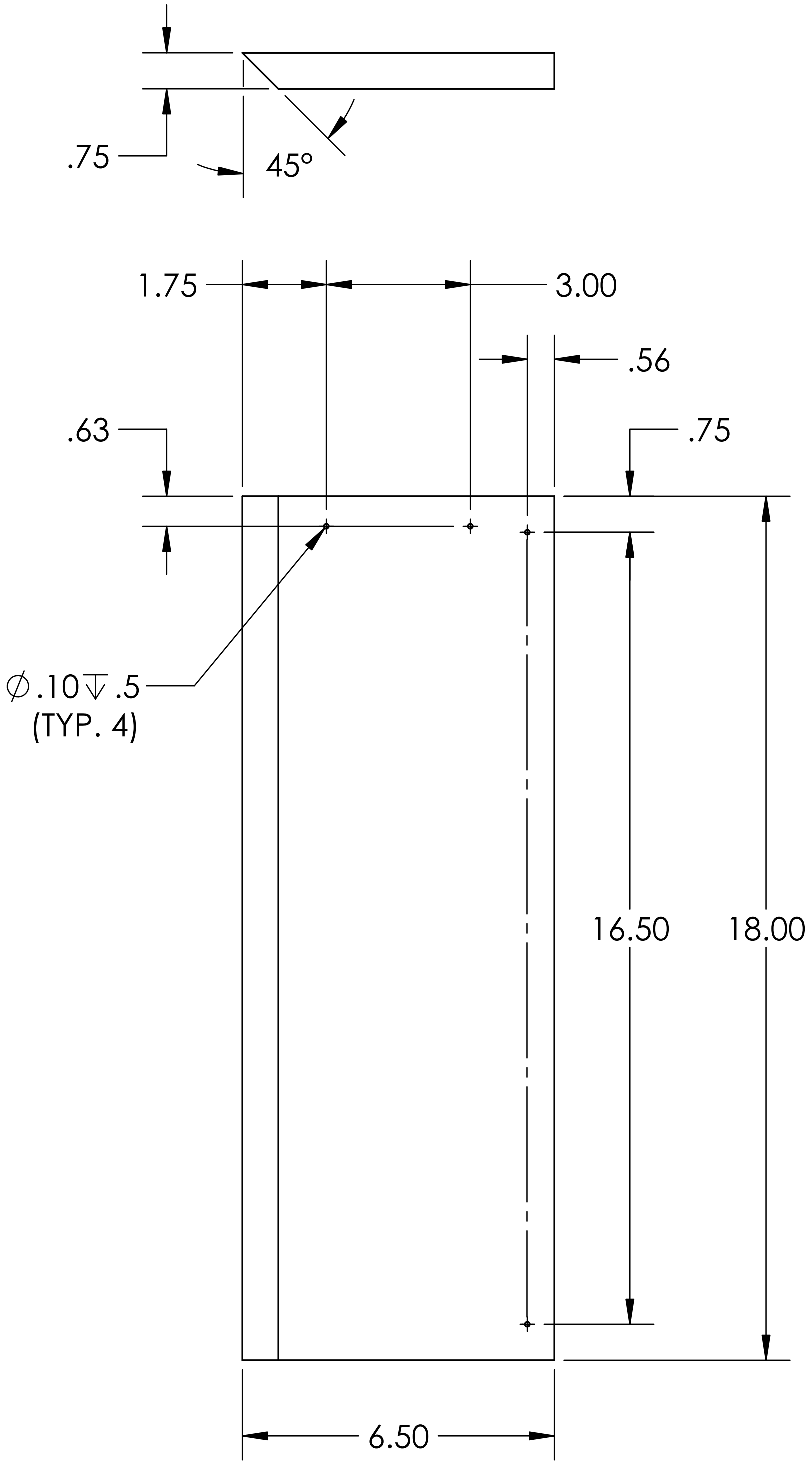
CAL POLY ME428/429/430
INCLUSIVE LECTERN

TITLE:

TOP PANEL - LEFT

SIZE	DWG. NO.	REV.
A	5.1.2L	-

SCALE:1:4 | UNITS: INCHES | SHEET 1 OF 1



FOR REFERENCE ONLY

NOTES:
1. ANGLE SHALL BE CUT WITH LOCK MITER ROUTER BIT.
2. ⌀.10 HOLE REPRESENT PILOT TO LOCATE HARDWARE.

PROPRIETARY AND CONFIDENTIAL

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGULAR: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

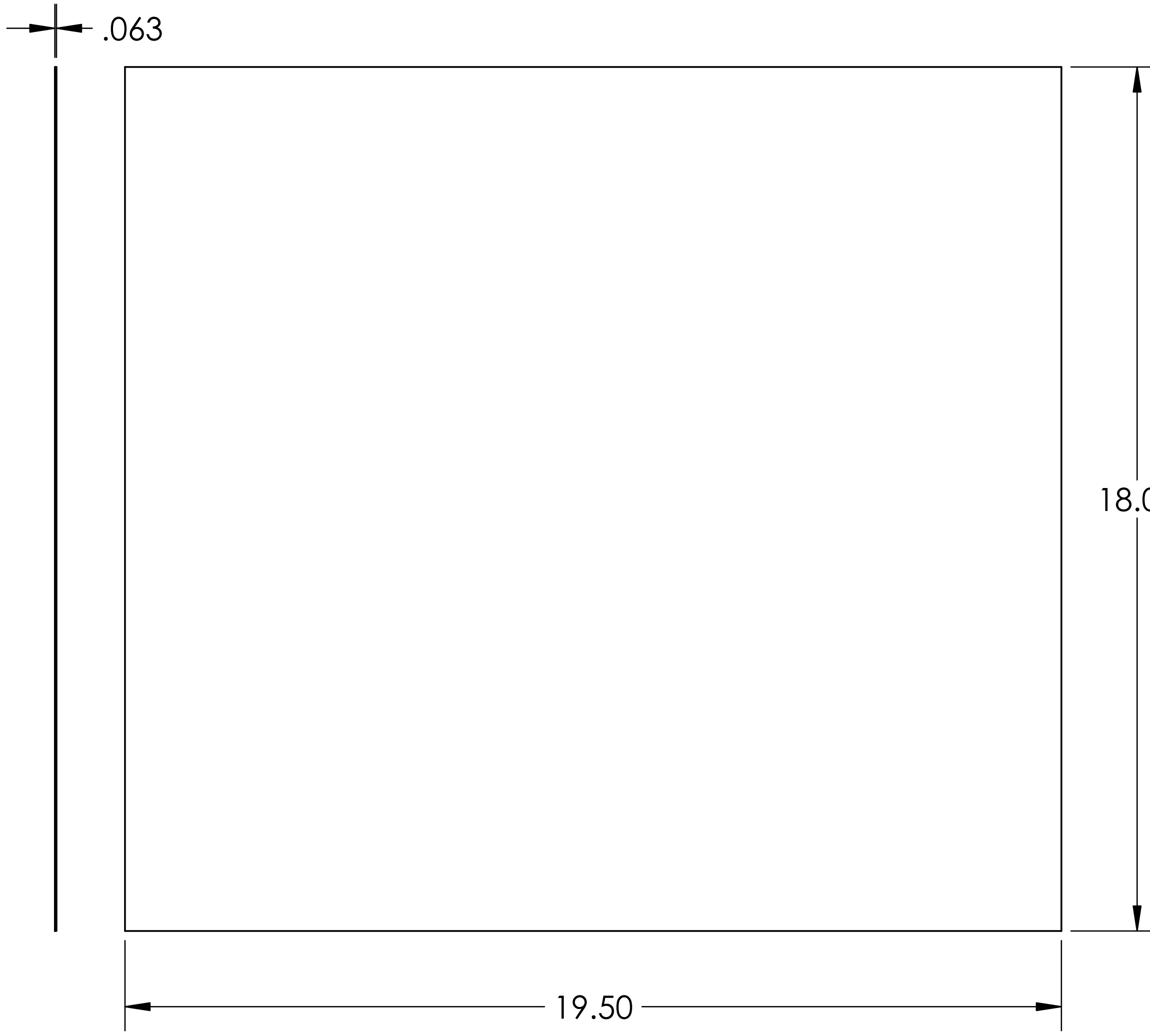
CAL POLY ME428/429/430
INCLUSIVE LECTERN

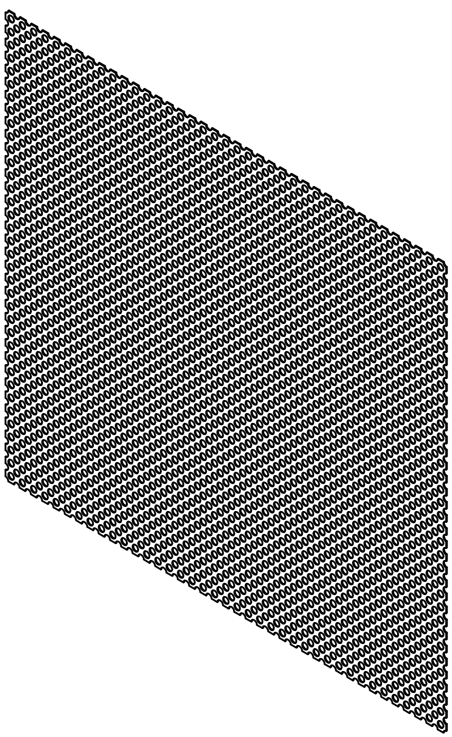
TITLE:

TOP PANEL - RIGHT

SIZE	DWG. NO.	REV.
A	5.1.2R	-

SCALE:1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. CONSTRUCT PART FROM PERFORATED SHEET METAL, Ø.1875 AND .25 SPACING OC.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

TOP PANEL - ACCESS

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL
6061

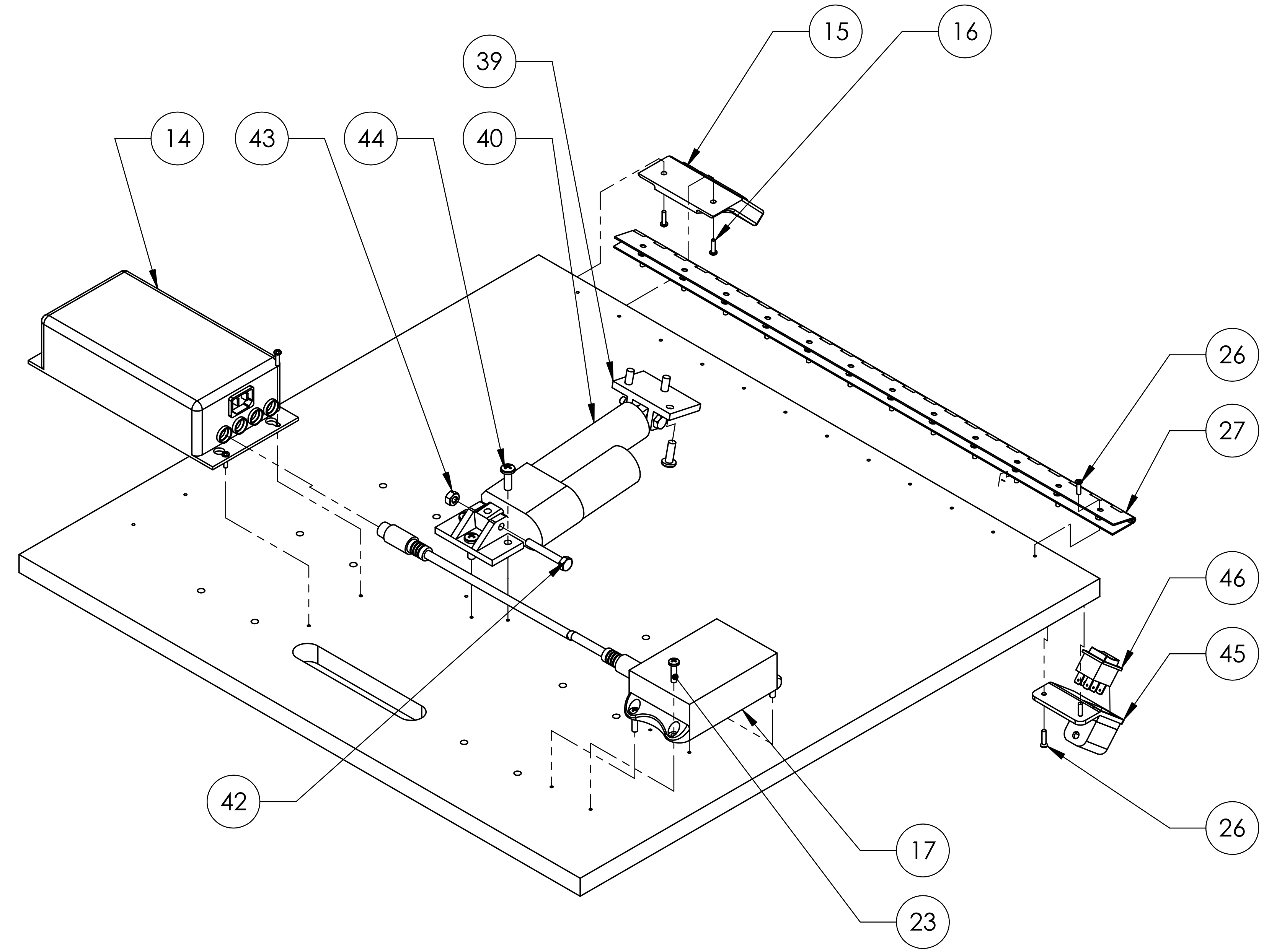
FINISH
BLACK POWDERCOAT

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
A	5.1.3	-

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1

ITEM NO.	PART NUMBER	Default/QTY.
1	6.1.1 - Base	1
2	6.1.3 - Panel - Front	1
3	6.1.4L - Panel - Left	1
4	6.1.4R - Panel - Right	1
5	6.1.5 - Shelf	1
6	6.1.6 - Shelf Mount	4
7	#10-24 X 5/8 Pan Head Screw	35
8	6.1.7 - Top Cover Mount - Front	1
9	6.1.8L - Top Cover Mount - Left	1
10	6.1.8R - Top Cover Mount - Right	1
11	6.2.1 - Logo Plate	1
12	6.2.2 - Logo Letters	1
13	6.2.3 - Logo Post	4
14	6.3.1 - Controller	1
15	6.3.2 - Controller Remote	1
16	#5-40 x 1/2 Pan Head Screw	6
17	6.4.1 - Splitter Box	1
18	6.4.2 - 3 Pin DIN Female Socket	1
19	6.4.3 - 7 Pin DIN Female Socket	2
20	socket button head cap screw_ai	6
21	6.4.4 - 7Pin DIN Male-Wire	1
22	6.4.5 - 7Pin DIN Male	1
23	#10-24 x 3/4 Pan Head Screw	4
24	6.5.1 - Worksurface	1
25	6.5.2 - Worksurface Stop	1
26	#8 x 1-1/4 Flat Head Screw	5
27	6.5.3 - Piano Hinge	2
28	#6 x 5/8 Flat Head Screw	28
29	6.6.1 - AV Mounting Frame	1
30	6.6.2 - US Outlet Plate	1
31	6.6.3 - HDMI Plate	1
32	6.6.4 - VGA_Stereo Plate	1
33	#6-32 Hex Jam Nut	10
34	0.1.1 - HDMI Cable End	1
35	0.1.2 - VGA Cable	1
36	0.1.3 - Audio Panel Mount Cable	1
37	0.1.3A - Audio Panel Mount Cable Nut	1
38	0.6.1C - AC Power Cable - IES90	1
39	6.6.5 - Microphone Shock Mount	1
40	flat head screw_ai	3
41	6.7.1 - Clevis	2
42	6.7.2A - Linear Actuator Housing	1
43	6.7.2B - Linear Actuator Shaft	1
44	1/4-20 x 1.5 Hex Bolt	2
45	1/4-20 Full Nylock Nut	2
46	flat head screw_ai	2
47	1/4-20 x 3/4 Hex Bolt	6
48	6.7.3 - Linear Actuator Switch Housing	1
49	6.7.4 - Linear Actuator Switch	1
50	6.8.1R - Upper Worksurface Panel - Right	1
51	6.8.3 - Upper Worksurface Panel - Front	1
52	6.8.4 - Lower Worksurface Panel - Front	1
53	#6-32 x 5/8 Pan Head Screw	10
54	3/16 Pop Rivet	8
55	6.8.1L - Upper Worksurface Panel - Left	1
56	6.8.2L - Lower Worksurface Panel - Left	1
57	6.8.2R - Lower Worksurface Panel - Right	1



NOTES:
1. SOME COMPNENTS OMITTED FOR CLARITY. REFER TO SHEET 2 FOR COMPLETE ASSEMBLY.

TOLERANCES:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

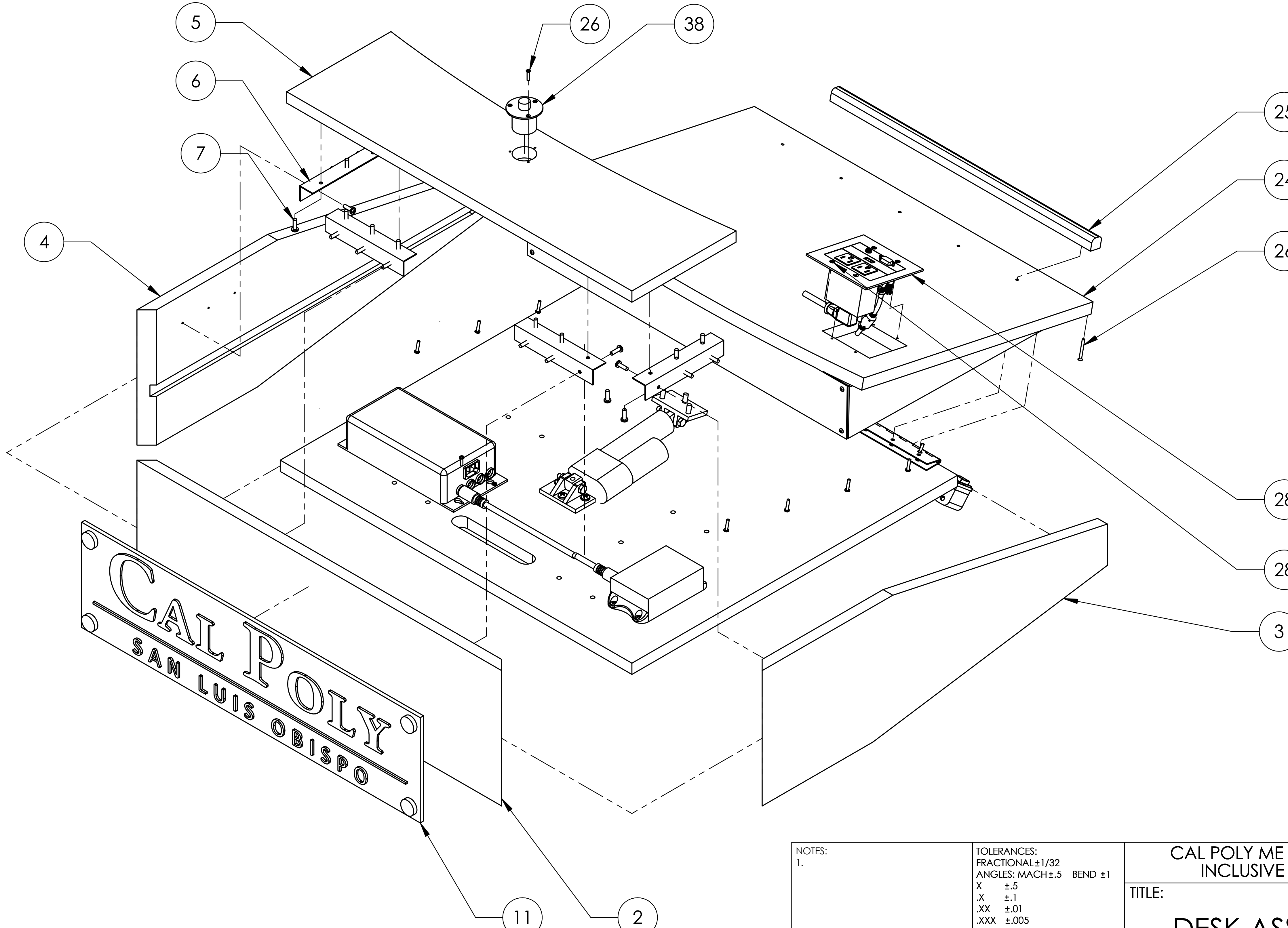
DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:
DESK ASSEMBLY

SIZE B | DWG. NO. 6.0.0 | REV -

SCALE: 1:8 | UNITS: INCHES | SHEET 1 OF 3



NOTES:
1.

TOLERANCES:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

PROPRIETARY AND CONFIDENTIAL

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

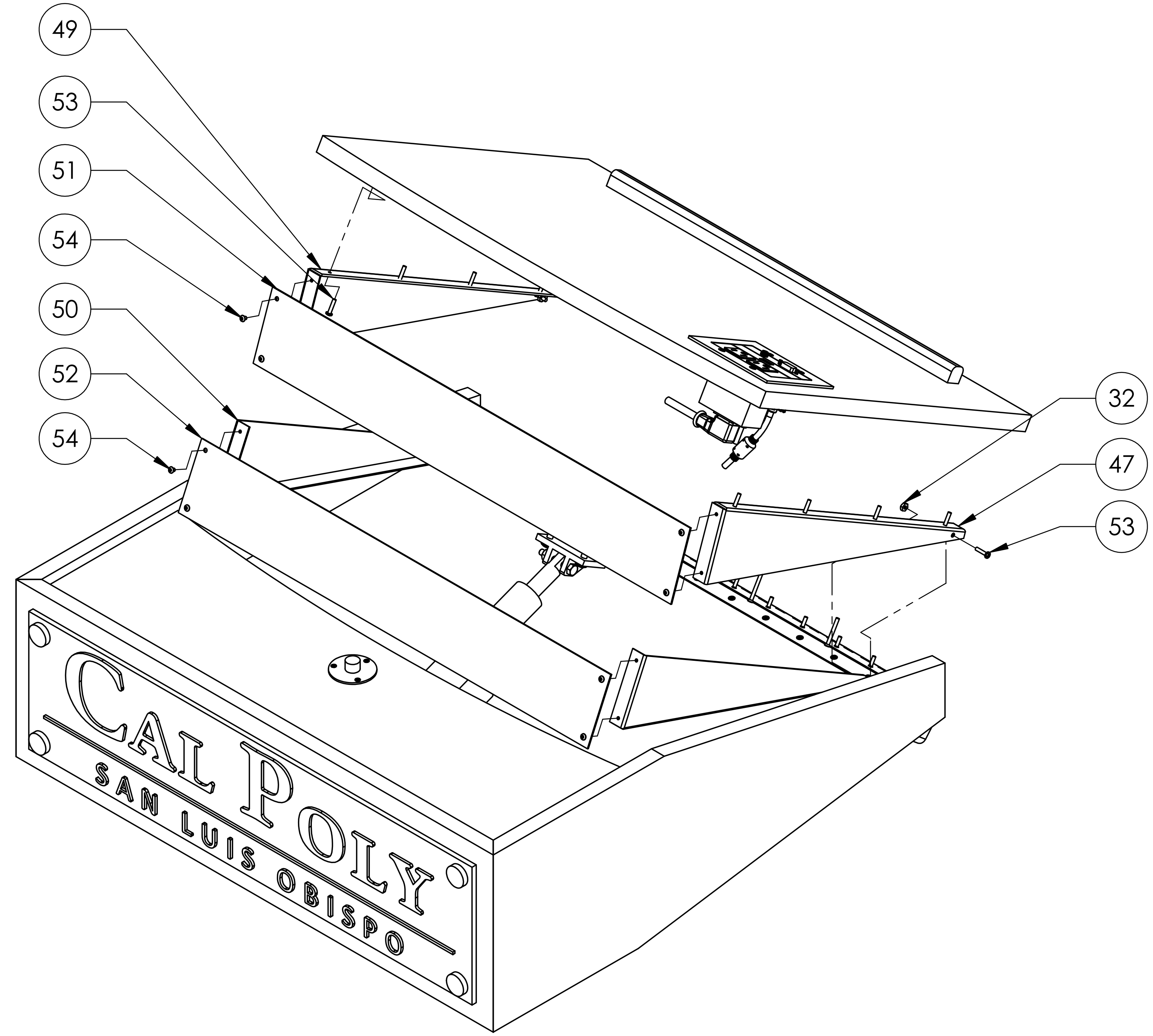
DESK ASSEMBLY

SIZE	DWG. NO.	REV
B	6.0.0	-

SCALE: 1:6 | UNITS: INCHES | SHEET 2 OF 3

4 3 2 1

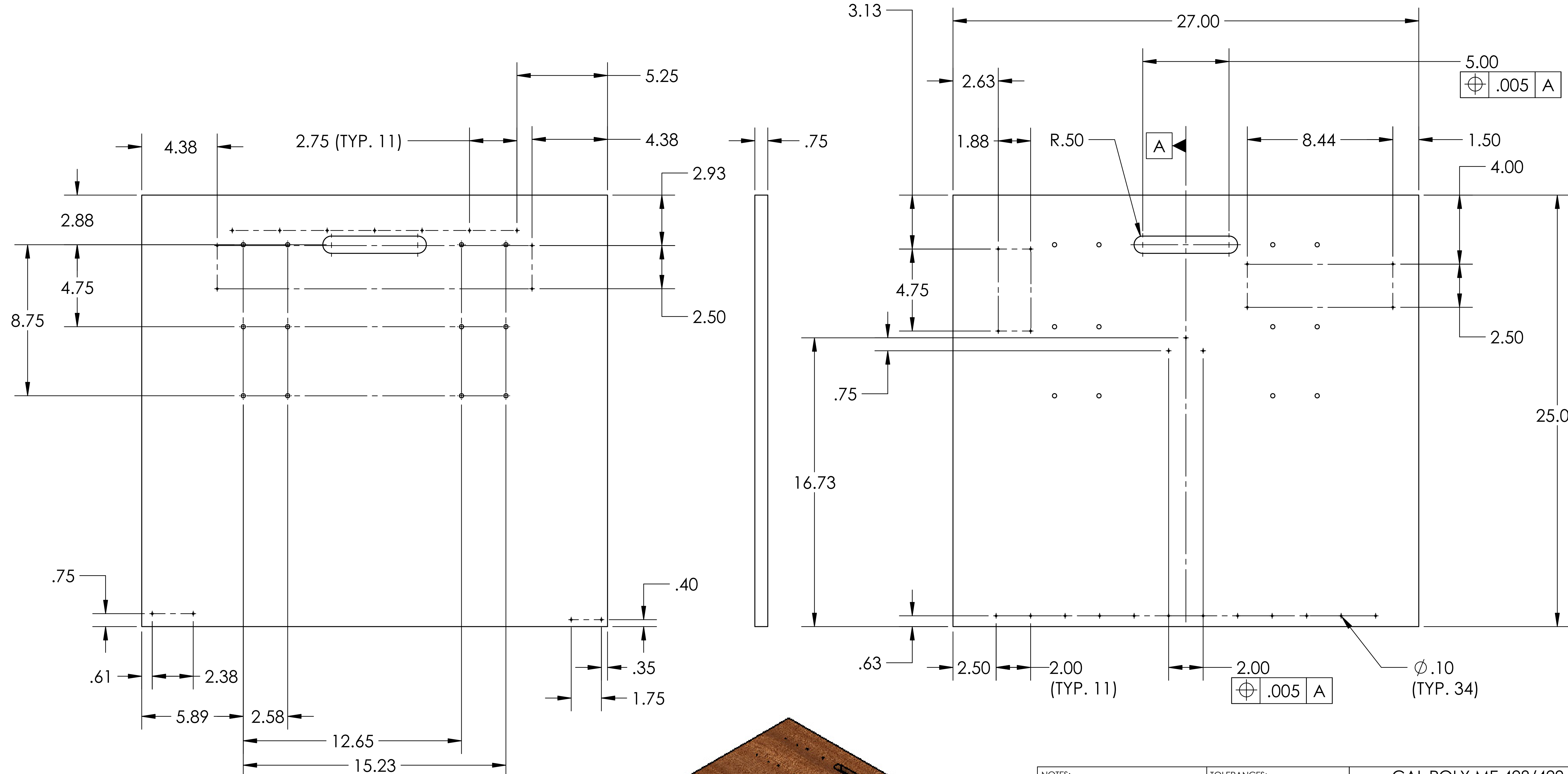
B

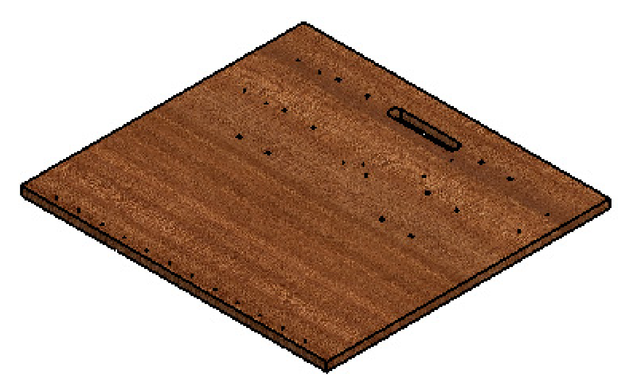


A

NOTES: 1.	TOLERANCES: FRACTIONAL±1/32 ANGLES: MACH±.5 BEND ±1 X ±.5 .X ±.1 .XX ±.01 .XXX ±.005	CAL POLY ME 428/429/430 INCLUSIVE LECTERN TITLE: DESK ASSEMBLY
PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLEWITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.	INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B MATERIAL N/A FINISH N/A DO NOT SCALE DRAWING	SIZE **B** DWG. NO. 6.0.0 REV - SCALE: 1:8 UNITS: INCHES SHEET 3 OF 3

4 3 2 1





FOR REFERENCE ONLY

NOTES:
1. ALL ⌀.10 HOLES REPRESENT PILOT HOLES FOR LOCATING HARDWARE. REFER TO 6.0.0 FOR ADDITIONAL FASTENING INFORMATION.

