

---

**RESEARCH ARTICLE**

## **Pressurization System on Aircraft Boeing 737-300F, Aircraft MSN: 28567 During Flight Hanoi to Bangkok: Problem Solving and Root Cause Analysis**

**Rexon Harris Simanjuntak<sup>1</sup> ✉ and Isdaryanto Iskandar<sup>2</sup>**

<sup>1</sup>*Universitas Katolik Indonesia Atmajaya, Jakarta, Indonesia*

<sup>2</sup>*Atma Jaya Catholic University of Indonesia, Indonesia*

**Corresponding Author:** Rexon Harris Simanjuntak, **E-mail:** [rexon.202204070069@student.atmajaya.ac.id](mailto:rexon.202204070069@student.atmajaya.ac.id)

---

### **ABSTRACT**

The aircraft, with type Boeing 737-300 freighter, Serial Number: 28567, Flight number: TMG-918, with a flight route from Hanoi International (HAN) to Bangkok International airport (BKK) on the date of 12 April 2021, with a take-off time of 22.00 UTC and landing time 22.25 UTC, is operated by PT XYX Airlines on a non-schedule flight. After taking off from Hanoi to Bangkok (HAN – BKK), with an altitude of nearly 10.000 ft flight level, the aircraft got a problem with the pressurization system in auto mode (auto system), and the cabin altitude indicator was shown 10.000 ft; cabin rate altitude indication at 2000 – 300 ft/minute (in normal rate 200 – 300 ft/minute). The pilot was unable to control the pressurization system in the auto system; in this condition, the Pilot followed the procedure for selecting the pressurization system from auto mode to manual mode, and after that, the cabin altitude indicator suddenly was shown fluctuated or became unstable. After the pressurization system operates in Manual mode and all conditions control by the flight crew, the captain makes the decision to aircraft return to base (RTB) flight back to Hanoi International airport (HAN) and land safely at 22.25 UTC. The author wants to analyse the root cause of the pressurization system problem by using several methods, as per 5 whys, fishbone diagrams, and fault tree analysis. Then the author compares the root cause results of each method to take corrective and preventive actions to solve the problems. All these cases were in Reference to SDR Report Control Number: 012/SDR-YGH/TMG/IV/2021. The report submitted by PT.Tri M.G. Intra Asia Airlines on 12 April 2021 and the Flight Log Manual (FML) Page No: 03232, dated 12 April 2021. The purpose of this research is to identify the problem and determine the root cause of the problem's inability to control the pressurization system and make a plan for corrective action and preventive action; then, the team will implement the corrective action and preventive action. Quality Division will check and monitor the effectiveness of corrective and preventive action in three months. After that, the team & Quality Division create the procedure and policy for the company standard. The author and team used the methodology 5 why (cause and effect diagram), Fishbone diagram (Ishikawa Diagram), and Fault Tree Analysis (FTA), and from each method will be found the root cause analysis. Then the author combines all root cause analyses to identify the problem and create problem-solving. The main result of this research was that the company was able to determine and implement the corrective action and preventive action for the uncontrollable problem pressurization system. The problem of the pressurization system that cannot be controlled causes the aircraft to return to base or cancel a flight to be expected not to happen again in all aircraft operated by PT. XYX company in the future.

### **KEYWORDS**

Pressurization system uncontrollable, Root cause analysis, and problem solving Corrective Action & Preventive Action.

### **ARTICLE INFORMATION**

**ACCEPTED:** 25 October 2022

**PUBLISHED:** 12 November 2022

**DOI:** 10.32996/jmcie.2022.3.3.7

---

### **1. Introduction**

In the modern era, the world needs fast transportation for carrying passengers, cargo, etc. The airplane is the fastest transportation vehicle. The airplane has several systems for airworthiness, safe condition, and comfortable for humans onboard in an airplane.

**Copyright:** © 2022 the Author(s). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) 4.0 license (<https://creativecommons.org/licenses/by/4.0/>). Published by Al-Kindi Centre for Research and Development, London, United Kingdom.

One system that makes humans comfortable in high altitudes is the pressurization system because humans shall be comfortable with the pressurization air at sea level altitude.

For this reason, the airplane flown at 8000 ft above sea level must have a pressurization system. Suppose the airplane pressurization system gets a problem during flight. In that case, the pilot shall reduce the flight altitude to 8000 ft from the sea level, find the nearest airport possible to rectify the pressurization problem, and continue flying because that needs to be avoided so as not to cause problems in order to achieve comfort in flight, and find the root cause of the problem to determine and implement the corrective action and preventive action so that problems will not occur in the future.

**2. Description Pressurization System Boeing 737-300f**

The pressurization control system is electrically controlled. It controls the exhaust of air to pressurize the passenger and control cabins, the electronic compartment. The pressurization control system has pressure controllers and a cabin pressurization outflow valve. The system has three modes: automatic, alternate, and manual. Automatic is the mode for normal operation. The alternate mode and the automatic mode are fully redundant. If one of these two channels fails, the system will automatically switch to the other. Normal operation requires no adjustment by the flight crew during the flight except for barometric correction. If the two automatic channels (AUTO and ALTN) do not operate, the crew can set the mode selector to manual mode.

