

Home Salon Booth

by

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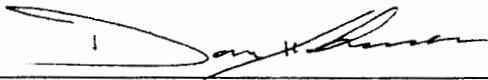
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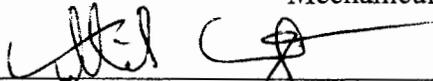
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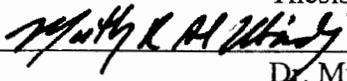
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ABSTRACT

The Home Salon Booth will give cosmetologists the ability to perform salon activities from a room in their own home. This is difficult to accomplish since most houses do not have a wash station with a reclining chair to wash someone's hair. They must jump in the shower or maneuver their head under a faucet to remove the salon products.

Other concerns include the lighting and available amperage at any given point in a residential home. Lights in a home are directly connected to the outlets in the same room or up to the whole side of the house. While running several hundred watts through the lights, little power is left to use all of the other salon tools for styling hair. One salon hairdryer can consume 2000 watts, while curling irons and flattening irons can use 1200 watts. These tools coupled together with the lights and anything else running on the same circuit immediately overloads the breaker in a residential home.

The Home Salon Booth will fix this problem enabling the simultaneous application of any salon equipment while running the lights and chair all together. This will be accomplished with the salon having its own breaker box capable of carrying 100 amps of current at 110V AC. This is enough to power some small houses but will enable the Home Salon Booth to be fully functional as well as safe to use.

The Home Salon Booth will provide many amenities needed to accomplish the tasks involved in performing salon treatments. Included will be a 3 function motorized chair, which will lift, rotate, recline, and align with the wash station using a logic circuit. The chair rotation and the chair height will have their own controls, while the rest of the system will operate using a logic circuit and only one double pole double throw (DPDT) switch. The booth is designed for various size adults, but can be accommodated to facilitate smaller individuals with a booster seat.

Time is a concern for the Home Salon Booth so the booth will convert from any starting position to the washing position in under 15 seconds. This will save valuable time for both the client and the cosmetologist when the wash station must be used. To make the booth able to accommodate most people there is a 300 pound weight limit set for the chair.

To ensure safe operation of all of the salon tools and the cosmetologist, all of the wall outlets will be ground fault circuit interrupters (GFCI.) This will ensure the safety of the cosmetologist if one of the salon tools fall into the wash station. There will be 3 dedicated 20 amp circuits with 2 GFCI outlets each. This will provide the cosmetologist 6 available outlets so there is no need to keep changing cords to use different equipment. Not even 2 salon hair driers on the same outlet will break the circuit.

Testing of the Home Salon Booth will include precise location of all of the booths positions, ability to run all motors simultaneously, and available amperage for the outlets and lights. Being able to run all of these systems concurrently and accurately will be the performance expected from the Home Salon Booth.

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INTRODUCTION

The ability to perform safe salon activities in a residential home requires major modifications to an existing room. The Home Salon Booth combines all of the necessary equipment and functions desired from a salon environment compacted into a versatile home unit. Cosmetologists need a chair with height adjustment and the ability to rotate. In addition the need for a wash station with a cut out neck support is a must when performing salon treatments. With this is also the need for good lighting and excellent available current from the outlets, because there is high power and current pulling equipment used by cosmetologists.

To simplify operation and to conserve space, a retractable sink is incorporated into the Home Salon Booth. This will allow the cosmetologist full range of motion around the client while retracted and quickly converted into the washing position when needed. This also adds another function to the chair, the ability to recline. All of these motions will be controlled with a logic circuit and a single switch once the back height has been adjusted to match up with the client's shoulder height. Adjusting the chair back to one of the six setting sets the corresponding height and wash station extension, while the chair reclines and rotates.

The chair rotates under power with the use of a toggle switch or aligns with the wash station when converting. For safety this has been designed with the ability to be pushed out of the way in case of a problem with the chair rotating into someone or something. Foot pedals have been installed to raise and lower the chair height. The wash station and chair recline functions are only controlled by the logic circuit. Converting the chair into the washing position must be accomplished in under 15 seconds.

Power requirements are a large concern for having a fully functioning salon booth. To allow the Home Salon Booth to have ample available power, a house breaker box able to carry up to 100 amps at 220V AC was selected to supply power to the booth. Three dedicated 20 amp ground fault circuit interrupter (GFCI) circuits have been installed to ensure the cosmetologist will have plenty of outlets for all of the salon tools used during a service. Lighting runs on another 20 amp circuit powering (12) - 40 watt bulbs for the proper lighting. The remaining 20 amps will supply the transformers with power to run the 4 DC motors. Two industrial power supplies are run in parallel to achieve 20 amps at 24V DC.

The Home Salon Booth will combine everything needed to perform all salon activities in a compact unit able to be assembled anywhere. A 1 gauge, 220V power line must be installed into the home and run to the Home Salon Booth. No additional breakers are needed because the booth has a 100 amp main installed in it. There must also be available hot and cold water hookups, while also in the neighborhood of a drain. Flexible hose connects these to the wash station and out to the drain.

The product objectives for the Home Salon Booth include the power circuits, GFCI outlets, one touch controls, and storage. The logic circuit needs to control the wash station and 3 function chair quickly and accurately. The Home Salon Booth will be able

to accommodate adults with 6 inches of adjustment. Smaller individuals will require a booster seat to be able to use the wash station.

This report will continue with the decision making process which led this design to its final stage. The budget is found in appendix C and the build schedule is included in appendix D, outlining the 8 week building process.

Problem Statement:

When selecting a cosmetology chair there are basically only a few options available. Entrepreneurs can select from pump action chairs, which are slow and laborious, or spend a lot of money on a self-contained hydraulic chair, which typically has only one motion usually for functions other than washing hair.

Salon booths typically do not have a wash station present at each station to do the necessary washing and rinsing that is required for salon treatments. Customers and cosmetologists must traverse halfway across the salon to get their hair washed, which is inconvenient and takes up valuable time for each.

Salon booths cannot have wash stations stationary, which are close enough to reach with the chair without being in the way of the cosmetologist while working. This leaves the only other option to have the wash stations away from the salon booth. This process is undesirable to execute and would benefit from this project.

The system will perform these functions:

- Provide different positions for varying size adults (manually set)
- Chair will move up and down (foot pedals)
- Chair will rotate under power (toggle switch)
- Retractable Wash station (automatic operation)
- Chair will recline for washing (automatic operation)
- Chair height and rotation will adjust when converting (automatic operation)

The tasks involved in this project include:

- Design and build a collapsible salon booth
- Design and build a chair which can perform the 3 desired functions
- Design and assembly of the cabinets which surround the retractable wash station
- The control of (4) 24V DC motors to move the system
- Power supply and utility hookups
- Design and build a logic circuit to control the system

SPECIFICATIONS OF THE HOME SALON BOOTH

The major requirements that I set for the Home Salon booth were for normal sized adults to be able to receive salon treatments from a cosmetologist's home. Weights, forces, and lengths were determined from test subjects and the chair and equipment was designed around them. Safe and sufficient power was determined by the environment and the requirements of the salon equipment. The mechanical system was designed to run off 24 volts DC.

The weight limit set for the chair was 300 pounds to ensure most people could use it. Industrial quality products were selected for the linear actuators, right angle gear motor, and power supplies. For raising and lowering the chair height a 500 pound, 18" extension linear actuator was selected to perform this function. The nameplate rating compared with my weight limit results in a factor of safety 1.67.

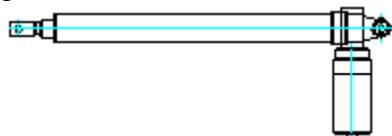


Fig. 1

This actuator was supported from the ground and a 1/2" threaded rod to ensure no motion in the x or y direction. When the actuator penetrates the finished floor there will be bracing to support the linear actuator from tipping in any direction.

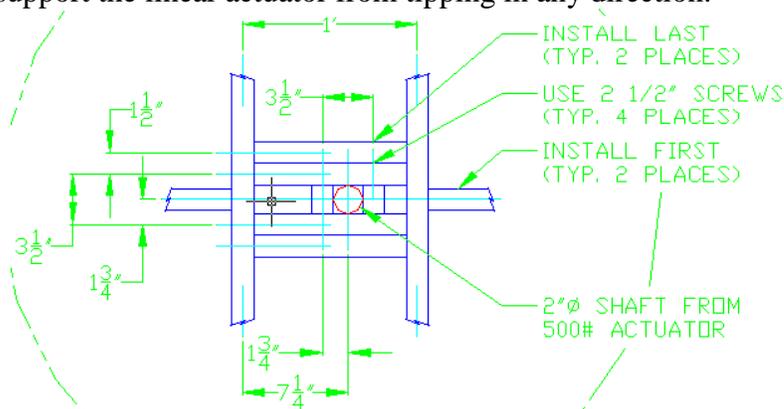


Fig. 2

When a 250 pound person is leaning back 40° in a chair, the force created by their back is 65 pounds (lbf.) A ratio was used to find the force for a 300 pound person resulting in 78 lbf. The chair recline arm had to be shorter on one side than the other so there was a torque created by the recline arm of 117 ft-lbs. This needed to be countered with a force able to push up the person from a reclined position with a 7.625" lever arm. The torque needed to return the chair to the upright position was 184.13 ft-lbs. A 250 pound, 8" extension linear actuator was selected to meet the need of pushing the client back to the upright position.

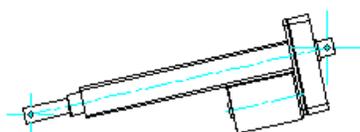


Fig. 3

The smallest industrial linear actuator I could find was rated at 100 pounds at 5 amps. For safety there was a 20 lbf limit put on the wash station extension, so there would be no one squished between the chair and wash station when it extends to meet the chair. In reality putting a 1 amp circuit breaker on this motor resulted in a force no more than 18 lbf before tripping the breaker.

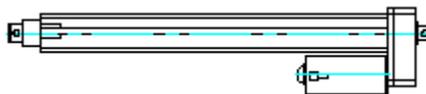


Fig. 4

To rotate the chair a right angle gear motor was selected for its compact size, slow output, and high starting torque. From a 1/17 HP permanent magnet DC motor the resulting output from the 60:1 worm gear is 46 in-lb of torque at 42 RPM. There is a 1.84"Ø rubber wheel attached to the end of the shaft raising the rated torque to 50 in-lb. The rubber wheel was selected to allow for the chair to be pushed out of the way if any problems occurred. This was good for the limited slip but required the wheel to be fixed to the shaft by keying the shaft collars and applying pressure to add friction, so the wheel would not slip freely on the shaft.



Fig. 5

There are several benefits of a permanent magnet (PM) motor which suited my needs well. The ability of the motor to be immediately reversible even while rotating is important because the control of the motor is quickly reversible. Size was a concern for the Home Salon Booth and a PM motor is much smaller than a shunt-wound motor because the solid ceramic magnet replaces all of the windings. This type of DC motor also provides at least 175% more starting torque than what is required during continuous operation [2, 3-8].

The PM motor selected will get the chair moving at a rotational speed of $37.73^\circ/\text{second}$. With the motor running at full speed the end of the rubber wheel will be traveling at 4.04 in/sec. This will get the chair moving quickly, but not enough to throw the person out of the chair. The center of the wheel relative to the outside of the wheel will be traveling at 3.7125 in/sec.

A circular rack and pinion gear set could be used to better handle the high startup torque, but this would not allow for any slip if the chair needed to be moved quickly. There is no way to run a worm gear from the pinion gear to allow the chair to be rotated by pushing the chair.

The chair was designed from 1½" square 6061-T4 aluminum tubing with 1/8" wall thickness. This material has a yield strength of 21 Ksi with a cross sectional area of

.6875 in². To ensure there was no chance for impalement of the client a ¼" thick aluminum plate was welded across the entire bottom of the chair. A 1000 pound 12"Ø lazy susan bearing was attached to the bottom of the plate to ensure good rotation of the chair. To the bottom of the lazy susan is attached a ¼" thick aluminum rotator plate on which the right angle gear motor will rotate the rubber wheel to turn the chair. Another ¼" thick aluminum cam is attached before the 500 pound linear actuator, which is used in conjunction with the 3 limit switches for the logic circuit. Finally the 500 pound linear actuator is cross braced in 4 directions to spread the force out to a 92.5 in² platform for dissipating the force out onto the cam plate.

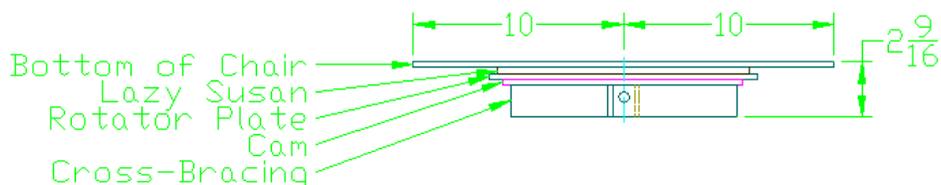


Fig. 6

The finished floor is constructed from standard 2"x4" boards at 1'-0" on center. These are covered with ¾" tongue-and-groove joint plywood with 1 5/8" screws every 6". This was selected because of the booth's modular design, requiring more strength for moving the sections around. The floor joists are constructed using 2"x12" for strength and to raise the booth up enough to fit most of the 18", 500 pound linear actuator inside it. Having a portable floor 15.375" above grade is necessary because of the 18", 500 pound linear actuator must be submerged into the floor. This enables the booth to be set up anywhere that there are power and utility hook-ups. The three wall sections are also made of 2"x4" construction at 1'-0" on center. Two of these walls are finished with 5/8" drywall and wallpaper.

The wash station is retractable to stay out of the way of the cosmetologist, while performing the service on a client. The wash station is operated using the logic circuit, which corresponds to the height setting in the back of the chair. The taller the person is the less the wash station will extend out from the wall. The frame has been custom built to hold the wash station, while sliding on the 100 pound drawer slides. From this extends a dog which actuates the limit switches to stop the extension when it reaches the proper washing position.

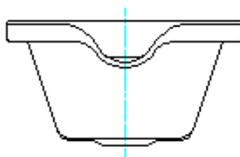
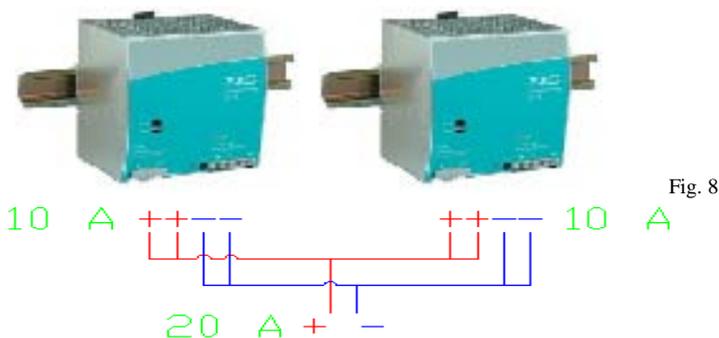


Fig. 7

Available power is a major consideration for the Home Salon Booth. Running any combination of salon tools should not trip the breakers in the breaker box. For this I have installed 3 dedicated 20 amp ground fault circuit interrupters (GFCI). These are available for three reasons: to provide ample available current for the salon tools, to provide 6 outlets to allow the cosmetologist to leave the equipment plugged in to save time, and to protect the user from shock because of dropping any of the equipment into

the wash station. The lighting is run on its own 20 amp circuit so it will not interfere with the equipment circuits. There are 2 other circuits, which are run for the power supplies for the chair motions. Each of these circuits is wired to a 10 amp slow blow fuse before going to each of the power supplies. A house breaker box with a 100 amp main was selected to bring in 220 volts and step the power down to 110 V. This box provides enough spaces to run up to 20 circuits; the Home Salon Booth will use 6 of the available breakers totaling in a maximum current pull of 100 amperes.

The power supplies were selected because of the large amperage need from the 4-24V DC motors. The power supplies that were selected are industrial quality SOLA HEVI-DUTY power supplies. Two power supplies were run in parallel to achieve the required 20 amps at 24 V DC needed for the 4 motors to run all at once. Each power supply is rated to provide 10 amps nominal current with 240 watts, capable of producing 12 amps for up to 2 minutes or up to 2x the nominal current for less than 2 seconds. This will be able to handle any high inrush current needs of the 4 DC motors. The system was designed to run off of 24V DC because of lower voltage in case of electrical shock to the cosmetologist or client.



The four 24V DC motors use various amounts of current, but some are limited by the use of miniature thermal circuit breakers. The 500 lb linear actuator is able to pull up to 11 amps, but the motor is limited to 10 amps. The 250 lb linear actuator has a max current rating of 5 amps and is protected at its maximum. The 100 lb linear actuator can consume 5 amps of current, but is limited to 1 amp for safety. The right angle gear motor has a maximum current draw of 6 amps and is limited to 2 amps. This totals a maximum steady draw of 18 amps from the power supplies. This ensures that the motors are within the normal operating range of the power supplies to enable a long life of the power supplies.

Wiring the logic circuit for the Home Salon Booth was another consideration which had to be considered. There were many places which I looked for wire size gauge requirements. The one that I used was connected with DC power supplies and made the connection between the maximum able to run through each gauge wire and the maximum amperage that can be carried for power transmission. For 10 gauge wire there is a maximum of 15 amps [3], which will be enough to handle the largest motor pulling a limited 10 amps max.

For the rest of the motors and 14 gauge wire was selected to use for its ability to carry 5.9 amps for power transmission [3]. The maximum of the other three motors is

limited to 5 amps. All of the relays were selected to be able to carry 15 amps of DC power through them. There is no need for the relays to overload or overheat and meltdown. This would be a complete failure of any one of the 4 systems of the Home Salon Booth. And even for the logic circuit the 20 relays which were used in conjunction with the 500 pound linear actuator were wired with 10 gauge wire. Each of the limit switches were also selected to carry up to 15 amps of current.

The terminal strips used in the construction of the logic circuit are able to handle up to 30 amps for the power supplies and 20 amps for the 3 small motors. The 30 amp terminal strips were selected to be able to handle any spike or high inrush of current that the power supplies could produce momentarily for all of the motors.

The electrical wire used for the outlets and switches is a 12 gauge, 3 strand (12/3) outdoor wire. This type of wire was selected because of the extra shielding protection to resist any chance of water interfering with the wires. The wires are run out of the way of the wash station, but because the wires are in close proximity to the water it was selected.

There were no problems running the (2) - 10A, 24V DC power supplies for hours at a time. The logic circuit was run roughly 12 times each way per hour without any overheating or problems. Running the system this often is considerably higher than any cosmetologist would use the system. Other than some height adjustment or chair rotation every so often converting the chair to the wash station would only be used up to twice per hour.

Available storage was also a concern for a cosmetologist to store all of their tools in an organized manner. There is an enormous amount of products, supplies, and tools which a cosmetologist needs to perform work on several different people. Two independent cabinet and drawer arrangements were designed to store all of the supplies in [4]. Each has a cabinet, four drawers, and an extending shelf for the cosmetologist to set tools and products on. There is a main countertop and another shelf available to put additional supplies. All of these were made from oak and finished with a pickling stain, which accents the natural color of the wood and makes it look old [5, p. 112]. All of the wood was then sealed with a polyurethane coating to protect it from any water or other chemicals.

PROBLEM ELEMENTS	PRODUCT OBJECTIVES	PERFORMANCE TESTS
Power Service 100 Amps @ 110 V AC	Circuits 20 Amps (Motors) 20 Amps (Lights) 3 - 20 Amp Outlets	Run everything at once.
Outlets near water	Ground fault circuit interrupters	GFCI outlet tester
Retractable Sink	12" Motion (7 N.C. limit switches)	Test positions
Motorized Chair	350° Rotation (3 limit switches for logic) (ON - OFF - ON toggle switch) 12" lift adjustment (6 - N.O. limit switches for logic) (6 - N.C. limit switches for logic) (2 - foot pedals) 300 lb weight limit 40° Recline (2 - N.C. limit switches for logic)	Test positions Rotate chair Test positions Test positions Raise and Lower Raise and lower several times Test positions
Adjustable Back Height	6 - Positions (1" apart) (6 - N.O. limit switches)	Test positions (Chair & Sink follow this setting)
Automation (logic circuit)	One touch controls (convert / return) 28 Relays to route power to motors	Test cycles (convert / return) Run logic
Storage	Drawers and Cabinets	

DESIGN CRITERIA

Incorporated into the Home Salon Booth will be several different functions. The wash station will come out of the side of the salon booth from a concealed position, which will not interfere with the cosmetologist during the rest of his/her services. With this will be an automatically adjusting chair, which will position the person for washing their hair by rotating, reclining, and adjusting the chair height. The chair will also move up and down with the use of foot pedals. Most of the functions will be controlled by linear actuators to provide steady smooth transition between the desired positions.

My initial customer will be my fiancé who will use this fully functioning prototype salon booth. This project could be used anywhere in a salon or be a convenient way to put a small salon in a home. Several of these stations could be arranged together saving on space and allowing more convenience to the stylists.

My parents will be the sponsor for my project throughout its design and assembly. I plan to keep the project when I am finished for use in my home. Technical Solution Specialists donated 2 - 24V DC, 10 amp power supplies for my project.

