

Drive & Control profile

Rexroth Aluminum Framing Takes Front Row Seat at Commercial Aircraft Interiors Manufacturer



The cart moves down the production line from station to station where sub-assemblies are installed onto the seat.

At C & D Zodiac passenger seats fly through stations of continuous flow line.

Most of us don't like to think about crowded airports with lines bogged down by security checkpoints and flights plagued by delays, but one thing that can make this stressful mess a little more tolerable is plopping down in a decent seat once we've finally made it on the plane.

C & D Zodiac of Ontario, California, is a leading manufacturer of those welcoming seats that signal the end of the struggle. In fact, C & D designs and manufactures multiple components for commercial aircraft cabin interiors, but at the 75,000-square-foot Ontario

Challenge

Convert an airline passenger seat production line from a batch and queue system to a one-piece, continuous flow line.

Bosch Rexroth Solution

- Assembly station carts constructed entirely of Rexroth aluminum structural framing.
- Die-cast gusset connectors, adjustable angle gusset kits, and end caps.
- Ergonomic tool rails and tool holders.

Benefits

- Increased production rate by 196 percent.
- Quality control has improved as work-in-progress seats on the production floor have been cut from 100 seats to less than ten.
- Ergonomic workstations.
- Congruent professional look with durable, anodized structural framing.
- Easy reconfiguration of workstations.



To streamline their production line, C & D Zodiac now employs station carts made of Rexroth's aluminum structural framing to transport airline seats from station to station. Converting to a continuous flow line has led C & D to nearly a 200% increase in airline seat production.

facility, seats are their specialty. C & D's customers represent every major airline and commercial aircraft manufacturer, including OEMs such as Embraer and Bombardier, and the site turns out 1,200 passenger seats per month. So, chances are if you're a frequent flyer, you've already made their acquaintance.

In order to place passengers in the lap of luxury, C & D Zodiac recently decided to convert its production line from a batch and queue system to a one-piece, continuous flow line. Since July 2006, C & D has been using a series of assembly station carts constructed entirely of aluminum structural framing components and systems supplied by the Linear Motion and Assembly Technologies group of the Bosch Rexroth Corporation. Now, a finished chair ranging in price from \$1,000 to

\$3,200 comes off the assembly line every 18 minutes in the box and ready to be shipped.

Making the Switch

Ryan Newham, C & D Zodiac industrial engineer, is the man

behind this unique one-piece flow line, and he explained how the line works.

Quite simply, in the one-piece flow line, also called a continuous flow line, a passenger seat moves through the production line from station to station. Following lean manufacturing principles, assembly work is divided among the stations equally, so each station has exactly 18 minutes worth of work per station. Each passenger seat is built on a fixture that is attached to a cart made of Rexroth aluminum framing. The cart moves down the line from station to station where sub-assemblies are installed onto the seat. Sub-assemblies for passenger seats include: armrests, food trays, legs, spreaders, tubes, diaphragms, baggage bars, backs, in-flight entertainment (IFE) components, and seat cushions.

An overview of the passenger seat assembly line shows sub-



Highly customizable workstations provide timely access to the right tool at the right time. In total there are approximately 211 steps using in excess of 311 parts.

assemblies feeding directly into the main assembly line, while custom sub-assembly workbenches are positioned close enough to allow the operator to place the finished sub-assembly directly onto presentation carts on the main line, or onto the final assembly stations.

In total, the passenger seat line comprises approximately 211 steps using about 311 parts. There are nine final assembly stations and ten sub-assembly stations. Sub-assemblies by category, include:

- Metal Structures: spreaders, tubes, diaphragms, quadrants, pivot brackets, legs, baggage bars
- Injection Molded Plastic Assemblies: food trays, armrests, back shrouds, cart bumpers
- Upholstery: back cushions/ covers, bottom cushion/ covers, back wraps
- Customizable Options: IFE components (credit card readers, monitor brackets, electrical harnesses, shrouds), ash trays, adjustable headrests

At each of these stations is a custom final assembly station, which is also made of Rexroth aluminum structural framing. This station holds a two-bin system of hardware used to install the sub-assemblies onto the chair. It also uses Rexroth tool holders to hold all of the hand tools needed in an ergonomic, handle-first, ready-to-use position. Some of the hand tools used on the production line include Helicoil hand inserting tools and tang breakers, screwdrivers, pliers, diagonal cutters, ratcheting box end wrenches, and Allen wrenches. The final stations also hold air tools hung from balancers



Tool holders hold all of the necessary hand tools in an ergonomic, handle-first, ready-to-use position.

overhead with air lines descending from the top of the workbench. All tools are placed within easy reach of the operator.