TOLERANCES:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

BASE

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

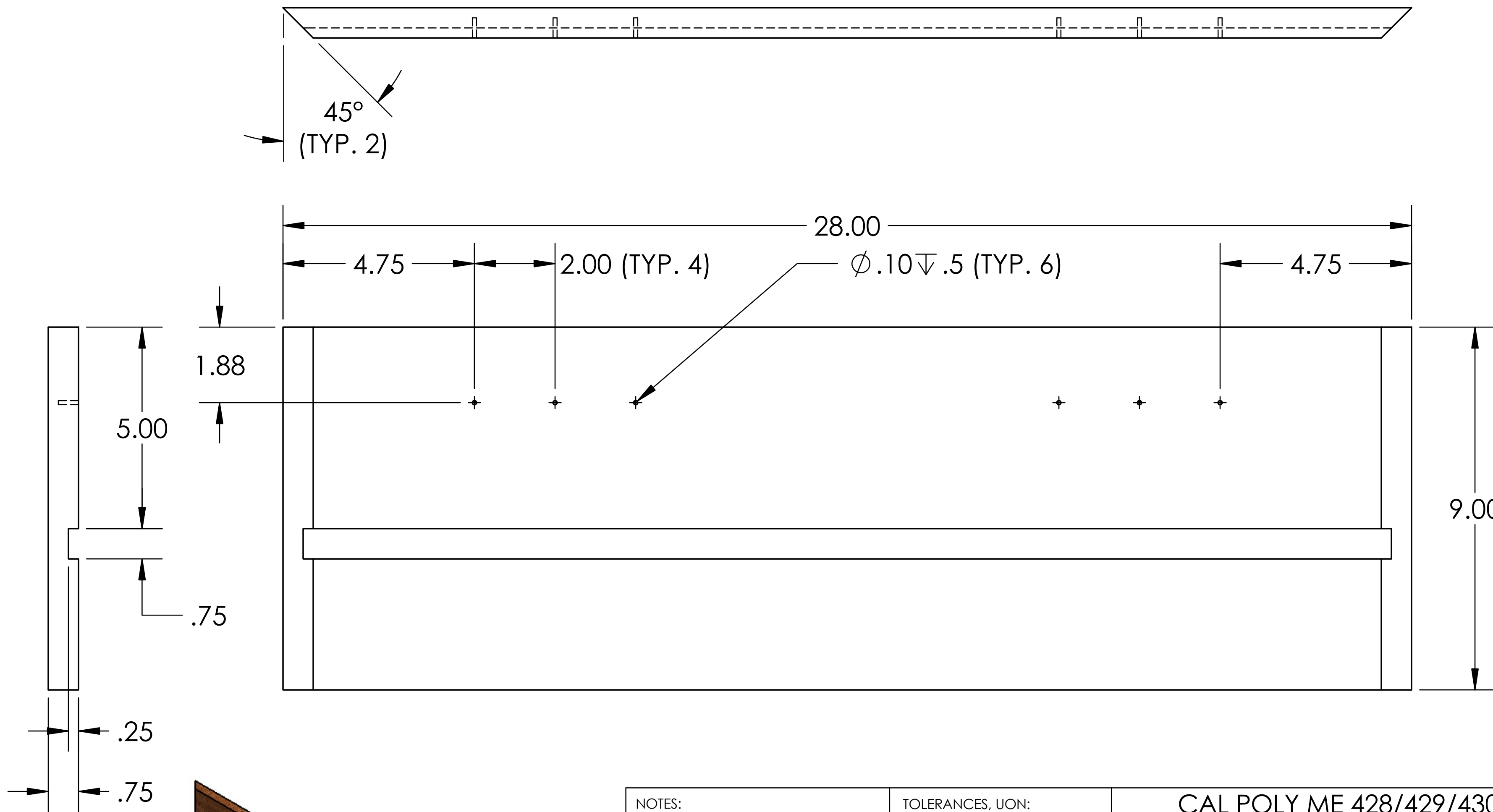
MATERIAL: MAHOGANY

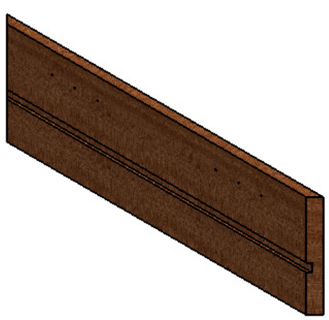
FINISH: UNFINISHED

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
B	6.1.1	-

SCALE: 1:6 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. ALL ∅ .10 HOLES REPRESENT PILOT HOLES FOR LOCATING HARDWARE. REFER TO 6.0.0 FOR ADDITIONAL FASTENING INFORMATION.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

TITLE:

PANEL - FRONT

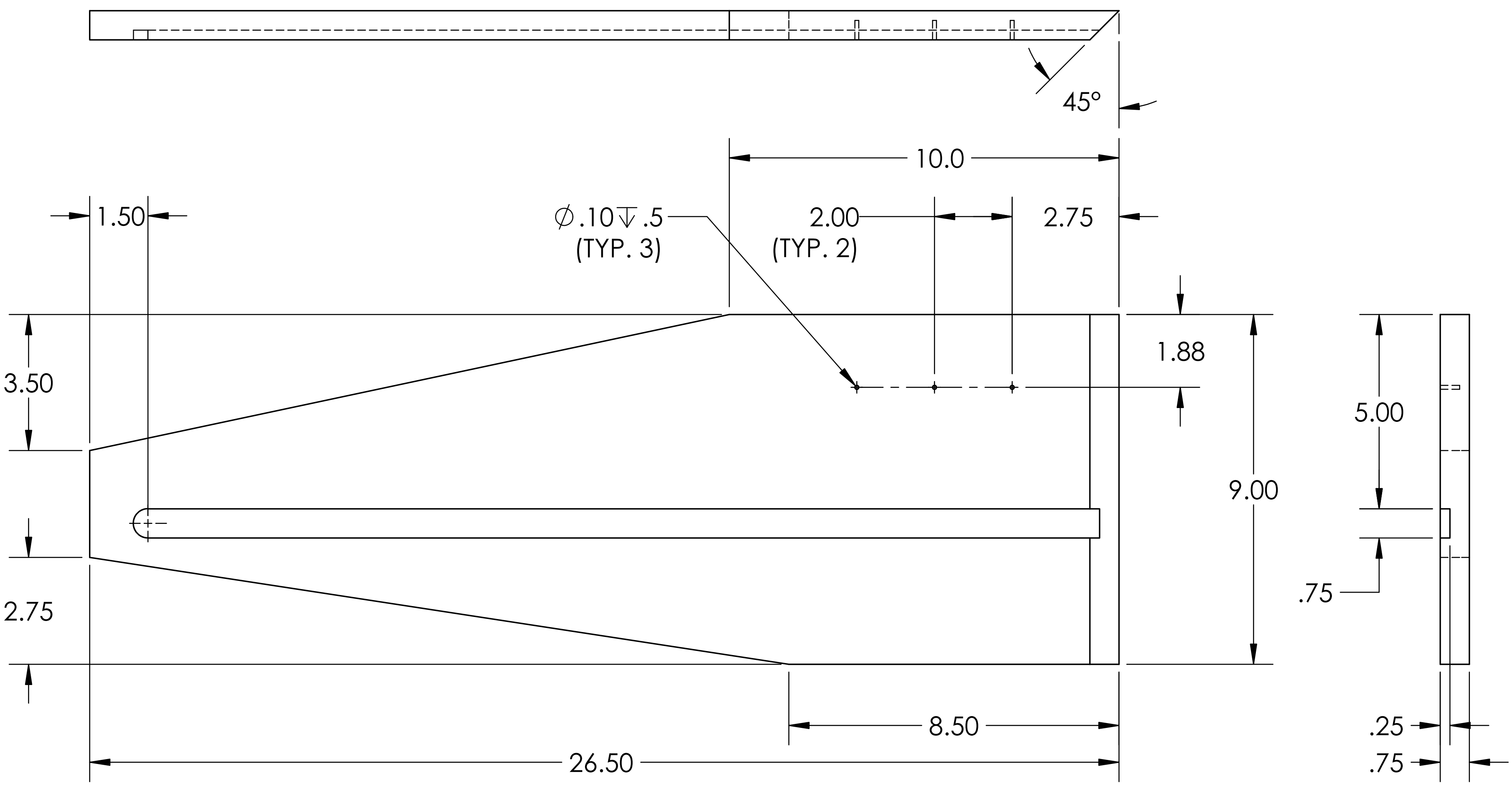
MATERIAL: MAHOGANY

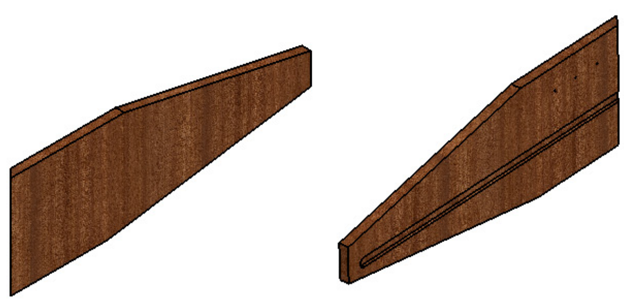
FINISH: UNFINISHED

DO NOT SCALE DRAWING

SIZE: A | DWG. NO. 6.1.3 | REV: -

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. ALL ⌀.10 HOLES REPRESENT PILOT HOLES FOR LOCATING HARDWARE. REFER TO 6.0.0 FOR ADDITIONAL FASTENING INFORMATION..

TOLERANCES, UON:
FRACTIONAL ± 1/32
ANGLES: MACH ± .5 BEND ± 1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

PANEL - LEFT

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

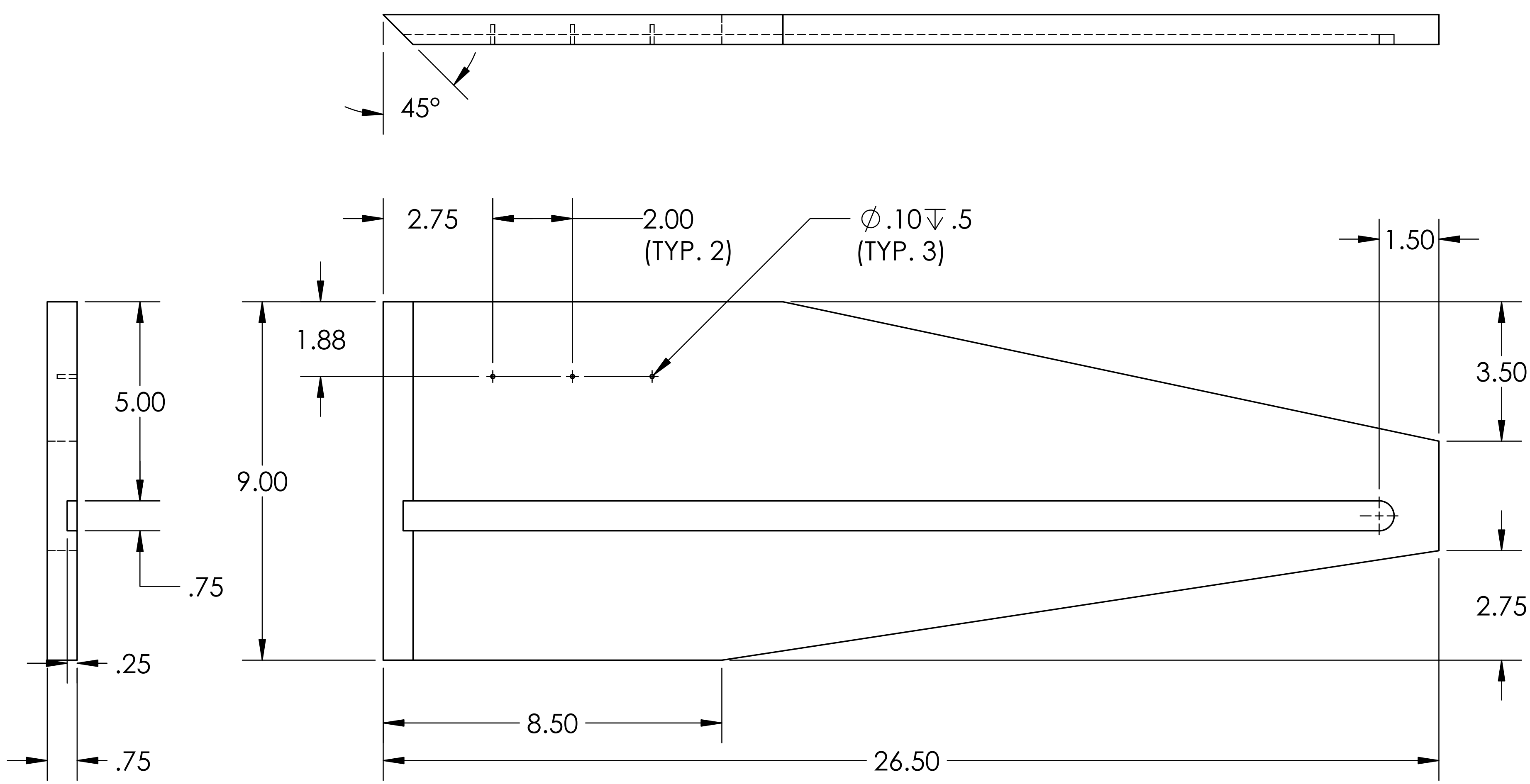
MATERIAL: MAHOGANY

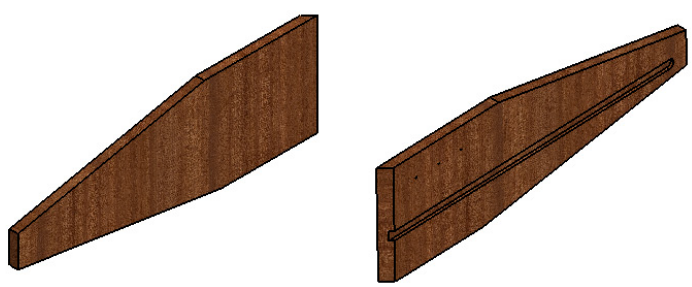
FINISH: UNFINISHED

DO NOT SCALE DRAWING

SIZE: A | DWG. NO.: 6.1.4L | REV: -

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. ALL ∅.10 HOLES REFERENCE PIOLT HOLES FOR LOCATING HARDWARE. REFER TO 6.0.0 FOR ADDITIONAL FASTENING INFORMATION.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

PANEL - RIGHT

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

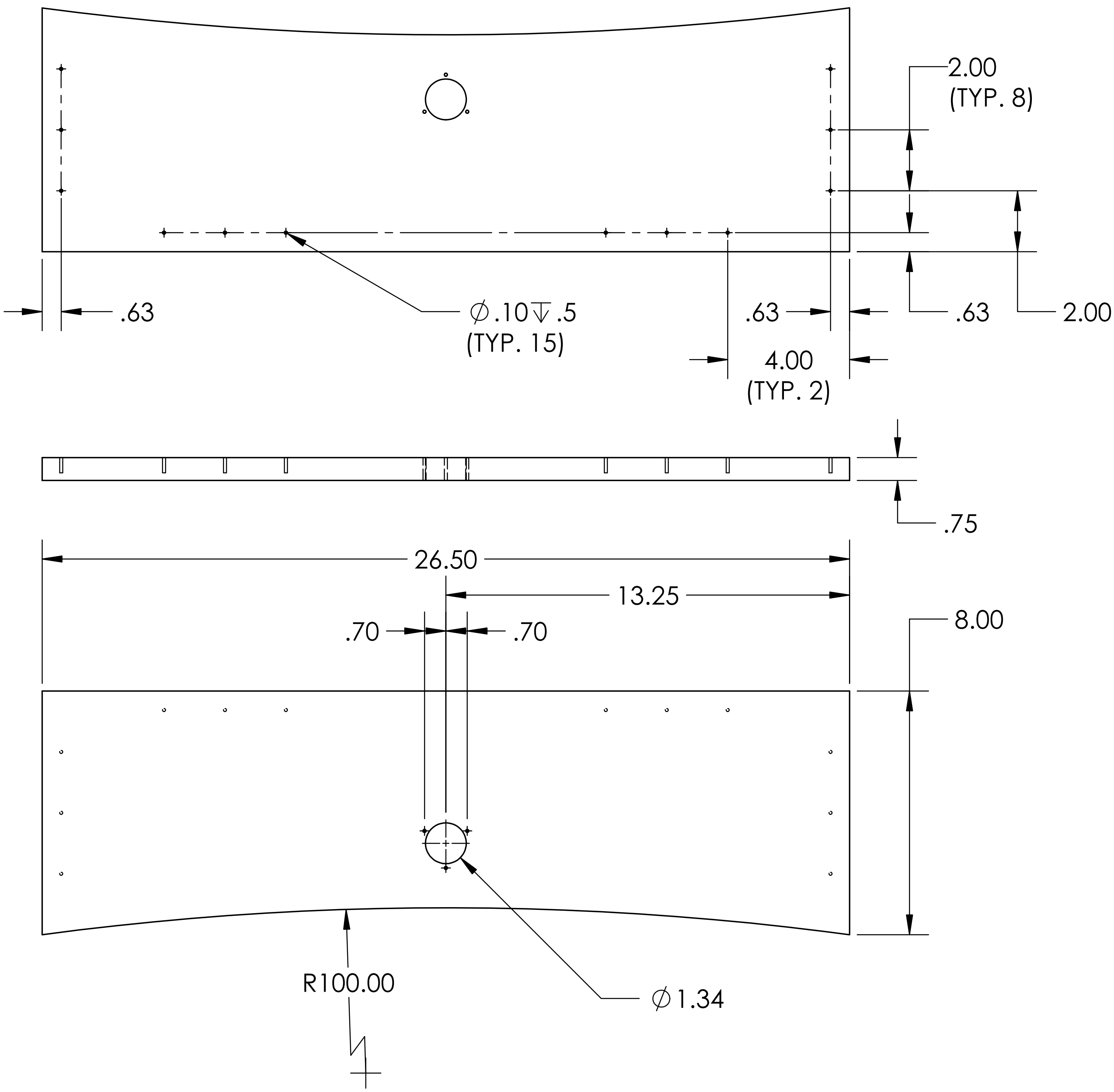
MATERIAL: MAHOGANY

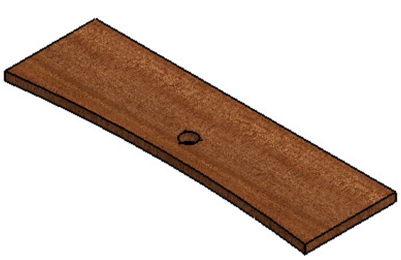
FINISH: UNFINISHED

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
A	6.1.4R	-

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. ALL ∅.10 HOLES REPRESENT PILOT HOLES FOR LOCATING HARDWARE. REFER TO 6.0.0 FOR ADDITIONALINFORMATION.

PROPRIETARY AND CONFIDENTIAL

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGULAR: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

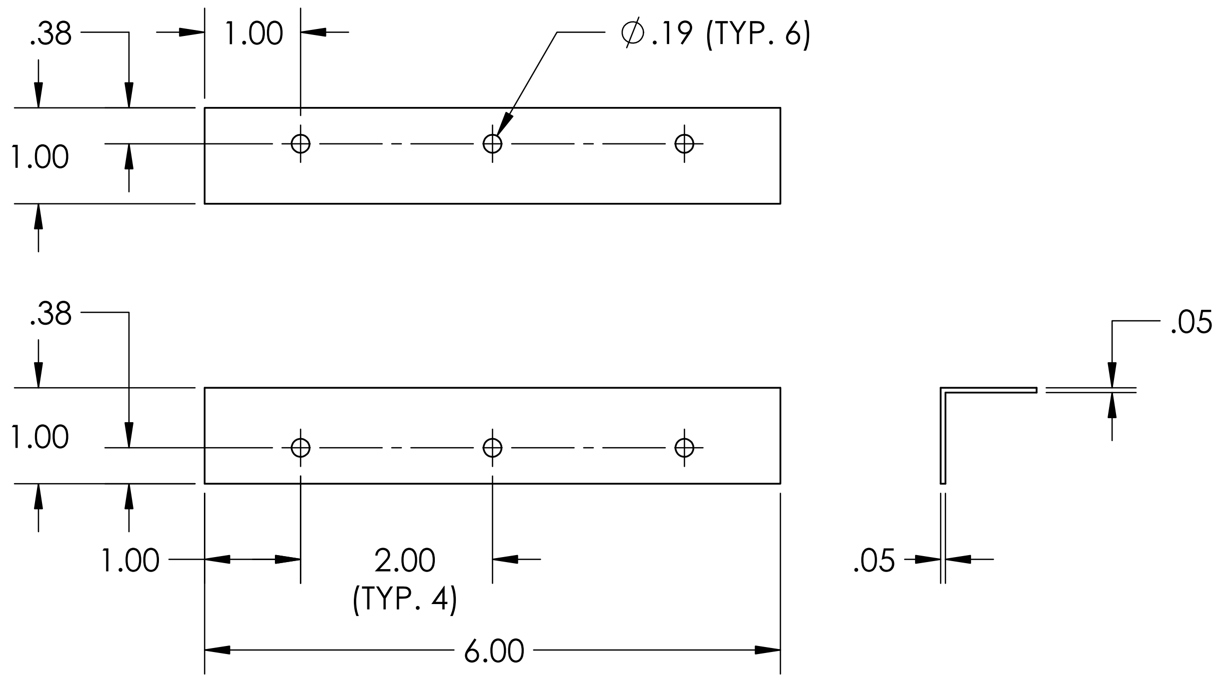
CAL POLY ME428/429/430
INCLUSIVE LECTERN

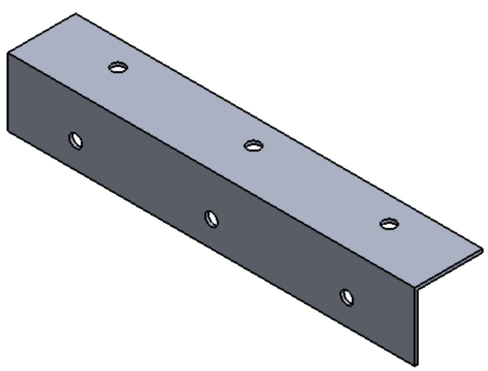
TITLE:

