Report of Course Work Assignment

Spring Semester Obligatory Part

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Contents

1 Problem Definition

In this assignment, it is asked to individually gather info about pilot production sample and future batch production (100 pieces). Also, sample production in real-life conditions is required to be simulated and organized. This report is a result of this assignment, which conducted the analysis on the **prototype of a new seat for economy class cabin** designed by the author. The following sections will be included in this report:

- Construction of the seat (Section 2)
- BOM analysis (Section 3, also the part type definition is also given in this section)
- Technical conditions for production (Section 4)
- Production process description (Section 5)
- The staff required for production (Section 6)

The seat for the economy-class cabin is a common part of the aircraft cabin, and it is also a part that is easy to be produced. Typically, the seat for economy class should be light, comfortable, and easy to be repaired or refurbished. Based on this requirement, the author designed a seat for the economy-class cabin, which is shown in Figure 1.

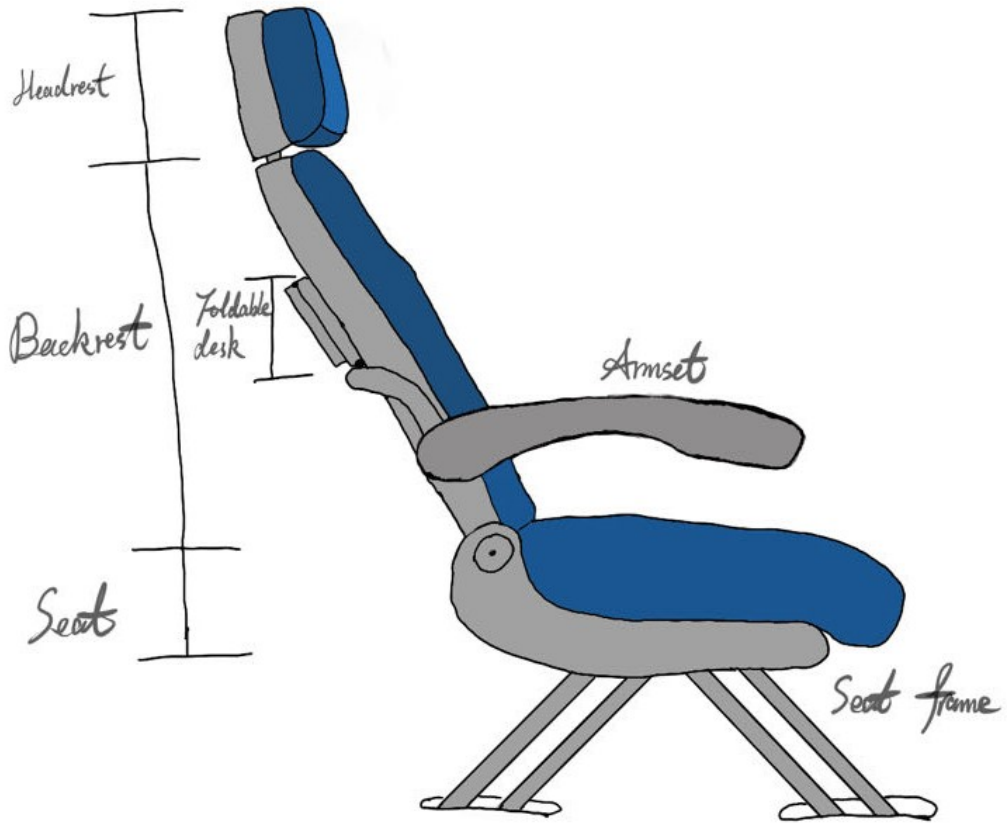

Figure 1: The prototype of the seat for economy class cabin (the support legs are not shown completely in the figure)

The seat is designed to provide passengers with a comfortable and enjoyable flying experience while being lightweight, durable, and easy to maintain. The dimensions of the seat have been optimized for passenger comfort and space efficiency, with a width of 17 inches (43.18 cm) to accommodate most passengers and a pitch of 31 inches (78.74 cm) to provide ample legroom.

The frame of the seat is made of lightweight composite materials or plastics that are strong and durable, yet light enough to reduce weight and fuel consumption. The cushion covers of the seat are made of high-quality polyurethane foam that provides excellent support and comfort for passengers during long flights.

To enhance passenger comfort, the seat features a polyurethane-filled headrest for optimal neck support and comfort. Armrests provide additional support and can be adjusted to suit passengers of different sizes.

The seat is designed with a recline function that allows passengers to adjust the angle of the seat for increased relaxation and comfort. The design also allows for quick and easy maintenance, repair, and refurbishment to minimize downtime and costs by using modular components that can be easily replaced or repaired. For example, the cushions and covers are pre-assembled and can be easily applied to the seat with specially designed button-like connections and locking mechanisms, or removed for cleaning or replacement.

Moreover, a foldable desk will be attached to the back of the seat. When it is unfolded, it can provide the passenger in the back with a desk, which can be used to hold food and beverages or used for entertainment.

Safety is a top priority and the seat design meets all safety regulations and requirements. The seat is crash-worthy, and fire-resistant, and provides easy access to emergency exits in case of an emergency.

Overall, this prototype for a new economy-class seat prioritizes passenger comfort, durability, and safety while minimizing weight and maintenance costs.

