U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: STANDARD OPERATING PROCEDURES FOR FLIGHT DECK CREWMEMBERS

Date: 2/27/03
Initiated By: AFS-210

AC No: 120-71A

1. PURPOSE.

a. General. Standard operating procedures (SOPs) are universally recognized as basic to safe aviation operations. Effective crew coordination and crew performance, two central concepts of crew resource management (CRM), depend upon the crew's having a shared mental model of each task. That mental model, in turn, is founded on SOPs. This advisory circular (AC) presents background, basic concepts, and philosophy in respect to SOPs. It emphasizes that SOPs should be clear, comprehensive, and readily available in the manuals used by flight deck crewmembers.

b. Using this Advisory Circular. This AC is designed to provide advice and recommendations about the development, implementation, and updating of SOPs. Appendix 1, Standard Operating Procedures Template, provides many important topics that should be addressed in SOPs. Stabilized Approach, characterized by a constant-angle, constant-rate of descent ending near the touchdown point where the landing maneuver begins, is among the SOPs specifically identified in this AC and is described in Appendix 2, Stabilized Approach: Concepts and Terms. These and the other appendices represent a baseline and a starting point. Start-up certificate holders and existing certificate holders should refer to the Template in Appendix 1, to Stabilized Approach in Appendix 2, and to the other appendices in developing comprehensive SOPs for use in training programs and in manuals used by their flight deck crewmembers.

c. What's New in this Advisory Circular. AC 120-71A revises and supersedes the earlier version, AC 120-71. Many minor changes have been made to improve clarity, accuracy, completeness, and consistency. Two significant changes are the conversion of the term pilot not flying (PNF) to pilot monitoring (PM) and the addition of a related Appendix addressing "Crew Monitoring and Cross-Checking." It is increasingly acknowledged that it makes better sense to characterize pilots by what they *are* doing rather than by what they are not doing. Hence, pilot flying (PF) remains an appropriate term and is unchanged in this AC. But the term pilot not flying misses the point. Studies of crew performance, accident data, and pilots' own experiences all point to the vital role of the non-flying pilot as a monitor. Hence, the term pilot monitoring (PM) is now widely viewed as a better term to describe that pilot. The term PM is used liberally throughout this AC. In those instances where the older term PNF appears, it should be understood that pilot monitoring (PM) is the preferred meaning.

2. CANCELLATION. This AC cancels AC 120-71, Standard Operating Procedures for Flight Deck Crewmembers, dated August 10, 2000.

3. SCOPE. Appendix 1 consolidates many topics viewed by operators and by the FAA as important to be addressed as SOPs in air carrier training programs and in the manuals used by air carrier flight deck crewmembers. **This AC does not list every important SOP topic or dictate exactly how each topic should be addressed by a certificate holder.** Instead, this AC offers a baseline of topics to be used as a reference. In practice, each certificate holder's manuals and training programs are unique. Each certificate holder could omit certain topics shown in the template when they do not apply, and, on the other hand, could add other topics not shown in the template when they do apply. This AC contains guidance intended for use primarily by Title 14 of the Code of Federal Regulations (14 CFR) part 119 certificate holders authorized to conduct operations under part 121. But operators of aircraft under 14 CFR parts 135, 125, 91, and others should also find this guidance useful.

4. RELATED REGULATIONS. 14 CFR part 121, sections 121.133, 121.141, 121.401; 14 CFR part 125, section 125.287; 14 CFR part 135, section 135.293.

5. RELATED READING MATERIAL.

a. AC 120-51 as amended, Crew Resource Management Training.

b. AC 120-48, Communication and Coordination between Flight Crewmembers and Flight Attendants.

c. AC 120-54, Advanced Qualification Program.

d. AC 121-32, Dispatch Resource Management Training.

NOTE: ACs may be obtained by choosing "Advisory Circulars" at the following FAA public Web site:

http://www.airweb.faa.gov

e. Controlled Flight into Terrain Education and Training Aid (Flight Safety Foundation, ICAO, and Federal Aviation Administration) http://www1.faa.gov/avr/afs/afs200/afs210/index.cfm

f. Flight Safety Digest, Nov. 98 – Feb. 99 (Flight Safety Foundation).

g. Approach-and-landing Risk Awareness Tool, as revised (Flight Safety Foundation) http://www.flightsafety.org/pdf/alar_risk_tool.pdf

h. CFIT Checklist, as revised (Flight Safety Foundation): http://www.flightsafety.org/pdf/cfit_check.pdf

i. Human Performance Considerations in the Use and Design of Aircraft Checklists (FAA). http://www1.faa.gov/avr/afs/afs200/afs210/index.cfm

j. FAA Flight Standardization Board (FSB) Reports. http://www.opspecs.com/AFSData/FSBRs/Final/

6. BACKGROUND.

a. Many aviation safety organizations including the FAA have recently reaffirmed the importance of SOPs.

b. For many years the National Transportation Safety Board (NTSB) has identified deficiencies in standard operating procedures as contributing causal factors in aviation accidents. Among the most commonly cited deficiencies involving flightcrews has been their non-compliance with established procedures; another has been the non-existence of established procedures in some manuals used by flightcrews.

c. The International Civil Aviation Organization (ICAO) has also recognized the importance of SOPs for safe flight operations. Recent amendments to ICAO Annex 6 establish that each member state should require that SOPs for each phase of flight be contained in the operations manual used by pilots.

d. Non-government aviation safety organizations such as Flight Safety Foundation, (Alexandria, VA) have concluded that airlines perform with higher levels of safety when they establish and adhere to adequate SOPs.

e. In 1997 the FAA joined with representatives from the National Aeronautics and Space Administration (NASA) and from a broad cross-section of aviation organizations to form the Commercial Aviation Safety Team (CAST). Chartered by the White House to reduce the commercial aviation accident rate by 80 percent in 10 years, this Team chose controlled flight into terrain (CFIT) as one of the first major aviation hazards to be addressed in meeting this challenge. The Team used a data-driven approach to identify interventions with the highest possible safety leverage, and to develop a comprehensive agenda to implement those interventions.

f. In its study of CFIT accidents, a CAST analysis team including the FAA corroborated the findings of the NTSB, ICAO, and other groups. Almost 50 percent of the 107 CFIT interventions identified by that analysis team related to the flightcrew's failure to adhere to SOPs or the certificate holder's failure to establish adequate SOPs. Subsequent CAST teams confirmed their analysis further.

g. This AC is in large part the final report and end-product of one of the CAST sub-teams, a group comprised of subject matter experts in aviation human factors, in airline operations, and in flightcrew training.

7. THE MISSION OF SOPs. To achieve consistently safe flight operations through adherence to SOPs that are clear, comprehensive, and readily available to flight crewmembers.

8. APPLYING THE SOPs TEMPLATE AND OTHER APPENDICES. Generally, each SOP topic identified in the template (following as Appendix 1) is important; the certificate holder should address them in some manner, if applicable. Stabilized Approach (Appendix 2) is a particularly important SOP. Other important SOPs, such as those associated with special operating authority or with new technology, are not shown in the template, but should be addressed as well, when applicable. Because each certificate holder's operation is unique, the certificate holder should develop the specific manner in which SOPs are addressed. Topics expanded and illustrated in the Appendices are for example only, and represent renditions of SOPs known to be effective. **No requirement is implied or intended to change existing SOPs based solely on these examples.** An SOP topic shown in the Appendices may be addressed in detail, including text and diagrams, or in very simple terms. For example, an SOP may be addressed in a simple statement such as: "ABC Airlines does not conduct Category 3 approaches."

9. KEY FEATURES OF EFFECTIVE SOPs.

a. Many experts agree that implementation of any procedure as an SOP is most effective if:

(1) The procedure is appropriate to the situation.

(2) The procedure is practical to use.

(3) Crewmembers understand the reasons for the procedure.

(4) Pilot Flying (PF), Pilot Not Flying (PNF) / Pilot Monitoring (PM), and Flight Engineer duties are clearly delineated.

(5) Effective training is conducted.

(6) The attitudes shown by instructors, check airmen, and managers all reinforce the need for the procedure.

b. If all elements (above) are not consistently implemented, flightcrews too easily become participants in an undesirable double standard condoned by instructors, check airmen, and managers. Flightcrews may end up doing things one way to satisfy training requirements and checkrides, but doing them another way in "real life" during line operations. When a double standard does appear in this way, it should be considered a red flag that a published SOP may not be practical or effective for some reason. That SOP should be reviewed and perhaps changed.

