National Defence / Défense nationale

SPRING 2000

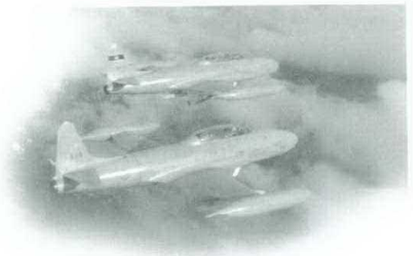
Flight Comment

IN THIS ISSUE :

- *Conversing with the CAS*
- *Spatial Disorientation and Unusual Attitudes*
- *Dangerous Cargo?*

Canada

Table of Contents



Cover Photo by Mike Reyno/Skytech Images

Flight Comment

Directorate of Flight Safety

Director of Flight Safety
Col M. Legault

Editor
Capt J.S. Medves

Art Direction
DGPA-Creative Services

Translation
Coordinator
Official Languages

Printer
Tri-co Printing Inc.
Ottawa, Ontario

The Canadian Forces Flight Safety Magazine

Flight Comment is produced 4 times a year by the Directorate of Flight Safety. The contents do not necessarily reflect official policy and unless otherwise stated should not be construed as regulations, orders or directives.

Contributions, comments and criticism are welcome; the promotion of flight safety is best served by disseminating ideas and on-the-job experience. Send submissions to:

ATT:
Editor, *Flight Comment*
Directorate of Flight Safety
NDHQ/Chief of the Air Staff
Major-General George R. Pearkes Bldg.
101 Colonel By Drive
Ottawa, Ontario K1A 0K2

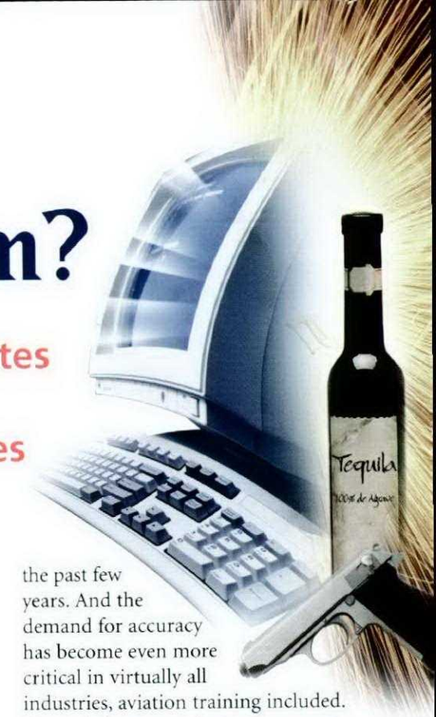
Telephone: (613) 995-7495
FAX: (613) 992-5187
E-mail: ac912@issc.debbs.ndhq.dnd.ca

Subscription orders should be directed to:
Publishing Centre, CCG,
Ottawa, Ont. K1A 0S9
Telephone: (613) 956-4800

Annual subscription rate:
for Canada, $19.95, single issue $5.50; for other countries, $19.95 US., single issue $5.50 US. Prices do not include GST. Payment should be made to Receiver General for Canada.

ISSN 0015-3702
A-JS-000-006/JP-000

Do We Have a Problem?



Professor Frank Vander Wert contemplates the reliability of computers and their operators in aviation training, and argues for the need for accuracy over speed.

Long ago, in another time, business communications wasn't an oxymoron. Then along came the magical computer, guaranteed to solve virtually all business communication problems. With it came new meaning for the old phrase, let your fingers do the walking.

Believe it or not there was a time when there were no computers in the world. In fact, some of the heavy hitters in the stone age didn't give computers much hope. During 1943 the Chairman of IBM, Thomas Watson, said, “I think there is a world market for about five computers.” That wasn't a terribly optimistic projection for technology that is embraced so widely today.

During 1949 the US Popular Mechanics magazine made the fairly unastute observation that “Computers in the future may weigh no more than 1.5 tons.” Not exactly palm-sized.

Next, fast-forward to 1977 when Ken Olson, President of Digital Equipment, remarked that “There is no reason for any individual to have a computer in their home.” Tell that to the huge number of people who today conduct business from their homes, with the level of computing power never dreamed of by some of those early prognosticators.

Do we have a problem?

Do we have two eyes? As some wag said, “A computer lets you make more mistakes faster than any other invention in human history, with the possible exception of handguns and tequila.” The computer gives you a great opportunity to display a lack of communications skills at an accelerated pace.

Are we dumbing down to a point and click society that can't read or understand their native language? No way, you may say. The USA Today newspaper ran an item in April 1999 regarding 12 students from Southern Methodist University who filed a suit against the University claiming a computer course was too hard. “They were told, if you can point and click you can handle the course,” their lawyer said. With remarkable Texan resolve, all 12 students rejected a second chance to take the class.

In a few short years students like these will probably graduate and be knocking on doors. Do you want something beyond the ability to point and click from the personnel on your team?

The real world

Anyone with a pulse knows that the pace and international nature of business has quickened tremendously over the past few years. And the demand for accuracy has become even more critical in virtually all industries, aviation training included. To put it in perspective, an accuracy rate of 99.9% would result in —

- Two short or long landings at each major airport per day.
- No telephone services for 10 minutes each week.
- No electricity or water for 8.6 hours per week.
- 2000 lost articles of mail per hour.
- At least 20,000 wrong prescriptions per year.
- Unsafe drinking water for one hour per month.

A good friend of mine was appointed Maintenance Manager at the European Hub of a major commercial carrier. He said that on one occasion a German supplier invoiced that carrier for DM 38,000, for services provided. The carrier sent him a cheque for $38,000. The conscientious supplier returned the cheque, reminding the carrier that the invoice was for Deutsche Marks. The carrier cut another cheque and sent it to the supplier for 38,000 Danish Krona. If time is money, how much did it take to unravel

that modest mess? And what damage did a first-rate carrier do to their reputation with that German supplier?

The US military has been known to stumble occasionally in conduct of their vast business. When I was with the Marketing Division of Messerschmitt-Bolkow-Blohm (MBB) at their Munich area headquarters, our group offered repair services for US Navy aircraft in the Mediterranean area. The downside was, so did virtually every other aircraft company in Europe.

One sunny day, a message from the US Navy Contracting Office in Naples printed out in our office. However, it was actually addressed to our primary Italian competitor and contained confirmation of man-hour rates, numerous sensitive contractual issues and other confidential business details. The data was practically gift-wrapped, and it wasn't even Christmas!

When I called the US Navy Commander at Naples to ask what he wanted us to do with the message we had received, it became incredibly quiet on the phone. The Contracting Officer quickly realised the implications of their oversight. Those pesky little electrons had done exactly what the Navy operator told them to do, but he obviously keyed in the wrong address for that message.

Who can't recount a tangle with some electrons gone awry? If companies don't have time to do it right the first time, when will they find the time to do it again, correctly?

An example from the cockpit

The airliner of today is a marvel of computers and other technology. But things can still go wrong. The media had a great time not long ago when an aircraft crossing the Atlantic missed its destination in a less than subtle way. The latest GPS-driven graphic cabin displays let the entire cabin watch as the airliner destined for Frankfurt headed directly to Brussels. Upon approach to Brussels Airport the only people aboard still not aware of the major error were the crew. Not only the wrong airport, but the wrong country. Incompetence plus incompetence still equals incompetence.

Can training help?

The short answer — yes. The long answer — the training needs to be relevant and take into account a broad range of very human factors. The challenge for the training and simulation side of the industry is quite simple: explore new and innovative ways to train that continue to cut down the human errors in aviation.

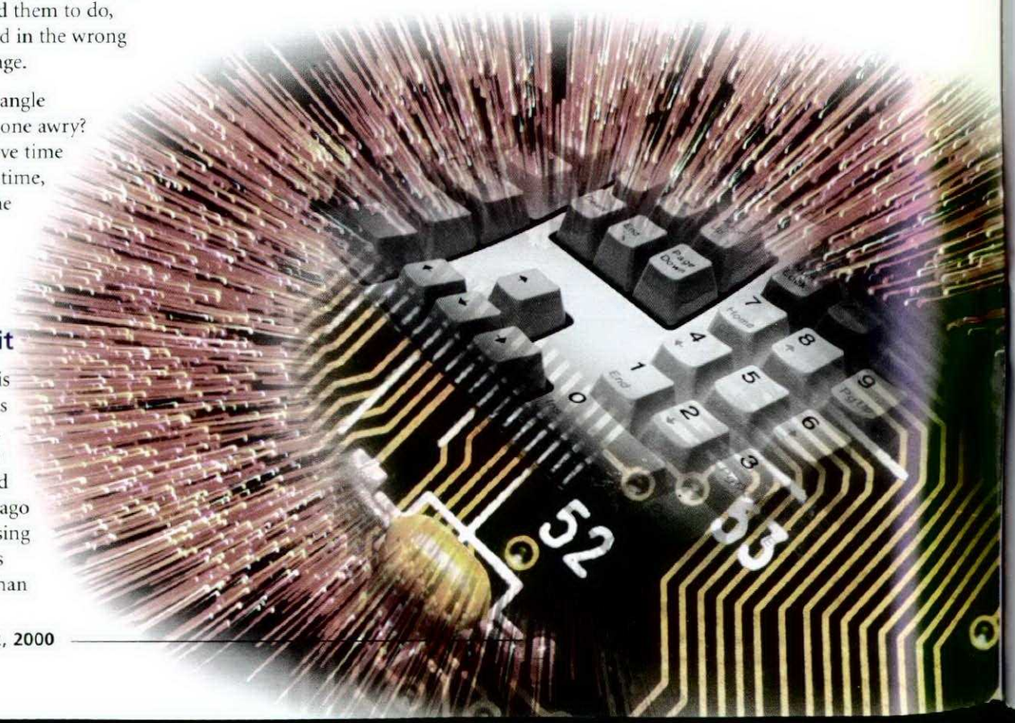
Computers have, in many ways, made business communications much more efficient. Yet the scope of developments can be overwhelming. The challenge was put in focus by Dean Cobb, Executive Vice President of Texas Instruments. In January 1998, he said, "The increasing amount of information being transmitted over the Internet is increasing at 14% per month. It would take a person working 10 hours a day more than 40 years to log on to all the sites that exist today on the World Wide Web." And how about today?

Facts don't cease to exist because they are ignored. The computer era was at our door many yesterdays ago. And at latest calculation, we each get a standard issue 168 hours per week to do what we want with that time. What to do? Retail a liberal dose of common sense? Strive for accuracy? It's still best valued in the business world. Moreover, it's critical to success. The computer can certainly be your friend and assistant in that goal.

I suspect that the world will continue to appreciate individuals who can express themselves accurately, clearly and convincingly. Progress has little to do with speed, but much with direction. Keep dot com under control!

– *Frank Vander Wert is a Professor of Aeronautical Sciences at Embry-Riddle Aeronautical University in Pullach, Germany*

Reprinted courtesy of The Journal of Professional Aviation Training *Volume 1 Number 6 July / August 1999* ◆



Safe Beginnings = Safe Landings

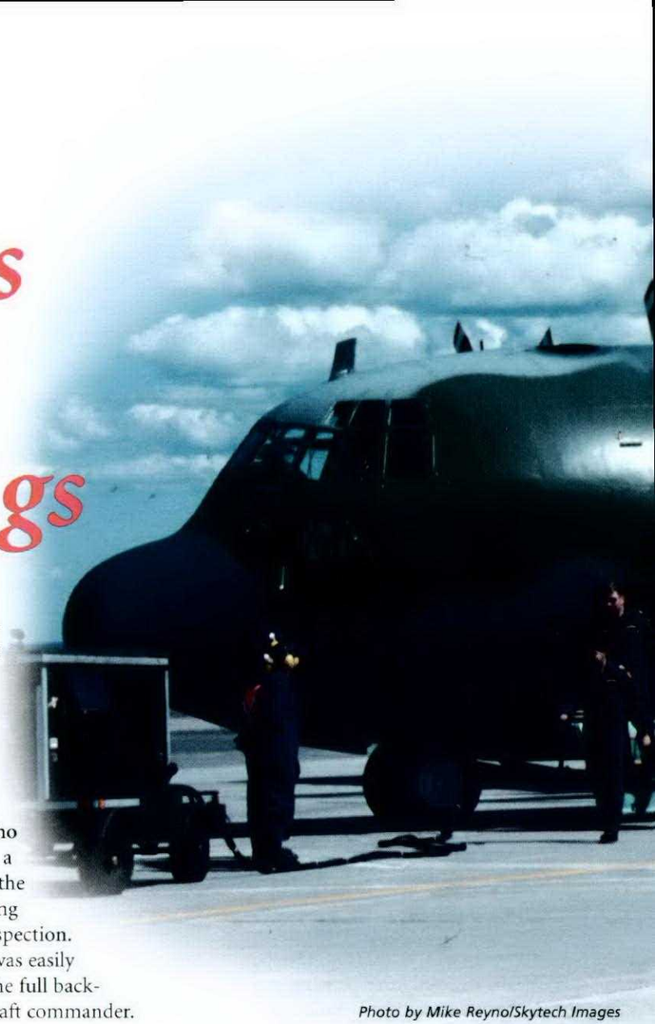


Photo by Mike Reynol/Skytech Images

In June of 1997 I was tasked to be a restricted loadmaster on a long-range trainer to western Canada. The flight would then proceed down to the United States and South America. The first leg was from Trenton to the east coast to pick up sixty ground troops and take them to Medicine Hat, Alberta.

We arrived at the airport at approximately 1600Z and were scheduled to take off at approximately 1730Z. The other loadmaster and I met with the unit enplaning officer and we were informed that the passengers were going to be at least 30–45 minutes late. We confirmed with the enplaning officer that all the passengers had been briefed and checked for any dangerous cargo they might be bringing in their personal kit. As a precaution we always do a spot check of approximately 10% personal kit.

Shortly there after the passengers showed up they proceeded to the aircraft where we randomly took 10 individuals and their belongings aside for an inspection prior to loading. As we were about to start the front-end crew was asking how long it would take to complete the inspection? We replied that we wouldn't be too long. Once we started we found dangerous cargo in almost all the kit of the 10 individuals. We decided to do a full kit inspection of everyone — something that was going to delay us by at least one hour. Now we had to deal with an upset chalk commander who was more than a little miffed at the thought of doing another full inspection. The situation was easily defused with the full backing of the aircraft commander.

We gave all the passengers the opportunity to turn in all the different dangerous items we listed for them. We then proceeded with the checking of their kit. We found too many things to list in one article, but the highlights were: hexamine tablets in a pouch with Ronson lighter fluid, strike anywhere matches, lithium batteries, and mountain stoves with naphtha still in them. The inspection took almost ninety minutes.

There were several things that could have prevented this scenario right from the beginning. Passengers need to know that their safety is our first and foremost concern. When they are asked to leave behind the items that are considered dangerous cargo it's for a reason, assuming an item is safe is a recipe for disaster. The unit enplaning officer must be extremely vigilant to ensure that a full kit inspection is carried out. Loadmasters must be willing to complete inspections regardless of the time it may take.

One last note for personnel traveling on any aircraft — it's not that we don't trust you (that was the response of some of those being inspected) but if one person has dangerous cargo with them then everyone must be inspected. If in doubt ask — it will always be to your benefit. ◆

"SPATIAL DISORIENTATION *and* UNUSUAL ATTITUDES"

Photo by Mike Reyno/Skytech Images

While flying night sorties against a Canadian navy task group in November 1997, my EWO (Electronic Warfare Officer) and I experienced a series of conditions, illusions and sensory inputs that resulted in a potentially deadly unusual attitude. We got lucky, and recognized the situation just in time to recover the aircraft at low altitude in night instrument flying conditions.

The sortie was planned as an air defence exercise and our mission was to fly a simulated missile profile against the navy task group. The setup parameters were fairly straight forward; we "launch" from a nearby T-33 (with 1000 feet vertical separation for the night/IMC conditions), descend to 1000 feet above sea level, and track an inbound radial to the TACAN of one of the frigates. After crossing our target we would initiate a climbing right-hand turn and proceed to a designated reset point where we would coordinate a second "launch" with the other T-33.

During execution of this plan, the launch and subsequent descent to 1000 feet ASL proceeded normally. Maximum continuous power was set and we accelerated to more than 400 KIAS. At this point the ship's air controller advised us that there would be a helicopter in the hover at 100 feet or below slightly beyond the target frigate. During the run-in, we got occasional glimpses of the stars above us through holes in the cloud cover. There was no moon that night, and the broken cloud condition obscured any useful horizon. As we got closer to the naval task group, we also saw the point-source lights of a dozen ships spread out in front of us. The red anti-collision lights of the helicopter came into view around the time we had begun the pull-up to start the climbing right turn.