The project will encompass a floor space area of around 63 square feet (6'-4"x10'); this will allow the station to be moved into any location with a standard door opening. There will be a floor built to hide the base of the chair and the power lines, which will run up through the center of the chair. The whole assembly will be built in modular sections, which will enable the booth to be disassembled to allow the system to be transported.

A certified cosmetologist and I will test the retractable wash station prototype. These results will be monitored for preciseness and for accuracy of the system's ability to achieve the desired positions set for the system. Further measuring and testing can be devised to assure the system functions properly.

The wash station will move up to 12" out from the side of the salon booth to reach out towards the chair. The wash station will be stowed for the rest of the time to keep it out of the way of the cosmetologist while working. The chair is designed from scratch and will have an adjustable height back, which will recline to facilitate washing the hair. Motion will be controlled using a logic sequence and also by manual controls, which will automatically or manually adjust the retractable wash station and salon chair.

According to the census bureau there are 293,406,589 people living in the United States [1]. Most people do not cut or color their own hair; they leave that to trained professionals. People get their hair cut several times each year. Some older women get their hair styled by hairdressers up to once per week. All told the cosmetology industry in the US alone does over 1 billion haircuts per year. This is a huge industry and a continuously growing market.

Logic Description

The logic for the system will be governed by the manual setting of the chair back height adjustment set by the operator to match the person's shoulder height. This will have a corresponding sink extension to match for each height selection. There will also be a height adjustment to bring the chair to the proper level for washing. Then the chair rotation logic from the cam under the chair will decide the fastest way to rotate into position to align the client's head up with the sink. The chair back will also recline, but it will only have an up and a down position.

The reverse action is somewhat simpler because there will be no concern to the chair height when it returns the person to the upright, front facing position, while retracting the sink into the stowed position.

Set logic

Back of chair (Manual Settings for Shoulder Height)

-6 NO limit switches which only one can be set at any given time.

Follow logic

Base of chair (Chair Height)

-6 NC limit switches to adjust the chair higher if it is required for converting.

-6 NO limit switches to adjust the chair down if above the required position for washing.

Base of chair (Chair Rotate)

-2 NO limit switches to find the fastest rotation to line up with the sink.

-1 NO limit switch to align the chair so it faces the vanity again.

Base of chair (Recline / Upright)

-1 NC limit switch that will recline the chair into washing position.

-1 NC limit switch that will return the chair back to the upright position.

Wall (Sink Extension)

-6 NC limit switches to adjust the sink to the proper extension.

-1 NC limit switch to bring the sink back into the stowed position.

Once the shoulder height has been selected and the operator hits the convert switch the booth will adjust the 4 appropriate settings automatically. The logic will start with all adjustments simultaneously until completion of each individual motion.

The **chair height** will be determined by the use of 2 limit switches for each setting. The first limit switch is NO, which will bring the chair up until it rides off of the housing of the 18", 500 pound actuator and breaks the circuit. The other in the pair will be NC, which will only be closed if the chair is above the housing of the linear actuator directing the actuator down. Each one of these pairs will correspond to one of the height adjustments set by the cosmetologist at the client's shoulder height.

The proper **chair rotation** is achieved with 2 NO limit switches that will be mounted 180° apart on a cam. This cam will have 2 diameters, which will close one of

the limit switches and activate the motor in the proper direction to align the chair with the sink. The third NO limit switch will be placed 90° from either on the raised part of the cam, allowing it to return the chair to the front facing position.

To **recline / upright** the chair there will be 2 NC limit switches. One will be placed at each of the extremes and will break the circuit once the chair back has reached the corresponding position.

For the **sink extension** there will be 6 different positions of extension and one for the retracted position. All of these will be NC limit switches, which will run the linear actuator in the proper direction until it reaches that point.

Relays will be used in conjunction with all of the limit switches except for the 6 in the back of the chair. These will only act as switches that will control the rest of the logic. The relays will allow direction of the polarity, which is sent to the motors to control direction. Each relay will have a latching circuit and 2 available output circuits. This results in 6 wires for each relay. The Home Salon Booth will only use the NO contacts on the relays. Once the relay is activated it will stay latched as long as the input current stays above a minimal level. The outputs can be either NO and NC, or both of one. If more logic is required then there will be a second relay attached to one of the NO sides of the primary relay resulting in one extra control for twice the price.

The relays will be mounted behind the wall, which houses the retractable wash station. This is necessary because of the back and forth routing from the power supplies to the motors and back to the power supplies. There are 23 limit switches in the chair, which require 17 relays to control the logic. The 7 limit switches that are used for the wash station will require 7 relays to adjust along with the chair back setting.



Fig. 9

The basics of wiring a relay up to run the logic for motor control of the DC circuit is as follows: For DC to operate correctly there must be a ladder diagram style of wiring. Positive power is routed to a limit switch, which, if current can pass, will activate a corresponding relay, latching the DPDT contacts until the limit switch state changes, breaking the circuit. The power must then be routed back to the power supply on the negative circuit. Positive power is then wired into one of the NO circuits of the relay and routed to the positive motor polarity. The corresponding NO on the same relay comes from the motor's opposite polarity through the relay to the negative power circuit.

To run the motor in reverse the wiring is a little different. The limit switch still works the same, latching the relay in the activated position, then wired to the negative circuit. One of the NO circuits on the relay comes from the positive circuit to the relay, and then out to the negative motor polarity. The positive motor polarity is then run out to the relay and then routed to the negative power circuit.

For control of the Home Salon Booth I wanted to make things as simple as possible. One major 20 amp DPDT toggle switch was installed to run the booth through the convert / return motions. This switch, when turned on, routes the power either to the convert side, which connects the power supply positive to 30 terminals and the power supply negative to 42 terminals or the return side. This will allow the logic to run for converting the chair into the washing position. The positives are hardwired to 9 limit switches and the other 21 go to NO contacts on the relays. The negatives are wired to 21 relays and 21 NO contacts from the relays. There are more relays on the negative side because of the 6 limit switches in the back of the chair to three limit switches each before their corresponding relay.

Switching this to the return side is much less complicated for the logic. Power is routed to three motors instead of all four. There are only 3 relays looking for one specific position each.

The only other functions of the circuit will be control of the chair height with the use of foot pedals and the chair rotation, which will be controlled with a SPDT toggle switch. These functions are always hooked directly up to the power supplies for adjustment at any time.

The power supplies purchased came with 2 positive outputs and 2 negative inputs each. All of the positives were put on the same circuit and all of the negatives were also put on the same circuit. Wiring the power supplies in parallel resulted in 20 amps at 24V DC. The power supplies can also be considered regulated transformers because they run off of 110V AC and output an adjustable output from 24 – 28V DC. These were tested with a digital multi-meter and adjusted to read 24.00 volts.

BUILD AND TEST

Assembling the Home Salon Booth will require the booth to be constructed in modular sections to enable the booth to be dismantled and moved from place to place. This is accomplished by having each of the major sections strong enough to hold the weight which will be added to them and be able to survive the stress of moving the sections around. Once all of the sections are constructed the task of wiring presents itself. Wires will be run in and out of the chair out of a hole in the middle of the floor; also each wall section will have outlets and switches attached to them for control and power. These will also need quick connectors for assembly.

The entire construction of the Home Salon Booth must be easily dismantled for transport. The 3 times that the booth was dismantled it took 4 people 30 minutes to completely tear down the booth. Moving the salon booth required a 16 foot box truck with at least 7'-0" under the door. Due to the sheer size of the booth and the weight of its components, the Home Salon Booth should be handled with at least 4 people. To enable a long life, durable parts and detailed labeling on the wiring will be required for the booth to be transported to its new resting place, again and again.

An assembly instruction manual will be included with the booth to ensure that it is assembled properly and consistently. The assembly instructions will be included later in the report, see Appendix A.

Testing of the project will begin with the functionality of the chair. The chair has 6 distinct back height positions with the ability to manually adjust to each position, which sets the logic for the rest of the booth to follow. These will be tested for accuracy of position and their ability to match the positions over and over again. Alignment of the chair with the wash station will be the concern for the testing stage. The chair will adjust the height, while turning, and reclining, while the wash station is extending to meet the back of the chair. These positions will be measured relative to each other and the results documented. The results will be analyzed to determine the precision of their movements in conjunction with the other moving parts.

Proper testing will be conducted when the system works together consistently and accurately. Once the booth has met these specifications statistical data can be graphed and charted to show the accuracy of the system. Details of the actual specifications are included in the performance objectives.

PERFORMANCE OBJECTIVES

The Home Salon Booth goals or criteria are reasonable. This project will be made in its entirety to full scale and will be able to be used and tested.

-Speed is a concern for the retractable wash station salon booth project. The operator would not want to crack someone in the head with the wash station when they are getting their hair washed, but the wash station can not creep along taking up time while changing positions. The salon booth completely change positions from any starting point to the reclined position at the wash station in less than 15 seconds.

- The testing of the Home Salon Booth will use measurable acceptable tolerances, which the chair and wash station must perform when starting in the various positions. Control within ½” of the desired position in any direction is where the chair and wash station must align to be considered reasonable accuracy for this prototype. The data collected from measuring the alignment of the wash station and chair can then be charted on a spreadsheet to see the spread of the data collected. These numbers can then be used to make statistical charts to show the distributions of the measured distances. To achieve a normal distribution of data there needs to be 30 tests from various positions to get good results from the testing procedure.

- Weight capabilities will be tested for the chair. The chair will be designed to accommodate a person weighing up to 300 pounds. After the retractable wash station salon booth is built it will be tested to lift the required weight from the down position to the up position 10 times. This will be timed to see if the system is meeting the required speed while under full load. The rotation will also be tested 10 times to ensure that the chair can perform the required rotation while loaded to its maximum design weight. There will be a safety factor designed into the frame and support of the chair of around two, to ensure that it will not collapse or break under the designed load.

- The objectives set for the Home Salon Booth include position accuracy, reliability, strength requirements, and simple easy to operate controls. Reliability will be provided by the testing processes. The reliability will be determined by the systems ability to perform the desired tasks throughout the testing process and beyond. The controls will be tested on five people who have not seen the project before and have no instruction how to operate the system to see if they can perform the functions of the chair. I will determine if the subjects can control the Home Salon Booth by asking them to perform functions of the chair with out prior instruction and seeing what they do. If they can perform these tasks, it will be determined that the controls are simple enough for anyone to use.

- Power supply is also a crucial requirement for the Home Salon Booth. The system's ability to operate multiple salon devices simultaneously as well as provide the adequate lighting system is going to be measured for performance. In

a salon there are several devices used: hair dryers, multiple size curling irons, straightening irons, and crimping heat irons. All of these pull a lot of amperage because most of them run on electrical resistance and need a lot of power. In addition there will be 18 lights mounted in the booth, which will be pulling 720 watts. There will also be three DC motors, which will pull current from the systems power supply. The system will be designed to run most of these tools at once without breaking circuits. The Home Salon Booth will be tested at full load of the system as well as running all of the necessary equipment and lights at once. The system will be designed not to buckle under full load.

-Proper grounding will be essential in this project. Two systems are needed to properly assure that there is no risk to the users while in use. There will be GFCI circuits for the wall outlets as well as in the breaker box of the salon booth.

-The retractable wash station will have six extended positions and one concealed position that it must achieve. These positions will be measured for accuracy and precision within ½” tolerance.

-The chair will have 16” of vertical travel and will be able to move from 14” above the floor level to 30”. This enables the cosmetologist to have a wide range of chair heights for performing work.

-The back of the chair will have six manually adjusted settings 1” apart to compensate for various size adults. This will have to be set by the cosmetologist prior to converting the chair into the washing position.

-The chair must recline roughly 30° to allow for the wash station to be used. This will be measured for the prototype’s ability to achieve the desired position.

-The booth must have areas which are heat resistant so there is no need to worry when using the curling irons.

-The wash station must not exceed 20 lbf when extending out from the wall. This ensures that no one is at risk of being squished when the system is converting.

Home Salon Booth Testing Results

Testing results from operating the Home Salon Booth
(Speeds are linear due to the linear actuator's constant speeds)
(Time shown in red are the extreme convert times. (15 sec. max))

Position 1: lowest back height, highest chair height, and furthest wash station extension.

Position 6: highest back height, lowest chair height, and least wash station extension.

Extreme Converting Times:

	Position:					
	1	2	3	4	5	6
Wash Station Convert Time (s):	11.5	11	10.5	10	9.5	9
Wash Station Extension (in):	11.5	11	10.5	10	9.5	9
Chair Height Convert:						
15" Above Floor - to - Position (s):	9.4	10.3	11.2	12.15	13.1	14
Chair Height Lowering (-in):	7.8	8.6	9.4	10.1	10.9	11.7
At Floor Height - to - Position (s):	8.6	7.7	6.8	5.9	4.9	4
Chair Height Extension (+in):	7.2	6.4	5.6	4.9	4.1	3.3
Chair Recline Convert (s):			8.6			
Chair Recline extension (in):			4.75			
Chair Rotation (180° max) (s):			4.77			
Chair Rotation (180° max) (in):			19.25			

Converting positions were very constant due to the limit switches being permanently fixed on the booth.
(statistical curves were unnecessary due to the constant positioning using the limit switches.)

Chair Rotation was short by 2-4° from center of the wash station when rotating CCW.

Chair Rotation was long by 1-3° from center of the wash station when rotating CW.

(this was due to the cam under the lazy susan and the quick stopping of the right angle gear motor)

Weight Lifting Abilities (300 lb. max):	No issues or problems with weight lifting capabilities.		
(+15" travel)	time (s):	19.5 (1.3 s/in)	S.F. = 1.67
(-15" travel)	time (s):	18 (1.2 s/in)	

(Raising the chair height actuator loaded to the design limit slowed the actuator from .83 to .77 (in/s)

Simple Controls: (Convert/Return switch, CCW/CW switch, Raise/Lower foot pedals)

(no prior instruction)

	Convert/Return switch	CCW/CW switch	Raise/Lower pedals
Subject 1	(correct)	(correct)	(correct)
Subject 2	(correct)	(correct)	(correct)
Subject 3	(correct)	(correct)	(backwards)
Subject 4	(correct)	(backwards)	(correct)
Subject 5	(correct)	(backwards)	(correct)

(The Convert/Return switch was labeled leading to no confusion between the positions.)

(The CCW/CW switch was labeled but 2 of the subjects did not think of which way was which.)

(The Raise/Lower pedals were placed w/ up on the right leading to little confusion with one subject.)

The wash station was restricted using a 1 Amp circuit breaker on a 5 Amp motor resulting in the motor tripping the breaker at around 18 lbf. This was measured using a weigh scale planted on my hip and watching how far the scale went up before the motor quit pushing. This is considered safe for anyone operating the Home Salon Booth to have no fear of being squished between the chair and wash station. The 24V DC **Power Supplies** performed with no problems for over 4 hours multiple times.

Table A

EXISTING PRODUCTS AND DESIGNS

In the hair cutting industry there are many styles and arrangements of wash stations and the way salons use them. There are also several different types of salon chairs, but putting them together in the same place for speed and ease of accessibility, is needed in the salon industry. The proposed design of the retractable wash station Home Salon Booth will enable better operations than the current systems.

Different salons have their own procedures, including the way they go about washing the client's hair. An approach is to have a line of wash stations with chairs already reclined for the person. There are salons which have beds on which the client lays down in while getting their hair washed. Some salons have portable wash stations, but the station can not move very far when it is attached to the utility hookups.

There are a few chairs, which can get very low to the ground some are controlled using a scissor lift but these chairs will not reach very high above the ground. There are other chair designs, which use hydraulics, either pump powered or by manual action, very few of these types of salon chairs even recline. There is spa and dentist chairs, which will recline, move up, and down but do not orientate themselves for a procedure. There are unlimited different chair designs all with their own different features in the world, I will design this one to meet the specific needs of my procedure.

The proposed automatically adjusted wash station design has not been used in the industry. The wash station must stay retracted to keep out of the way of the cosmetologist while performing their services. When performing color treatments or other salon services to a customer, each cosmetologist needs their own workspace including a wash station, to wash the client's hair when receiving service. Time is wasted while the pair is walking back and fourth from the hair cutting station to the wash station. Service to the customer is compromised.

There are many chair designs out there but this proposed design is unique. Linear actuators are a common throughout industry. They provide good steady linear motion and do not require much power to run them. These along with a right angle gear motor will control the chair and wash station motions. Each of the functions will run on its own 24 volt DC motor and some will have controls to move them. The other functions including the chair recline and sink extension will only move when the convert / return switch is activated. Using a logic circuit to route power to the motors the chair and sink will adjust automatically when a switch is hit to meet the required positions.

RECOMMENDATIONS

There were few problems with the Home Salon Booth, but during assembly and transport, design improvements were identified to better meet the requirements for the booth.

The first issue which could have been designed better is the need for a cable tray and quick connection bars which have up to 50 inputs and outputs. The cable tray would have provided a better representation of exactly how much wire was going to be consumed. The Home Salon Booth consumed 950' of 10 gauge wire, 750' of 14 gauge wire, and 70' of 12/3 outdoor shielded wire. For a salon booth with a footprint of 10'-0" x 6'-7½" this is an enormous amount of wire. The logic circuit was completed, but the wire added most of the extra cost to building this project.

The chair was not fastened tightly to the 500# actuator. The very small gap between them allowed the chair to wobble when someone sat in the chair. This was not unsafe but was undesirable for the person sitting in the chair. The best way to fix this problem is to have a large thread diameter on the bottom of the chair and attach this to the actuator in the vertical direction, instead of putting a bolt through the hole at the bottom of the cam plate horizontally.

The right angle gear motor has a high startup torque when changing directions. The resulting torque from this motor was up to 50 in-lb, which made the original rubber wheel wear out its inner diameter and start to slip on the shaft. For safety reasons this design was selected because if the chair tried to squish someone it could be easily pushed out of the way with little force. The rubber wheel selected has no inner collar which could be fixed to the shaft. To overcome this problem a shim was machined and wedged into the inner wheel diameter locking the wheel to the flat part on the shaft. To better handle the torque a circular rack and small pinion gear would have transmitted the force better. The pinion would have the ability to be locked onto the shaft better.

Other concerns with the booth are the shear weight and the booths ability to be moved easily. It can fit through any standard door frame but proved to be fairly heavy to be tossed around on a regular basis such as EXPO weekend. Assembly and disassembly did not have any problems but required a large truck and crew. To lighten to load some 1"x12" boards could have been used for the floor joists to cut some of the weight in this section. Thinner drywall boards could have been used than the selected 5/8" thick drywall, dropping the weight on 2 of the wall sections.

All of these modular sections were built to last the extra stresses of being tossed around, also for long life of the booth itself. A permanent installation of the Home Salon Booth could benefit from using lighter building materials.

CONCLUSION

Wrapping up a senior year, the Home Salon Booth applied much technical knowledge and experience into a complete package. The building of the Home Salon Booth was challenging and required quite a bit of time but gave me the design experience of putting all of the pieces together. Building a project of this magnitude involved careful planning and detailed drawings to insure production of this type of system again and again.

More modifications could be made to make the modular design more mobile. It was interesting to accomplish and surprise the faculty, which were concerned about the booth's ability to be moved. This is also helpful because the booth will be moving several times in the next few years. Hopefully the durable construction and industrial quality products will stand the test of time and service to last for many years to come.

There could be many other systems able to perform the motions at an unlimited basis within the design specifications. Using a computer and precise measuring equipment on all of the motions the booth would enable adjustment to many more different size individuals than the six of the design. Sensors or proximity switches could replace all of the limit switches allowing for a longer wear life. There are several systems which could have been replaced with better systems. All it takes is money.

The cost of the bill of materials for this project was within a very reasonable price of having all of this equipment inclusive in the Home Salon Booth environment. The only things that were not included were the plug in tools, products, and scissors. The rest of the salon environment, including the 3 function chair and retractable wash station, was included in the package. The Home Salon Booth is a simple investment for someone looking to perform salon activities in the comfort of their own home.

DIRECTIONS FOR ASSEMBLY

INITIAL SETUP

The floor joists must be positioned in the proper orientation to allow the 2 walls to be where the user wants them but the utility wall must be near hot and cold water hook-ups, a drain, and the 220V AC power supply. This position is adjustable considering all of the water attachments are on flexible hoses and power cords can reach anywhere. The walls can hide all of the hardware and electrical wiring if positioned right.

Once the floor joists have been arranged the 500 pound (#), 18" stroke linear actuator must be set at the proper north to south dimension (see dwg. 401 for details.) There are 2 1/2" threaded rods which need to be inserted into the holes in the bottom of the floor joists and coupled together. Once these are sticking out the sides of both floor joists attach the nuts and with a tape measure line up the actuator vertically to be on center 38.75" north of the south side. This actuator must then be temporarily supported under the motor to point the actuator up as straight as possible.

The power wires labeled for the 500# actuator (M1) must be run from the motor out to the side with the utility wall. These wires must be able to reach the logic circuit when it is mounted later.

SUB FLOOR

Once this is in place the sub floor section must be maneuvered into the proper orientation corresponding with the floor joists (see dwg. 405.) Make sure that all of the wires are coming out through the hole in the floor toward the top of the sub floor. There is a strap which holds all of the wires together and from falling through the floor while setting the sub floor on top of the floor joists. Using 4 people lift the sub floor over the top of the 500# linear actuator and slide the sub floor down the actuator until it is in place on top of the floor joists.