10. THE IMPORTANCE OF UNDERSTANDING THE REASONS FOR AN SOP.

a. Effective Feedback. When flight crewmembers understand the underlying reasons for an SOP they are better prepared and more eager to offer effective feedback for improvements. The certificate holder, in turn, benefits from more competent feedback in revising existing SOPs and in developing new SOPs. Those benefits include safety, efficiency, and employee morale.

b. Troubleshooting. When flight crewmembers understand the underlying reasons for an SOP, they are generally better prepared to handle a related in-flight problem that may not be explicitly or completely addressed in their operating manuals.

11. COLLABORATING FOR EFFECTIVE SOPs.

a. In general, effective SOPs are the product of healthy collaboration among managers and flight operations people, including flightcrews. A safety culture promoting continuous feedback from flightcrews and others, and continuous revision by the collaborators distinguishes effective SOPs at airlines of all sizes and ages.

b. New operators, operators adding a new aircraft fleet, or operators retiring one aircraft fleet for another must be especially diligent in developing SOPs. Collaborators with applicable experience may be more difficult to bring together in those instances.

c. For a startup certificate holder, this AC and its appendices should be especially valuable tools in developing SOPs. The developers should pay close attention to the approved airplane flight manual (AFM), to AFM revisions and operations bulletins issued by the manufacturer, and to the applicable Flight Standardization Board (FSB) report issued by the FAA. Desirable partners in the collaboration would certainly include representatives of the airplane manufacturer, pilots having previous experience with the airplane or with the kind of operations planned by the operator, and representatives from the FAA, including the principal operations inspector (POI), members of the Certificate Management Team, and members of the Certification, Standardization, and Evaluation Team (CSET). It is especially important for a new operator to maintain a periodic review process that includes line flightcrews. Together, managers and flightcrews are able to review the effectiveness of SOPs and to reach valid conclusions for revisions. The review process will be meaningful and effective when managers promote prompt implementation of revisions to SOPs when necessary.

d. An existing certificate holder introducing a new airplane fleet should also collaborate using the best resources available, including the AFM, operations bulletins, and the FSB report. Experience has shown that representatives of the airplane manufacturer, managers, check airmen, instructors, and line pilots work well together as a team to develop effective SOPs. A trial period might be implemented, followed by feedback and revision, in which SOPs are improved. By being part of an iterative process for changes in SOPs, the end user, the flight crewmember, is generally inclined to accept the validity of changes and to implement them readily.

e. Long-established operators should be careful not to assume too readily that they can operate an airplane recently added to the fleet in the same, standard way as older types or models. Managers, check airmen, and instructors should collaborate using the best resources available, including the AFM, operations bulletins, and the FSB report to ensure that SOPs they develop or adapt for a new airplane are in fact effective for that aircraft, and are not inappropriate carryovers.

12. SUMMARY. Safety in commercial aviation continues to depend on good crew performance. Good crew performance, in turn, is founded on standard operating procedures that are clear, comprehensive, and readily available to the flightcrew. This AC provides an SOPs template and many other useful references in developing SOPs. Development of SOPs is most effective when done by collaboration, using the best resources available including the end-users themselves, the flightcrews. Once developed, effective SOPs should be continually reviewed and renewed.

/s/ Louis C. Cusimano, for
James J. Ballough
Director, Flight Standards Service

NOTES ON APPENDICES

The following appendices contain examples of standard operating procedures (SOPs) that are identical or similar to some SOPs currently in use. Those examples do not represent a rigid FAA view of best practices, which may vary among fleets and among certificate holders, and may change over time.

Some of the examples may be readily adapted to a certificate holder's flightcrew training and operating manuals for various airplane fleets. Others may apply to a certain airplane fleet and may not be adaptable apart from that fleet.

In some cases a term shown in an appendix is a term used by a certificate holder, not the equivalent term used by the FAA. Example: Where the FAA would use the term "height above touchdown," or HAT, the example shows that the certificate holder has used the term "above field elevation," or AFE.

APPENDIX 1

STANDARD OPERATING PROCEDURES TEMPLATE

A manual or section in a manual serving as the flightcrew's guide to standard operating procedures (SOPs) may double as a training guide. The content should be clear and comprehensive, without necessarily being lengthy. No template could include every topic that might apply unless it were constantly revised. Many topics involving special operating authority or new technology are absent from this template, among them ETOPS, PRM, SMGS, RNP, and many others.

The following are nevertheless viewed by industry and FAA alike as examples of topics that constitute a useful template for developing comprehensive, effective SOPs:

- Captain's authority

- Use of automation
    - The operator's automation philosophy
    - Specific guidance in selection of appropriate levels of automation
    - Autopilot/flight director mode control inputs
    - Flight management systems inputs
    - Monitoring of automated systems and Flight Mode Annunciator (FMA)
    - Cross checking of FMS routing with ATC clearance during preflight

- Checklist philosophy
    - Policies and procedures
        - (Who calls for; who reads; who does)
    - Format and terminology
    - Type of checklist
        - Challenge-Do-Verify
        - Do-Verify
    - Walk-arounds

- Checklists
    - Safety check -- power on
    - Originating/receiving
    - Before start
    - After start
    - Before taxi
    - Before take-off
    - After take-off
    - Climb check
    - Cruise check
    - Preliminary landing
    - Landing
    - After landing

Parking and securing
Emergency procedures
Non-normal/abnormal procedures

- Communications
  - Who handles radios
  - Primary language used
    - ATC
    - On the flight deck
  - Keeping both pilots in the loop
  - Company radio procedures
  - Flight deck/cabin signals
  - Cabin/flight deck signals

- Briefings
  - CFIT risk considered (see example, paragraph 4 h in this AC)
  - Special airport qualifications considered
  - Temperature corrections considered
  - Before takeoff
  - Descent/approach/missed approach
  - Approach briefing generally done prior to beginning of descent

- Flight deck access
  - On ground/in flight
  - Jumpseat
  - Access signals, keys

- Flight deck discipline
  - PF/PM duties and responsibilities
  - Sterile cockpit
  - Maintaining outside vigilance
  - Monitoring/cross-checking

- Transfer of control
  - Additional duties
  - Flight kits
  - Headsets/speakers
  - Boom mikes/handsets
  - Maps/approach charts
  - Meals

- Altitude awareness
  - Altimeter settings
  - Transition level
  - Callouts (verification of)
  - Minimum safe altitudes (MSA)

Temperature corrections
Monitoring during last 1000 feet of altitude change

- Report times
  - Check in/show up
  - On flight deck
  - Checklist accomplishment

- Maintenance procedures
  - Logbooks/previous write-ups
  - Open write-ups
  - Notification to maintenance of write-ups
  - Minimum equipment list (MEL)
    - Where it is accessible
  - Configuration Deviation List (CDL)
  - Crew coordination in ground de-icing

- Flight plans/dispatch procedures/takeoff and landing calculations
  - VFR/IFR
  - Icing considerations
  - Fuel loads
  - Weather package
  - Where weather package is available
  - Departure procedure climb gradient analysis

- Boarding passengers/cargo
  - Carry-on baggage
  - Exit row seating
  - Hazardous materials
  - Prisoners/escorted persons
  - Guns onboard
  - Count/load

- Pushback/powerback

- Taxiing
  - All engines running
  - Less than all engines running
  - On ice or snow
  - Prevention of runway incursion

- Crew resource management (CRM)
  - Crew briefings
    - Flight attendants
    - Flightcrew

- Weight & balance/cargo loading
  - Who is responsible for loading cargo, and securing cargo
  - Who prepares the weight & balance data form; who checks it
    - Copy to crew

- Flight deck/cabin crew interchange
  - Boarding
  - Ready to taxi
  - Cabin emergency
  - Prior to take-off/landing

- Take-off
  - PF/PM duties and responsibilities
  - Who conducts it
  - Briefing, IFR/VFR
  - Reduced power procedures
  - Tailwind, runway clutter
  - Intersections/land and hold short procedures (LAHSO)
  - Noise abatement procedures
  - Special departure procedures
  - Flight directors
    - Use of: Yes/No
  - Callouts
  - Clean up
  - Loss of engine
    - Transfer of control, if appropriate
    - Rejected takeoff
    - After V1
      - Actions/callouts
  - Flap settings
    - Normal
    - Nonstandard and reason for
    - Crosswind
  - Close-in turns

- Climb
  - Speeds
  - Configuration
  - Confirm compliance with climb gradient required in departure procedure
  - Confirm appropriate cold temperature corrections made

- Cruise altitude selection
  - Speeds/weights

- Position reports/pilot weather reports (PIREPs)
  - ATC – including PIREPs of hazards such as icing, thunderstorms, and turbulence
  - Company