“We tried shadow boards before with pegboard type wire hooks, but these proved too fidgety

for operators to use,” explained Newham. “They usually cause the operator to orient the tool in an unnatural position before they place it on the shadow board, and the same situation occurs when operators are retrieving tools.”



Complete with air lines that descend from the top of the workbench, overhead balancers occupy the final stations.

Newham and his crew also observed that if the shadow board was too far away from the operator or, if it was too difficult to place or retrieve tools, the operator was more likely to just place the tools on top of the workbench.

“Hand tool holders must be designed so that placement and retrieval are practically innate,” concluded Newham. “The Rexroth tool rack presents the hand tools in a natural, handle-first manner, and, because it is modular, it is easy to add or remove tools at a later date.”

One-Piece Outworks

Batch and Queue

Before converting its production line into a “one piece flow” system, C & D employed the “batch and queue” method.

“When we used batch and queue, we had mountains of sub-assembly parts everywhere on carts and shelves, but we would never seem to have the actual parts we needed,” recalled Newham. “We would build all of the seats up to a certain point and store them on the floor waiting for the next step.”

According to Newham, the batch and queue system repeatedly left the production line with a hundred or more seats on the production floor in various stages of construction, which caused several problems. “All of the work-in-progress seats occupied limited floor space and were not producing any profit,” explained Newham. “And, while the seats waited for a next step or parts, they were



Adjustable angle gusset kits permit quick adjustment of shelves on a workbench, workstation, or cart.

susceptible to damage as workers and equipment were forced to move around them.” In addition, noted Newham, the seats were only partially completed, which saddled C & D with the burden of trying to track their various stages of completion and made it difficult to manage timely inspections and quality control.

Since conversion to the continuous flow line using the carts, C & D now has only eight or nine work-in-progress chairs that are all actually being worked on, instead of just waiting for the next step that might be a day away. Overall, conversion to the continuous flow line has led to nearly a 200 percent increase in production.

“When we decided to convert the line from batch and queue to

continuous flow, we chose Rexroth aluminum framing because of its ease of construction, its vast flexibility, and its fit and finish,” said Newham. “There is no welding or painting involved, so it greatly simplifies and speeds up construction to keep production moving.” Newham also noted the appeal of the aluminum framing’s finished, durable, anodized coating, which gives C&D a congruent, professional look throughout the facility.

“Because everything is bolted together, we have the ability to make adjustments or add on more features as the needs of the line change,” noted Newham. “I can’t tell you how many times I have designed something in AutoCAD, then when I actually built it, I realized maybe a shelf should be a little bit lower, or a tool holder should be a little bit higher for a person who is shorter. Or, once I realized the person I made a workbench for was left handed, and I had put all the tools on the right. Rexroth aluminum framing gives me the confidence that I have the flexibility to make my designs work. And, when I’m all done, I have equipment that is custom built for my exact needs, and it looks stunning and very professional.”

The large variety of aluminum framing sizes and shapes offered C & D the cost-effective, reconfigurable design Newham was looking for. Die-cast gusset connectors exemplify the product’s flexibility with no required machining and connections that

are available anywhere along the t-slot. Alignment tabs also aid assembly, as does the drop-in, t-bolt design. C & D also used adjustable angle gusset kits, which allow quick adjustment to any angle, including, as Newham noted, when there is a need to facilitate quick angular adjustment of shelves on a workbench, workstation, or cart. Tool rails and holders allow easy movement of tools from side-to-side to address operator handedness and other space issues, reduce worktable space, and enhance personnel safety and ergonomics. Finally, end caps provide a clean, finished appearance.

In addition to aluminum structural framing, C & D Zodiac is also using the new Bosch Lithium ion 10.3V electric screwdriver, which despite its compact size packs a lot of torque and features precision variable speed control even at very slow speeds.

According to Newham, the actual construction of the Rexroth components of the line took about two months, while the entire process of converting to one-piece flow with all the parts, time studies, and mapped processes was carried out over a year.

“Steve Kirnig, Rexroth district distribution manager and Jeff Brock, project engineer for Rexroth distributor Automation Controls have both been very helpful in giving us complete solutions so that we could build our one piece flow line,” said Newham. “Jeff is always visiting, and working with us to find the best answers.”

Rexroth
Bosch Group