SHELF

SIZE	DWG. NO.	REV.
A	6.1.5	-

SCALE:1:5	UNITS: INCHES	SHEET 1 OF 1





NOTES:
1.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

SHELF SUPPORT

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

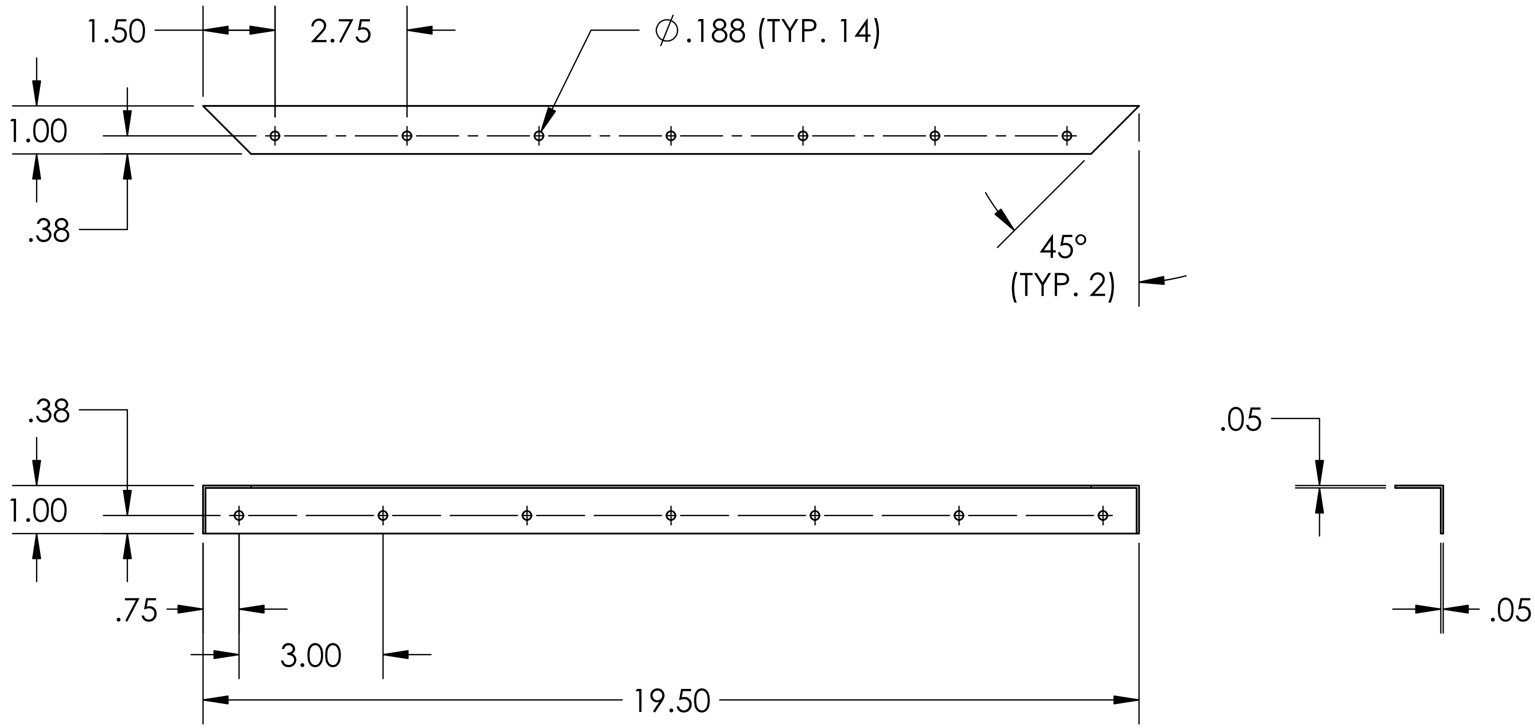
MATERIAL
6061

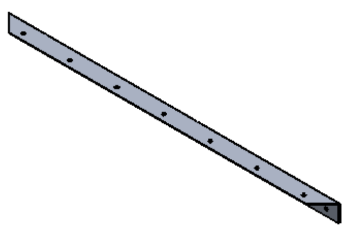
FINISH
UNFINISHED

DO NOT SCALE DRAWING

SIZE: A | DWG. NO. 6.1.6 | REV -

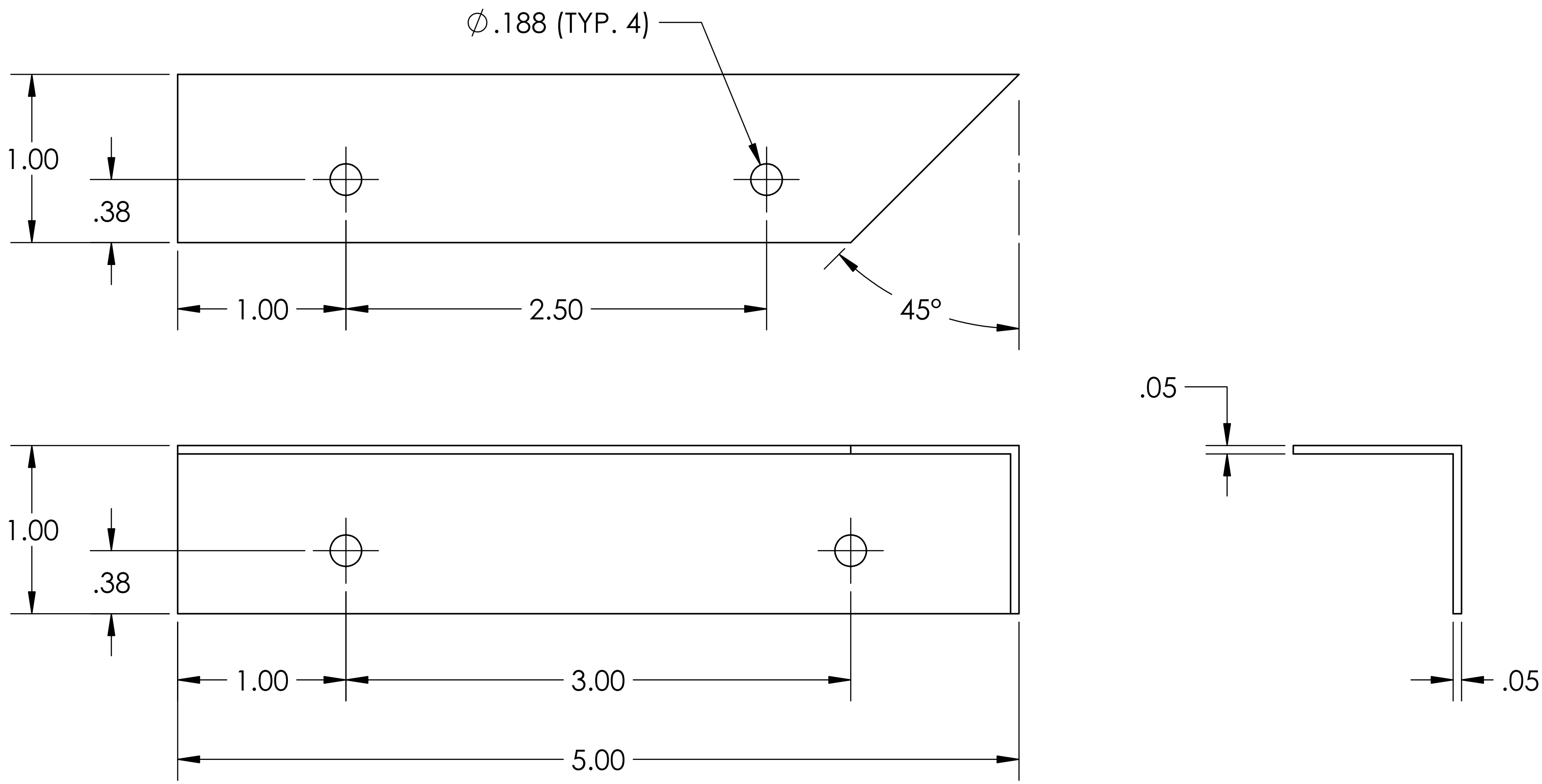
SCALE: 1:2 | UNITS: INCHES | SHEET 1 OF 1

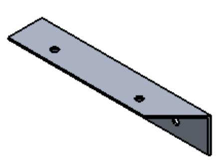




FOR REFERENCE ONLY

NOTES: 1.	TOLERANCES, UON: FRACTIONAL ±1/32 ANGLES: MACH ±.5 BEND ±1 X ±.5 .X ±.1 .XX ±.01 .XXX ±.005	CAL POLY ME 428/429/430 INCLUSIVE LECTERN TITLE: TOP COVER MOUNT - FRONT
PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.	INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B MATERIAL 6061 FINISH UNFINISHED DO NOT SCALE DRAWING	SIZE A · DWG. NO. 6.1.7 · REV - SCALE: 1:4 · UNITS: INCHES · SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: 6061

FINISH: UNFINISHED

DO NOT SCALE DRAWING

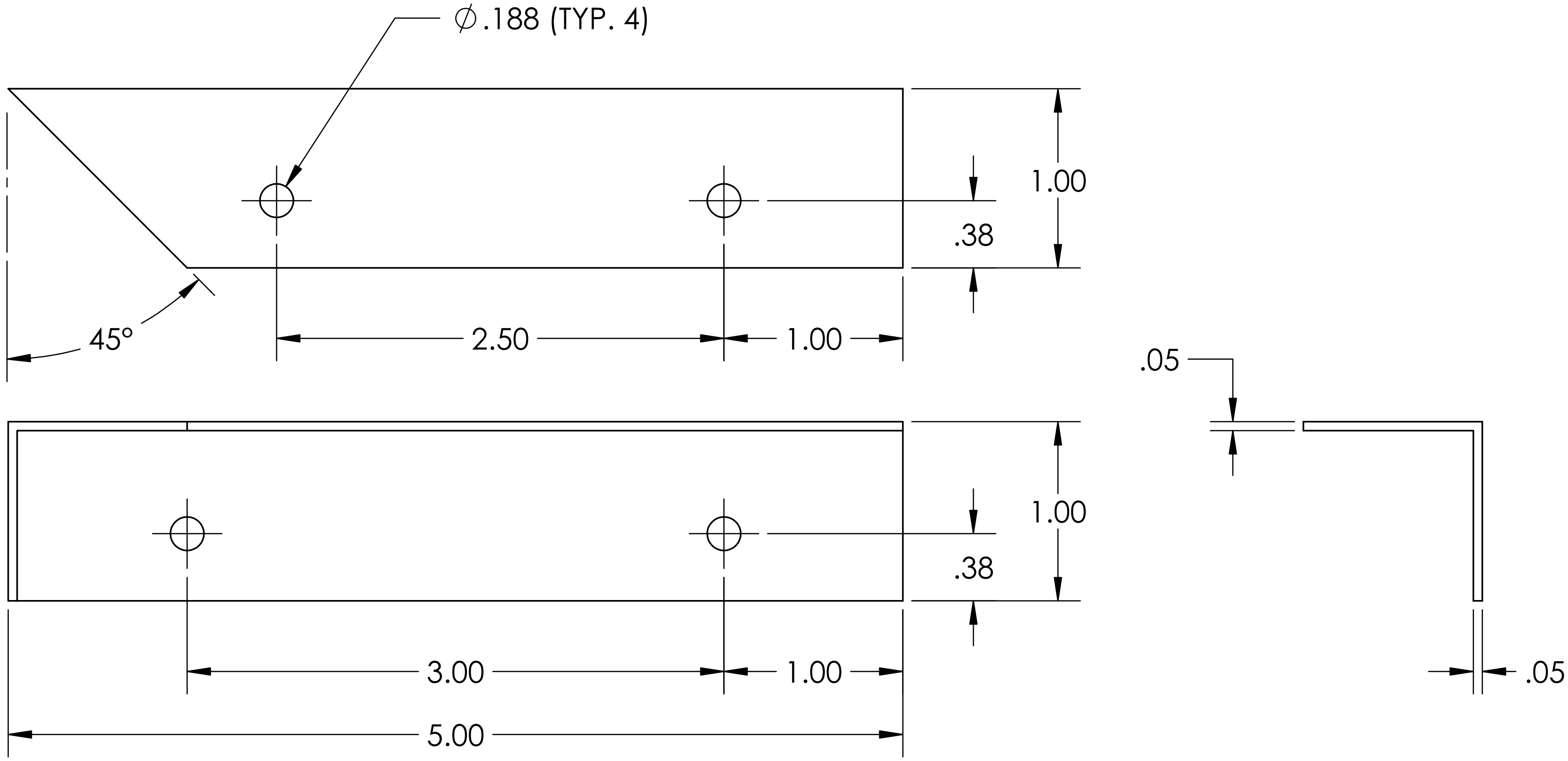
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:
TOP COVER SUPPORT - LEFT

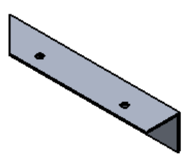
SIZE	DWG. NO.	REV
A	6.1.8L	-
SCALE: 1:1	UNITS: INCHES	SHEET 1 OF 1

2 1

B B



A A



FOR REFERENCE ONLY

NOTES:
1.

PROPRIETARY AND CONFIDENTIAL

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL
6061

FINISH
UNFINISHED

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

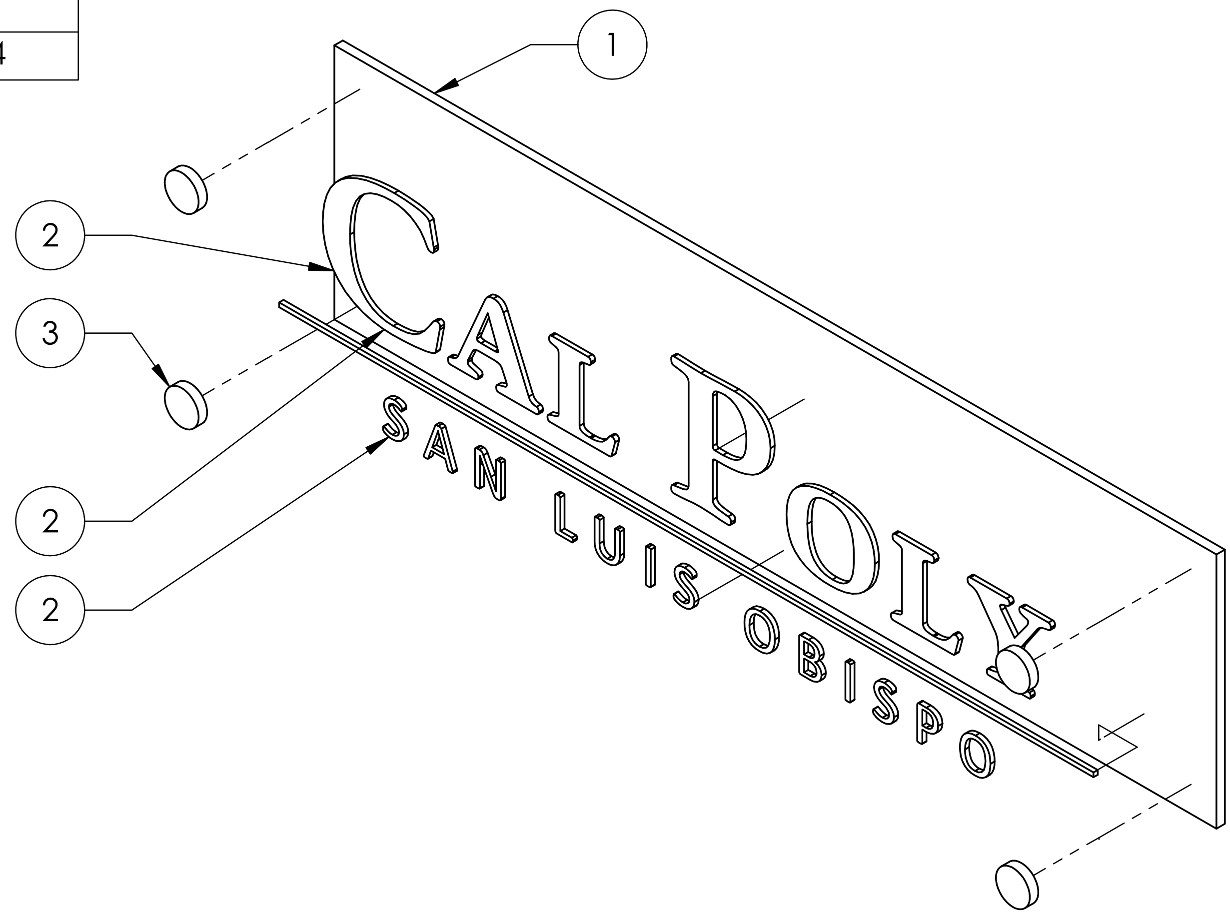
TITLE:
TOP COVER SUPPORT - RIGHT

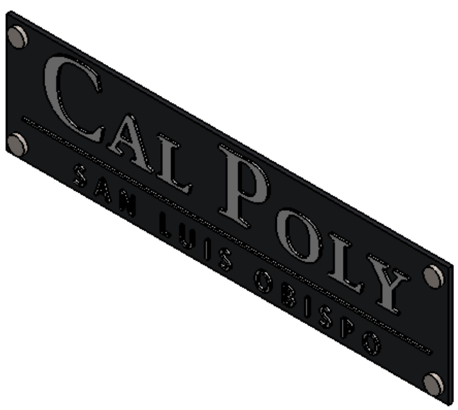
SIZE	DWG. NO.	REV
A	6.1.8R	-

SCALE: 1:1	UNITS: INCHES	SHEET 1 OF 1

2 1

ITEM NO.	PART NUMBER	QTY.
1	6.2.1 - Logo Plate	1
2	6.2.2 - Logo Letters	1
3	6.2.3 - Logo Post	4





FOR REFERENCE ONLY

NOTES:
1. PERFORM BOND OF LOGO LETTERS TO PLATE WITH ADHESIVE 1.5.1, OR EQUAL.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

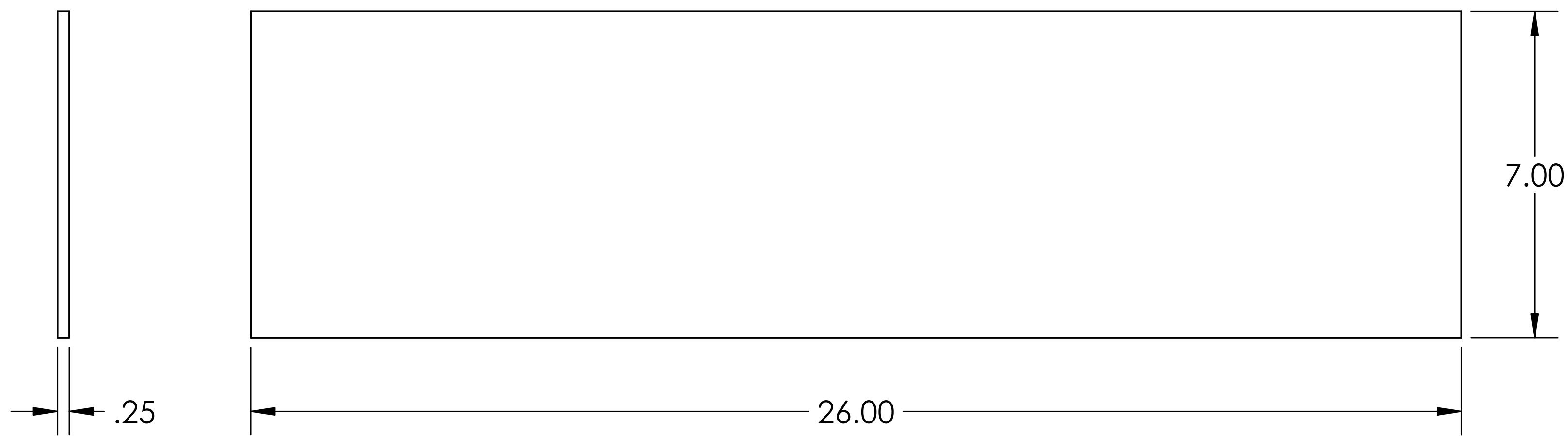
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

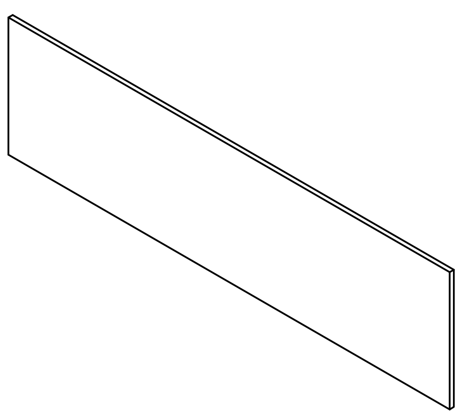
TITLE:

LOGO ASSEMBLY

SIZE A | DWG. NO. 6.2.0 | REV -

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

LOGO PLATE

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: 6061

FINISH: BLACK POWDERCOAT

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
A	6.2.1	-

SCALE: 1:4	UNITS: INCHES	SHEET 1 OF 1

FOR REFERENCE ONLY

NOTES:
1. LETTERS TO BE CUT OUT INDIVIDUALLY ON LASER CUTTER. DIMENSIONS FOR REFERENCE AND QUALITY CONTROL. FONT SHALL BE IN ACCORDANCE WITH CAL POLY TRADEMARK LICENSING.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: ACRYLIC

FINISH: WHITE, OPAQUE

DO NOT SCALE DRAWING

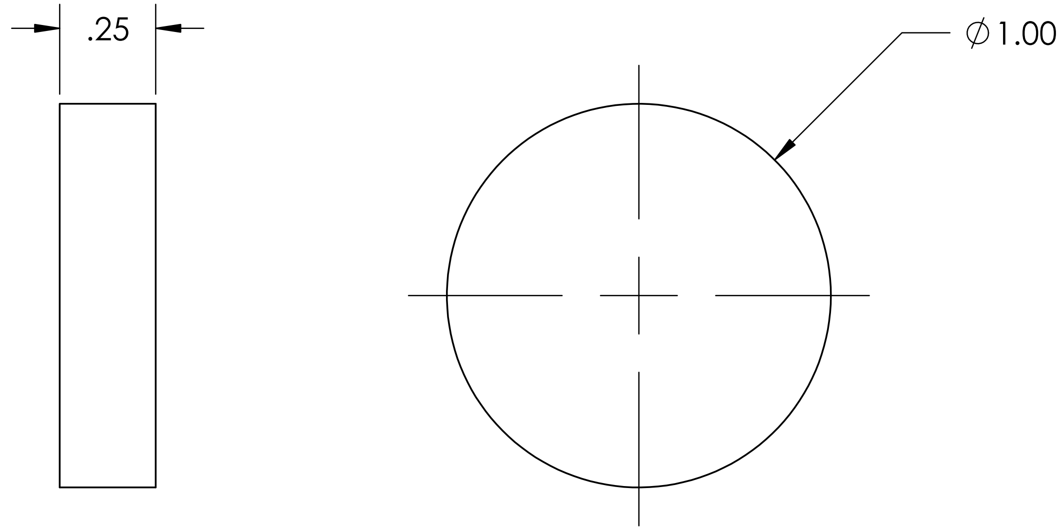
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

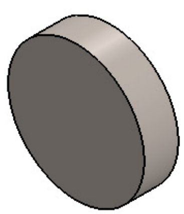
TITLE:

LOGO LETTERS

SIZE	DWG. NO.	REV
A	6.2.2	-

SCALE: 1:4	UNITS: INCHES	SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

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INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL
ALUMINUM

FINISH
UNFINISHED

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

LOGO POST

SIZE	DWG. NO.	REV
A	6.2.3	-

SCALE: 2:1	UNITS: INCHES	SHEET 1 OF 1

Standard configurations

Performance data	
Adjustment speed	speed control
Duty cycle	2/18 min. or 10 %, max. 5 switching cycles per minute
Control unit	microprocessor control
Input voltage	EU: 207-254.4 V / 50 Hz US: 90-127 V / 50-60 Hz
Output voltage	29 V DC
Power output	360 VA
Standby	0.3 Watt
Components	
Indicators	4 status LEDs for fault diagnosis
Limit switch	programmable upper and lower position (container stop,shelf height)
Housing colour	black RAL 9005
Supply cable	pluggable: GB-plug with earthing, black, straight, 3000 mm, PVC USA-plug with earthing, black, straight, 3000 mm, PVC AUS-plug with earthing, black, straight, 3000 mm, PVC JAP-plug with earthing, black, straight, 3000 mm, PVC earthing pin plug, black, straight, 3000 mm, PVC
SMPS	yes
Further data	
Connectivity [1]	connections for drives: 1-3 (automatic drive detection) connections for operating elements: 1
Protection type	IP20
Protection class	I
Relative humidity	30% – 75%
Ambient temperature	+10°C - +40°C
Function LED	yes
Memory	yes
Assembly options	fastening drill-holes

Extra configurations

Performance data	
Control unit	microprocessor control with customised programming
Further data	
Connectivity [2]	Linking of up to 4 control units
Safety	expanded system protection with collision detection
Equipment options	external sensor for collision detection

Note: Responsibility for OKIN products when used for specific applications and for adherence to the appropriate guidelines, standards and laws is borne by the manufacturer of the complete system into which OKIN products are fitted. We accept no liability for the correctness.