- Emergency descents

- Holding procedures
  - Procedures for diversion to alternate

- Normal descents
  - Planning and verbalizing beginning of descent point
  - Risk assessment and briefing (see example, paragraph 4.g in this AC)
  - Speedbrakes: Yes/No
  - Flaps/gear use
  - Icing considerations
  - Convective activity

- Ground proximity warning system (GPWS or TAWs)
  - Escape maneuver

- TCAS

- Windshear
  - Avoidance of likely encounters
  - Recognition
  - Recovery / escape maneuver

- Approach philosophy
  - Monitoring during approach
  - Precision approaches preferred
  - Coordinate with ATC and plan ahead to avoid rushed approaches
  - Stabilized approaches standard
  - Use of navigation aids
  - Flight management system (FMS)/autopilot
    - Use, and when to discontinue use
  - Approach gates
    - Limits for stabilized approaches
  - Use of radio altimeter
  - Go-arounds: Plan to go around on every approach; change plan to land when visual, or when conditions permit in low-visibility operations – only if stabilized

- Individual approach type
  - All types, including engine-out

- For each type of approach
    - Profile
    - Airplane configuration for conditions
        - Visual approach
        - Low visibility
        - Contaminated runway
    - Flap/gear extension
    - Auto spoiler and auto brake systems armed and confirmed armed by both pilots, in accordance with manufacturer's recommended procedures (or equivalent approved company procedures)
    - Actions and callouts

- Go-around / missed approach
    - When stabilized approach gates are missed
    - Actions and callouts (see example, Appendix 4)
    - Clean-up profile

- Landing
    - Actions and callouts during landing
    - Close-in turns
    - Crosswind
    - Rejected
    - Actions and callouts during rollout (see example, Appendix 18)
        - "No Spoilers" callout
        - Reverse thrust "Overboost" callout
    - Transfer of control after first officer landing

APPENDIX 2

STABILIZED APPROACH: CONCEPTS AND TERMS

A **stabilized approach** is one of the key features of safe approaches and landings in air carrier operations, especially those involving transport category airplanes.

A stabilized approach is characterized by a **constant-angle, constant-rate of descent** approach profile ending near the touchdown point, where the landing maneuver begins. A stabilized approach is the safest profile in all but special cases, in which another profile may be required by unusual conditions.

All appropriate **briefings and checklists** should be accomplished before 1000' height above touchdown (HAT) in instrument meteorological conditions (IMC), and before 500' HAT in visual meteorological conditions (VMC)

Flight should be **stabilized by 1000'** HAT in IMC, and by 500' HAT in VMC.

An approach is stabilized when all of the following **criteria** are maintained from 1000 HAT (or 500 HAT in VMC) to landing in the touchdown zone:

The airplane is on the correct[1] track.

The airplane is in the proper landing configuration.

After glide path intercept, or after the final approach fix (FAF), or after the derived fly-off point (per Jeppesen) the pilot flying requires no more than normal bracketing corrections[2] to maintain the correct track and desired profile (3° descent angle, nominal) to landing within the touchdown zone. Level-off below 1000' HAT is not recommended.

The airplane speed is within the acceptable range specified in the approved operating manual used by the pilot.

The rate of descent is no greater than 1000 feet per minute (fpm).

- If an expected rate of descent greater than 1000 fpm is planned, a special approach briefing should be performed.
- If an unexpected, sustained rate of descent greater than 1000 fpm is encountered during the approach, a missed approach should be performed. A second approach may be attempted after a special approach briefing, if conditions permit.

Power setting is appropriate for the landing configuration selected, and is within the permissible power range for approach specified in the approved operating manual used by the pilot.

APPENDIX 2 (continued)

When no vertical guidance is provided: Vertical guidance may be provided to the pilot by way of an electronic glideslope, a computed descent path displayed on the pilot's navigation display, or other electronic means. On approaches for which no vertical guidance is provided, the flightcrew should plan, execute, and monitor the approach with special care, taking into account traffic and wind conditions. To assure vertical clearance and situation awareness, the pilot not flying should announce crossing altitudes as published fixes and other points selected by the flightcrew are passed. The pilot flying should promptly adjust descent angle as appropriate. A constant-angle, constant-rate descent profile ending at the touchdown point is the safest profile in all but special cases.

Visual contact. Upon establishing visual contact with the runway or appropriate runway lights or markings, the pilot should be able to continue to a safe landing using normal bracketing corrections, or, if unable, should perform a missed approach.

No visual contact. The operator may develop procedures involving an approved, standard MDA buffer altitude or other approved procedures to assure that descent below MDA does not occur during the missed approach. If no visual contact is established approaching MDA or an approved MDA buffer altitude, or if the missed approach point is reached, the pilot should perform the published missed approach procedure. (OpSpec paragraph C073 provides for special authorization under certain conditions to go below the MDA while executing a missed approach.) Below 1000' HAT, leveling off at MDA (or at some height above MDA) is not recommended, and a missed approach should be performed.

Note [1] : A **correct track** is one in which the correct localizer, radial, or other track guidance has been set, tuned, and identified, and is being followed by the pilot. Criteria for following the correct track are discussed in FAA Advisory Circulars relating to Category II and Category III approaches. Criteria for following track in operations apart for Category II and Category III are under development.

Note [2] : Normal bracketing corrections relate to bank angle, rate of descent, and power management. Recommended ranges are as follows (operating limitations in the approved airplane flight manual must be observed, and may be more restrictive):

Bank angle	Maximum bank angle permissible during approach is specified in the approved operating manual used by the pilot, and is generally not more than 30°; the maximum bank angle permissible during landing may be considerably less than 30°, as specified in that manual.
Rate of descent	± 300 fpm deviation from target
Power management	Permissible power range is specified in the approved operating manual used by the pilot
Overshoots	Normal bracketing corrections occasionally involve momentary overshoots made necessary by atmospheric conditions. Such overshoots are acceptable. Frequent or sustained overshoots caused by poor pilot technique are not normal bracketing corrections.

APPENDIX 3

(examples)

ATC COMMUNICATIONS
and
ALTITUDE AWARENESS

ATC Communications: SOPs should state who (PF, PM, FE/SO) handles the radios for each phase of flight, as follows:

PF makes input to aircraft/autopilot and/or verbally states clearances while PM confirms input is what he/she read back to ATC.

Any confusion in the flight deck is immediately cleared up by requesting ATC confirmation.

If any crewmember is off the flight deck, all ATC instructions are briefed upon his/her return. Or if any crewmember is off the flight deck all ATC instructions are written down until his/her return and then passed to that crewmember upon return. Similarly, if a crewmember is off ATC frequency (e.g., when making a PA announcement or when talking on company frequency), all ATC instructions are briefed upon his/her return.

Company policy should address use of speakers, headsets, boom mike and/or hand-held mikes.

Altitude Awareness: SOPs should state the company policy on confirming assigned altitude.

Example: The PM acknowledges ATC altitude clearance.
If the aircraft is on the autopilot then the PF makes input into the autopilot/altitude alerter. PF points to the input while stating the assigned altitude as he/she understands it. The PM then points to the input stating aloud what he/she understands the ATC clearance to be confirming that the input and clearance match.

If the aircraft is being hand-flown then the PM makes the input into the Altitude Alerter/autopilot, then points to the input and states clearance. PF then points to the alterter stating aloud what he/she understands the ATC clearance to be confirming that the alerter and clearance match.

Example: If there is no altitude alerter in the aircraft then both pilots write down the clearance, confirm that they have the same altitude, and then cross off the previously assigned altitude.