CHAIR SETUP

There are (4) – 3/8"Ø 24" long rods which are threaded up to 10" down one side. These must be inserted into the 4 corresponding holes surrounding the 500# linear actuator with the threads extending out from the floor. Once these are in place check the extension of the 500# actuator and see if it is at least 12" extended. This will allow for more room when installing the chair onto the 500# linear actuator. If the actuator is not extended enough it can be rotated CCW until it reaches the desired length.

Two people must grab the chair from one handle each and one person must guide the limit switches onto the 500# linear actuator first then followed by the chair. There is a 1/2"Ø x 2 1/2" long bolt, which connects the chair bottom to the actuator. Once this is secured the two people can release the chair. The limit switch rack for the chair height must have the 4 rods inserted into the bottom of the rack in the proper orientation (see

limit switch rack for details.) (4) – 3/8” nuts must be threaded completely down the 10” threads, which are extending from the floor. They will secure the rods onto the limit switch rack by pushing the threaded end of the rod up into the hole on the bottom of the top plate of the limit switch rack. The limit switch rack must then be mounted to the bottom of the chair with 4 machine screws.

WALL SECTIONS

The wall sections should be set up next. First set up the side wall by sliding the section into the cutouts, which are west of the east side (see dwg. 401.) Continue to hold the wall section until the main wall is set in place and bolted to it. The main wall runs along the north side of the floor joists. The top of the sections, where they meet, requires a 1/4” x 3 1/2” long bolt to keep it in place. Once this is installed there are two screws, which fasten the main wall to the floor joists. The utility wall can now be put into place at the east end of the booth. This again needs to be fastened to the main wall with a 1/4” x 3 1/2” long bolt. Finally a brace spans the distance between the side wall and utility wall which needs to be fastened to keep the walls from moving.

WASH STATION

The wash station drawer slides must be installed from the inside of the booth sticking the retracted side in first through the hole. This is secured to the walls with (4) - 1/4” x 3 1/2” long bolts, 2 on the side wall and 2 on the utility wall. The limit switches must then be mounted under the sink drawer slide with 2 more bolts. Extend the drawer slides to the furthest position.

Mount the 100# linear actuator between the wall joists using the 14” steel rod. Once this is attached then mount the free end of the 100# linear actuator to the bottom of the sink drawer slides with a 1/4” x 3” long bolt. The wash station can now be mounted onto the drawer slides and the plumbing can be installed. The temperature control knob must be mounted to the sink in the corresponding hole. This has a screw clamp which must be removed before mounting and then tightened to hold the knob in place. Next the hoses from the side wall must be hooked into their corresponding hot or cold side of the temperature control knob bottom. These are pressure fittings, which must be pushed onto the copper pipe as much as possible then the nut must be screwed down to tighten the connection. The flexible washing hose must then be screwed into the bottom of the temperature control knob once it is fed through the other sink hole.

The drain can now be installed on the bottom of the sink. Unscrew the bottom mount and feed the 90° pipe through the bottom of the sink directing it toward the side wall. Then feed the mount around the pipe to the bottom of the sink and screw until very tight securing the drain with a good seal. The drain flexible hose can now be run from the drain adaptor to the side wall.

WIRING

The electric box and fuse panel should be mounted to the north side of the back of the side wall and secured with (2) ¼” x 3½” long bolts. This wall holds your power hookups for the power supplies and wall outlets. The 4 – 12/3 outdoor cords can be run to the 3 outlets and to the light switch connecting each circuit with 20 amps each. The cords run to the outlets each have quick connects and the order is not important. The fourth cord will need to be wired up to the switch and secured with wire nuts.

The logic circuit can now be placed under the electric box and fuse panel. There will be various wires which must hang out to the left when the logic circuit is installed. The (2) - 10 amp, 24 V DC power supplies can be wired up to the logic circuit by inserting all of the eight 10 gauge wires into the proper polarity outputs of the power supplies. The 500# linear actuator can be connected as well. These wires should be coming out from the center of the floor joists under the side wall. Several other wires need to be quick connected at the logic circuit and at the base of the chair. The wires in and out of the chair include:

•BC1I – BC6I	(back of chair limit switches in)	(6)
•CH1A – CH6A	(chair height limit switches out)	(6)
•CH1B – CH6B	(chair height limit switches out)	(6)
•SE2 – SE7	(sink extension out to limit switches)	(6)
•CRO1I – CRO3I	(chair rotate limit switch in)	(3)
•CRO1O – CRO3O	(chair rotate limit switch out)	(3)
•CRE1I – CRE2I	(chair recline limit switch in)	(2)
•CRE1O – CRE2O	(chair recline limit switch out)	(2)
•M3+, M3-	(motor 3, recline control)	(2)
•M4+, M4-	(motor 4, chair rotate control)	(2)

These wires must also be connected to the logic circuit from the bulge of wires which comes out from the sub floor to the side wall. The wires coming from here labeled SE must first go to the sink extension limit switches and then there are wires, which come from these limit switches and get quick connected at the logic circuit. Motor 2 should be connected to the logic circuit as well.

Once all of the wires are installed a band should be wrapped around the wires coming out of the hole in the sub floor on both sides of the wire connectors. These should then be coupled together with another band which will relieve any stress of the wire connectors from separating. Then the wires can be pushed down into the floor as much as possible to hide them and to avoid any hazard of tripping over them. When the chair is in operation this group of wires will slide in and out of the floor along with the chair height or extreme rotation. If for some reason the wires get stuck, jostle or kick the bulge and relieve the point that the wires are caught on.

All of the quick connectors are fully shielded so there is no concern for insulating the connection points. These should be wrapped tightly to allow the wires to slide freely without the concern of snagging a single connector on something.

CABINETS

There are two major cabinet sections which need to be placed at the end of each of the wall sections. The cabinet with one large door should be placed at the left side of the main wall along the edge of the floor line. The second cabinet with two doors should be placed on the right side of the side wall. This should align with the outer edge of the booth as well. The smaller shelf should be placed on the left side of the sink drawer slides as close as possible. There are 2 legs for the countertop which need to be placed on the side of the small shelf and the first cabinet with one large door. The countertop should now be placed on the two legs and the support which runs along the main wall. The shelf and cabinet should be arranged to take up the remaining space and appear to be all one piece.

SELECTING A CUSTOMER

All Customers:

- Salon Owners
- Cosmetologists
- Home / Personal Use
- Hair Show Booths

Key Customers:

The Key customers for the project will be salon owners and for personal in home use. This product is a simple way to get the whole salon package nicely compacted into one unit.

Size of the project is critical for the customers, because most businesses are concerned about floor space and to put this system in your home will also require a compact design. Most homes do not come equipped with hair wash stations and people must resort to uncomfortable positions under a standard sink or shower to wash their hair before cutting or to remove product from the hair.

Key Customer:

My key customer for this project will be the designer's fiancé. She will be utilizing the system to enable her to perform salon activities in their home. The existing process for this task is not convenient and would benefit greatly from having this type of system in place.

User Survey Attributes for Data Collection:

- Safety -The system operates in control and under code
- Easy Operation -Simplistic and user-friendly controls
- Noise -How loud the project will be
- Appearance -Based on customer appeal
- Cost -Monetary value of the project
- Benefits -Amenities for convenience
- Reliability -Performance criteria
- Value -Relative to other options
- Function Interests -Desired abilities of project
- Appeal of project -Interest in project

Measurable Data for Survey:

- Safety -Rating of importance for system to be safe
- Easy Operation -Rating of desire for simple controls
- Noise -Desired level of noise while in operation
 - Rating of existing environment noise
- Appearance -Choices of desired look of project
- Cost -For comparable price, customer still interested
- Benefits -Is the product valuable to the customer
- Reliability -Rating of performance expectations

Value -Does the customer see effectiveness in this project

Functional Interests -Importance of one touch control

-Interest in amount of controls available

-Interest in extreme positions

Appeal of Project -Does the project interest the potential customer

How to Achieve Customer Satisfaction:

Simplicity -Having minimal easily accessible controls where needed

Durability -Design the project to high standards and criteria

Low Maintenance -Cosmetologists do not want to service a machine

Low Cost -Customers are willing to pay for quality and functionality

Safety -System must be safe to operate

SURVEY

This survey is for finding desired attributes for a Salon Booth with a Retractable Wash station and Motorized Chair. The project itself is a salon booth, which has a retractable wash station on the side of the stylist chair to enable the cosmetologist to wash the clients' hair quickly and easily at their own station. The questions answered in this survey will help me in deciding how to design certain aspects of the project. Thank-you for taking the time to input your opinions for this survey.

For this survey the rating values will range from 1 to 5. 1 will be a low rating or of minimal importance, where 5 will be a high rating or one with great importance.

Salon Booth easy to operate?

Not Very Important	1	2	3	4	5	Highly Important
--------------------	---	---	---	---	---	------------------

Would you Benefit from using this type of Salon Booth?

Not Really	1	2	3	4	5	Yes, Definitely
------------	---	---	---	---	---	-----------------

Is the existing process undesirable to execute?

No it is Fine	1	2	3	4	5	Yes, Definitely
---------------	---	---	---	---	---	-----------------

Rating of the importance of safety in your salon environment?

Not Very Important	1	2	3	4	5	Highly Important
--------------------	---	---	---	---	---	------------------

What is the relative amount of hair washing required?

Occasionally	1	2	3	4	5	Every Person
			Half of the Clients			

Relative noise typically in the Salon Environment?

Very Quiet	1	2	3	4	5	Very Loud
------------	---	---	---	---	---	-----------

Would added noise be Undesirable in Salon?

Not Really	1	2	3	4	5	Yes, Definitely
------------	---	---	---	---	---	-----------------

Your opinion of desired look of booth?

Simple, not lavish	1	2	3	4	5	Very Fancy
--------------------	---	---	---	---	---	------------

Is Reliability a concern in deciding to use this product?

Not Really	1	2	3	4	5	Very Important
------------	---	---	---	---	---	----------------

Yes or No Questions:

Does this project interest you?

Would you benefit from the ability to use multiple controls?

If comparable in price, would you be interested in purchasing this product?

Is there a need for this product in the salon industry?

Comments:

Thank You ☺

DISCUSSION OF RESULTS FROM SURVEY

For my senior design project I am designing a Salon Booth with Retractable Wash station and Motorized Chair. After writing the survey they were distributed out to a graduating class of salon students. The subjects who were questioned for my survey were women in the range of 18 to 25 years old and all will be entering the work force shortly. Most of the results obtained were positive and will be helpful in making some of the design decisions later in the project.

The salon booth being easy to operate is a heavily desired trait, which the cosmetologists want. Being very busy is not a time to be confused about how to operate the chair needed to manipulate the client to perform their tasks.

I asked the cosmetologists if they would benefit from this type of salon booth and the results were very good. Most of them sound interested but without seeing or using such a product one cannot truly judge its advantages.

The existing process was shown to be somewhat undesirable by the numbers. Some of the cosmetologists are used to the traditional ways of doing things and are not up for change. Most feel that is a hassle to bring the client into another room to wash their hair and then return them to the booth for the drying and styling. Only one person felt strongly that the existing process was just fine.

The importance of safety in a salon environment is rated highest on my results. This is why I intend to design a powerful system capable of handling all of the necessary equipment used by the cosmetologist. As many safety implements as possible will be added to make the Salon Booth as safe as possible.

People who visit a salon are usually getting the full treatment unless they are in just for a quick styling by the cosmetologist. Women usually get their hair at least partially colored which requires a wash afterwards to remove the chemicals, which are in the hair. Most of the people answered that everyone receives washing treatment when visiting a salon.

The relative noise in the salon was moderately high but not overbearing. When there are 10 women going to town with hair dryers, running water, and gabbing all at the same time the environment is bound to be pretty loud.

Adding noise to this environment would also not be desired by the cosmetologists. Also the client would not like to hear loud noises other than the ones inherent already in a salon.

Most of the people questioned in this survey thought that the booth should look good but not all said that it should be too fancy. This will be taken into consideration when I design my salon booth. I want a nice professional look from my design.

Reliability is a big concern with the decision to use this product. If it fails in any way the cosmetologist might not be able to perform their. This would make the salon booth a huge paperweight. The design must work properly and accurately again and again. Adequate testing of the project to ensure that it functions properly and without default is essential.

All but one individual surveyed was interested in my project and thought that they could benefit from using it. All but two people would consider buying this product if it was on the market or thought that there was a need for this type of salon booth at all.

The only comment was to make sure that the wash station has to be out of the way of the cosmetologist. This is already designed with the retractable wash station and should perform without hindering the motions of the cosmetologist.

This survey has collected opinions on the Home Salon Booth and the functionality that should be emphasized on during the design process. It seems to be a desirable product to those in the field of cosmetology.

This project will consider every aspect of the design, making all of the features on the design easy to use and durable for long lasting life. This product must also be safe to use and also safe for the whole salon environment. The design will also be concerned with the cosmetics of this salon booth. If it were introduced into the market it would not make it if it could not jive well with the normal salon environment, which is elegant. A lot of money is spent in a professional salon, and people expect their surroundings and equipment to be top notch. The customers who receive these services want to be pampered and feel like they are in a nice environment so it is a necessity to design the salon booth to look good, be very tasteful, and comfortable.

Tabulated results can be found in Appendix B-6 (table B) for the survey.

RESULTS OF USER SURVEY

Results of the User Survey									
Survey	Question								
#	1	2	3	4	5	6	7	8	9
1	5	3	5	5	5	5	5	5	5
2	4	4	5	5	5	5	5	4	4
3	5	5	5	5	5	5	5	5	5
4	5	4	4	4	4	3	3	4	4
5	5	4	4	5	4	5	4	4	3
6	4	4	4	5	4	5	5	4	4
7	2	4	4	5	5	3	5	4	5
8	5	5	5	5	5	5	5	5	5
9	4	5	5	5	4	5	4	4	5
10	5	5	3	5	5	4	4	3.5	5
11	5	4	5	5	5	4	4	3.5	5
12	5	5	5	5	5	4	5	5	5
13	5	5	4	5	5	4	4	4	5
14	4	5	2	5	5	3	3	3	5
15	5	5	3	4	4	3	1	3	5
16	5	4	3	5	5	5	4	3	4
17	5	3	3	5	5	5	5	3	5
18	5	5	1	5	5	4	3	5	4
19	5	5	5	5	5	4	3	5	5
20	4	4	3	5	4	3	5	4	3
21	5	5	4	5	5	5	5	5	5
22	5	5	3	5	5	4	2	4	5
$\Sigma =$	102	98	85	108	104	93	89	90	101
$\sigma =$	4.636363	4.454545	3.863636	4.909090	4.727272	4.227272	4.045454	4.090909	4.590909

Yes No Questions		
#	Yes	No
1	21	1
2	21	1
3	20	2
4	20	2

Table B

Budget

Lumber:	Price ea.	Quantity	Total	
2"x4"x8'	\$2.55	32	\$81.60	Walls
2"x4"x10'	\$2.88	2	\$5.76	Walls
2"x8"x8'	\$7.13	1	\$7.13	Floor Joists
2"x8"x10'	\$9.58	2	\$19.16	Floor Joists
2"x12"x8'	\$10.76	1	\$10.76	Floor Joists
2"x12"x10'	\$12.60	5	\$63.00	Floor Joists
4'x8'x3/4" Plywood	\$28.29	2	\$56.58	Flooring
4'x8' Drywall	\$7.67	4	\$30.68	Walls
Drywall Mud	\$4.56	1	\$4.56	
Drywall Tape	\$0.99	1	\$0.99	
2'x4'x1/4" plywood	\$3.89	1	\$3.89	Chair
Miscellaneous			\$40.00	
Flooring				
Linoleum 76"x96"	\$80.00	1	\$80.00	Flooring
Linear Actuators				
Motor #1	\$316.00	1	\$316.00	Lift Chair
Motor #2	\$250.75	1	\$250.75	Retract wash station
Motor #3	\$194.75	1	\$194.75	Recline Chair
Motor #4	\$420.80	1	\$385.00	Turn Chair
Switch Motor #1	\$250.00	1	\$250.00	Momentary
Switch Motor #2	\$57.10	1	\$57.10	Momentary
Switch Motor #3	\$57.10	1	\$57.10	Momentary
Miscellaneous				
Screws			\$60.00	
Nuts/Bolts/Washers			\$40.00	
Control				
Relays	\$9.42	28	\$263.76	
Socket for Relay	\$5.42	28	\$151.76	
Foot Pedals	\$2.59	2	\$5.18	
Limit Switches	\$2.26	28	\$63.28	
Toggle Switch	\$9.97	2	\$19.94	
12/3 Outdoor Wire	\$0.89	per foot	73	\$64.97
14 Ga. Wire	\$100.00	1	\$100.00	
10 Ga. Wire	\$100.00	1	\$100.00	
Wire Connectors Male	\$34.76	1	\$34.76	
Wire Connectors Fem	\$38.73	1	\$38.73	
Wire Forks	\$6.79	8	\$54.32	
12 Ckt. Term. Strip	\$11.93	12	\$143.16	
Male 20A Plug	\$11.82	3	\$35.46	
Female 20A Socket	\$19.76	3	\$59.28	
Power System				
GFCI outlets	\$12.99	3	\$38.97	
Wall Switches	\$13.97	2	\$27.94	
Cover Plate	\$0.49	3	\$1.47	
Switch Housing	\$0.49	3	\$1.47	
Fusible Pullout Box	\$9.97	1	\$9.97	
Time Delay Fuse	\$2.87	2	\$5.74	

Power Source	\$465.00		1	donated	
Power Box 100A	\$27.49		1		\$27.49
20A Breaker	\$5.79		1		\$5.79

Chair

Upholstery	\$40.00		1		\$40.00
Aluminum Frame 1½"x1½"	\$89.90	(21'-1")	1		\$89.90
Lazy Susan	\$7.00		1		\$7.00
Cushion (cotton)	\$10.00		1		\$10.00
Rubber Wheel	\$1.24		1		\$1.24
Aluminum Welding	\$45.00	per hour	6		\$270.00

Wash Station

Drawer Slide 100lb	\$17.99	24" full	1		\$17.99
Wash Station	\$169.00		1		\$169.00
Hoses	\$50.00		1		\$50.00
Valves	\$15.00		2		\$30.00
Plumbing Fittings	\$20.00		1		\$20.00

Cabinets

Wood	41.95		1		\$41.95
Trim					\$10.00
Handles	3.00		13		\$42.00
Riding Slides 22"	\$10.99		4		\$43.96
Drawer Slides 10"	\$8.59		4		\$34.36
Drawer Slides 24"	\$17.99		1		\$17.99
Drawer Slides 12"	\$14.29		1		\$14.29
Shelving and Jig set	\$29.99		1		\$29.99
1/4" shelf pins	\$3.99	(16 count)	1		\$3.99
4 Bulb Light Strip	\$19.95		3		\$59.85
Light Bulb	\$0.97		12		\$11.64
Main Mirror	\$19.97		1		\$19.97
Hinges	\$2.99	(pair)	3		\$8.97

		\$4,312.34
Sales tax		0.07
		\$4,614.20

Schedule for building the Home Salon Booth

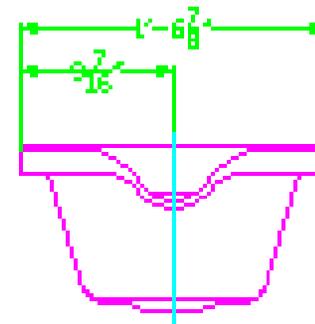
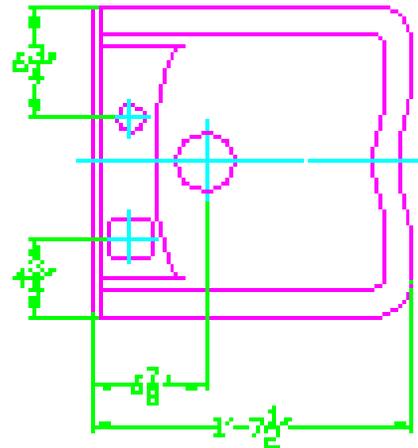
29-Mar-04	5-Apr-04	12-Apr-04	19-Apr-04	26-Apr-04	3-May-04	10-May-04	17-May-04	22-May-04
Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	EXPO

- Week 1:** Collect all Parts and Materials Needed for Construction of the Project.
- Week 2:** Build Structure Frame: 3 Walls, Floor, and Sub Flooring.
- Week 3:** Cut Raw Materials and Weld Frame of Chair Together, Linkage for Sink
- Week 4:** Install all Motors and Wiring Including Power Systems and Relay Circuitry
- Week 5:** Install Plumbing, Fixtures, and Sink
- Week 6:** Build and Finish Vanity and Surrounding Cabinets, Finish Drywall (Paint/Stain)
- Week 7:** Install and Adjust Limit Switches to meet the Required Specifications
- Week 8:** Test Week
- EXPO**

