In response to aviation industry concerns over cold weather altimetry errors, AFS-400 sponsored an analysis to determine if current 14 CFR Part 97 instrument approach procedures in the United States National Airspace System (NAS) are at risk during cold temperature operations. MITRE's Center for Advanced Aviation System Development (CAASD) conducted the study. Beginning in 2008 MITRE analyzed instrument procedures at 1,754 airports. Over 26,000 instrument approach segments were reviewed.

The study used the coldest recorded temperature for analyzed airports in the last five years, and specifically investigated if there was a probability that expected altitude errors in a barometric altimetry system, during these less than standard day operations, could exceed the Required Obstacle Clearance (ROC) used on procedure segment altitudes. If the probability of ROC being exceeded went above one percent on any segment of an approach, a temperature restriction was applied to the segment. However, the probability of the ROC being exceeded precisely at an obstacle position is extremely low, providing an even greater safety margin. In general, application of these minimum operating temperatures should have a low impact on availability of procedures. Of over 3,000 airports analyzed, only 284 had approach segments that had the potential to have its ROC exceeded on any approach segment. According to the study "seventy-five percent of the affected procedures / airports have experienced less than one percent of days when the temperature went below the operational limit over the past five years."

Altimeter errors are introduced when temperatures are different than standard. During operations when the temperature is above the standard, an aircraft's true altitude (actual height above the ground) will be higher than the indicated altitude on the aircraft's altimeter. When the ambient temperature is below the standard temperature, the aircraft's true altitude is lower than the indicated altitude.

The critical situation is during operations when the temperature is below the standard temperature. Operating into airports at temperatures below the standard temperature combined with other possible altimetry errors can place the aircraft too close to the ground and create a hazard. When using Baro-VNAV, cold temperatures reduce the glide path angle putting the aircraft closer to obstacles and the ground. The current charted temperature limits on RNAV approaches were evaluated for the final approach segment only. These approaches may only be flown at or beneath the charted temperature restriction with a compensating aircraft. These temperature restrictions must be adhered to in addition to applying cold temperature compensation. Pilots without temperature compensating aircraft are responsible to calculate and make a manual cold temperature altitude correction to the designated segment or segments of the approach.

Unlike many ICAO member states, the United States Air Force and Canada, the Federal Aviation Administration does not require pilots to compensate for cold temperature operations. Paragraph 7-2-3 Altimeter Errors discusses the issues surrounding altimetry errors when pilots are flying into areas of lower atmospheric pressures and temperatures below standard day. Paragraph 7-2-3e ends with the following statement: "When operating in extreme cold temperatures, pilots **may** [emphasis added] wish to compensate for the reduction in terrain clearance by adding a cold temperature correction."

Based on the AFS-400 analysis, the FAA is proposing that at 284 specifically designated airports pilots apply a cold temperature altitude correction to published Standard Instrument Approach Procedure altitudes when the ambient temperature reaches a predetermined level. The initial

number of airports, 284, are based on airports with runway lengths of 2,500 feet and greater and applying the MITRE model. In response to this new AFS procedure, ATO will create a DCP to the AIM, Chapter 5, Air Traffic Procedures.

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A list of "Cold Temperature Restricted Airports" designated with a temperature restrictions during cold temperature operations and guidance on when and how to calculate and apply altitude corrections to affected 14 CFR Part 97 approach segments may also be found at the bottom right corner of the http://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/dtpp/ digital - Terminal Procedures Search page.

Pilots **without** temperature compensating aircraft are responsible to calculate and make a manual cold temperature altitude correction to the designated segment or segments of the approach using the AIM 7-2-3, ICAO Cold Temperature Error Table. Use the 5000 ft column from the table for calculating corrections at "height above airport" greater than 5000ft. No interpolation above the 5000 ft required. Pilots will add correction from table to segment altitude/s and fly at the new altitude. DO NOT make an ALTIMETER change to accomplish altitude correction.
Pilots **with** temperature compensating aircraft must ensure the system is on and operating for each designated segment. Pilots must ensure they are flying at corrected altitude. If the system is not operating, the pilot is responsible to calculate and apply a manual cold weather altitude correction using the AIM 7-2-3 ICAO Cold Temperature Error Table. DO NOT make an ALTIMETER change to accomplish altitude correction.

The altitude correction will be applied to the indicated segments (see list below), on all procedures, to all runways at the airport, when the reported airport temperature is at or below the airport cold temperature restriction. Authorization to apply a cold temperature altitude restriction to an individual runway will be identified by EXCEPTION: The airport/s and runway/s listed below have been approved for an exception.

Cold Temperature Designated Airports: Airports are listed by ICAO code, Airport Name, Temperature Restriction in Celsius/Fahrenheit and affected Segment. One temperature may apply to multiple segments. *Italicized airports have two segments with a different temperature restriction. The warmest temperature will be indicated on Airport IAPs next to a snowflake symbol,* ❄ -35°C *, in the United States Terminal Procedure Publication.*

Intermediate Segment: Calculate and apply correction to all altitudes in intermediate segment when reported airport temperature is at or below the temperature restriction. This includes FAF altitude.

Final Segment: Calculate and apply correction to all altitudes in the final segment when reported airport temperature is at or below the temperature restriction. This includes step down fixes and minimums. A correction may be added to the FAF altitude if desired, but is not required.