APPENDIX 4

(example)

NORMAL GO-AROUND -- ACTIONS and CALLOUTS

Callouts: shown in **"BOLD TEXT" -- Actions:** shown with bullets **(•)** in plain text		
Go-around	**PF**	**PM**
	"GO AROUND" • Press either GA switch **"GO-AROUND POWER"** • Verify thrust levers move to GA power • Rotate towards 15° pitch attitude, then follow flight director commands **"FLAPS 20"**	• Verify GA annunciates • Select flaps 20 • Verify thrust levers move to maintain 2,000 FPM climb rate **"POWER SET"**
Positive Rate of Climb	• Verify positive rate of climb **"GEAR UP"** • Execute published missed approach or proceed as instructed by ATC	**"POSITIVE RATE"** • Position gear lever UP • Advise ATC • Monitor missed approach procedures
At or above 400' AFE	**"LNAV" or "HEADING SELECT"**	• Select LNAV or HDG SEL • Verify LNAV or HDG SEL annunciates
Climbing through 1,000' AFE	**"REF 80"** **"FLAPS_____"** (Retract flaps on flap retraction speed schedule)	• Set command airspeed cursor to V_{REF} 30 + 80 • Select proper flap setting, when requesting
At flap retraction speed	**"FLAPS UP, AFTER TAKEOFF CHECKLIST"**	• Retract flaps • Accomplish checklist

APPENDIX 5

(example)

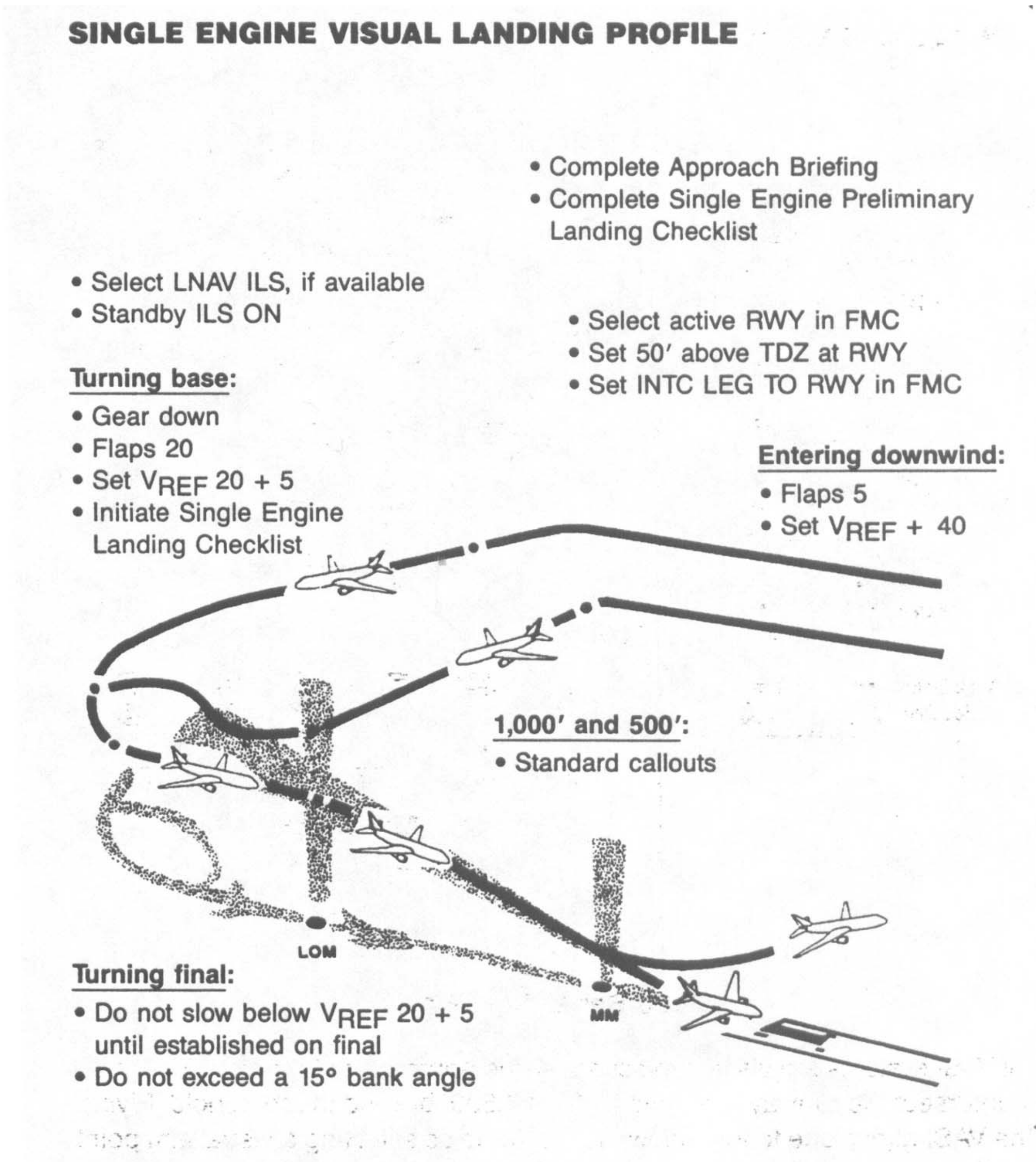
SINGLE ENGINE GO-AROUND -- ACTIONS and CALLOUTS

Callouts: shown in **"BOLD TEXT" -- Actions:** shown with bullets **(•)** in plain text		
	PF	**PM**
Go-around	**"GO AROUND"** • Press either GA switch **"GO-AROUND POWER"** • Advance thrust lever to GA power • Rotate towards 10° pitch attitude, then follow flight director commands **"FLAPS 5"**	• Verify GA annuciates • Verify GA power set • Select flaps 5 **"POWER SET"**
Positive Rate of Climb	• Verify positive rate of climb **"GEAR UP"**	• Position gear lever UP • Advise ATC
	•• Execute airport specific "Engine Failure Missed Approach," published missed approach, or proceed as instructed by ATC, as appropriate	
At or above 400' AFE, or lower if Engine Failure procedure specifies a turn prior to 400' AFE	**"LNAV" or "HEADING SELECT"**	• Select LNAV or HDG SEL • Verify LNAV or HDG SEL annunciates • Monitor missed approach procedure
Climbing through 1,000' AFE or obstruction clearance altitude (OCA), whichever is higher	**"REF 80"** **"FLAPS_____"** (Retract flaps on flap retraction speed schedule)	• Set command airspeed cursor to VREF 30 + 80 • Select proper flap setting, when requested
At flap retraction speed	**"FLAPS UP"**	• Retract flaps
At V_{REF} 30 + 80	**"MAXIMUM CONTINUOUS THRUST AFTER TAKEOFF CHECKLIST"**	• Press CON on TMSP • Set MCT **"POWER SET"** • Accomplish After Takeoff Checklist

APPENDIX 6

(example)

SINGLE ENGINE VISUAL LANDING -- PROFILE



APPENDIX 7

(example)

SINGLE ENGINE ILS APPROACH -- ACTIONS and CALLOUTS

Callouts: shown in **"BOLD TEXT" -- Actions:** shown with bullets **(•)** in plain text		
	PF	**PM**
Initial Approach	**"FLAPS 1, REF 60"** **"FLAPS 5, REF 40"**	• Select flaps 1 • Set command airspeed cursor to V_{REF} 30 + 60 • Select flaps 5 • Set command airspeed cursor to V_{REF} 30 + 40
When Cleared for the Approach	•• Verify Nav radio tuned to appropriate ILS frequency • Select APP mode	• Verify LOC and G/S annunciates white (armed) on ADI
LOC Alive	• Verify localizer indication	**"LOCALIZER ALIVE"**
LOC Capture	•• Verify LOC annunciates green (captured) on ADI	
GS Alive	• Verify G/S indication **"GEAR DOWN, FLAPS 20, V_{REF} 20 + 5, SINGLE ENGINE LANDING CHECKLIST"**	**"GLIDESLOPE ALIVE"** • Position gear lever DOWN • Select flaps 20 • Set command airspeed cursor to VREF 20 + 5 • Complete Single Engine Landing Checklist
GS Capture		**"GLIDESLOPE CAPTURE"**

APPENDIX 8

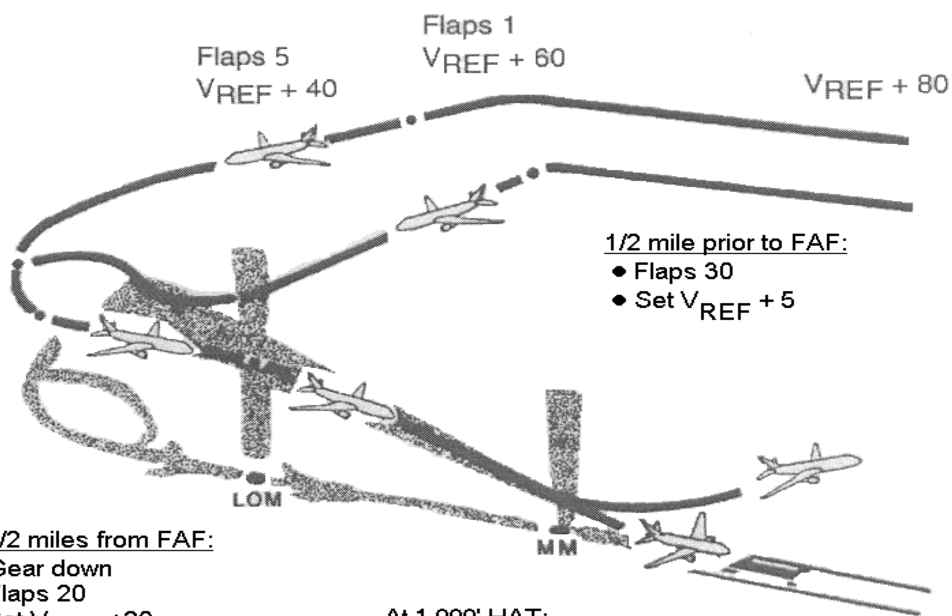
(example)

APPROACH PROFILE: LNAV, LOC, or LOC B/CRS

- Complete Approach Briefing
- Complete Preliminary Landing Checklist

When cleared for the approach:

- Select LNAV, LOC, or LOC B/CRS*, as appropriate
- Verify armed
- Set raw data backup, as required



2-1/2 miles from FAF:

- Gear down
- Flaps 20
- Set V_{REF} +20
- Initiate Landing Checklist

At 1,000' HAT:

- Stabilized Approach

At MDA or MDA Buffer Altitude:

- Set missed approach altitude
- If runway environment is in sight and the aircraft is in a position from which a normal approach to the intended runway can be made, land the aircraft.

