



DELTA

TechOps

Technical Operations Center Tour Guide Handbook



For MEDICAL EMERGENCY call
OCCUPATIONAL HEALTH @ 4-3220 or 911

For all other Emergencies call the
Atlanta Operational Manager (AOM) @ 4-7438



DELTA



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This Handbook is a tool for you to use as a TechOps Tour Guide. The contents are arranged so that you may customize your tour. The purpose of this information is to provide you material to perform a 2 hour tour of the TOC. It is best to perform the tour starting on one end of the TOC and proceed to the other end. You may notice some shops are omitted. To include all shops would add a considerable amount of time, and most tour guides agree that they would not add materially to the tour.

Remember that it is an honor to serve as a tour guide. The people of TechOps trust you to represent Delta in a favorable way. This means that you should have a positive attitude about yourself and Delta. By expressing this to our visitors, you will make a favorable impact upon them and yourself. Thank you for your help.

Items to Remember

Ref: TOPSMM

1. Tours of the Atlanta TOC must be arranged in advance with the General Manager—Safety, Security, and Environmental Compliance or by using the TechOps Visitor Pre-Authorization Request Form located on the TechOps Safety, Security and Environmental web page.
2. All adult and student age visitors must bring a valid drivers license or passport in order to participate in the tour. No children under eight are allowed to take the tour.
3. At the ATL TOC, employees may escort from one to five visitors inside the Delta EA area (inside the hangar, shop, administrative areas, or parking lot).
4. Employees must remain with the visitors at all times. Should it become necessary for any visitor(s) to leave the area (rest break, meal break, etc.), another escort must be provided to ensure that no individual is left unescorted. If necessary, all visitors must leave the area together.
5. In the event of a building evacuation, the group must be escorted together to the nearest outside area as per the emergency response plan indicates.
6. Visitors should display their visitor pass on the outer most garment at all times.
7. Escorts shall ensure that visitor(s) adhere to the same standard of safety as all Technical Operations personnel.
8. In the case of an emergency, escorts will be responsible for leading visitors to the designated gathering point as shown in the departmental Emergency Response Plan.
9. Escorts shall ensure that visitors have access to proper Personal Protective Equipment (PPE) and use it when entering designated areas.



Welcoming Remarks

Welcome to Delta's Technical Operations Center or the "TOC".

Delta began as a crop dusting company in Monroe, Louisiana in 1925. In 1928 the company became Delta Air Service and expanded to passenger service. In 1941 the headquarters moved from Monroe to Atlanta. Over the years, several mergers/acquisitions with other airlines have occurred; Chicago & Southern (1953), Northeast (1972), Western (1987), Pan Am (1991), and Northwest (2008).

From its hubs in Atlanta, Cincinnati, Detroit, Memphis, Minneapolis-St. Paul, New York-JFK, Salt Lake City, Amsterdam and Tokyo-Narita, Delta, its Northwest subsidiary and Delta Connection carriers offer service to 347 destinations in 64 countries and serve more than 160 million passengers each year. Including the SkyTeam and worldwide codeshare partners, Delta offers flights to 570 destinations in 120 countries.

Delta Air Lines is the world's largest airline, with over 85,000 employees worldwide, with some 24,000 employees based in our Atlanta hub. Delta has a fleet of more than 795 aircraft including the MD-88, MD-90, 737, 747, 757, 767, 777, and Airbus aircraft. Atlanta-Hartsfield Jackson International Airport is the home to Delta's primary maintenance facility.

Delta Air Lines has the lowest OSHA recordable injury rates in the domestic airline business and is the first U.S. airline that has ever reached OSHA's Voluntary Protection Program (VPP) Star status. The TOC is an active Star site.



Technical Operations



Technical Operations

Over 9,600 people make up the Technical Operations Division or "TechOps", and about 5,500 employees are at this TOC facility. Other TechOps employees are assigned to facilities throughout the country and around the world.

