
S.O.P. #: TACTICAL OPERATIONS MANUAL #01

SUBJECT: POSITIVE PRESSURE VENTILATION

DIVISION: EMERGENCY OPERATIONS

Objective: To facilitate the rapid and systematic removal of smoke and gases from structures during firefighting operations, utilizing the concepts of positive pressure ventilation.

Section 1: Equipment Needed

A. Gas Powered Positive Pressure Fan

1. 21" Power Blower, 4-cycle engine, 7890+ cubic feet/minute (cfm) output.

B. Electric Powered Smoke Ejectors

1. 16", 20", 24"

Section 2: Applicable Structures

Positive Pressure Ventilation may be utilized on, but is not limited to, the following:

- A. Single and Multiple Family Dwellings
- B. Apartment Buildings
- C. Hi-Rise Buildings
- D. Malls
- E. Windowless Buildings
- F. Basements
- G. Attics
- H. Strip Stores

Section 3: General Information

- A. Positive pressure ventilation is simply another tactic for the Company Commander to consider using on the fireground. Positive pressure ventilation is most successful when used on a confined space fire and, therefore, is not applicable on every fireground incident.
- B. The establishment of a fireground ventilation officer, familiar with the principles and practices of positive pressure techniques, should take place in the initial suppression operation. As with any ventilation practice, effective communication is paramount in effectively implementing positive pressure ventilation.
- C. Positive pressure ventilation is MOST effective when ONE firefighter, along with the Officer in Charge, is allowed to implement and control the ventilation operation.
- D. When implementing the positive pressure ventilation technique, regulation of the size of the discharge opening is very important, as this will control the interior pressure of the structure, resulting in increased efficiency of the operation. This can be accomplished by utilizing only the top portion of a window, having a sliding or overhead door open only 1/4 of the way, etc. The more interior pressure created, the quicker the operation will remove smoke. It is important to remember to pressurize from the windward side of the structure, and exhaust to the leeward side, especially on strong windy days (when possible).

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- E. When implementing the positive pressure ventilation technique, the use of multiple fans may be indicated for a more efficient operation. Positive pressure ventilation can be used in a series or pressure mode, or side-by-side in the parallel or volume mode. If you have two fans of different sizes, place the larger fan in front of the smaller fan because of its higher cubic feet per minute (cfm) output and the smaller fan behind to maintain the seal. The front fan is placed 2-3 feet from the opening; the back fan 5-6 feet to maintain the seal.
- F. When using windows as discharge points in the operation, be sure to remove any screens that may be present. Removing screens will increase the airflow by 30%-40%. Also, remember to either remove or tie back curtains.
- G. Positive pressure ventilation is NOT to be used in suspected backdraft situations.
- H. When encountering large loading dock doors, close down the doors 1/2 way to lessen the opening.
- I. Positive pressure ventilation must not be started until you are ready to attack the fire within approximately 15 seconds. Then start the blower, making sure you have an exhaust opening.

Section 4: Specific Applications

A. Single Family Dwellings - One story

- 1. Place fan 5-6 feet away from door opening so as to have the entire door area sealed in a "cone" fashion. (See Figure 1.) Check for proper placement by feeling around the opening with a bare hand for air flow.