- or -

- If runway environment is not in sight, perform a missed approach procedure.

* Aircraft not equipped with B/CRS feature, use LNAV

APPENDIX 9

(example)

LNAV, LOC, or LOC B/CRS APPROACH -- ACTIONS and CALLOUTS

Callouts: in **"BOLD TEXT" -- Actions:** with bullets (•) in plain text		
	PF	PM
Initial Approach	**"FLAPS 1 REF 60"** **"FLAPS 5, REF 40"**	• Select flaps 1 • Set command airspeed cursor to V_{REF} 30 + 60, if requested • Select flaps 5 • Set command airspeed cursor to V_{REF} 30 + 40, if requested
2-1/2 miles from FAF	**"GEAR DOWN, FLAPS 20, REF 20, LANDING CHECKLIST"**	• Position gear lever DOWN • Select flaps 20 • Set command airspeed cursor to VREF 30 + 20, if requested • Initiate Landing Checklist
½ mile prior to FAF	**"FLAPS 30, REF 5"** • Set/Request MDA or MDA Buffer Altitude	• Select flaps 30 • Set command airspeed cursor to VREF 30 + 5, if requested • Set altitude, if requested

APPENDIX 9 (continued)

At FAF	•• Start timing, if appropriate	
	Select/Request V/S	• Set V/S, if requested • Monitor descent
At 1,000' AFE	• Verify altitude • Stabilized approach	**"1,000 ft."**
At 100' above MDA (or MDA buffer altitude)	PF	PM
	• Verify altitude	**"100 ABOVE"** • Divide time between monitoring instruments and scanning outside for runway environment
AT MDA (or MDA buffer)	**"SET MISSED APPROACH ALTITUDE"** • Execute missed approach	**"MINIMUMS"** • Set missed approach altitude
(Runway environment IS in sight)	•• Call out appropriate visual cues	
	"LANDING"	**"RUNWAY IN SIGHT"** • Monitor speed and sink rate
	•• See landing procedure	
—or— *(Runway environment NOT in sight or a safe landing is NOT possible)*	**"GO-AROUND"**	**"MISSED APPROACH POINT, NO CONTACT"**
	•• See go-around procedure	

APPENDIX 10

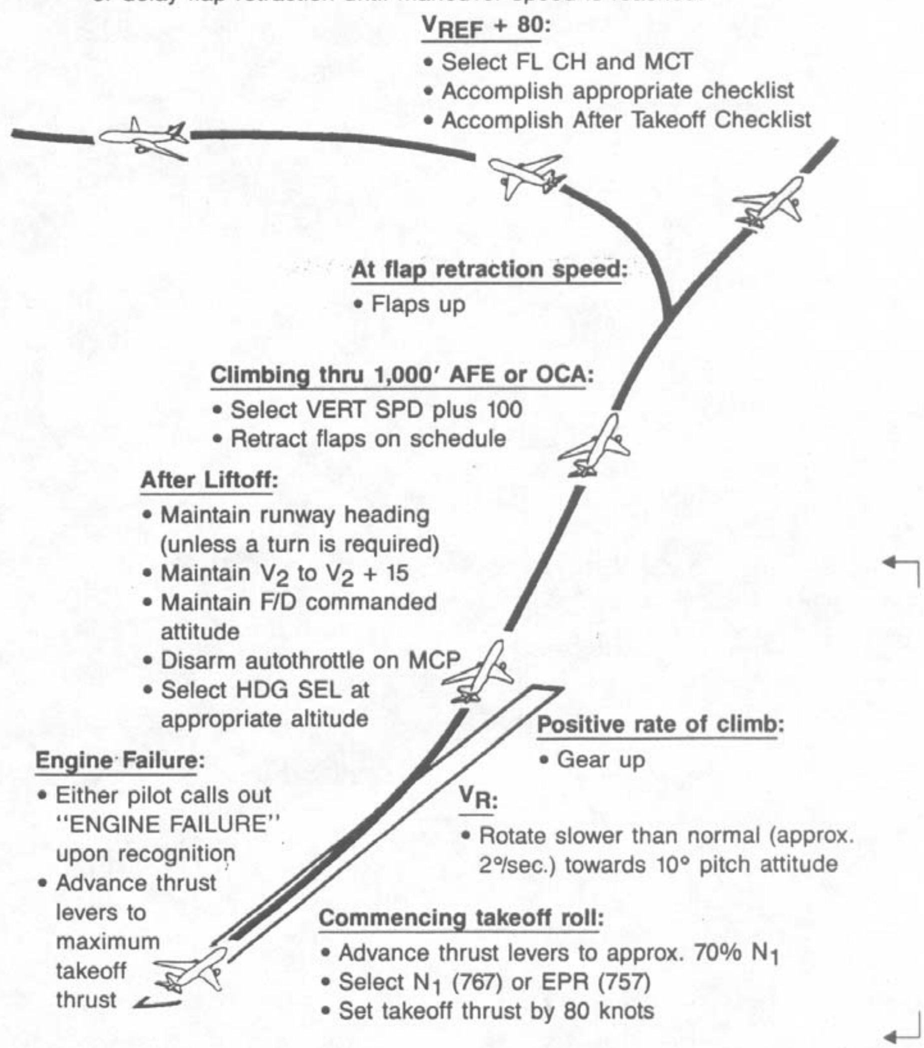
(example)

ENGINE FAILURE AT or ABOVE V1 -- PROFILE

ENGINE FAILURE AT OR ABOVE V_1 PROFILE

FLAP/SPEED SCHEDULE				
	Flap Setting for Takeoff			
	20	15	5	1
Select flaps 5 at	V_{REF} + 20	V_{REF} + 20		
Select flaps 1 at	V_{REF} + 40	V_{REF} + 40	V_{REF} + 40	
Select flaps 0 at	V_{REF} + 60	V_{REF} + 60	V_{REF} + 60	V_{REF} + 60
Final Segment Climb	V_{REF} + 80			

NOTE: After takeoff (and accelerating), the next lower flap setting may be made 20 knots prior to the maneuver speed for the flap settings as shown in the table above. In the event of a turn during flap retraction, limit bank angle to 15° or delay flap retraction until maneuver speed is reached.



APPENDIX 11

(example)

ENGINE FAILURE AT or ABOVE V_1 -- ACTIONS and CALLOUTS

<table>
<tr><td colspan="3">**Callouts:** in **"BOLD TEXT" -- Actions:** with bullets **(•)** in plain text</td></tr>
<tr><td rowspan="3">Engine Failure</td><td>PF</td><td>PM</td></tr>
<tr><td colspan="2">•• Pilot first noting Engine Failure
"ENGINE FAILURE"</td></tr>
<tr><td>**"SET MAX POWER"**</td><td>• Advance thrust levers to maximum takeoff thrust
"POWER SET"</td></tr>
<tr><td>V_R</td><td>• Rotate towards 10° pitch attitude</td><td>**"ROTATE"**</td></tr>
<tr><td>Positive rate of climb</td><td>• Verify positive rate of climb
"GEAR UP"</td><td>**"POSITIVE RATE"**
• Position gear lever UP</td></tr>
<tr><td rowspan="3">After lift-off</td><td>• Maintain F/D commanded attitude
"ADVISE ATC," when appropriate</td><td>• Monitor speed and attitude
• Advise ATC</td></tr>
<tr><td colspan="2">•• Comply with airport specific "Engine Failure After Takeoff" procedure (if published); otherwise, fly runway heading</td></tr>
<tr><td>**"HEADING SELECT"**</td><td>• Select HDG SEL
• Verify HDG SEL annunciates
• Position A/T arm switch OFF</td></tr>
</table>

APPENDIX 11 (continued)