The TOC, or Jet Base as it was originally called, opened its doors on June 21, 1960. The original Jet Base (called TOC 1 today) housed over 1,600 employees in its 9 acres under roof. At the time of the dedication of this facility, Delta's fleet included 79 aircraft of which only 9 were jets. The first expansion of the Jet Base was completed in May of 1968 to increase space to 16 acres under roof and housed over 3,300 employees. In 1973 the Jet Base expanded to more than twice its size to over 36 acres under roof. The second hangar, referred to as TOC 2, spans 785 feet wide. An addition was made to TOC 1 in 1982 which increase its depth by 80' to accommodate larger aircraft. The latest expansion occurred in 1991 with the addition of TOC 3. Within TOC 3s 750,000 square feet are four floors of shops and warehouses in addition to three paint hangar bays. The TOC currently consists of 63 acres under roof, counting all floors.

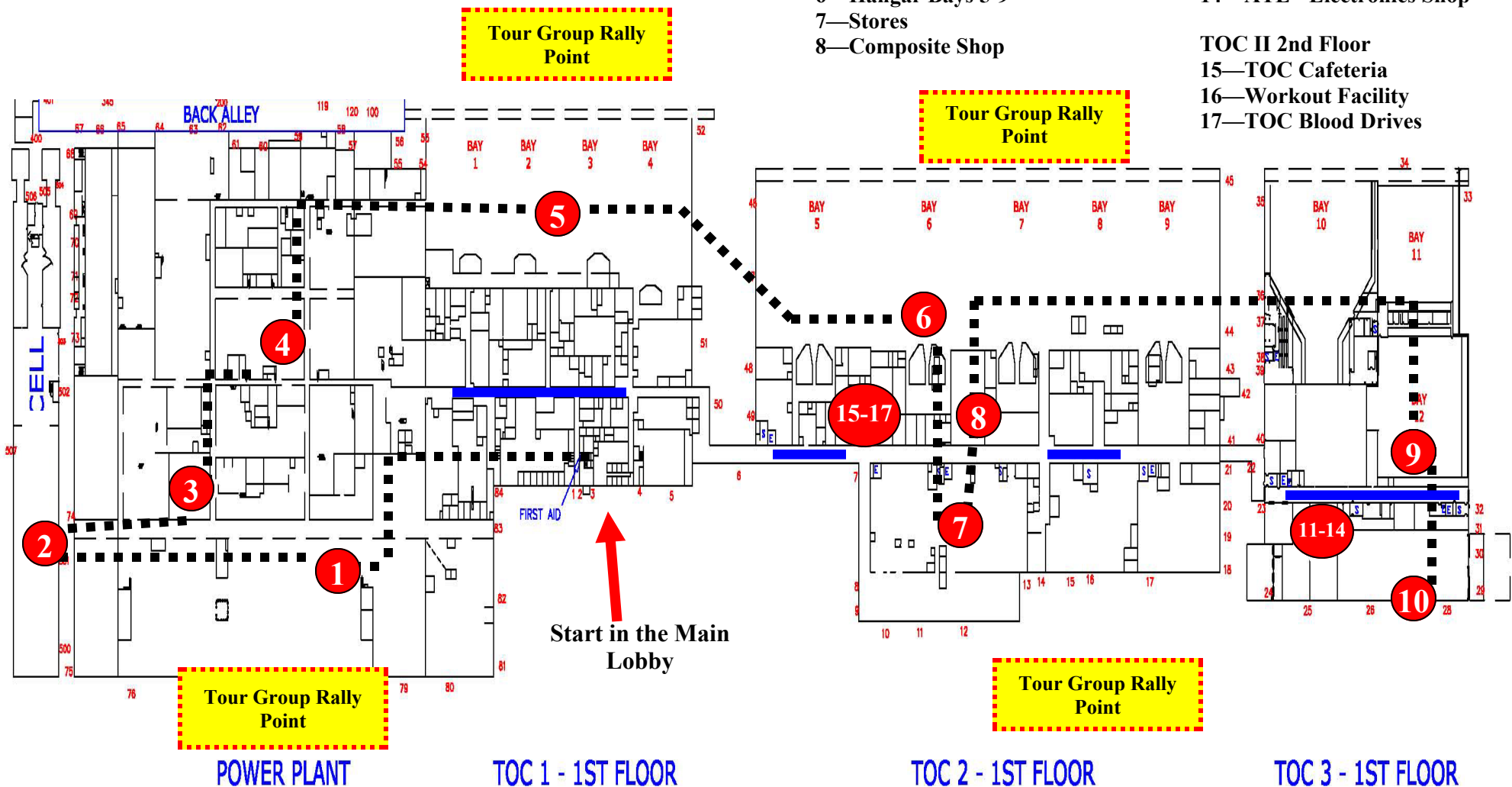
Annual maintenance performed at the TOC include the production of over 200,000 aircraft components per year, over 650 engines and 350 APUs, and over 200+ Major Visits (PSV) per year, 260+ Hangar Overnight Visits and Letter Checks per year, and 200+ Modification and Paint Visits per year. TechOps is also a Maintenance/Repair/and Overhaul (or MRO) provider for over 150 aviation and airline customers around the globe.