2 Construction of the seat

In this section, the separation of the seat designed above will be constructed.

2.1 Seat frame

The seat frame, depicted in Figure 2, has been fabricated through a meticulous selection of plastic materials for the seat, headrest, backrest, and other joints, along with the integration of aluminum alloy supportive components. The primary objective of this combination is to attain an optimal balance between weight reduction and safety enhancement. One end of the support structure is firmly attached to the ground, while the opposite extremity is fastened to the seat's undercarriage employing screws. This configuration facilitates structural stability and also provides the possibility of replacing or servicing other parts of the frame. The hinge connection mechanism enables a range of motion for the backrest, permitting it to swing obliquely forward and backward up to 35 degrees, thus offering passengers a more comfortable seating experience.

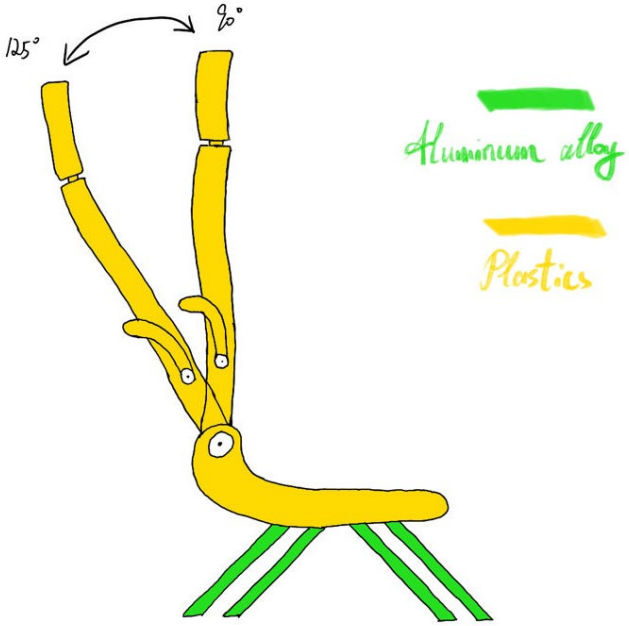

Figure 2: Seat frame (the support legs are not shown completely in the figure)

2.2 Seat Assembly

The seat assembly, shown in Figure 3, comprises the cover and cushions. The cover, crafted from polyurethane leather, is endowed with waterproof, oil-proof, easy-to-clean features, and outstanding durability. The cushion is composed of superior-quality polyurethane foam that offers passengers excellent support and comfort over extended flights. To generate a peaceful and comfortable ambiance, blue is presumed to be the chosen color for the cover, but airline companies can specify a different color scheme according to their preferences. The cover and cushions come pre-assembled and can be effortlessly affixed to the seat via specialized button-like connections and locking mechanisms, as illustrated in Figure 4.

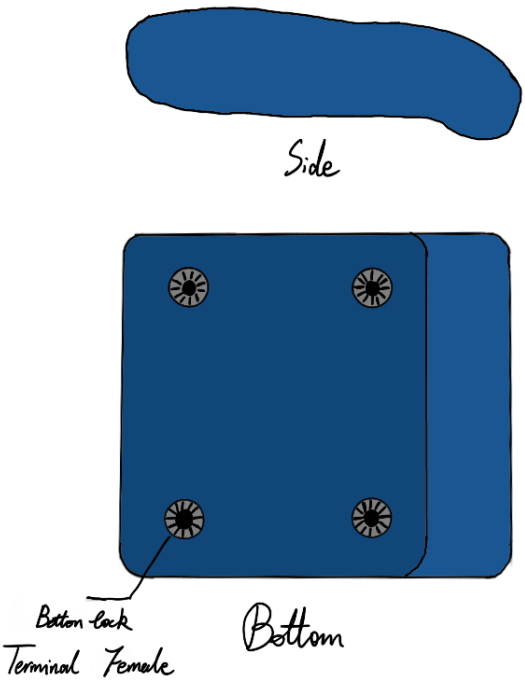

Figure 3: Seat assembly

2.3 Headrest Assembly

The headrest assembly substantially resembles that of the seat; the sole difference is in its size. Consequently, this report does not provide a specific explanation of the headrest assembly.

2.4 Backrest Assembly

The backrest assembly substantially resembles that of the seat; the sole difference is in its size. Consequently, this report does not provide a specific explanation of the backrest assembly.