The pull-up was more aggressive than it should have been because the red light visible on the helicopter still 2–3 miles away seemed to be moving and climbing in front of me (the helicopter was actually stationary in the hover below 100 feet, exactly where the ship said it would be). The sensation of movement was quite convincing. Once the pull-up was initiated, I set a 30 degree bank right turn, and out of habit, my EWO and I both looked in the direction of the turn for a few seconds, then looked back at the instruments. The indications were:

Attitude Indicator:	Bank– increasing through 120 degrees (still rolling right) Pitch– nose tracking down through the horizon
Altimeter:	Apex at 3900 feet, beginning to descend
Airspeed:	Increasing through 380 KIAS
Vertical Speed Indicator:	Increasing rate of descent

The aircraft was essentially at the top of a very shallow wing-over. I centralized the controls, and given the continued right banking trend and analysis of the other instruments, I rolled left to level the wings. The pullout was completed by approximately 900 feet ASL and I set a wings-level climb attitude (this time remaining on the instruments). My EWO and I began discussing the incident as we climbed away; however, we remained focused on the mission requirement for a second run-in and started for the reset point. The EWO then drew my attention to the accelerometer, and I realized we had pulled 5.5 G to recover from the dive. Then everything began to sink in and we elected to return to base.

Analysis of this sequence of events highlights the ease with which we can become complacent and comfortable with high performance flying in demanding conditions. This was the third night of sorties much like this one, and most of the night crews were becoming quite fatigued due to the irregular sleep cycle that this ops tempo imposed. We were wearing immersion suits since a previous mission several hours earlier, and were most likely dehydrated. The attitude indicator in that vintage of T-33 was designed to provide only a minimum of pitch information and has no sky-ground colour code. As well, the T-33's ailerons are boosted hydraulically, and the aircraft is well known for its roll instability.

There was a sense of visual awareness caused by the lights and stars that led me away from a disciplined instrument crosscheck. I had channelized my attention outside the cockpit to the helicopter's light (probably experiencing "visual autokinesis"). The combination of pitching up, right rolling moment, and the associated deceleration, combined with the head movement to the right led to an unrecognized state of spatial disorientation (defined as Type I Spatial Disorientation). The vestibular apparatus and somatosensory system were deprived of the visual cues that calibrate their sensory inputs and provide our sense of orientation. The absence of these cues contributed to the inaccurate "seat of the pants" sensation that I experienced in the climbing turn.

There are doubtless other phenomena that contributed to this series of conditions and actions. I have tried to summarize this incident with the aid of the definitions found in the CFP-148 Manual of Instrument Flying (Annex B). I highly recommend pilots and navigators have a look at this section of the CFP-148. It has probably been a while since most of us attended a Spatial Disorientation class of any sort. As well, a review of Unusual Attitude recoveries with decision gates for ejection or recovery (at low altitude) could prove useful. I was lucky that the bank had continued and the "analyze" phase was basically instantaneous. From the point of recognition I had only enough time to carry out the recovery. Had there been any hesitation or lack of certainty about the progression of the attitude, the only other option would have been ejection, at night, upside down, over the Pacific Ocean. Most importantly, all this could have been avoided with thorough crew coordination, proper rest, detailed night IMC mission planning, and above all, disciplined and effective instrument crosschecks.

– *Captain P. Boyle*
414 (Combat Support) Squadron
19 Wing, Comox ◆

SAR Story

As the guys in the back were making fun of me, I once again told "John" that we should turn back a few miles to the last valley I could remember on the map and start again. He smiled and said nothing as he gave his head a nod indicating to me that he knew where we were and not to worry. It was a nice clear afternoon and we had been searching the same mountain range for the past few days. I figured that if he wasn't worried, then why should I? After all, he was a SAR veteran, full of stories and loved by all. I, on the other hand, was a pipeliner fairly new to the squadron and I had still to earn the trust and respect of many on the helicopter side of the house. I tried to cover up the fact that I had no clue as to our location in the BC mountains, but it was just as the guys in training said it would be, simply look away once or lose track of a valley and you're lost. The old Omega and Loran were not accurate enough to be of any help so I tried to recognize any feature to pinpoint our location, but it all looked the same. John seemed to be in control, adding his little comments to the crew on how it was just like a newbie to get lost.

At that point, we agreed that it would be best just to head back to Stuart for the night and resume covering our assigned search area in the morning. After a few more humorous attempts at getting John to go back, he surprised me by heading over a ridge into a new valley. The crew seemed indifferent at this point except to make encouraging remarks about John's experience in SAR and his time on the West Coast and that he surely must know where we were. It did not take long before John was over a few more valleys and I knew that I would never recognize any features being so far away from my last known position.

We suddenly found ourselves over a valley with low-lying cloud below us and I could not believe how much altitude we had gained in such short time. John still had the crew worked up and I thought that I was the only one who was getting nervous. I remembered another SAR pilot telling me that if I felt uncomfortable in flight, that there would always be someone else on the crew who felt the same and that all I had to do was speak up and the others would follow. At that point, I told John that I thought that we could be in some trouble soon if we didn't figure something out. Sure enough, a few crewmembers agreed and we finally got serious about our situation.

As we kept climbing, hoping to get visual over the next range, we found ourselves in the worst situation possible. The flight engineer echoed our thoughts about our diminishing fuel state suggesting that we should think about putting down somewhere. The problem was that we were now at over ten thousand feet above sea level with a solid layer below us. Not a reassuring feeling when you have no clue where you are or what is below you. The Stuart airport did not have a precision approach that eliminated the hope of shooting an ILS back to solid ground. The flight engineer had calculated our VNE for ten thousand feet to be around fifty five knots. The blades were struggling for dense air as they went around and I think that it was at that point that the last comic on board realized we were no longer making fun of being uncertain of exact position.

Silence turned to cheers when we heard the crew of a SAR Twin Otter calling the Stuart airport. Silence soon took over again as they informed us that with their fuel state since the weather was down at Stuart they would be heading direct for Terrace. All thoughts of the Twin Otter vectoring us to the airport vanished and no mention of our situation was ever passed to the Twin Otter crew. I think John felt guilty and did not want details of our little adventure passed all over search headquarters and the squadron for fear of ridicule if we ever made it back.

We were circling when we spotted the only mountain peak above the cloud layer. Upon examination of the map we headed for the peak since we figured it was within ten miles of Stuart. John handled the old Labrador like the seasoned pro he was as we descended the side of the mountain barely maintaining VFR hoping of breaking out. Our fuel situation was critical and we agreed to put down anywhere when we made it through. Visual again, I quickly found our position and we decided to head for Stuart until our low fuel light came on. Luckily, we made it without any further incident and it was strongly recommended by John that we keep our little trip to ourselves. Being the new guy on the block, I wondered how many little trips other guys had been on and thought that this was all part and parcel of being a SAR pilot?

I think the biggest shock I got was not from the fact that John had almost lead his crew to death's door, but on shut down one of the guys came forward and congratulated John on what a great job he had done of bringing us down. He went on to say that not many pilots on squadron could have brought us home safely if they found themselves in the same situation. I sat in amazement as the cheers for John echoed the cabin. I could not help but wonder where this crewmember was for the past two hours? I wanted to ask him who he thought got us into the situation that required John's skill and experience to bring us back in one piece?

The following week, John was downgraded to first officer and a reevaluation of his IFR skills was ordered. No reason was given, but I am certain our little trip was the cause. Rumors spread of who might of spoken out, but I promised myself that from that moment on I would not be intimidated or impressed by any other pilot's experience or skill if he attempted to endanger me or any other crew member.

I later went on to instruct at the helicopter flight school for ab-initio students, and of all my SAR stories, I made sure they listened to and understood my little story about my flight with John.

– *Captain Ringuette* ◆

Photo by Mike Reyno/Skytech Images

SAR Accident

On June 14, 1986 I was the SAR Tech Team Leader of one of three Twin Otter aircraft from 440 Squadron that were involved in an aircraft search in the foothills region of the Rocky Mountains near Calgary Alberta. This was my fourth day on search and things were starting to get a little trying with the lack of success and the severe turbulence we were encountering in our assigned search areas. After a quick lunch in Calgary we talked with the other two Twin Otter aircrew about the bizarre winds, turbulence and the uncomfortable conditions in the back of the aircraft. Needless to say, we took off again with renewed vigor for another four hours of searching.

An hour into our afternoon search one of our civilian spotters spotted an unknown object in a saddle between two mountains. Our aircraft was brought around and we tried to identify the object. This was no easy task and with each pass our aircraft made we got lower and things got scarier — and certainly a lot more dangerous. Finally, with white knuckles and a pale face I said, "Listen Sir, mark the location on your map and let's get a helicopter to check it out. We don't have to crash trying to identify something that a helicopter can check out!" Without any disagreement, but with a chilled silence, the location was marked on the map and we continued on with our search.

Not twenty minutes later we noticed large amounts of black smoke in the search area next to us and decided to fly over to investigate. What we saw was one of the most sobering and intensely emotional things an aircrew member can see. Staring us in the face was one of our own yellow search aircraft, in pieces and on fire, spread down the side of a mountain

After going into the crash to account for the eight persons on board and doing the other things that SAR Techs do, my team member and I eventually made it back to Calgary. The next day I saw my Aircraft Commander. After initial greetings one of the first things he said to me was "Thanks for calling off identifying that object in the saddle yesterday. My pride took over and I had to identify it". I shrugged and said "Yeah, no problem".

There were no survivors on board Rescue 807, and perhaps because we had an Aircraft Commander that listened to the input of his crew, we didn't end up like them.

– Warrant Officer Fred Denninger ◆

Photo by Mike Reyno/Skytech Images

Dangerous Cargo?

It was the summer of 1995. As a brand new 10 TAG flight engineer on Twin Hueys I soon found myself in Haiti. It was quite the challenging with a very busy flying schedule. Most of our flying involved transporting troops and patrolling. Occasionally we would do some compulsory training trips.

One particular trip took us to the hills and inland fields. After awhile someone got the great idea of cactus shopping — they thought it would pretty up the shelter we called home. It took no time at all to find the perfect cactus in the desert-like conditions, about 18 inches in length with lots of needles. I volunteered to go out and retrieve the unfamiliar plant. To my dismay it became evident that even the root of the plant had needles — flying-glove piercing needles. After a little while, and a little blood shedding, the important cargo was hastily secured under one of the pilot's helmet bag. In retrospect, a cargo strap would have been more appropriate.

After a short flight back to camp, I did the standard 'two full' from the back which required me to do instrument check for landing. As I got out of my seat and knelt down I was instantly aware of the flight safety implications of not properly securing my cargo! The high-pitched scream from the back startled both pilots. They completed a quick assessment of the situation and through tears of laughter managed to land without further incident. After a quick debrief, and a short hop for medical aid, my ordeal was over. I learned a valuable, but painful lesson about flight safety and due diligence during all phases of flight.

– *Master Corporal Finnegan* ◆

Conversing with the CAS

The following is a portion of a conversation I had with Lieutenant General Kinsman. The entire transcript is available in electrical form by request from Lieutenant Colonel Millar, EA to the CAS

Editor:
What can you do as the Chief of the Air Staff?

LGen Kinsman:
To influence the way the air force is going you mean?

Editor:
Yes, sir.

LGen Kinsman:
I have two focal points. This office has to focus on the present — from the standpoint of making sure there is no unnecessary impediment to people getting the job done, and I have got to focus on the future. We can't sacrifice tomorrow for today. I mean that is why we are moving money around from one budget to another. We put the pinch on ourselves now, but we do so that we have got the capability, the modernized equipment, whatever, twenty years from now.

How do I change the organization? It is probably imperceptible to people on a day to day basis. It is one of those things that as you go through more senior levels in this or any other organization the impact that you have on a day to day basis becomes less and less apparent.

Editor:
I'd like to talk about communications and the expectations of what people think they should do or what they perceive is expected of them? I was reading about an accident that occurred in another air force. They talked about operational tempo and fatigue as being potential factors. The Wing Commander, when he was interviewed, said that if there had been any problems the squadron leader would have told him. But interestingly enough the article claims the organization maintained a sixty days surge tempo for five years! We live in a "can do" culture like you said. What do you expect of your CO's, your squadron leaders, and your Wing Commanders?

LGen Kinsman:
"Can do" is an absolutely essential part of our organization. If we were to lose the "can do" spirit then we would be very unspectacular. But "can do" for me is not going beyond the boundaries that we have given ourselves, or the boundaries that we should have as individuals based upon our training and our own personal skills.

Now you can't define that. Everybody that flies any type of airplane in the Canadian Forces sooner or later gets to a point were they should know they are now at a point where if they go any further they are exceeding either the rules, their airplane's capability, or their own capability. I don't ask anybody to "can do" into that zone. I ask people to "can do" from the standpoint of doing what should be reasonably expected of them. Every now and then someone sort of transcends that and that's when your in the gray zone — that makes you vulnerable or a hero depending upon whether you fail or you succeed. But we don't want to spend our time in that gray zone as an organization.

That's part of the professionalism that we try to develop in people, to take "can do" and translate it into confidence in their skills. Challenging themselves to improve constantly, challenging the organization to improve, but not going beyond personal capabilities or the capability of their equipment. In some cases what is "doable" for one person is not "doable" for another person, and that I accept.

You can't define, and I would defy anybody to, a common limit for people — what is "can do" and beyond what level you should not go, it evolves. Everybody who is part of an organization needs to understands the limitations of the new people in the organization. I have seen great examples of that — very professional mentoring, and I have seen the worst of it. I have seen very experienced and skilled people showing off to young

people. As far as I'm concerned all that they were doing was putting a lot of pressure on the less experienced person to try and be able to do something; perhaps before they actually have the required skills. That is unacceptable as far as I'm concerned.

Editor:

A little about media scrutiny. Are you worried about people becoming risk adverse?

LGen Kinsman:

No, I'm not concerned, but this is one of those areas where a commander can influence the air force. Whether it is a commander at this level or a commander in another area — they can make a huge difference.

I don't think anybody in our organization will become risk adverse based upon somebody being taken to task for having broken the rules or having done something that's stupid. They will become risk adverse if they sense that everybody is out there looking at them through a microscope and if anything goes wrong the system is going to try and put the blame on them. So it is one of those leadership issues I've worked on in the period of time that I have been here. Listening to the commanders in the field, and of course General Campbell is in Winnipeg, whose ear is even closer to the ground and he makes those operational decisions because that's his mandate. Overall you have to be satisfied that people show great judgement. A classic case to me is the Hercules that kept coming back to Trenton.

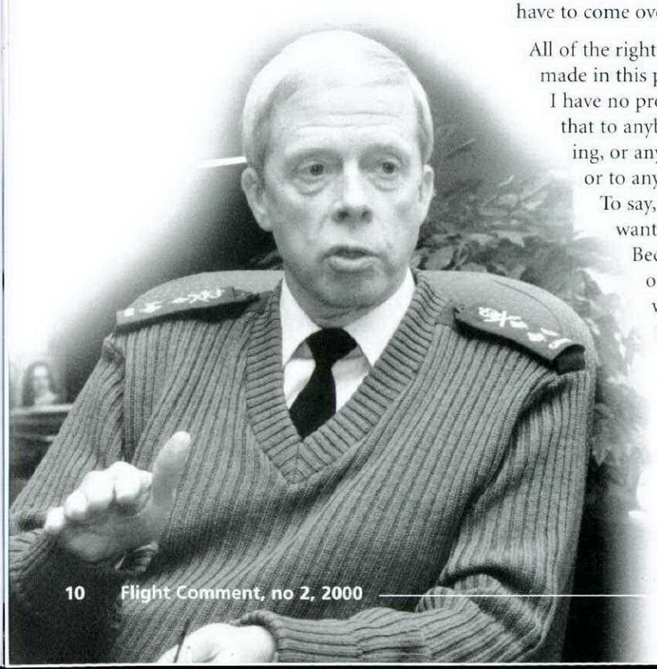
Editor:

How is that?

LGen Kinsman:

Not withstanding the amount of pressure there was, whether it was acknowledged as pressure or not, surely everybody in the organization sensed a certain amount of pressure that the next time the Hercules left it would be serviceable to fly all the way to Darwin. The fact that people brought it back three times in order to make sure that it was really fixed before it went on, to me is a source of a tremendous amount of satisfaction. They didn't decide they couldn't afford to go back again. They didn't decide that "we'll take this airplane, and no matter what, we will go over to Darwin — then tell them that it is broken and then people will have to come over and fix it".

All of the right decisions were made in this particular case and I have no problem explaining that to anybody in this building, or anybody in this city, or to any media person. To say, "what would you wanted them to do?" Because anything other than what did would have been non-professional.