DewertOkin GmbH • Weststraße 1 • 32278 Kirchlengern
Phone: +49 (0)52 23 / 9 79 -0 • Fax: +49 (0)52 23 / 7 51 82 • Email: info@okin.de • Internet: http://www.okin.de

HSU DISPLAY

OKIN
A Phoenix Mecano Brand

Standard configurations

Components

Indicators	LED display; table height display in cm or inches; output of a service code
Housing colour	black RAL 9005
Further data	
Protection type	IP20
Relative humidity	30% – 75%
Ambient temperature	+10°C - +40°C
Keys	9
Assembly options	fixing under the table top
	can be slid horizontally under the table top

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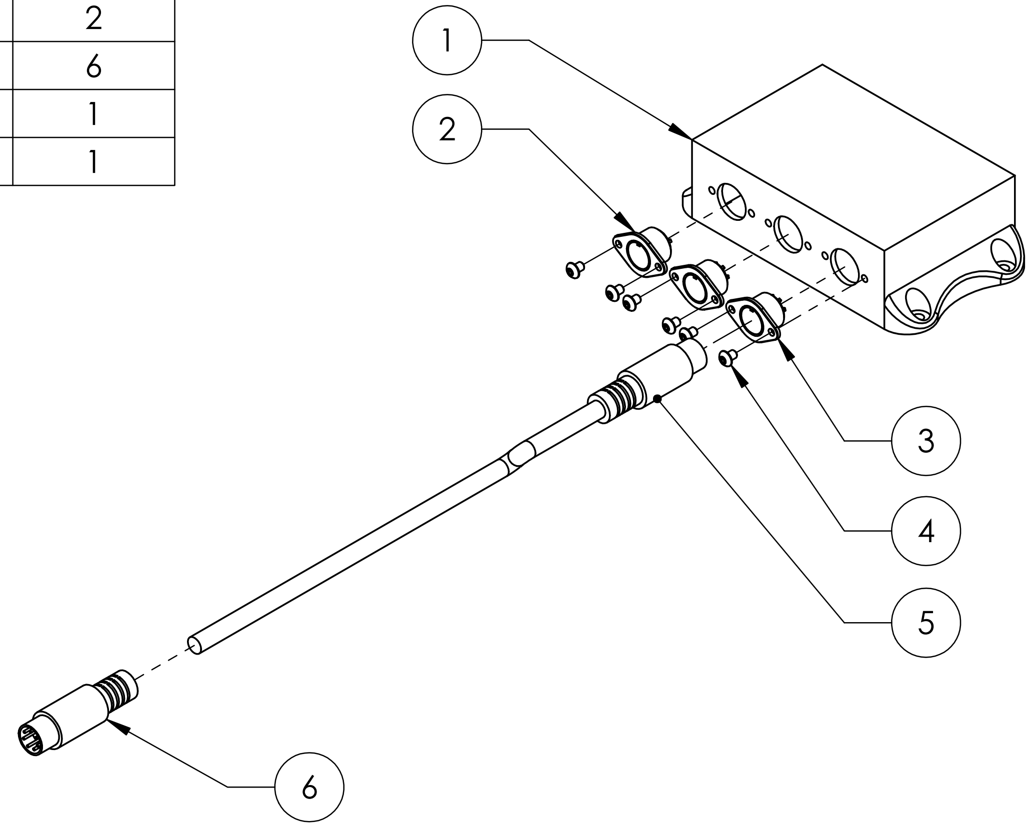
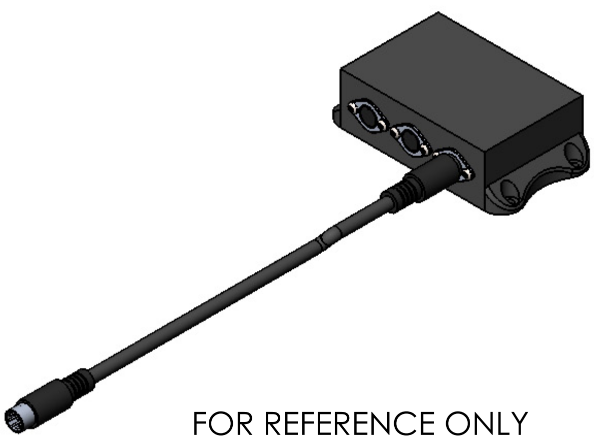
Phone: +49 (0)52 23 / 9 79 -0 • Fax: +49 (0)52 23 / 7 51 82 • Email: info@okin.de • Internet: http://www.okin.de

ITEM NO.	PART NUMBER	QTY.
1	6.4.1 - Splitter Box	1
2	6.4.2 - 3 Pin DIN Female Socket	1
3	6.4.3 - 7 Pin DIN Female Socket	2
4	#6-32 X 5/8 Pan Head Screw	6
5	6.4.4 - 7Pin DIN Male-Wire	1
6	6.4.5 - 7Pin DIN Male	1





FOR REFERENCE ONLY

NOTES:
1. ITEMS 5 AND 6 SHALL BE SOLDERED TOGETHER AND SHINK WRAPPED AS NECESSARY. COORDINATE EXACT CABLE LENGTH IN FIELD,

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

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INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

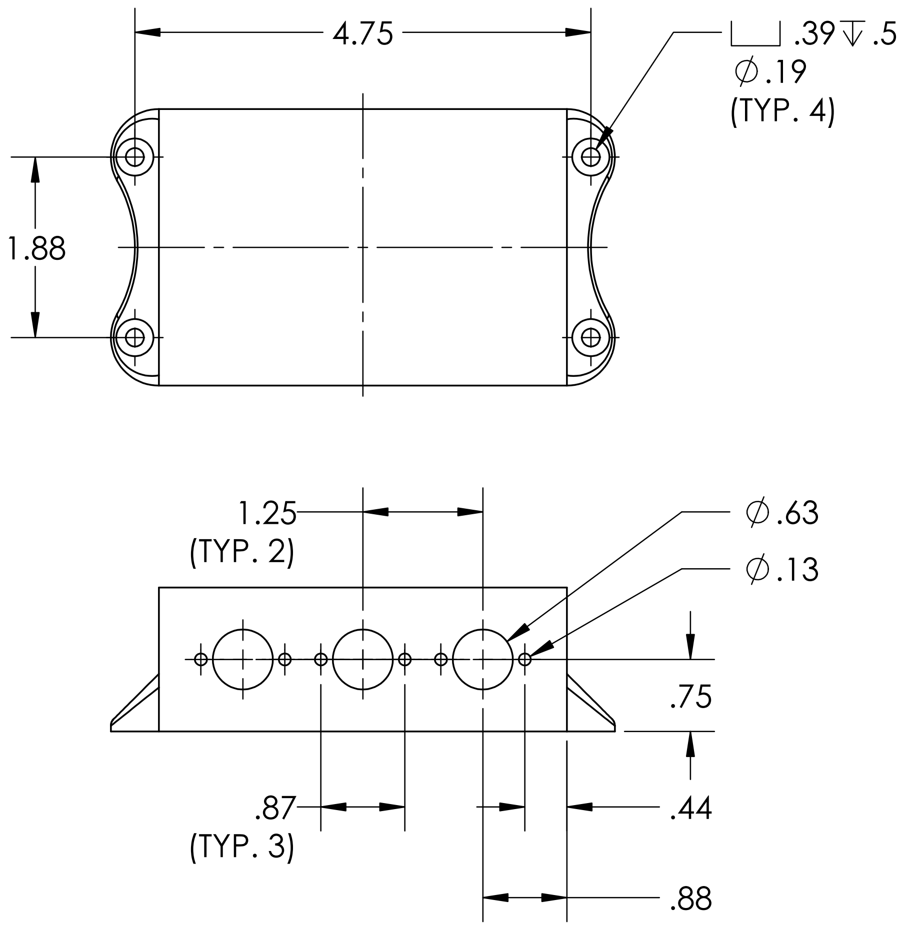
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

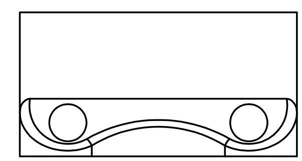
TITLE:

SPLITTER ASSEMBLY

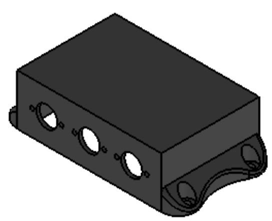
SIZE A | DWG. NO. 6.4.0 | REV -

SCALE: 1:2 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY



FOR REFERENCE ONLY

NOTES:

1. PART SHALL BE CONSTRUCTED USING 3D-PRINTER METHOD. ONLY MATING DIMENSIONS SHOWN FOR CLARITY.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

SPLITTER BOX

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: ABS

FINISH: UNFINISHED

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
A	6.4.1	-

SCALE: 1:2 | UNITS: INCHES | SHEET 1 OF 1

CUI INC

date 09/01/2015

SERIES: SD-XXSN | DESCRIPTION: STANDARD DIN CONNECTOR

FEATURES
- panel mount
- vertical
- shielded

RoHS

PART NUMBER KEY

SD - XX SN

Base Number

Pin Options
30 = 3 pins
40 = 4 pins
50 = 5 pins
60 = 6 pins
70 = 7 pins
80 = 8 pins

SPECIFICATIONS

parameter	conditions/description	min	typ	max	units
rated input voltage			100 12		Vac Vdc
rated input current	at 100 Vac at 12 Vdc			1 2	A A
contact resistance				30	mΩ
insulation resistance	at 500 Vdc	100			MΩ
voltage withstand	for 1 minute			1,000	Vac
insertion force	SD-40SN all other models			6.5 4	kg kg
withdrawal force	SD-40SN all other models	1 1		5 3.5	kg kg
operating temperature		5		70	°C
life			5,000		cycles
flammability rating	UL94V-0				
RoHS	2011/65/EU				

6.4.2 - 3 PIN DIN FEMALE SOCKET

CUI INC

date 09/01/2015

SERIES: SD-XXSN | DESCRIPTION: STANDARD DIN CONNECTOR

FEATURES
- panel mount
- vertical
- shielded

RoHS

PART NUMBER KEY

SD - XX SN

Base Number (SD)

Pin Options (XX)
30 = 3 pins
40 = 4 pins
50 = 5 pins
60 = 6 pins
70 = 7 pins
80 = 8 pins

SPECIFICATIONS

parameter	conditions/description	min	typ	max	units
rated input voltage			100 12		Vac Vdc
rated input current	at 100 Vac at 12 Vdc			1 2	A A
contact resistance				30	mΩ
insulation resistance	at 500 Vdc	100			MΩ
voltage withstand	for 1 minute			1,000	Vac
insertion force	SD-40SN all other models			6.5 4	kg kg
withdrawal force	SD-40SN all other models	1 1		5 3.5	kg kg
operating temperature		5		70	°C
life			5,000		cycles
flammability rating	UL94V-0				
RoHS	2011/65/EU				

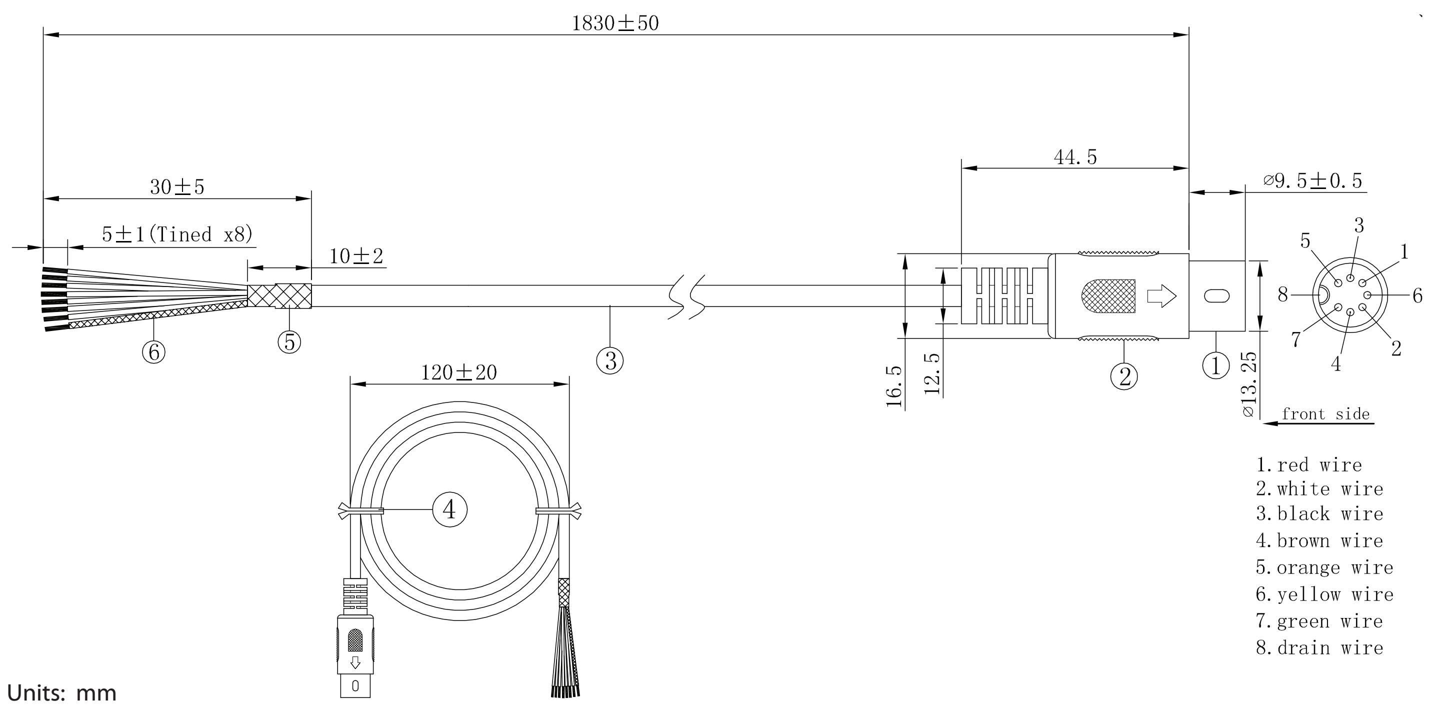
6.4.3 - 7 PIN DIN FEMALE SOCKET

Specifications:

connector description (1)	7P standard DIN male, molding style, brass, nickel plating, 270°, P/N 50-00174
overmold (2)	inner: PE; outer: 60P, PVC, black
wire description (3)	7C, 20 AWG, UL2464, 300 V, 80 C, 7.5 mm, shielded, VW-1, PVC, 60P, P/N 30-00027
cable outer diameter	Ø7.5 mm
cable color	black
cable length	1830 ± 50 mm
twist tie (4)	black
shrink tube (5)	Ø8.0, 105°C, 10 ± 2 mm, black
shrink tube (6)	Ø1.0, 105°C, 30 ± 5 mm, black
current rating	2 A @ 12 Vdc

Notes:
Function test: no open, no reversed polarity, no short circuit, no INT
RoHS compliant

Mechanical drawing:



Units: mm

6.4.4 - 7 PIN DIN MALE-WIRE

tolerance X: ±0.5 mm .X: ±0.3 mm .XX: ±0.05 mm
applicable unless otherwise indicated in specification or on drawings

Tensility International Corporation reserves the right to substitute parts which are functionally equivalent to the ones specified.

Initial	Date

CUI INC

SERIES: SD | DESCRIPTION: STANDARD DIN CONNECTOR

FEATURES
- strain relief
- 3~13 pins
- 100 Vac rated

RoHS

PART NUMBER KEY

SD - XX

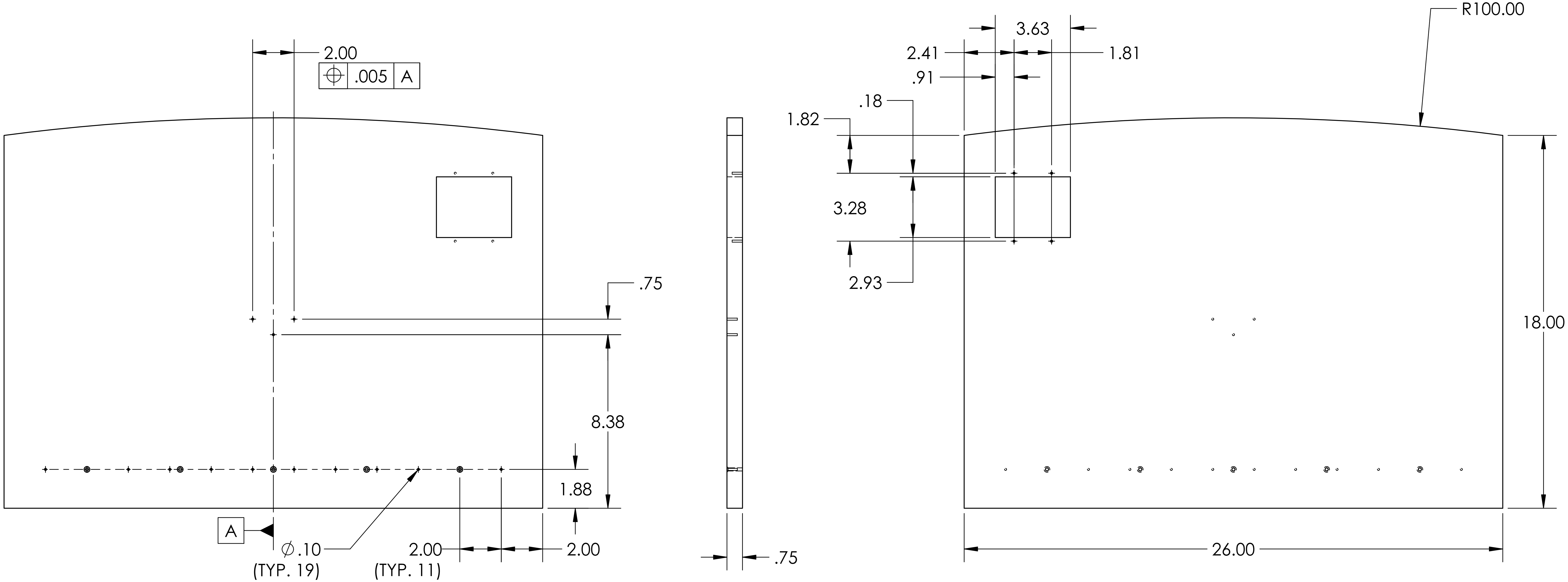
Base Number: SD

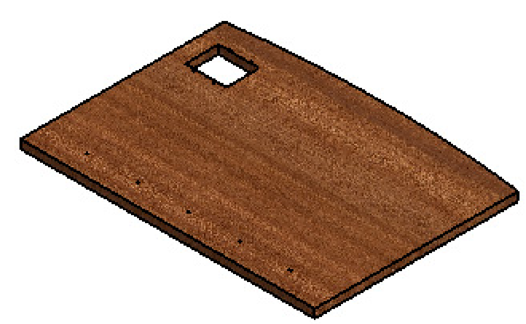
Pin Options:
30 = 3 pins
40 = 4 pins
50 = 5 pins, 180 degrees
51 = 5 pins, 240 degrees
60 = 6 pins
70 = 7 pins
80 = 8 pins, 270 degrees
81 = 8 pins, 262 degrees
130 = 13 pins

SPECIFICATIONS

parameter	conditions/description	min	typ	max	units
rated input voltage			100 12		Vac Vdc
rated input current	at 100 Vac at 12 Vdc			1 2	A A
contact resistance				30	mΩ
insulation resistance	at 500 Vdc	100			MΩ
voltage withstand	for 1 minute			1,000	Vac
insertion force				4	kg
withdrawl force		1		3.5	kg
operating temperature		5		70	°C
life			5,000		cycles

6.4.5 - 7 PIN DIN MALE





FOR REFERENCE ONLY

NOTES:
1. ALL ∅.10 HOLES REPRESENT PILOT HOLES TO LOCATE HARDWARE. REFER TO 6.0.0 FOR ADDITIONAL FASTENING INFORMATION.

TOLERANCES:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

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INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

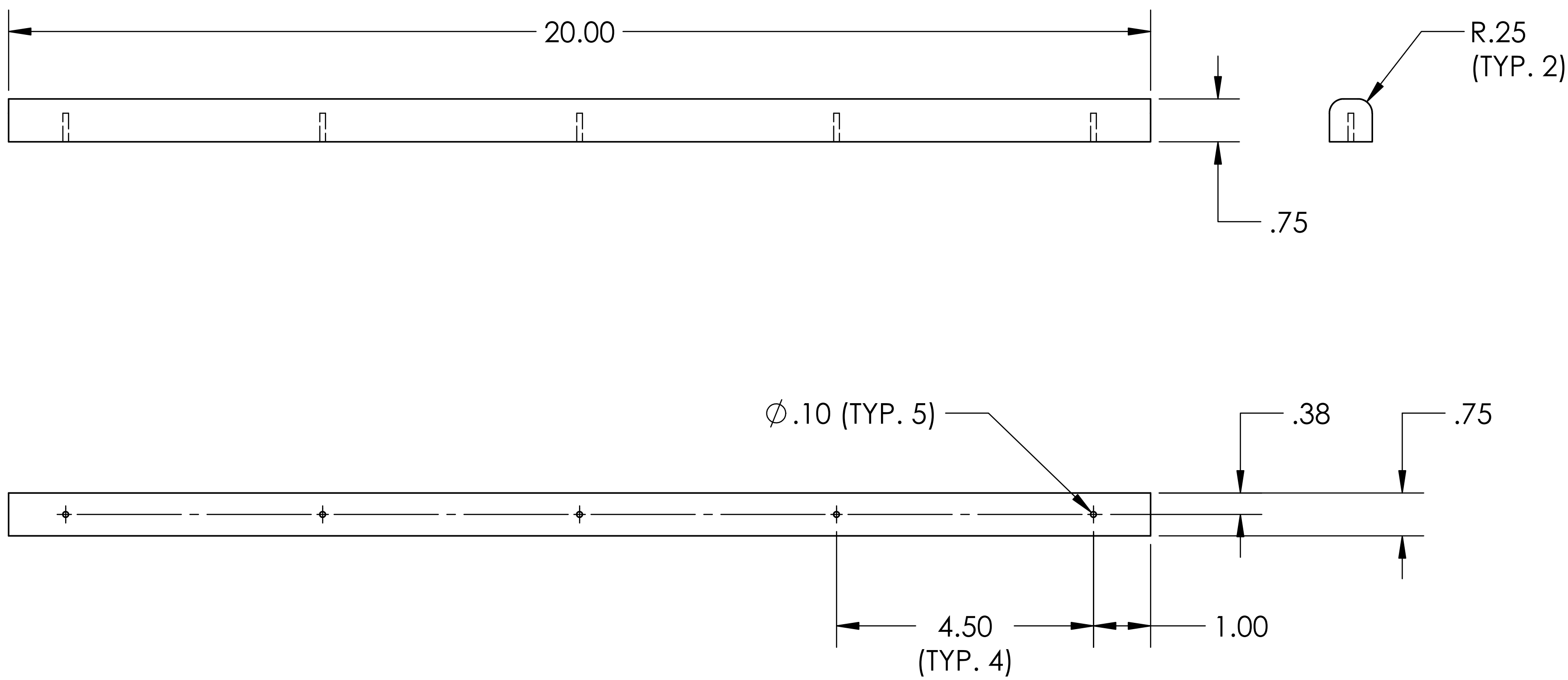
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

WORKSURFACE

SIZE	DWG. NO.	REV
B	6.5.1	-

SCALE: 1:5 | UNITS: INCHES | SHEET 1 OF 1



FOR REFERENCE ONLY

NOTES:
1. ALL ∅.10 HOLES REPRESENT PILOT HOLES FOR LOCATING HARDWARE. REFER TO 6.0.0 FOR ADDITIONAL FASTENING DETAILS.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

WORKSURFACE STOP

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: MAHOGANY

FINISH: UNFINISHED

DO NOT SCALE DRAWING

SIZE: A
DWG. NO.: 6.5.2
REV: -

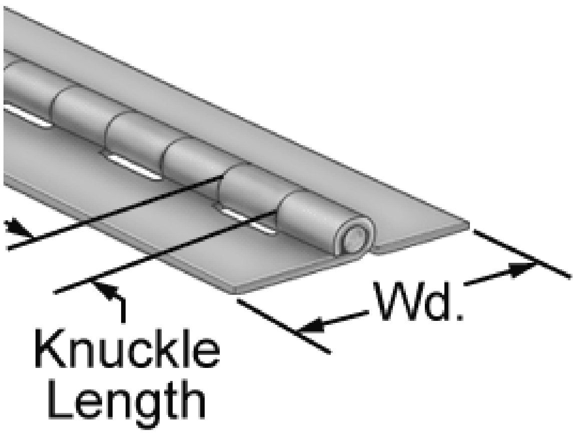
SCALE: 1:3
UNITS: INCHES
SHEET 1 OF 1

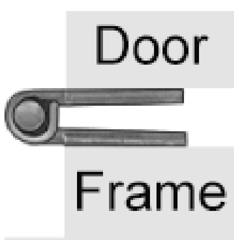
(562) 692-5911
(562) 695-2323 (fax)
la.sales@mcmaster.com
Text 75930

Type 304 Stainless Steel Piano Hinge without Holes

1582A245

.050" Thick, 2" Wide, 1/8" Pin Diameter





Width	2"
Pin Diameter	1/8"
Knuckle Length	1/2"
Length	1 ft., 2 ft., 3 ft., 4 ft., 5 ft., 6 ft., 7 ft., 8 ft.
Additional Specifications	0.050" Thick Leaf
RoHS	Compliant

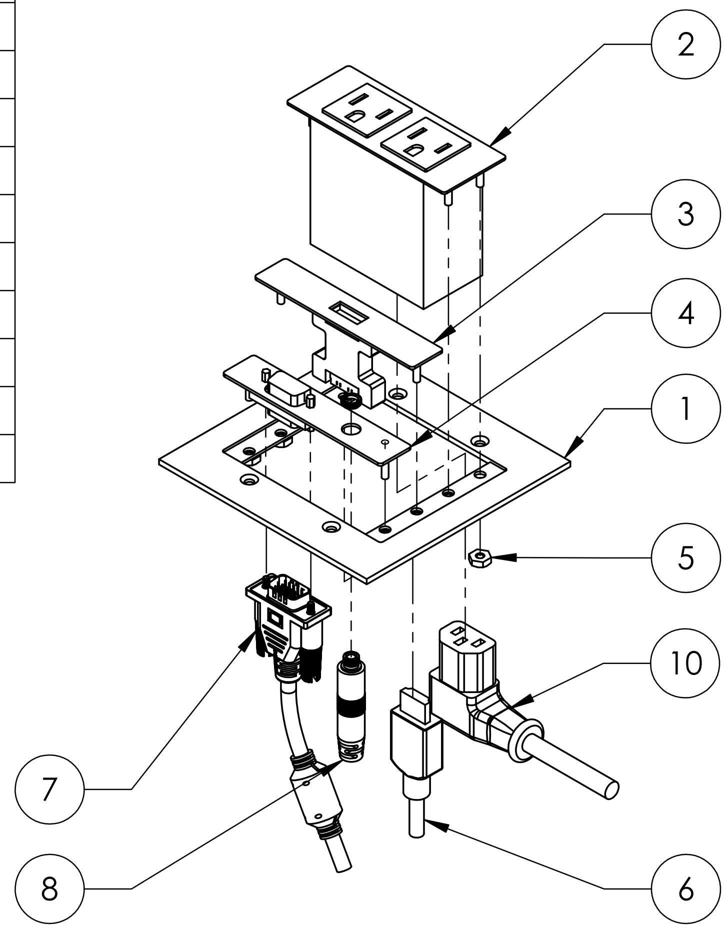
Choose Type 304 stainless steel hinges for greater corrosion resistance than steel. The full range of motion is 270°. All are surface mount. Note: Prices are 15% to 20% lower when you buy 10 or more hinges of the same size.

