

“What The Hell Did We Hit, Man?”

These two pilots ignored the final segment step-down fix during a VOR approach, with tragic results.

By Wally Roberts

THE TITLE OF THIS ARTICLE isn't from some B-movie screenplay. Rather, it's the startled statement by the co-pilot of a Cessna Citation 550 shortly after hitting the guy wire of a 700-foot antenna, which sheared off 8.5 feet of the Citation's left wing. The crew was able to maintain some control for about another 1.5 miles, then the aircraft went into an uncontrolled dive and impacted the ground. The two pilots were killed and the aircraft was destroyed.

The Citation (N91MJ) was equipped with a cockpit voice recorder (CVR) which faithfully recorded the last 30

minutes of this ill-fated IFR flight. The CVR reveals a wealth of information about this crew's disregard for the mandatory requirements of the approach they were flying: the VOR/DME RWY

inforces the fundamental principle that non-precision approaches, especially to non-precision runways (runways without a full ILS IAP), have varying levels of risk, some of which aren't necessarily apparent to the pilot.

IN THE CRUNCH

17 at Marco Island Airport (MKY), FL. The NOS chart effective on the date of the accident is shown on page 3. Also shown is the Jeppesen chart for the same IAP, which was revised nine months after the accident and was the current chart when this article was written.

A careful examination of this IAP re-

Passenger pick up

The Cessna was being positioned to pick up passengers at the Florida resort of Marco Island. The flight had originated at a St. Louis area airport and proceeded uneventfully to its destination until a few moments prior to disaster. From my reading of the CVR transcript, I suspect the flight was in CAVU con-
(continued on page 3)

INSIDE INFORMATION

❑ **Instruction**—When You Depart VFR. There are times when it's faster to get a clearance once airborne, provided you can do it safely (page 6).

❑ **IFR Quiz**—Summer Briefing. More weather interpretation using the METAR/TAF (page 8).

❑ **Chart Review**—Following the Missed. The “combination” missed for these two IAPs requires intercepting three different VOR radials (page 10).

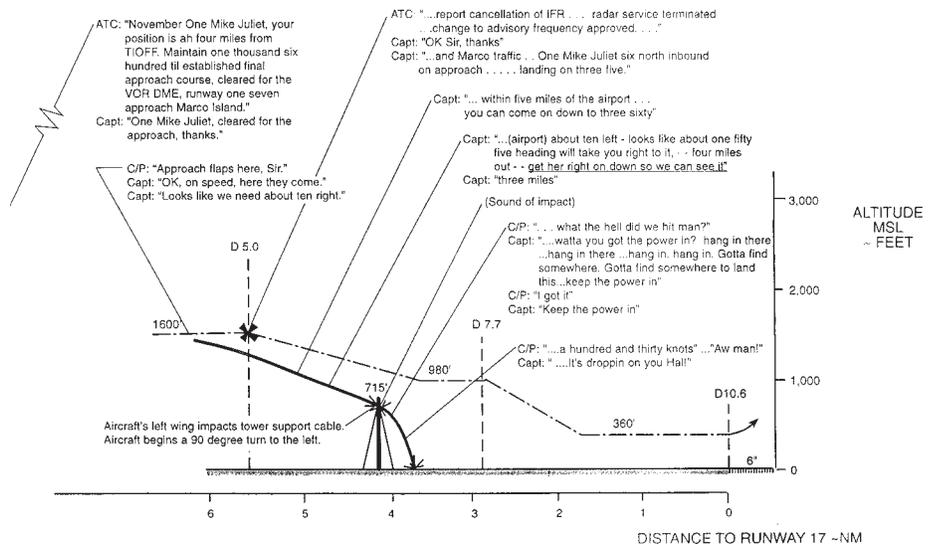
❑ **Please Clarify**—Truth or Consequences. Failure to disclose information on his medical application cost this pilot his certificates (page 12).