LGen Kinsman:

I want to volunteer something. You asked a question a little while back, about leadership. When I look at the people who have impressed me — the people who have affected my life the most — there were three predominant elements of leadership.

Be fair.

Be consistent.

The other dimension for me, which I don't think you'll find in any leadership book per se, it's just a personal credo — is to **be human**. We are all playing out a certain role in this organization, but we are still none the less human beings, and if we treat each other like that, then wherever we are is going to be a better place to be. It's a lesson that I learned by observing my dad who was in the public service for 25 years. It didn't have any affect on me at the time, but in retrospect it did. When my dad came home it was clear that there were some days that had been better than others were. There were some very special days; and those very special days were normally when the boss (the major), had come from his office, or had come from another part of the building, to pass on an atta-boy — to occasionally thank my dad for something that he had done. My dad did not expect the major to come thank him personally, but it sure made him a loyal and devoted follower and it cost nothing. It's so easy to do, and it has such a large payback from the standpoint of cohesion within the organization.

So those are my three anchor points. People normally don't remember what you say, but they will always remember what you do. Actions really are more powerful than words.

People are drawn normally to a technical type of skill; doctors, dentists, engineers, pilots, navigators, that's what they want to do and I think that's entirely understandable to begin with. But, people who want to go into leadership of their respective organizations need to broaden their interests.

They need those additional skills, that additional understanding, that additional experience, in order to do a credible job of leading the organization from the operational or the strategic level.

Editor:

Is it fair to expect further significant change?

LGen Kinsman:

This organization has become a lot stronger over the last 10 years because of the challenges that it had to face. And it has come through, as far as I'm concerned, with flying colours. It hasn't been without its traumas and it hasn't been without its disruptions, but given the nature of challenge it was inevitable. Even now there isn't an end per se to some of the change. For all the people who have contributed over that period of time I have a tremendous amount of admiration. To have worked through all that disruption, and all of the unknowns and uncertainties, and to have achieved what they have achieved is very impressive. You can go to any type of operation in the air force. You don't have to go further than maybe seven or eight months ago and you will be able to find an example of where we delivered the goods and did it in a very professional fashion.

Looking ahead, I think we have very few people who don't understand that we will never reach a point where we can say "there it is; that's how you define the air force, and its activities, and all the things around it, and its going to look exactly like that for the foreseeable future". Almost everybody understands, based upon the last ten years, that's not what this organization is going to be about.

We made a commitment half way through the decade that we would be an organization that was constantly striving for improvement. Improvement means change so people have to be prepared.

Having said all that, my feeling is that the frequency and the amplitude of the change is going to be significantly less than what we have seen in the last ten years.

Editor:

There seems to be more and more time spent on programmes and qualifications. Are we in danger of losing our focus?

LGen Kinsman:

Anybody in the Canadian Forces has to understand that they belong to a national institution. It is a national institution because it is representative of the nation and that includes national laws and values. Our organization has to be one of the organizations that doesn't just adopt those rules, but lives them; puts them into application.

There is a tremendous demand on everybody to fill their knapsacks with as many tools as possible. But I will also point out that we, people like the Chief of the Air Staff, people like the CDS, don't impose these or don't subscribe to these requirements simply because we have not come up with a new idea lately. It is because it is a component of what we see as an essential part of this organization — which is that it is absolutely critical that the Canadian Forces continue to be seen and supported as a national institution.

Editor:

There seem to be less reluctance on the part of personnel to use the media to express themselves professionally.

LGen Kinsman:

Your acid test should be within the chain of command. An individual should feel comfortable in taking an issue to their supervisor or their union within their organization.

Believe me, in the last four years so much of the conflict that I have seen; tension between individuals, or between individuals and the organization, if there had been an intervention, a common sense intervention very early on, there would not have been a problem. In many cases it's a straight misunderstanding, or it's an "I understand what you are saying, but under the circumstances I can't address your problem because of this, this and this".

So your question was how do people express and how do people state opinions. I encourage anybody in any organization to try and do it internally to begin with because that's the best determination of whether or not you have a healthy organization or not. From a standpoint of taking it to far end and communicating with outside sources, in the sense that by making a big splash about it in the newspapers or on the news — is that going to help solve the problem? It doesn't. It will put a lot of heat and light on it, it will make people spend an awful lot of time looking at it, but the chances are with an issue that has been gone over several times before that won't do anything really to change it.

Editor:

It all returns to effective communication.

LGen Kinsman:

I have a pet theme. Communication is comprised of information plus understanding. I don't think that there is any shortage of information out there. It's on a web page, it's in a camcorder, it's an electronic transmission of some sort, or it's in some guideline or policy book. The information is out there, it's the understanding of the information that frequently is not there, and therefore communication is incomplete.

The understanding of what we are, what we are doing, what we are evolving to be, what we are going to have to do, and how we are going to do it — that has been very difficult to convey over the last ten years.

We are by our very nature a group of people who have to have a plan,

if we don't have one we are very uncomfortable. I think that that's been part of the difficulty over the last 10 years. It has been very difficult to convey our plan. People are saying, "What is our plan? Once I know the plan I can get on with it". Unfortunately, it has been very difficult to actually come up with a plan or you come up with a plan and 6 months later the assumptions changed so you change the plan. I think it's been very hard on leadership on all levels.

One of the goals of the air force has to be to move as quickly as we can back to a situation in which people will know more of the answers — knowing most of the answers with the full knowledge that there will always be a certain amount of uncertainty. That's why we have a number of study groups that are taking look at airlift in the future, fighter operations in the future, maritime patrol operations in the future and so on and so forth. With increasingly stable financial and resource assumptions, what are we going to do in the longer term? Once we have decided what that is people will say, for better for worse, just tell me what we're going to do so that we can understand what it is and we can get on with it.

Editor:

During your time in the air force what has been your favorite job?

LGen Kinsman:

I have had so many really great jobs. I can't think of a job that I have not enjoyed. When all is said and done, there are obviously a number of jobs that I would have never thought that I would be in, or that I would have necessarily volunteered for. But one of the things that I proved to myself is that diversification really is essential for broadening and enhancing your understanding.

I have spent time involved with professional development and education. I was an instructor pilot for a couple tours, Director of Air Studies at Staff College, and Commander of 14 Training Group. None of those were what I would have thought that I wanted to do when I started. I was like most people — interested in airplanes, interested in flying, and that's all I wanted to do. But in retrospect all of those things helped broaden my perspective and understanding of what makes the organization tick. All of them ultimately contributed to my ability to do this job.

Editor:

Who has inspired you?

LGen Kinsman:

It started on my very first tour when I worked for a period of time with the Wing Commander RCAF who was the commander of 2 CFFTS. I was a rookie Flying Officer and he spent time with me. He showed me his leadership style and why it was that way. He, more than anybody else, helped me to understand that being a good leader is not a popularity contest.

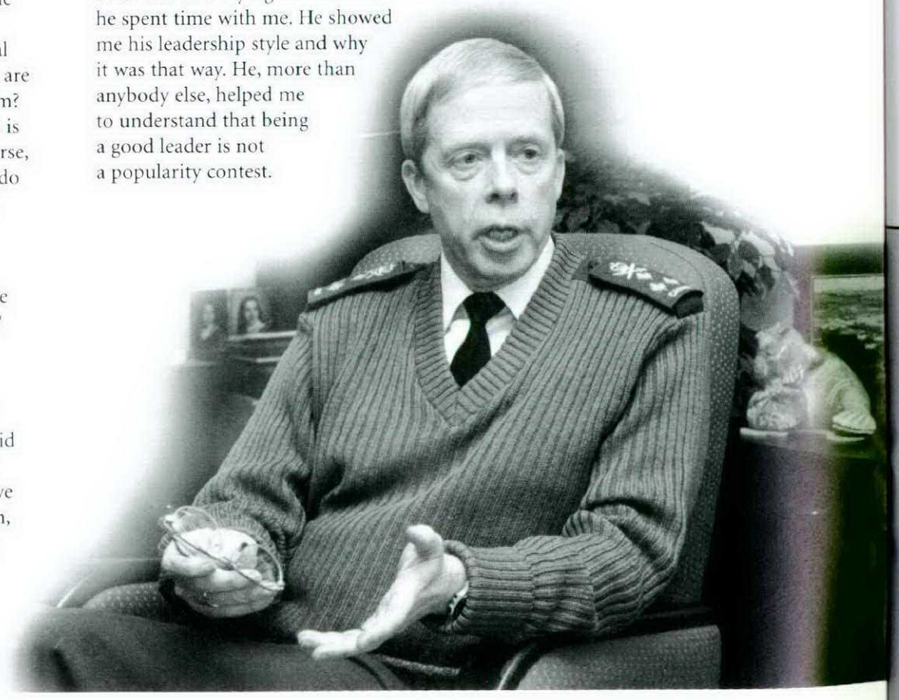
It is most important that you make the right decisions for the organization. If you do that for the organization, and for the people who are parts of the organization, ultimately you will have their respect and having people's respect is more important than being popular.

Editor:

What makes you proud to be the Commander of Air Command?

LGen Kinsman:

It's seeing people doing their work and seeing how proud they are of the work that they are doing. It's the enthusiasm of folks; they sense that this is an organization they want to belong to. It's one that offers them all sorts of challenges and the opportunity to do things that they wouldn't be able to in just about any other walk of life, and they are excited by that. ◆



Not Speaking Up

Arriving at my first squadron, having recently received my wings, was a truly exciting experience. One of the first pilots I got to know was Mitch*. I had heard that Mitch was an excellent pilot. He had flown in both the military and civilian worlds and at age 35 he had logged over 10,000 flying hours. Mitch was also the epitome of politeness and friendliness. He had been with the squadron for several years and he was liked and respected by everyone.

Whenever I went flying as a co—pilot with Mitch; however, all I saw was a "cowboy". He certainly was an outstanding pilot, as polite and giving in the cockpit as he was on the ground. Yet Mitch regularly broke the rules — low flying, flying VFR in less than VFR conditions, and routinely pushing the envelope of the aircraft's performance. I was always confident in Mitch's flying abilities, but uncomfortable with his lack of regard for rules — rules that were in-place for reasons of flight safety.

The tragedy is that I never said anything to him. How could I? He was a really nice guy, and a very experienced pilot, and always interested in helping me improve my skills as a pilot. I heard some of the other lieutenants talk about Mitch's flying conduct, but no one would speak up to our squadron supervisors. How could we? Everyone liked and respected Mitch, and as new guys, we certainly didn't want to rock-the-boat. So we hid behind "the code" and kept quiet.

After some months of being with the squadron, Mitch was flying with our flight commander during a trip that resulted in an A category crash. There were no passengers on board and the two miraculously survived with only minor injuries. It was determined during the Board of Inquiry that Mitch was at the controls when the crash occurred. Furthermore, the Board found that his actions and lack of regard for the rules were major cause factors in the aircraft's loss. The Flight Commander stated that he knew that "something" was wrong during the final moments prior to impact, but because he felt Mitch "knew what he was doing" he was reluctant to speak up.

Who was responsible for the crash, the Flight Commander, Mitch, or me? I guess we all were. The point is that many factors were involved, several windows had to line up over a long period of time in order to finally have the ingredients for a near fatal accident. In the beginning my silence saved me from possible ridicule. In the end luck saved the crew. Had I spoken up, perhaps things would have been different. ◆

* *The name and circumstances have been altered.*

DFS Commendation

Sergeant Andy Schuszter

Sergeant Schuszter has continuously demonstrated an uncommon and infectious zeal in promoting the flight safety programme at 442 Squadron. He has been personally responsible for thoroughly investigating over two hundred technically related flight safety occurrences. Sergeant Schuszter's outstanding dedication and professionalism has prevented accidents and has made 442 Squadron a safer place to work. ◆

For Professionalism

Master Corporal Dave Rainbird

Master Corporal Rainbird, a flight engineer serving with the Kosovo Rotary Wing Aviation Unit, was conducting a pre-flight inspection of a Griffon helicopter when he noticed that the transmission fluid was low. After topping up the fluid level Master Corporal Rainbird elected to carry out a more in-depth inspection of the area. He had earlier decided that given the high operational tempo, extreme heat, and pervasive dust, that an additional examination of critical components would be prudent.

During his additional inspection Master Corporal Rainbird noticed a small amount of black residue on the rear of the number two hydraulic system line. He then reached down into the transmission well and running his hand along the rear of the line he felt a groove. He determined that the transmission chip detector wire rubbing against the hydraulic line had caused the erosion. The damage, which was undetectable by the naked eye, amounted to wear through over two thirds of the line's wall.

Master Corporal Rainbird's extra effort and professionalism resulted in the identification of a significant flight safety hazard. The failure of the hydraulic line would have likely resulted in a forced landing in an area where uncharted minefields abound. *Well done.* ◆

Corporal Marc St-Denis

Corporal St-Denis was assigned to carry out a final close out quality assurance check on a Hornet aircraft. During his inspection he noticed a metallic object on the floor. Unable to determine exactly what the object was, but being concerned with safety, Corporal St-Denis decided to investigate further.

Corporal St-Denis' research revealed that the object was a planning link attachment pin from the landing gear assembly of a Hornet aircraft. Further examination of the gear assembly showed that the internally relieved bolt had split in two because of corrosion. Had the fault remained undetected the safe operation of the aircraft's landing gear could have been compromised.

Corporal St-Denis' initiative and professionalism resulted in the discovery and elimination of a significant flight safety hazard. After a local flight safety investigation was completed a special inspection of the entire Hornet fleet was ordered. *Well done* ◆

Corporal Sylvain Fortin

During a routine Aurora flight a pressurized sonobuoy launch tube fired without the breech cap being fully closed. The blow back fortunately caused only minor injuries to the operator although the assembly was damaged. The operator believed that the cap had not seated properly in the breech, but had still provided continuity.

Corporal Fortin, an aviation technician, replaced the launch tube handle assembly and confirmed that the breech cap closed and locked properly in the breech. Feeling uncomfortable that he had not found the root cause of the occurrence, Corporal Fortin decided to investigate further. He discovered that the launch tube had been worked on previously for a similar fault requiring replacement of the wiring bracket. Corporal Fortin returned to the aircraft and discovered that the safety switch was sticking in the ready to fire position.

Corporal Fortin demonstrated superior professionalism and initiative in continuing to research a fault beyond the obvious explanation. His actions averted the possibility of another operator facing serious injury. *Well done.* ◆

Corporal Christian Mauen

Corporal Mauen, an aviation systems technician, was assigned to a periodic maintenance crew working on a Hornet aircraft. While carrying out an inspection of the central section of the aircraft, his attention was drawn to wear marks on one of the structural walls. Concerned that the smudge could be indicative of a significant fault, Corporal Mauen decided to investigate further.

Corporal Mauen's initial research showed that a fuel line rubbing against the wall had caused the marks. Suspecting that there was more to the problem he was able to determine that there was further rubbing against another fuel line. Both fuel lines had been severely damaged. A local investigation revealed two other aircraft with the same fault.

Corporal Mauen's attention to detail and perseverance led to the discovery of a significant safety hazard. His initiative was directly responsible for the issuing of a fleet wide special inspection. *Well done.* ◆

Corporal David Martel

During a routine corrosion control inspection of an Aurora aircraft, Corporal Martel noticed that something appeared to be abnormal in the number-three engine intake. He crawled into the intake and discovered that a clamp had been installed on the torque meter shroud. The clamp was a flip over type that should be lock-wired for safety in case it should become undone — this one had not. Suspecting that the clamp had been mistakenly installed during engine build up, Corporal Martel inspected the remaining engines and found none had a clamp installed in the same area. After consulting technical orders, Corporal Martel promptly informed his supervisor of his concerns.

Further investigation revealed that although the clamp was listed in the parts index of technical orders, the required positioning was ambiguous. Liaison with engine bay personnel confirmed that the clamp had been incorrectly installed in the wrong location. If the clamp had vibrated loose it would have in all likelihood been ingested into the engine and destroyed it.

Corporal Martel's alertness and attention to detail resulted in the detection and elimination of a significant flight safety hazard. *Well done.* ◆

After Smoke Detected in Cargo Compartment Crew Lands DC-10, Then Fire Destroys Aircraft

Although there were only minor injuries in the evacuation, the evacuation was delayed by the flight crew's failure to depressurize the aircraft. Investigators were unable to determine the fire's ignition source but found evidence of undeclared hazardous cargo.