Our Atlanta facility covers nearly 2.7 million square feet (about 250,830 square meters or the size of 47 football fields) and was specifically designed to provide a smooth flow of work and material. Aircraft work is done in one area, engine work in another, components in yet another—all tied together by an efficient, reliable multi-vehicle transportation system capable of delivering material and parts quickly.

TechOps Tour Map

For Your Safety!

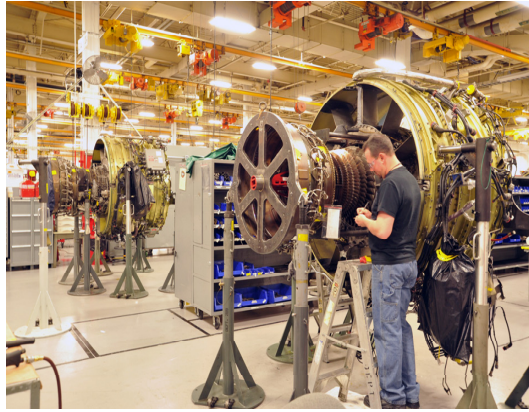
1. Remember to walk in the designated lanes in the hallways.
2. Identify the Severe Weather Assembly Areas shown in blue.
3. Evacuate to the designated rally points.



1. Engine Shop

The Engine shop maintains seven different models of engines manufactured by GE and Pratt & Whitney. The engines are monitored while in service and sent to the shop for refurbishment as necessary.

Engines are disassembled, and the parts are sent to the various shops to be cleaned, inspected, and reconditioned. All the parts are then returned to the assembly area where they are made ready for test. Before an engine goes back into service, it's put through the rigors of one of our engine test cells. Annually, more than 650 engines and 350 Auxiliary Power Units (APU) are tested in the four test cells at Delta TechOps. The largest cells are capable of testing engines providing up to 70,000 pounds of thrust.



WARNING: DO NOT ALLOW VISITORS TO ENTER INTO THE ENGINE SIDE WITHOUT PROPER PPE – SAFETY GLASSES!



2. Blade and Vane Shop

The critical portions of jet engines are comprised of a series of hundreds of air moving blades and guide vanes. During the restoration process, the blades and vanes are removed, inspected, and routed to the Blade and Vane shop for refurbishment.