BIBLIOGRAPHY

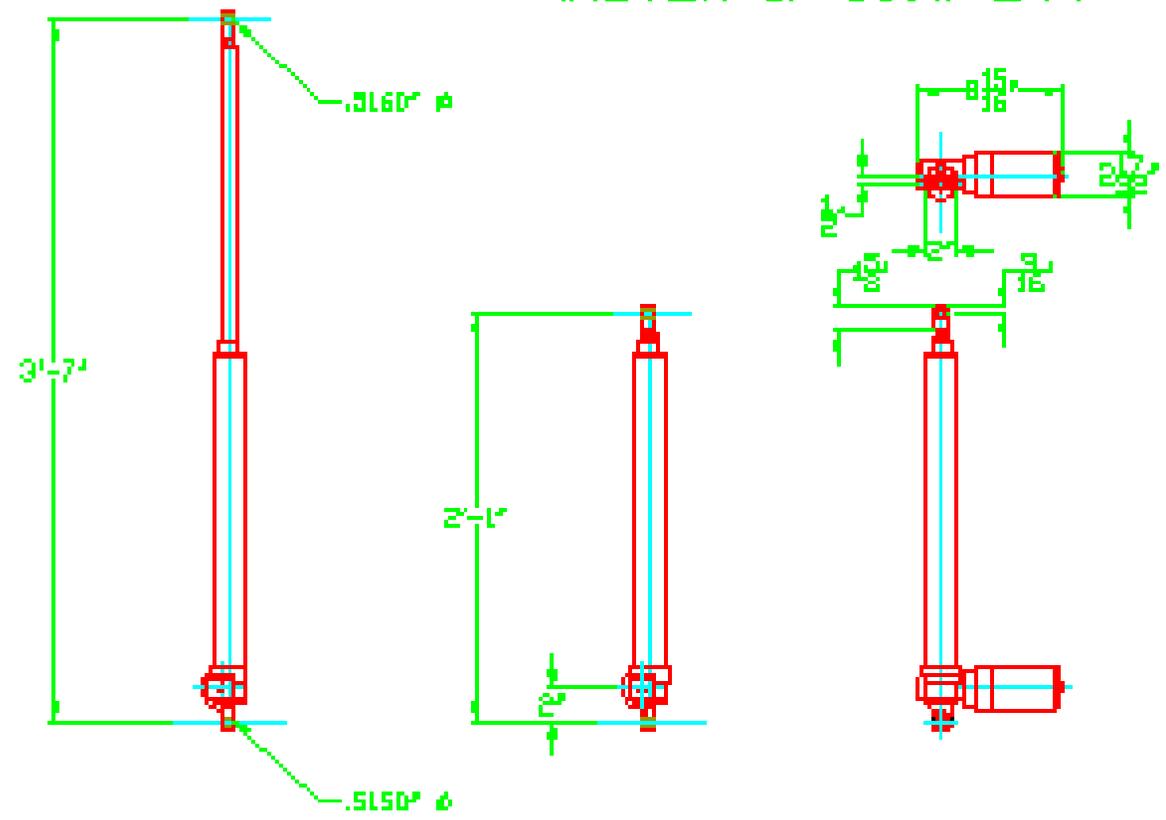
- [1] US Census Bureau. (Jun 03, 2004). Retrieved June 3, 2004, from <http://www.census.gov/>
- [2] Permanent Magnet. Bodine Electric Company: Catalog S-15, 2003
Received partial fax March 4, 2004. Cook, D. R. Thal-mor associates, Inc.
- [3] PowerStream Technology. (2004, March 16). PowerStream is a Lund instrument engineering, Inc. company. Retrieved April 5, 2004, from http://www.powerstream.com/Wire_Size.htm
- [4] Cary, J. (1983). Building your own kitchen cabinets: layout • materials • construction • installation, Newtown, CN: The Taunton Press, Inc.
- [5] Flexner, B. (1994). Understanding wood finishing: how to select and apply the right finish, Emmaus, PA: Rodale Press.

WASH STATION DETAIL



DATE	1/26/2004	SENIOR DESIGN PROJECT I	
DRAWN BY	ISH	SALON BOOTH WITH	
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR	KETTLER BEIERCREUTZ	RETRACTABLE SINK AND	
EXPD	MAY 21-22	SYNCHRONIZED CHAIR	
NO.	1	BY	ISH
-	-	-	-
-	-	-	-
-	-	-	-
1	PRELIMINARY LAYOUT DRAWING	ISH	201 1

LINEAR ACTUATOR CHAIR HEIGHT (MOTOR 1) 500# 24V



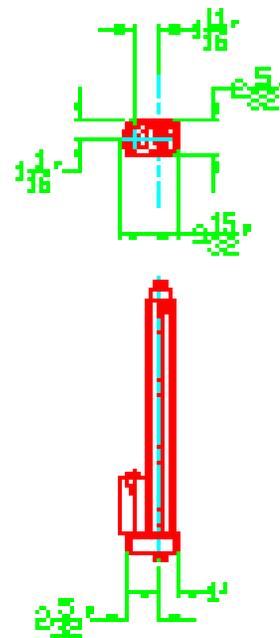
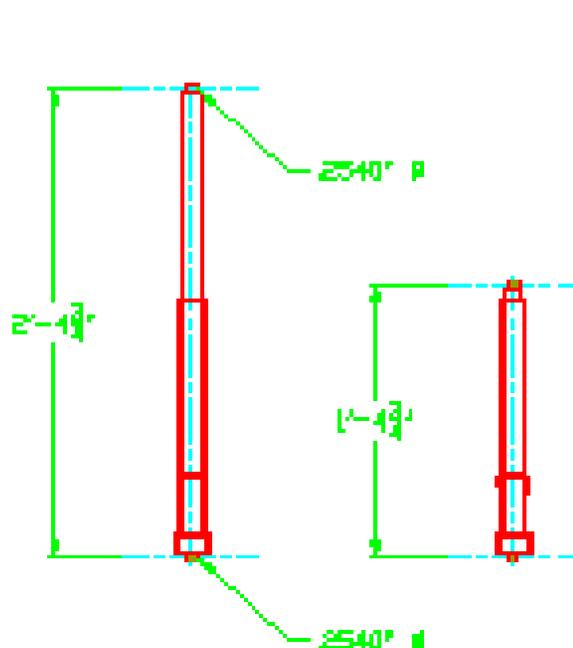
NOTES:

- 1. CURRENT LIMITING FUSE @ 10 AMPS

SPEED (IN/MIN):	50
SPEED (IN/SEC):	.833
MAX CURRENT:	11 AMPS
POWER:	24VDC
POWER SOURCE:	30LA S0M20-24-100
LIFTING CAPACITY:	500#
EXTENSION:	18"
MANUFACTURER:	DUFF NORTON
MODEL:	HPD6-104-18

DATE:	1/27/2004	SENIOR DESIGN PROJECT I	
DRAWN BY:	ISH	SALON BOOTH WITH	
SCALE:	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR:	KETTL BEIDERBREITZ	RETRACTABLE SEAT AND	
EXPD:	MAY 21-22	SYNCHRONIZED CHAIR	
REV:	1	LINEAR ACTUATOR	
-	-	CHAIR HEIGHT	
-	-	(MOTOR 1) 500# 24V	
-	-	DESIGNED BY:	REVISED
1	PRELIMINARY LAYOUT DRAWING	ISH	202 1

SINK EXTENSION LINEAR ACTUATOR MOTOR 2



NOTES

1. CURRENT LIMITING FUZE @ 1 AMP@

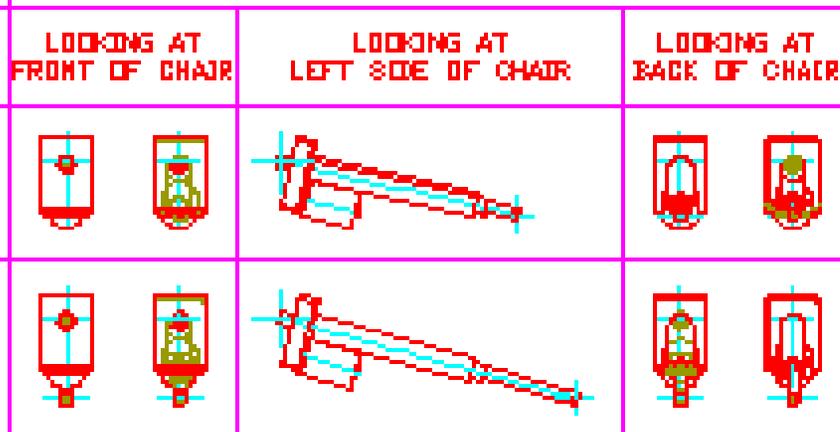
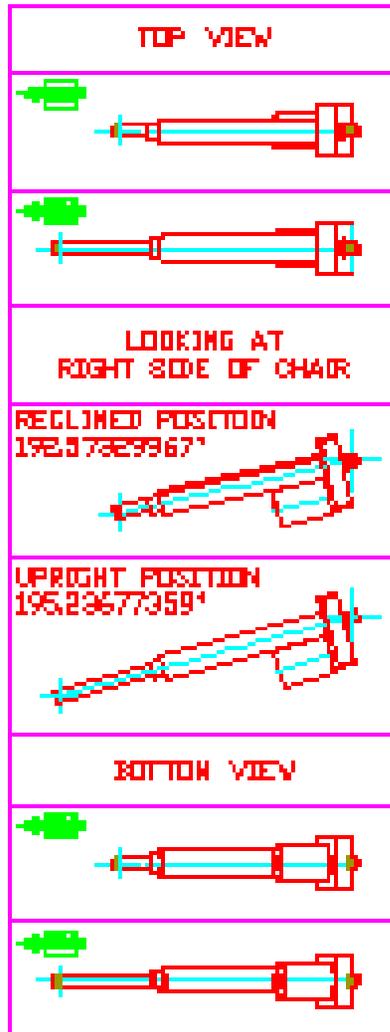
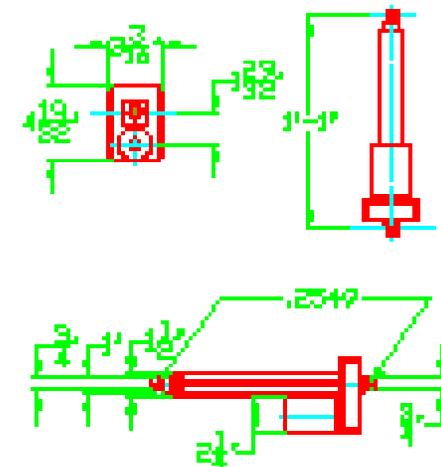
SPEED (IN/MIN)	60
SPEED (IN/SEC)	1
MAX CURRENT	5 AMPS
POWER	24VDC
POWER SOURCE SOLA	SDM0-24-100
LIFTING CAPACITY	100#
EXTENSION	12"
MANUFACTURER	DUFF NORTON
MODEL	TN001-2406-12

DATE: 1/29/2004
 DRAWN BY: ISH
 SCALE: NO SCALE
 ADVISOR: KETTL CORDERGREUTZ
 EDP: MAY E1-E2

SENIOR DESIGN PROJECT I
 SALON BOOTH WITH
 AUTOMATICALLY ADJUSTED
 RETRACTABLE SINK AND
 SYNCHRONIZED CHAIR

NO.	DESCRIPTION	BY	DATE	REVISION
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
1	PRELIMINARY LAYOUT DRAWING	ISH	203	1

RECLINE LINEAR ACTUATOR



NOTES:

L CURRENT LIMITING FUSE @ 5 AMPS	
SPEED (IN/MIN)	88
SPEED (IN/SEC)	.53
MAX CURRENT	5 AMPS
POWER	24VDC
POWER SOURCE SOLA SIM80-24-100	
LIFTING CAPACITY	250#
EXTENSION	8"
MANUFACTURER	DUFF NORTON
MODEL	TH008-2906-8

DATE: 1/28/2004
 DRAWN BY: ISH
 SCALE: NO SCALE
 ADVISOR: KETTL CORDERGREUTZ
 EXP: MAY 21-22

SENIOR DESIGN PROJECT I
 SALON BOOTH WITH
 AUTOMATICALLY ADJUSTED
 RETRACTABLE SINK AND
 SYNCHRONIZED CHAIR

NO.	DESCRIPTION	BY	DATE	
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
1	PRELIMINARY LAYOUT DRAWING	ISH		

LINEAR ACTUATOR RECLINE (MOTOR 3)	
DRAWN BY	REVISION
204	1

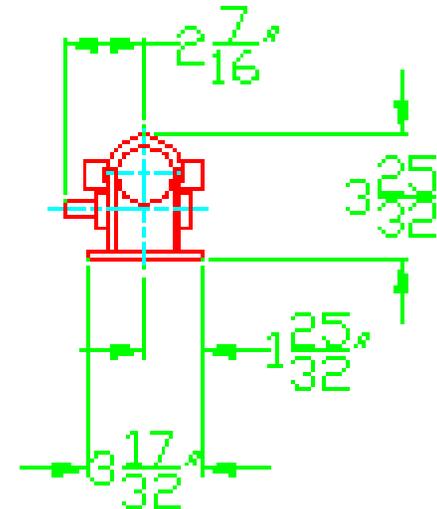
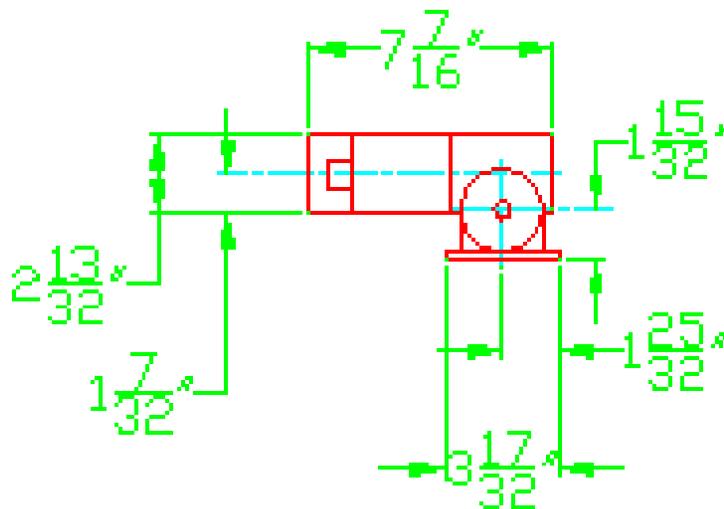
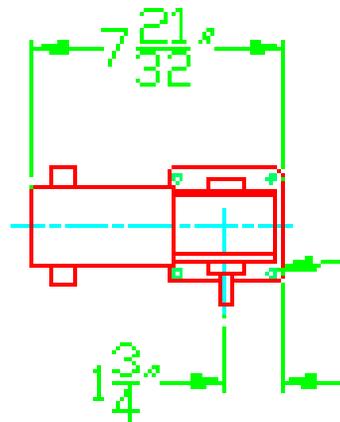
CHAIR ROTATE DC MOTOR

SLIGHTLY BIG RUBBER WHEEL
FOR INTERFERENCE
.9075" R
LB35" Ø



LR .2490" Ø
.5" THICK
CIRCUMFERENCE: 3.76"

(4) .265" Ø HOLES



NOTES:

1. CURRENT LIMITING FUSE @ 2 AMP@

SPEED (REV./MIN)	42
SPEED REDUCTION:	60d
CURRENT @ RATED TORQUE	2.6 AMPS
POWER	24VDC
POWER	1/17 HP
RATED TORQUE:	88 (LB-IN)
MAX TORQUE	46 (LB-IN)
OUTPUT SHAFT Ø	.4950-.4990"
POWER SOURCED SOLA SINEO-24-00	
MANUFACTURER:	BIDDNE
MODEL:	4694 W/ CUSTOM GEAR RATIO

DATE: 1/88/8004
DRAWN BY: ISH
SCALE: NO SCALE
ADVISOR: KETIL CEDERCREUTZ
EXPI: MAY 81-82

TENDER DESIGN PROJECT 1
SALON BOOTH WITH
AUTOMATICALLY ADJUSTED
RETRACTABLE SINK AND
SYNCHRONIZED CHAIR

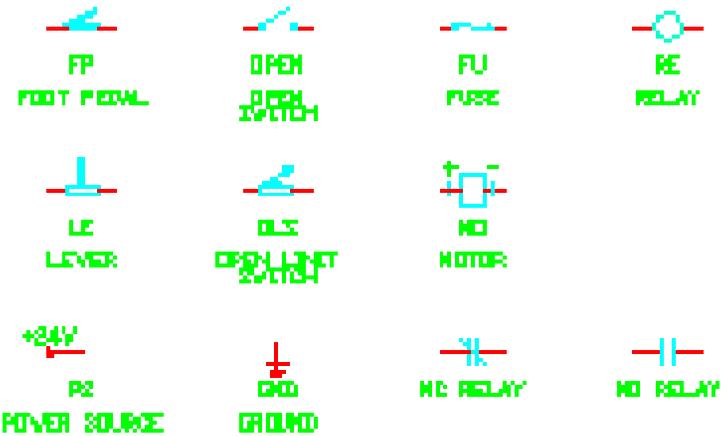
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-	-	-		
-	-	-		
1		ISH	PRELIMINARY LAYOUT DRAWING	205 1