❑ **Refreshment**—How Do You Measure Up? There are some people who just work harder than others at being a professional (page 16).

❑ **Plus Readers' Advisories, AIM Update** and much more of interest.

CIRCUMSTANCES: Aircraft was positioning from St. Louis, MO. During a VOR DME 17 approach, the aircraft hit a tower/transmission line some 3-3/4 nm from runway 17. A supporting tower cable took 8-1/2 feet off of the left wing.
WEATHER: 800 broken, 1500 overcast, visibility 6 miles in fog, wind 150/12, temp 73/67 F dewpoint
TIME: 12:25 EST
FATALITIES: 2

Flight Path Profile
Ce-550 Citation
MARCO ISLAND, FLORIDA
31 DECEMBER, 1995



Flight path profile created by Allied Signal, Inc. Reprinted with permission.

It Really Works

This reader averted disaster when his airplane stopped climbing.

I want to let you know how much your articles helped a new instrument pilot. Like many others, I suspect my training didn't adequately address departure procedures in a serious you're-on-your-own non-radar environment. I was departing Western Yellowstone (WYS, 6,700 feet) yesterday in a Cessna 177 Cardinal. I followed the published IDP, but after about three minutes, the airplane simply stopped climbing for a while.

I was tempted to press on through the downdraft, but all this stuff I read suddenly came back to me: if I don't make the climb gradient I might kill myself. There were no guarantees, no terrain alerts blinking on ATC radar. I was completely on my own. I made a quick 180 while I could still barely see the ground and returned to the field. I really think I might have pressed on or at least didn't have such sense of urgency had I not read your articles about IDPs, approach designs, etc.

Instrument training seems to focus on what is a secondary concern: ATC interaction and regulations, not what really matters: staying out of the rocks when you can't see outside. IDPs and terrain awareness are given none, or at best, very casual treatment in all the big name IFR textbooks. Neither does the FAA written probe this area.

Martin Kosina
Via Internet

Thanks for the message. It's stuff like this that makes our efforts worthwhile. The FAA could put more emphasis on this area, and so could more flight instructors.

Missed approaches

Wally Roberts' article, "The Properly Flown Missed" (July *IFRR*) was very good, and an excellent refresher. Since the July issue came out, I have received a number of calls regarding a statement Roberts made concerning climbing, once you decide to miss. The question is, "Climb to what altitude?" We have

had this question before, and after a brief discussion with a tower controller at MSP, he indicated that one can initiate the climb to the published missed approach altitude. What are your views on this issue?

Casey Seabright
Minneapolis, MN

Roberts replies: "When ATC clears you for an approach, they must protect the entire missed approach area. Of course, where there is lots of traffic and robust radar capabilities, we know they often 'bet on the come.' Unless or until ATC provides a 'radar miss' with a different altitude, the prescribed missed approach altitude belongs to the pilot once cleared for the approach.

"Suppose the FAF (or perhaps some fix prior to the FAF) has either a mandatory or maximum altitude which is lower than the missed approach altitude, and you decide to 'miss' well before the FAF. Unless you can obtain an amended clearance from ATC, the applicable maximum or mandatory altitudes would apply until passing those fixes.

Instrument training seems to focus on what is a secondary concern: ATC interaction and regulations, and not what really matters, which is staying out of the rocks when you can't see outside.

"Another way to look at it: the approach segments leading to the final approach segment lead indirectly to the missed approach segment. Only the final approach segment leads directly to the missed approach segment.

"The article was written on the premise that the missed approach commences somewhere inside the FAF. Perhaps I should have covered the 'really early' miss, but it's all a trade-off for an attempt at clarity and focus."

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What The...

(continued from page 1)

ditions until just before commencing the IAP. The crash occurred at 1225 hours local time.

Weather conditions

MKY has an AWOS, but it was inoperative on the day of the accident. Instead, the crew obtained the ATIS at Naples (11 miles northwest of MKY) which reported, "...measured ceiling 1,200 broken, 3,000 overcast, visibility six miles and fog, temperature 73, dew point 67, wind 150 at 8..." Ft. Myers Approach (the final ATC facility that handled N91MJ) provided the crew with the Ft. Myers altimeter.