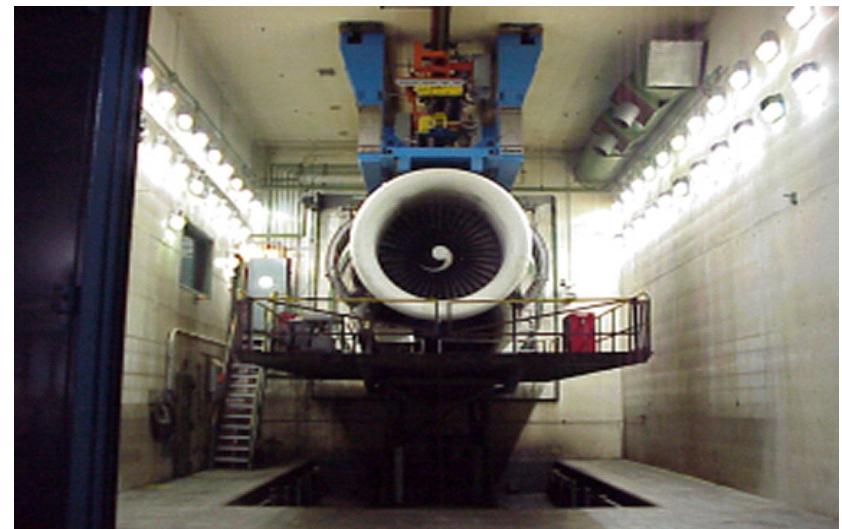
3. Test Cells

Engines refurbished in the shop must be tested before they are installed on the aircraft. Engines are transported on a special cart to the Test Cell facility and are prepared for testing by installing the test adapters. The test adapters consist of an interface beam (Referred to as the “Strong Back”) and large fiberglass inlet shroud which directs air smoothly into the engine to simulate flight operation. This also allows the engines to be hoisted and attached to the mono rail system (Large Test Cells Only) and transferred via the rail to the appropriate test cell where the engine interfaces with the testing computers, as well as the fuel, air, and electrical supplies.

The walls of the building are 3’ (90cm) thick and the ceiling, including the engine mounting structure, is approx 8’ (240cm) thick. Sound dampeners are in place to absorb noise during the engine tests. The Test Cells will run engines up to 70,000 lbs of thrust. Large hydraulic lift platforms are used to raise the AMT’s and tooling up to the engine for maintenance.

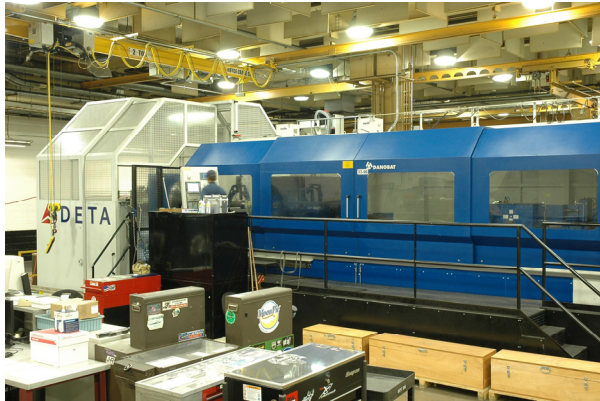
The control room has visibility to the engine under test through 3 heavy 3” thick bullet proof glass windows. The engine is tested using the throttle controls and computer displays in the control room. An engine is run for three hours or more at various power settings while meter readings are recorded by the computer. When all running conditions are satisfactory, the engine is disconnected and prepared to be installed on an aircraft when needed.

**WARNING: DO NOT ENTER ENGINE TEST AREA WITHOUT APPROVAL!
WARNING: DO NOT ALLOW VISITORS TO ENTER THE SOUND DAMPENERS!**



4. Machine Shop

Delta has one of the finest machine shops in the southeast, with over 125 machines costing up to \$1,500,000 each. Many of the machines are computer controlled which increases efficiency by over 75% than that of a manually controlled machine. The Universal Grinder can handle landing gear parts up to 10' in diameter and 10' in length. The Glidden & Lewis Boring Mill has digital readouts indicating measurements from various working points on a given part. This machine is accurate to within 1/10,000' (.003mm) of desired measurement. Obviously, the machine operator must be a meticulous individual.



balancing machine. Without this balancing process the engine could not withstand the vibrations while in service and would fail in a short time.

4. Rotor Shop

Engine compressor and turbine assemblies must be balanced to withstand up to 10,000 revolutions per minute with virtually no vibration. Blades are weighted individually prior to assembly. Once assembled into a turbine wheel they are brought to a static balance (not turning). The turbine wheels are then combined into a larger assembly and tested by rotation and then balanced on a dynamic

Fuel Component Shop

The jet engine fuel controls (same function as a carburetor on an auto), engine pumps (same as fuel pump), and other fuel components are reconditioned in this area. A Main Engine Control (cost over \$200K) will be taken completely apart, all piece parts will be measured for close tolerance operation, piece parts will be replaced, and then will be reassembled and tested. There are over 100 o-rings which are replaced per MEC at a cost of \$4-\$30 each.

This shop contains a machine shop to perform engineering approved operations such as repair, alteration, and manufacture.

The second half of the shop contains the test stands which check the function of the different fuel components including fuel spray pattern which is critical to the smooth operation of the engine. The test stands use calibrated fluid which simulates fuel. Some of the test stands even simulate flight operations such as temperature and altitude.