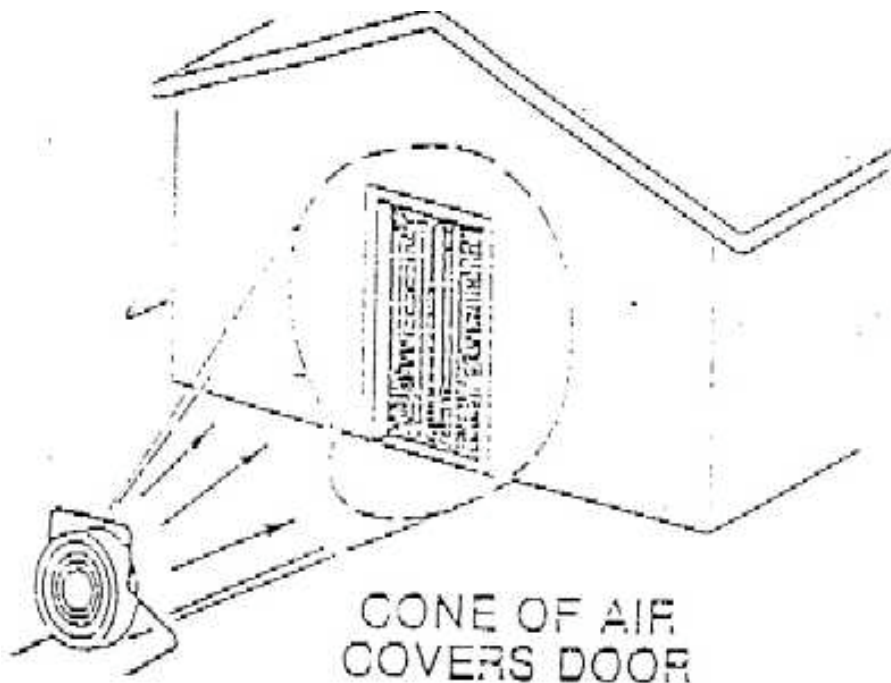


FIGURE 1

2. Have a single discharge opening to the outside, either a door, window or a forced opening, on the opposite side of the structure to create a "single" pathway of air flow from one end of the structure to the opposite end following the natural flow of air, if possible. (See Figure 2.)

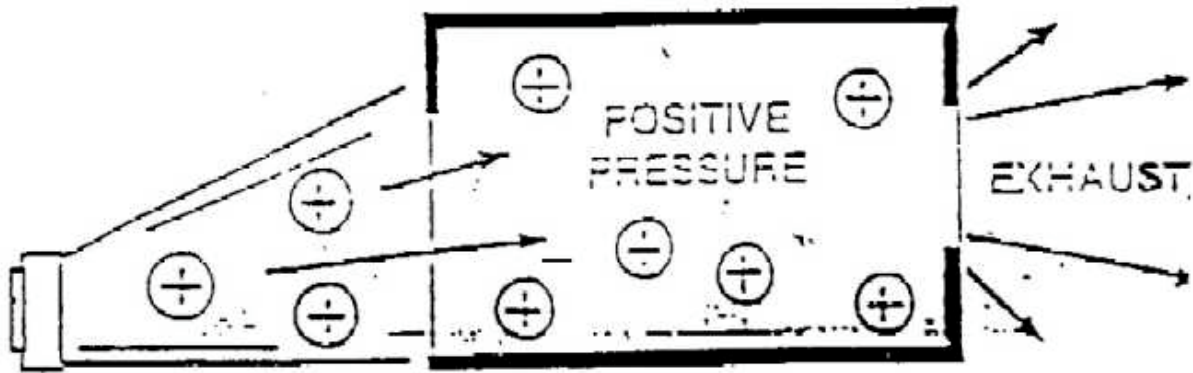


FIGURE 2

3. In the event that numerous windows have been removed during suppression efforts, PPV can still be accomplished by compartmentalizing individual rooms or areas by opening and closing individual doors as necessary. (See Figure 3.)

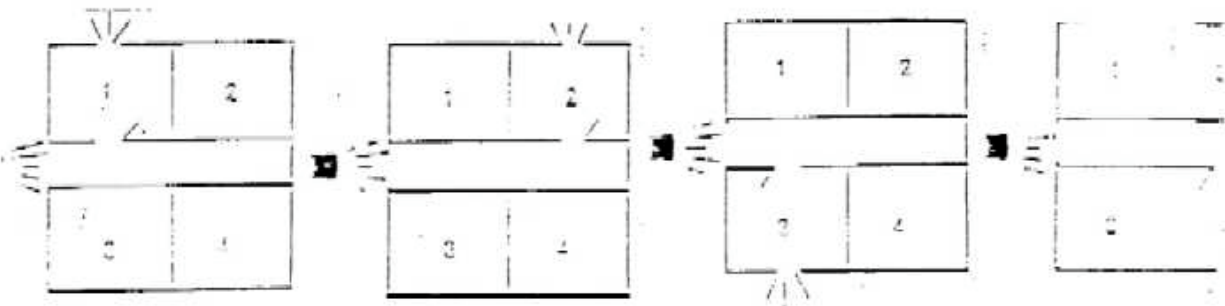


FIGURE 3

B. Single Family Dwelling - Multiple stories

1. Clear the first floor as would be done with a single-story dwelling, making sure all openings are closed on the floors above.
2. After ventilating the first floor, close the discharge opening on this floor thereby forcing the air flow upward into the second floor and out the airflow opening.