In manual mode, the outflow valve is controlled directly by the toggle switch on the selector panel. In each of the three systems, cabin pressure is maintained by positioning the outflow valve to regulate airflow from the cabin with respect to air from the air conditioning system. The Digital Cabin Pressurization Control System (DCPCS) is an electrically operated and controlled system that meters the amount of air exhausted from the airplane to provide controlled pressurization off all the aircraft compartments within the pressure shell, i.e. the passenger cabin or main cargo, flight deck, electronic compartment, forward and aft cargo compartment, and the lower nose compartment. The DCPCS consists of a pressure control panel, two identical pressure controllers, and a pressurization outflow valve. In the case of problem PK-XXX. (See: 1 Boeing Aircraft Maintenance Manual ATA 21-51-11, ATA 21-31-00, ATA 21-25-22, Revision Sep 25, 2017.)

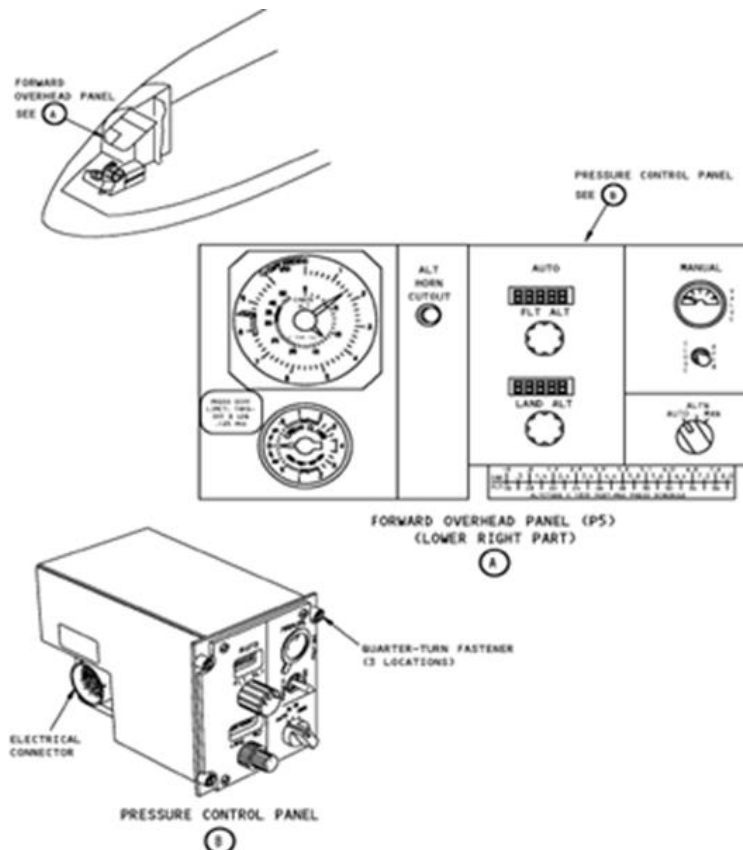


Figure 1. [Pressurization control panel on an overhead panel on cockpit Boeing 737-300]

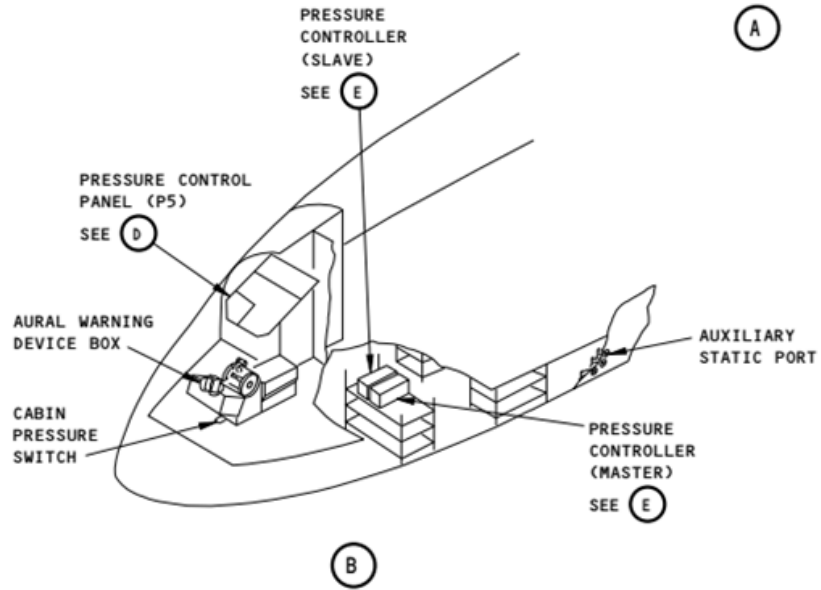
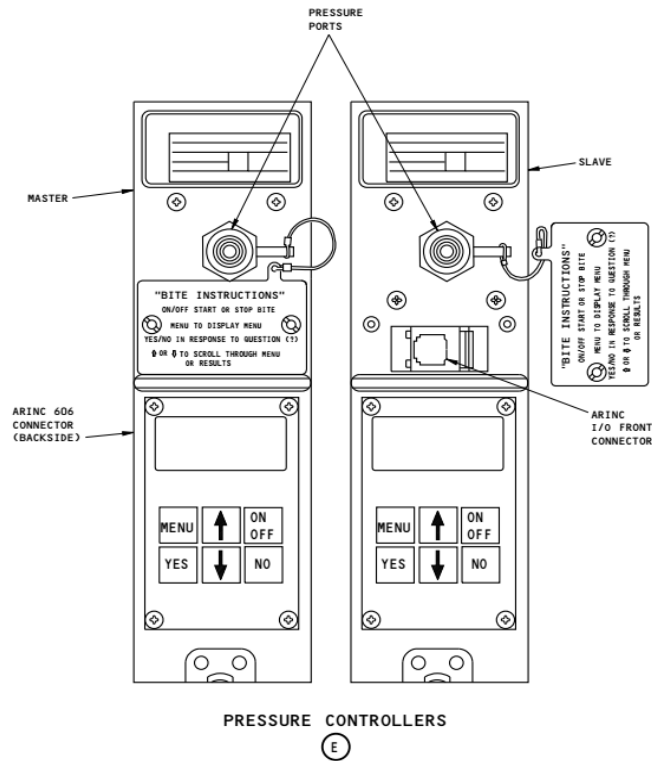