5. Hangar Bays 1-4

The TOC I hangar is 600' (183m) long. It was modified in 1982 with an addition to make it 250' (76m) deep. It accommodates 2 wide bodied and 4 smaller aircraft. Identify the types of aircraft that are in the hangar. The hangar bays are staffed with personnel performing routine and non-routine maintenance on the aircraft. The principle objective is to complete all assigned maintenance in the minimum amount of ground time through the maximum utilization of manpower, skills, and equipment.

WARNING: DO NOT ALLOW VISITORS PAST THE GREEN LINE WITHOUT APPROVED PPE – SAFETY GLASSES!



6. Hangar Bays 5-9



The hangar is 1,060' (323m) long 300' (91m) deep, and 93' (28m) high. It is one of the world's largest cantilevered structures (supported from one side, shed-like). It accommodates 6 wide body and 6 or more smaller aircraft simultaneously.

Identify the types of aircraft that are in the hangar. This may be the first opportunity visitors have had to see a jet aircraft up close. Point out the landing gear, flaps, and engines. Aircraft work

scope consists of routine visits such as Packaged Service Visits (PSV), contract maintenance (Insourcing), aircraft modifications, and landing gear changes. The space is also utilized for non-routine maintenance visits.

Point out the tail docks. Over 100 electric motors move the platforms up, down, in, and out. The huge cables that raise the structure are rated at a quarter of a million pounds. There are personnel elevators at the back of the structures to reach the various levels.

WARNING: DO NOT ALLOW VISITORS PAST THE GREEN LINE WITHOUT APPROVED PPE – SAFETY GLASSES!

On Board an Aircraft in One of the Bays

(Check with the Hangar Work Center @ 4-2805 prior to the tour to arrange which aircraft to board)

WARNING: PRIOR TO BOARDING, CAUTION VISITORS TO REMAIN CLEAR OF OPEN DOORS. BE ESPECIALLY CAREFUL THAT CHILDREN REMAIN UNDER CLOSE ADULT SUPERVISION! AVOID BOARDING AIRCRAFT WITHOUT DOOR RESTRAINTS INSTALLED.

Inside the Cabin

After getting the Supervisor's permission, take your group on board an aircraft. Allow visitors to carefully move about the cabin. Point out the different components they will see throughout the tour, such as the In Flight Entertainment systems. Let the visitors know the cabin is pressurized in flight to ensure a temperature of 72°F with plenty of oxygen even though outside air temp is approximately -50°F and there is little oxygen at typical cruising altitude of 35,000 feet.



Inside the Cockpit

WARNING: DO NOT ALLOW VISITORS TO TOUCH ANYTHING!

Point out the flight crew seats (pilot, first officer, and jump seat), control column, rudder pedals, and various instruments the visitors will see maintained throughout the tour such as the autopilot control panel, flight management control panel, and the CRT or LCD displays.



7. Stores

The Stores retriever / picker system was built to accommodate the many piece parts needed to maintain our aircraft. The 10 aisles each have a robotic Crane which automatically picks the correct tray of parts among the 25,000 storage bins. The operation is capable of moving up to 300 orders per hour. When an order is placed the system lets the Crane know which tray to pull so the Stores Supply Attendant can fill the order. Each Crane is capable of lifting 200lbs and can be operated manually if the automatic function fails. When the tray is brought to the clerk, the box location of the part required is highlighted on LCD screen. Once the order is packaged, it is distributed internally to the shop or to a Line maintenance facility in or out of Atlanta.



8. Composite Shop

This shop repairs and rebuilds aircraft structures such as flaps, ailerons, rudders, landing gear doors, tail cones and nose/fan cowls. The shop has its own tool room and its own Nondestructive Testing (NDT) department, which inspects items with ultrasound and magnetic resonance. NDT also has an infrared camera to detect liquids in the structure.