C. Basements

1. No exterior openings - utilizing two fans
 - a. Position one fan at the top of stairway leading to the basement, blowing down into basement. This fan can be a 16" electric to alleviate carbon monoxide fumes which are generated by the gasoline powered fans.
 - 1) Do not seal the opening.
 - 2) Place fan close to the door forcing air through the bottom half of the doorway. As air is forced in, smoke is forced out of the top half of the door.
 - b. Utilizing the second fan, the building should then be pressurized, as usual, making sure the air current moves across the basement entrance with the discharge opening to the outside on the opposite side.
 - c. As smoke is forced from the basement by the first fan to the ground floor, it is discharged outside by the second fan. (See Figure 4.)

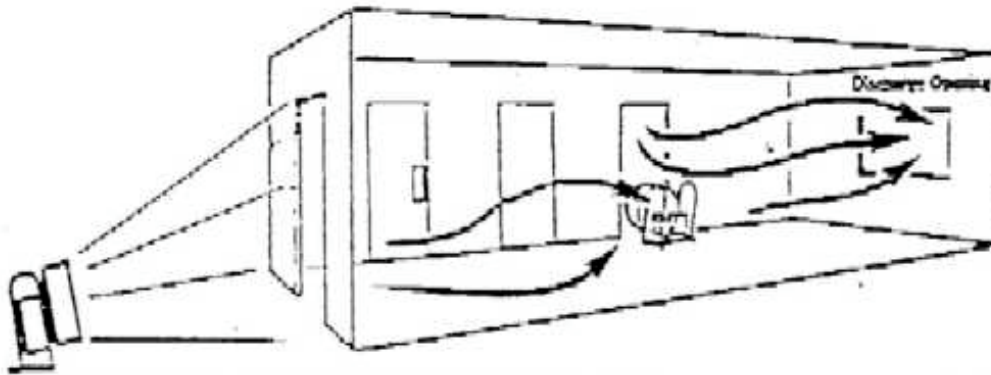


FIGURE 4

2. Existing basement openings
 - a. Close the first floor opening from basement to eliminate smoke travel to remaining floor areas.
 - b. Following the same principles as in single-story dwellings, pressurizing the area for smoke removal.
 - 1) Pressurize, following the same procedure for "BASEMENTS--NO EXTERIOR OPENINGS".
 - 2) Place fan at basement opening on floor above the basement, pressurizing basement in this manner.
 - 3) The 4-cycle PPV blower must not be layed horizontal, as the oil will not lubricate the blower.

D. Attics

1. Before beginning to clear the attic, clear the area of the building likely to receive the most smoke damage from opening the hatch or door to the attic.
2. Utilizing existing entrance to attic, seal opening in a cone fashion.
3. Utilize existing openings in attic, such as louvers or turbines, or, if indicated, a ventilation hole cut in the roof to exhaust smoke from the attic.
4. In the absence of any openings from the attic to the outside, follow the same procedure as for basements without an opening.
5. Be aware of any roof operations, as conditions during fire attack should be monitored.

E. Strip Stores

1. Follow guidelines for single story dwelling.
2. Next, move to the farthest occupancy where smoke is entering and exhaust that occupancy.
3. After the occupancy is clear, close the discharge opening thereby pressurizing the area and limiting smoke spread.
4. Continue the procedure to occupancies on both sides of involved occupancy, pressurizing until the space is clear and the source area is clear.
5. Additional fans may be set up in other areas to expedite building clearing.
6. Positive pressure ventilation fans may also be set up on either side of the involved structure to reduce smoke spread. (See Figure 5)
7. Check in void spaces above drop ceilings for fire extension.