FSF Editorial Staff

In the early-morning darkness of Sept. 5, 1996, the crew of a McDonnell Douglas DC-10-10CF cargo aircraft operated by Federal Express Corp. (FedEx) landed their aircraft at Stewart International Airport, Newburgh, New York, U.S., after the flight crew was alerted during cruise flight by the smoke-detector system that there was smoke in the cabin cargo compartment. The captain and flight engineer were slightly injured while evacuating the aircraft, and the first officer and two nonrevenue passengers — the aircraft's only other occupants — evacuated without injury. The aircraft was destroyed by fire.

The U.S. National Transportation Safety Board (NTSB), in its final accident report, determined that the probable cause of the accident was "an in-flight cargo fire of undetermined origin."

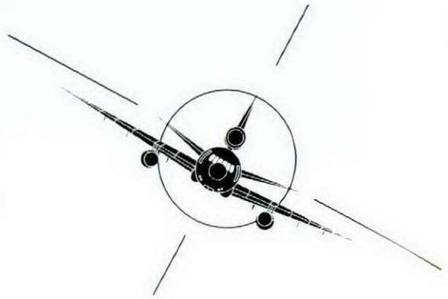
FedEx Flight 1406 was en route from Memphis, Tennessee, U.S., to Boston, Massachusetts, U.S., with a scheduled return flight to Memphis. The flight engineer said that prior to the flight he was briefed by a FedEx dangerous-goods specialist about hazardous materials in cargo containers in cargo positions 1L/1C and 3R (Figure 1) and about the Halon-hose connections to the container in cargo position 1L/1C, which was designed to hold flammable goods.

"The dangerous-goods specialist then gave the captain the Notification of Dangerous Goods Loading Form (Part A) containing required [by the U.S. Department of Transportation (DOT)] hazardous materials information, which the captain signed," said the report. "According to the FedEx flight operations manual, 'Appropriate parts (A; B and/or BR; C and/or CR) of the Notification of Dangerous Goods Loading Form ... are required for each departure.'

"The Part A forms list the class of hazardous materials and where they are on the airplane, and [serve] as the required written notification to the pilot-in-command. The Part B forms are the individual shipping documents for each shipment of hazardous materials, other than radioactive materials. The Part BR forms are for shipments of radioactive materials. The Part C and CR forms are comparable to the Part B and BR forms, respectively, but are used for domestic shipments only."

Flight 1406, operating under U.S. Federal Aviation Regulations (FARs) Part 121, took off from Memphis at 0242 local time, with the first officer as the pilot flying (PF) and the captain as the pilot not flying. The two nonrevenue passengers were seated in a foyer area directly behind the cockpit. The flight crew said that the engine start, taxi, takeoff and climb were normal.

"The airplane's upper cargo deck was loaded with 23 cargo containers and one cargo pallet," said the report. "The lower forward cargo compartment contained six cargo containers, and the lower aft cargo compartment contained seven containers."



At 0536:23 the aircraft was at flight level (FL) 330. The cockpit voice recorder (CVR) recorded the captain asking, "What the hell's that?"

Both the first officer and the flight engineer said, "Cabin cargo smoke."

The captain said, "You see that ... we got cabin cargo smoke ... cabin cargo smoke."

The flight engineer said, "Cabin cargo smoke, oxygen masks on.

The report said, "The CVR indicates that the crew then donned oxygen masks and established crew communications, as is required by the first two steps on the Fire & Smoke Checklist ...

"During postaccident interviews and in his deposition, the captain stated that he initially donned his smoke goggles, but had to remove his eyeglasses to do so. During the landing phase of the flight, he removed his goggles so he could replace his glasses. The captain also said that the goggles were dirty and scratched. The first officer stated that he elected not to wear his smoke goggles because he felt that they would unduly restrict his peripheral vision. The flight engineer initially donned his smoke goggles, but then removed them after noting that no smoke was entering the cockpit."

At 0536:40, the flight engineer said, "Okay, it's no. 9 smoke detector." The first officer suggested that the passengers enter the cockpit. They did so and then donned oxygen masks.

At 0537:56, the captain said, "Okay, it's moving forward whatever it is ... it's up to [smoke detector no.] 7." The captain asked the flight engineer to test the smoke-warning system, and during the test several lights were flashing rather than steady.

The report said, "The FedEx DC-10 flight manual states, 'If a flashing [cargo fire/smoke-detector] indicator light is observed during the normal test procedure of the cargo fire/smoke-detector units, the crewmember is alerted that the detector unit connected to the flashing light is beginning to deteriorate. **A flashing indicator light does not signify an inoperative fire/smoke detector.** ... A totally inoperative fire/smoke-detector unit will not illuminate during the normal test procedure. (Emphasis in original.)"

At 0539:28, the captain said, "That's seven and eight."

At 0539:31, the flight engineer said, "Those others may be failing in the blinking mode."

The captain said, "I got 10 now," and then, "We've definitely got smoke, guys ... we need to get down right now, let's go."

The captain chose to have the first officer continue as PF while the captain communicated with air traffic control and worked with the flight engineer on performing the checklists.

After the captain informed the U.S. Federal Aviation Administration (FAA) Boston Air Route Traffic Control Center (ARTCC) of the emergency at 0540:43, Flight 1406 was cleared for immediate descent to 11,000 feet. The captain later said that although he did not call for the Emergency Descent Checklist, he believed that he had completed all the checklist items from memory.

The ARTCC controller told the pilots that the Albany (New York, U.S.) County Airport was about 50 miles (80 kilometers) ahead of the aircraft and Stewart was 25 miles (40 kilometers) behind.

But at 0542:36 the ARTCC controller said, "I've got Albany in your 11 o'clock and about 45 miles [72 kilometers] or Stewart in your southwesterly position and, ah, 40 miles [64 kilometers] ... your choice."

The captain chose to divert to Stewart and was given vectors to the airport.

At 0541:41, the flight engineer began the Cabin Cargo Smoke Light Illuminated Checklist. At 0543:02, he said, "I'm manually raising the cabin altitude ... there is smoke in the, ah, cabin area." The CVR recorded the flight engineer asking five times, between 0543:22 and 0549:09, what the three-letter identifier for Stewart was. The identifier (SWF) was, nevertheless, supplied by ARTCC twice, at 0543:47 and 0546:26.

The report said, "During postaccident interviews, the flight engineer told [NTSB] investigators that he was confused by some items on the Cabin Cargo Smoke Light Illuminated Checklist and acknowledged that he did not accomplish step no. 6, Cabin Air Shutoff T-Handle (when the T-handle is pulled, airflow is maintained to the cockpit area, but all airflow is shut off to the main-deck cargo area).

"Regarding step no. 7, Maintain 0.5 [Differential] Pressure Below FL 270, or 25,000 [Feet] Cabin Altitude Above FL 270, [the flight engineer] acknowledged that he did not attempt to maintain 0.5 pounds per square inch (psi) differential pressure, but said that he had selected 'manual' on the outflow valve control and 'cranked it open a couple of times.'"

The flight was handed off from ARTCC to New York terminal radar approach control (TRACON). In response to a question from TRACON, the captain indicated that there were hazardous materials on board. The captain said in talking to investigators that as the aircraft approached Stewart, visibility in the cockpit was good, but he could smell smoke through his oxygen mask.

Flight 1406 was cleared for landing on Runway 27, and the aircraft was landed at 0554:28. The captain took over the controls from the first officer during the rollout and stopped the aircraft on a taxiway, where aircraft rescue and firefighting (ARFF) trucks were positioned.

Weather at the time of the landing was recorded by the Stewart tower as: wind from 280 degrees at four knots; surface visibility two miles (3.2 kilometers) with mist; broken clouds at 3,000 feet above ground level and an overcast layer of clouds at 7,000 feet above ground level; temperature 64 degrees Fahrenheit (F; 18 degrees Celsius (C)) dew point 63 degrees F (17 degrees C); and altimeter setting 30.18 inches of mercury (1022 hectopascals).

"The flight engineer said that when he opened the cockpit door after landing, he saw that the foyer area was full of smoke, and he could not see the smoke barrier [a curtain] at the aft end of the foyer." said the report. "The captain later told investigators that both he and the flight engineer called for an emergency evacuation. The CVR indicates that at 0555:07, the captain stated, 'We need to get the [hell] out of here," and that 12 seconds later the flight engineer said, 'Emergency ground egress.'"

Both the captain and the flight engineer later said that the Emergency Evacuation Checklist had not been performed, although the flight engineer said that he had turned off the battery switch.

The flight engineer attempted to open the L1 (forward left) and R1 (forward

right) doors, but was initially unsuccessful; at the same time, the captain attempted to open the cockpit window and felt resistance, then a hissing sound when air escaped. The captain shouted that the aircraft was still pressurized.

The flight engineer then depressurized the aircraft by rotating the outflow valve control, and again attempted to open the L1 and R1 doors. Both evacuation slides deployed (although the L1 door opened only partially) and the captain and the first officer were able to open their cockpit windows.

The report said, "The L1 and R1 cabin doors are plug-type doors that are normally powered up and down by an electric motor through a gearbox, cable drums, sprockets and torque tube, and one-eighth inch [0.3-centimeter/ nylon-coated drive cables that are attached to the door. During emergency operation, an air motor drives the door open [using air supplied from a] bottle charged with nitrogen to 1,500 psi.

"The door is designed to open when activated when the cabin pressure differs by less than approximately 0.5 psi from the external pressure. If an attempt to open the door is made with the pressure differential greater than 0.5 psi, the bottle pressure will bleed off and the door will not open. A ratchet-type lock prevents the door from closing all the way if it is only partially opened."

The captain and first officer remained in the cockpit, their upper bodies outside the windows, until the flight engineer and the passengers had evacuated the aircraft by the R1 evacuation slide. The captain and first officer then used the cockpit windows' escape ropes to evacuate, during which the captain suffered rope burns on his hands and the flight engineer's forehead was slightly cut.

"The flight engineer said that while he was in the airplane, the smoke was 'oily and sooty' and acrid smelling, and that it made breathing unpleasant and difficult," said the report. "He said that before he left the cockpit, he used his oxygen mask to fill his lungs with oxygen and then entered the foyer area. He stated during his deposition that he did not consider using the PBE [protective — breathing equipment] that was available in the cockpit because he was anxious to open the exit doors, and he thought [that] this could be accomplished relatively quickly. He also indicated that he forgot that the PBE was available in the cockpit."

Initially, firefighters entered the foyer area, from which they attempted to extinguish the fire using hand-held hoses, but their access to the cargo compartment was blocked by the cargo net and the forward cargo containers. After some difficulty, they opened the fuselage cargo door about 0650 and again attempted to extinguish the fire by aiming hand-held hoses into the cabin. About 0655, one hour after the aircraft landed and about one hour and 19 minutes after the illuminated smoke-detector lights were seen, fire burned through the top of the fuselage.

"Some of the witnesses ... and video footage taken by firefighters of the right side of the airplane indicate that early visible flames came through the top of the fuselage at a point approximately even with the trailing edge of the wings (in an area roughly corresponding to the junction of cargo container rows 8 and 9)," said the report. "However, a FedEx mechanic who had assisted firefighters in opening the cargo door said that just before observing the fire erupting through the top of the fuselage he saw paint bubbling, aluminum melting and 'fingers' of fire coming from the left side of the fuselage five [feet] to eight feet [1.5 meters to 2.4 meters] back from the left wing (which roughly corresponds to the forward portion of cargo container position 6L)."

The incident commander reconsidered the firefighting strategy after the fire penetrated the fuselage.

"Firefighters began using truck-mounted turrets aimed at the breached areas of the fuselage," said the report. "These firefighting efforts continued until approximately 0925, when the fire was extinguished and cleanup operations began.

"There were melted and partially consumed aluminum fuselage skin, longerons and frames throughout the interior fuselage. ...The fuselage crown was consumed by the fire ... from approximately the middle of container row 4 to the middle of container row 5. The frame flanges on either side of this consumed area of the fuselage crown were burned and melted. The left side of the fuselage crown was also consumed by fire (in) an area corresponding to approximately the middle of cargo container 6L [that is, the container in cargo position 6L] to the middle of cargo container 9L."

Areas in the lower cargo compartment were scorched, but none of the cargo containers in the lower forward and lower center cargo compartments were damaged, and the lower aft cargo compartment was empty.

The fuselage separated at fuselage station (FS) 1531 and FS 1986 (between cargo container rows 8 and 9 and between cargo container rows 15 and 16). The interior skin of the separated section was sooted at the crown.

"Soot deposits on the left side of the cabin interior just forward of FS 1531 (which was at the front of cargo container row 9) were in a 'V' pattern with the lowest point of the 'V' being on the floor level at the fuselage-separation point," said the report. [According to standard fire-investigation principles, the narrow point of a conical 'V' pattern indicates the fire's origin.]

The airplane, whose replacement cost was estimated at US$95 million, was destroyed by the fire. Most of the cargo was destroyed by fire, smoke and the firefighting agent applied during ARFF operations. The destroyed cargo was valued at an estimated $300 million.

The captain, 47, had been flying for FedEx since 1979. He held an airline transport pilot (ATP) certificate and, at the time of the accident, he had 12,344 hours of flight time, with 883 hours in type as first officer and 1,621 hours as captain.

The captain had a first-class medical certificate with the restriction, "must wear corrective lenses."

The first officer, 41, was hired by FedEx in 1989. He had an ATP certificate and a type rating in the McDonnell Douglas DC-9. His first-class medical certificate carried the restriction, "must wear corrective lenses," and the first officer indicated that he had worn his eyeglasses at all times during the accident flight.

At the time of the accident, the first officer had 6,535 hours of flight time, with 1,101 hours in the DC- 10 as a flight engineer and 237 hours as a first officer.

The flight engineer, 45, had been flying for FedEx since March 1996. He had an ATP certificate and was type-rated in the Boeing 737. His first-class medical certificate included the restriction, "must wear corrective lenses," and he told investigators that his eyeglasses were needed only for distant vision and that he removed them periodically. He said that he was not wearing his eyeglasses during the emergency portion of the accident flight.

At the time of the accident, the flight engineer had 3,704 hours of flight time, with 188 hours in the DC-10 as flight engineer.

After leaving the aircraft, the flight engineer provided firefighters with the top sheet of Part A of the "Notification of Dangerous Goods Loading."

The report said, "A 'Dangerous Goods Separation Pouch' for each cargo container that transports a declared hazardous-materials package is inserted into the Part A envelope. ... The Part A and the separation pouch do not indicate the specific hazardous materials and the quantities on board the airplane.

"Specific information about the hazardous materials in a given package, such as the proper shipping name, United Nations identification number, and hazard class, quantity and 24-hour emergency telephone number, is found on the "Notification of Loading of Dangerous Goods (Parts B or C)' ... ."

ARFF at Stewart was provided by the New York Air National Guard (ANG), assisted by municipal fire departments. The Stewart FedEx station manager arrived at the ramp facility about 0603, and personnel were in communication by telephone with the FedEx Global Operations Command Center (GOCC) in Memphis. State and local emergency, police, environmental-protection and health agencies also responded to the accident.

The report said, "Both the initial incident commander and the ANG fire chief (who took over at 0700 as incident commander) indicated that they were concerned about the safety of the firefighters and the possible exposure of personnel at the scene to the hazardous materials or their combustion by-products. Consequently, both requested (but did not receive) copies of what they referred to as 'manifests' from the flight crew and other FedEx representatives so they could identify the specific hazardous materials on board and their quantities and locations on the airplane.

"The ANG fire department log had entries at 0730, 0815 and 1125 logging ANG personnel's efforts to have FedEx fax copies of the 'manifest' to airport operations or to the FedEx ramp facility at Stewart. The fire chief also stated that he gave a local FedEx employee two fax numbers at the ANG command center, and he assigned two ANG personnel to stand by those machines. However, no faxes from FedEx were received at those machines."

FedEx told NTSB investigators that the FedEx dangerous-goods hub in Memphis and the GOCC faxed several copies of Part A, Parts B, BR or CR, the Dangerous Goods Separation Pouches and the weight-and-load plans at various times during the morning to the emergency-operations center at Stewart.

"The airport operations log contained entries at 0635 that the FedEx 'manifest' had arrived by fax, and, at 0656, that additional hazardous-materials 'manifest' information had been received," said the report. "Airport officials who received those faxes indicated that [the faxed documents] were of poor quality and therefore did not provide them with the needed information."

After delivering the Part A form to firefighters, the flight engineer told firefighters that the Part B forms and other documentation were on the back of the cockpit door.

"However, [the Part B forms and other documentation] were not retrieved until the day after the accident when the burned and water-soaked remains of the shipping documents were recovered," said the report. "During the deposition proceeding, the ANG fire chief stated that about one hour and 15 minutes after the firefighting operation began, FedEx employees advised that the Part Bs were on the aircraft. The fire chief indicated that no attempt was made to retrieve the Part Bs at that time because of the severity of the fire."