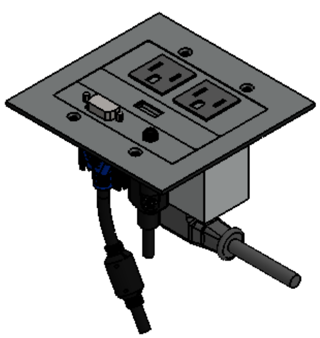
6.5.3 - PIANO HINGE

2 1

ITEM NO.	PART NUMBER	QTY.
1	6.6.1 - AV Mounting Frame	1
2	6.6.2 - US Outlet Plate	1
3	6.6.3 - HDMI Plate	1
4	6.6.4 - VGA_Stereo Plate	1
5	#6-32 Hex Jam Nut	8
6	0.1.1 - HDMI Cable End	1
7	0.1.2 - VGA Cable	1
8	0.1.3 - Audio Panel Mount Cable	1
9	0.1.3A - Audio Panel Mount Cable Nut	1
10	0.6.1C - AC Power Cable - IES90	1

B B





FOR REFERENCE ONLY

A A

NOTES:
1.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

AV PANEL - WORKSURFACE

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL N/A

FINISH N/A

DO NOT SCALE DRAWING

SIZE A | DWG. NO. 6.6.0 | REV -

SCALE: 1:3 | UNITS: INCHES | SHEET 1 OF 1

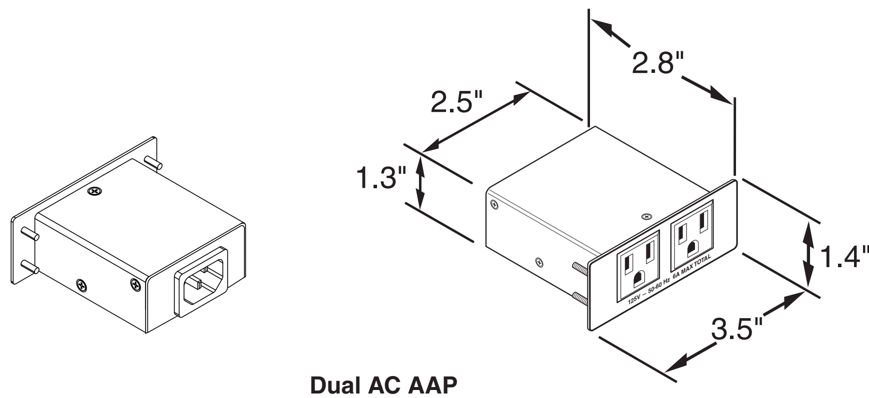
2 1

Specifications

Dual AC AAP

General

Power	125 VAC, 50-60 Hz, 6 A max. total
Temperature/humidity	Storage: -40 to +158 °F (-40 to +70 °C) / 10% to 90%, noncondensing Operating: +32 to +122 °F (0 to +50 °C) / 10% to 90%, noncondensing
Mounting options	Rack or furniture mountable with optional AAP mounting frames
Panel type	Cold-rolled steel
Enclosure dimensions	
Faceplate	1.4" H x 3.5" W x 0.1" D (3.5 cm H x 8.9 cm W x 0.3 cm D) (double space AAP plate)
Isolation enclosure	1.3" H x 2.5" W x 2.8" D (3.3 cm H x 6.3 cm W x 7.1 cm D) With AC power cord attached, allow at least 4.5" (10.4 cm) depth in the wall or furniture.



Dual AC AAP
USA Model

Product weight	0.3 lbs (0.1 kg)
Shipping weight	1 lbs (1 kg)
Vibration	ISTA 1A in carton (International Safe Transit Association)
Regulatory compliance	
Safety	c-UL, UL
Environmental	Complies with the appropriate requirements of RoHS and WEEE.
Warranty	3 years parts and labor

NOTE: All nominal levels are at ±10%.

NOTE: Specifications are subject to change without notice.

8.1-090915-D4

6.6.1 - AC OUTLET PLATE

Professional *Microphone Accessories*

AT8416
MICROPHONE SHOCK MOUNT

Description

The Audio-Technica AT8416 shock mount effectively isolates mounted microphones from impact vibration and shock handling noise. It is intended for use with microphones mounted on lecterns, pulpits, conference tables and similar surfaces. Designed especially for UniPoint® gooseneck microphones, it may be used with other lightweight microphones as well.

The use of a shock mount is particularly important in any application where wide-range sound equipment is used, and where high-level low-frequency sounds can be expected.

The AT8416 shock mount system utilizes two oversize chloroprene rings, similar to rubber bands. The rings are mounted transversely. An aluminum mounting stud with 5/8"-27 threads is held in the central cavity formed by the opposing bands, thereby "floating" the shock mount assembly, and isolating it from mechanical coupling to the resonating surface. A slot is provided in the mounting flange to allow a small-diameter cable to pass down the mounting hole. A cable channel secures the cable in the flush mount assembly and helps to further deaden the transmission of vibration.

When properly installed, the AT8416 isolates the microphone from contact with the mounting surface, and eliminates pickup of low-frequency resonances caused by mechanical coupling. This generally allows higher sound reinforcement levels and higher gain-before-feedback.

Installation

5/8"-27 Mount: Drill a 1 3/8" hole at the desired point in the mounting surface. Screw the base of the microphone onto the threads of the mounting stud. Drop the microphone cable down through the hole in the mounting surface, making certain the cable is captured by the slot in the mounting flange and is in place in the cable channel along the side of the shock mount (Fig. 1). *Leave some slack in the cable between the mic and the mounting flange;* pulling the cable snug will "bypass" the suspension. Set the shock mount in place, with the cable slot away from the "front," and secure with the three screws provided (Fig 2).

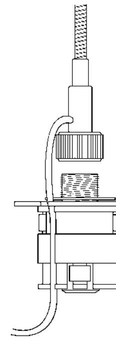
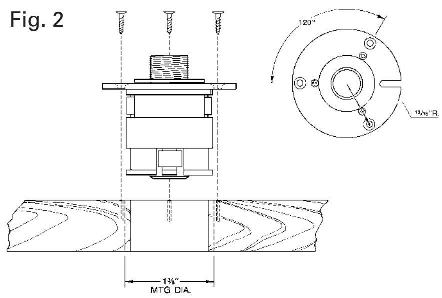


Fig. 1

Fig. 2



Plug-in Mount: Drill a 1 3/8" hole at the desired point in the mounting surface. Run the XLRF connector of the microphone cable up through the hole. Remove the mounting stud from the AT8416 and insert the XLRF connector up through the chloroprene rings (Fig. 3). Secure the shock mount with the three screws provided (as in Fig. 2). Attach the XLRF connector to the microphone and work the connector body back down into the shock mount (Fig. 4).

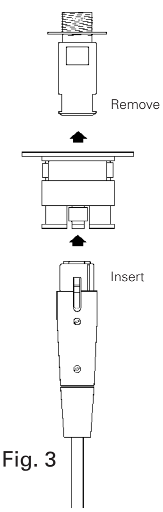


Fig. 3

Since the design of the shock mount "floats" the microphone, with no rigid, fixed position, take care to center the mounting stud (or connector) in the shock mount cavity. This will ensure that the microphone stands upright. If the microphone still leans to one side after installation, the mounting stud or connector can be repositioned without damage.

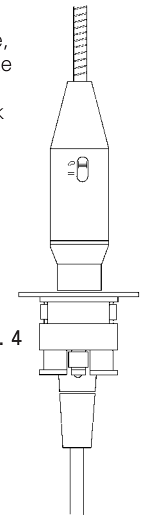


Fig. 4

AT8416 SPECIFICATIONS

DEPTH	
MOUNTING FLANGE	0.08" (2 mm)
BODY	1.26" (32 mm)
DIAMETER	
MOUNTING FLANGE	2.01" (51 mm)
BODY	1.34" (34 mm)
MOUNTING STUD	0.71" (18 mm)
WEIGHT	2.5 oz (71 grams)
SUSPENSION SYSTEM	2 chloroprene rings

One-Year Limited Warranty

Audio-Technica microphones and accessories purchased in the U.S.A. are warranted for one year from date of purchase by Audio-Technica U.S., Inc. (A.T.U.S.) to be free of defects in materials and workmanship. In event of such defect, product will be repaired promptly without charge or, at our option, replaced with a new product of equal or superior value if delivered to A.T.U.S. or an Authorized Service Center, prepaid, together with the sales slip or other proof of purchase date. ***Prior approval from A.T.U.S. is required for return.*** This warranty excludes defects due to normal wear, abuse, shipping damage, or failure to use product in accordance with instructions. This warranty is void in the event of unauthorized repair or modification.

For return approval and shipping information, contact the Service Department, Audio-Technica U.S., Inc., 1221 Commerce Drive, Stow, Ohio 44224.

Except to the extent precluded by applicable state law, ***A.T.U.S. will have no liability for any consequential, incidental, or special damages; any warranty of merchantability or fitness for particular purpose expires when this warranty expires.***

This warranty gives you specific legal rights, and you may have other rights which vary from state to state.

audio-technica®

Audio-Technica U.S., Inc., 1221 Commerce Drive, Stow, Ohio 44224
Audio-Technica Limited, Old Lane, Leeds LS11 8AG England
Form No. 0315-0705-02-B/W

XLR Series General Performance Characteristics

ITT's broad range of XLR connectors are extensively used in a wide variety of audio OEM applications.

The XLR Series features a quick disconnect latch lock along with a rugged design to withstand extended field use. Available in configurations of 2 and 7 positions, our plugs and receptacles offer precision, machined contacts, shock-absorbing rubber insulators, and lightweight aluminum shells. All XLR connectors are RoHS Compliant.

RoHS COMPLIANT PART NUMBERS

First introduced in 1958, these connectors have been so instrumental in the advancement of audio technology that our XL series was inducted into the TECnology Hall of Fame in 2007. Today our connectors continue to lead the way into the digital revolution.

Applications

- **Amplifiers**
- **Equalizers**
- **Mixers**
- **Medical Electronics**
- **Recording Equipment**
- **Test Instruments**
- **Industrial Control Devices**
- **Microphones**
- **TV Cameras**

Product Features and Benefits

- Rugged design to withstand extreme field use
- Resilient socket insulator which minimizes vibration and electrical noise
- Quick disconnect latch lock
- Low reflectivity satin finish
- Interchangeable and intermateable with XLB-PCB and XLM-PCB

Performance Specifications

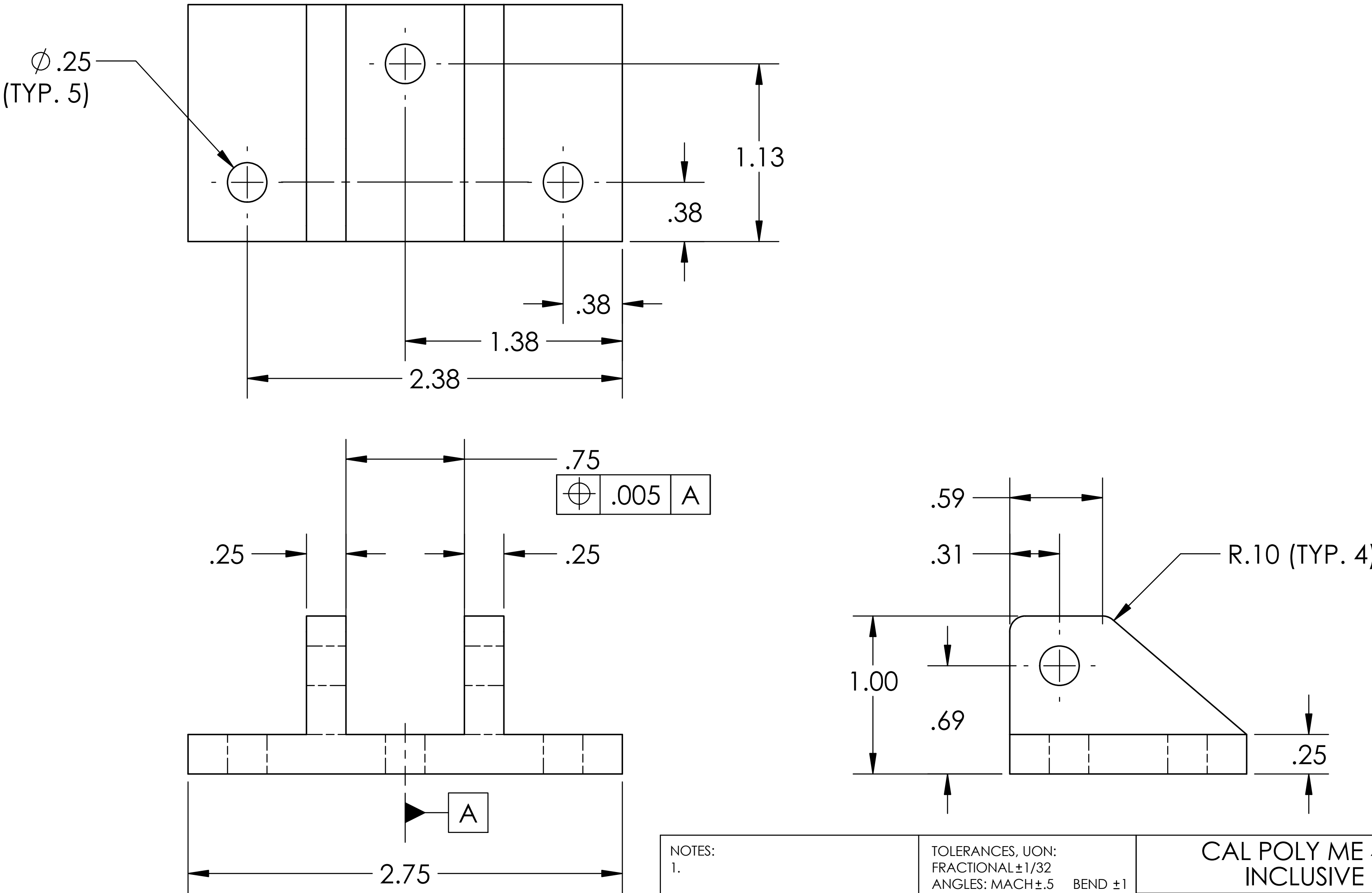
Temperature Rating	–35°C to +125°C	Insulation Resistance	5,000MΩ min at 500 VDC
Number of Contacts	2 to 7	Contact Resistance	5m Ω Max to 10m Ω Max
Rated Current	5A to 15A	Durability Cycles	500 Mating Cycles
Rated Voltage(AC)	133V to 200V	Wire Accommodation Reference AWG (Max)	#14 to #20
Dielectric Withstanding Voltage (AC)	1,400V to 1,600 V	Wire Cross Selection (Max)	0.5mm to 2.1mm

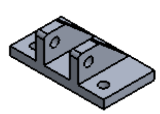
Materials and Finishes

Description	Material	Finish/Treatment
Contacts	Copper Alloy	Silver or Gold
Insulator	Socket- Chloroprene Pin- Nylon	-
Shell	Aluminum Alloy*	Satin Nickel
Barrel	Steel	Nickel
Bushing	Chloroprene	-
Latch Lever	Steel	Nickel

* For adapters XLR-3-11-11-F/XLR-3-12-12-F the material is brass

6.6.6 - FEMALE XLR ADAPTER





FOR REFERENCE ONLY

NOTES:
1.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: 6061

FINISH: UNFINISHED

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:

CLEVIS

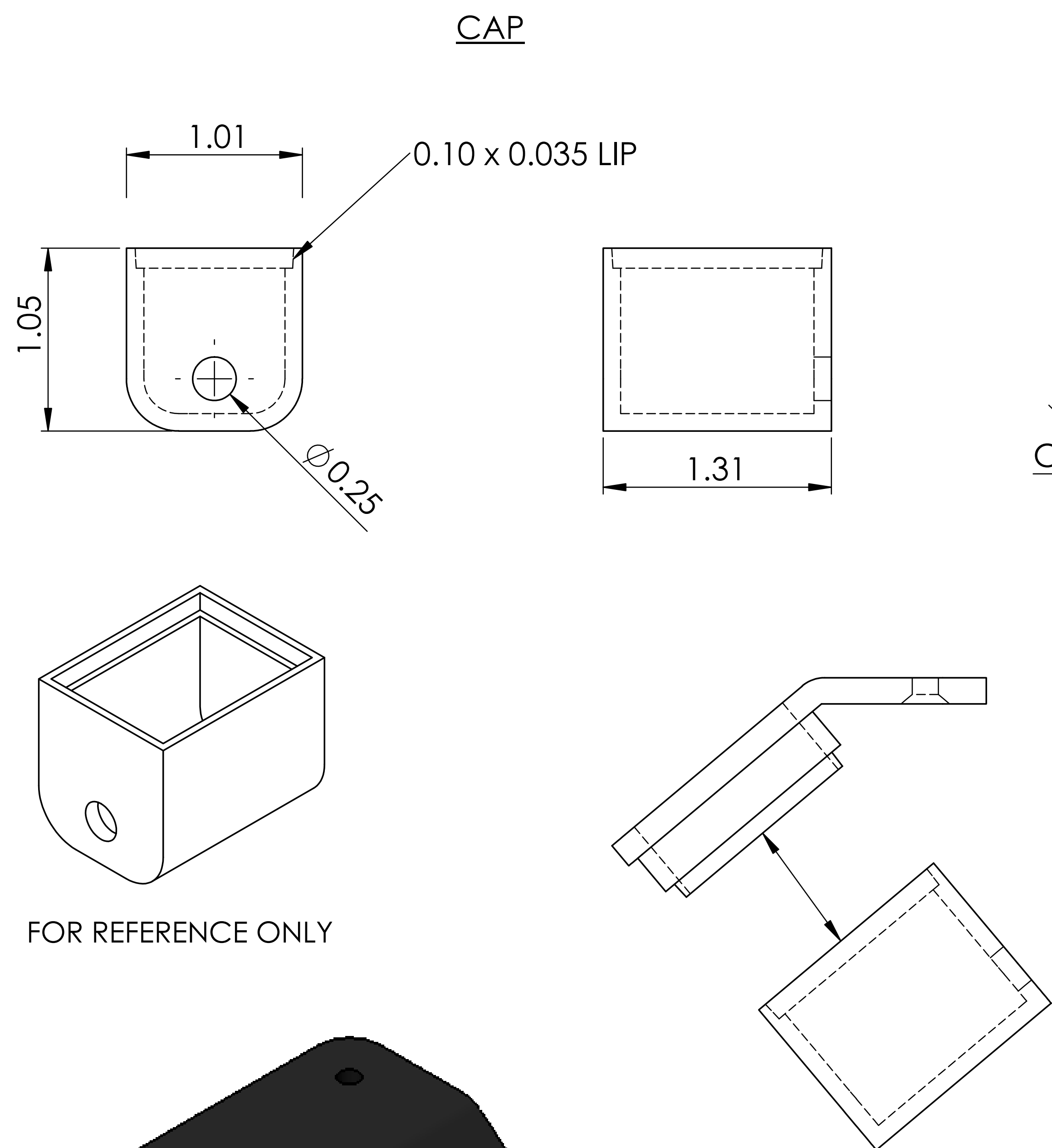
SIZE	DWG. NO.	REV
A	6.7.1	-
SCALE: 1:1	UNITS: INCHES	SHEET 1 OF 1

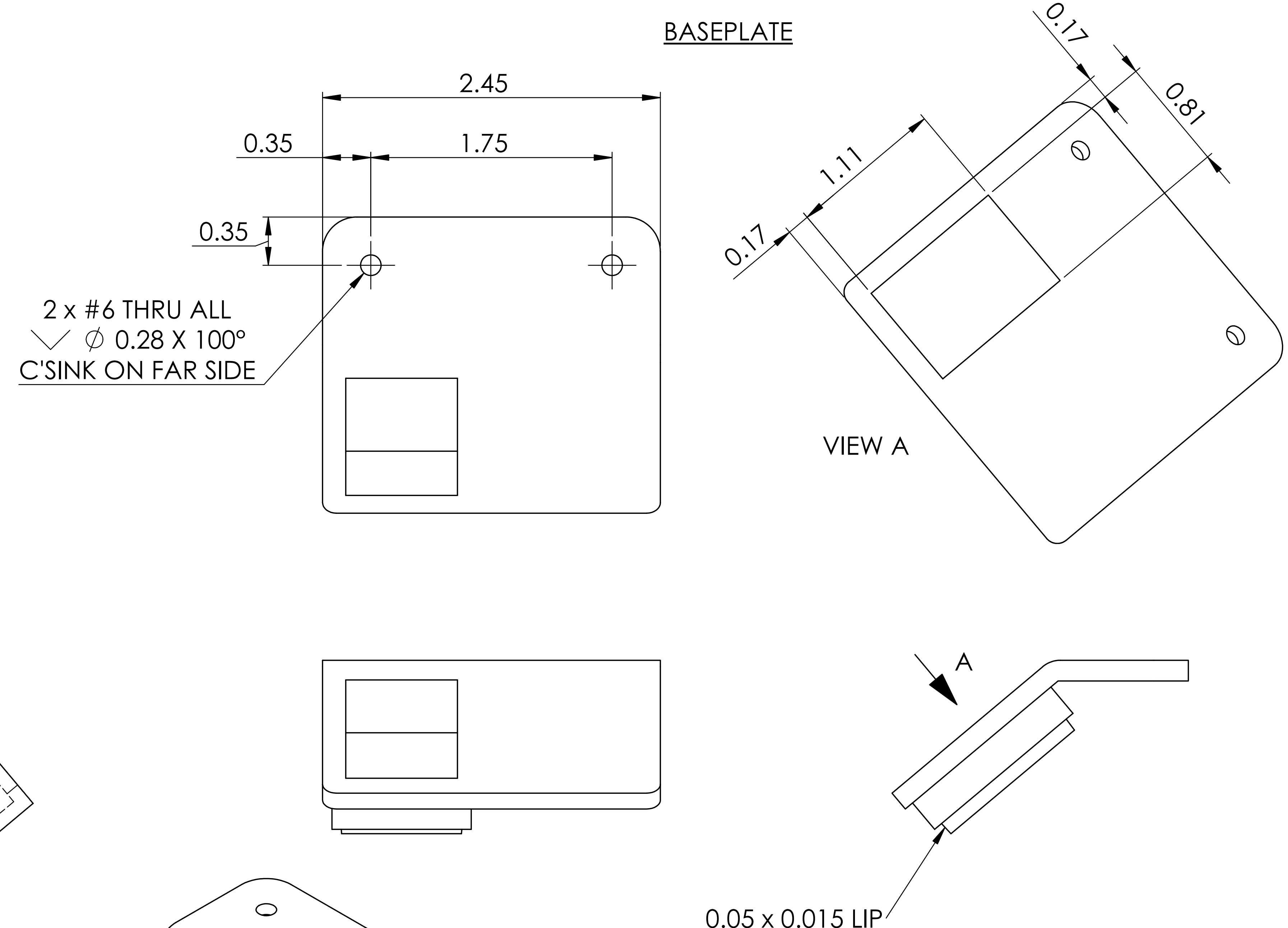
Product Data Sheet

ACTUATOR LD3/LD3Q

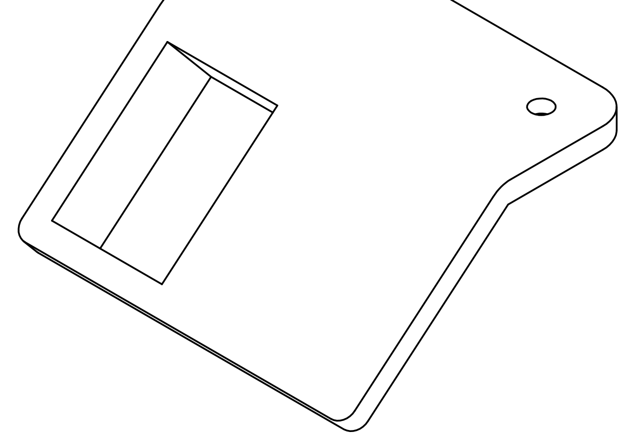
Features

- LD3 features its compact design, which is suitable for various applications that require limited installation space, such as window opener and adjustable car driver seat. Quiet version, LD3Q, is available for applications that require compact size and quiet operation.
- Main applications：Industrial, homecare, furniture
- Input voltage：24V DC / 12V DC
- Max. load：1200N (push/pull)
- Max. current：3.5 A @ 12V DC
- Max. speed：44 mm/sec @ no load
- Stroke：50~300 mm (other strokes are available)
- Duty cycle：25% or 1 min continuous operation in 4 min.
- IP protection level：IP54
- Color：Aluminum grey
- Certified：EN 55014-1
  EN55014-2
- Noise level：≦70dB (Normal version) / ≦55dB (Quiet version)
- Preset limit switches





FOR REFERENCE ONLY



FOR REFERENCE ONLY

NOTES:
1. 3-D PRINTED PARTS.
2. SNAP FIT ASSEMBLY.
3. DIMENSIONS PROVIDED ARE FOR VERIFYING SCALE AND HOLE ALIGNMENT ONLY.

TOLERANCES:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: PLA

FINISH: UNFINISHED

DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:
LINEAR ACTUATOR SWITCH HOUSING

SIZE **B** | DWG. NO. 6.7.3 | REV -

SCALE: 1:1 | UNITS: INCHES | SHEET 1 OF 1

Momentary 6 Pin DPDT Black Button On/Off/On Rocker Switch AC 250V/10A 125V/15A

Market Price: $11.89
Model Number : a13011000ux0120

Features: double pole double throw(DPDT) contact type, 6pin terminals, black button, on off on snap in rocker switch.