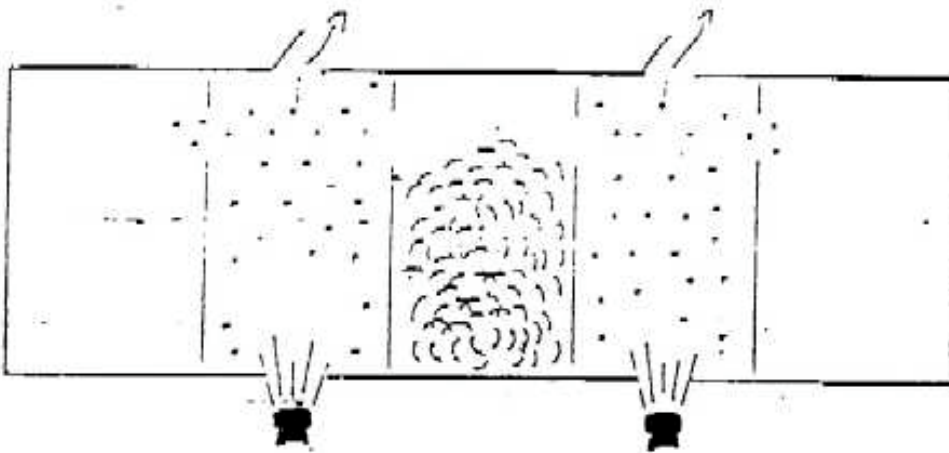


FIGURE 5

F. Multi-Story Buildings, Highrise Buildings, Windowless Buildings

1. Locate the enclosed stairwell having roof access. If smoke is encountered in that stairwell, a firefighter should be sent to the top of the stairwell, closing all doors that are not already closed on the way up. This firefighter should have S.C.B.A., a spare bottle, and portable radio.
2. Next, pressurize the stairwell with the PPV fan augmenting the natural upward draft created when the top and bottom of the stairwell are opened.
3. Positive pressure fans should be used in a series or in an in-line mode; the first fan 5-6 feet from doorway and the second fan 2-3 feet in front of the first fan, to assist in pressurizing the stairwell. (See Figure 6.)

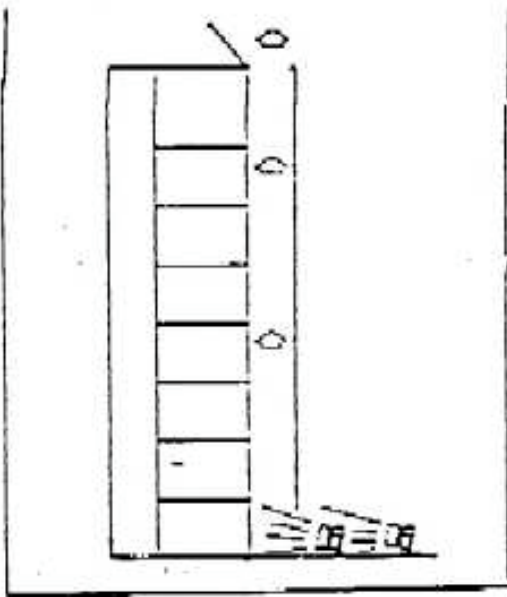


FIGURE 6

4. After the stairwell is cleared, removal of smoke from each floor is started, ventilating the lowest involved floor first and working up to the highest floor of contamination.

5. Ventilate each floor by providing a discharge opening, such as a window or door, on each floor. An opposite stairwell can also be used, utilizing the stairwell that has the roof access for the discharge. (See Figure 7.)

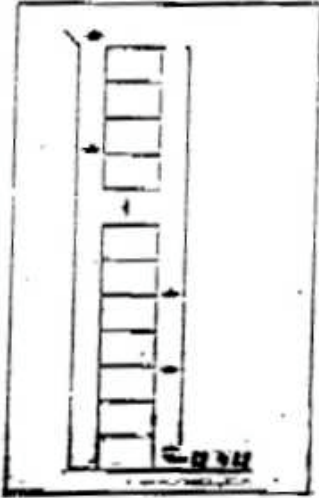


FIGURE 7

6. To facilitate a quicker discharge of smoke, incorporate both stairwells, utilizing one stairwell to provide fresh replacement air, and the other stairwell to serve as a "chimney" to remove smoke and fire gases. (See Figure 8.)