Figure 2. [Location Pressurization controller in aircraft]



F43773 S00041206099\_V1

Pressurization Control System - Component Location  
Figure 1/21-31-00-990-812-002 (Sheet 4 of 4)

Figure 3. [Digital CPC/Pressurization Controller]

### Schematic pressurization system

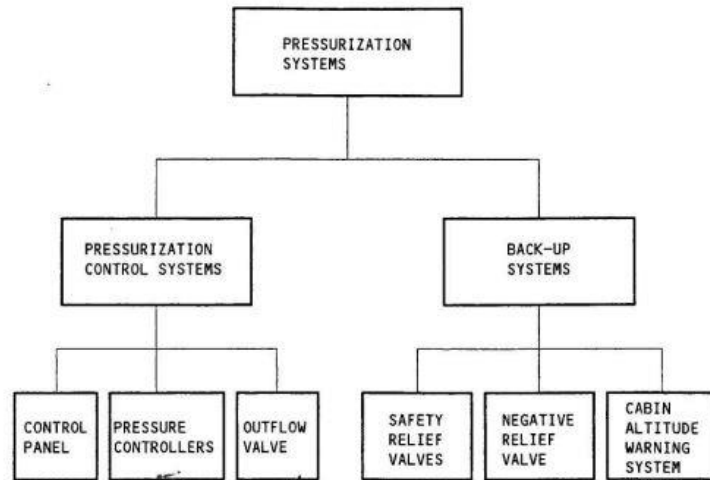


Figure 4. [Schematic pressurization system]

### 3. Methodology

The company formed a team to solve the problem in the aircraft itself and in all aspects; the company used several steps, which are:

1. Forming a team.
2. Brainstorming the team  
Forming a wealth of ideas about the considered, which leads to achieving the set goal. (see:14). all team members provide ideas, and all ideas are accepted and recorded.  
Improving the ability to cooperate in a team facilitates the formation of a creative atmosphere and encourages enthusiasm. (see 14).  
All team members become solid, respect each other's ideas, and complement each other.
3. Collection of the data.
4. Identifying the root cause of the problem with the quality tools are 5 why (cause and effect diagram, Fishbone diagram, and Fault Tree Analysis (FTA)).
5. Determining the corrective action and preventive action.
6. Implementing corrective action and preventive action.
7. Measurement of the effectiveness of implementation in a period of time (in three months).
8. Creating preventive action becomes the procedure and policy

#### 3.1 Root Cause Analysis

Root Cause Analysis (RCA) is a method of problem-solving aimed at identifying the root cause of the problem (see: 6).

Finding and identifying the actual problem is very important for the organization to take corrective action and preventive action to avoid the problem and its effect in the future, minimize losses and make safe air conditions. Otherwise, root cause analysis (RCA) is the method of problem solving used for identifying the root causes of faults or problems. The procedure for RCA comprises six steps: (1) Extracting and screening the Non-conformance event, (2) Building a team and formulating the plan, (3) investigating the event and ordering the problem, (4) Analyzing the direct factors and organizational factors, (5) Contemplating and implementing the measures, and (6) Evaluating the effectiveness of the measures (see: 2)

After that event company focuses on finding the root cause analysis with a few steps below:

1. The company/organization extracted and screened the nonconformance and collected all data related to the aircraft Boeing 737-300F, pressurization system, and all maintenance activity for the last six months.
2. The company/organization was building a special team for this case to formulate the plan and evaluate all aspects related to the pressurization problem.

The member of a team is:

1. Chief Inspector as the leader.
  2. Chief Standard operation as the member.
  3. Senior pilot as the member.
  4. Quality Control Inspector as the member.
  5. Quality Assurance Inspector as the member.
  6. Engineer Boeing 737-300 as the member.
  7. Safety Officer as the member.
3. The team started investigating and collecting information from Captain, First Officer, and Engineer in charge on flight number TMG-918.
  4. After the team collected the data and got all the information, they started analyzing the direct factor and organizational factors using the method Five Why, Fishbone diagram, and Fault Tree Analysis.
  5. The team formulated the root cause and implemented corrective and preventive action steps.
  6. After corrective and preventive action was performed and implemented, the team evaluated the effectiveness of the measures, and the information they took from the Flight maintenance log, pilot report, engineer report, station report, and from aircraft surveillance report.

### **3.2 Reason of Issuance**

AFML No: 03232 date issued: 12 April 2021, Discrepancies: RTB due to a Pressurization problem after take-off/while climbing cabin altitude indicate nearly 10.000 when the present altitude of 10.000 feet is unable to control pressurization.

### **3.3 Methode Root Cause Analysis Problem Solving**

The team and author in his research used several methods to find the root cause of the problem, as per below:

1. 5 Why method
2. Fishbone diagram
3. Fault Tree Analysis.

The author will use all methods one by one from these methods to find the root cause of the problems above; then, after getting the root cause of each method, then the author will compare the results from one method with other methods to be taken into consideration and determine the corrective actions and preventive action were taken and implemented in the company or organization.