Looking around the shop you will find the following:

1. In the right corner is a large blue oven which is used to remove all moisture contained within the aircraft structure prior to repair.
2. In the center left there is a clean room which is used to put together the layers of fragile fiberglass or carbon composites used in this shop. There are many layers in an aircraft structure. For example, a 757 fan cowl has over 300 layers of material arranged in a pattern to ensure maximum strength and performance.
3. Next on right is the metal bond area. This is where one can see examples of the honeycomb structure found within some surfaces.
4. To the left is a large Autoclave which measures 5' (1.5m) by 22' (6.7m). The Autoclave is a computer controlled chamber which uses pressure (to prevent gaps) and heat to cure the aircraft structures.
5. The tables on the left are made by Delta to hold the different structures manufactured, repaired, and refurbished in the shop.
6. Point out the large blue grinding booth used to remove damage and prepare the surfaces for maintenance.
7. Lastly, let group know of the large water tank in the back of the shop used for final Hydro Static test for certain metal bond parts. If any air bubbles show up, the part has to be re-worked.

9. Paint Hangar Bays 10-12

The most recent addition to the TOC is this state-of-the-art facility which, although under budget, cost more than \$280 million when built. This is the first hangar developed by a major U.S. Air Carrier specifically dedicated to painting. With a ceiling height of 93 feet, the bays can simultaneously accommodate a Boeing 747, Boeing 767 and a Boeing 757 aircraft. Dedicated to environmental and employee safety and efficiency, the advanced, temperature-controlled bays offer automated ventilation and exhaust methods to facilitate different washing, de-painting and painting procedures. Each bay has its own air filtration, recirculation, and fire protection system. The elevated platforms and moving cranes enable Delta's technicians to reach any spot on the plane, even the top of the tails, which on some aircraft are over 50 feet high. The giant Stacker Cranes can lift up to 2,000 lbs and carry a minimum of two (for safety) to a maximum of four technicians. The Stacker Cranes cost approximately \$1 million each. Each paint aircraft takes 4-7 days to complete and will use 50-65 gallons of paint. 4-6 aircraft per month come through for a new paint job and each aircraft in Delta's fleet is on a 5-6 year rotation.

The TOC III hangar is also home to the Atlanta Intermediate Maintenance Operation (IMO) which is a specialized crew of Aviation Maintenance Technicians (AMT) who alleviate Line Maintenance of "Off-Line" aircraft repairs. The IMO group performs routine and non-routine maintenance not only in Atlanta, but travels to sites around the world.

WARNING: DO NOT ALLOW VISITORS TO ENTER INTO PAINT BAYS IF DOORS ARE CLOSED AND LIGHTS ARE FLASHING!



10. Wheel and Brake Shop

The Wheel and Brake shop utilizes a system of conveyors to move parts rapidly and efficiently through the production line. Once a tire is removed from the wheel, the wheel halves are separated and sent through a large dishwasher type cleaner called the “Chicken Washer” (the company that produced it also produces commercial chicken washers). After cleaning, the parts are inspected for cracks using Non-Destructive testing methods such as fluorescent penetrant and eddy current processes. With an average of 80 wheels built per day, they have a turn time under three days. 16,000 wheels are processed through this shop annually. New or re-capped (we usually get 8 re-caps per carcass) tires are stored in an automated tire storage and retrieval system and are installed on rims through the use of a computerized Robotic Wheel Torque System. The tires are filled with nitrogen to prevent moisture in the tire and will typically last for 300 landings (approx. 45 days).

Brake assemblies are disassembled, cleaned, and inspected. New color coded (for size and thickness) brake linings are installed and the unit is reassembled. Brake assemblies can weigh several hundred pounds depending on aircraft type. Approximately 4,000 brake assemblies are reconditioned annually. Brake landings range from 550 to 2500 receipts per night. Brake assemblies can last from 400 to 2,000 landings per overhaul, depending on aircraft type.

WARNING: DO NOT ALLOW VISITORS INTO SHOP WITHOUT APPROVED PPE – HEARING PROTECTION AND SAFETY GLASSES!



11. Avionics

Delta’s Avionics shops test and repair aircraft electronic parts or Line Replaceable Units (LRU). A majority of the work performed in these shops are to the component level. This means the Technicians determine the cause of failure to a component such as a resistor or a circuit chip and replace the bad part. All of the Technicians in these shops are certified to the highest level of internationally recognized soldering standards.