The ANG base commander attempted to learn, from FedEx's vice president for security, details of the hazardous materials aboard the aircraft.

"According to the ANG command post chief, the vice president advised the command post chief that he could not provide the information because the [NTSB] had taken over the investigation," said the report. "In a Jan. 27, 1997, letter of explanation to the [NTSB], FedEx stated that the vice president's actions were consistent with company policy, which dictates that once the [NTSB] has taken con-

trol of an aircraft-accident investigation, all information pertaining to that investigation is to be forwarded to the [NTSB]. The FedEx letter also stated that at the time of the ANG request, the senior [New York Department of Environmental Conservation] law-enforcement officer, the [New York State Police] and other appropriate state officials already had copies of documents listing the hazardous materials on board."

Investigators assessed the damage to cargo containers and their contents.

"The cargo containers that had been in the main cabin were removed from the airplane and arranged in the same order in which they had been in the airplane," said the report. "A conical 'V' burn pattern was observed from right to left and from forward to rear with the lowest (deepest-burned) area centered over container 6R. It was observed that the cargo in containers surrounding 6R (position 6L, 7R and 5R) was burned to a greater depth along the sides next to container 6R than in the other areas of those containers."

The containers in positions 1L/1C and 3R held declared hazardous materials.

The container in cargo position 1L/1C had soot on the upper outside but no soot inside.

"The contents of container 1L/1C were secured by netting, and the packaging was tight and in place," said the report. "No discrepancies were noted during the postaccident examination regarding the separation, segregation and orientation of the packages in the container." Only one package within the container showed signs of damage, caused by leakage from a cooler pack.

The container in cargo position 3R was severely burned on the sides, although not on the bottom.

"The cargo container was emptied and its radioactive contents inventoried," said the report. "All of the inner containers for the radioactive materials were found intact. Ten separate shipments of radioactive materials were found in the container. All other recognizable shipments declared as hazardous materials were also unloaded from 3R and inventoried. Some contents were consumed by fire; others had sustained some level of water [damage] and/or fire damage."

The container in cargo position 6R was the only one to exhibit fire damage in every level of its contents, as well as its bottom.

"Container 6R's aluminum roof, three Lexan® walls and nylon roll-up curtain (the fourth wall) were completely consumed by fire, except for a small portion at the bottom center of the aft Lexan wall," said the report.

Four shipments were included in the container in cargo position 6R: one of industrial metal valves, one of an Expedite Model 8909 DNA [deoxyribonucleic acid, the cell-nucleus component that transmits hereditary characteristics] synthesizer (Figure 3) and two separate computer shipments.

The report said, "The [DNA synthesizer] unit contained several bottles with labels that included flammability symbols, and some of the bottles contained liquid. One large bottle in the aft row had a very strong odor when it was removed from the unit. Because this unit was found at the lowest point of the 'V' burn pattern, the [NTSB] investigation evaluated and analyzed the liquids contained in this unit.

"According to PerSeptive [Biosystems Inc., the manufacturer], when the synthesizer is set up for normal operation, the reagent bottles contain a variety of liquid reagents, several of which are regulated as hazardous materials, including acetonitrile and tetrahydrofuran (THF), both of which are classified as flammable liquids under the DOT hazardous-materials regulations."

The glass bottles inside the DNA synthesizer and portions of the tubes affixed to the bottles were removed and labeled.

The report said, "On Dec. 16 and 17, 1996, at the NASA [U.S. National Aeronautics and Space Administration] Kennedy Space Center [near Cape Canaveral, Florida, U.S.], investigators documented and analyzed the fluids and debris recovered from the DNA synthesizer; fluid removed from the industrial valves; green, red and cream-coloured material found on the inboard side of the [6R] container floor; and burned debris that had been removed from cargo container 6R.

"Gas chromatography/mass spectrometry was used to analyze the residues left in the bottles of the accident synthesizer. Specifically, investigators looked for the presence of the 15 chemicals used in the DNA synthesizer and for the presence of aqueous film-forming foam, a fire-fighting agent that was sprayed on the accident airplane."

Investigators attended demonstrations of the process that had been used to purge and dry the bottles in the DNA synthesizer when the synthesizer had been prepared for shipping by its owner, Chiron Corp. The residues left in the bottles from the second of the two demonstrations, which took place at the U.S. Armed Forces Institute of Pathology (AFIP) [Washington, D.C., U.S.], were analyzed for comparison with the residues found in the DNA synthesizer aboard the accident aircraft.

"The largest liquid sample in the accident synthesizer (approximately five milliliters in the AUX 3 reagent bottle) had a concentration of 4.3 percent of acetonitrile and 0.01 percent of THF" said the report. "This is equivalent to about 200 microliters of acetonitrile and 0.5 microliters of THF. In comparison, the AUX 3 bottle from the synthesizer that was purged at AFIP, according to the procedures in PerSeptive's manual, contained only 66 microliters of acetonitrile and 0.2 microliters of THF. Thus, after the accident, the AUX 3 bottle from the accident synthesizer contained about two and a half times the amount of acetonitrile and THF as did the AUX 3 bottle from the synthesizer purged at AFIP using the prescribed PerSeptive procedures."

To learn why the hazardous chemicals were found in greater quantities in the DNA synthesizer from the accident aircraft than in a DNA synthesizer correctly purged in a demonstration, investigators studied the procedures that had been used to prepare the synthesizer for shipment, which had been performed by a PerSeptive field engineer at the Chiron laboratory on Aug. 28, 1996.

The report said, "In a Sept. 16, 1996, interview 11 days after the accident, the field engineer described the next steps he took to prepare the machine for shipment as follows. He ran the 'prime all' function three times on each column position, and then emptied all of the bottles by turning them upside down until they stopped dripping. [In a footnote, the report said, "The 'prime all' cycle function draws some liquid from every reagent bottle so that every flow path in the machine is flushed."]

"He then ran the 'prime all' function again three times on each column position to dry the instrument. (When the 'prime all' function runs without liquid in the bottles, a dry, inert gas is pumped through the flow paths and bottles.) He said that he did not remove the internal reagent bottles after these drying cycles, but that he visually inspected them and they appeared dry. He said that he then depressurized the synthesizer by disconnecting the inert gas supply and loosening each internal reagent bottle to relieve the internal pressure."

On April 4, 1997, Chiron sent the NTSB a computer diskette on which was a data file named "history.log," containing records of the manual inputs that the field engineer had performed when he prepared the synthesizer for shipment. Among the data on the diskette were 57 entries signifying "manual function invoked."

In a follow-up interview on Aug. 28, 1997, the field engineer said that the first seven and the last six of the "manual function invoked" entries were for the "prime all" functions that he performed to flush and dry the synthesizer.

The report said, "The field engineer explained that the remaining 44 'manual function invoked' entries in the 'history.log' file ... were the result of his having invoked the prime individual' function [for a particular bottle position] a number of times for each reagent position on each of the two columns.

"He acknowledged that these additional functions were not prescribed by PerSeptive as part of the normal purging procedure, but indicated that he took these additional steps to ensure that fluid from each reagent position was being properly delivered. (He stated that he did not have written guidance with him when he purged the accident synthesizer, but that he based the purging on Service Note 89-006, 'Preparing an Expedite System for Storage or Transport.')"

At the end of the August 1997 interview, the field engineer said that he was " 100 percent certain" that no fluids were visible in the synthesizer after the purging was completed.

"The field engineer stated that he saw no leakage, malfunction or operational problems and that he did not observe anything unusual about the instrument during the purging and drying process," said the report.

On Aug. 30, 1996, a Chiron research scientist completed and signed a Chiron "Outgoing Procedure Checklist."

"The form provides information to Chiron's shipping department about the contents of the package and other shipping information, such as the recipient's address and telephone number," said the report. "The entry to indicate if the package contained hazardous materials was marked 'N' (for 'No') and had a handwritten entry reading, 'Instrument was thoroughly decontaminated of all chemicals.' The research scientist acknowledged that he did not verbally confirm with the PerSeptive field engineer that the synthesizer had been decontaminated."

Investigators searched for other cargo that might have ignited the fire.

The report said, "The salvaged cargo (from containers other than 6R and the hazardous-materials containers), which had been packed and stored in approximately 122 large cardboard boxes, was searched for aerosol cans and other items that might have constituted undeclared shipments of hazardous materials. Seven aerosol cans and various other items were retrieved. Because all the aerosol cans were breached, it was determined that their testing would not be of value because it would not reveal their original contents.

"Testing of other items revealed that the liquids in four plastic bottles and several milliliter ... vials had a hydrogen-ion concentration (pH) of 1.0; the liquid in another plastic bottle had a pH of 1.8; the liquid in a plastic cylinder had a pH of nearly 9.0. There were also two containers of liquid with flash points of 60 degrees C (140 degrees F) and 65 degrees C (149 degrees F), respectively."

Four separate packages, damaged by fire and water, found among the cargo debris contained a total of 91.6 pounds (41.5 kilograms) of marijuana.

The NTSB considered the actions of the flight crew in the emergency descent and landing.

"Although the airplane was landed successfully, several required items were not accomplished during the descent and landing," said the report. "The flight engineer failed to perform step no. 6 of the Cabin Cargo Smoke Light IlluminatedChecklist (pulling

the cabin-air shutoff T-handle). If he had done so, airflow would have been shut off to the main cargo deck area while being maintained to the cockpit. The [NTSB] concludes that the flight engineer's failure to pull the cabin-air shutoff T-handle...allowed the normal circulation of air to continue to enter the main cargo area, thereby providing the fire with a continuing source of oxygen and contributing to its rapid growth."

The report also noted the flight engineer's failure to complete step no. 7 of the Cabin Cargo Smoke Light Illuminated Checklist, which was to maintain a differential cabin pressure of 0.5 psi.

"As a result, the occupants were unable to immediately open and exit from the primary evacuation exits (the L1 and R1 doors) because the airplane was still pressurized," said the report. "The flight engineer acknowledged that instead of manually maintaining the appropriate pressure differential, after he had placed the outflow valve control in the manual position, he only 'cranked it open a couple of times [turns].' Because they were at 33,000 feet and operating on only one pressurization pack, the outflow valve would have been almost completely closed before the flight engineer cranked it. As demonstrated in the [NTSB's] test on a similar DC-10, manually cranking the outflow valve control two times will not perceptibly open the outflow valve from fully closed on a static airplane."

The report said that the flight engineer was "overloaded and distracted" from accomplishing the Fire & Smoke Checklist and the Cabin Cargo Smoke Light Illuminated Checklist, as well as the normal Descent Checklist and Before Landing Checklist, by repeatedly asking for the three-letter identifier for Stewart to obtain runway information for the airport.

Although acknowledging the captain's intention to coordinate the crew's activities during the emergency descent and landing with the first officer as PF, NTSB said that the captain nevertheless did not ensure that all necessary tasks were completed.

"The captain did not call for any checklists to address the smoke emergency, which was contrary to FedEx procedures," said the report. "(The flight engineer initiated the Fire & Smoke and Cabin Cargo Smoke Light Illuminated Checklists.) Nor did he explicitly assign specific duties to each of the crewmembers. The captain also did not recognize the flight engineer's failure to accomplish required checklist items, provide the flight engineer with effective assistance or intervene to adjust or prioritize [the flight engineer's] workload. In fact, the captain repeatedly interrupted the flight engineer during his attempts to complete the Fire & Smoke Checklist, thereby distracting him from his duties." [In a footnote, the report said, "At 0538:38 and 0539:13, the captain interrupted him to ask whether he had run a test on the smoke-detector system, which is not an item listed on the checklist."]

While preparing for the landing, the captain did not initiate the Emergency Evacuation Checklist, which included an item for depressurizing the aircraft.

"If this checklist had been initiated, it would have provided another opportunity for the crew to accomplish the necessary depressurization that was missed on the Fire & Smoke Checklist," said the report. "In addition, the captain told investigators that he did not initiate the Emergency Descent Checklist, but said that he thought that he had accomplished the items on that checklist by memory. Although the Emergency Descent Checklist ... was probably not applicable to this situation, the captain's statement is troubling because it suggests a belief that checklist items can be adequately accomplished from memory alone. Finally, the CVR transcript indicates that the captain did not call for an emergency evacuation. (After the captain said, 'We need to get [the hell] out of here,' the flight engineer said, 'Emergency ground egress.')"

NTSB called for the FAA principal operations inspector for FedEx to review FedEx emergency procedures and training, including crew resource management training, in the light of the accident.

In connection with the captain's and first officer's decision not to wear their smoke goggles, and the flight engineer's decision to remove his goggles, the report said, "Evidence in this accident indicates that smoke did not enter the cockpit in significant amounts until after the crew had landed and stopped the airplane," said the report. "However, the [NTSB] is concerned that under different circumstances, the failure of crewmembers to don smoke goggles or to keep the goggles on during an emergency could adversely affect the outcome."

NTSB commented on the emergency evacuation.

The report said, "The flight engineer stated that before he entered the foyer area to evacuate via the R1 door, he filled his lungs with oxygen from his oxygen mask. He did not use the PBE, which would have provided him with protection from the smoke while he attempted to open the foyer doors. In postaccident interviews, he stated that he was anxious to open the exit doors quickly, and he forgot that the PBE was available. [NTSB] concludes that crewmembers who do not use [the] PBE during a smoke or fire emergency may place themselves at unnecessary risk in attempting to address or escape from the situation.

"The L1 door was not available as an emergency exit because it only opened partially as a result of the flight engineer's attempt to open the door while the airplane was still pressurized. ... Although the lack of the L1 door as an escape route was not a significant factor in this accident, [NTSB] is concerned that under other circumstances the loss of a passenger-exit door could have serious safety consequences.

[NTSB] concludes that crewmembers may not be adequately aware that attempting to open a passenger-exit door when the airplane is still pressurized may result in the door not opening."

Investigators sought to determine where the fire had begun. But the fire lasted for about four hours after smoke was first detected, and conditions changed during that period, which made it difficult to draw conclusions from the remaining evidence.

The report said, "One factor that investigators considered was the 'V' burn pattern that originated at container 6R. It is a basic premise of fire science that such a 'V' pattern often points to the origin of a fire. However, as explained in the National Fire Protection Association's Guide for Fire and Explosion Investigations, NFPA 92 1, 'Each time another fuel package is ignited or the ventilation to the fire changes, the rate of energy production and heat distribution will change. Any burning item can produce a plume and, thus, a "V" pattern. Determining which pattern was produced at the point of origin by the first material ignited becomes more and more difficult as the size and duration of the fire increases.'"

The container in cargo position 6R evidenced the most severe heat and fire damage, and was the only container to show heat damage on its bottom. Nevertheless, NTSB could not confirm that the fire originated in that container.

The report said, "If the fire had not burned so long, the 'V' burn-damage pattern and the extensiveness of the fire damage to 6R would have been stronger evidence of a fire originating inside 6R. Further, the deep burn and severe damage found in container 6R could also be accounted for by the fact that it was relatively empty and therefore largely unprotected by cargo.

"Thus, the Lexan side walls and nylon curtain could have fallen directly onto the floor of 6R and burned there, resulting in the severe damage to the floor of 6R and the exterior surfaces of the synthesizer. When Lexan is heated, it typically burns, melts and puddles, producing heat that would be sufficient to cause the damage to container 6R and its contents. Thus, a fire that originated outside of 6R but eventually spread to that area could have resulted in a similar damage pattern."

NTSB also considered whether the fire might have started aft of container row 6.

"Comments on the CVR suggest that the smoke-detector activation sequence might have begun with detector no. 9 and initially moved forward; this suggests that the fire might have started aft of row 6," said the report. "Further, some of the first flames to have breached the crown were observed approximately above the area occupied by container rows 8 and 9. Although the smoke-detector activation sequence and location of the early breakthrough of flames cannot be considered reliable indicators of a fire's initial location, a possible connection between these factors and the location of the fire's origin could not be discounted."

Containers in rows 8 and 9 and the surrounding areas showed significant burn damage, but the damage appeared to be somewhat less than the damage around the container in location 6R.

The report said, "However, 9L contained a significant quantity of undamaged materials with a low melting point (polyurethane, polystyrene and polyethylene), and the corner posts of that container sustained fire damage only to the forward outboard post. Similarly, containers 9R and 8R contained significant amounts of unburned combustibles (such as paper items) after the fire.

"Thus, in comparing the fire damage in 6R with that in rows 8 and 9, it is possible that the fire in those rows was as significant as that in the area of 6R, but it might have started at or near the top of a container and was unable to progress very far into the volume of cargo loaded into those containers.

"In sum, there was insufficient reliable evidence to reach a conclusion as to where the fire originated."