### **3.4 Why Method**

Five whys (or 5 whys) is an iterative interrogative technique used to explore the cause-and-effect relationships underlying a particular problem. The primary goal of the technique is to determine the root cause of a defect or problem by repeating the question "Why?" five times. The answer to the fifth why should reveal the root cause of the problem. (See: 3)

Taiichi Ohno considers repeatedly asking why to be the scientific approach on which the Toyota production system is based. Repeatedly asking why prevents focusing on obvious symptoms while ignoring the true root cause. (see: 9)

The tool is very beneficial in developing critical thinking; it is frequently a quick method of solving a problem. (see:11).

The simplest way to perform a root cause analysis is to ask why 5 times. In the case above, the answers might read as follows: (see 10) Why is the Aircraft RTB during Flight Hanoi – Bangkok? Because Aircraft Pressurization problems are:

1. Why is the Aircraft Pressurization problem? Because pressurization could not be controlled.
2. Why is pressurization could not be controlled? Because pressurization control system problem.
3. Why is the pressurization control system problem? Because of Digital Cabin pressure controller problem.
4. Why is the Cabin Digital pressure controller problem? Because Digital CPC P/N 7121-19971-01AC is a problem.
5. Why is Digital CPC P/N 7121-19971-01AC a problem? Because Digital CPC P/N 7121-19971-01AC is Low Reliability.

**Barrier:** Replaced Digital CPC P/N 7121-19971-01AC with P/N 21933-01AC.

**4. Results and Discussion**

This case is a reference to SERVICE DIFFICULTY REPORT (SDR) No: 012/SDR-YGH/TMG/IV/2021, which was submitted to Indonesia DGCA on 12nd April 2021 and was discussed for the solution with the DGCA inspector on 24 September 2021.

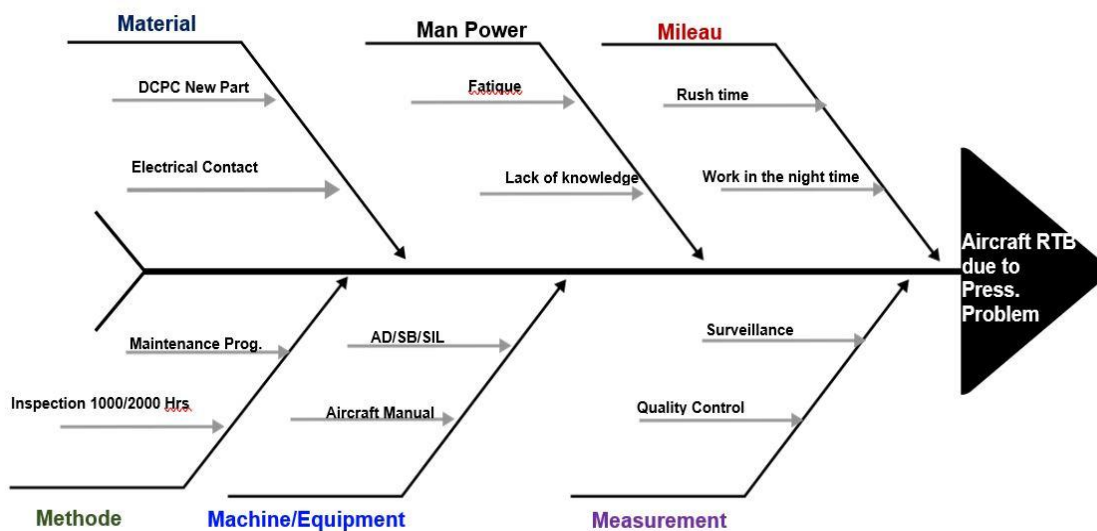
The team also discussed this case with another airline operator which operates the same type of aircraft Boeing 737-300F, and we found the problem was the old part number of the Digital CPC shall be replaced with the new model digital CPC with the P/N 21933-01AC reference to Boeing Service Letter No. 737 SL-21-087.

**4.1 Fishbone Diagram Method**

The fishbone analysis is a tool for analysing the business process and its effectiveness. It is also commonly referred to as the "Ishikawa Diagram" because it was invented and incorporated by Mr. Kaoru Ishikawa, a Japanese quality control statistician ( see 4).

Factors to be considered are the six Ms: man (people), measurements, material, milieu (environment), methods, and machines (equipment). These factors can and should be modified to fit an individual process. (See:9).

The team used the fishbone diagram method to find the Root Cause Analysis from several possible aspects to not only focus on the aircraft's technical and operational problems. This is to find the right corrective and preventive actions from several aspects of the emergence of the causes of the problem so that this problem does not occur again in the future.



**4.1.1 Mileau**

During performed maintenance work, the engineering work is in rush time because the transit time is very short, between 40 minutes. At that time engineer shall be performing walk around aircraft inspection, servicing aircraft, and supervising offloading and loading process of cargo.

Another problem is also the engineer on board all flights with aircraft, and also during night time.

**4.1.2 Mileau root cause:**

1. The rush time during working.
2. Working in the night time.

**Barrier:**

1. If there is any technical problem, Technical Manager sends the email to marketing for the first time with one hour delay; if the problem still exists Technical Manager sends an email for the second time period for more hours delay time. If the problem still exists in the second time period, Technical Manager declares Aircraft AOG status.
2. If working at night, the Technical manager should provide another engineer for assistance. The station manager should provide facilities and equipment for working at night,

**Man:**

For this case, on the man side, the team looked for the possibility of a human fatigue factor because the engineer who carried out maintenance activities was also on the previous flight, otherwise was less rest time or no fresh conditions while performing the work.