12. Electronics Shop

This shop performs testing and repairs on cockpit display components such as CRT and LCD displays. The 737NG Heads-Up Display (HUD) is also maintained in this shop. (Note the darkrooms used for the display systems)



In addition to those components, the shop has an area dedicated to gyro repair. Standby Horizon Gyros (indicating system used in the event of a power failure) and Laser Gyro navigation systems are tested and repaired in the back of the gyro area. Ask a technician to point out the blue triangular component which contains the laser.

13. Audio Visual Shop

The Audio Visual shop maintains some of the In-Flight Entertainment (IFE) systems common to all Delta passengers. Seat controls, displays, and Flight Attendant intercom systems are tested and repaired in this area. This is a high volume shop which produces over 1000 components each month.

In addition to the IFE this shop also maintains the aircraft “Black Boxes”. These components (actually two items: cockpit voice recorder and flight data recorder) are actually Orange! These units record aircraft information such as engine speed, flight control angle, altitude, etc. The cockpit voice recorder maintains a history of all audio in the cockpit – better watch what you say, it’s being taped! A shop mechanic may be able to demonstrate the operation of these units – just ask.

TOC III 2nd Floor



14. Automatic Test Equipment (ATE) Electronics Shop

The ATE shop is equipped with computer operated test units used to test complex Autopilot, Navigation, and Electronic Engine Controls. This computer controlled equipment reduces test time up to 500% (for example a manual test of 80 hours would only take 4 on an ATE). Although these ATEs can be quite costly

(some over \$1M), they not only reduce test time but one ATE can test several different parts – The Teradyne CTS can test over 100 different parts.



TOC II 2nd Floor

15. TechOps Café

TechOps employees can now utilize the services of the café conveniently located on the 2nd floor of the TechOps II. The Café services Delta employees with breakfast, lunch and dinner provided by Allmora Culinary Services. Employees can enjoy a full-service gourmet deli, international cuisines, and an expanded salad bar. Also provided are an assortment of snacks and Starbucks coffee.

The new facility includes an updated dining area with a full range of health and wellness food options. The TechOps Café also offers a full-service catering option.

The new café was opened on November 2010 with a ceremonial ribbon cutting. During the opening ceremonies, Tony Charaf—President of Delta TechOps, cut the ribbon alongside of employees while free coffee and pastries were provided.



TOC II 2nd Floor

16. TechOps Fitness Center

The TechOps Fitness Center occupies over 11,000 square feet and is located directly next to the café on the second floor, 1775 Aviation Blvd. The center offers membership options for all active Delta employees and contractors.

Note: Only employees with TOC access Delta ID badges will be allowed to use the facility.

Hours of Operation: Monday through Sunday from 4:30 a.m. until 11:00 p.m.

Fitness Center features include:

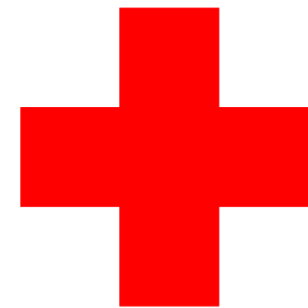
- Polar BodyAge™
- FitLinxx
- Matrix and Cybex strength training equipment
- Free weights
- State of the art Matrix cardiovascular machines including integrated televisions, Ipod connections, and Virtual Active
- Group fitness studios
- Group cycling studios
- Men's and women's locker room facilities and showers
- Full complement of locker room amenities
- Complimentary towel service



17. TechOps Blood Drives

TechOps is a corporate leader by setting the standard for a better community blood supply. Employees have the opportunity to help the community by donating blood several times throughout the year. TechOps hosts 4-6 blood drives per year along with the American Red Cross including a holiday drive in the month of December. Employees can schedule their donation time through an appointment page on the TechOps Home Page.

Employees enjoy donating blood while receiving care from a workforce of friendly American Red Cross nurses. The TechOps blood drives are also staffed with friendly TechOps employees who act as volunteers.



American Red Cross

Closing Remarks

On behalf of TechOps and the many employees here we would like to thank you for visiting our facility today! Let them know it is our pleasure to have them visit. Do your duty as a good host in bidding them farewell! You never know how much it will mean to Delta in future years for these visitors to have toured our facility. A large part of their impression of our company will be their impression of you.

Thank you for all your help! Please return visitor safety glasses to the lobby.



 DELTA
TechOps





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