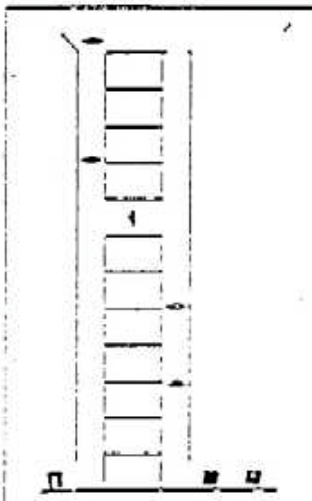


FIGURE 8

7. Elevator shafts can be used if they have a roof and floor access opening.

8. Pressurized Stairwell Towers

- a. Smokeproof Enclosure Ventilation Systems are being incorporated into new Hi-Rise Construction as well as new Mid-Rise Construction. These enclosure systems are independent of the other building ventilation systems. The equipment and ductwork are located within the smokeproof enclosure with intake or exhaust directly from and to the outside. This ventilation equipment is activated by smoke detectors installed at each floor level at an approved location at the entrance to the stairwell tower. These stair shafts are provided with a dampered relief opening at the top of the stairwell tower, and supplied with sufficient air to discharge a minimum positive pressure of 2500 cfm through the relief opening, while at the same time maintaining a minimum positive pressure in the stairwell. These systems are designed to operate with all stairway doors closed under maximum anticipated stack effect.
- b. The Company Commander is responsible for being familiar with these types of buildings within their battalions. Preplanning these buildings with these systems is paramount, in order to effectively utilize these systems in suppression operations.
- c. Upon arrival of the initial Company Commander, the following actions should take place:
 - 1) Report to enunciator panel or command center within the building, usually located near the main entrance of the building.
 - 2) Locate the on/off switch(s) on the enunciator panel, turn switch(s) on, activating stairwell(s) pressurization system.
 - 3) In the event you use a stairwell tower for smoke removal from a certain floor or area, make sure that stairwell tower exhaust system is shut off. If not, you will be fighting the system and unable to exhaust the smoke into this opening.

9. If the building in question is more than 15 stories, an additional fan placed in the intake stairwell blowing into the floor being cleared may be necessary. (See Figure 9.)

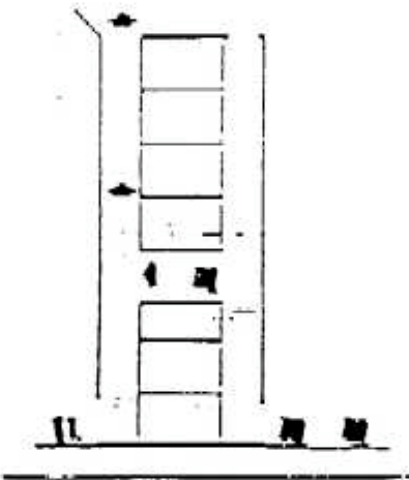


FIGURE 9

10. You may wish to create a pressurized stairwell for emergency evacuation of personnel.

G. Apartment Complexes

1. Open Common Stairwells - Place fan 3-5 feet outside of main entrance of common entrance to facilitate removal of smoke and gases from this area thereby controlling stairwell access and egress for firefighters and occupants.
2. Enclosed Common Stairwells
 - a. Company Commanders must make a decision as to what they feel is a prudent manner in which to proceed in ventilating these areas. Initial placement of the fan 3-5 feet outside of main entrance is still indicated as the intake area for replacement air.
 - b. The discharge area is provided by one of the following:
 - 1) Exhaust the smoke from stairwell through the involved apartment.
 - 2) Exhaust the smoke from stairwell through an uninvolved apartment.
 - 3) Remove the glass at the uppermost landing of the stairway thereby exhausting smoke.

Note: Extreme caution must be exercised to prevent injuries to firefighters and civilian personnel from falling glass.
 - 4) Establish a ventilation hole in the roof immediately above the stairwell, followed by opening the scuttle hatch in the stairwell and exhausting the smoke through these openings.
3. Additional fans should then be placed 3-5 feet outside of involved apartment and proceed as if a single-story dwelling.
4. Additional fans may be deployed for smoke removal at the other individual apartments.

H. Malls

1. If an individual store is involved, proceed as if a "Strip Store."
2. In ventilating a large area, secure a single opening and discharge point. Augment the procedure by incorporating several fans at doorway opening, either in-line or parallel, as well as fans strategically placed throughout common areas to boost internal pressure and thereby increase cfm.
3. Utilize internal HVAC equipment, if possible, keeping in mind the possibility of heat and smoke spread in using this equipment.

I. Utilization in Aircraft Emergencies

1. Position fan at point of aircraft to be entered.
 - a. Front most entrance of aircraft, usually passenger entrance.

- b. Over wing emergency exits. (See figure 10.)