The weather at MKY was probably substantially worse than Naples. Witnesses that saw the Citation hit the tower stated the top of the tower was obscured by clouds. These witnesses said the airplane appeared out of the clouds just before striking the guy wire.

Another crew that had successfully flown the IAP 30 minutes before the Citation stated there was no problem with the approach. This crew encountered VFR conditions four miles north of the airport. However, when this same crew departed 44 minutes after the crash, they estimated the ceiling at 250-300 feet.

The Citation hit the guy wire at

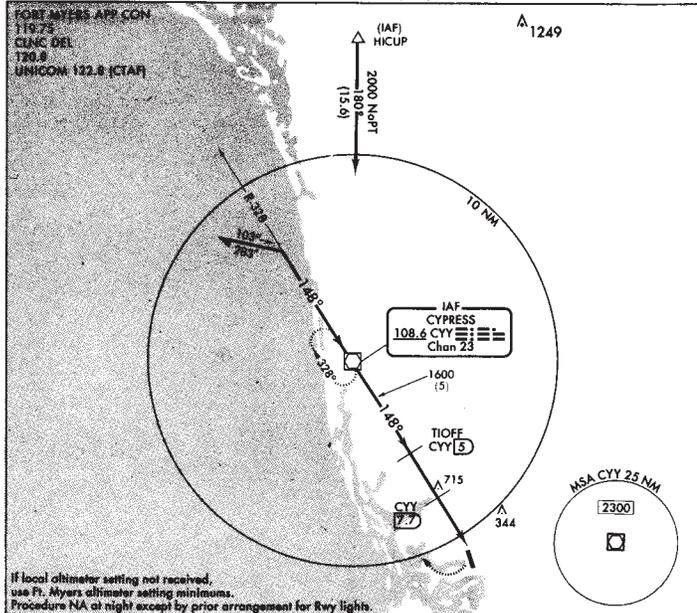
proximately 600 feet msl. As a result, it's reasonable to conclude the ceiling in the vicinity of the tower was 600-700 feet agl.

Crew coordination

The co-pilot was the flying pilot. The captain wanted to circle-to-land on Runway 35, even though this would have likely resulted in a tailwind. Apparently, he wanted to save a taxi back to the terminal building at the north end of the airport.

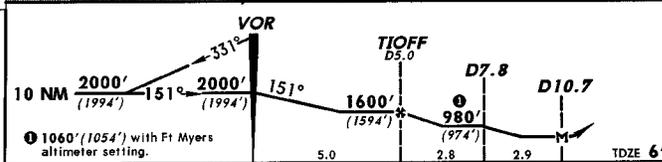
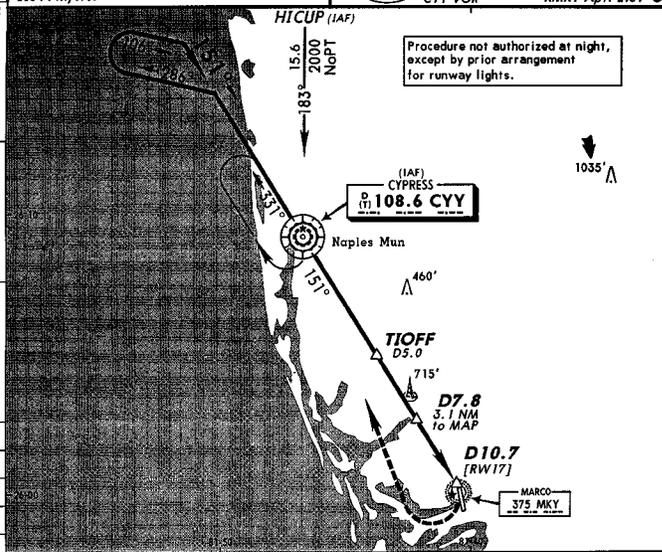
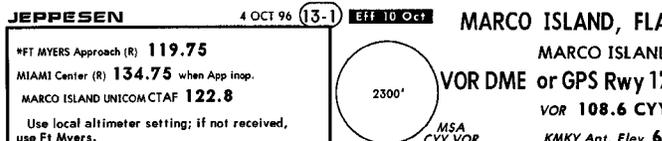
(continued on next page)