The engineers also do not know information from aircraft manufacturers about the latest Service Information Letter (SIL)/ Boeing Service Letter No. 737 SL-21-087 with the subject for replaced Digital CPC P/N 7121-19971-01AC with P/N 21933-01AC.

The human interaction with systems makes it imperative that the users, operators, and maintenance people be considered during the design, development, and operational phases of the system's life (see:12).

**The root causes identified are:**

1. Fatigue working more than 10 hours.
2. Lack of knowledge/information.

**Barrier:**

1. The scheduler should create a rule for maximum working time in a day.
2. The engineer should be sent for training policy, AD, SB, and SIL.

**Material:**

Material failure, in this case, was found the old Part number of Digital CPC still used on the aircraft Boeing 737-300F with MSN: 28567, even though there has been published from the aircraft manufacturer is Boeing Service Letter No. 737 SL-21-087, with the subject replaces the Digital CPC with Digital CPC P/N 21933-01AC.

**The root causes identified are:**

1. Digital CPC P/N 7121-19971-01AC is the Low reliability part.
2. Electrical contact.

**Barrier:**

1. Replaced Digital CPC P/N 7121-19971-01AC with P/N 21933-01AC.
2. Provide aircraft contact cleaner for old P/N CPC shall be a clean electrical connector and reset the system every week.

**Measurement:**

Measurement failure, in this case, was the Quality Division only performed surveillance one time in a month, and also Quality control is rarely attended during maintenance activity special when performing pressurization maintenance task card during heavy maintenance because maintenance activity was performed at MRO in another province, and no budgeting for transportation and accommodation Quality personnel.

1. Aircraft surveillance.
2. Quality control.

**Barrier:**

1. Quality control performs aircraft surveillance for monitoring the SIL shall be performed in all aircraft.
2. Quality control performs inspection task cards related to the Pressurization system inspection in every A-Check.

**Machine:**

Machine failure, in this case, was found aircraft SB or SIL from aircraft manufacture was not updated, or the latest publication of aircraft AD/SB/SIL did not reach the Engineer.

The aircraft maintenance manual hard copy or soft copy for work reference was not available in the aircraft.

**The root causes identified are:**

1. Aircraft Maintenance Manual.
2. Aircraft AD/SB/SIL

**Barrier:**

1. The company provides the aircraft maintenance manual with the latest revision in soft copy.
2. The company provides laptops for every aircraft.
3. Engineering shall be publication aircraft the AD/SB/SIL

**Method:**

Method failure, in this case, was the maintenance program for performing pressurization system maintenance every 4000 flight hours, otherwise is too long and frequent for performing maintenance of the inspection pressurization system.

**The root causes identified are:**

1. Maintenance program
2. 1000, 2000 flight hours Inspection, and/or 6 month/ 1 year inspection.

**Barrier:**

1. Maintenance program related performed all pressurization system checks at 4000 Flight hours changed to every 2000 Flight hours.
2. Every A-Check inspects, cleans, and lubricates the component related to the pressurization system.

**4.2 Fault Tree Analysis Method**

Fault tree analysis (FTA) is a type of failure analysis in which an undesired state of a system is examined. This analysis method is mainly used in safety engineering and reliability engineering to understand how systems can fail.

Fault Tree Analysis is a method or technique used to identify the problem contributing to a failure's occurrence. It is used to break down broad categories into finer and finer levels of detail. (see 11).

The hazard identification is carried out as the first step of a Formal Safety Assessment (FSA), and the modeling of the relation between the relevant events is made using Fault Tree Analysis (FTA). (see: 13).

The team studied and evaluated the pressurization system of aircraft Boeing 737-300F, saw the schematic pressurization system technical drawing from the Aircraft Maintenance manual then formulated it into the Fault Tree Analysis method.

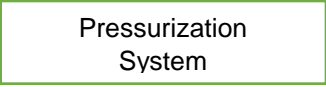






In implementing fault tree analysis, these steps should be Noticed:

Identify the failure effect to be analysed. Typically, this will be a critical effect that must be eliminated or reduced. It should be a complex failure, which may be caused by combinations of other failures, rather than a low-level failure with simple causes.

This may be found using other tools, such as Failure Mode and Effects Analysis (See:5) For the symbol we are using in this journal, please see Table 1.



**Table 1. [Symbol used in Fault Tree Analysis]**

No	Symbol	Description	Remark
1		Pressurization system (overall system)	All pressurization systems, including auto pressurization system and manual pressurization system
2		Pressurization Auto mode/Manual mode system.	Aircraft have pressurization systems are : 1. Auto pressurization system. 2. Manual pressurization system.
3		OR gate system	The output, Q of a "Logic OR Gate" only returns "LOW" again when ALL of its inputs are at a logic level "0". In other words, for a logic OR gate, any "HIGH" input will give a "HIGH" logic level "1" output. (See 7)
4		AND gate system	The output state of a digital logic AND gate only returns "LOW" again when ANY of its inputs are at a logic level "0". In other words, for a logic AND gate, any LOW input will give a LOW output. (See: 7)
5		Mechanical control movement	The movement is controlled by a mechanical system.
6		Electrical control movement	The movement is controlled by the electrical system.
7		Barrier	A barrier is something such as a rule, law, or policy that makes it difficult or impossible for something to happen or be achieved.