Missed Approach Segment: Calculate and apply correction to all altitudes in the missed approach segment when reported airport temperature is at or below the temperature restriction.

Identifier	Airport Name	Temperature	Intermediate	Final	Missed App
Alaska					
PABL	Buckland	-38C/-36F	X		
PABR	Wiley Post-Will Rogers	-41C/-42F	X		
PABT	Bettles	-51C/-60F	X		
PACH	Chuathbaluk	-38C/-36F	X		
PACI	Chalkyitsik	-32C/-26F	X		
PACM	Scammon Bay	-35C/-31F	X		
PACV	Merle K (Mudhole) Smith	-21C/-6F	X		
PACX	Coldfoot	-10C/14F	X		
PADE	Deering	-24C/-11F	X		
PADK	Adak	-17C/1F		X	
PADL	Dillingham	-37C/-35F	X		
PADM	Marshall Don Hunter Sr	-21C/-6F	X		
PAEN	Kenai	-31C/-24F	X		
PAFA	Fairbanks Intl	-20C/-4F	X		
PAFM	Ambler	-43C/-45F	X		
PAFS	Nikolai	-22C/-8F	X		
PAGA	Edward G. Pitka Sr.	-33C/-27F	X		
PAGH	Shungnak	-19C/-2F	X		
PAGL	*Golovin*	-20C/-4F	X		
PAGL	*Golovin*	-29C/-20F			X
PAGM	Gambell	-35C/-31F	X		
PAGS	Gustavas	-24C/-11F	X		
PAHC	Holy Cross	-28C/-18F	X		
PAHL	Huslia	-31C/-24F	X		
PAHO	Homer	-24C/-11F	X		
PAHX	Shageluk	-36C/-33F	X		
PAII	Egegik	-39C/-38F	X		
PAIK	Bob Baker Memorial	-21C/-6F	X		
PAIL	Iliamna	-18C/0F	X		
PAJN	Juneau Intl	-22C/-8F	X		
PAKA	Tatitlek	-19C/-2F	X		
PAKK	Koyuk Alfred Adams	-34C/-29F	X		
PAKP	Anaktuvuk	-6C/21F	X		
PAKT	Ketchikan Intl	-11C/12F	X		
PAKU	Ugnu-Kuparuk	-44C/-47F	X		
PAKV	Kaltag	-20C/-4F	X	X	
PAKW	Klawock	-11C/12F		X	

PALG	Kalskag	-40C/-40F	X		
PALP	Alpine Airstrip	-40C/-40F	X		
PAMB	Manokotak	-32C/-26F	X		
PAMC	McGrath	-24C/-11F	X		
PAMH	Minchumina	-24C/-11F	X		
PAMK	St Michael	-36C/-33F	X		
PAMY	Mekoryuk	-33C/-27F	X		
PANA	Napakiak	-37C/-35F	X		
PANI	*Aniak*	-23C/-9F		X	
PANI	*Aniak*	-33C/-27F	X		
PANN	Nenana Muni	-33C/-27F	X		
PANO	Nondalton	-12C/10F	X		
PANU	Nulato	-28C/-18F	X		
PANV	Anvik	-31C/-24F	X		
PAOM	Nome	-31C/-24F	X		
PAOO	Toksook Bay	-40C/-40F	X		
PAOR	Northway	-19C/-2F	X		
PAOT	Ralph Wien Memorial	-43C/-45F	X		
PAPG	Petersburg James A Johnson	-11C/12F	X		
PAQH	*Quinhagak*	-16C/3F	X		
PAQH	*Quinhagak*	-32C/-26F			X
PAQT	Nuiqsut	-41C/-42F	X		
PARS	Russian Mission	-15C/5F	X		
PARY	Ruby	-33C/-27F	X		
PASA	Savoonga	-27C/-17F	X		
PASC	Deadhorse	-45C/-49F	X		
PASH	Shishmaref	-40C/-40F	X		
PASK	Selawik	-43C/-45F	X		
PATA	Ralph M Calhoun Memorial	-32C/-26F	X		
PATE	Teller	-39C/-38F	X		
PATG	Togiak	-26C/-15F	X		
PATK	Talkeetna	-26C/-15F	X		
PATQ	Atqasuk Edward Burnell Sr. Mem	-35C/-31F	X		
PAUN	Unalakleet	-38C/-36F	X		
PAUO	Willow	-35C/-31F	X		
PAVC	King Cove	-13C/9F	X		
PAVL	Kivalina	-33C/-27F	X		
PAWB	Beaver	-41C/-42F	X		
PAWD	Seward	-3C/27F	X		

PAWG	Wrangell	-10C/14F	X		
PAWI	Wainwright	-41C/-42F	X		
PFAL	Allakaket	-34C/-29F	X		
PFEL	Elim	-27C/-17F	X		
PFKK	Kokhanok	-16C/3F	X		
PFKW	Kwethluk	-37C/-35F	X		
PFNO	Robert (Bob) Curtis Memorial	-16C/3F	X		
PFSH	Shaktoolik	-24C/-11F	X		
PFTO	Tok Junction	-19C/-2F	X		
PFYU	Fort Yukon	-45C/-49F	X		
PPIZ	Point Lay LRRS	-33C/-27F	X		