VOR/DME or GPS RWY 17 AL-6449 (FAA)



CATEGORY	VOR/DME			
	A	B	C	D
S-17	360-1 354 (400-1)			
CIRCLING	420-1 414 (500-1)	460-1 454 (500-1)	460-1 1/2 454 (500-1 1/2)	560-2 554 (600-2)
FT. MYERS ALTIMETER SETTING MINIMUMS				
S-17	440-1	434 (500-1)	440-1 1/2 434 (500-1 1/2)	440-1 1/2 434 (500-1 1/2)
CIRCLING	500-1	494 (500-1)	500-1 1/2 494 (500-1 1/2)	560-2 554 (600-2)

VOR/DME or GPS RWY 17 26°00'N-81°40'W
Amdt 5 MARCO ISLAND, FLORIDA MARCO ISLAND (MKY)



	STRAIGHT-IN LANDING RWY 17		CIRCLE-TO-LAND	
	MDA(H) 520' (514') With Local Altimeter Setting	MDA(H) 600' (594') With Ft Myers Altimeter Setting	Max Kts MDA(H)	With Ft Myers Altimeter Setting MDA(H)
A	1	1	90	560'(554')-1
B	1	1	120	660'(654')-1
C	1 1/2	1 1/2	140	560'(554')-1 1/2
D	1 3/4	1 3/4	165	660'(654')-2

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The NOS chart (left) is the procedure valid the day of the accident. The Jepp chart (right) is the current procedure.

What The . . .

(continued from page 3)

There was some discussion about the IAP, but it was casual and incomplete. The co-pilot asked, "What's the MDA for the approach, remember?"

"Oooh, it's about uh, three sixty," replied the captain, who then added, "Two thousand till established and once you pass the VOR, you can (go) down to sixteen hundred... (to or possibly for) five miles... thence." The captain continued, "After five miles... come down..." The co-pilot added, "Three sixty."

"Thence... as the book says," said the captain.

Ft. Myers Approach held N91MJ at 2,000 feet in the vicinity of Cypress VOR because of a departure off Naples Airport. The captain said, "Well, whenever he does clear you, down to six-teen hundred..."

"Okay..." responded the co-pilot. The captain then added, "It, it's more than five miles and it will be all the way down to nine eighty." At this point, N91MJ was cleared for the approach: "(N91MJ), your position is uh, four miles from TIOFF. Maintain one thousand six hundred till established final approach course. Cleared for the VOR DME, runway one seven approach Marco Island."

The co-pilot called for approach flaps. Then, the captain said, "Looks like we need about ten right." Immediately after this the captain said, "One down at nine eighty," followed by, "Shoot." The altitude alert sounded, and the co-pilot stated, "Hopefully." The captain then said, "Yeah, you otta be in pretty good shape if you don't mind sneaking around a little bit. Yeah, within five miles of the airport you can come on down to three sixty..."

Then, two beeps followed by a single beep similar to an altitude alert signal could be heard on the CVR. The captain responded with, "Yuk." The co-pilot then stated, "Set the alarm." The captain followed with, "Ah, the airport's a little bit to your left..."

The sound of three beeps similar to

an altitude alert signal could be heard. The captain then said, "...about 10 left. Looks like about a one fifty five heading will take you right to it, four miles out. Get her right on down so we can sees [sic] it." The sound of a long beep similar to altitude alert signal could be heard. The captain then said, "Three miles." Then, one of the pilots said, "There's just a..." which was interrupted by the sound of an impact.