The pressurization system on the aircraft Boeing 737-300F divided into two major systems are:

1. Pressurization auto control system or Auto mode consists of three major component systems: 1. Control panel system, 2. Pressurization controller/DCPC system, 3. Outflow valve system.
2. Pressurization manual control system or Manual mode consists of three major systems: 1. Safety relief valve system; 2. Negative relief valve system; 2. Cabin altitude warning system.

Pressurization system in FTA schematic.

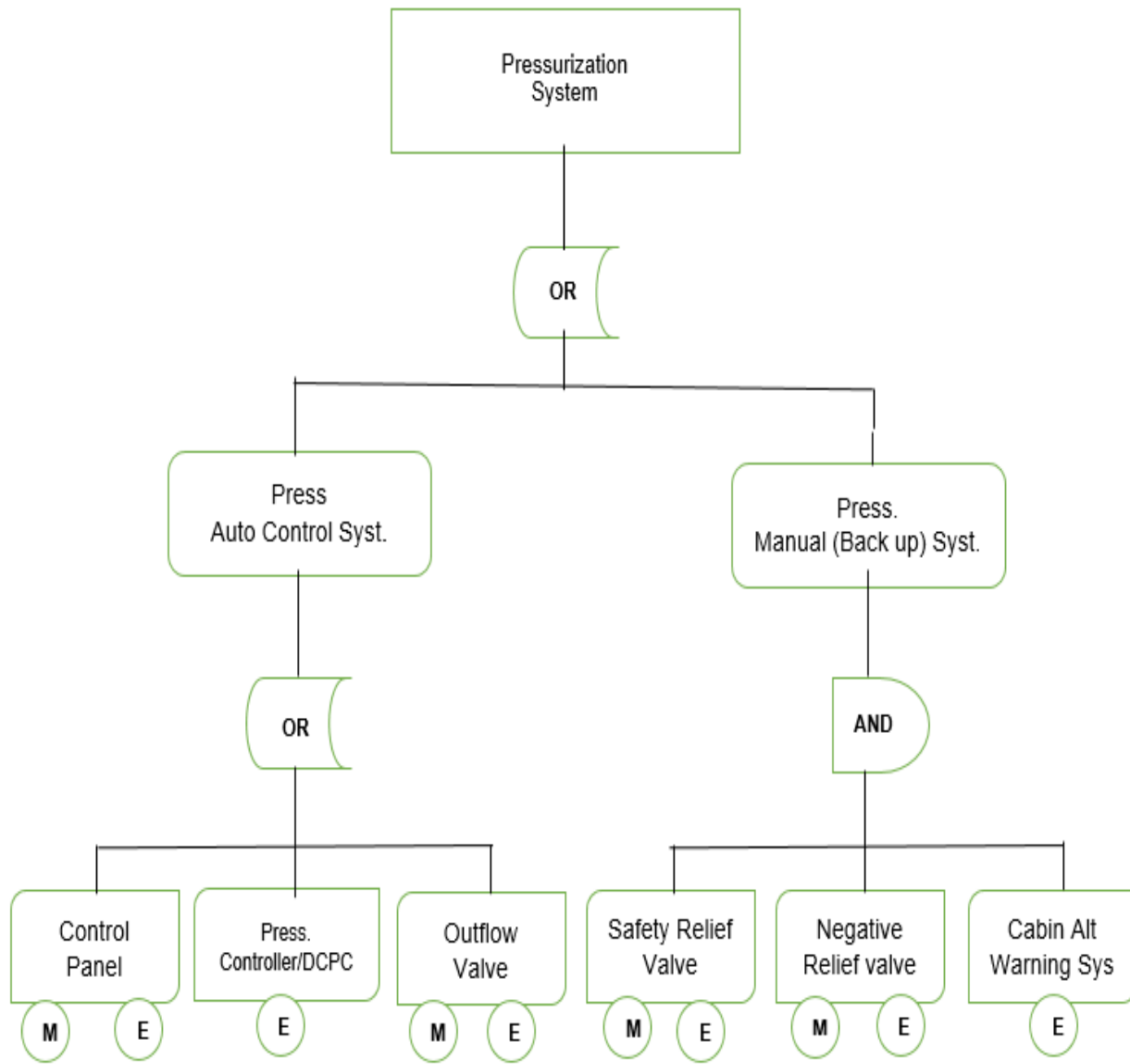


Figure 5. [Fault Tree Analysis Pressurization system aircraft Boeing 737-300F]