LEGEND

GENERAL

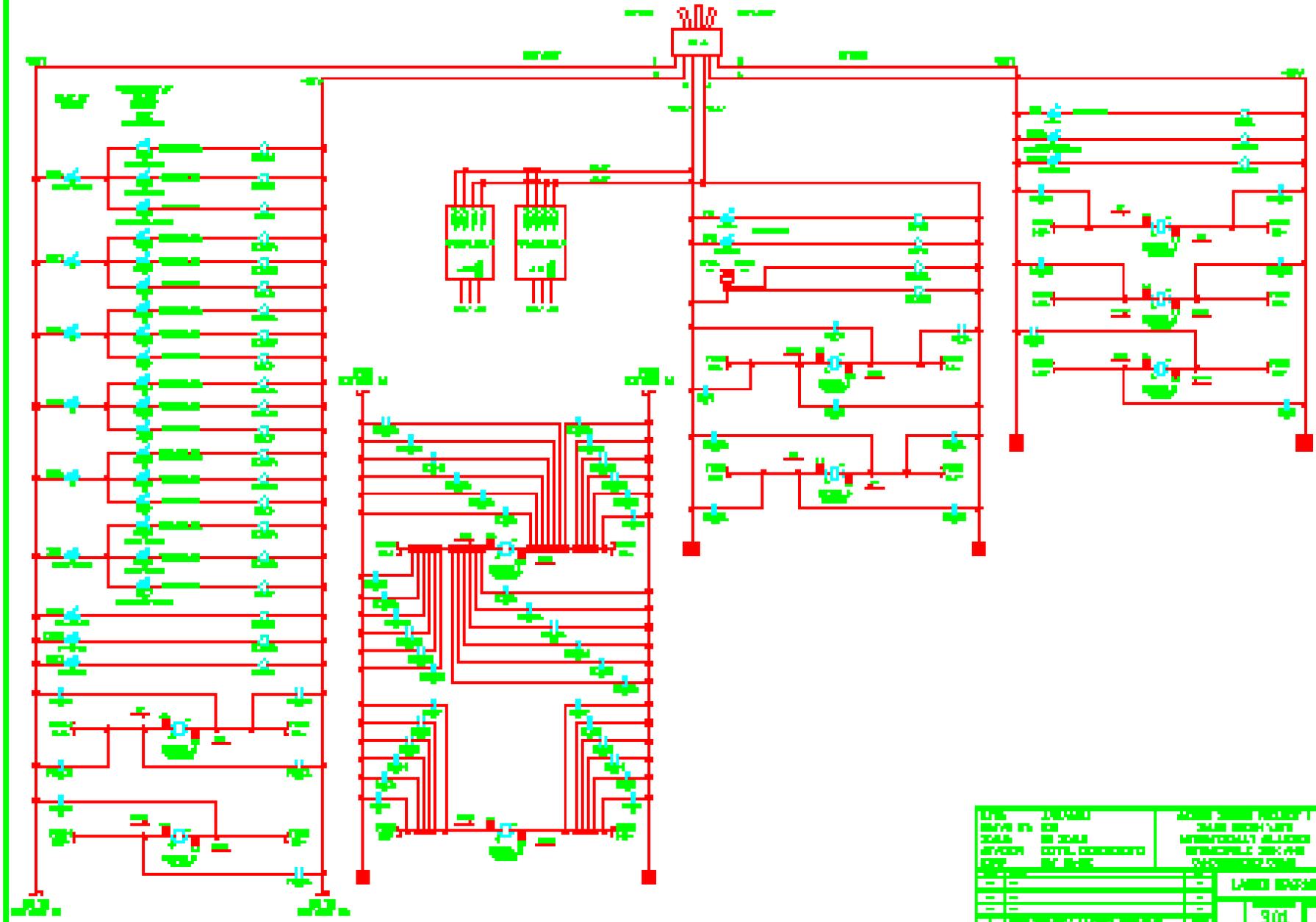


ELECTRICAL



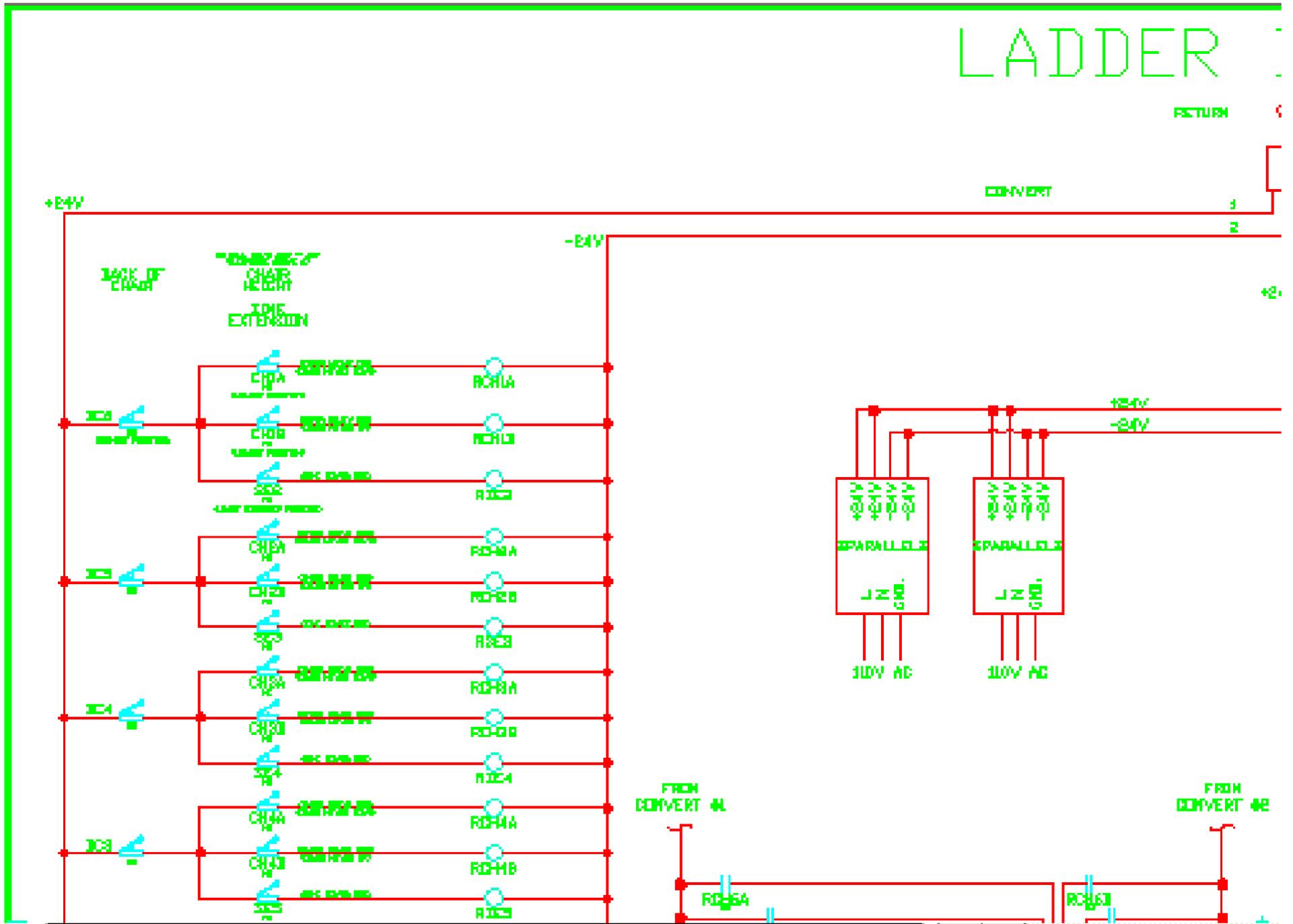
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DRAWN BY:	ISH						
SCALE:	NO SCALE						
ADVISOR:	KETTL CORDERGRENZ						
EXPO:	MAY E1-E2						
NO.	NO.	LEGEND					
-	-	-	-				
-	-	-	-				
-	-	-	-				
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DRAWN BY	REVISION						
300	1						

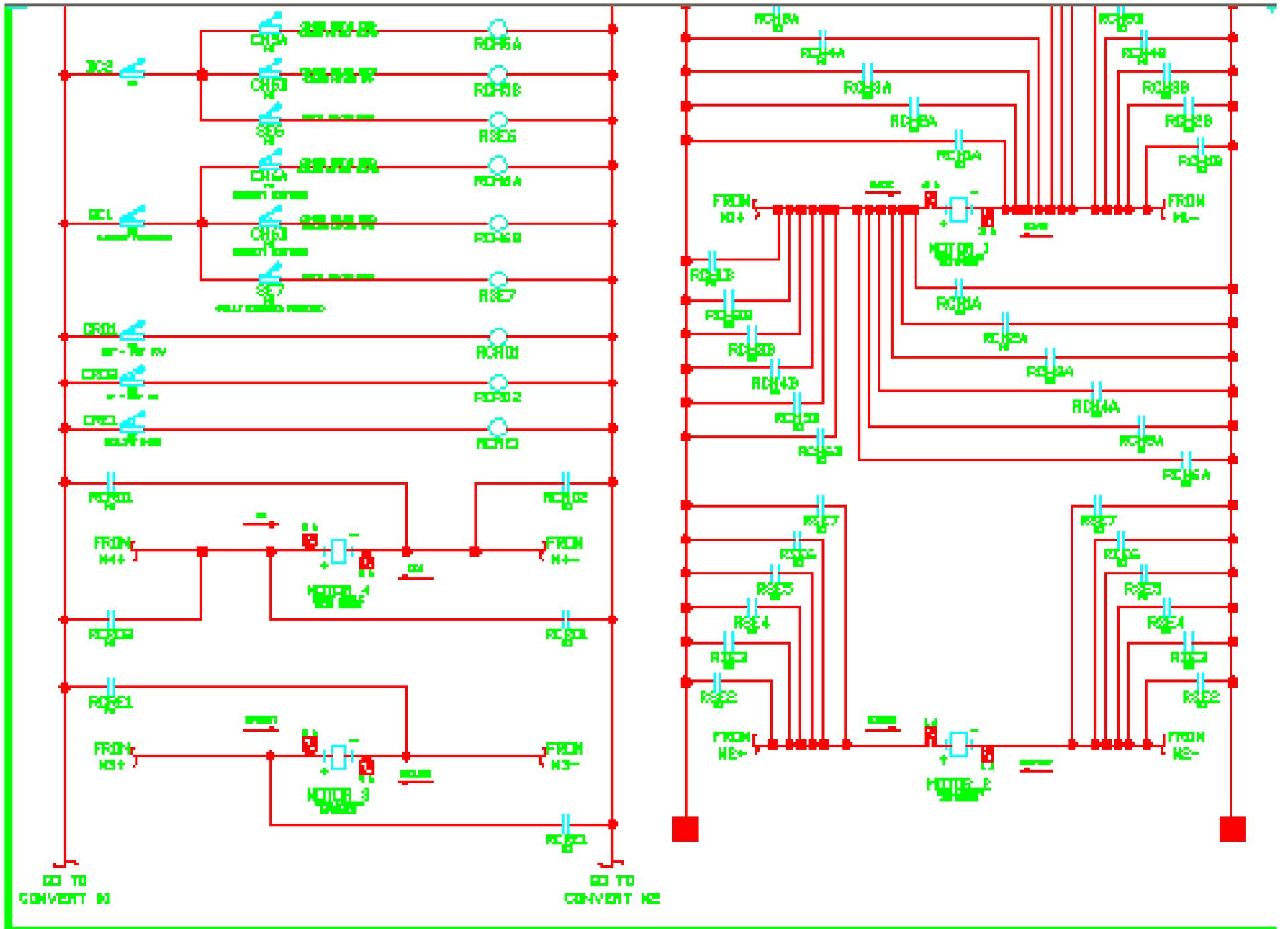
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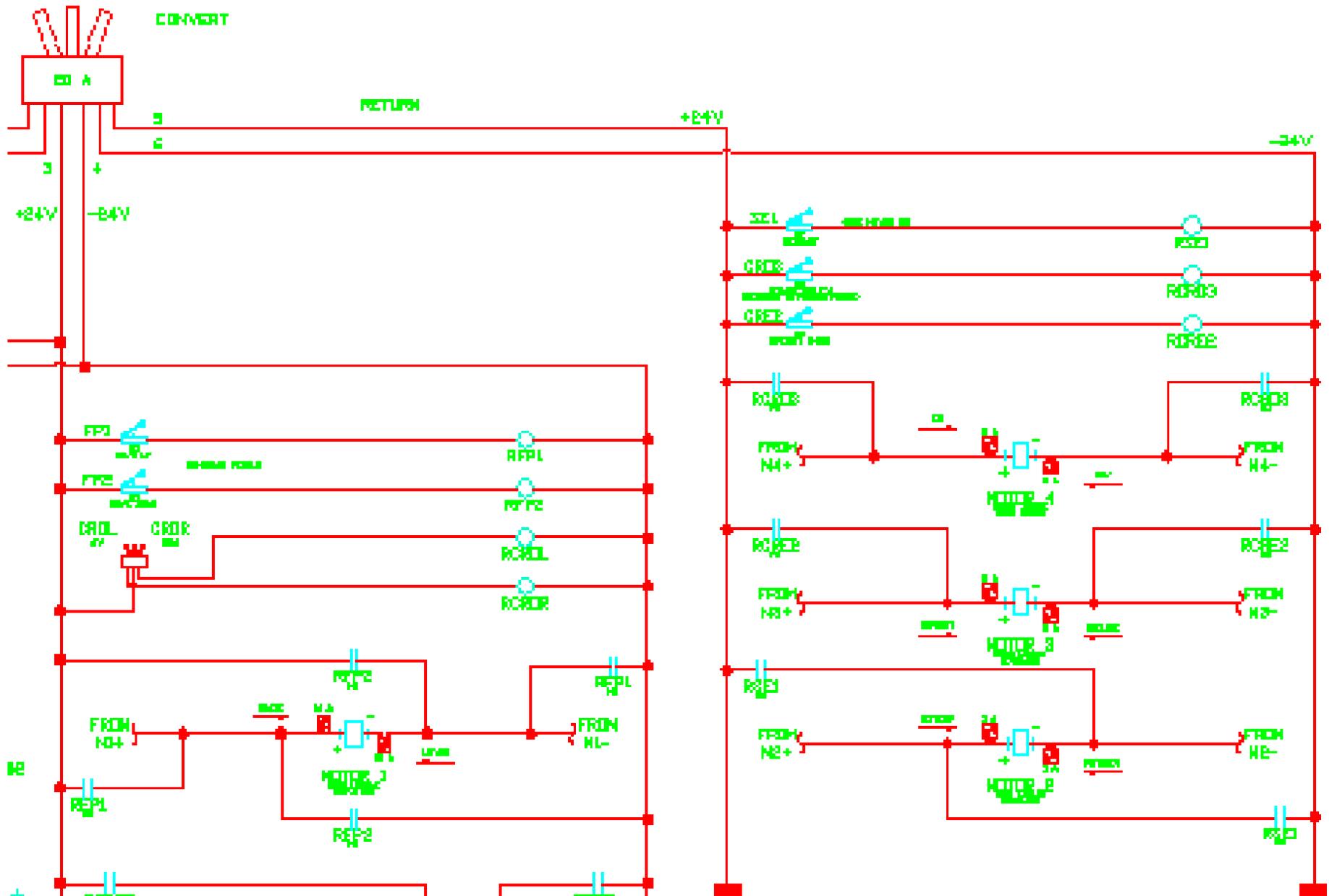
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BY	J. SMITH	BY	J. SMITH
CHKD	M. JONES	CHKD	M. JONES
APPV	K. BROWN	APPV	K. BROWN
REV	01	REV	01
LADDER DIAGRAM		LADDER DIAGRAM	
301		301	

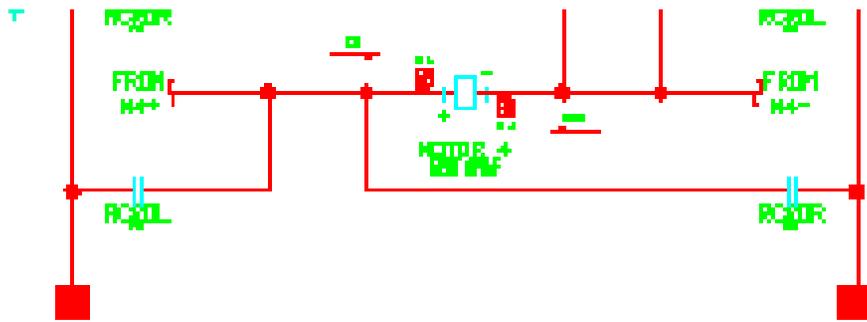
LADDER :





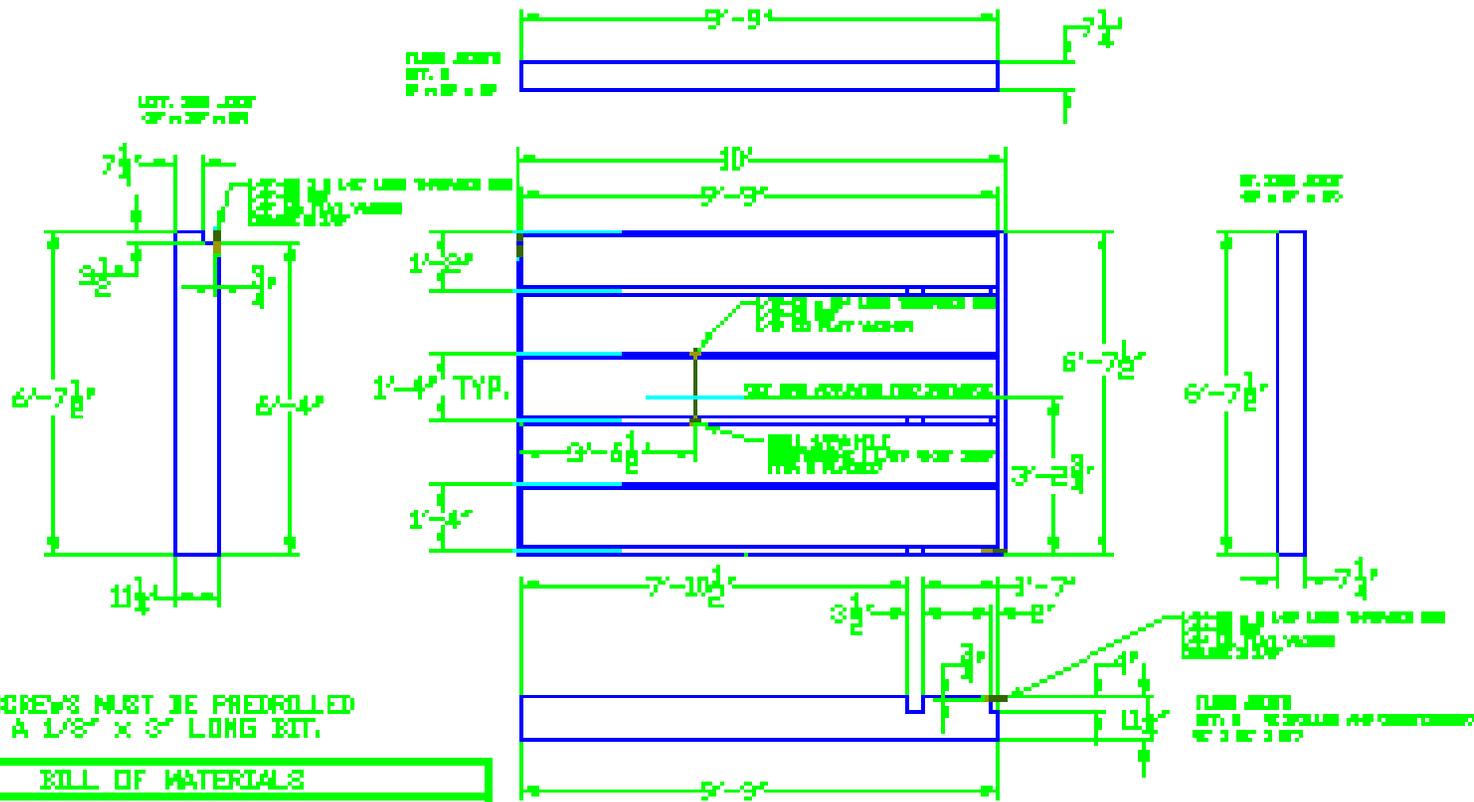
DIAGRAM





DATE:	4/15/2004	SENIOR DESIGN PROJECT 1	
DRAWN BY:	JSH	SALON BOOTH WITH	
SCALE:	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR:	KETIL CEDERCREUTZ	RETRACTABLE SINK AND	
EXPO:	MAY 21-22	SYNCHRONIZED CHAIR	
NO.	DESC.	NO.	
-	-	-	LADDER DIAGRAM
-	-	-	
-	-	-	
1	PRELIMINARY LAYOUT DRAWING	JSH	
		SPARE NUMBER	REVISED
		301	1

FLOOR JOISTS LAYOUT & DESIGN PLAN VIEW



NOTE:

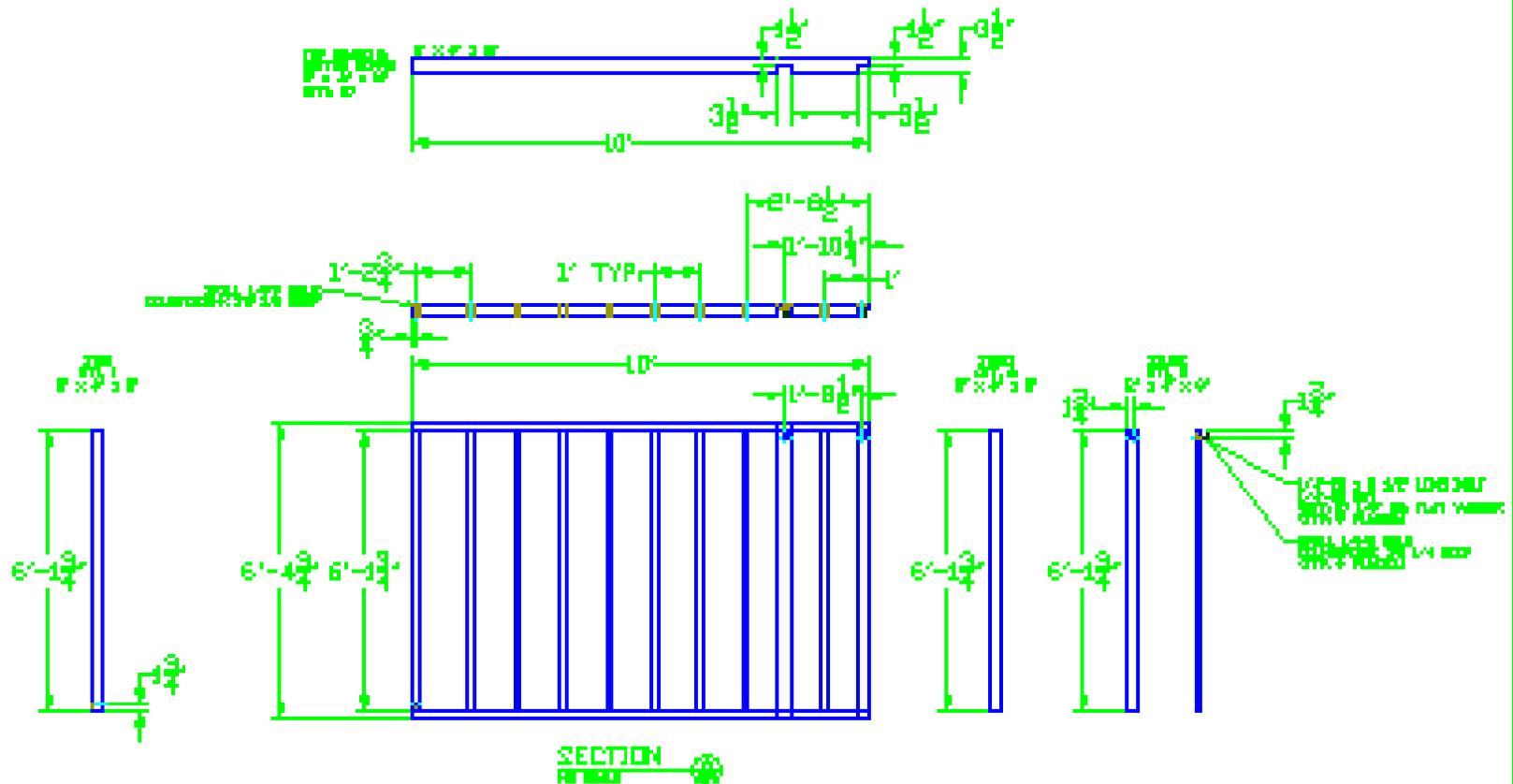
1. ALL SCREWS MUST BE PREDRILLED WITH A 1/8" x 3" LONG BIT.