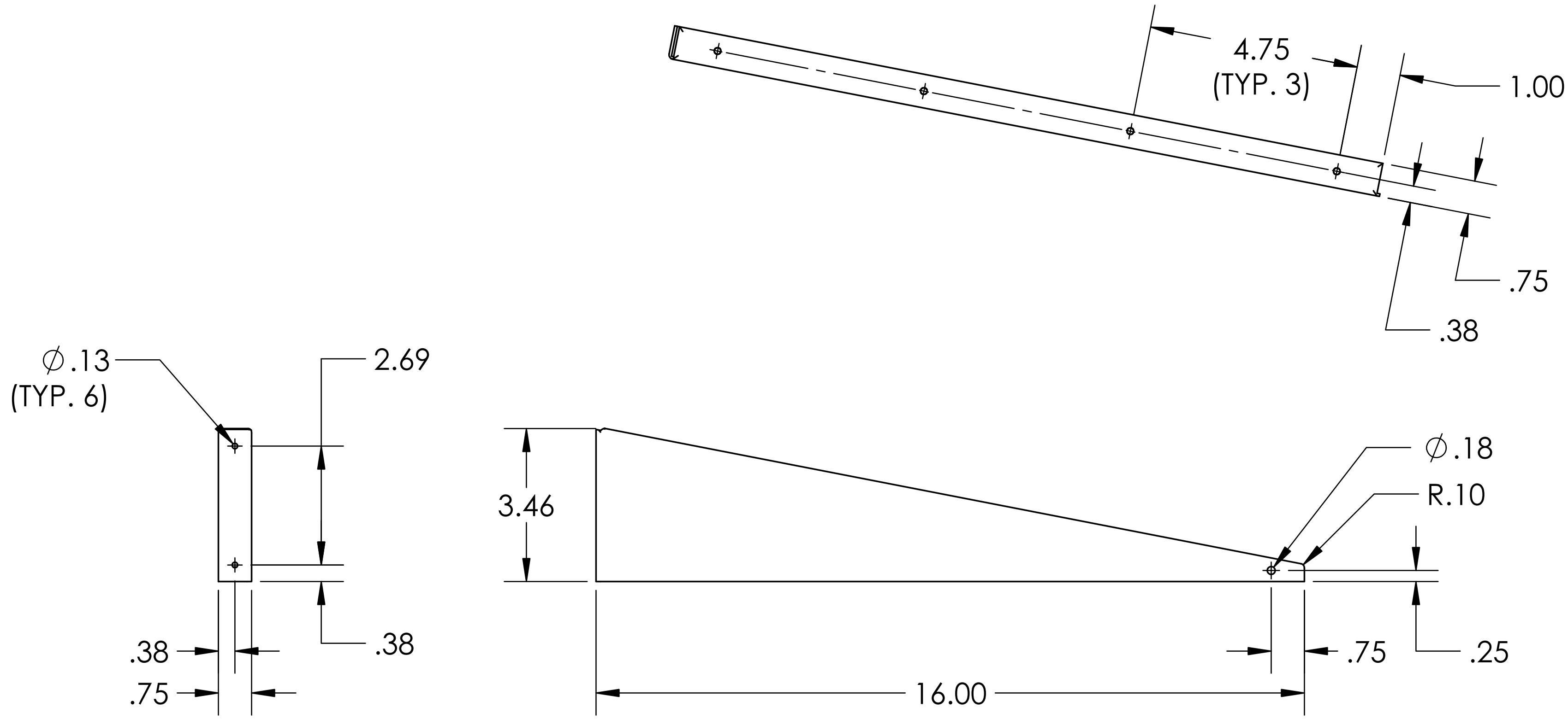
Descriptions:

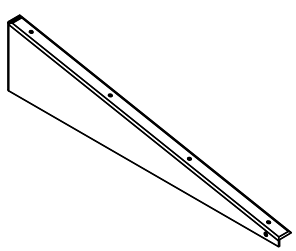
- Features: double pole double throw(DPDT) contact type, 6pin terminals, black button, on off on snap in rocker switch.
- Widely applied to controlling all kinds of household appliances such as water dispenser, treadmill, coffee pot and so on.
- Marked on the rocker: I/O/I(on off on) for precise indications.

Specification:

Item Name	Rocker Switch
Type	On/Off/On (DPDT),Momentary
Terminals	6 Pin
Voltage & Current	AC 10A/250V, AC 15A/125V
Overall Size	~31 x 24 x 30mm / 1.2" x 0.94" x 1.1"(L*W*T)
Mounting Hole Size	30 x 21.4mm / 1.1" x 0.8"(L*W)
Color	Black
Material	Plastic, Metal
Total Net Weight	14g
Package Content	1 x Rocker Switch

6.7.4 - LINEAR ACTUATOR SWITCH





FOR REFERENCE ONLY

NOTES:
1. CONSTRUCT PART FROM PERFORATED SHEET METAL, .1875 DIA HOLES AT .25 SPACING OC. PERFORATION NOT SHOWN FOR DRAWING CLARITY.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL 6061

FINISH BLACK POWDERCOAT

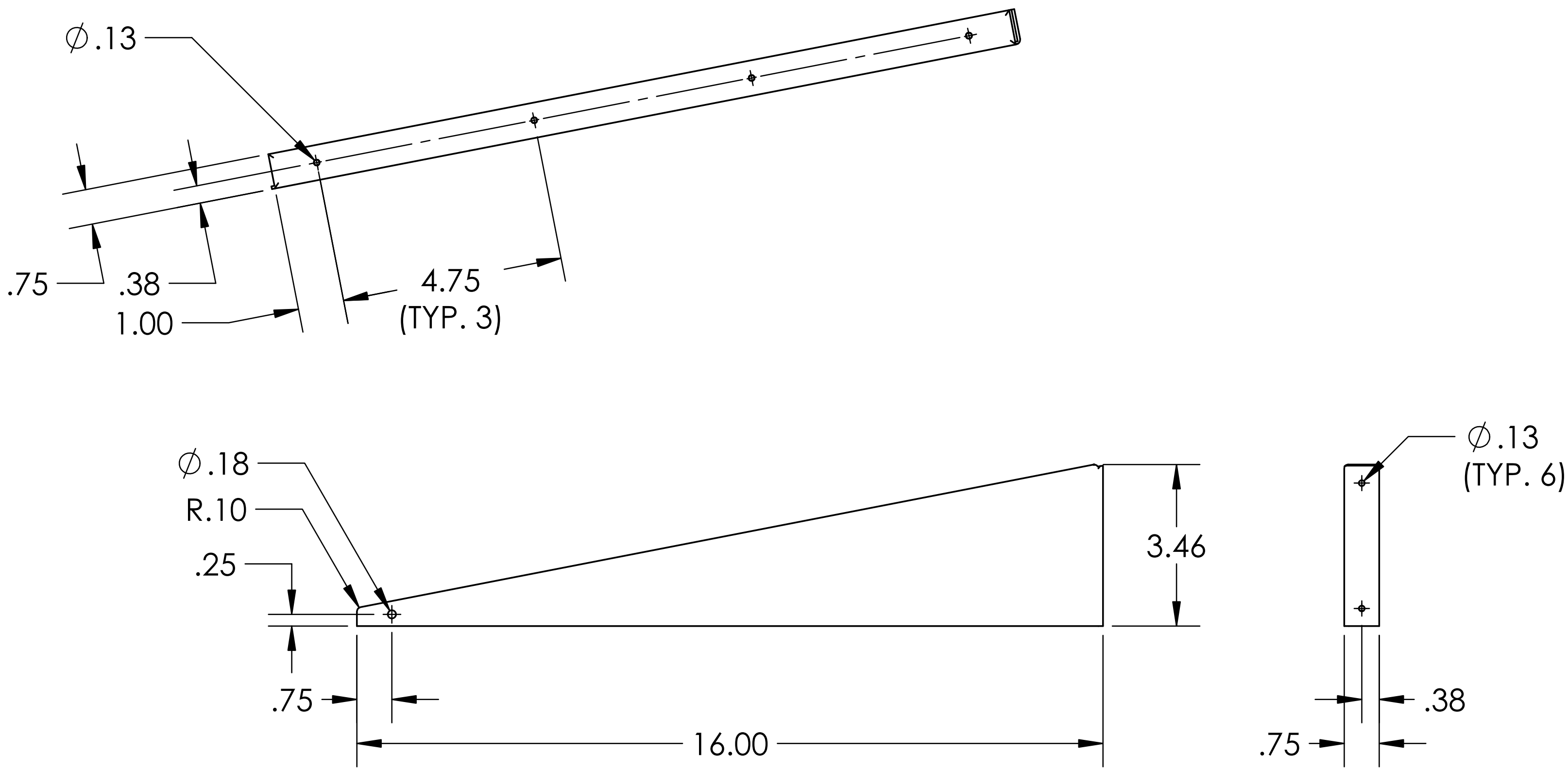
DO NOT SCALE DRAWING

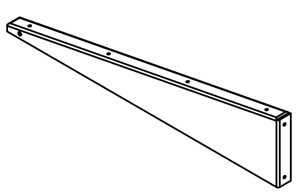
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE: UPPER WORKSURFACE PANEL - LEFT

SIZE A | DWG. NO. 6.8.1L | REV -

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. CONSTRUCT PART FROM PERFORATED SHEET METAL, .1875 DIA AND .25 SPACING OC. PERFORATION NOT SHOWN FOR DRAWING CLARITY.

TOLERANCES, UON:
FRACTIONAL ± 1/32
ANGLES: MACH ± .5 BEND ± 1
X ± .5
.X ± .1
.XX ± .01
.XXX ± .005

PROPRIETARY AND CONFIDENTIAL

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: 6061

FINISH: BLACK POWDERCOAT

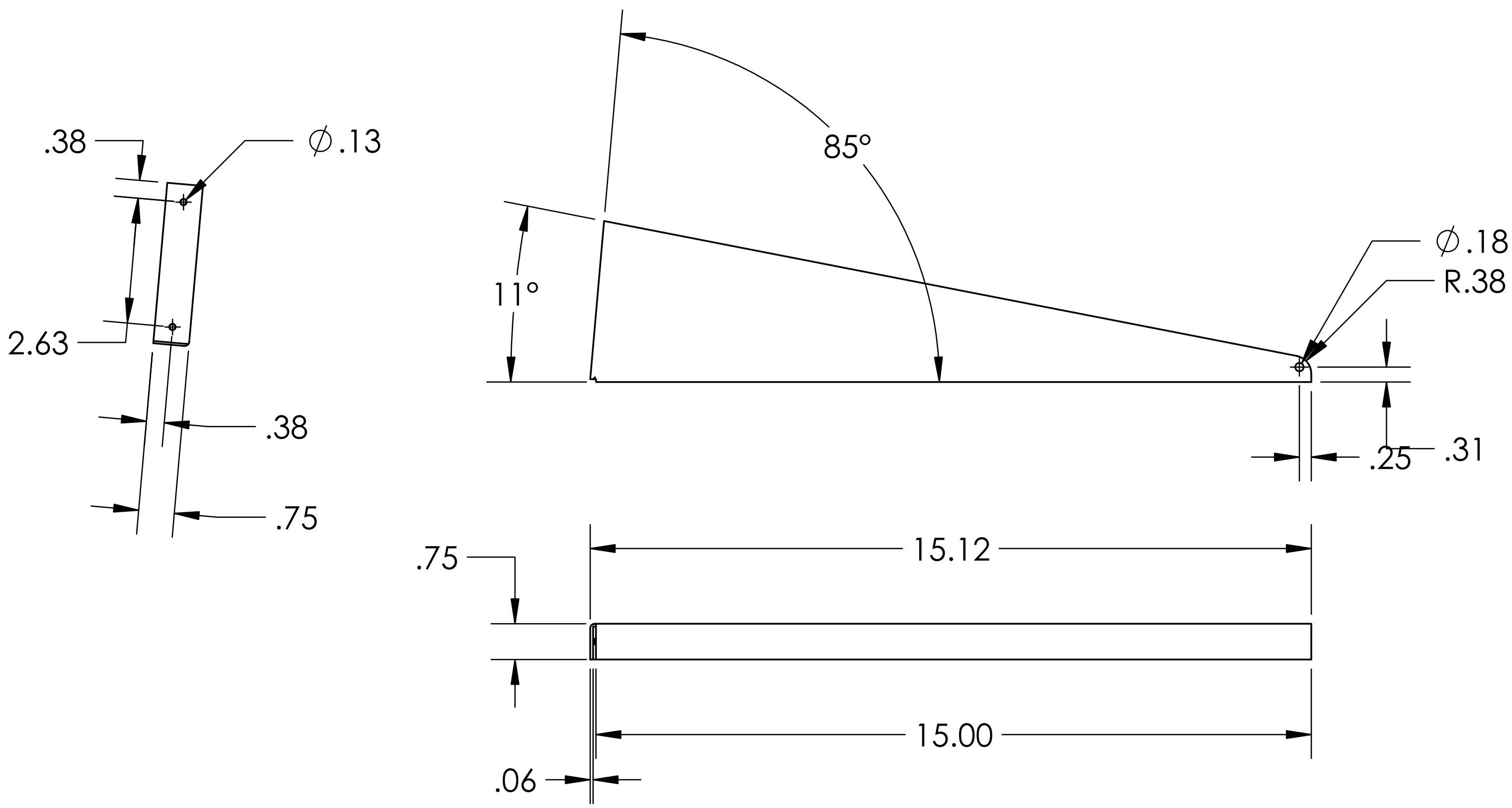
DO NOT SCALE DRAWING

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:
UPPER WORKSURFACE PANEL - RIGHT

SIZE: A
DWG. NO.: 6.8.1R
REV: -

SCALE: 1:4 | UNITS: INCHES | SHEET 1 OF 1



NOTES:
1. CONSTRUCT PART WITH PERFORATED SHEET METAL, .1875 DIA AND .25 SPACING OC. PERFORATION NOT SHOWN FOR DRAWING CLARITY.

TOLERANCES, UON:
FRACTIONAL ± 1/32
ANGLES: MACH ± .5 BEND ± 1
X ± .5
.X ± .1
.XX ± .01
.XXX ± .005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:
LOWER WORKSURFACE PANEL - LEFT

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

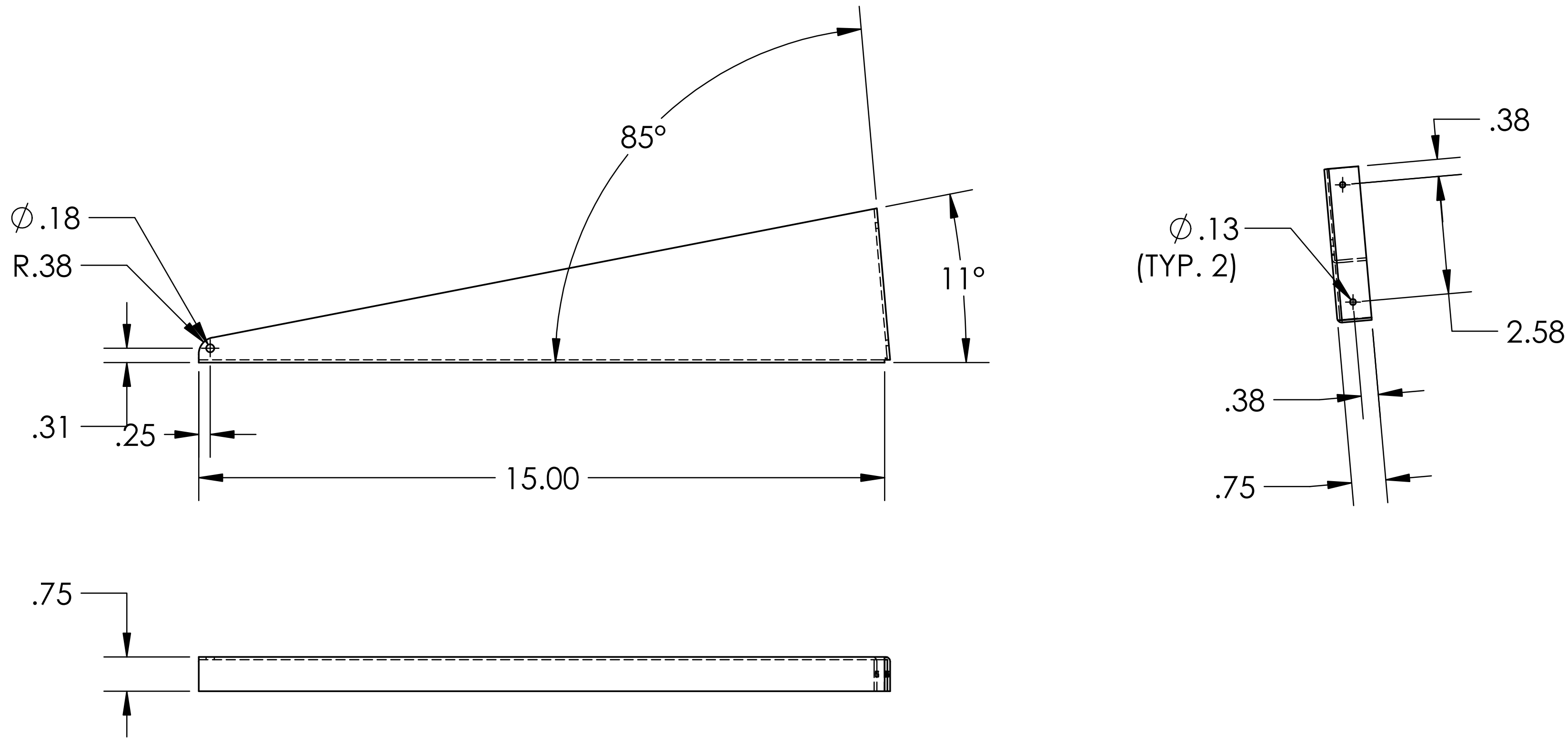
MATERIAL: 6061

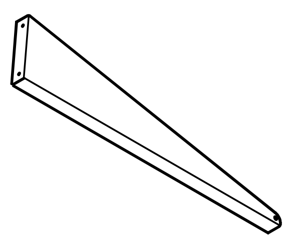
FINISH: BLACK POWDERCOAT

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
A	6.8.2L	-

SCALE: 1:4	UNITS: INCHES	SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. CONSTRUCT PART FROM PERFORATED SHEET METAL, .1875 DIA AND .25 SPACING OC. PERFORATION NOT SHOWN FOR DRAWING CLARITY.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL: 6061

FINISH: BLACK POWDERCOAT

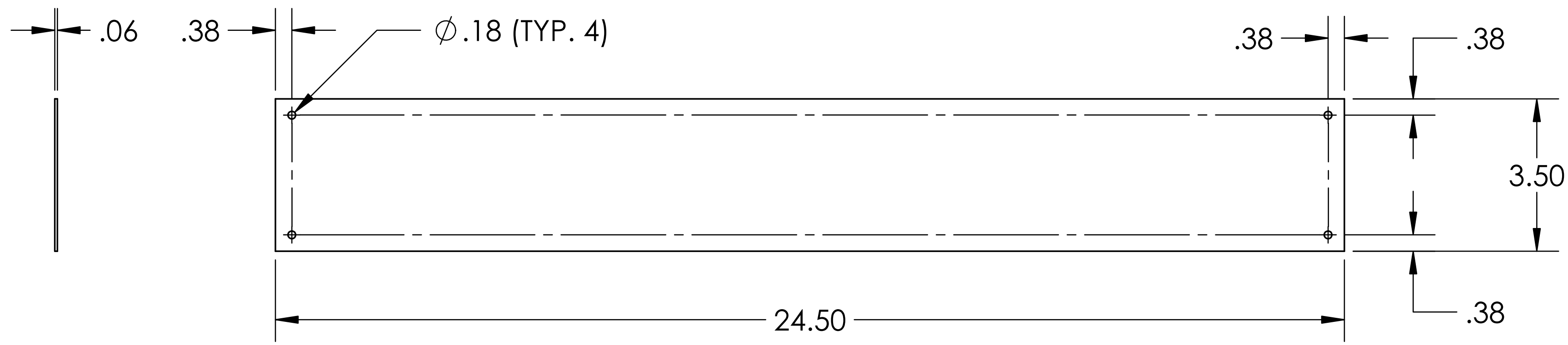
DO NOT SCALE DRAWING

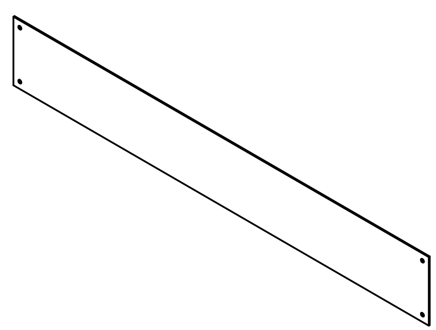
CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE: LOWER WORKSURFACE PANEL - RIGHT

SIZE	DWG. NO.	REV
A	6.8.2R	-

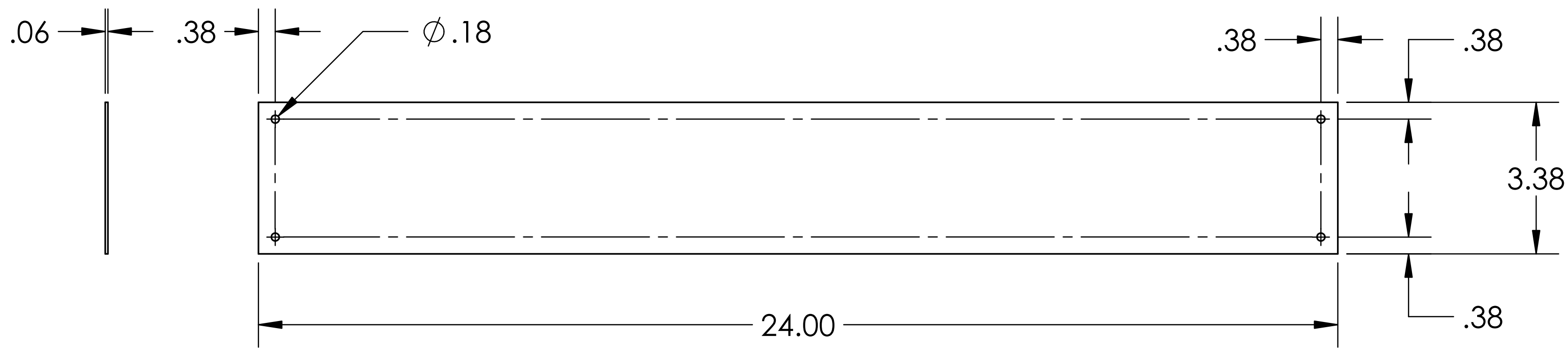
SCALE: 1:4	UNITS: INCHES	SHEET 1 OF 1

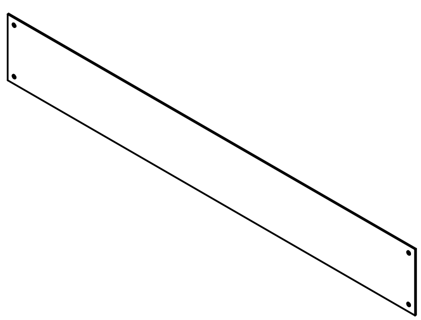




FOR REFERENCE ONLY

NOTES: 1. CONSTRUCT PART FROM PERFORATED SHEET METAL, .1875 DIA AND .25 SPACING OC. PERFORATION NOT SHOWN FOR DRAWING CLARITY.	TOLERANCES, UON: FRACTIONAL ±1/32 ANGLES: MACH ±.5 BEND ±1 X ±.5 .X ±.1 .XX ±.01 .XXX ±.005	CAL POLY ME 428/429/430 INCLUSIVE LECTERN TITLE: UPPER WORKSURFACE PANEL - FRONT
PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CAL POLY, SLO. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CAL POLY, SLO IS PROHIBITED.	INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B MATERIAL 6061 FINISH BLACK POWDERCOAT DO NOT SCALE DRAWING	SIZE A · DWG. NO. 6.8.3 · REV - SCALE: 1:4 · UNITS: INCHES · SHEET 1 OF 1





FOR REFERENCE ONLY

NOTES:
1. CONSTRUCT PART FORM PERFORATED SHEET METAL, .1875 DIA AND .25 SPACING OC. PERFORATION NOT SHOWN FOR DRAWING CLARITY.