The brief remainder of the CVR recording is shown on page 1 (This illustration was kindly provided by Allied Signal, the developer of the new enhanced ground proximity system [EGPWS]. Allied Signal is interested in accidents such as this one, as they develop tower-obstacle warning routines in their EGPWS.)

Inferences

I drew several inferences from the CVR transcript, the foremost of which is the crew had departed the electronic final approach course while still IMC, in an attempt to align with Runway 17. Further, for reasons unknown to me, they believed the lowest MDA applied within five miles of the airport when, in fact, it didn't apply until 3.1 miles from the airport. It's also possible they weren't using the approach chart; instead relying on their recollection of the approach procedure—this is speculation at best, however.

The crew made one call on the CTAF

The tower hit by the Citation is 3.46 nm from the Runway 17 threshold. If this were an ILS approach, and an obstacle were within the primary area of the ILS final segment 3.46 miles before the runway, a 3-degree glideslope would be at 1,158 feet msl. The maximum allowable height of an obstacle applying ILS criteria would be 618 feet msl. The required obstacle clearance would be 540 feet vs. 250 feet for the VOR/DME Rwy 17 IAP, and with a rock-solid electronic glideslope vs. the relative fallible use of a barometric altimeter for vertical clearance.

after getting cleared for the approach. There was no response. Although the weather conditions cannot be inferred with certainty, it's reasonable to assume the Citation was still in IMC nearing the step-down altitude of 980 feet. This should have been a "heads up" to fully mind the store, and to fly the approach carefully and in full conformance with the approach chart.

If the crew had the chart available, it should have been the Jeppesen chart in effect on the day of the crash, based on the fact the crew used Jeppesen charts. The Jepp chart (unlike the NOS obscure portrayal of the 715-foot tower) clearly showed the tower in the same graphical manner as the later chart on page 3. This should have been a real clue as to the purpose of the step-down altitude.

Even had the tower not been charted, proper use of the step-down fix would have handily avoided the accident. *Proper* use of the step-down requirement would have meant the minimum altitude from TIOFF to D7.7 was 1,060 feet, not 980 feet because the local altimeter setting was not available (note the charted Ft. Myers' remote altimeter setting requirements both for crossing the step-down fix and for minimums). This point was glossed over by the NTSB in its accident report.

The correct MDA would have been 500 feet after the step-down fix, because the crew intended to circle-to-land on Runway 35. Had the crew flown 1,060 feet to 7.7 DME, followed by a descent to 500 feet until the MAP, it's likely they would have seen the airport before the MAP, at which time they could have departed the electronic guidance for a visual circle-to-land maneuver when within one mile or so of the MAP.

No visual options

The two visual alternatives to a full IAP (contact or visual approach) weren't available to the Citation crew. A contact approach couldn't have been approved because there was no weather report for MKY. Also, ATC couldn't have approved a visual approach unless the crew had reported the airport in sight. In any case, either a visual or con-

tact approach would have been the height of folly under the circumstances.

Nonetheless, it appears the crew attempted a “quasi” visual approach. FAR 91.175 clearly required adherence to the full IAP until the flight had the required visual references, and the aircraft was either in a position to make a normal descent for a straight-in landing on Runway 17, or it was in position at or above the circling MDA to visually enter the circling maneuvering area when within approximately one mile of the airport. At circling MDA, and within about one mile of the airport, the crew could have elected to circle to either Runway 35 or Runway 17, provided they made their intentions clear on CTAF. (For further reading on circling approaches, see “Circling and the Visual Segment” January 1996, *IFRR*.)

The 700-foot tower is located approximately 3.5 nm northwest of the approach end of Runway 17. It’s approximately 5,000 feet right of the extended runway centerline, and about 2,000 feet left of the VOR/DME RWY 17 final approach course radial. After the accident, the FAA received two letters requesting that the tower be relocated to a point further from the airport. One letter was from the airport operator. The other letter was written by a retired airline pilot-user of the airport, who wrote directly to the FAA administrator.