Unable to determine where the fire originated, investigators sought evidence of an ignition source. Because a chemical smell had been noticed inside the DNA synthesizer, and because other items in the container in location 6R were believed unlikely to have been an ignition source, the synthesizer was given particular scrutiny.

NTSB said that the evidence indicated that the DNA synthesizer had not been completely purged of hazardous chemicals before being placed on the accident aircraft.

The report said, "Although the field engineer (who had prepared the synthesizer for shipment) asserted that there were no problems with the purging of the machine, he also indicated that he performed the additional individual priming functions as an additional measure to ensure that liquid was flowing through the machine. This suggests that he wanted to ensure that liquid was flowing properly. These additional manual priming functions could be consistent with his having made repeated attempts to isolate or correct a perceived problem. Further, the existence of a breach in the system might also explain how chemicals found their way to enclosed areas of the machine that later exhibited severe fire damage.

"Although [NTSB] could not positively determine the specific deficiency in the purging process, the purging and drying procedures performed at PerSeptive's corporate offices and at AFIP demonstrated that when the procedures in Service Note 89-006 were carefully followed, it resulted

in the synthesizer bottles containing trace amounts of chemicals less than those found in the accident synthesizer. The most reasonable explanation for the presence of excessive quantities of chemicals in the synthesizer is that one or more of the bottles containing chemical reagents used in the DNA synthesis process (at least one of which contained THF) was not sufficiently emptied before the purging process began."

Investigators acknowledged that the chemical residues in the synthesizer might have been a factor in the fire's ignition, but were unable to say specifically how that event might have occurred.

The report said, "Tests of the liquids from the accident synthesizer showed that flammable chemicals (THF and acetonitrile) were still present in the bottles on the machine after the fire. The quantity of chemicals remaining in the synthesizer's bottles after the fire was insufficient to have caused the external fire damage to the synthesizer and the cargo container. However, it is likely that significant amounts of the chemicals were consumed in the prolonged and intense fire, and thus the synthesizer probably contained much larger quantities of these flammable chemicals before the fire.

"These volatile chemicals — particularly the THF — could ignite a fire. THF, which is highly flammable under any circumstances, can also form unstable peroxides that can explode on contact with certain other materials or autoignite (spontaneously explode) in sufficient concentrations. Although the investigation examined this as a possible ignition scenario, it could not be determined whether the chemicals in the synthesizer played any role in igniting the fire. The investigation could not develop a viable and convincing scenario to explain how the synthesizer could have started a fire."

Other cargo containers and their debris were also examined to seek possible ignition sources, but no sources were identified. Because of deterioration and destruction of some of the cargo, however, NTSB could not rule out the contents of another cargo container as a source of the fire.

NTSB considered the possibility that the marijuana found to have been carried on the accident aircraft might have undergone a reaction, on being exposed to oxygen, that generated heat and combustion.

"The police investigator who documented the marijuana seizures explained that shippers of contraband such as marijuana attempt to reduce the size of the package by 'using a vacuum to vacuum out all the air and get it as compact as possible,'" said the report. "Thus, although the marijuana would have been compressed, there would have been little or no oxygen available to permit or support the biological reaction needed to lead to spontaneous combustion. Further, neither the police investigator nor any of the fire experts or consultants questioned during the course of the [NTSB] investigation were aware of a fire being initiated by spontaneous combustion of a marijuana shipment."

All aircraft systems, including the electrical system, were examined for malfunctions that might have been ignition sources. No malfunctions were found, and NTSB ruled out aircraft systems as an initial cause of the fire.

NTSB expressed concern about the increasing percentage of incidents related to undeclared hazardous materials.

The report said, "The number of hazardous-material releases for aviation, as reported to the DOT Hazardous Materials Information System (HMIS), increased from 163 incidents in 1987 to 1,015 incidents in 1997, an increase of 523 percent. Following changes in the HMIS incident-reporting format in 1990, the number of incidents caused by declared vs. undeclared shipments could also be distinguished. Of the 297 total aviation incidents reported for 1990, 234 incidents (79 percent) were attributed to declared shipments and 63 incidents (21 percent) to undeclared shipments. In comparison, of the 1,0 15 incidents reported in 1997 (an increase of 242 percent from 1990), 666 incidents (65 percent for 1997) were attributed to declared shipments and 349 incidents (35 percent for 1997) to undeclared shipments.

"Thus, between 1990 and 1997, the number of hazardous-material releases attributed to declared shipments increased by 185 percent, and the number of hazardous-material releases attributed to undeclared shipments increased by 454 percent. Further, in the two-year period from 1996 through 1997, the number of incidents resulting from undeclared shipments rose 82 percent, from 192 incidents in 1996 to 349 incidents in 1997."

NTSB said that a number of apparently undeclared hazardous materials had been shipped on Flight 1406.

"Because the [DNA] synthesizer was not intended to be shipped with any hazardous materials, it was shipped as general freight and was not packaged or labeled in accordance with DOT requirements and was not accompanied by the required paperwork," said the report. "Because the presence of flammable chemicals in the DNA synthesizer was wholly unintended and unknown to the preparer of the package (PerSeptive) and the shipper (Chiron), it is unlikely that the shipment of those chemicals on board Flight 1406 would have been prevented by better hazardous-materials education or improved screening of packages offered for transportation. However, it does demonstrate the safety threat posed by undeclared and improperly packaged hazardous materials.

"Seven aerosol cans and several plastic bottles containing acidic or alkaline liquids that could be corrosive, and two samples containing potentially flammable or combustible liquids were found in the cargo debris.

Although the original contents of the aerosol cans recovered from the accident aircraft could not be determined, aerosol cans, as pressurized containers with compressed gases, are regulated hazardous materials.

"The acidic and alkaline liquids in the plastic bottles were also likely subject to the DOT hazardous-materials regulations as corrosive materials.

Consequently, the aerosol cans and the containers of acidic liquid likely constituted undeclared shipments of hazardous materials."

Although marijuana is not classified as a hazardous material by U.S. transportation regulations, and the contraband shipment was ruled out as a factor in the accident, NTSB cited its presence in the accident aircraft as another example of the ease with which undeclared materials can be shipped on commercial flights.

The report said, "[NTSB] is especially concerned that, except in the case of properly packaged and declared shipments of hazardous materials, carriers generally do not inquire about the content of packages being shipped domestically, nor are they required to do so... Although air carriers and the FAA apparently agree on the seriousness of the problem, consideration is not being given to innovative measures, such as identifying package contents on the airbills or using technologies like x-ray machines to detect undeclared hazardous materials.

"(NTSB] concludes that transportation of undeclared hazardous materials on airplanes remains a significant problem, and more aggressive measures to address it are needed. Thus, [NTSB] believes that, in addition to the efforts already under way by the FAA, the DOT should require, within two years, that a person offering any shipment for air transportation provide written responses, on shipping papers, to inquiries about hazardous characteristics of the shipment, and develop other procedures and technologies to improve the detection of undeclared hazardous materials offered for transportation. The inquiries may include answering individual and specific questions about whether a package contains a substance that might be classified hazardous (e.g., 'Does this package contain a substance that might be corrosive [or flammable, a poison, an oxidizer, etc.]')."

NTSB discussed the importance of ARFF officials being able to obtain timely information about the exact identity and quantity of hazardous materials involved in an aircraft accident or incident. Lacking such information, safety officials cannot be sure what type and level of response are needed to protect lives, property and surrounding communities.

"Neither the assistant fire chief who served as the initial incident commander nor the ANG fire chief received specific information during the firefighting phase of the emergency (before 0925) about the identity of the hazardous materials, their quantities or the number of packages on the airplane," said the report. "By 0700, about one hour after the airplane had landed, the only information about the hazardous materials on board the airplane that had been provided to the initial incident commander came from the Part A form and a handwritten list provided by the FedEx station at the airport.

This information indicated only the hazard classes of the hazardous materials on board the airplane and their location in the airplane by cargo-container position."

FedEx was unable to generate a single data sheet with full details of each shipment of declared hazardous-materials cargo, including the shipping names, identification numbers, hazard classes, quantities, numbers of packages and locations.

The report said, "[FedEx] relied on faxing copies of the individual Part Bs for the approximately 85 hazardous-materials packages on board, which proved to be burdensome, time consuming and, in this case, ineffective. Also, because of the poor quality and legibility of many of the handwritten Part Bs, much of the information was unusable.

"Compared to the other modes of transportation, it is less likely that shipping papers on board an accident aircraft will survive or be accessible because of the greater likelihood of fire and destruction of the airplane. Because of the danger of fire, a flight crew is also less likely to have time to retrieve the shipping papers after a crash. [NTSB] concludes that the DOT hazardous-materials regulations do not adequately address the need for hazardous-materials information on file at a carrier to be quickly retrievable in a format useful to emergency responders."

The report described as "inappropriate" the FedEx vice president's statement to the ANG that copies of the hazardous-materials forms could not be provided to the ANG because NTSB was in control of the investigation.

"Although [NTSBI appreciates FedEx's efforts to recognize [NTSB's] primacy in aircraft-accident investigations, (NTSB) has not promoted, nor does it support, a policy that would interfere with a carrier's ability to assist emergency responders in transportation emergencies, especially when hazardous materials are involved," said the report.

NTSB believed that planning and coordination among the various agencies responding to the accident exhibited deficiencies leading to confusion about the respective responsibilities of the participants.

"More effective preparation for emergencies involving hazardous materials and a system for coordination among the ANG, Stewart International Airport management and all local and state emergency-response agencies are needed," said the report. "[NTSB] is concerned that FAA requirements do

not specifically address the need to prepare for hazardous-materials emergencies, and that other airports may be similarly unprepared for hazardous-materials emergencies. ... Therefore, [NTSB] believes that the FAA should require all certificated airports to coordinate with appropriate fire departments, and all state and local agencies that might become involved in responding to an aviation accident involving hazardous materials, to develop and implement a hazardous-materials response plan for the airport that specifies the responsibility of each participating local, regional and state agency, and addresses the dissemination of information about the hazardous materials involved."

NTSB reiterated its long-standing concern about the difficulties faced by airport firefighters trying to extinguish aircraft-interior fires. NTSB suggested that fire departments' current technology cannot extinguish an interior fire in time to safeguard occupants and cargo.

The report said, "[NTSB] is aware that the FAA has researched fire-extinguishing systems for airplane interiors, including testing of a water-spray system that would discharge water into a particular area of the airplane when triggered by sensors in that area. Because the system would discharge water only to a focused area of potential fire, it would minimize the total amount of water that would need to be carried on board, thereby reducing the weight penalty of such a system. FAA tests showed that when this system was used to fight a fire, it delayed the onset of flashover [the ignition of unburned gases along the length of the cabin ceiling], reduced cabin-air temperatures, improved visibility and increased potential survival time.

"[NTSB] is concerned about the number of losses that have occurred and concludes that currently, inadequate means exist for extinguishing on-board aircraft fires. Therefore, [NTSB] believes that the FAA should re-examine the feasibility of onboard airplane cabin-interior fire-extinguishing systems for airplanes operating under [FARs] Part 121 and, if found feasible, require the use of such systems.

"[NTSB] realizes that requiring on-board extinguishing systems may not entirely resolve these safety concerns because [the fire-extinguishing systems] may become disabled by crash impacts. Further, [NTSB] realizes that the full implementation of such technology will require a number of years. Therefore, [NTSB] concludes that in addition to the safety benefits provided by onboard extinguishing systems, ARFF capabilities must also be improved so that firefighters are able to extinguish aircraft interior fires in a more timely and effective manner."

Based on its investigation, NTSB published the following findings:

- "The flight crew was properly certificated and qualified in accordance with the applicable regulations and company requirements. Evidence from crew-duty time, flight time, rest time and off-duty activity patterns did not indicate that behavioral or psychological factors related to fatigue affected the flight crew on the day of the accident;
- "The smoke-detection system installed on the airplane functioned as intended and provided the crewmembers with sufficient advance warning of the in-flight fire to enable them to land the airplane safely;
- "The Boston [ARTCC] and New York [TRACON) controllers responded appropriately once they were aware of the emergency and provided appropriate and needed information to assist the crew in the emergency descent and landing;
- "The airplane was properly certificated, equipped and maintained in accordance with applicable regulations. No evidence of systems, mechanical or structural failures was found;
- "The flight engineer's failure to pull the cabin-air shutoff T-handle, as required by the Cabin Cargo Smoke Light Illuminated Checklist, allowed the normal circulation of air to continue to enter the main cargo area, thereby providing the fire with a continuing source of oxygen and contributing to its rapid growth. However, [NTSB] could not determine the degree to which it might have contributed to the severity of the fire;
- "The evacuation was delayed because the flight crew failed to ensure that the airplane was properly depressurized;
- "The captain did not adequately manage his crew resources when he failed to call for checklists or to monitor and facilitate the accomplishment of required checklist items;
- "Crewmembers who do not use protective-breathing equipment during a smoke or fire emergency may place themselves at unnecessary risk in attempting to address or escape from the situation;
- "Crewmembers may not be adequately aware that attempting to open a passenger exit door when the airplane is still pressurized may result in the door not opening;
- "The DNA synthesizer was not completely purged of volatile chemicals (including acetonitrile and tetrahydrofuran) before it was transported on board Flight 1406;
- "The presence of the aerosol cans, the containers of acidic liquid, as well as several packages of marijuana on board the accident flight illustrate that common carriers can be unaware of the true content of many of the packages they carry;
- "The transportation of undeclared hazardous materials on airplanes remains a significant problem, and more aggressive measures to address it are needed;
- "The [DOT] hazardous-materials regulations do not adequately address the need for hazardous-materials information on file at a carrier to be quickly retrievable in a format useful to emergency responders;
- "FedEx's policy of providing information only to [NTSB] after [NTSB] initiates an investigation is inconsistent with the need to quickly provide emergency responders with essential information to assess the threat to themselves and the local community;
- "More effective preparation for emergencies involving hazardous materials and a system for coordination among the Air National Guard, Stewart International Airport management, and all local and state emergency-response agencies are needed;
- "Airport emergency plans should specifically address hazardous-materials emergencies;
- "Currently, inadequate means exist for extinguishing onboard aircraft fires; [and,]
- "In addition to the safety benefits provided by on-board extinguishing systems, aircraft rescue and firefighting capabilities must also be improved so that firefighters are able to extinguish aircraft interior fires in a more timely and effective manner."

NTSB made a number of recommendations to U.S. transportation-safety organizations.

To DOT:

- "Require, within two years, that a person offering any shipment for air transportation provide written responses, on shipping papers, to inquiries about hazardous characteristics of the shipment, and develop other procedures and technologies to improve the detection of undeclared hazardous materials offered for transportation. (A-98-71)."

To FAA:

- "Require the principal operations inspector for [FedEx] to review the crew's actions on the accident flight and evaluate those actions in the context of FedEx emergency procedures and training (including procedures and training in crew resource management) to determine whether any changes are required in FedEx procedures and training. (A-98-72);
- "Require [FedEx] to modify its evacuation checklist and training to emphasize the availability of protective breathing equipment during evacuations in an environment containing smoke, fire or toxic fumes. (A98-73);
- "Require all (FARs) Part 121 operators of airplanes that rely on air pressure to open exit doors to make crewmembers aware of the circumstances of this accident and remind them of the need to ensure that the airplane is depressurized before attempting to open the passenger-exit doors in an emergency. (A-98-74);
- "Require, within two years, that air carriers transporting hazardous materials have the means, 24 hours per day, to quickly retrieve and provide consolidated, specific information about the identity (including proper shipping name), hazard class, quantity, number of packages and location of all hazardous materials on an airplane in a timely manner to emergency responders. (A-98-75);
- "Require the principal operations inspector for [FedEx] to ensure that all FedEx employees who may communicate with emergency responders about a transportation accident involving hazardous materials understand that they should provide those emergency responders with any available information about hazardous materials that may be involved. (A-98-76);
- "Require all certificated airports to coordinate with appropriate fire departments, and all state and local agencies that might become involved in responding to an aviation accident involving hazardous materials, to develop and implement a hazardous-materials response plan for the airport that specifies the responsibility of each participating local, regional and state agency, and addresses the dissemination of information about the hazardous materials involved. Such plans should take into consideration the types of hazardous-materials incidents that could occur at the airport based on the potential types and sources of hazardous materials passing through the airport. Airports should also be required to coordinate the scheduling of joint exercises to test these hazardous-materials emergency plans.(A-98-77);
- "Re-examine the feasibility of on-board airplane cabin-interior fire-extinguishing systems for airplanes operating under (FARs) Part 121 and, if found feasible, require the use of such systems. (A-98-78); [and,]
- "Review the aircraft-cabin interior fire-fighting policies, tactics and procedures currently in use, and take action to develop and implement improvements in firefighter training and equipment to enable firefighters to extinguish aircraft-interior fires more rapidly. (A-98-79)."