TOLERANCES, UON:
FRACTIONAL ±1/32
ANGLES: MACH ±.5 BEND ±1
X ±.5
.X ±.1
.XX ±.01
.XXX ±.005

CAL POLY ME 428/429/430
INCLUSIVE LECTERN

TITLE:
LOWER WORKSURFACE PANEL - FRONT

INTERPRET GEOMETRIC TOLERANCING PER: Y14.5B

MATERIAL
6061

FINISH
BLACK POWDERCOAT

DO NOT SCALE DRAWING

SIZE	DWG. NO.	REV
A	6.8.4	-

SCALE: 1:4	UNITS: INCHES	SHEET 1 OF 1

Appendix C: Bill of Materials

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See attached (3) sheets for Bill of Materials

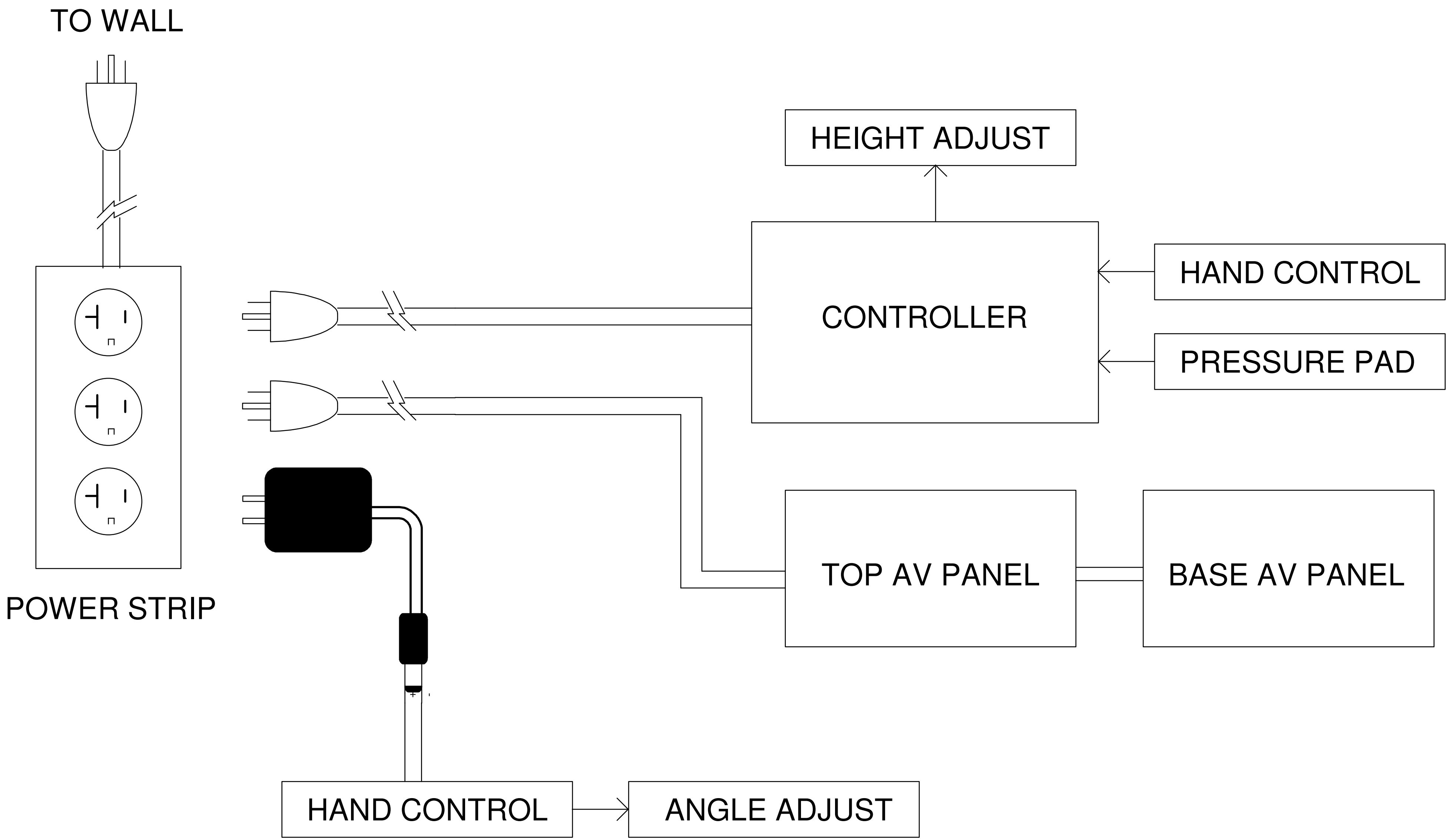
Inclusive Lectern Parts List			Bill Of Materials					
Subsystem	Component	IL P/N	Description	Supplier	Supp P/N	Price	Qty	Subtotal
Lectern	Lectern	0.0.0	n/a					
	HDMI Cable	0.1.1	GE 6' HDMI Cable	Target	11247012	$ 17.49	1	$ 17.49
	VGA Panel Cable	0.1.2	v7 6' VGA Male to Male	Walmart	1156-06C	$ 5.97	1	$ 5.97
	Audio Panel Mount Cable	0.1.3	Stereo Dual Panel Mount F/F Cable, 6'	DataPro	1223-06C	$ 15.94	1	$ 15.94
	XLR Panel Cable	0.1.4	XLR Panel Mount Female Ext.	DataPro	1232-06C	$ 35.00	1	$ 35.00
	Foot Control Wire	0.1.5	18 Gauge, 3 Conductor, 20 foot	Amazon	-	$ 13.15	1	$ 13.15
	Shrink Wrap	0.1.6	uxcell Black 1.5mm Dia. Heat Shrink Tubing	Amazon	-	$ 5.11	2	$ 10.22
	Hardware: Bottom Act Leg	0.2.1	Workrite Sierra HXL, 6mm x 13 Bolt	Workrite	-	$ -	4	$ -
	Hardware: Bottom Cover	0.3.1	M6-1.0 x 25 CSK Bolt	Ace Hardware	-	$ 0.30	2	$ 0.60
	Hardware: Middle Cover	0.4.1	1/4-20 x 1-7/8" CSK Bolt	Ace Hardware	-	$ 0.25	4	$ 1.00
	Hardware: Top Cover	0.5.1	#10 x 5/8 Screw	Ace Hardware	-	$ 0.20	11	$ 2.20
	Hardware: Desk	0.6.1	#10 x 5/8 Screw	Ace Hardware	-	$ 0.20	11	$ 2.20
	Hardware: Desk	0.6.2	#10 x 5/8 Screw	Ace Hardware	-	$ 0.20	11	$ 2.20
	Hardware: Desk	0.6.3	#10 x 5/8 Screw	Ace Hardware	-	$ 0.20	11	$ 2.20
Base	Base Assembly	1.0.0	n/a					
	Hardware: AV Panel Screw	1.0.0A	#6 x 5/8" Screw (12pk)	Home Depot	282265	$ 1.18	4	$ 4.72
	Hardware: Foot Pedal Wire	1.0.0B	3 Wire 2-10ft Retracting Cable	McMaster-Carr	7088K212	$ 53.67	1	$ 53.67
	Hardware: Power Strip	1.0.0C	#6 x 5/8" Screw	Material from 1.0.0A		$ -	4	$ -
	Aluminum Subframe	1.1.0	n/a					
	Hardware: Foot Washer	1.1.0A	1/4" Washer	Home Depot	655554	$ 0.11	4	$ 0.44
	Hardware: Foot Nut	1.1.0B	1/4"-20 Nut	Home Depot	655414	$ 0.06	4	$ 0.24
	Cross Member	1.1.1	3"x4"x0.125" 3' Aluminum Square Tube	McMaster-Carr	6546K66	$ 56.64	1	$ 56.64
	Leg Mount Support	1.1.2	Same as 6.3.2	Material from 6.3.2				
	U-Channel	1.1.3	3"x1.5"x0.125" 3' Aluminum U-Channel	Online Metals	-	$ 13.19	1	$ 13.19
	Leg - Left	1.1.4L	1.5"x3"x0.125" 6' Aluminum Square Tube	Online Metals	-	$ 38.17	1	$ 38.17
	Leg - Right	1.1.4R	Same as 1.1.4L, but mirrored	Material from 1.1.4L		$ -	1	$ -
	Leveling Mount	1.1.5	High Capacity Leveling Mount	McMaster-Carr	62805K32	$ 2.05	4	$ 8.20
	Angle Bracket	1.1.6	(5/8" x 1", .5"W x .12"t) 3/4" x 48" x 1/8" Al Ang	Home Depot	204273996	$ 9.27	1	$ 9.27
	Cross Member Inside Panel	1.2.1	8' Cherry Lumber 1"x8"	Aura	-	$ 37.50	1	$ 37.50
	Cross Member Outside Pnl	1.2.2		Material from 1.2.1		$ -	1	$ -
	Leg Inside Side Panel	1.2.3		Material from 1.2.1		$ -	1	$ -
	Leg Outside Side Panel - Left	1.2.4L		Material from 1.2.1		$ -	1	$ -
	Leg Outside Side Panel - Right	1.2.4R		Material from 1.2.1		$ -	1	$ -
	Leg End Cap	1.2.5		Material from 1.2.1		$ -	1	$ -
	Cross Member Top Panel	1.2.6	8' Mahogany Lumber 1"x12"	Aura	-	$ 56.00	1	$ 56.00
	Leg Top Panel	1.2.7		Material from 1.2.1		$ -	1	$ -
	AV Panel - Lower	1.3.0	n/a					
	AV Mounting Frame	1.3.1	AAP 102 - Two-Gang AAP Mounting Frame	Extron Elec.	60-300-02	$ 20.00	2	$ 40.00
	HDMI Plate	1.3.2	HDMI Female - Female Barrel	Extron Elec.	70-616-02	$ 30.00	2	$ 60.00
	VGA_Stereo Plate	1.3.3	9-Pin F/F, One 3.5mm Stereo to Solder	Extron Elec.	70-102-13	$ 22.00	2	$ 44.00
	XLR Plate	1.3.4	XLR 3-pin Male to Solder Cups -Switch	Extron Elec.	70-103-X1	$ 21.00	1	$ 21.00
	AC Outlet Male Port	1.4.1	Male AC, Flush-mount Connector (Leviton 5239)	Amazon	-	$ 11.17	1	$ 11.17
	3 Pin DIN Female Socket	1.4.2	3 Pin DIN Female Socket	Digikey	CP-1230-ND	$ 2.31	1	$ 2.31
	3 Pin DIN Male Angle	1.4.3	3 Pin DIN Male Angle	Digikey	CP-1330-ND	$ 2.84	2	$ 5.68
	Switch Mat	1.4.4	10" x 17" Momentary Switch Mat	McMaster-Carr	7351K61	$ 117.74	2	$ 235.48
	Panel Adhesive	1.5.1	3M Scotch-Weld DP100 Plus	DigiKey	3M155801-ND	$ 22.58	2	$ 45.16
Actuation	Actuation Assembly	2.0.0	n/a					
	Hardware: Mounting Bracket	2.0.0A	M6-1.0 x 65 Hex Bolt	Workrite	-	$ -	8	$ -
	Telescoping Leg	2.1.0	Workrite Sierra HXL - Okin ID21	Workrite	-	$ -	2	$ -
	TL Mounting Tube	2.2.1	2"x3"x0.125" 3' Aluminum Rect Tube	Online Metals	-	$ 23.08	2	$ 46.16
	TL Mounting Bracket - Left	2.2.2L	Workrite Sierra HXL	Workrite	-	$ -	2	$ -
	TL Mounting Bracket - Right	2.2.2R	Workrite Sierra HXL	Workrite	-	$ -	2	$ -
	TL Mounting Spacer	2.2.3	(0.5OD x 1.75L) 1/2" x 2' Aluminum Round Bar	Online Metals	-	$ 8.59	1	$ 8.59
	Weld Nut	2.3.1	1/4-20 Flanged, Captive, Weld Nut (20pk)	McMaster-Carr	90955A112	$ 15.81	1	$ 15.81
	Weld Nut Spacer - Side	2.3.2	(0.5OD x 1.057) 1/2" Aluminum Round Bar	Material from 2.2.3		$ -	2	$ -
	Weld Nut Spacer - Front	2.3.3	(0.5OD x .907) 1/2" Alunimum Round Bar	Material from 2.2.3		$ -	2	$ -
	Angle Bracket	2.3.4	Same as 1.1.6	Material from 1.1.6		$ -	1	$ -
Bottom Cover	Bottom Cover	3.0.0	n/a					
	Bottom Panel - Front	3.1.1	(18.25"H x 17"W) 3/4" Cherry Cabinet Ply	Aura/Hayward	-	$ 115.00	1	$ 115.00

	Bottom Panel - Side	3.1.2	(18.25"H x 4"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Bottom Panel - Access	3.1.3	(15"H x 15.5"W) 2'x2' Al. Perf. Sht .1875D, .25S	Online Metals	-	$ 30.44	1	$ 30.44
	Power Strip	3.1.4	3-Outlet Grounded Power Strip, Trip Lite 3SP	Home Depot	203792766	$ 15.47	1	$ 15.47
	Power Supply - Linear Act	3.1.5	60W 12V Power Supply	Amazon	-	$ 9.99	1	$ 9.99
	Bottom Acrylic Strip	3.2.1	(18"Hx8"W) 0.060" 24 x 48 P/N 7328	Eplastics	-	$ 60.00	1	$ 60.00
	Bottom Metal Strip	3.2.2	(18"H x 10"W) 20ga. SS304	Online Metals	-	$ 34.88	1	$ 34.88
Middle Cover	Middle Cover	4.0.0	n/a			$ -	1	$ -
	Middle Panel - Front	4.1.1	(18.25"H x 19"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Middle Panel - Left	4.1.2L	(18.25"H x 5.25"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Middle Panel - Right	4.1.2R	(18.25"H x 5.25"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Middle Panel - Access	4.1.3	(16"H x 17.5"W) 2'x2' Al. Perf. Sht .1875D, .25S	Online Metals	-	$ 30.44	1	$ 30.44
	Angle Bracket	4.1.4	(5/8" x 1", .5"W x .12"t) 3/4" x 48" x 1/8" Al Ang	Material from 1.1.6		$ -	1	$ -
	Acrylic Strip	4.2.1	(18"H x 10"W) White Acrylic	Material from 3.2.1		$ -	1	$ -
	Acrylic End	4.2.2	(3/4"H x 10"W) White Acrylic	Material from 3.2.1		$ -	1	$ -
	Metal Strip	4.2.3	(18"H x 8"W) SS304	Material from 3.2.2		$ -	1	$ -
Top Cover	Top Cover	5.0.0	n/a			$ -	1	$ -
	Top Panel - Front	5.1.1	(18.25"H x21"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Top Panel - Left	5.1.2L	(18.25"Hx6.5"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Top Panel - Right	5.1.2R	(18.25"Hx6.5"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Top Panel - Access	5.1.3	(18"H x 19.5"W) 2'x2' Al. Perf. Sht .1875D, .25S	Online Metals	-	$ 30.44	1	$ 30.44
	Angle Bracket	5.1.4	Same as 4.1.4	Material from 1.1.6		$ -	1	$ -
	Acrylic Strip	5.2.1	Same as 4.2.1	Material from 3.2.1		$ -	1	$ -
	Acrylic End	5.2.2	Same as 4.2.2	Material from 3.2.1		$ -	1	$ -
	Metal Strip	5.2.3	Same as 4.2.3	Material from 3.2.2		$ -	1	$ -
Desk	Desk	6.0.0	n/a	Material from 3.1.1		$ -	1	$ -
	Hardware: Controller	6.0.0A	Workrite Sierra HXL	Workrite	-	$ -	4	$ -
	Hardware: Splitter Housing	6.0.0B	#6 x 5/8" Pan Head Screw (12pk)	Home Depot	282265	$ 1.18	1	$ 1.18
	Hardware: Worksurface Stop	6.0.0C	#6 x 1-1/4" Flat-head Wood Screw (4pk)	Home Depot	204587437	$ 1.18	2	$ 2.36
	Hardware: Filament	6.0.0D	1.75mm PLA, Black	Amazon	-	$ 19.95	1	$ 19.95
	Hardware: Clevis	6.0.0E	1/4-20 x 1-3/4" Hex Bolt (2pk)	Home Depot	205037867	$ 0.65	1	$ 0.65
	Hardware: Clevis	6.0.0F	1/4-20 Hex Nut	Ace Hardware	-	$ 0.20	1	$ 0.20
	Base	6.1.1	(27"H x 24.5"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Panel - Front	6.1.3	(7.5"H x 28"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Panel - Left	6.1.4L	(7.5"H x 26.5"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Panel - Right	6.1.4R	(7.5"H x 26.5"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Shelf	6.1.5	(8"H x 26.5"W) 3/4" Cherry Cabinet Ply	Material from 3.1.1		$ -	1	$ -
	Shelf Mount	6.1.6	(6"L) 1" x 1" x .05" Alum L-Bracket	Home Depot	796942	$ 9.96	2	$ 19.92
	Top Cover Mount - Front	6.1.7	(19.5"L) 1" x 1" x .05" Alum L-Bracket	Material from 6.2.5		$ -	1	$ -
	Top Cover Mount - Left	6.1.8L	(6"L) 1" x 1" x .05" Alum L-Bracket	Material from 6.2.5		$ -	1	$ -
	Top Cover Mount - Right	6.1.8R	(6"L) 1" x 1" x .05" Alum L-Bracket	Material from 6.2.5		$ -	1	$ -
	Logo Assembly	6.2.0	n/a			$ -	1	$ -
	Logo Plate	6.2.1	(X"xX"xX") 12"x24" 16ga SS304 Sheet	Online Metals	-	$ 36.17	1	$ 36.17
	Logo Letters	6.2.2	(7"H x 24"W) 12"x24" Acrylic		-	$ -	1	$ -
	Logo Post	6.2.3	12"L 1" Round Aluminum Bar	Online Metals	-	$ 7.79	1	$ 7.79
	Controller	6.3.1	Workrite Sierra HXL	Workrite	-	$ -	1	$ -
	Controller Remote	6.3.2	Workrite Sierra HXL	Workrite	-	$ -	1	$ -
	Splitter Assembly	6.4.0	n/a					
	Splitter Housing	6.4.1	3D printed splitter housing	DS	-	$ -	1	$ -
	3 Pin DIN Female Socket	6.4.2	3 Pin DIN Female Socket	Digikey	CP-1230-ND	$ 2.31	1	$ 2.31
	7 Pin DIN Female Socket	6.4.3	7 Pin DIN Female Socket	Digikey	CP-1230-ND	$ 2.31	2	$ 4.62
	7 Pin DIN Male to Wire	6.4.4	7 Pin DIN Male to Wire	Digikey	839-1066-ND	$ 8.73	1	$ 8.73
	7 Pin DIN Male Straight	6.4.5	7 Pin DIN Male Straight	Digikey	CP-1070-ND	$ 1.64	1	$ 1.64
	Worksurface	6.5.1	(X"xX"xX") 3/4" Cherry Cabinet Ply, Unfinished	Material from 3.1.1		$ -	1	$ -
	Worksurface Stop	6.5.2	(3/4"H x 19.5"W) Leftover Hardwood	Material from 1.2.1		$ -	1	$ -
	Piano Hinge	6.5.3	SS304, w/o Holes, .050"Leaf, 2"w, 24"L	McMaster-Carr	1582A245	$ 13.51	1	$ 13.51
	AV Panel - Worksurface	6.6.0	n/a	Material from 1.3.1		$ -	1	$ -
	AV Mounting Frame	6.6.1	Same as 1.3.1	Material from 1.3.1		$ -	1	$ -
	US Outlet Plate	6.6.2	Dual AC AAP - AC Outlet	Extron Elec.	70-584-02	$ 95.00	1	$ 95.00
	HDMI Plate	6.6.3	Same as 1.3.2	Material form 1.3.2		$ -	1	$ -
	VGA_Stereo Plate	6.6.4	Same as 1.3.3	Material from 1.3.3		$ -	1	$ -
	XLR Shock Mount	6.6.5	Gooseneck Microphone Adapter	Audio-Technica	AT8416	$ 78.00	1	$ 78.00
	XLR Female Adapter	6.6.6	Female to Female 3-Pin XLR Adapter	Radio Shack	2740014	$ 9.99	1	$ 9.99

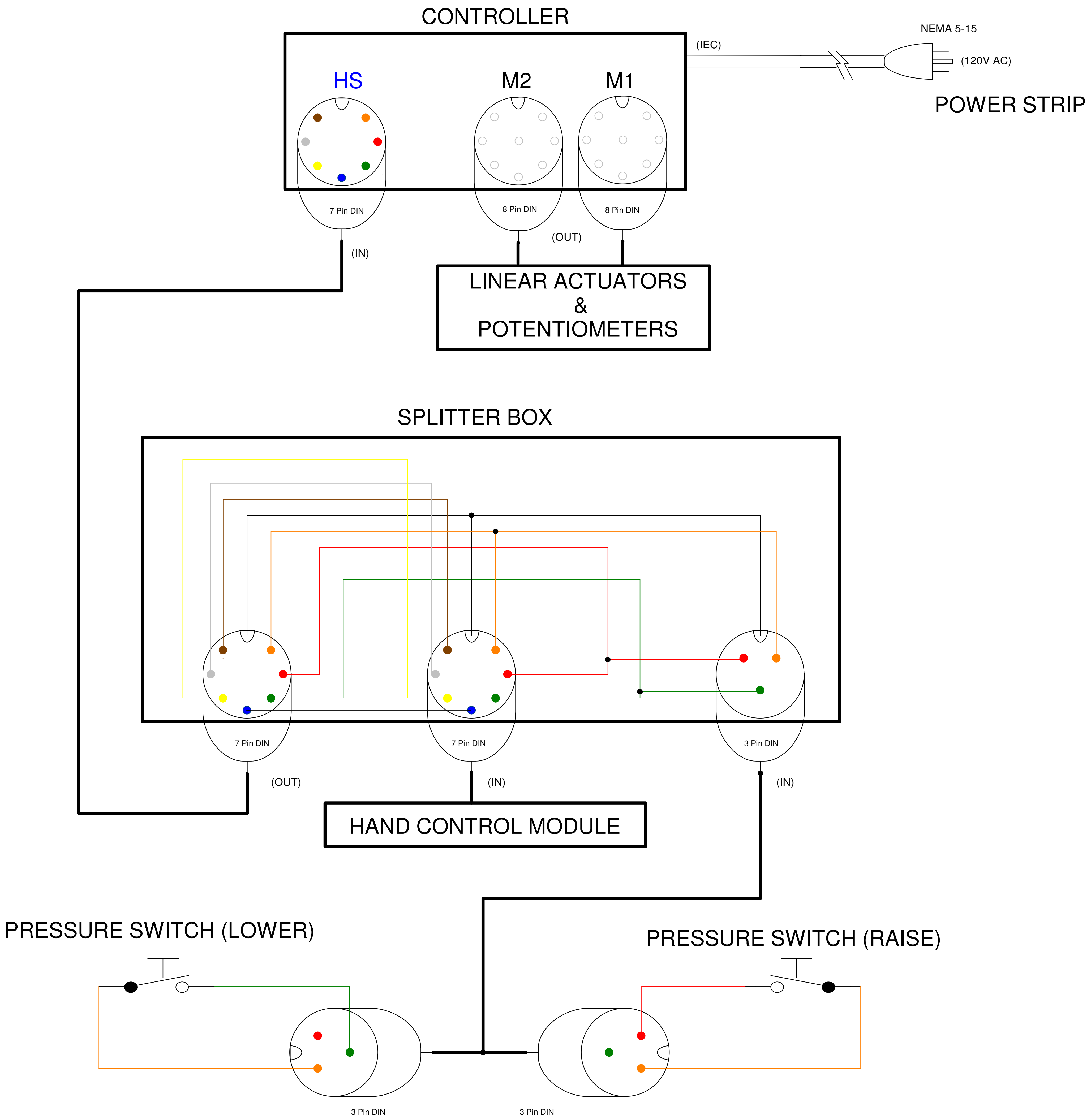
	Clevis	6.7.1	(X"xX"xX") 1' - 1.5" Square Bar 2024-T352	Online Metals	-	$ 32.99	1	$ 32.99
	Linear Actuator	6.7.2	2" Stroke, 110lb, 12V Linear Actuator	Creative Werks	LACT2P	$ 107.95	1	$ 107.95
	Linear Actuator Switch Housing	6.7.3	3D printed switch housing	DS	-	$ 6.63	1	$ 6.63
	Linear Actuator Switch	6.7.4	uxcell Momentary 6 Pin DPDT Rocker Switch	Amazon	-	$ 6.63	1	$ 6.63
	Upper Worksurface Panel - Left	6.8.1L	(3.5"H x 18"W) Al. Perf. Sht .1875 Hole, .25 Stag	Online Metals	-	$ 24.35	3	$ 73.05
	Upper Worksurface Panel - Right	6.8.1R	(3.5"H x 18"W) Al. Perf. Sht .1875 Hole, .25 Stag	Material from 6.8.1L		$ -	1	$ -
	Lower Worksurface Panel - Left	6.8.2L	(3-3/8"H x 17-5/8"W) Al. Perf. Sht .1875 Hole, .25 Sta	Material from 6.8.1L		$ -	1	$ -
	Lower Worksurface Panel - Right	6.8.2R	(3-3/8"H x 17-5/8"W) Al. Perf. Sht .1875 Hole, .25 Sta	Material from 6.8.1L		$ -	1	$ -
	Upper Worksurface Panel - Front	6.8.3	(3.5"H x 24-1/2"W) Al. Perf. Sht .1875 Hole, .25 Stag	Material from 6.8.1L		$ -	1	$ -
	Lower Worksurface Panel - Front	6.8.4	(3-3/8"H x 24"W) Al. Perf. Sht .1875 Hole, .25 Stag	Material from 6.8.1L		$ -	1	$ -
	Upper_Lower Wire	6.8.5	1lb Fishing Line	Walmart	-	$ 1.56	1	$ 1.56
Labor/Tooling	Welding Process	-	Cal Poly Shop Technician to Weld Al. Frame	Cal Poly	-	$ 12.00	1	$ 12.00
	Lock Miter Bit	-	3/4" carbideLock Miter Router Bit	Home Depot	100660688	$ 95.97	1	$ 95.97
	Wood Glue	-	Titebond II 16oz Premium Wood Glue	Home Depot	107209	$ 5.47	1	$ 5.47
	White Decal Paint	-	Rust-oleum White Spray Paint	Home Depot	-	$ 3.87	1	$ 3.87
	Tung Oil	-	Klean-Strip Boiled Linseed Oil	Home Depot	459704	$ 7.98	1	$ 7.98
	Epxoy Applicator	-	3M Scotch-Weld EXP Plus II Applicator - Mod91	Amazon	-	$ -	1	$ -
Shipping	Shipping: Online Metals	-	$50 off order >$200, originally $36.11	-	-	$ -	1	$ -
	Shipping: McMaster-Carr	-		-	-	$ 20.00	1	$ 20.00
	Shipping: Extron Electronic	-		-	-	$ 20.00	1	$ 20.00
	Shipping: DataPro	-		-	-	$ 8.00	1	$ 8.00
	Shipping DigiKey	-		-	-	$ 7.30	1	$ 7.30
	Shipping: Baird	-	FedEx Freight Economy - 6 days	-	-	$ 289.00	1	$ 289.00
	Shipping: Trossen Robotics	-		-	-	$ 15.00	1	$ 15.00
	Shipping: EPlastic	-		-	-	$ 30.00	1	$ 30.00
	Shipping : Amazon	-		-	-	$ 10.00	1	$ 10.00
							Total	$ 2,066.58

Appendix D: Electrical Schematics

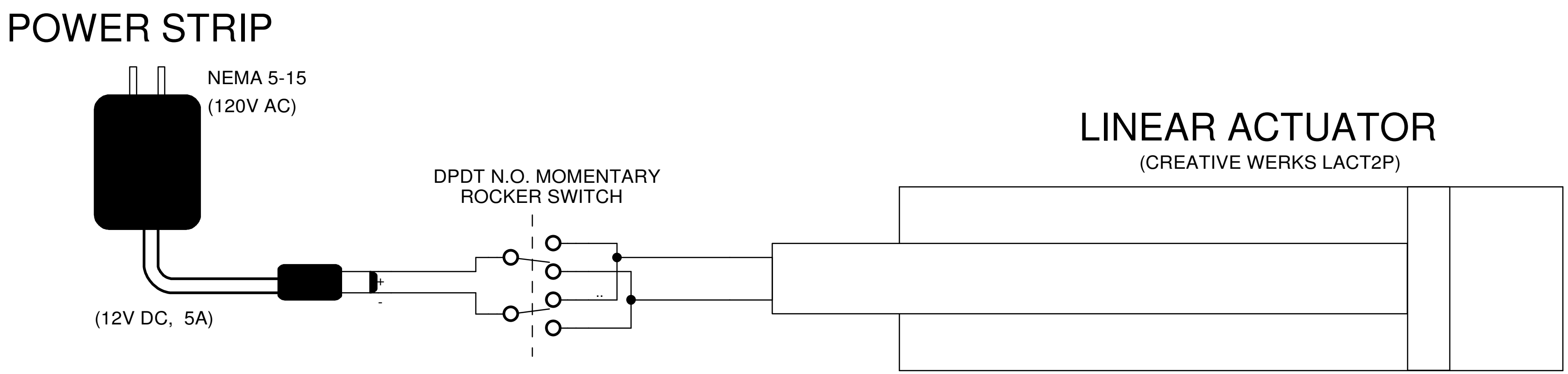
See attached sheets corresponding to the list above.