ENGINE FAILURE AT or ABOVE V_1 -- ACTIONS and CALLOUTS

<table>
<tr><td colspan="3">Callouts: in “BOLD TEXT” -- Actions: with bullets (•) in plain text</td></tr>
<tr><td rowspan="2">Climbing through 1,000’ AFE or obstruction clearance altitude (OCA), whichever is higher</td><td>PF</td><td>PM</td></tr>
<tr><td>“VERTICAL SPEED PLUS 100”
• Reduce pitch and accelerate
“FLAPS______”
(Retract flaps on flap retraction speed schedule)</td><td>• Select VERT SPD to +100 FPM
• Select proper flap setting, when requested</td></tr>
<tr><td>At flap retraction speed</td><td>“FLAPS UP”</td><td>• Retract flaps</td></tr>
<tr><td>At V_{REF} 30 + 80</td><td>“FLIGHT LEVEL CHANGE, MAXIMUM CONTINUOUS THRUST, ENGINE _______ CHECKLIST, AFTER TAKEOFF CHECKLIST”</td><td>• Select FL CH
• Press CON on TMSP
• Set MCT
“POWER SET”
• Accomplish appropriate checklist
“ENGINE _________ CHECKLIST COMPLETE”
• Accomplish After Takeoff Checklist</td></tr>
</table>

APPENDIX 12

(example)

WINDSHEAR – TAKEOFF WHILE on the RUNWAY -- RECOVERY TECHNIQUE

Takeoff While on The Runway
Recovery Technique

- THRUST
- Apply thrust aggressively (Firewall Power)
- PITCH
- Push go-around switch
- Rotate toward 15° no later than 2,000 ft. remaining
- Increase beyond 15° if required to lift off
- Follow flight director commands

Note: After lift-off, follow After Lift-off Recovery Technique

After Lift-off/On Approach Windshear
Recovery Technique

- THRUST
- Apply thrust aggressively (Firewall Power)
- PITCH
- Push either go-around switch
- Adjust toward 15°
- Follow flight director commands
- Increase beyond 15° if required to ensure acceptable flight path
- Always respect stickshaker
- CONFIGURATION
- Maintain existing configuration

Note: With a WINDSHEAR warning, if normal commands do not result in a substantial rate of climb, the AFDS smoothly transitions to a 15° pitch attitude or slightly below the pitch limit indicator, whichever is less.

APPENDIX 13

(example)

GROUND PROXIMITY WARNINGS

Refer to the FOM for Ground Proximity Warning System general procedures. See Chapter 13 (in this handbook) for the system description.

BELOW GLIDESLOPE ALERT
If a GLIDESLOPE alert is activated between the altitudes of 1,000’ and 150’ AGL, application of power sufficient to bring the airplane back up toward the glideslope beam center will cancel the alert when it is less than 1.3 dots below the glideslope. The allowable deviation increases to 2.7 dots at 50’ AGL. This deviation causes an offscale deflection on the glideslope deviation scale.

GPWS WARNING ESCAPE MANEUVER

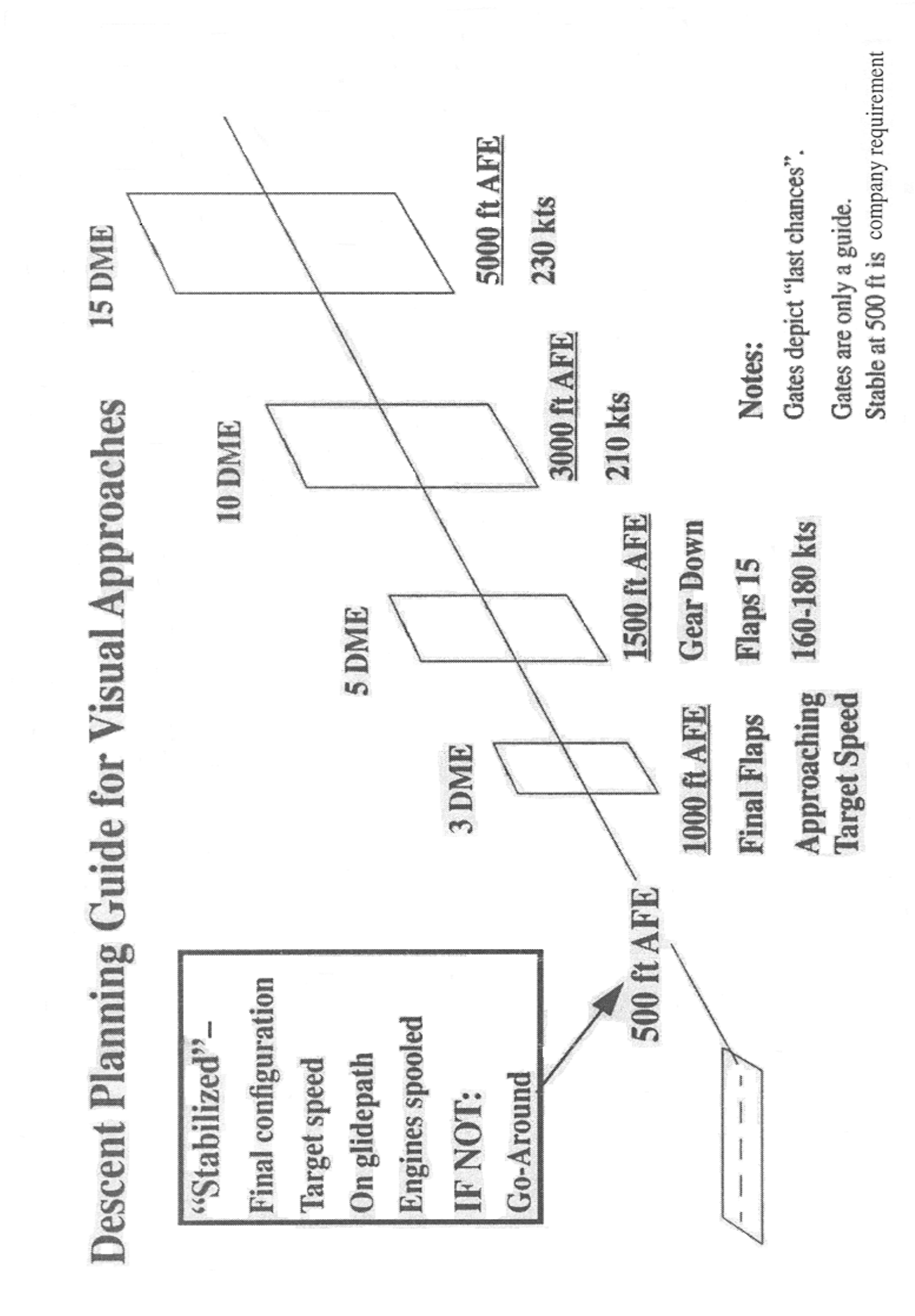
If a GPWS “PULL UP” warning or “TERRAIN” alert occurs at night or in IMC, perform the following maneuver entirely from memory:

<table>
<tr><td colspan="3">Callouts: in “BOLD TEXT” -- Actions: with bullets (•) in plain text</td></tr>
<tr><td>Step</td><td>PF</td><td>PM</td></tr>
<tr><td>1</td><td>Thrust
• Auto throttles – disconnect
• “FIREWALL POWER,” set firewall thrust
Pitch
• Autopilot – disconnect
• Roll wings level
• Rotate (3°/sec) to 20° pitch attitude. If GPWS warning continues – increase pitch (respect stickshaker/buffet)</td><td>• Verify all actions have been completed and call out any omissions
• Monitor radio altimeter, and call out information on flight path (e.g., “300 FEET DESCENDING; 400 FEET CLIMBING,” etc.)</td></tr>
<tr><td>2</td><td>Configuration
• Speedbrakes – retract
• Do not alter gear/flap configuration</td><td rowspan="3">• Call out safe altitude (e.g., “MSA IS 3,400 FEET”)
• Advise ATC</td></tr>
<tr><td>3</td><td>• Climb to safe altitude</td></tr>
<tr><td>4</td><td>• Resume normal flight. Retract flaps on flap retraction speed schedule.</td></tr>
</table>

APPENDIX 14

(example)

DESCENT PLANNING GUIDE for VISUAL APPROACHES



APPENDIX 15

(example)

DESCENT PLANNING for VISUAL APPROACHES

DESCENT PLANNING for VISUAL APPROACHES

At each airport, ATC has established descent profiles to vector aircraft to intercept an instrument approach. However, pilots are cleared for visual approaches with the descent profile at the discretion of the pilot. If the pilot's descent profile does not result in a stabilized visual approach by 500' AFE, then a missed approach must be executed (FOM page 5-37).