To the FAA Research and Special Programs Administration:

- "Require, within two years, that air carriers transporting hazardous materials have the means, 24 hours per day, to quickly retrieve and provide consolidated specific information about the identity (including proper shipping name), hazard class, quantity, number of packages and location of all hazardous materials on an airplane in a timely manner to emergency responders. (A-98-80)."

NTSB reiterated earlier recommendations to FAA:

- "Issue guidance to air-carrier pilots about the need to don oxygen mask and smoke goggles at the first indication of a possible in-flight smoke or fire emergency. (A-97-58); (and)
- "Establish a performance standard for the rapid donning of smoke goggles; then ensure that all air carriers meet this standard through improved smoke-goggle equipment, improved training or both. (A-97-59)."

Editorial note: This article was based on the U.S. National Transportation Safety Board Aircraft Accident Report: In-flight Fire/Emergency Landing, Federal Express Flight 1406, Douglas DC-10-10, N68055, Newburgh, New York, Sept. 5,1996 Report no. NTSB/AAR-98/03, dated July 22, 1998. The 137-page report includes a photograph, figures and appendixes.

Further Reading from FSF Publications

"Chemical Oxygen Generator Activates in Cargo Compartment of DC-9, Causes Intense Fire and Results in Collision with Terrain." Accident Prevention Volume 54 (November 1997).

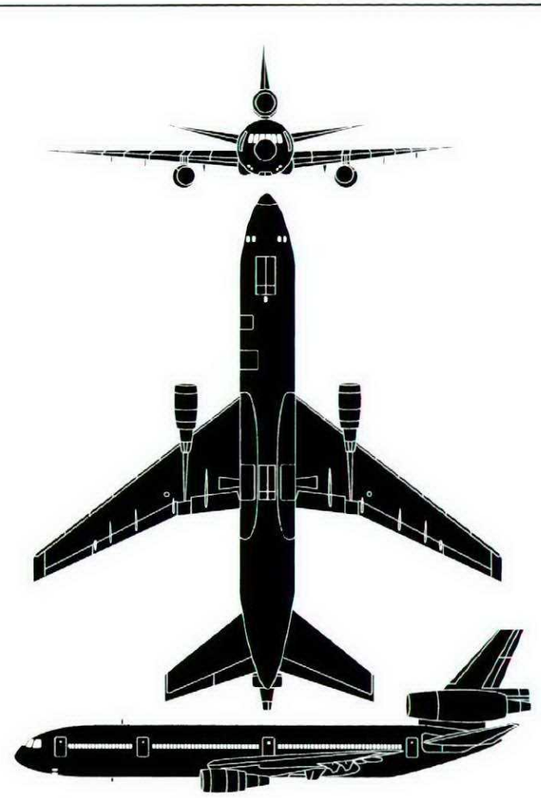
"Hidden, Smoky Fire in MD-87 Aft Cabin Forces Emergency Evacuation After Landing." Accident Prevention Volume 53 (December 1996).

Sarkos, C.P. "FAA Proposes New Rules on Cargo Compartment Fire Detection and Suppression." Cabin Crew Safety Volume 31 (November-December 1996).

Koenig, R.L. "U.S. Reports Examine New Tools Aimed at Improving Survival Rates in Aircraft Fires." Cabin Crew Safety Volume 30 (September-October 1995).

Kapustin, R. "Fire-involved Accidents and Incidents Reviewed." Flight Safety Digest Volume 12 (March 1993).

– *Reprinted courtesy of the Flight Safety Foundation* **Accident Prevention** *Vol. 55 No. 11-12 November-December 1998* ◆



McDonnell Douglas DC-10-10CF

The McDonnell Douglas DC-10-10 was the first model in the DC-10 series, and first flew in August 1970. The aircraft, powered by General Electric CF6-6D or CF6-6D1 turbofan engines, was produced in an initial version with a maximum takeoff weight of 410,000 pounds (185,970 kilograms) and a range of 3,600 miles (5,795 kilometers). A later version with added center-wing fuel capacity has a maximum take-off weight of 4,205 miles (6,768 kilometers).

Normal cruising speed is Mach 0.82, with a service ceiling of 34,800 feet (10,605 meters) with the CF6-6D engine or 35,200 feet (10,730 meters) with the CF6-6D1 engine. The DC-10-10CF was designed as a passenger version of the DC-10-10 that could be easily and quickly converted to cargo use.

Source: Jane's *All the World' Aircraft*

Cockpit Voice Recorder

Transcript,

FedEx Flight 1406, Sept. 5, 1996

RDO	= Radio transmission from accident aircraft
CAM	= Cockpit area microphone sound or source
-1	= Voice identified as captain
-2	= Voice identified as first officer
-3	= Voice identified as second officer (flight engineer)
-?	= Voice unidentified
BCNTR	= Boston air route traffic control center
INT	= Transmissions over aircraft interphone system
-1	= Voice identified as captain
-2	= Voice identified as first officer
-3	= Voice identified as second officer (flight engineer)
NYAPP	= New York terminal radar approach control
*	= Unintelligible word
#	= Expletive deleted
()	= Questionable text

Note: All times expressed in eastern daylight savings time. Only radio transmissions involving the accident aircraft were transcribed.

Source: U.S. National Transportation Safety Board

Time	Source	Content
0536:00	CAM	[start of transcript]
0536:00	CAM-1	oh you were back there when we discussed all this, I forgot.
0536:04	CAM-1	this thing's on a… this thing is on a check status.
0536:07	CAM-2	is it?
0536:07	CAM-1	it's just the fact that they got the paperwork all screwed up.
0536:10	CAM-2	we'll couple it up?
0536:12	CAM-1	you just want to go ahead and couple it yourself and just go ahead and make the landing?
0536:15	CAM-2	yeah, do they want an autoland though?
0536:17	CAM-1	yeah.
0536:18	CAM-2	they do want an autoland?
0536:18	CAM-1	yeah.
0536:19	CAM-2	***.
0536:20	CAM-1	just follow through on it? … it's visual, I don't give a #.
0536:23	CAM-1	what the hell's that?
0536:25	CAM-2,3	cabin cargo smoke.
0536:27	CAM-1	you see that… we got cabin cargo smoke… cabin cargo smoke.
0536:31	CAM-3	cabin cargo smoke, oxygen masks on.
0536:36	CAM-3	slash courier communication established.
0536:38	CAM-1	alright we got it.
0536:40	CAM-3	okay it's number nine smoke detector.
0536:40	BCNTR	fedex fourteen zero six turn twenty degrees left vectors behind company for boston.
0536:44	CAM-3	let the courier know.
0536:46	RDO-1	understand twenty left for fourteen zero six?
0536:49	BCNTR	that's correct… I have company traffic about twenty-five north of ya at thirty-three also going into boston… he's an airbus.

0536:56	RDO-1	roger.
0536:59	BCNTR	I didn't figure I'd have to vector this early in the morning.
0537:03	CAM-2	why don't you have those guys come up here.
0537:08	INT-1	there you go… everybody checked in.
0537:09	INT-2	okay why don't you have those —
0537:11	INT-3	okay second officer up.
0537:18	INT-2	why don't you have those guys come up here.
0537:22	INT-1	okay we're getting two of them now.
0537:26	INT-1	let's get on it… on the red tabs there and ah —
0537:29	INT-2	why don't you have those guys come up here?
0537:31	INT-1	let's open the door and see what it looks like.
0537:42	CAM-3	why don't you guys come up.
0537:48	INT-1	let's find out what we've got going here.
0537:56	INT-1	okay it's moving forward whatever it is… . it's up to seven.
0538:06	INT-3	okay fire and smoke… oxygen mask and smoke goggles as required on one hundred percent… crew and courier communication established… that completes the phase ones.
0538:14	INT-1	roger.
0538:17	INT-3	cockpit door and smoke screen closed.
0538:27	INT-3	it's closed… if descent is required proceed to step six… if descent not required proceed to step fourteen.
0538:38	INT-1	have you run a —
0538:40	INT-3	pull cabin air.
0538:42	INT-3	type of smoke or fire on step fourteen… descent not required.
0538:48	INT-3	cabin cargo smoke.
0538:55	INT-3	can best be recognized by checking smoke detectors second officer's panel by observing smoke or fire in the main deck cargo area… that completes ah fire and smoke going to cabin cargo smoke.
0539:07	INT-1	what we've got is cabin cargo, right?
0539:11	INT-3	that's affirmative.
0539:13	INT-1	alright… have you run the test on it yet?
0539:18	INT-3	doing that now.
0539:28	INT-1	that's seven and eight.
0539:31	INT-3	those others may be failing in the blinking mode.
0539:37	INT-1	the blinking mode is a normal test is it not?
0539:41	INT-3	pardon me?
0539:43	INT-1	they should come on blinking on the test, isn't that correct?
0539:45	INT-3	no they should come on steady on the test.
0539:47	INT-1	okay.
0539:47	INT-3	everything should come on steady.
0539:49	INT-1	okay.
0539:50	INT-3	okay ready to run the cabin cargo smoke light —
0539:52	INT-1	I got ten now.
0539:55	INT-3	ready to run the cabin cargo smoke light illuminated.
0539:57	INT-1	go ahead.
0540:01	INT-3	okay it says pack function selectors two off… two are off.
0540:07	INT-1	we've definitely got smoke guys… we need to get down right now let's go.
0540:18	RDO-1	okay what's the closest field I wonder… here let me talk to them here.
0540:22	RDO-1	center fedex fourteen zero six.
0540:24	BCNTR	- saying something about the closest field I'll get back to that in a second but one hundred heading seven thousand expect straight in runway six.
0540:30	RDO-1	let's run it, let's get this thing depressurized… let's get it down.
0540:34	RDO-1	center fedex fourteen zero six.
0540:38	RDO-1	center fedex fourteen zero six.
0540:40	BCNTR	fedex fourteen zero six go ahead… you have a problem?
0540:43	RDO-1	yes sir we do… we have smoke in the cabin at this time… we're at three three zero… we'd like to proceed direct and we need to descend at this time.
0540:53	BCNTR	fedex fourteen zero six roger descend and maintain one one thousand… stewart altimeter three zero one five and if you want to go to albany it's in your eleven o'clock and about fifty miles… stewart is probably the closest airport it'll be at ah hundred and eighty degree turn and about twenty-five miles.

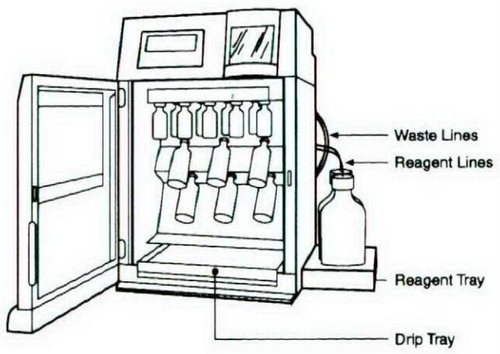
0541:11	RDO-1	okay stewart field ah and a right turn to ah a hundred and eighty degrees now?
0541:17	BCNTR	you'd make a left hand turn to a heading of two four zero and it is uhm let's see now twenty five miles… left turn heading two four zero.
0541:27	RDO-1	left turn two four zero… say the weather at stewart.
0541:32	CAM-1	(go ahead turn).
0541:35	INT-3	okay ready to run when you are.
0541:38	INT-1	okay run the checklist.
0541:41	INT-3	okay courier mask and goggles verify on one hundred percent… cockpit air outlets open… they are open… it says ah land as soon as possible… and we are descending now… if unable to extinguish fire and smoke manually raise cabin altitude to twenty-five thousand … while you're in a descent to eleven?
0542:03	INT-1	roger, go ahead and start raising it.
0542:07	INT-3	okay continue the descent.
0542:21	INT-3	and we now have just detectors eight, nine and ten… we've lost detector seven… it's gone out.
0542:28	INT-1	roger.
0542:30	INT-3	okay what's that ah… stand by.
0542:36	BCNTR	fedex fourteen zero six I've got albany if you want to go up to stewart you can do that… I've got albany in your eleven o'clock and about forty-five miles or stewart in your southwesterly position and ah forty miles … your choice.
0542:49	RDO-1	okay we need to get it on the ground… we need to get to stewart… give us vectors.
0542:53	BCNTR	okay fedex fourteen zero six roger turn left heading two four zero… you can remain in a left hand turn and stewart's wide open for ya.
0543:00	RDO-1	roger.
0543:02	INT-3	and I'm manually raising the cabin altitude… there is smoke in the ah cabin area.
0543:03	CAM	[sound of overspeed warning alert]
0543:06	INT-1	roger.
0543:12	INT-2	okay… okay you have an approach plate for us?
0543:25	CAM-?	*
0543:22	INT-3	what's the three letter identifier for stewart?
0543:30	RDO-1	give me a plate for —
0543:38	BCNTR	fedex calling boston say again please.
0543:43	RDO-1	center… stewart field… what's that listed under?
0543:47	BCNTR	sierra whiskey foxtrot newburgh new york.
0543:49	CAM-?	newburgh new york.
0543:51	RDO-1	okay.
0544:04	BCNTR	fedex fourteen zero six if you could when you get a chance the uhm fuel on board and souls please.
0544:12	INT-3	thirty-three thousand pounds.
0544:14	RDO-1	thirty-three thousand pounds… five souls on board.
0544:18	BCNTR	could you say that one more time please?
0544:19	RDO-1	thirty-three thousand pounds… five souls on board.
0544:19	CAM	[sound of overspeed warning alert]
0544:22	BCNTR	thirty-three thousand five souls… thank-you.
0544:25	INT-3	and ah current altimeter.
0544:27	RDO-1	current altimeter setting please?
0544:28	BCNTR	stewart altimeter three zero one five, sir.
0544:32	RDO-1	three zero one five.
0544:34	INT-3	three zero one five set in the back.
0544:44	BCNTR	fourteen zero six descend and maintain four thousand… you can proceed direct to kingston VOR… that's india golf november… that's for the VOR runway two seven at stewart.
0544:55	RDO-1	okay what's that frequency?
0544:57	BCNTR	stand by one second… frequency's one one seven point six, sir.
0545:15	INT-3	and it looks like we just have smoke detector ten lit now.
0545:19	RDO-1	okay, sir, we don't have the VOR approach to two seven on file here on the airplane.
0545:34	BCNTR	fedex fourteen zero six roger… would you like a visual to the airport?
0545:36	RDO-1	roger, get us down to the airport and we'll take the visual… the only thing we have on board is for the ILS to nine.

0545:44	BCNTR	alright ILS to nine is the only thing you can handle okay… it's a two one zero heading now for the airport and it's twenty-eight point two miles from your present position and you can expect a visual.
0545:55	RDO-1	roger two one zero.
0545:57	INT-3	okay what is the three letter identifier for —
0545:58	BCNTR	and fedex fourteen zero six maintain four thousand.
0546:08	RDO-1	it's cleared to four thousand now for fedex fourteen zero six?
0546:10	BCNTR	fedex fourteen zero six affirmative maintain four thousand.
0546:14	INT-3	three letter identifier again for that airport?
0546:19	RDO-1	ah stewart?
0546:21	INT-3	yeah.
0546:21	RDO-1	S-T-W.
0546:26	BCNTR	sierra whiskey foxtrot is stewart.
0546:31	INT-3	okay we are depressurized.
0546:34	INT-1	alright.
0546:41	RDO-1	and center, I don't know if I did it before but fourteen zero six is declaring an emergency and we do need equipment standing by.
0546:44	BCNTR	fourteen zero six, that's already been taken care of… the equipment will be standing by.
0546:51	RDO-1	roger.
0546:52	INT-3	okay, it says fire… check extinguished… the lights are off… it's still smoky out there.
0546:56	BCNTR	fourteen zero six fly your present heading… expect a visual approach to the stewart airport from new york approach control… contact new york approach one three two point seven five.
0547:05	RDO-1	three two seven five,roger.
0547:08	INT-3	caution… no crewmember should leave the cockpit to fight a fire… we're not gonna do that.
0547:14	RDO-1	approach, fedex fourteen zero six.
0547:17	NYAPP	fedex fourteen zero six new york approach … stewart altimeter is three zero one eight… descend and maintain four thousand… did you figure out what approach you need yet?
0547:24	RDO-1	three zero one eight down to four thousand.
0547:27	RDO-1	keep the speed up man, don't slow to two fifty… we're in an emergency situation here.
0547:31	NYAPP	american fourteen zero six speed's your discretion… speed's not a problem… I just need to know what approach you want?
0547:36	RDO-1	roger we do not have a two seven approach plate… all we have is runway nine… if we can get it we'd like to get in there visually if you can line us up.
0547:43	NYAPP	roger fourteen zero six… do you want me to run line up for runway niner or runway two seven?
0547:47	RDO-1	two seven.
0547:49	NYAPP	american fourteen zero six roger… fly heading two one zero… correction fly heading one niner zero.
0547:54	RDO-1	one nine zero.
0548:07	INT-3	I need the three letter identifier for that airport so I can call it up.
0548:11	RDO-?	S-W-F.
0548:13	NYAPP	american fourteen zero six be advised stewart weather as of zero nine four five zulu winds are calm ... three miles visibility… fog and a broken layer at seven thousand feet… stewart altimeter's three zero one eight.
0548:26	RDO-1	three zero one eight, roger.
0548:27	CAM-2	slats extend.
0548:29	INT-3	okay, land at nearest suitable airport… cabin cargo smoke light illuminated checklist complete.
0548:36	RDO-1	okay, they're out, aren't they?
0548:38	CAM	[sound of overspeed warning alert]
0548:38	RDO-1	get rid of it… but we still need to get this thing on the ground.
0548:41	CAM-2	what's the field elevation?
0548:41	NYAPP	american fourteen zero six roger… the VOR runway two seven approach course goes off the kingston two four four radial if you want to tune that in.
0548:50	CAM	[sound of altitude alert and overspeed warnings]
0548:54	RDO-1	roger, two forty-four degree radial.
0548:59	NYAPP	american fourteen zero six descend and maintain three thousand.
0549:02	RDO-1	three thousand, fourteen zero six.