**NOTE:**



Electrical control movement



Mechanical control movement

4.3 Fault Tree Analysis Barrier

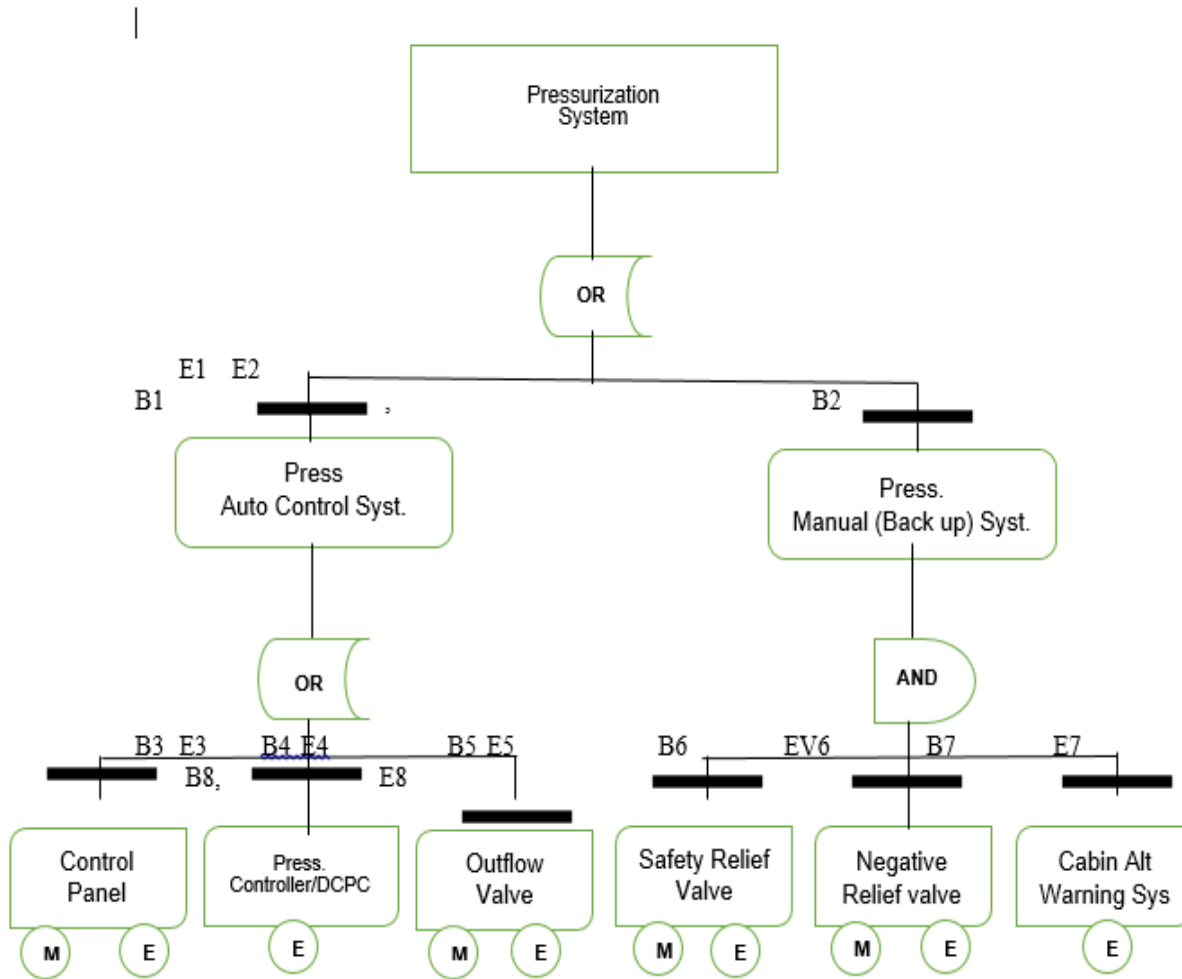


Figure 6. [Fault Tree Analysis and Barrier Pressurization system aircraft Boeing 737-300F]

**NOTE:**

Barrier: 

**BARRIER 1:**

Perform pressurization auto control system functional test and leak check every 2000 hours flight inspection and/or every one-year inspection for preventive and detection for pressurization system performance condition in aircraft.

**EVENT B1:**

Auto system pressurization will be a total failure, and for backup or to normalize the pressurization system during flight, the pilot shall select the manual mode pressurization system; otherwise, the manual pressurization system shall be in satisfactory condition.

**BARRIER 2:**

Perform manual control system functional test and leak check every 2000 hours flight inspection and/or every one-year inspection. It may be inoperative; provide AUTO and STANDBY control modes to operate normally.

**EVENT B2:**

Manual system pressurization will be a total fail (Aircraft grounded) because if any emergency situation in case during in-flight auto pressurization system fails and also manual pressurization fails, the aircraft will be flown in unpressurization condition with reference to Quick Reference Hand Book (QRH) aircraft shall be in flight level below 10.000 ft sea level.

**BARRIER 3:**

Perform pressurization control panel every 1000 flight hours and/or every six months.

Manually position the outflow valve in the 25% open position:

- A. Position the Pressurization Mode selector to MAN.
- B. Hold the VALVE toggle switch in the OPEN position until the valve position indicator indicates 25% open.

**EVENT B3:**

Auto system pressurization can not be controlled for cabin altitude.

**BARRIER 4:**

Perform Reset pressurization control/ DCPC every 1000 flight hours and/or every six months.

May be inoperative provided:

- a) Flight is conducted in an unpressurized, and
- b) Outflow valve is positioned to 25% open to the position.

**EVENT B4:**

Auto system pressurization cannot be controlled.

**BARRIER 5:**

Perform Detailed visual inspection and lubrication outflow valve every 1000 flight hours and/or every six-month inspection.

It may be inoperative open, provided both packs operate normally.

It may be inoperative open with one pack operating normally, provided flight altitude remains at or below FL 200.

**EVENT B5:**

Cabin pressure altitude will be a total failure (uncontrol auto pressurization system).

**BARRIER 6:**

Perform Detailed visual inspection and lubrication Safety Relief valve every 1000 flight hours and/or every six months.

One may be inoperative and closed for pressurized flight. It may be inoperative provided flight is conducted in an unpressurized configuration

**EVENT B6:**

During aircraft landing, the pressurization system will be a problem due to delays for equal pressurization between the aircraft cabin and outside.

**BARRIER 7:**

Perform Detailed visual inspection and lubrication Negative Relief valve every 1000 flight hours and/or every six months.