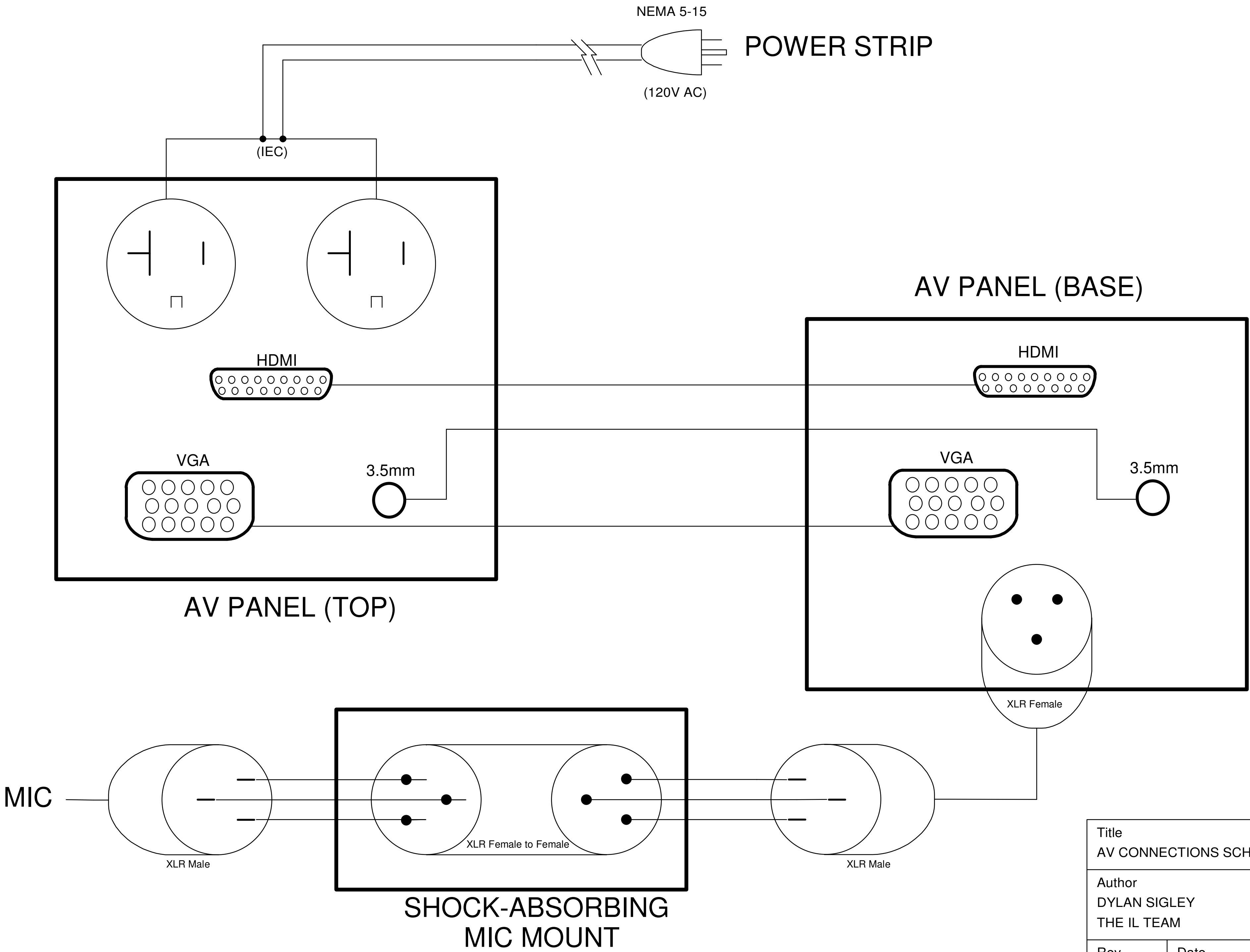
Title ELECTRICAL CONNECTIONS OVERVIEW		
Author DYLAN SIGLEY THE IL TEAM		
Rev. 1.0	Date 2/10/2016	Sheet 1 OF 4



Title HEIGHT CONTROL DETAIL SCHEMATIC		
Author DYLAN SIGLEY THE IL TEAM		
Rev. 1.0	Date 2/10/2016	Sheet 2 OF 4



Title		
ANGLE CONTROL DETAIL SCHEMATIC		
Author		
DYLAN SIGLEY THE IL TEAM		
Rev.	Date	Sheet
1.0	2/10/2016	3 OF 4



Title		
AV CONNECTIONS SCHEMATIC		
Author DYLAN SIGLEY THE IL TEAM		
Rev. 1.0	Date 2/10/2016	Sheet 4 OF 4

Appendix E: Detailed Supporting Analysis

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See attached (3) sheets for Supporting Analysis

1. Define System Variables

Weight

$F_{app} := 300\ lb$

$W_{desk} := 40\ lb$

$W_{act} := 20\ lb$

$W_{base.center} := 11\ lb$

$W_{base.legs} := 12\ lb$

Lectern Geometry

$x_{ADA} := 20\ in$

$x_{cg.desk} := 1.75\ in$

$x_{level} := 3.875\ in$

Leg Geometry

$h_{leg} := 3\ in$

$b_{leg} := 1.5\ in$

$t_{leg} := 0.125\ in$

$l_{leg} := 24\ in$

$E_{Al} := 10.9 \cdot 10^{6}\ \frac{lb}{in^{2}}$

2. Static Rigid Body Analysis

Assume: Lectern about to "fold" such that all normal force is at tip of leg.

Sum forces in the y-direction:

$$R_{legs} := F_{app} + W_{desk} + W_{act} + W_{base.center} = 371\ lb$$

(2) legs, therefore, each leg carries half the load.

$$R_{leg} := \frac{R_{legs}}{2} = 185.5\ lb$$

Sum moments about the intersection of Base Leg and Actuator Leg

$$L_{leg} := \frac{F_{app} \cdot x_{ADA} + W_{desk} \cdot x_{cg.desk}}{R_{legs} + W_{act} + W_{base.center}} = 15.1\ in$$

3. Stiffness Verification

The actual leg length that was determined for aesthetic properties is a total length of 27.5". Assuming that the center of the welded section is the "fixed" point, the effective leg length is 24".

$$I_{leg} := \frac{1}{12} \cdot b_{leg} \cdot h_{leg}^{3} - \frac{1}{12} \cdot \left(b_{leg} - 2 \cdot t_{leg}\right) \cdot \left(h_{leg} - 2 \cdot t_{leg}\right)^{3} = 1.209\ in^{4}$$

$$\delta_{leg} := \frac{R_{leg} \cdot L_{leg}^{3}}{3 \cdot E_{Al} \cdot I_{leg}} = 0.016\ in$$

4. Tipping Consideration

Case #1:
An important consideration is the suceptibility to tip over when pushed from the presenter side. In this case, the tipping point is considered when static friction reaches its limit and kinetic friction is impending. Therefore, the entirety of the weight of the lectern would be on the tipping point.

The loading is exactly the same as Part 1, however, the lever arm on which the loads act is lengthened to be at the point of the Leveling Feet. The Leveling Feet are centered 3-7/8" aft of the cenerline of the actuating legs that were the pivot point for Part 1.

$$M_{tip1} := \frac{\sqrt{2}}{2} \cdot F_{app} \cdot \left(x_{ADA} + x_{level}\right) + W_{desk} \cdot \left(x_{cg.desk} + x_{level}\right) + \left(W_{act} + W_{base.center}\right) \cdot \left(x_{level}\right) = (5.41 \cdot 10$$

At the extreme lectern heights:

ADA (27"): $F_{tip1.ADA} := \frac{M_{tip1}}{27\ in} = 200.362\ lb$

Max (51.75"): $F_{tip1.max} := \frac{M_{tip1}}{51.75\ in} = 104.537\ lb$

Case #2:
The other tipping senario would be pushing from the front (such as when the lectern is being relocated). The tipping point is again considered when static friction reaches its limit and kinetic friction is impending. Therefore, the entirety of the weight of the lectern would be on the tip of the two legs.

$$M_{tip2} := W_{desk} \cdot \left(l_{leg} - x_{cg.desk}\right) + \left(W_{act} + W_{base.center}\right) \cdot \left(l_{leg}\right) = \left(1.634 \cdot 10^{3}\right)\ lb \cdot in$$

At the extreme lectern heights:

ADA (27"): $F_{tip1.ADA} := \frac{M_{tip2}}{27\ in} = 60.519\ lb$

Max (51.75"): $F_{tip1.max} := \frac{M_{tip2}}{51.75\ in} = 31.575\ lb$

4. Welded Joint Calculation at Joint in Base

Weld Geometery

$$b := \frac{4}{\cos(10\ °)}\ in$$

$$d := 3\ in$$

$$r := \left(\left(\frac{b}{2}\right)^2 + \left(\frac{d}{2}\right)^2\right)^{.5}\ in$$

Applied Load

$$M := 7160\ in \cdot lb$$

Filler Metal Specifications

$$\tau_{allowable} := 11.5 \cdot 10^3\ \frac{lb}{in^2}$$

Solving for Shear Flow in the Weld

$$J_u := \frac{(b+d)^3}{6}\ in^3$$

$$J := .707 \cdot h_{min} \cdot J_u$$

Applying the max shear equation to solve for h_{min}

$$\tau_{allowable} := M \cdot \frac{r}{J}$$

$$h_{min} := .034in$$

5. Weld Nut Calculation

Loctite 234 Structural Adhesive Properties

$$\tau_{max} := 2700\ \frac{lb}{in^2}$$

Shear Loading

$$V := 20\ lb$$

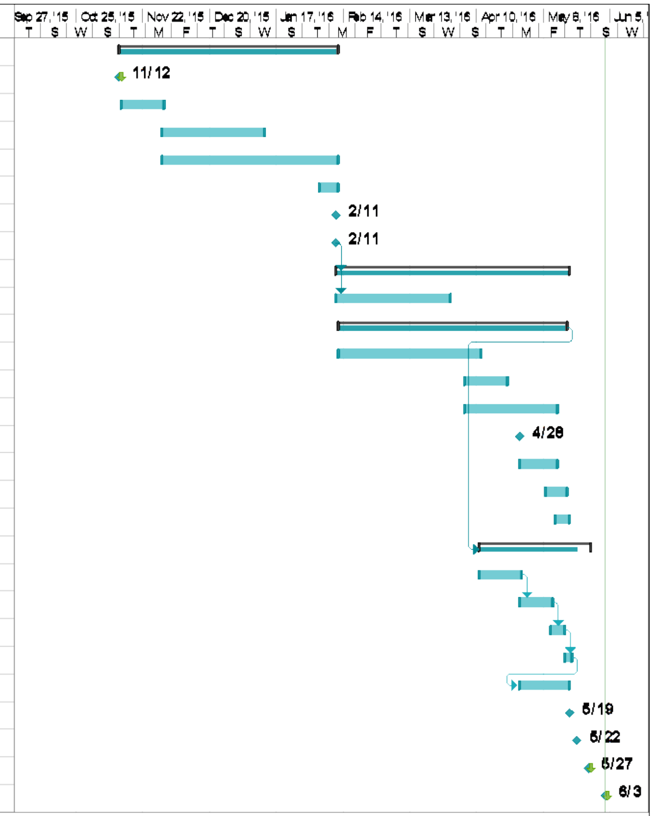
Solving for Minimum Adhesion Area

$$A_{min} := \frac{V}{\tau_{max}}$$

$$A_{min} = 0.007\ in^2$$

Appendix F: Project Schedule

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		**DESIGN**	**13.2 wks**	**Thu 11/12/15**	**Thu 2/11/16**		
2		PDR	0 days	Thu 11/12/15	Thu 11/12/15		
3		3D Modeling	12 days	Fri 11/13/15	Mon 11/30/15		
4		Hardware Selection	6.2 wks	Mon 11/30/15	Mon 1/11/16		
5		Detailed Analysis	10.8 wks	Mon 11/30/15	Thu 2/11/16		
6		Engineering Drawings	1.2 wks	Thu 2/4/16	Thu 2/11/16		
7		Class - CDR Presentation	0 days	Thu 2/11/16	Thu 2/11/16		
8		Class - Final Design Report	0 days	Thu 2/11/16	Thu 2/11/16		
9		**BUILD**	**14 wks**	**Thu 2/11/16**	**Wed 5/18/16**	**8**	
10		Part Procurement	6.8 wks	Thu 2/11/16	Tue 3/29/16	8	
11		**Manufacturing Overview**	**13.6 wks**	**Fri 2/12/16**	**Tue 5/17/16**		
12		Subframe	8.4 wks	Fri 2/12/16	Mon 4/11/16		
13		Carpentry	14 days	Tue 4/5/16	Fri 4/22/16		
14		Electrical	5.8 wks	Tue 4/5/16	Fri 5/13/16		
15		Hardware Review	0 days	Thu 4/28/16	Thu 4/28/16		
16		Finishing	12 days	Thu 4/28/16	Fri 5/13/16		
17		Asthetic	1.4 wks	Mon 5/9/16	Tue 5/17/16		
18		Final Assembly	4 days	Fri 5/13/16	Wed 5/18/16		
19		**TEST**	**35 days**	**Mon 4/11/16**	**Fri 5/27/16**	**11**	
20		Subsystem Testing	2.8 wks	Mon 4/11/16	Thu 4/28/16		
21		Functioning Prototype	2 wks	Thu 4/28/16	Wed 5/11/16	20	
22		Test Prototype	0.8 wks	Wed 5/11/16	Mon 5/16/16	21	
23		Final Product	0.6 wks	Tue 5/17/16	Thu 5/19/16	22	
24		Test Final Product	3 wks	Thu 4/28/16	Wed 5/18/16	23	
25		Global Accessibility Awareness Day Presentation	0 days	Thu 5/19/16	Thu 5/19/16		
26		Paul Wolff Accessibility Awards	0 days	Sun 5/22/16	Sun 5/22/16		
27		Senior Project Expo	0 days	Fri 5/27/16	Fri 5/27/16		
28		Final Report	0 days	Fri 6/3/16	Fri 6/3/16		



Project: IL Project
Date: Fri 6/3/16

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

Appendix G: Senior Expo Poster

Appendix H: DVP&R

Inclusive Lectern DVP&R

Date: June 3, 2016 — Sponsor: John Lee

Item No	Specification or Clause Reference	Test Description	Acceptance Criteria	Responsibility	Sample Quantity	Timing: Start date	Timing: Finish date	Results: Test Results	Results: Qty Pass	Results: Qty Fail	Results: Notes
1	Actuation speed	Actuated Table with 75% load	> 1.2 in/s	Trent Canales	1	2/2/16	2/2/16	1.4 in/s	1	0	Worked great
2	Shear Test	Test epoxied locknuts at rated load	go / no go	Sean Day	4	4/6/16	4/6/16	Held 15lbs statically	4	0	Weldnut did not fail under loading
3a	Leg Actuation	Test for proper leg functionality when mocked up	go/no go	Stephen Sippel	1	4/22/16	4/22/16	no go	0	1	Controll system initialized incorrectly, legs over exetnded, leg failure, repair cap and 3D print new drive coupler
3b	Leg Actuation Redo	Test for proper leg functionality after repairs had been made	go/no go	Dylan Sigley	1	4/27/16	4/27/16	no go	0	1	Leg initalization caused drive coupler to fail.
3c	Leg Actuation Redo 2	Test for proper leg functionality after repairs had been made	go/no go	Trent Canales	1	4/28/16	4/28/16	no go	0	1	Improper reassembly cuased drive coupler to fail. 3D print more drive couplers
3d	Leg Actuation Redo 3	Test for proper leg functionality after repairs had been made	go/no go	Trent Canales	1	4/28/16	4/28/16	go	0	1	Proper functionality, controller bugs worked out
4	Worksurface Adjustment	Confirm worksurface actuats over spec'd angle	12 to 35 degrees	Dylan Sigley	1	5/4/16	5/4/16	12 to 38	1	0	Within Range
5	Color match wood components	Test stains on various woods to confirm color matches	go, no go	Stephen Sippel	1	5/2/16	5/3/16	go	1	0	Tested various colors, teak natural provided desired/best results
6	Tipping Test	Test to see how much force is required to couse tipping in all four possible directions	TBD	Trent Canales	4	5/13/16	5/13/16				unable to be completed
7	Visual	Test at different stages for speaker visibility	go / no go	Dylan Sigley	3	5/16/16	5/16/16				unable to be completed
8	Electrical	Powered components	go / no go	Sean Day	2	5/16/16	5/16/16	go	1	0	All systems work
9	Electrical	AV connectivity	go / no go	Dylan Sigley	1	5/16/16	5/16/16	go	1	0	All Systems work
10	Height test	Min/max height range	Min: 26 in Max: 52 in	Stephen Sippel	1	5/16/16	5/16/16	25.5-51.5	1	0	Range is small by 0.5", met critical lower height limit

Appendix I: User Manuals

I1. Lectern Transportation and Setup

Inclusive Lectern

Transportation and Setup Guide

Revision Date: 06.10.2016

1. Prior to transportation, ensure the lectern is in the fully lowered position to reduce tipping risk and actuator wear.
2. Lift lectern onto transportation cart.
3. Secure by inserting clamps and tightening wing nuts.
4. Transport to event location and reverse Steps 3 and 2, respectively.
5. Gently place the lectern in the desired position. When determining location, note that AV accessibility and the 120V power connection are both on the right side of the base of the lectern.
6. Connect an extension cord from a 120V wall outlet to the power connection on the right side of the lectern base.
7. Connect the two floor mats on the 3-pin sockets on the base of the lectern. From the presenter's perspective, the *up-mat* must be on the right side, and the *down-mat* on the left. In other words, "right is raise", "left is lower". If the mats are not connected to their correct sides, they will not work. If possible, ensure the mats will not be accidentally activated, by securing them down with bright tape.
8. Presenters that use a computer can connect to HDMI, VGA, 3.5mm, and 120V power directly to the AV panel on the worksurface.
9. If desired, a wireless gooseneck microphone can be screwed into the mount in the center of the top of the lectern.

Note: Steps 5-9 can be performed in any order.

I2. Disassembly

Inclusive Lectern

Disassembly Guide

Revision Date: 06.10.2016

1. Prepare for disassembly by adjusting the lectern to the lowest height. Skip this step in case of actuator failure.
2. With 120V power still connected, use the left hand control to raise the worksurface to the maximum angle.
3. Disconnect 120V power.
4. Remove (4) buttonhead screws to remove the Upper Front Worksurface Cover. Repeat for the Lower Front Worksurface Cover.
5. Then, access the socketcap screw that attaches the Linear Actuator to the bottom of the worksurface. Remove the screw and tip worksurface back until it is vertical.
6. With available access, reach under the shelf on the right-hand side and disconnect (4) cables from the Controller: power cable, hand & foot control cable, motor cable 1, and motor cable 2.
7. With the motor cables free from the controller, unscrew the wire clamp holding the coiled cables to the base of the Desk.
8. Now, move to the back side of the lectern and remove the (4) buttonhead screws to remove the Top Access Panel. Repeat for the Middle and Bottom Access Panels.
9. Route the loose motor cables through the concentric access hole in the Base of the Desk and the Supporting Cross Member. Then, feed through routing hole at each corresponding leg until completely free from upper assembly.
10. Next disconnect all wiring from the Legs and the Base. First, cut the ziptie that secures the retractable keyring to the wiring harness.
11. Then, simply unplug the three power cords connected to the power strip on the inside of the left leg.
12. Continue by removing the (4) screws that secure the Base AV Plate to the Base and disconnecting (3) cables from the back side of the Panel.
13. Next, locate the XLR panel within the AV plate and remove the four jam nuts on the back side that secure the XLR panel.
14. With the main wiring harness loose, the Desk section of the lectern may be removed from the legs. To do this, loosen and remove the (12) hex nuts on the top side of the Base of the Desk. The (8) closest to the presenter will require an additional wrench on the bottom side to hold the bolt, while the (4) under the shelf have captured bolts.

15. The next step is easiest performed with two people. One person should stand on the front side of the lectern and lift the Desk portion straight up six inches. While this is happening, the other person should work from the underside to feed the wiring harness through the access hole in the Cross Member. Once the cables are free, set on a stable surface.
16. Now, the cover panels may be removed. For the middle cover, remove the bolts on each side first. Then, loosen the (2) front bolts a half turn each. The cover should be loose enough to remove the spacers and fender washers from between each side of the panel and the corresponding leg. Finally, complete the removal of the front bolts.
17. For the bottom cover, simply remove the (2) front bolts.
18. Next, remove the cross member by removing the bolt that serves as a pin on both sides. Then remove the (4) brass bushings and remove the Cross Member.
19. If work on the legs is required, remove the Pinned Joint Adapters from the top of each leg by removing the (4) socketcap bolts at the top of each leg.
20. Next, tip the lectern forward until the bottom is perpendicular with the ground to allow access to the bottom fasteners of the legs. Remove the (4) buttonhead screws at the base of each leg.
21. Tip the lectern back to flat ground. Remove the power supply from the left leg. Pull straight up on each leg to remove from mounting socket.

I3. Installation and Preparation of New Height Actuators

Inclusive Lectern

New Leg Modification Guide

Revision Date: 06.10.2016

Upon receiving the new legs as outlined in the Recommendations, there are a few modifications that are required before they can be implemented into the lectern system. Additionally, prior to performing the modifications, verify once more the dimensions of the new legs are exactly the same as the existing legs.

1. First, if the legs are not in the fully collapsed state, plug in system to adjust to the fully collapsed position.
2. Remove the Countersink screw at the bottom of the leg.
3. Fix the upper two sections of the leg and pull the bottom section off the stack. Be careful to contain the (8) plastic guides that become exposed.
4. The first modification required is to remove the adapter at the base of the bottom section that allows it to interface with the original table leg feet.
5. After removing the bulk of the interface adapter and creating a smooth surface on all sides for the bottom five inches, confirm proper fitment within the mounting sockets on the base of the lectern.
6. Then, use a horizontal bandsaw to remove 1" from the top of the bottom section to allow clearance for the weld nuts and Middle Cover.
7. The next modification is to the middle section of the leg assembly. First, prepare the surface for the bonding of the weld nuts by sanding the powercoat from the top inch of the front and sides of the leg.
8. Once a clean metal surface has been prepared, spray Loctite Activator on the surface. Also, spray the activator on the weld nut. Refer to the Loctite recommendations for dry and cure times.
9. Next, apply Loctite Adhesive to the flanges of the weld nuts and secure to the leg using a clamp.
10. Once the weld nuts dry, slide the bottom section of the leg back on. Again, make sure all (8) plastic guides are in place. Tighten the countersink screw in the bottom.

The first time the legs are powered after the modifications, they should be rest by holding the down arrow for 5 seconds while in the fully collapsed state.

I4. Troubleshooting Guide

Inclusive Lectern

Troubleshooting Guide

Revision Date: 06.10.2016

Problem	Solutions
Projector or AV connections are not functioning properly.	1. Ensure all AV connections (worksurface panel, base panel, wall panel) are secure. 2. Check the display settings of the computer. **On Windows**: Win+P, or Control Panel > Hardware and Sound > Connect to a projector. **On Mac**: Apple Menu > System Preferences > Displays > Arrangement. 3. Remove the Extron AV panels. Inspect the various connections on the backsides.
Lectern will not raise or lower with hand controls or floor controls. **Note: If there was a loud crunching noise, do not attempt to raise or lower!** Repairs within the actuating legs will likely be necessary.	1. Ensure the power connections at the wall and base of the lectern are secure. 2. Check the hand control module for an error code. You may need to press a button on to awaken it. See the "error messages" issue at the bottom of this table. 3. Visually inspect the surge protector that is mounted to the bottom privacy panel. If any of the 3 plugs are unplugged, remove the panel, and reconnect them. 4. Raise the worksurface using the angle adjustment control switch. Inspect the controller box (front right inside the worksurface). There are 4 connections to it, ensure they are all connected. It will be difficult to see, so it may help to use a flashlight, or rely on touch only. 5. Check that the blue 7-pin connector (the hand control module) is connected to the Y-splitter, which connects to the controller box. If none of these solutions solve the issue, it is likely a mechanical failure that will require maintenance.

<table>
<tr>
<td>Lectern will not raise or lower with floor controls (but hand controls do work).

Note: If there was a loud crunching noise, do not attempt to raise or lower! Repairs within the actuating legs will likely be necessary.</td>
<td>If both floor mats aren’t functioning:
1. Ensure that each pad is connected to the correct 3-pin socket, according to Appendix I2.
2. Inside the worksurface, check that the 3-pin male cable connector is connected to the Y-splitter, which connects to the controller box.

If one floor mat isn’t functioning:
1. Ensure that the pad is connected to its 3-pin socket.
2. Check the 3-pin male connector for the mat. They can be opened by removing the electrical tape, and carefully prying the fitting off. Broken connections should be soldered together.
3. Check the connections of the 3-pin female socket. It can be unscrewed, and pulled out slightly. Broken connections should be soldered together.</td>
</tr>
<tr>
<td>Work surface angle adjustment does not work.</td>
<td>1. Ensure the power connections at the wall and base of the lectern are secure.
2. Visually inspect the surge protector that is mounted to the bottom privacy panel. If any of the 3 plugs are unplugged, remove the panel, and reconnect the plug(s).
3. Ensure that the two pairs of Traxxas quick-disconnectors inside the worksurface are connected.

If none of these solutions solve the issue, it is likely a connection problem in the angle adjustment switch, or damage to the linear actuator.</td>
</tr>
<tr>
<td>Height adjustment hand control module displays error codes.</td>
<td><table><tr><td>Code</td><td>Description</td></tr><tr><td>0 RESET</td><td>A cable is not connected to the control box. First, remove any objects under the lectern that will prevent it from lowering to its lowest possible setting. Next, hold the down arrow button until the lectern reaches lowest height and moves upward slightly. The height will be displayed and the lectern will now work properly.</td></tr></table></td>
</tr>
</table>

<table>
<tr><td rowspan="12"></td><td>hot</td><td>System needs to cool down. Wait 10 minutes before adjusting height.</td></tr>
<tr><td>E16</td><td rowspan="5">One or more cables may be loose. Unplug power cord then check that all cable connections are secure. Plug in power cord. The 0_{RESET} code will appear. Then hold the down arrow button until the lectern reaches the lowest height and moves upward slightly. The height will be displayed and the lectern will now work properly.</td></tr>
<tr><td>E17</td></tr>
<tr><td>E18</td></tr>
<tr><td>E29</td></tr>
<tr><td>E30</td></tr>
<tr><td>E31</td><td>This indicates that the lectern has been reset; simply press the up arrow button</td></tr>
<tr><td>E44</td><td rowspan="3">The lectern is overloaded on one leg. To balance the load across all legs, redistribute any heavy objects on your worksurface.</td></tr>
<tr><td>E45</td></tr>
<tr><td>E46</td></tr>
<tr><td></td><td>Controls are locked. Press and release button 1, then press and release button 2, and then press and release button 3.</td></tr>
</table>