0549:08	RDO-1	boy this sucks doesn't it.
0549:09	CAM	[interrupt in CVR audio from tape splice]
0549:09	INT-3	is there a three letter identifier-
0549:10	CAM-2	is there a VOR or something on the field?
0549:13	RDO-1	yeah, two forty-four here… intercept that… that's off the kingston VOR… going into the runway.
0549:17	NYAPP	fedex fourteen zero six that's affirmative… on your present… turn ten degrees right to intercept the kingston two four four radial.
0549:23	RDO-1	intercept the two four four radial… ten degrees right.
0549:25	CAM	[sound of altitude warning]
0549:28	INT-3	I can't give you any take-off or landing data.
0549:32	INT-1	you can't?
0549:33	INT-3	I can't find the airport in my directory.
0549:37	RDO-1	just get a weight and use your table tops.
0549:43	RDO-1	get rid of the boards.
0549:48	RDO-1	three hundred and thirty thousand pounds.
0549:53	RDO-1	V ref is one thirty-one for flaps fifty… one thirty-six for thirty-five.
0550:03	NYAPP	fedex fourteen zero six turn right heading two two zero to intercept the kingston two four four radial… descend and maintain two thousand five hundred.
0550:11	RDO-1	two thousand five hundred and two two zero on the heading.
0550:13	CAM	[sound of altitude alert warning]
0550:20	INT-3	in range… airspeed bugs.
0550:22	RDO-1	okay we're working on it… two seventeen's your top bug.
0550:30	RDO-1	one eighty-seven's the next one … one fifty-five… the next one -
0550:41	NYAPP	fedex fourteen zero six when you get a second the fire department needs to know if there's any hazardous material on the plane.
0550:48	INT-1	(Larry?)
0550:49	INT-3	yes.
0550:50	RDO-1	yes there is, sir.
0550:53	INT-1	okay, it's coming alive.
0550:59	RDO-1	go to twenty-five hundred feet.
0551:04	INT-3	and I've got additional smoke detectors on now.
0551:06	NYAPP	fedex fourteen zero six the lights are all the way up… you can expect to stay on this frequency… you will not have another frequency change… you'll be cleared to land from this ah on this frequency… the airport is at twelve o'clock and ten miles… report in sight.
0551:16	RDO-1	fourteen zero six wilco.
0551:21	RDO-1	okay, what's your double bug?
0551:23	NYAPP	fedex fourteen zero six descend and maintain two thousand three hundred.
0551:26	RDO-1	twenty-three hundred, roger.
0551:27	CAM-2	flaps fifteen.
0551:28	RDO-1	twenty-three hundred.
0551:30	RDO-1	what's the double bug in there on the table top… for ah three hundred thirty thousand?
0551:32	CAM	[sound of altitude alert warning]
0551:36	INT-3	ah three thirty… stand by.
0551:41	NYAPP	fedex fourteen zero six… this is not a standard approach… this is an angled approach to the runway.
0551:42	INT-3	two fifty-eight is optimum.
0549:32	RDO-1	roger.
0551:50	INT-1	what'd you get for a double bug?
0551:52	CAM-2	hey bruce, I don't have the plate… you're gonna have to talk me in to this.
0551:56	RDO-1	I am talkin' you into it… we don't have the plate for this either… we're doing a visual.
0551:59	INT-3	okay for thirty-five ah… thirty-five extend that's all I've got.
0552:06	CAM-2	flaps twenty-two.
0552:08	NYAPP	fedex fourteen zero six descend and maintain two thousand.
0552:10	RDO-1	two thousand fedex fourteen zero six.
0552:12	INT-3	V ref thirty-five extend is one thirty-six.
0552:13	CAM	[sound of altitude warning alert]
0552:15	NYAPP	fedex fourteen zero six field is twelve o'clock and seven and a half miles.
0552:17	RDO-1	Roger.
0552:21	INT-3	one thirty-six for V ref flap… thirty-five extend.
0552:26	CAM-2	gear down… before landing checklist.
0552:32	RDO-1	I think I'm starting to see the runway out there at twelve o'clock.

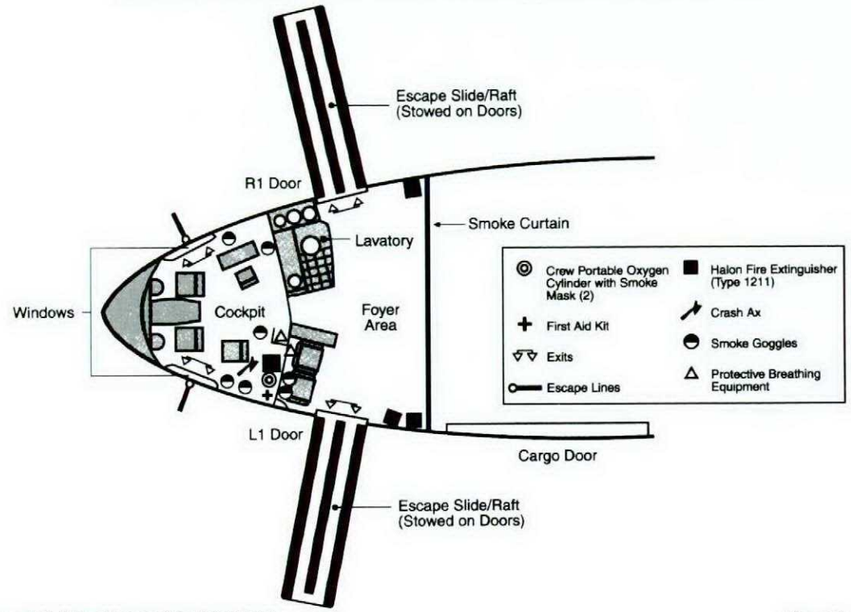
0552:38	RDO-1	it comes in at an angle.
0552:42	NYAPP	fedex fourteen zero six field is now twelve o'clock and five miles… do you need lower?
0552:48	RDO-1	yeah affirmative… have they got the lights all the way up… we don't see the runway.
0552:52	NYAPP	fedex fourteen zero six that's affirmative… the lights are all the way up.
0552:57	INT-3	landing gear?
0552:59	INT-1	down and three green.
0553:00	NYAPP	fedex fourteen zero six descend and maintain one thousand two hundred.
0553:01	INT-3	twelve o'clock.
0553:02	RDO-1	that's not it.
0553:06	INT-3	thrust computer.
0553:08	RDO-1	fourteen zero six… fourteen zero six still doesn't have the field here, sir… we've ah we're visual conditions sir… we do not see the runway.
0553:15	NYAPP	fedex fourteen zero six say again.
0553:17	RDO-1	yes sir, we do not see the runway ah at stewart… now we have it in sight.
0553:21	INT-3	over here at the left.
0553:23	NYAPP	fedex fourteen zero six you said you have the field?
0553:26	RDO-1	yes sir, I do believe we have the field at this time.
0553:28	NYAPP	fedex fourteen zero you're cleared to land runway two seven.
0553:31	CAM-2	flaps thirty-five… go right to fifty.
0553:33	RDO-1	that's not the right runway I don't think, is it?… yeah it is.
0553:37	INT-3	thrust computer.
0553:38	RDO-1	okay that's the runway right there.
0553:42	CAM	[Ground-proximity warning system (GPWS) one thousand foot call]
0553:42	INT-3	thrust computer… antiskid… spoiler.
0553:45	RDO-1	test and armed.
0553:49	RDO-1	want some flaps fifty.
0553:55	INT-1	want the autothrottles?
0554:01	INT-3	flaps and slats?
0554:02	RDO-1	okay I've got fifty land.
0554:05	INT-3	before landing checklist complete.
0554:06	CAM	[GPWS five hundred foot call]
0554:08	CAM	[two GPWS sink rate warnings]
0554:11	RDO-1	pull it on up.
0554:16	RDO-1	everything's done.
0554:20	CAM	[GPWS one hundred foot call]
0554:21	CAM	[GPWS sink rate warning]
0554:23	CAM	[GPWS fifty, forty, thirty, twenty and ten foot calls]
0554:28	CAM	[sound similar to that of touchdown]
0554:29	CAM	[sound similar to that of auto-spoiler deployment]
0554:37	CAM	[sound similar to that of reverse thrust]
0554:44	CAM	[sound similar to that of engine spooling down]
0554:46	INT-1	okay, I've got it… nice job.
0554:56	NYAPP	fedex fourteen zero six when able you can go over to tower frequency twenty-one eight.
0555:01	RDO-2	twenty-one what?
0555:02	NYAPP	one two one point eight.
0555:03	INT-3	okay on the lights we've got a… (forward fire… I'm deploying aft).
0555:07	RDO-1	we need to get the hell out of here.
0555:10	CAM	[sound of engine fire warning alarm starts]
0555:12	INT-3	agent arm cylinder one switch.
0555:19	INT-3	emergency ground egress.
0555:23	CAM	[sound of engine fire warning alarm stops]
0555:24	RDO-1	blow blow the door.
0555:27	CAM	[end of tape] ◆

Expedite Model 8909 DNA Synthesizer



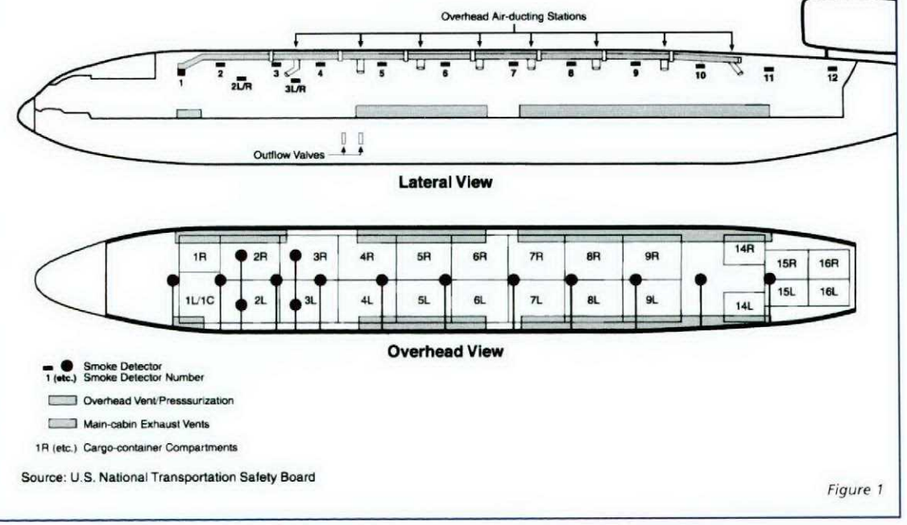
Source: U.S. National Transportation Safety Board *Figure 3*

Forward Area of DC-10-10CF, FedEx Flight 1406, Sept. 5, 1996



Source: U.S. National Transportation Safety Board *Figure 2*

Systems and Cargo-container Compartments of DC-10-10CF, FedEx Flight 1406, Sept. 5, 1996



Source: U.S. National Transportation Safety Board *Figure 1*

Old Pilot New Tricks...

I Think Not

Oh what a beautiful morning, oh what a beautiful day...

The aircraft coming out of a number 2 periodic is ready for the test flight. All the ground handling and checks are done, everything is fine, now it is time to get airborne. Following a normal take off roll, I start climbing and attempt to retract the landing gear, but it remains locked in the down position. I've had the problem before; likely a ground safety switch, let's override it and raise the gear. It works. Before I go any further with the flight, I'd like to know if the gear would go back down. I select the lever down, but nothing happens. Oh well, I decide to terminate the flight and get the system fixed; my hand goes to the hand pump and I begin to pump. After 1/2 a stroke, the pressure is so high that I cannot pump any more and the gear is still up!

I've learned in my time as a maintenance test pilot that almost anything can happen, but if the engine is running, and the aircraft is flying, then the emergency becomes a problem.

The need to rush is only a function of the fuel remaining and the distance to your airport - two items in my favour today. I also know that there are technicians who are ready to help so I decide to call upon their expertise, but first, let's try the circuit-breaker. Pull and reset... nothing. Let's try some Geez...nothing. Well I'm out of ideas. Better look at the checklist and plan for a wheels up landing. Although I know that I'll want to reduce my fuel to 400 pounds, I am not sure of the rest of the procedure. Also, given the possibility of a post landing fire I consider ejecting, but I decide against it given the circumstances.

The technicians are now on the radio. One suggestion is something I have already tried — pull the circuit breaker and try the handle. I pull the circuit breaker, raise the landing gear lever, and lower it once again. Nothing happens.

That's when I finally wake up! I pull the emergency landing gear selector handle, pump the gear down, and land with no further incident.

What have I learned?

First. Even though I know my checklist quite well, time permitting, I can always go back to it to confirm the steps.

Second. In stressfull times, proper terminology will help. In this case the landing gear control is a lever, not a handle. The emergency landing gear selector is a handle. Pulling the emergency handle, as opposed to trying the landing gear lever, might have been a better phrase to use.

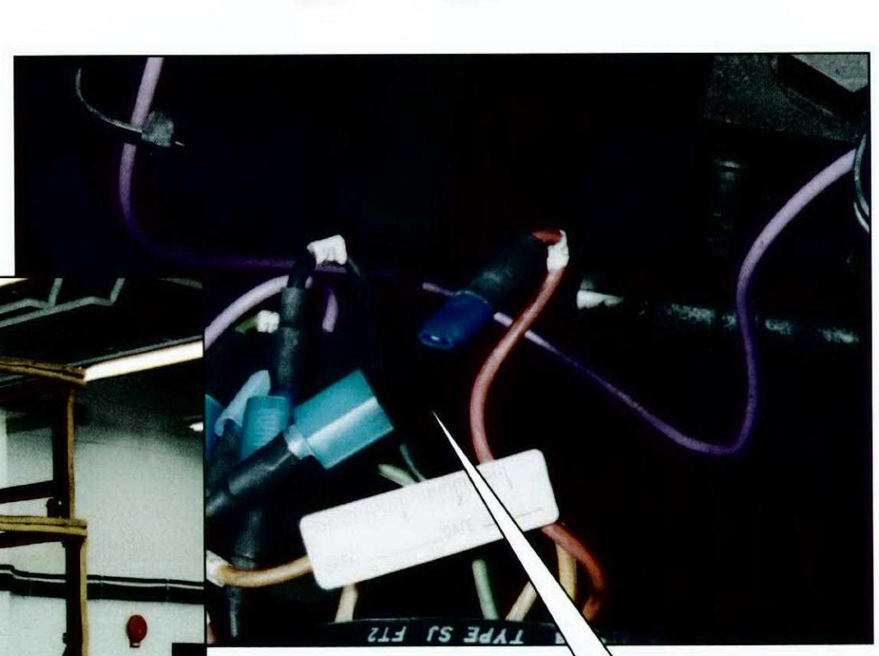
Third. Do not be afraid to ask for help. Technicians or controllers may come up with excellent suggestions.

Fourth. Do not rush your handling of the problem if you can; you'll surely make a mistake.

Fifth. Do not take your performance for granted. Even with more than 6000 hrs on type, I made a mistake that could have led to a damaged aircraft, serious injury, or perhaps someone else writing this story. SCARY ISN'T IT !!!

Photo by Mike Reyno/Skytech Images

An Accident Waiting to Happen



Wiring disconnected