Visual approaches can be difficult. The wide range of variables, such as position and altitude when cleared for the approach, the lack of glideslope information, and establishing separation from a variety of visual traffic all contribute to the complexity. The secret to flying a good visual approach is accurate descent planning. This requires analysis at sequential points during the descent/approach, and making corrections to altitude and airspeed.

The Descent Planning Guide provides suggested reference points or "gates" to assist in analyzing the descent to arrive at 500' AFE in a stabilized condition. As you progress through these "gates," it is important that any deviations be corrected immediately to arrive at the next "gate" within the parameters. The longer the delay in making a correction, the greater the chance of arriving at 500' AFE in an unstabilized condition.

During the early stages of the descent, corrections to altitude and/or airspeed can usually be done using speedbrakes. If in the latter stages of the descent/approach, or if speedbrakes are not effective in correcting to the desired airspeed/altitude, consider extending the landing gear to assist in increasing rate of descent and/or deceleration. Extending flaps and slats to increase deceleration or descent rate is not as effective as the use of speedbrakes and gear extension.

Utilizing the FMC to reference the landing runway is an excellent technique for a visual approach. This will easily establish a DME reference to the landing runway for the targeted "gates." The key to a successful visual approach is to plan and make corrections early.

APPENDIX 16

(example)

PRELIGHT

Preflight
Preflight (Page 1 of 2)

<table>
<tr><th>CAPTAIN</th><th>FIRST OFFICER</th></tr>
<tr><td colspan="2">The first pilot on the flight deck will determine the aircraft maintenance status prior to actuating switches and controls.</td></tr>
<tr><td>Brief the lead flight attendant (see FOM, chapter 9).
Accomplish the captain’s preflight.

After fueling is complete, verify that the fuel load on board meets the requirements of the dispatch release and is adequate for the route of flight.</td><td>Accomplish the exterior preflight.

Accomplish the first officer’s preflight.

Record the current ATIS information.

Note: The captain may accomplish this step if it will expedite the departure process.

When the fuel slip becomes available, review it for any discrepancies, and perform the reasonableness check (see FOM, chapter 5). Verify that the fuel on board meets the requirements of the dispatch release and the flight plan.

Check the ECAM FUEL page to verify the total fuel load and the proper distribution.</td></tr>
<tr><td colspan="2">Obtain and print the ATC clearance using ACARS Predeparture Clearance (PDC) procedures. If ACARS PDC is not available, obtain the ATC clearance using voice procedures at a time convenient to both crewmembers. The captain may ask the first officer to call for the clearance or the first officer may initiate the call after ensuring the captain is prepared to listen as the clearance is received. The captain will monitor the clearance as it is copied by the first officer.</td></tr>
<tr><td>Verify that the proper clearance altitude and transponder code are set.

Ensure that the cleared route is the active FMGC route, or modify as required.</td><td>Set the clearance altitude in the FCU ALT window.

Set the transponder code.

Verify that the cleared route is the active FMGC route.</td></tr>
</table>

APPENDIX 16 (continued)

(example)

PREFLIGHT

Preflight (Page 2 of 2)

<table>
<tr><th>CAPTAIN</th><th>FIRST OFFICER</th></tr>
<tr><td colspan="2">Set the required navigation frequencies and courses for the departure. If required, use the RAD NAV page to modify the frequencies and courses.

Caution: Frequencies and courses set by the pilot must be cleared when no longer required.

Review the preliminary MGL (see FOM, chapter 8). This will enable the crew to plan the anticipated runway, flap setting, and FLEX capability.</td></tr>
<tr><td>At a convenient time prior to engine start, give a pilot briefing to ensure an understanding by both pilots as to the conduct of the flight (see FOM, chapter 9).</td><td></td></tr>
<tr><td>♦ Call for the PREFLIGHT CHECK. Verify, as appropriate, and respond to the PREFLIGHT CHECK.</td><td></td></tr>
<tr><td></td><td>Read, verify as appropriate, and respond to the PREFLIGHT CHECK.

Announce “PREFLIGHT CHECK COMPLETE.”

If the takeoff weight data becomes available prior to engine start, complete the initialization on INIT page B. Insert ZFW and BLOCK FUEL.</td></tr>
</table>

APPENDIX 17

(example)

CREW BRIEFINGS

Pilot Briefing

The purpose of the pilot briefing is to enhance communications on the flight deck and to promote effective teamwork. Each crewmember is expected to perform as an integral part of the team. The briefing should establish a mutual understanding of the specific factors appropriate for the flight.

A pilot briefing will be given prior to starting engines for the first flight of the day (subsequent flight, if applicable). The captain determines the length and detail of the briefing. Factors to consider include:

- Experience level of the pilots
- Special MEL procedures as a result of inoperative components
- Altimeter setting units
- Use of delayed engine start and/or engine out taxi procedures
- Presence of armed passengers, when applicable

When personnel occupy the extra crew seat(s), ensure they understand the use of oxygen/interphone operations and emergency exits, and sterile flight deck procedures.

Takeoff Briefing

A Takeoff Briefing will be given prior to takeoff. Factors to consider include:

- Takeoff weather conditions
- Runway surface conditions
- NOTAMS
- Departure review
- Obstructions and high terrain
- Closeout weight and balance message/takeoff numbers
- Critical conditions affecting the GO/NO GO decision (e.g., gross weight limited takeoff, wet or slippery runway, crosswind, aircraft malfunctions)
- Birdstrike potential, if applicable

APPENDIX 17 (continued)

(example)

CREW BRIEFINGS

Flight Attendant Briefing

The purpose of the flight attendant briefing is to develop a team concept between the flight deck and cabin crew. An ideal developed team must share knowledge relating to flight operations, review individual responsibilities, share personal concerns, and have a clear understanding of expectations.

Upon flight origination or whenever a crew change occurs, the captain will conduct a verbal briefing, preferably with all the flight attendants. However, preflight duties, passenger boarding, rescheduling, etc. may make it impractical to brief the entire flight attendant complement. Regardless of time constraints, company policy is that the captain must brief the lead flight attendant. The briefing will be supplemented with a completed Flight Attendant Briefing Form.

The briefing should cover the following items:

- Logbook discrepancies that may affect flight attendant responsibilities or passenger comfort (e.g., coffee maker inop, broken seat backs, manual pressurization, etc.)
- Weather affecting the flight (e.g., turbulence – including appropriate code levels, thunderstorms, weather near minimums, etc.). Provide the time when the weather may be encountered rather than a distance or location (e.g., "Code 4 Turbulence can be expected approximately one hour after takeoff.")
- Delays, unusual operations, non-routine operations (e.g., maintenance delays, ATC delays, re-routes, etc.)
- Shorter than normal taxi time or flight time which may affect preflight announcements or cabin service.
- Any other items that may affect the flight operation or in-flight service such as catering, fuel stops, armed guards, etc.
- A review of the sterile flight deck policy, responsibility for PA announcements when the Fasten Seat Belt sign is turned on during cruise, emergency evacuation commands, or any other items appropriate to the flight.
- During the briefing, the captain should solicit feedback for operational concerns (e.g., does each person understand the operation of the emergency exits and equipment). The captain should also solicit feedback for information which may affect expected team roles. Empower each crewmember to take a leadership role in ensuring all crewmembers are made aware of any potential item that might affect the flight operation.
- The lead flight attendant will inform the captain of any inoperative equipment and the number of flight attendants on board.
- The captain will inform the lead flight attendant when there are significant changes to the operation of the flight after the briefing has been conducted.

Appendix 18

(MD-80 example)

Landing Rollout – Actions and Callouts

Callouts: shown in "BOLD TEXT" – Actions: shown with bullets	
PF	**PM**
• Moves throttles to Idle	• Observes Spoiler Lever moves aft to EXT position. • If spoiler lever does not move aft to EXT position, PM calls, "**NO SPOILERS**" and moves lever to full extend position and up to latched position.
• Deploys Thrust Reversers • Maintains directional control and initiates braking as required	• Monitors Thrust Reverser Deployment • Advises PF of thrust reverser status • Advises PF if 1.6 EPR is exceeded on dry runway or 1.3 EPR is exceeded on a wet or contaminated runway. (Suggested EPR limits may be exceeded in the event of an emergency)
	• Monitors airspeed and announces, "**80 KNOTS**"
• Reduces reverse thrust to achieve idle reverse thrust by 60 knots.	
If First Officer is PF, a positive transfer of controls shall occur during landing roll-out in accordance with company procedures	
• Clearing runway, retracts spoilers and announces, "**FLAPS UP, AFTER LANDING CHECKLIST**"	• Confirms retraction of ground spoilers and selects flaps to 0/RET position.