BILL OF MATERIALS

QTY.	DESCRIPTION
5	2" x 12" x 10'
1	2" x 12" x 8'
2	2" x 8" x 10'
1	2" x 8" x 8'
47	3" SCREWS
1	1/2"-33 x 18" LONG THREADED ROD
1	1/2"-13 NUT
2	1/2" I.D. FLAT WASHER
2	1/4"-20 x 5 1/2" LONG THREADED ROD
2	1/4"-E0 NUT
2	1/4" I.D. FLAT WASHER

DATE	1/28/2004	VENDOR DESIGN PROJECT 1	
DRAWN BY	ISH	SALON BOOTH WITH	
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR	KETIL CEDERCREUTZ	RETRACTABLE SINK AND	
EXPD	MAY 21-22	SYNCHRONIZED CHAIR	
NO.	REV.	FLOOR JOISTS LAYOUT & DETAIL	
-	-		
-	-		
-	-		
-	-		
1	PRELIMINARY LAYOUT DRAWING	ISH	
		DRAWN BY	REVISION
		401	1

MAIN WALL LOOKING NORTH ELEVATION & DESIGN



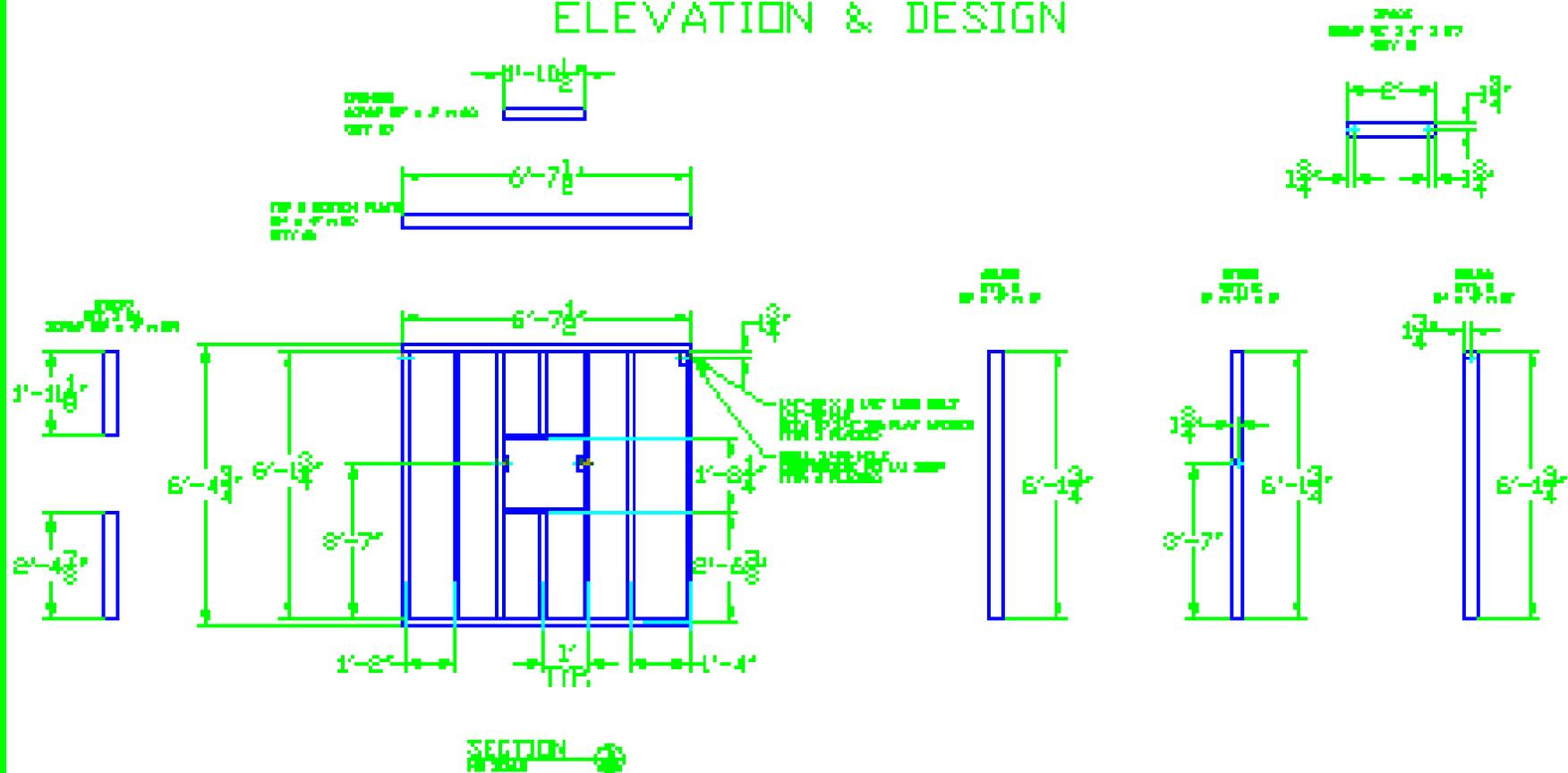
NOTE:

1. ALL SCREWS MUST BE PREDRILLED WITH A 1/8" x 3" LONG BIT.

BILL OF MATERIALS	
QTY.	DESCRIPTION
2	2' x 4' x 10'
11	2' x 4' x 8'
44	3" SCREWS
2	1/4"-20 x 3 1/2" LONG BOLT
2	1/4"-20 NUT
4	1/4" I.D. FLAT WASHER

DATE	1/28/2004	TENDER DESIGN PROJECT 1 SALON BOOTH WITH AUTOMATICALLY ADJUSTED RETRACTABLE SINK AND SYNCHRONIZED CHAIR		
DRAWN BY	ISH			
SCALE	NO SCALE			
ADVISOR	KETIL CEDERCREUTZ			
EXPO	MAY 21-22			
NO.	DATE	BY	MAIN WALL LAYOUT & DETAIL	
-	-	-		
-	-	-		
-	-	-		
1	PRELIMINARY LAYOUT DRAWING	ISH	DRAWN SHEET	BY SHEET
			402	1

SIDE WALL LOOKING EAST ELEVATION & DESIGN



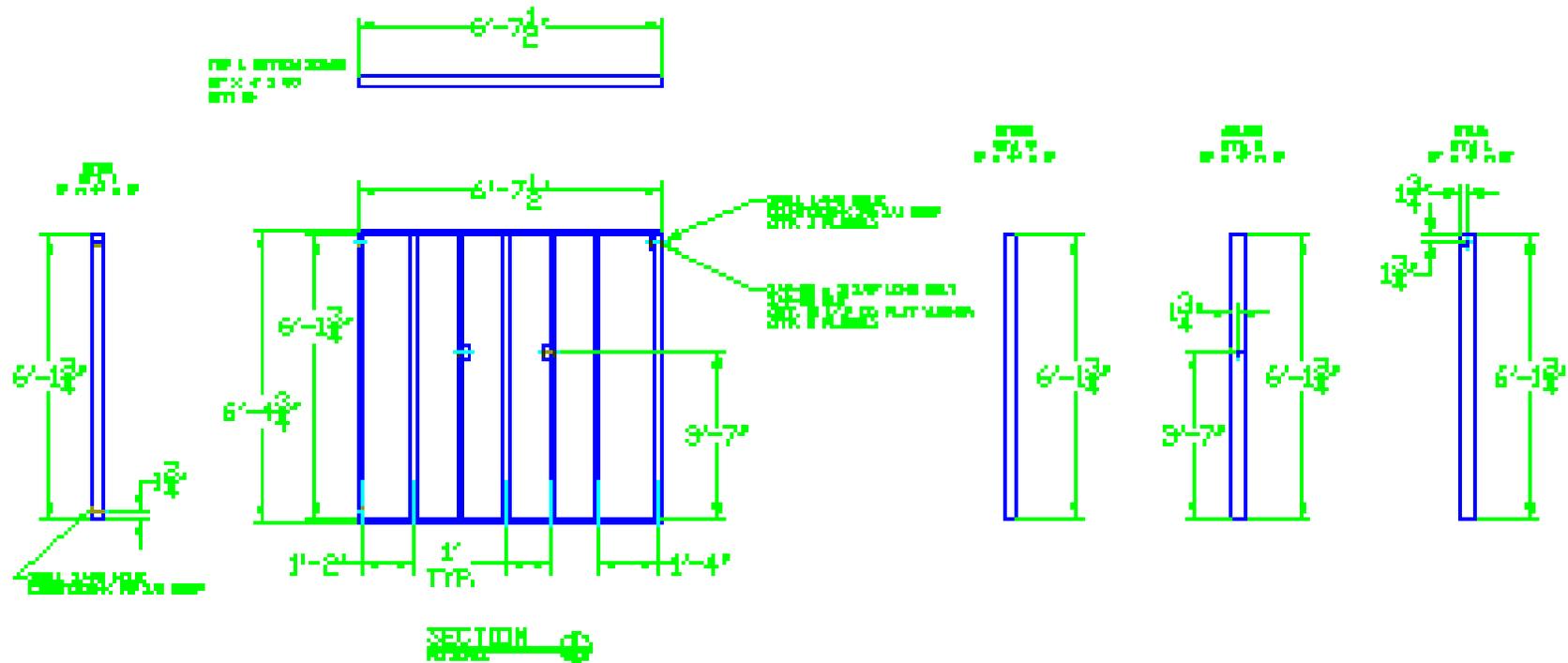
NOTE:

1. ALL SCREWS MUST BE PREDRILLED WITH A 1/8" x 8" LONG BIT.

BILL OF MATERIALS	
QTY.	DESCRIPTION
10	2" x 4" x 8'
40	3" SCREWS
3	1/4"-20 x 3 1/2" LONG BOLT
3	1/4"-20 NUT
6	1/4" L3 FLAT WASHER

DATE	1/28/2004	OWNER DESIGN PROJECT 1	
DRAWN BY	ISH	SALON BOOTH WITH	
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR	KETTEL CEDERCREUTZ	RETRACTABLE SINK AND	
EXPD	MAY 21-22	SYNCHRONIZED CHAIR	
NO.	DATE	BY	SIDE WALL LAYOUT & DETAIL
-	-	-	
-	-	-	
-	-	-	
-	-	-	
1	PRELIMINARY LAYOUT DRAWING	ISH	DRAWN UNDER 403
			REVISION 1

UTILITY WALL DESIGN ELEVATION LOOKING EAST



NOTE:

1. ALL SCREWS MUST BE PREDRILLED WITH A 1/8" x 3" LONG BIT.

ROLL OF MATERIALS

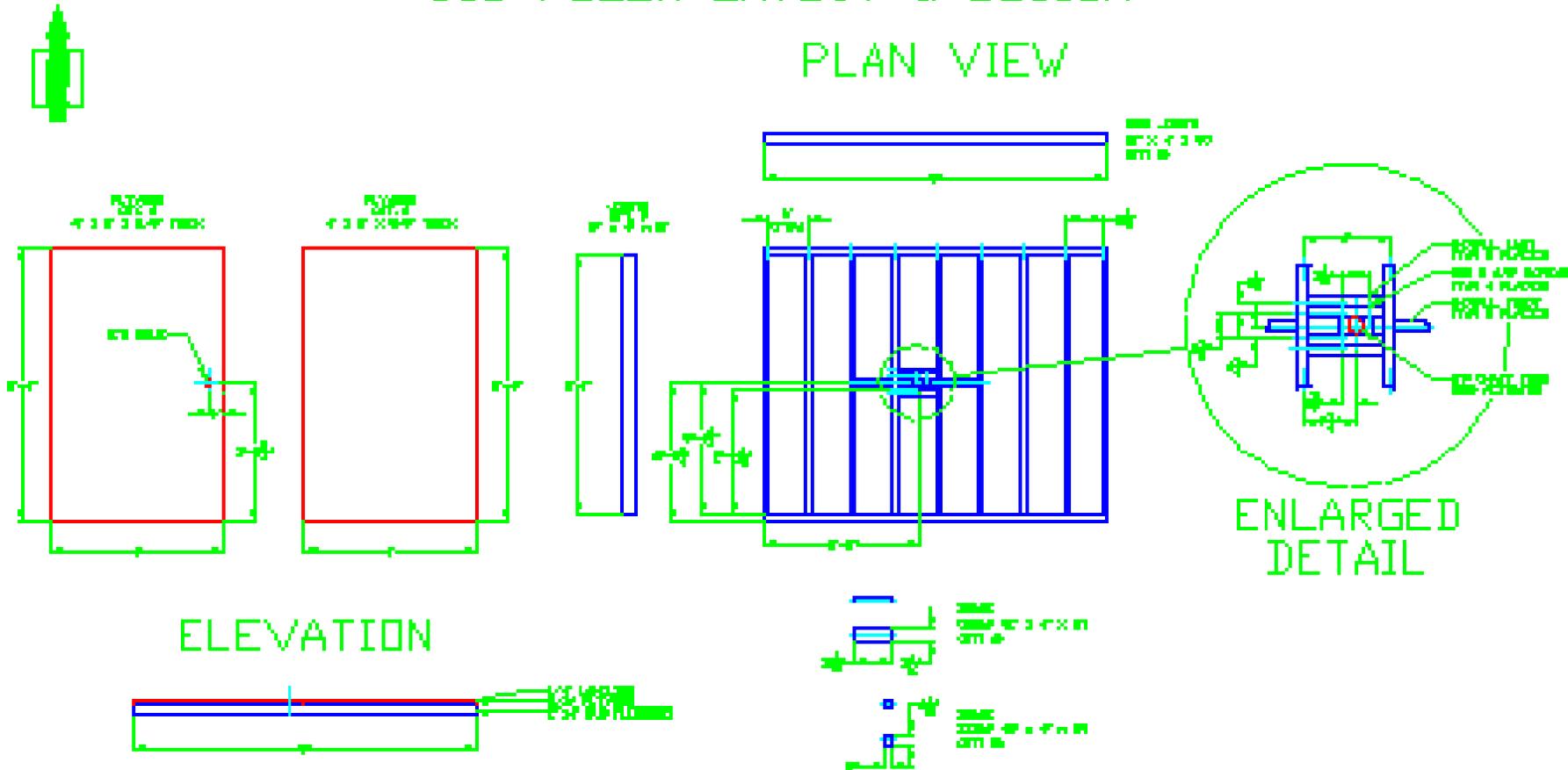
QTY.	DESCRIPTION
3	2" x 4" x 8"
28	3" SCREWS
3	1/4"-20 x 3 1/2" LONG BOLT
3	1/4"-60 NUT
6	1/4" DIA FLAT WASHER

DATE	1/28/2004	TENDR DESIGN PROJECT 1 SALON BOOTH WITH AUTOMATICALLY ADJUSTED RETRACTABLE SINK AND SYNCHRONIZED CHAIR
DRAWN BY	ISH	
SCALE	NO SCALE	
ADVISOR	KETTIL CEDERCREUTZ	
EXPD	MAY 21-22	
NO.	1	30
-	-	-
-	-	-
-	-	-
1	PRELIMINARY LAYOUT DRAWING	ISH

UTILITY WALL ELEVATION & DETAIL	
<small>BLANK SHEET</small>	<small>SHEET NO.</small>
404	1

SUB FLOOR LAYOUT & DESIGN

PLAN VIEW



ELEVATION

NOTE:

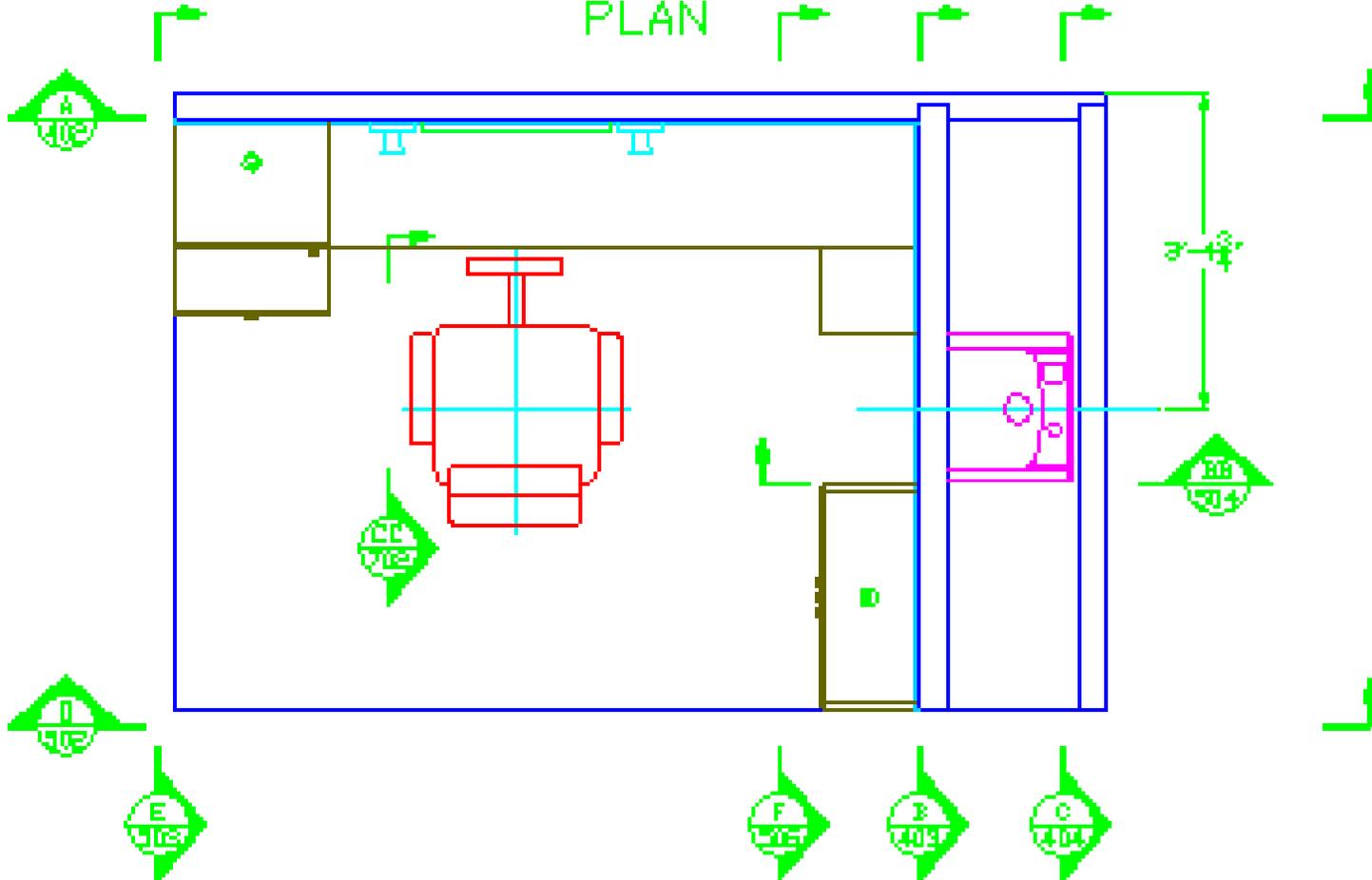
1. ALL SCREWS MUST BE PREDRILLED WITH A 1/8" X LENGTH LONG BIT.