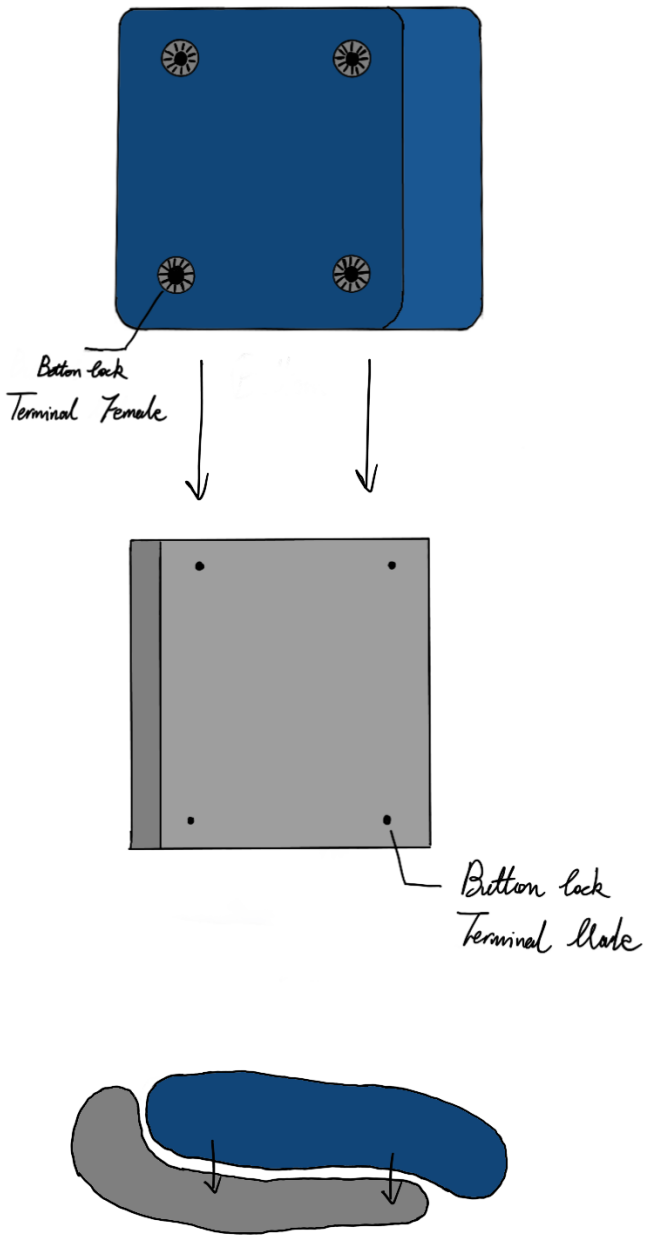

Figure 4: Button-like connections and locking mechanisms on the seat frame and seat assembly and their connection

2.5 Armrests

A single seat features dual armrests, affording passengers the opportunity to rest their arms individually and comfortably, thereby eliminating the necessity of sharing armrests with adjacent passengers. The armrests, constructed from plastic, exhibit lightweight and durable properties. Additionally, a hinge binds the armrests' root to the seatback, enabling the armrests to be raised, thus allowing for more convenient entry and egress or shared seating accommodations among companions. The armrests are depicted in Figure 5.

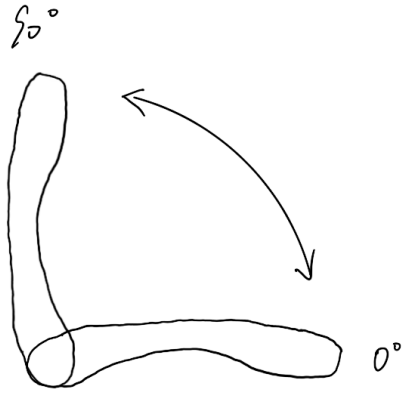

Figure 5: Armrest (can be raised and lowered for a range of motion of 90 degrees)

2.6 Foldable Desk Assembly

Constructed from lightweight and rigid plastic, the foldable desk serves to provide passengers with a practical platform for stowing personal effects or consuming meals. Boasting a maximum load-bearing capacity of 5 kg, passengers will be duly informed of the reduced weight limit of 4 kg in the interests of safety. Articulated via a hinge affixed to the backrest, the table may be folded upwards or downwards at will. A single swivel latch, positioned on the desk's lower periphery, serves to secure the table in a folded configuration, retaining it against the backrest when not in use. Upon opening this latch, the desk descends by means of gravity to a level position in front of the passenger. Figure 6 illustrates the design of the foldable desk.

2.7 Connections and Fasteners

In the current prototype, the integrity of the structure relies significantly on the efficacy of the connections and fasteners employed. Screws serve as an essential component, securing the legs to the floor and fastening the seat frame to maintain stability. Hinges, on the other hand, are implemented in all rotational joints, including those between the backrest and seat frame, armrest and seat frame, and foldable desk and backrest. In addition, button-like connections are integrated into the design to facilitate the attachment of the seat assembly to the seat frame, enabling straightforward replacements of covers and cushions and simplifying the seat's cleaning process. This innovative design feature holds significant potential for enhancing the functionality of the seat.

3 BOM Analysis

The Bill of Materials (BOM) for the economy class seat prototype is shown in Table 3. In the table, the parts, components, materials, size and weight are listed. Also, the part type definition is given in the last column of the table.