The FAA reviewed the location and height of the tower, and determined it wasn’t hazardous at its present location and height. The tower was erected so long ago the FAA was unable to locate the original, formal determination of no hazard required by FAR 77.

The issue of tower height and location with respect to airports is both emotional and subjective. If this tower were directly on the extended runway centerline, perhaps the FAA’s expert view of safety risk would be different.

TERPs twist

From an instrument approach design aspect, however, I see an interesting twist: What are the human-factors implications of flying only 250 feet over the top of a tower in IMC, when the

airport environment is a flatland place like Florida? If a pilot flew 250 feet over the top of a 700-foot agl tower on a clear day, and an FAA inspector saw it, would there be an FAR 91.13 or FAR 91.119(c) enforcement action?

Also, take a close look at the geometry in this case: the VOR/DME final was offset 23 degrees right of the runway centerline. Yet, the tower is to the left of the nominal centerline of the electronic flight-path. This means any visual correction to align with the runway could take an airplane over the tower if weather conditions permitted an early departure from the final approach course. The TERPs criteria simply don’t address such obstacle/human-factors nuances.

IFRR made a Freedom of Information Act request for the files associated with the MKY IAPs. One internal FAA comment that piqued our interest was in response to the two letters requesting that the tower be moved. This memo was from the IAP design branch to the FAA regional staff handling the letters: “TERPs criteria is [sic] developed to accommodate the worst of mountainous terrain conditions and this tower and the resulting procedure are [sic] within ‘normal’ rather than ‘extreme’ criteria. There is no TERPs reason to relocate this tower and the procedure is still sound.”

(What constitutes “normal” and “extreme” TERPs criteria escapes me.)

The framers of TERPs criteria always hoped the FAA procedure designers would not use the cookie-cutter method of approach procedure design. Whether the treatment of this tower with respect to the VOR/DME RWY 17 IAP represents a cookie-cutter application of criteria I’ll leave for you to ponder. Further, for those of you with a working knowledge of TERPs, what about maxing out descent gradients in the final segment for sake of the highest possible altitude over the tower?

Really big lessons

The first lesson to be gleaned out of this accident is the knowledge and discipline that must be used on every IAP,

especially on non-precision IAPs to airports where the pilot has less than intimate familiarity with all terrain and manmade obstacles. The second profound lesson is towers that aren’t protected by a step-down fix can sometimes be lurking slightly more than 250 feet below MDA, and might not even appear on the approach chart. (For more on this, see “What’s Below MDA and DH?” April, 1996 *IFRR*.)

The minimums increased at MKY in the present IAPs because of a new high-rise resort building west of the airport. The builder agreed to install a non-federal LOC/DME IAP, which will again lower minimums and provide much better approach alignment. That IAP should be in the books by the time this article is published.

The VOR/DME RWY 17 final approach radial was realigned because of magnetic and VOR station changes. The 7.7 DME step-down fix was moved to 7.8 DME, because the 7.7 DME fix didn’t provide full fix displacement protection as required by TERPs for DME fixes. The NTSB missed this fact, although the slight fix charting error in no way contributed to this accident.

Wally Roberts is a retired airline captain, former chairman of the ALPA Terps Committee, and an active CFII in San Clemente, CA. Visit Wally’s website at <http://www.terps.com>

Editor’s note: The NTSB determined the probable cause of this accident was “the pilot’s disregard for the MDA for a specific segment of the VOR/DME approach...”

In reality, both pilots disregarded the minimum altitude (not the MDA) for the approach segment from TIOFF to the 7.7 DME Fix. The pilots were only authorized to descend to the applicable MDA *after* crossing the step-down fix. Using the Ft. Myers altimeter, they should have maintained 1,060 feet from TIOFF to 7.7 DME, then descended to the MDA of 500 feet in order to circle to Runway 35.