ROLL OF MATERIALS

QTY.	DESCRIPTION
11	2" x 4" x 8'
62	3" SCREWS
8	2 1/2" SCREWS
108	1 1/8" SCREWS (SPACE EVERY 6")
2	48" x 96" x 3/4" THICK PLYWOOD
1	76" x 96" SHEET OF LAMINUM FLOORING

DATE	3/3/2004	TENDR DESIGN PROJECT 1		
DRAWN BY	ISH	SALON BOOTH WITH		
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED		
ADVISOR	KETTIL CEDERCREUTZ	RETRACTABLE SINK AND		
EXPD	MAY 21-22	SYNCHRONIZED CHAIR		
NO.	DATE	BY	SUB FLOOR LAYOUT & DETAIL	
-	-	-		
-	-	-		
-	-	-		
-	-	-		
1	PRELIMINARY LAYOUT DRAWING	ISH	405	1

SECTION CUTS PLAN



DATE	2/8/2004	TENDER DESIGN PROJECT 1	
DRAWN BY	ISH	SALON BOOTH WITH	
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR	KETTIL CEDERCREUTZ	RETRACTABLE SINK AND	
EXPO	MAY 21-22	SYNCHRONIZED CHAIR	
NO.	DATE	BY	SECTION CUTS
-	-	-	
-	-	-	
-	-	-	
1	PRELIMINARY LAYOUT DRAWING	ISH	
		REVISION NUMBER	REVISION
		501	1

NOTES:
1. PLAN DETAIL ON DRAWING 401 & 405

5/8" THICK DRYWALL
 24" x 30" MIRROR
 6 BULB VANITY LIGHTS (QTY. 6)

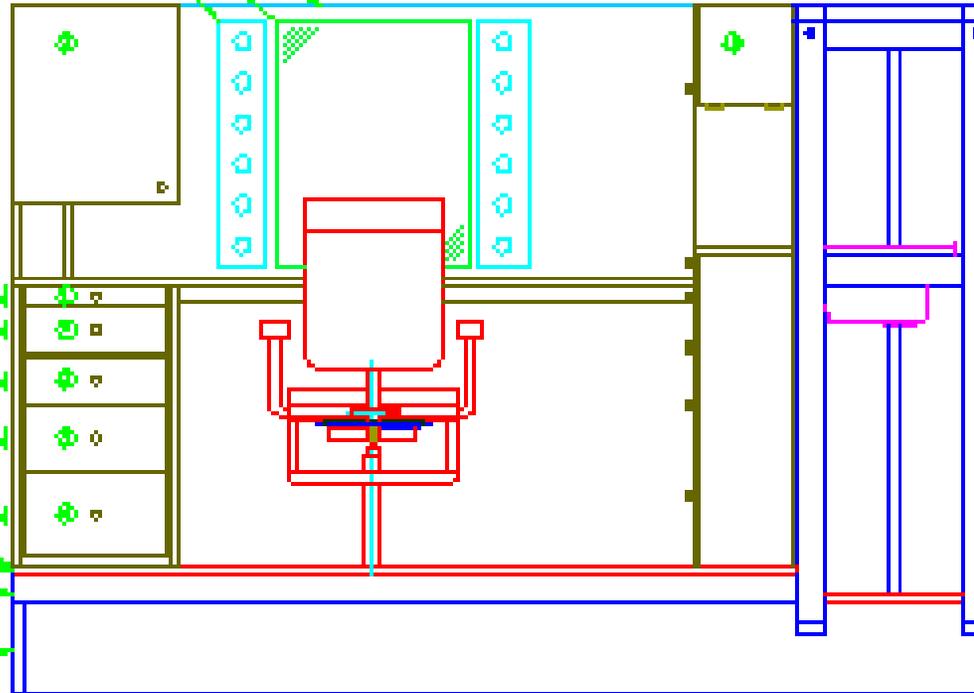
ELEVATION
 LOOKING NORTH
 MAIN WALL

20" W x 84" H CABINET w/ 1 SHELF

2" PLATFORM 24" EXTENSION
 6" DRAWERS 20" EXTENSION
 6" DRAWERS 20" EXTENSION
 8" DRAWERS 20" EXTENSION

10x20" DRAWERS 20" EXTENSION
 1/4" LAMBOUH
 3/4" FLOORING
 2"x4" SUB FLOORING

2"x12" FLOOR JOISTS



SECTION
 NO SCALE



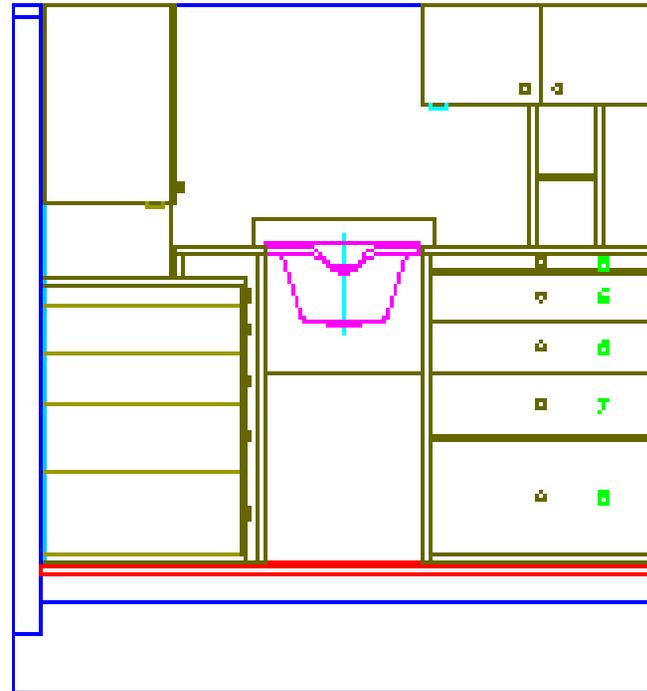
NOTES

1. FOR DETAILS ON DRAWERS SEE DWG# 601
2. FOR DETAILS ON CABINETS SEE DWG# 602

DATE	2/8/2004	SENIOR DESIGN PROJECT 1	
DRAWN BY	ISH	SALON BOOTH WITH	
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR	KETTEL CEDERCREUTZ	RETRACTABLE SINK AND	
EXPD	MAY 21-22	SYNCHRONIZED CHAIR	
NO.	1	BY	ISH
PRELIMINARY LAYOUT DRAWING		ELEVATION LOOKING NORTH	
		PLANS SHEET	REVISION
		502	1

BILL OF MATERIALS	
QTY.	DESCRIPTION
4	4' x 8' x 5/8" THICK SHEETS OF DRYWALL
1	24" x 30" MIRROR
2	6 BULB VANITY LIGHTS
-	-

ELEVATION
LOOKING EAST
SIDE WALL



2 CABINETS NO SHELVES 29" W x 12" H

CONTROL PANEL 6" x 17.25"
7" OPEN SHELVES

2" PLATFORM 12" EXTENSION
6" DRAWERS 10" EXTENSION
6" DRAWERS 10" EXTENSION
8" DRAWERS 10" EXTENSION

14.25" DRAWERS 10" EXTENSION

1/4" LAMINUM
3/4" FLOORING
2 3/4" SUB FLOORING

SECTION **E**
NO SCALE **503**

DATE 2/9/2004
DRAWN BY ISH
SCALE NO SCALE
ADVISOR KETIL CEDERCREUTZ
EXPD MAY 21-22

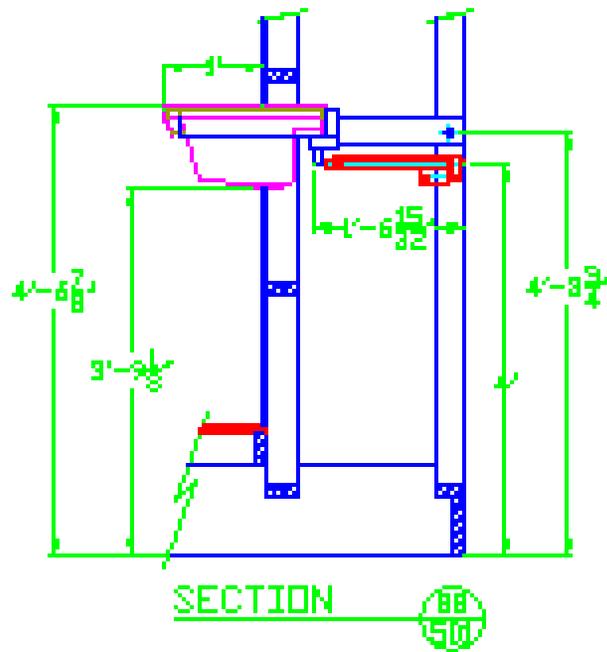
SENIOR DESIGN PROJECT 1
SALON BOOTH WITH
AUTOMATICALLY ADJUSTED
RETRACTABLE SINK AND
SYNCHRONIZED CHAIR

BILL OF MATERIALS	
QTY.	DESCRIPTION
-	-
-	-
-	-
-	-

NO.	DESCRIPTION	BY
-	-	-
-	-	-
-	-	-
1	PRELIMINARY LAYOUT DRAWING	ISH

ELEVATION LOOKING EAST	
BLANK SHEET	SHEET
503	1

SECTION DETAILS



DATE 2/9/2004
 DRAWN BY ISH
 SCALE NO SCALE
 ADVISOR KETIL CEDERCREUTZ
 EXPD MAY 21-22

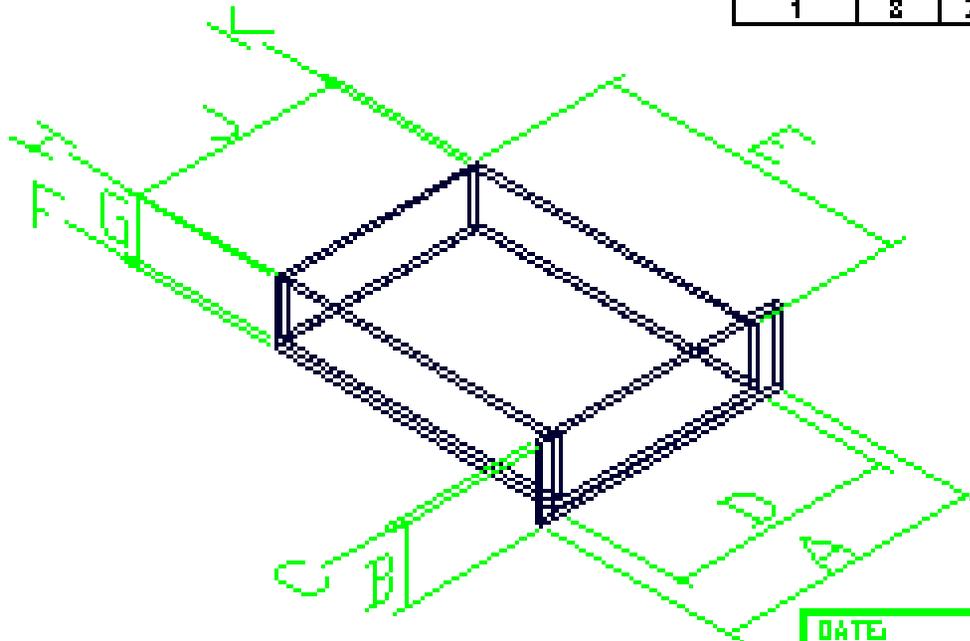
INDOR DESIGN PROJECT 1
 SALON BOOTH WITH
 AUTOMATICALLY ADJUSTED
 RETRACTABLE SEAT AND
 SYNCHRONIZED CHAIR

NO.	DESCRIPTION	DATE	BY
-	-	-	-
-	-	-	-
-	-	-	-
1	PRELIMINARY LAYOUT DRAWING		ISH

SECTION DETAILS	
CLASS NO.	REVISION
504	1

DRAWER DIMENSIONAL DATA

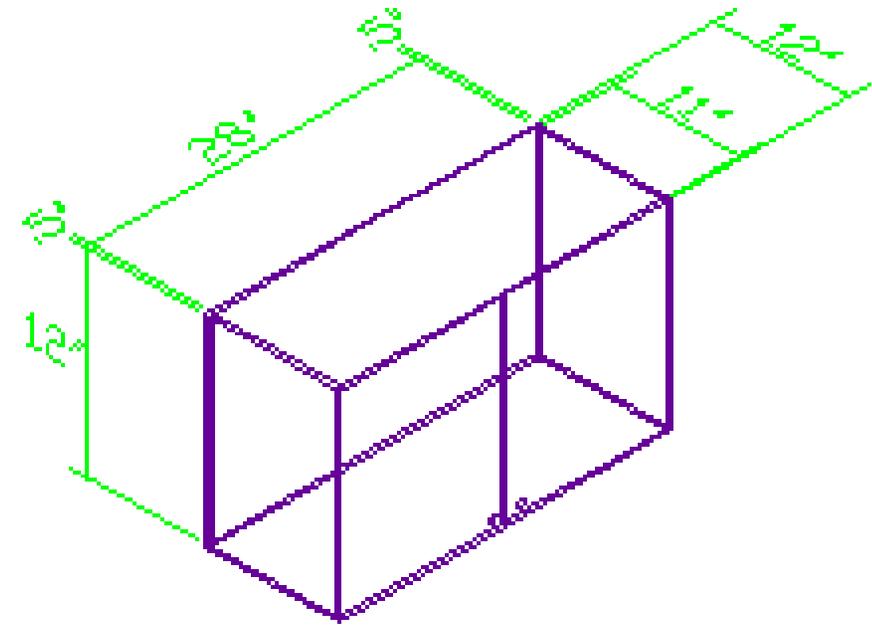
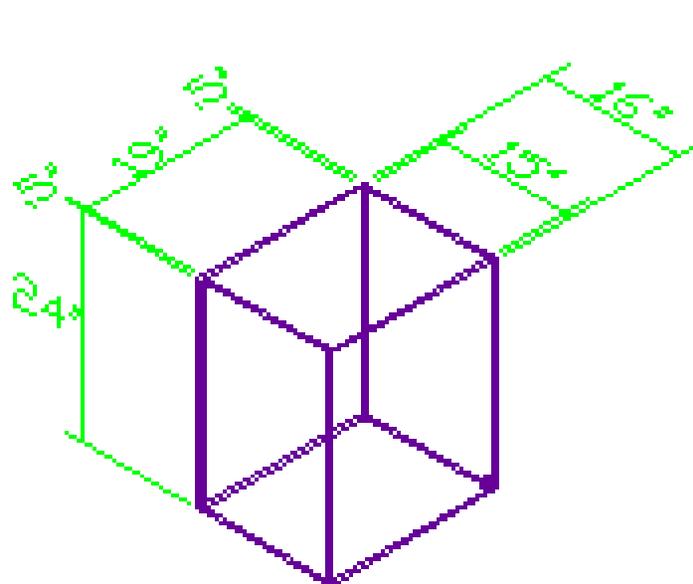
DIMENSIONAL DATA FOR DRAWERS											
Quantity	I.D	A	B	C	D	E	F	G	H	J	K
1	1	20	2	05	17	24	025	175	0.75	155	0.75
2	2	20	6	05	17	24	025	5	0.75	155	0.75
1	3	20	8	05	17	24	025	7	0.75	155	0.75
1	4	20	10.3	05	17	24	025	9.25	0.75	155	0.75
1	5	28	2	05	26	11.5	025	175	0.75	245	0.75
2	6	28	6	05	26	11.5	025	5	0.75	245	0.75
1	7	28	8	05	26	11.5	025	7	0.75	245	0.75
1	8	28	14.3	05	26	11.5	025	13.25	0.75	245	0.75



BILL OF MATERIALS	
QTY.	DESCRIPTION
2	4" x 8" x 1/2" THICK WOOD
8	5/4" x 5/4" x 8" TRIANGLE BOARD
1	BLUE
12	HANDLES
1	84" FULL EXTENSION DRAWER SLIDE
4	32" DRAWER SLIDE
1	14" FULL EXTENSION DRAWER SLIDE
4	14" DRAWER SLIDE

DATE	1/28/2004	VENDOR DESIGN PROJECT 1	
DRAWN BY	ISH	SALON BOOTH WITH	
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR	KETTEL CEDERCREUTZ	RETRACTABLE SINK AND	
EXPO	MAY 21-22	SYNCHRONIZED CHAIR	
NO.	DATE	DRAWER DIMENSIONAL DATA	
-	-		
-	-		
-	-		
1	PRELIMINARY LAYOUT DRAWING	ISH	
		CLASS NO.	ISSUE
		601	1

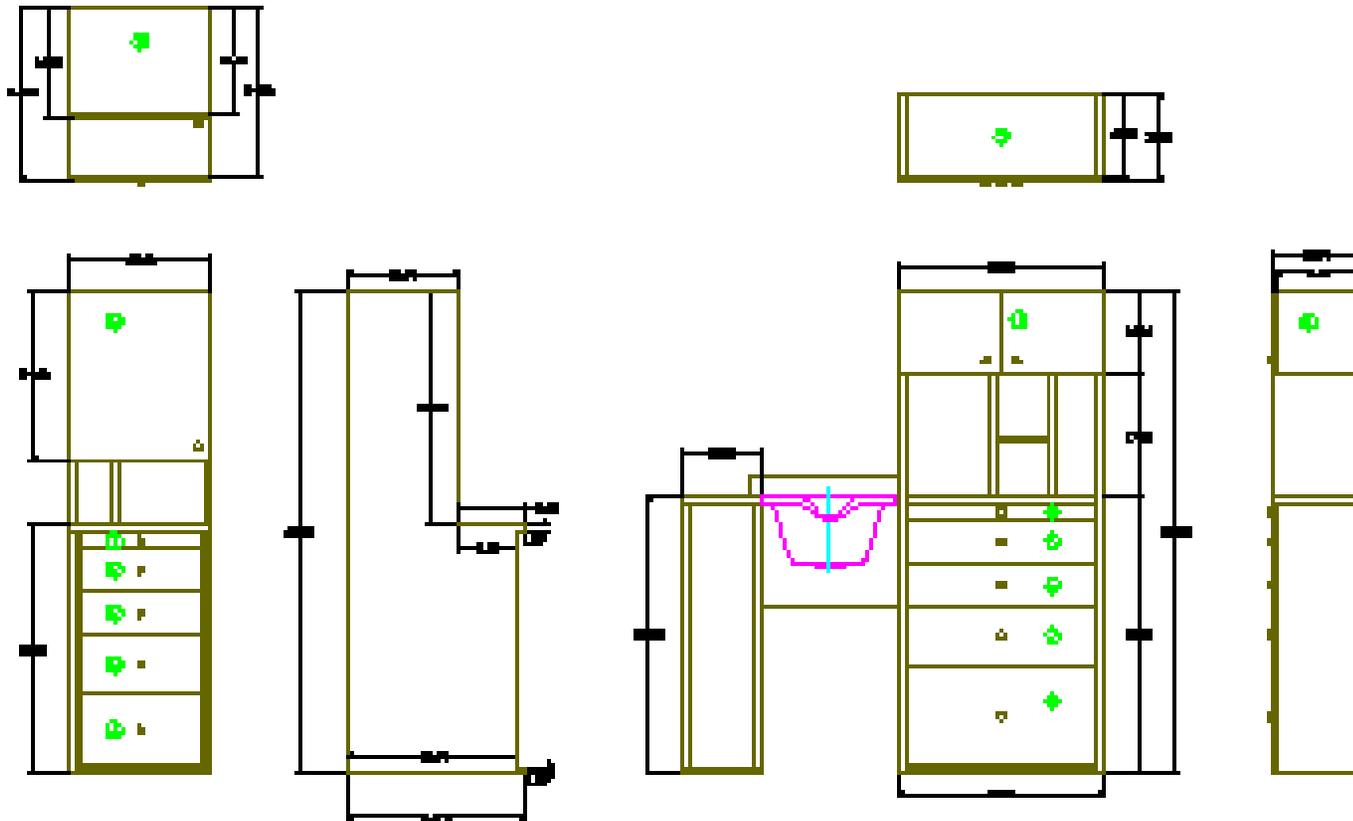
CABINETS DIMENSIONAL DATA



BILL OF MATERIALS	
QTY	DESCRIPTION
1	4" x 3" x 1/2" THICK WOOD
1	2 1/4" x 2 1/4" x 1/2" TRIANGLE BOARD

DATE	1/14/2004	SENIOR DESIGN PROJECT 1 SALON BOOTH WITH AUTOMATICALLY ADJUSTED RETRACTABLE SINK AND SYNCHRONIZED CHAIR			
DRAWN BY	ISH				
SCALE	NO SCALE				
ADVISOR	KETIL CEDERCREUTZ				
EXPO	MAY 21-22				
NO.	DATE	BY	CABINETS DIMENSIONAL DATA		
-	-	-			
-	-	-			
-	-	-		CLASS NO.	SECH.
1	PRELIMINARY LAYOUT DRAWING	ISH	602	1	

CABINETS DIMENSIONAL DATA

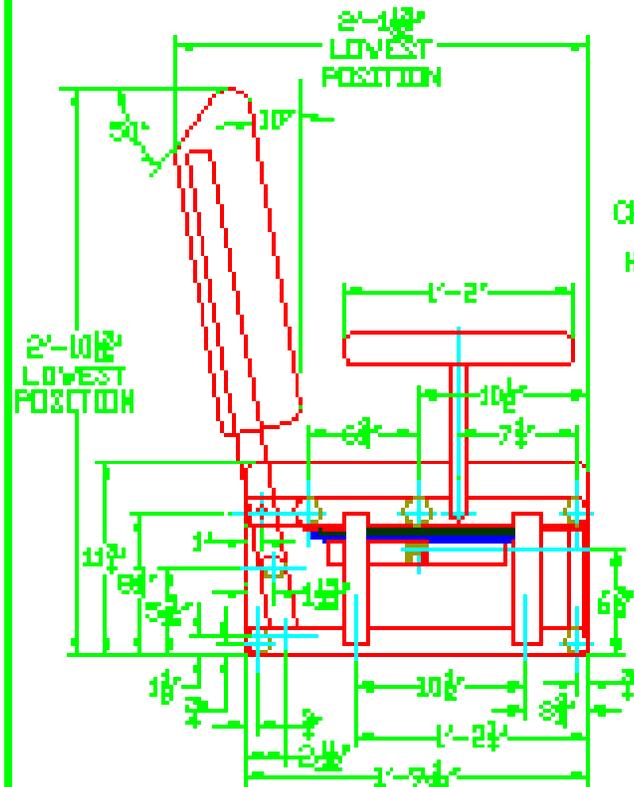


DATE	1/28/2004	TENDER DESIGN PROJECT 1	
DRAWN BY	ISH	SALON BOOTH WITH	
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR	KETIL CEDERCREUTZ	RETRACTABLE SINK AND	
EXPO	MAY 21-22	SYNCHRONIZED CHAIR	
NO.	NO.	CABINETS DIMENSIONAL DATA	
-	-		
-	-		
-	-		
1	PRELIMINARY LAYOUT DRAWING	ISH	603 1

CHAIR DETAILS

(CHAIR IN LOWEST BACK POSITION)