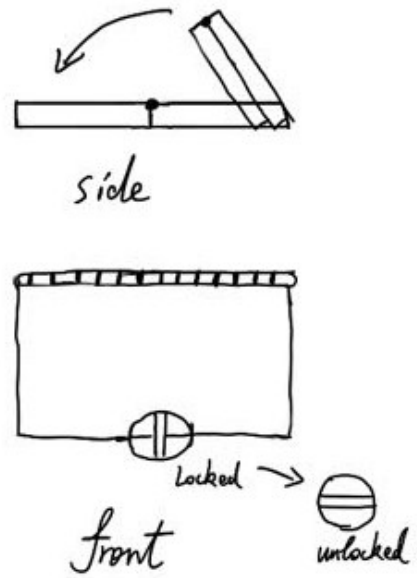

Figure 6: Foldable desk assembly

Table 1: Bill of Materials (BOM) for the Economy Class Seat Prototype

Name	Part	Code	Description (Function)	Unit	Quantity	Material	Size	Weight	Type
Seat Frame	Leg	SF-001	High-strength aluminum stick (support the weight of the seat and the passenger)	Set of 8	1	High-strength aluminum	25" x 2.4" x 0.79" (63.64cm x 6cm x 2cm)	0.12 kg / 0.27 lbs	Purchased
	Seat frame	SF-002	Plastic frame (support of the seat assembly)	Each	1	Thermoplastics reinforced with carbon fibers (TRCF)	17" x 17" x 2.5" (43.18 cm x 43.18 cm x 6.3 cm)	0.9 kg / 2 lbs	Purchased
	Backrest frame	SF-003	Plastic frame (support of the backrest assembly)	Each	1	TRCF	26" x 17" x 2.5" (66.04 cm x 43.18 cm x 6.3cm)	1.8 kg / 4 lbs	Purchased
	Headrest frame	SF-004	Plastic frame (support of the headrest assembly)	Each	1	TRCF	9" x 12" x 2" (22.86 cm x 30.48 cm x 5.1cm)	0.3 kg / 0.7 lbs	Purchased
	Recline mechanism	SF-005	Recline adjustment mechanism (adjusts seat recline angle)	Each	1	Metal and plastic	-	0.5 kg / 1.1 lbs	Purchased
Seat Assembly	Seat Cushion	SC-001	Polyurethane foam cushion (provides passenger comfort)	Each	1	Polyurethane foam	17" x 19" x 4" (43.18 cm x 48.26 cm x 10.16 cm)	2 kg / 4.4 lbs	Purchased
	Seat Cover	SC-002	PU leather cover (covers the seat cushion)	Each	1	PU leather	17" x 19" (43.18 cm x 48.26 cm)	-	Purchased
Headrest Assembly	Headrest Cushion	HR-001	Polyurethane foam cushion (supports passenger head)	Each	1	Polyurethane foam	9" x 12" x 2" (22.86 cm x 30.48 cm x 5.1cm)	0.5 kg / 1.1 lbs	Purchased
	Headrest Cover	HR-002	PU leather cover (covers the headrest cushion)	Each	1	PU leather	9" x 12" (22.86 cm x 30.48 cm)	-	Purchased
Backrest Assembly	Backrest Cushion	BR-001	Polyurethane foam cushion (supports passenger back)	Each	1	Polyurethane foam	26" x 17" x 4" (66.04 cm x 43.18 cm x 10.16cm)	0.5 kg / 1.1 lbs	Purchased
	Backrest Cover	BR-002	PU leather cover (covers the backrest cushion)	Each	1	PU leather	26" x 17" (66.04 cm x 43.18 cm)	-	Purchased
Armrests	-	AR-001	Molded plastic (supports passenger arms)	Pair	1	TRCF	10" x 2" x 2.5" (25.4 cm x 5cm x 6.3cm)	1 kg / 2.2 lbs	Purchased
Foldable desk assembly	-	FD-001	Two flat panels joined together by a hinge (provide support to passengers' stuff or room for entertainment)	Pair	1	TRCF	5" x 12" x 0.2" (12.7cm x 30.48cm x 0.5cm)	0.09 kg / 0.2 lbs	Purchased
Connections and Fasteners	Buttons	CF-001	Stainless steel buttons (connect cushions and covers)	Pack of 10	1	Stainless steel	-	0.01 kg / 0.02 lbs	Purchased
	Screws	CF-002	Stainless steel screws (fasteners)	Pack of 50	1	Stainless steel	-	0.05 kg / 0.11 lbs	Purchased
	Bolts	CF-003	Stainless steel bolts (fasteners)	Pack of 20	1	Stainless steel	-	0.1 kg / 0.22 lbs	Purchased
	Nuts	CF-004	Stainless steel nuts (fasteners)	Pack of 20	1	Stainless steel	-	0.05 kg / 0.11 lbs	Purchased
	Washers	CF-005	Stainless steel washers (fasteners)	Pack of 50	1	Stainless steel	-	0.05 kg / 0.11 lbs	Purchased
	Hinge	CF-006	Stainless steel hinge (connections)	Pack of 10	1	Stainless steel	-	0.01 kg / 0.02 lbs	Purchased

4 Technical Conditions for Production

4.1 Workshop Site Sizes

Due to that, all the parts of the seat are bought from our suppliers, the workshop site size is mainly composed of the inventory and the assembly line. For a batch of 100 pieces, the parts need to prepare should be enough for 105 pieces.

Consider the stacking height limit for each layer is 2 meters and the width and the length are also 2 meters, and the storage structure is three layers, as shown in Figure 7.

Figure 7: Stocking Structure

For each stocking unit with a volume of 2m x 2m x 2m, the number of parts that can be stored is listed in Table 2.