One actuator may be inoperative for pressurized cargo-only flight, provided the A/C is depressurized before landing. Extended overwater flight is prohibited

**EVENT B7:**

During aircraft landing at the airport below sea level pressurization system will be a problem.

**BARRIER 8:**

Perform Detailed visual inspection and operational test cabin alt warning system every 1000 flight hours and/or every six-month routine inspection.

It may be inoperative provided flight altitude remains at or below 10,000 feet MSL.

Test Warning system during Daily Check.

**EVENT B8:**

If there is any problem with the pressurization system, there is no warning signal for the pilot.

**5. Conclusion**

**Material:** The Boeing 737-300F with the MSN 28567, still using an old type model for Digital CPC with P/N 7121-19971-01AC, had a problem with Low Reliability.

**Man power:** The engineer was not yet getting the familiarization or publication about Airworthiness Directive (AD) from DGCA/FAA, Service Bulletin (SB), and Service Information Letter (SIL) from Aircraft Manufacture (Boeing 737).

**The Milieu:** The Engineer found rush time maintenance activity during pre-flight, transit, and daily inspection. Working alone in the early morning and also after on board with the flight is hard for the engineer.

**The Machine:** The Aircraft Maintenance Manual softcopy or hardcopy is not available on board the aircraft; the manual is a work reference for the engineer.

The latest AD/SB/SIL revision was not yet sent publication from the company to the engineer.

**Measurement:** The Quality Division performs aircraft surveillance once a month.

The Quality control has not supervised every maintenance task card related to the pressure system inspection.

**Method:** The maintenance programs related to pressure system maintenance activities must be re-evaluated.

Aircraft Maintenance Inspection every 1000 flight hours, 2000 flight hours, and/or 6 month/one-year Inspection shall be performed pressurizations system maintenance task card.

The most important solution for this problem was in the material or component Digital CPC; the company shall be provided the new model Digital CPC with Part no: P/N 21933-01AC for all aircraft Boeing 737-300F which PT operates. XYX as soon as possible because with the new part number of component Digital SPC, the problem will not occur again with reference to Boeing Service Information Letter/SIL No: 737SL-21-087.

**5.1 Suggestion**

1. If the CPC controller still no replaced with the new Part number, it is possible the problem will come in again at any time; for this case, after the aircraft landing for corrective action engineer will be performed to reset the CPC controller and check the pressurization system in according with AMM 21-31-00-715-076-001.
2. Replaced Digital Pressure Controller reference to Boeing 737-SL-21-087 with the subject Replace the Digital Pressure Controller CPC P/N: 7121-19971-01AC with the P/N 21933-01AC.
3. Perform refresher training for engineers about pressurization systems and about familiarization Airworthiness Directive (AD) from DGCA/FAA, Service Bulletin (SB), and Service Information Letter (SIL) from Aircraft Manufacture (Boeing 737).
4. The Pilot shall be getting more exercise about pressurization to fail in the simulator for prevention if this situation reoccurs.
5. The Engineering team shall be sent the Latest Revision Aircraft maintenance manual and aircraft AD/SB/SIL to all of the engineers.
6. The Company shall avoid rush working, with reporting procedure from the engineer if it requires more time for maintenance action.
7. While working in the early morning or at night, The Company shall provide maintenance facility for lighting, equipment, tool, etc.
8. The Quality division shall perform aircraft surveillance for routine activity once every week.
9. Every maintenance task card related to the pressurization system and operational and functional test shall be witnessed by Quality control.
10. The company shall change the maintenance program inspection schedule to become more stringent for the maintenance related to the pressurization system.

**Funding:** This research received no external funding.

**Conflicts of Interest:** The authors declare no conflict of interest.

**Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers.

## References

1. Application of Fishbone Analysis for Evaluating Supply Chain and Business Process (n.d) – A Case Study in on The St. James Hospital, *International Journal of Managing Value and Supply Chains (IJMVSC)* 3(2).
2. Boeing Service Letter No. 737 SL-21-087.
3. Boeing Aircraft Maintenance Manual ATA 21-51-11, ATA 21-31-00, ATA 21-25-22, Revision Sep 25, 2017.
4. Dale H. B and Carol B. (n.d). *Total Quality Management: Fifth Edition*; ISBN 978-93-530-6631-4.
5. Electronic Tutorial website (n.d): [https://www.electronics-tutorials.ws/logic/logic\\_3.html](https://www.electronics-tutorials.ws/logic/logic_3.html).
6. Google Wikipedia.
7. Harry A. (n.d). *Aviation Maintenance Management*: Ph.D.; ISBN 0-07-142251-X.
8. Mohammad S J. (2011). *International Journal of Multidisciplinary Sciences and Engineering*, 2(6)
9. Pedro A & Guedes S. (2006) Fault-tree models of accident scenarios of RoPax vessels; *International journal of automation and computing* 3
10. Root Cause Analysis. (n.d). A Step-By-Step Guide to Using the Right Tool at the Right Time, Matthew A. Barsalou, International Standard Book Number-13: 978-1-4822-5880-6 (eBook - PDF).
11. Trisna. (2013). Analisis Implementasi Lean Manufacturing dengan Lean Assessment dan Root Cause Analysis pada PT. XYZ, author: e-*Journal Teknik Industri FT USU* 3(3)
12. Techniques For Root Cause Analysis (n.d); Baylor University Medical Center Proceedings; 14:2, 154-157, DOI: 10.1080/08998280.2001.11927753).
13. Takuya N. (2010). *Journal Method of Analysing Factors Contributing to Non-conformance in Nuclear Industry*, ANQ Congress 2010, New Dehli,