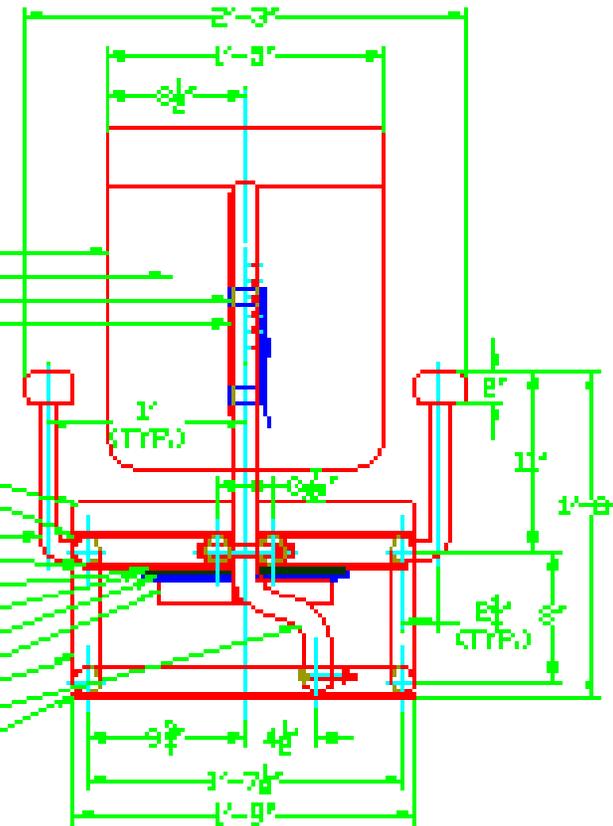
RIGHT SIDE OF CHAIR
LOOKING WEST



BACK VIEW
LOOKING NORTH

- CHAIR BACK CUSHION SEE DWG 706
- CHAIR BACK FRAME SEE DWG 706
- HEIGHT ADJUSTMENT SEE DWG 703
- RAIL SEE DWG 703

- CUSHION SEAT SEE DWG 706
- 1/4\" BOARD SEE DWG 706
- ARM REST SEE DWG 703
- BOTTOM PLATE SEE DWG 704
- 12\" LAZY SUSAN SEE DWG 704
- ROTATOR PLATE SEE DWG 704
- CAN SEE DWG 704
- SUPPORT BRACKET SEE DWG 704
- CHAIR FRAME SEE DWG 709
- RECLINE ARM SEE DWG 705
- 1/4\" BOARD SEE DWG 706



NOTES

1. PLAN VIEW ON DWG 702

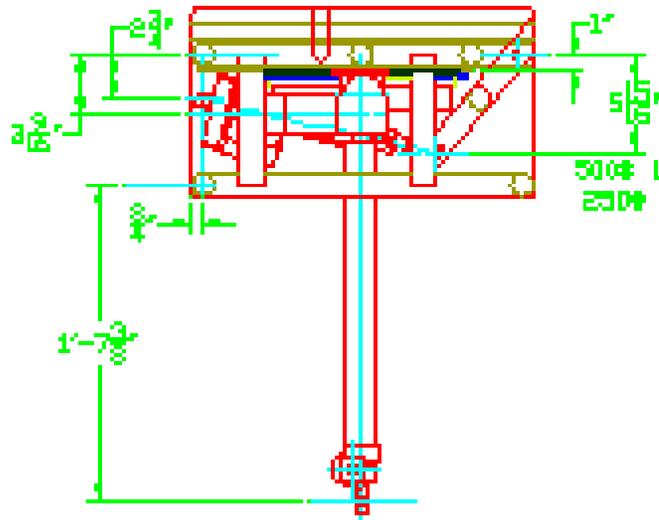
DATE	3/5/2004	TENDER DESIGN PROJECT 1	
DRAWN BY	ISH	SALON BOOTH WITH	
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR	KETTL CERBERGRENITZ	RETRACTABLE SINK AND	
EXPO	MAY 21-22	SYNCHRONIZED CHAIR	
NO.	REV.	DATE	BY
-	-	-	-
-	-	-	-
-	-	-	-
1	PRELIMINARY LAYOUT DRAWING	ISH	
		DESIGN INDEX	REVISED
		701	1

CHAIR DETAILS EQUIPMENT PLACEMENT

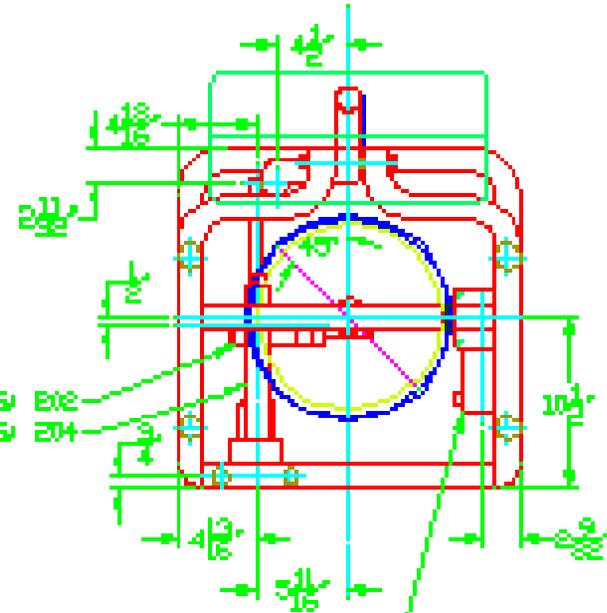
PLAN VIEW
(CHAIR IN THE UPRIGHT POSITION)



LEFT SIDE OF CHAIR
LOOKING EAST
(CHAIR IN THE RECLINED POSITION)



500# 1 1/2" ACTUATOR SEE DWG. 602
250# 8" ACTUATOR SEE DWG. 204



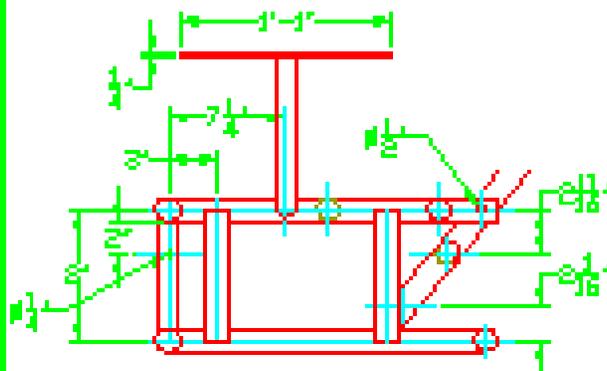
RIGHT ANGLE GEARMOTOR SEE DWG. 205

SECTION
NO SCALE

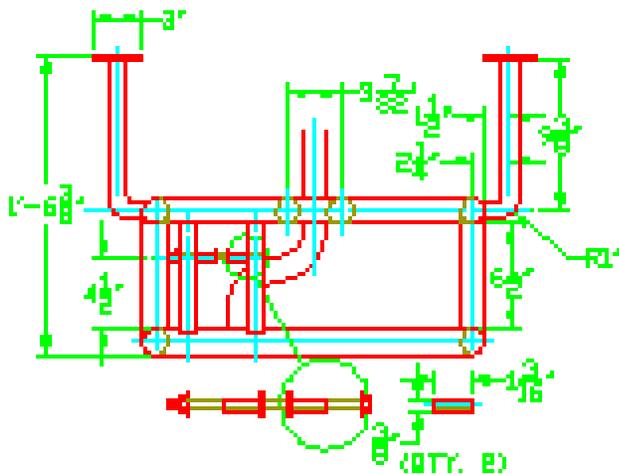


DATE	3/5/2004	TENDER DESIGN PROJECT 1	
DRAWN BY	ISH	SALOON BOOTH WITH	
SCALE	NO SCALE	AUTOMATICALLY ADJUSTED	
ADVISOR	KETTIL CEDERCREUTZ	RETRACTABLE SINK AND	
EXPD	MAY 21-22	SYNCHRONIZED CHAIR	
NO. OF SHEETS	NO.	CHAIR DETAILS	
-	-	EQUIPMENT PLACEMENT	
-	-	DRAWN BY	ISSUED
-	-	702	1
1	PRELIMINARY LAYOUT DRAWING	ISH	

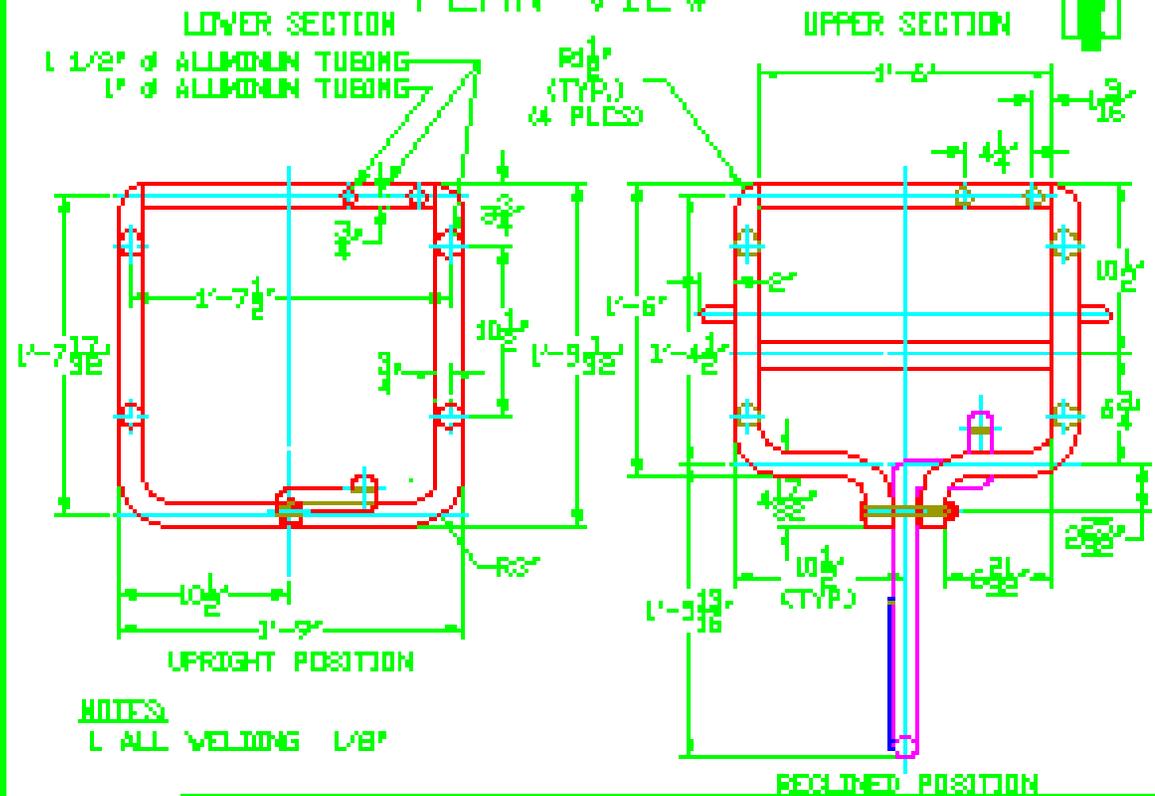
ELEVATION
LOOKING EAST



ELEVATION
LOOKING SOUTH



FRAME DETAILS
PLAN VIEW



NOTES:
L ALL WELDING 1/8"

BILL OF MATERIALS

QTY.	DESCRIPTION
-	1 1/2" x 1/4" WALL THICKNESS ALUMINUM TUBING (16.875')
-	1" x 1/4" WALL THICKNESS ALUMINUM TUBING (3')
1	1/4"-20 x 6" LONG HEX HEAD CAP SCREW
1	1/4"-20 HEX NUT
4	1/4" ID FLAT WASHER
2	SPACERS - 3/8" ROUND STOCK DRILLED 1/4" HOLE

SIZE	CUT LENGTHS
1 1/2" x 1"	2-0'-9 1/2" (A), 2-0'-11" (B), 2-0' (C), 2-0' (D), 4-0' (E), 1-0' (F), 1-0' (G), 2-0' (H), 2-0' (I), 2-0' (J), 2-0' (K), 2-0' (L), 2-0' (M), 2-0' (N), 2-0' (O), 2-0' (P), 2-0' (Q), 2-0' (R), 2-0' (S), 2-0' (T), 2-0' (U), 2-0' (V), 2-0' (W), 2-0' (X), 2-0' (Y), 2-0' (Z)
1" x 1/4"	2-0'-9 1/2" (A), 2-0" (B), 2-0" (C), 2-0" (D)

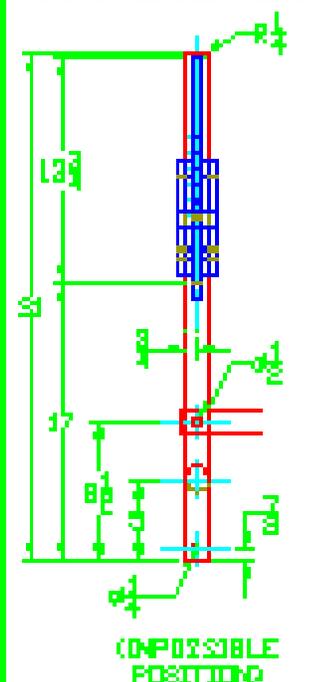
DATE	3/5/2004	TENDR DESIGN PROJECT 1 SALON BOOTH WITH AUTOMATICALLY ADJUSTED RETRACTABLE SINK AND SYNCHRONIZED CHAIR
DRAWN BY	ISH	
SCALE	NO SCALE	
ADVISOR	KETIL CEDERCREUTZ	
EXPD	MAY 21-22	

NO.	DATE	BY	DESCRIPTION
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
1		ISH	PRELIMINARY LAYOUT DRAWING

REVISED	REVISION
703	1

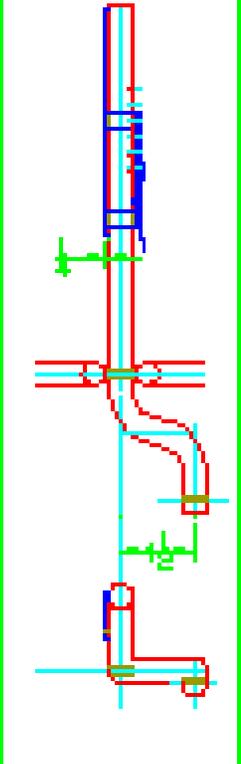
RECLINE ARM & HEIGHT ADJUSTMENT

**ELEVATION
LOOKING WEST**
1 1/2" x 1/8" ALUMINUM TUBING



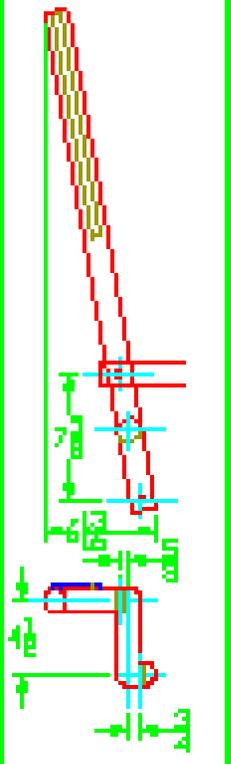
NOTES:
1 ALL TUBING ACCOUNTED FOR ON DWG# 705.
2 WELD CHANNEL ONTO ARM 1" SX PER SIDE.

**ELEVATION
LOOKING NORTH**
UPRIGHT POSITION



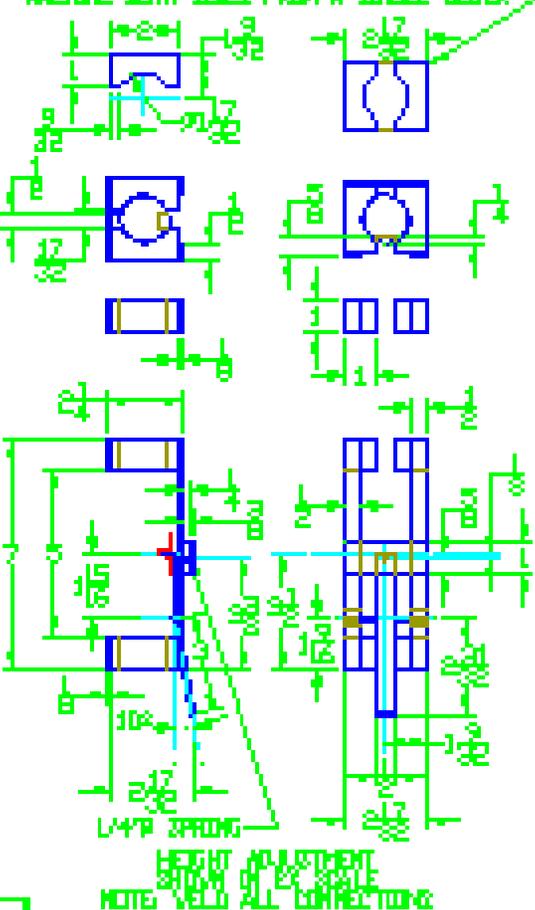
PLAN VIEW

**ELEVATION
LOOKING WEST**
UPRIGHT POSITION



PLAN VIEW

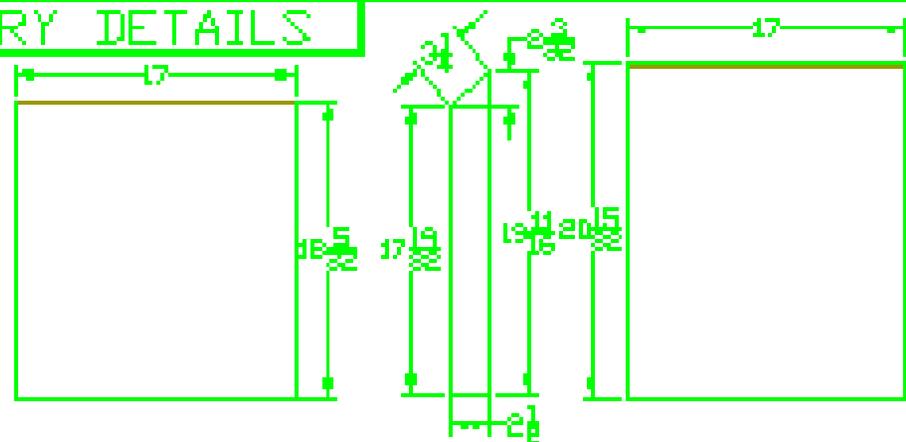
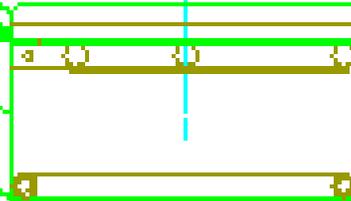
MACHINE BOTH SIDES FROM A SINGLE BLOCK



UPHOLSTERY DETAILS

1" SOFT PADDING
 1" STIFF PADDING
 1/4" THICK BOARD
 NYLON MATERIAL
 TO COVER ENTIRE
 BASE OF CHAIR
 1/4" THICK BOARD

ELEVATION
LOOKING WEST



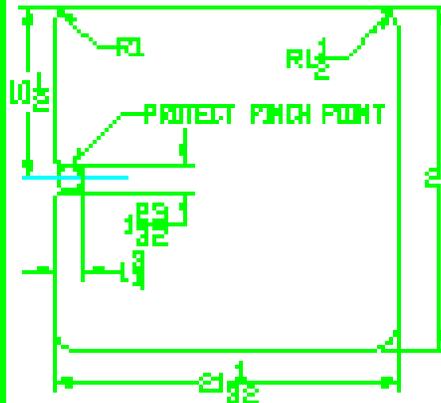
BACK SIDE

SIDE BOARDS
(QTY. 2)

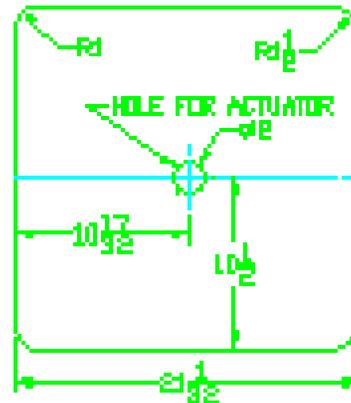
CUSHION SIDE

PLAN VIEW

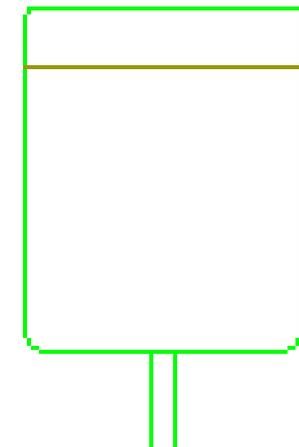
1/4" PLYWOOD
TOP BOARD



1/4" PLYWOOD
BOTTOM BOARD



1/4" THICK BOARD
 1" SOFT PADDING
 1" STIFF PADDING
 1/4" THICK BOARD
 NYLON MATERIAL
 TO COVER ENTIRE
 BACK OF CHAIR
 1/4" THICK BOARD
 1/4" THICK BOARD



NOTES

L FIELD MOUNT BACK TO HEIGHT ADJUSTER

DATE: 3/5/2004
 DRAWN BY: ISH
 SCALE: NO SCALE
 ADVISOR: KETTEL CEDERCREUTZ
 EXPD: MAY 21-22

TENDR DESIGN PROJECT 1
 SALON BOOTH WITH
 AUTOMATICALLY ADJUSTED
 RETRACTABLE SEAT AND
 SYNCHRONIZED CHAIR

SIZE	CUT LENGTHS
BOARD DIMS:	21" x 10 1/2" (2) 21" x 10 1/2" (2) 21" x 10 1/2" (2)
BILL OF MATERIALS	
QTY.	DESCRIPTION
-	1/4" THICK PLYWOOD 8633 FT ²

NO.	DATE	BY	DESCRIPTION
-	-	-	-
-	-	-	-
-	-	-	-
1		ISH	PRELIMINARY LAYOUT DRAWING

UPHOLSTERY DETAILS	
DATE ISSUED	ISSUED
706	1