Table 2: The upper limit of the number of each part that can be stored in one stocking unit

Name	Volume (m^3)	Storage limit	Need
Leg	0.00076368	10475	840
Seat frame	0.011746428	681	105
Backrest frame	0.017965125	445	105
Headrest frame	0.003553541	2251	105
Seat Assembly	0.021172087	377	105
Headrest Assembly	0.003553541	2251	105
Backrest Assembly	0.028972329	276	105
Armrests	0.0008001	9998	210
Foldable desk assembly	0.000193548	41333	210

It can be found that the number of parts that can be stored in one stocking unit is far more than the number of parts needed for a batch of 100 pieces. Therefore, the storage space is sufficient. Suppose we store each part in independent stocking units, also consider one workbench for all the screws and fasteners and three -more stocking units for the assembled seats, the total number of stocking units needed is 12. The inventory size would be the area of the workbench, four three-layer stocking structures and the aisles. Therefore, the inventory size is $S_{\text{inventory}} = 12 \times 16 = 192\text{m}^2$, which includes a very large margin for passage and logistics.

To assemble such a product, an assembly line would need to be established with different stations for each component. Below is a suggested assembly line process:

1. Frame assembly station - Assemble the aluminum legs and plastic frames (SF-001, SF-002, SF-003, SF-004) to form the seat frame structure.

2. Recline mechanism installation station - Install the recline mechanism (SF-005) onto the seat frame.

3. Cushion installation station - Install the polyurethane foam cushions (SC-001, HR-001, BR-001) onto the plastic frames.

4. Armrest and desk assembly station - Assemble the molded plastic armrests (AR-001) and foldable desk assembly (FD-001) onto the seat frame.

5. Final assembly station - Attach the buttons (CF-001) to connect the cushions and covers, and fasten all components with screws (CF-002), bolts (CF-003), nuts (CF-004), and washers (CF-005) using appropriate tools. Attach the hinges (CF-006) to the foldable desk assembly.

Assuming that each station will require a workspace of at least three times the size of the largest component, the assembly line will require a space of at least $1.9812 \times 1.2954 = 2.566\text{m}^2$ for each station. Therefore, the total space required for the assembly line will be at least $2.566 \times 5 = 12.83\text{m}^2$ for the five stations listed above. Additionally, there should be space for the workers to move around and transport the components from one station to another. Thus, the final assembly line space would be at least 25m^2.

Moreover, consider the stage of quality check, which will be introduced in Section 5.5, the space for the quality check is $S_{\text{QC}} = 1.5S_{\text{assemblyline}} = 37.5\text{m}^2$.

In all, the workshop site size is $S_{\text{workshop}} = S_{\text{inventory}} + S_{\text{assemblyline}} = 192 + 25 + 37.5 = 254.5\text{m}^2$. (Exclude the other Facilities that will be introduced in Section 4.3 that are not directly related to the production process.)

4.2 Consumables

4.2.1 Electricity

According to industry sources, the electricity consumption of a typical sewing machine ranges from 200 to 400 watts per hour, while a cutting machine can consume up to 2,000 watts per hour. The power consumption of an assembly robot would depend on its size and capabilities.

Assuming an average power consumption of 500 watts per hour per machine, and an average of 20 machines in operation at any given time, the assembly line would require a total power supply of 10,000 watts per hour, or 10 kilowatts per hour (kWh). This translates to a daily consumption of 240 kWh (10 kW x 24 hours), assuming the line operates 24 hours a day.

Assuming an average lighting power density of 11 watts per square meter, the electricity consumption for lighting the inventory area would be 2,387 watts per hour, or 2.387 kWh. This translates to a daily consumption of 57.3 kWh (2.387 kW x 24 hours), assuming the lights are on 24 hours a day.

Therefore, the total daily electricity consumption of the workshop would be 297.3 kWh (240 kWh + 57.3 kWh).

4.2.2 Water

Assuming that each stage of the assembly line requires water for cooling and cleaning and that each stage uses about 10 liters of water per day, the total water consumption per day would be 5 stages x 10 liters/stage = 50 liters/day.

4.2.3 Lubricants

Assuming that each stage of the assembly line requires lubricants for machinery and equipment and that each stage uses about 0.5 liters of lubricants per day, the total lubricant consumption per day would be 5 stages x 0.5 liters/stage = 2.5 liters/day.

4.2.4 Office supplies

Assuming that each office employee needs about 5 sheets of paper, 1 ink cartridge, and 2 pens per day and that there are 2 office employees working each day, the total office supply consumption per day would be 2 employees x (5 sheets + 1 ink cartridge + 2 pens) = 14 units/day.

4.3 Other Facilities Needed

Forklifts, as shown in Figure 8, are needed for logistics, such as loading products or transporting parts and products between the inventory and the assembly line. Besides, for the sake of humanitarianism, a restroom and a break room are designed for the workers. The restroom should be equipped with a toilet, a sink, and a hand dryer. The break room should be equipped with a refrigerator, a microwave, a water dispenser, and a sofa.

Figure 8: Forklift

4.4 Safety Measures

1. Training - All workers involved in the assembly line process and the inventory should undergo proper training on how to safely operate machinery, handle tools, follow safety procedures, handle materials and use equipment safely.

2. Personal protective equipment (PPE) - Workers should wear appropriate PPE such as gloves, eye protection, ear protection, and steel-toed boots to protect them from potential hazards.

3. Machine guarding - Machinery used in the assembly line should be properly guarded to prevent workers from accidentally coming into contact with moving parts.

4. Material handling equipment - Equipment used for transporting and storing inventory such as forklifts, pallet jacks, and ladders should be properly maintained and operated according to safety standards.