Appendix 19

(examples)

Crew Monitoring And Cross-Checking

Background

Several studies of crew performance, incidents and accidents have identified inadequate flight crew monitoring and cross-checking as a problem for aviation safety. Therefore, to ensure the highest levels of safety each flight crewmember must carefully monitor the aircraft's flight path and systems and actively cross-check the actions of other crew members. Effective monitoring and cross-checking can be the last barrier or line of defense against accidents because detecting an error or unsafe situation may break the chain of events leading to an accident. Conversely, when this layer of defense is absent, errors and unsafe situations may go undetected, leading to adverse safety consequences. It is difficult for humans to monitor for errors on a continuous basis when these errors rarely occur. Monitoring during high workload periods is important since these periods present situations in rapid flux and because high workload increases vulnerability to error. However, studies show that poor monitoring performance can be present during low workload periods, as well. Lapses in monitoring performance during lower workload periods is often associated with boredom and/or complacency.

Crew monitoring performance can be significantly improved by developing and implementing effective SOPs to support monitoring and cross-checking functions, by training crews on monitoring strategies, and by pilots following those SOPs and strategies. This Appendix focuses on the first of these components, developing and implementing SOPs to improve monitoring.

A fundamental concept of improving monitoring is realizing that many crew errors occur when one or more pilots are off-frequency or doing heads-down work, such as programming a Flight Management System (FMS). The example SOPs below are designed to optimize monitoring by ensuring that both pilots are "in the loop" and attentive during those flight phases where weaknesses in monitoring can have significant safety implications.

Review and modification of existing SOPs

Some SOPs may actually detract from healthy monitoring. Operators should review existing SOPs and modify those that can detract from monitoring. For example, one air carrier required a PA announcement when climbing and descending through 10,000 feet. This requirement had the unintended effect of "splitting the cockpit" at a time when frequency changes and new altitude clearances were likely. When the air carrier reviewed its procedures it realized that this procedure detracted from having both pilots "in the loop" at a critical point and consequently decided to eliminate it.

Another carrier required a company radio call to operations once the aircraft had landed. A critical review of procedures showed that this requirement, although sometimes necessary, had resulted in runway incursions because the first officer was concentrating on making this radio call and not fully monitoring the captain's taxi progress. The procedure was modified so that crews make this call only when necessary and then only once all active runways are crossed, unless unusual circumstances warrant otherwise (such as extensive holding on the ground.)

In addition to modifying existing SOPs, operators may consider adding sections to the SOP manual to ensure that monitoring is emphasized, such as:

- **High-level SOPs that send an over-arching message that monitoring is a very important part of cockpit duties.**

  Examples:

  A. Change title of "Pilot Not Flying" (PNF) to "Pilot Monitoring" (PM).
  B. The SOP document could explicitly state that monitoring is a primary responsibility of each crewmember.

     Example:

     Monitoring Responsibility

     - The PF will monitor/control the aircraft, regardless of the level of automation employed.
     - The PM will monitor the aircraft and actions of the PF.

  Rational:

  A. Several air carriers have made this change because they feel it is better to describe what that pilot should be doing (monitoring) rather than what he/she is not doing (not flying).
  B. Although some SOP documents do define monitoring responsibilities for the PF, this role is often not explicitly defined for the PNF (PM). In many cases non-monitoring duties, such as company-required paperwork, PA announcements, operating gear and flaps, are clearly spelled-out, but seldom are monitoring duties explicitly defined for each pilot.

- **SOPs to support monitoring during airport surface operations**
  (also refer to AC 120-74)

  Examples:

  A. Both pilots will have taxi charts available. A flight crewmember—other than the pilot taxiing the aircraft—should follow the aircraft's progress on the airport diagram to ensure that the pilot taxiing the aircraft is following the instructions received from ATC.
  B. Both pilots will monitor taxi clearance. Captain will verbalize to FO any hold short instructions. FO will request confirmation from Captain if not received.
  C. When approaching an entrance to an active runway, both pilots will ensure compliance with hold short or crossing clearance before continuing with non-monitoring tasks (e.g.,

FMS programming, Airborne Communications Addressing and Reporting System (ACARS), company radio calls, etc.).

Rational: Pilot-caused runway incursions often involve misunderstanding, not hearing a clearance or spatial disorientation. These SOPs are designed to do several things.

A. The requirement for both pilots to have taxi charts out ensures that the pilot who is not actively taxiing the aircraft can truly back-up the pilot who is taxiing.
B. Requesting that both pilots monitor the taxi clearance and having the captain verbalize any hold short instructions is a method to ensure that all pilots have the same understanding of the intended taxi plan.
C. The requirement to suspend non-monitoring tasks as the aircraft approaches an active runway allows both pilots to monitor and verify that the aircraft stops short of the specified holding point.

- **SOPs to support improved monitoring during vertical segments of flight** (also refer to Appendix 3 of this document, "ATC Communications and Altitude Awareness")

Examples:

A. PF should brief PM when or where delayed climb/descent will begin.
B. Perform non-essential duties/activities during lowest workload periods such as cruise altitude or level flight.
C. When able, brief the anticipated approach prior to top-of-descent.
D. During the last 1,000 feet of altitude change both pilots should focus on the relevant flight instruments to ensure that the aircraft levels at the proper altitude. (When VMC one pilot should include scanning outside for traffic; however, at least one pilot should focus on ensuring that the aircraft levels at the proper altitude.)

Rational: A study on crew monitoring conducted by NASA Aviation Safety Reporting System (ASRS) revealed that three-quarters of the monitoring errors in that study occurred while the aircraft was in a vertical phase of flight, i.e., climbing, descending or approach. These SOP statements ensure that proper attention can be devoted to monitoring during vertical phases of flight.

A. The ASRS monitoring study highlighted that a number of altitude deviations occurred when crews were given an altitude crossing restriction, but then failed to begin the descent in a timely manner. Briefing the anticipated top-of-descent point not only promotes healthy CRM, but also allows the other pilot to "back up" the planned descent point and ensure the descent begins at the proper point. Example: "We'll begin our descent at 80 DME."
B. Studies likewise show that in order to minimize the chance of a monitoring error, crews should schedule performance of non-essential duties/activities during the lowest workload periods, such as cruise altitude or level flight.
C. Briefing the anticipated instrument approach prior to descent from cruise altitude allows greater attention to be devoted to properly monitoring the descent because the crew is

not having to divide attention between reviewing the approach and monitoring the descent. It also allows greater attention to be devoted to the contents of the approach briefing, which can increase situation awareness and understanding of the intended plan for approach and landing.

D. Many altitude deviations occur because pilots are not properly monitoring the level off. This SOP statement is to ensure that pilots concentrate on ensuring the aircraft levels at the proper altitude, instead of being distracted by or performing non-monitoring tasks.

- **SOPs to support improved monitoring of automation**

Examples:

A. Before flight, the routing listed on the flight release must be cross-checked against the ATC clearance and the FMS routing.
B. When making autoflight systems inputs, comply with the following items in the acronym CAMI:
C onfirm FMS inputs with the other pilot when airborne
A ctivate the input
M onitor mode annunciations to ensure the autoflight system performs as desired
I ntervene if necessary.
C. During high workload periods FMS inputs will be made by the PM, upon the request of PF. Examples of high workload include when flying below 10,000 feet and when within 1000 feet of level off or Transition Altitude.
D. Pilots should include scanning of the Flight Mode Annunciator as part of their normal instrument scan, especially when automation changes occur (e.g., course changes, altitude level off, etc.).

Rational:

A. It is not unusual for the routing that is loaded in the FMS to be different from the routing assigned by ATC, especially in those cases where the flight plan is uplinked directly into the FMS, or when an FMS stored company route is used. Various studies have demonstrated that FMS programming errors made during preflight are not likely to be caught by flightcrews during flight. Therefore it is critical that these items be cross-checked before takeoff.

B. The above-mentioned ASRS monitoring study found that 30 percent of the monitoring errors in that study's dataset occurred when a crewmember was programming a Flight Management System (FMS). Another NASA-funded study showed that even experienced pilots of highly automated aircraft sometime fail to adequately check the Flight Mode Annunciator to verify automation mode status. The acronym "CAMI" can be used to help emphasize cross-checking of automation inputs, monitoring and mode awareness.

C. The statement concerning FMS inputs during high workload allows the PF to concentrate on flying and monitoring by simply commanding FMS inputs during highly vulnerable times. Several ASRS reports indicate problems with failure to level-off and failure to reset altimeters to proper settings. Therefore, the definition of "high workload" should include those vulnerable phases.

D. *Automated flight guidance systems can have mode reversions and can sometimes command actions that are not anticipated by pilots. Therefore, pilots should include the Flight Mode Annunciator into their normal instrument scan. Special attention should be given to periods of course changes, altitude level off, etc.)*