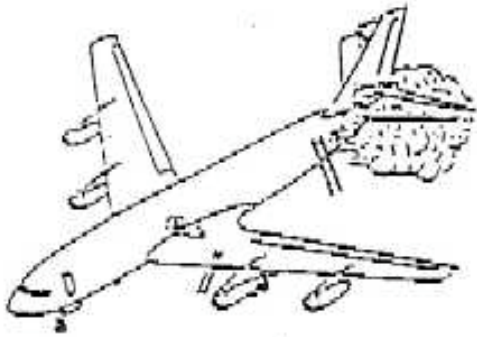


FIGURE 10

- c. Rear entrance where food service loads.
- 2. Hard to reach entry points.
 - a. Hang fan on "A" frame ladder for extra height. (See figure 11.)



Figure 11

- b. Place fan on mobile stairwell and move into position. (See figure 12.)

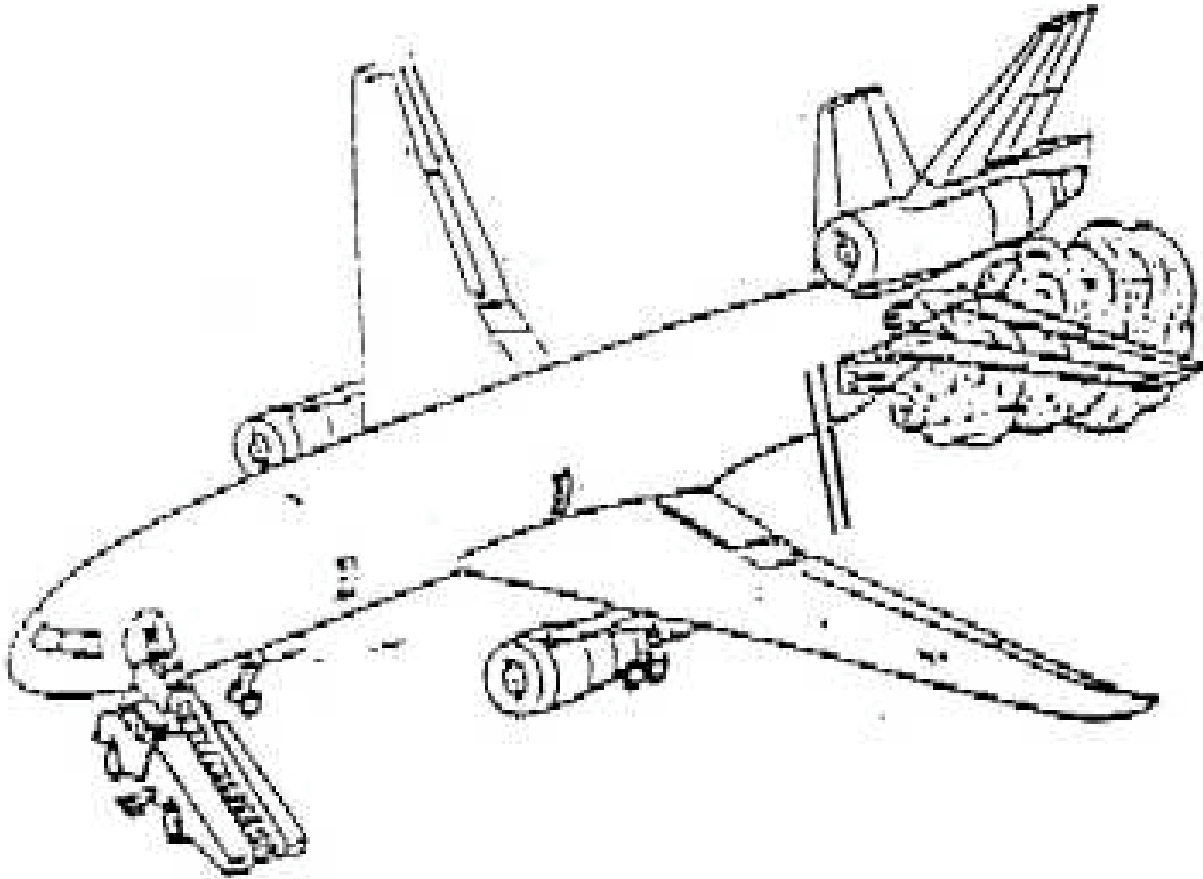


Figure 12