5. Ergonomics - Workstations should be designed to promote good posture and reduce the risk of repetitive strain injuries.

6. First aid and emergency response - A first aid kit should be readily available, and workers should be trained on emergency response procedures in case of an accident or injury. Also, fire prevention measures should be in place such as having fire extinguishers, smoke detectors, and proper storage of flammable materials.

7. Housekeeping - Good housekeeping practices should be followed to keep the inventory storage area clean and free from clutter, which can lead to tripping hazards.

8. Regular maintenance and inspection - Regular maintenance and inspection of machinery and equipment should be conducted to ensure they are functioning correctly and do not pose a hazard to workers.

4.5 Factory Site Structure

Based on the depiction in this section, the factory site structure is shown in Figure 9.

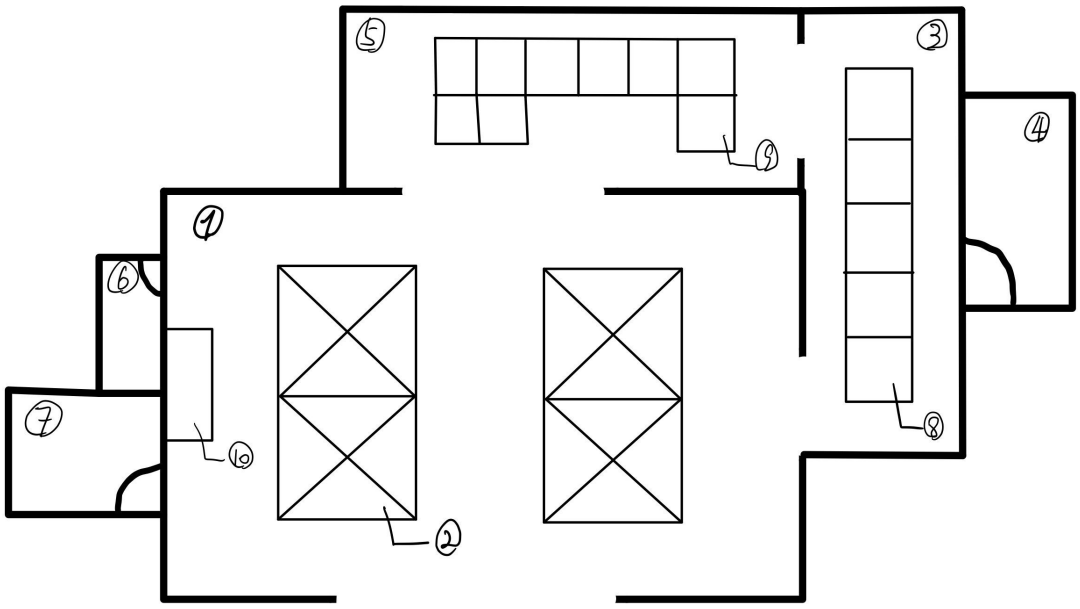

Figure 9: Factory Site Structure

①: Inventory. ②: Stocking structure. ③: Assembly room. ④: Employee office (the furniture such as the desks is not shown in the figure). ⑤: Quality check room. ⑥: Restroom (the furniture such as the toilet is not shown in the figure). ⑦: Break room (the furniture such as the sofa is not shown in the figure). ⑧: Assembly line with 5 stations. ⑨: Quality check stations with 9 stages. ⑩: Workbench storing the screws and fasteners.

5 Production Process Description

Here the process to produce the parts are shown along with the assembly procedures, though all the parts of the seat are bought from the suppliers and our factory will only focus on the assembly. The overall production sequence is shown in Figure 10.

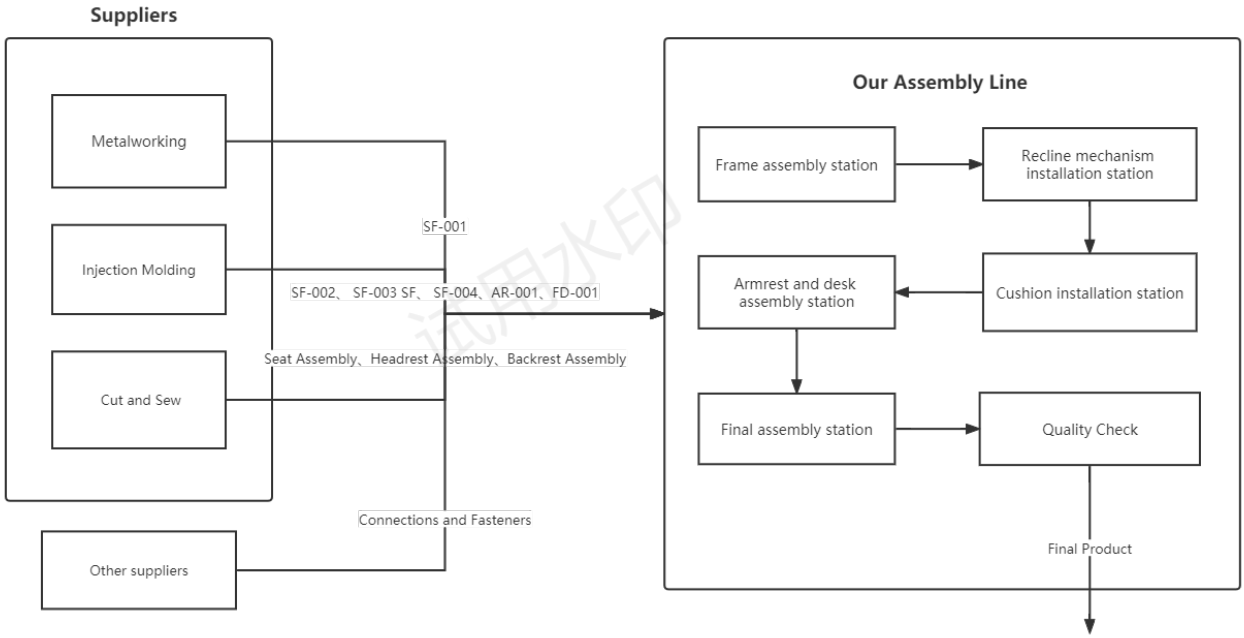

Figure 10: Production Sequence

5.1 Metalworking

In this procedure, the high-strength aluminum will be cut and shaped into the sticks we need (SF-001). The machines needed in this procedure are the saw and lathe, shown in Figure 11 and Figure 12 respectively. The saw is used to cut the aluminum into the length we need, and the lathe is used to shape the aluminum into the shape we need.

5.2 Injection Molding

In this procedure, the thermoplastics reinforced with carbon fibers (TRCF) will be processed and shaped into the parts we need (SF-002, SF-003, SF-004, AR-001 and FD-001). First, the TRCF material will be cut into small pellets or granules of uniform size that can be easily melted and molded. The TRCF material should also be properly dried to prevent moisture absorption and ensure consistent quality. Second, load the TRCF material into the hopper of an injection molding machine. The hopper will feed the material into a heated barrel for melting. Third, the TRCF material is heated and melted in the barrel of the injection molding machine. The temperature and pressure settings may vary depending on the specific TRCF material being used. Once the TRCF material is molten, it is injected into a mold cavity under high pressure. The mold is designed to produce the desired shape and size of the final product. Then, the TRCF material inside the mold is allowed to cool and solidify, taking the shape of the mold cavity. The cooling time and temperature depend on the thickness and complexity of the part being molded. After the TRCF material has solidified, the mold opens and the finished part is ejected from the mold cavity. Finally, the finished part may require trimming and finishing to remove any excess material or improve its surface quality. This can be done using various techniques such as cutting, sanding, or polishing.

During these steps, the industrial machines and tools include

Figure 11: Saw machine

Figure 12: Lathe machine

1. Raw Material Preparation: Pelletizer, dryer
2. Loading the Material: Injection molding machine with hopper and screw feeder
3. Heating and Melting: Injection molding machine with heating elements, barrel, and screw
4. Injection: Injection molding machine with mold clamping unit, injection unit, and nozzle
5. Cooling and Solidification: Injection molding machine with cooling system, mold release agent, and mold temperature controller
6. Ejection: Injection molding machine with ejector pins, knockout bars, and robotic arm (optionally)
7. Trimming and Finishing: Cutting tool (such as a saw or cutter), sandpaper or polishing cloth or files.

The machines needed are shown in Figure 13, 14, 15, 11 and 16.

Figure 13: Pelletizer with dryer

Figure 14: Injection molding machine 1

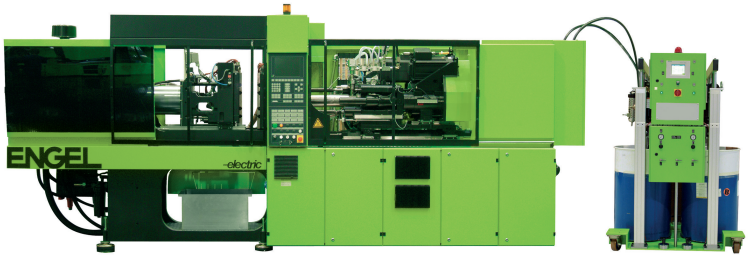

Figure 15: Injection molding machine 2

Figure 16: Finishing and polishing tool

5.3 Cut and Sew

In this procedure, polyurethane foam and PU leather are shaped to make the seat assembly, backrest assembly and headrest assembly. First, measure and cut the polyurethane foam to fit the size and shape of the seat cushion needed. Then, place the cut polyurethane foam into a mold or shape it manually by carving, sanding, or cutting using appropriate tools. Once the polyurethane foam has been molded, cover it with a layer of batting or fabric to provide a smooth surface for the PU leather cover.

As for the PU leather, first, measure and cut the PU leather to fit the size and shape of the seat cover needed. Second, sew together the pieces of PU leather to form the cover of the seat cushion. Then, place the PU leather cover over the top of the polyurethane foam cushion and stretch it tightly around the foam to ensure a snug fit. Use an adhesive or staples to secure the edges of the PU leather cover to the underside of the foam cushion. Finally, finish the seat cushion by adding any necessary trimmings, such as piping or buttons.

The tools and machines typically used in these steps include (partly shown in Figures 17, 18, 19 and 20),

1. Measuring and Cutting: Measuring tape, sharp blade or utility knife
2. Mold Polyurethane Foam: Grinding machine, sanding machine, carving tool, hot wire cutter
3. Cover Polyurethane Foam: Staple gun, scissors
4. Sew PU Leather: Sewing machine, thread
5. Attach PU Leather Cover: Adhesive, staple gun
6. Add Finishing Touches: Piping cord, button covering kit, decorative trim, etc.

Figure 17: Carving tool

5.4 Installation and Assembly

In this procedure, the parts produced in the previous steps will be assembled into the final product. The detail of the assembly line has been explained in Section 4. The machines and tools needed in this procedure include (shown in Figure 21)

1. Frame assembly station: Drill, rivet gun
2. Recline mechanism installation station: Drill, screwdriver

Figure 18: Hot wire cutter

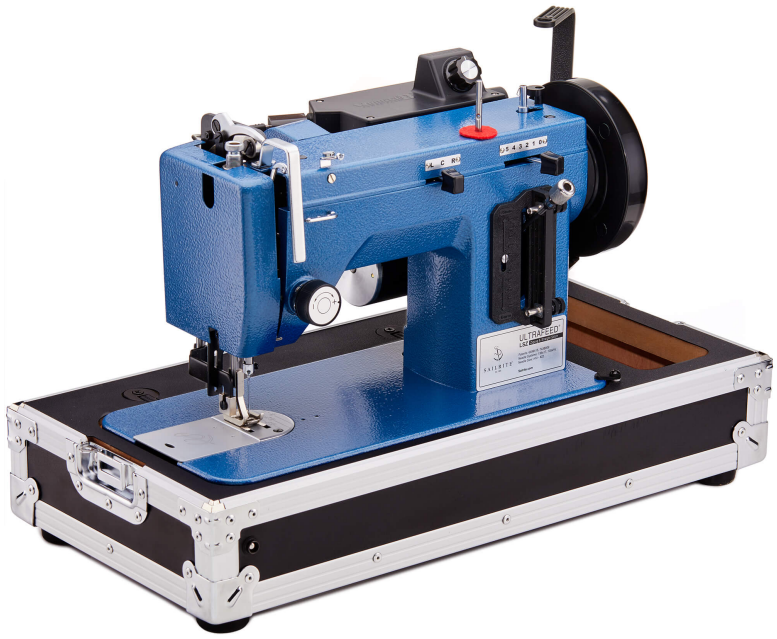

Figure 19: Sewing machine

Figure 20: Staple gun

3. Cushion installation station: None (by hand)
4. Armrest and desk assembly station: Screwdriver, drill
5. Final assembly station: Screwdriver, drill

Figure 21: Drill and screwdriver

5.5 Quality Control

1. **Dimensional check**: Verify that the width and height of the seat meet the specified dimensions.
2. **Weight verification**: Ensure that the weight of the seat is within the specified range to ensure compatibility with the aircraft.
3. **Frame inspection**: Test the strength of the frame by applying a load to the seat and checking for any signs of deformation or failure. Ensure all the parts of the frame, including the headrest frame, backrest frame, seat frame, armrests and desks won't detach under the load and torque.
4. **Cushion quality check**: Check if the cushion covers are uniform and free from any blemishes, wrinkles, or tears. Test the elasticity and softness of the polyurethane foam.
5. **Recline function and armrests test**: Test the recline function and armrests to confirm that they operate smoothly and correctly. Confirm that they are adjustable within the designed range and not moveable without any limitations.

6. **Modular component check**: Confirm that modular components, including cushions, covers, buttons, locking mechanisms, and other parts are assembled correctly and fit securely.
7. **Foldable desk inspection**: Test the foldable desk to ensure that it functions as intended and is sturdy enough to support items within the designed load capacity.
8. **Safety compliance check**: Confirm that the design meets all safety regulations and requirements, is crash-worthy, fire-resistant, and provides easy access to emergency exits in case of an emergency.
9. **Cleaning and maintenance verification**: Ensure that the seat is designed for quick and easy maintenance, repair, and refurbishment and can be cleaned easily without causing damage to the seat.

6 Staff

6.1 Workers

Assuming an average workspace of 1.5 m^2 per worker, it can be estimated that the maximum number of workers that can be working at any given time is 16 (25/1.5). Assuming three shifts of work (morning, afternoon, and night), it can be estimated that the total number of workers in a day is 48 (16 x 3). However, the practical number of workers would be less than this, as the number of products needed at this time is only 100.

6.2 Employees

Employees are needed to manage the factory and the workers. The number of employees needed is estimated to be 2, including the safety and technical manager and the accountant.

6.3 Guards

Guards are needed to ensure the safety of the factory. The number of guards needed is estimated to be 6, including the three shifts (2 for one shift).

6.4 Estimated time for production

Assuming 16 workers work together at a time and are separated into the assembly line and the quality check, as each worker has a specific task to complete, the assembly line sequence suggests that each station would take around 5-10 minutes to complete. Therefore, the total assembly time for one seat would be approximately 25-50 minutes. Assuming the factory operates 24 hours a day, the production is 28. To completely produce a batch of 100 pieces, it would take 4 days.

For quality checks, if we assume that each check takes an average of 5 minutes per item, then the quality control process would take approximately 45 minutes. Therefore, assuming the factory operates 24 hours a day, the number of products that can undergo quality checks and wait for delivery is 32.

Overall, the factory would need to operate for 4 days to produce 100 seats.