Aviation Investigation Final Report

Location:	Jackson, Wyoming	**Incident Number:**	WPR11IA055
Date & Time:	November 22, 2010, 09:29 Local	**Registration:**	N718QS
Aircraft:	ISRAEL AIRCRAFT INDUSTRIES GULFSTREAM 200	**Aircraft Damage:**	None
Defining Event:	Runway excursion	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

The flight crew reported that, prior to the flight, they were initially delayed due to weather and low runway friction values (MU) at their intended destination. (MU values range from 0 and 100, where 0 is the lowest friction value and 100 is the maximum friction value. A MU value of 40 or less is the level at which aircraft braking performance starts to deteriorate and directional control begins to be less responsive.) Dispatch personnel later reported that the conditions had improved and that the crew was released for the flight. While en route, the crew monitored weather and runway conditions at the destination airport and calculated the required landing distances, which they found to be within acceptable limits for the reported MU values of 41, 37, and 36.

About 10 minutes before landing, MU values were reported as 40, 42, and 40, with patchy thin snow over patchy thin packed snow and ice on the runway surface. The flight crew received these MU values, continued their approach to the airport, and landed. During the landing roll, thrust reversers were deployed, and the crew noted that all of the ground and air slat indication lights were green and that the anti-skid system began to pulse; however, the airplane was not slowing down. Despite the application of maximum thrust reverse, there was no effect on slowing the airplane, and it exited the departure end of the 6,300-foot runway and came to rest just beyond the blast pad. The flight crew reported no mechanical malfunctions or failures with the airplane that would have precluded normal operation. About 7 minutes after the runway overrun, MU values were recorded as 34, 33, and 23. As indicated by the MU values reported just prior to landing, and the lower values reported shortly after landing, the landing was made at a time when the runway conditions were deteriorating, and the braking performance was becoming less effective.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: The flight crew's inability to stop the airplane during landing roll on a snow- and ice-contaminated runway. Contributing to the runway overrun were the deteriorating runway conditions.

Findings

Aircraft	Surface speed/braking - Attain/maintain not possible
Environmental issues	Snow/slush/ice covered surface - Contributed to outcome

Factual Information

History of Flight

Landing-landing roll	Runway excursion (Defining event)

On November 22, 2010, about 0929 mountain standard time, an Israel Aircraft Industries Gulfstream 200 airplane, N718QS, was undamaged during a runway overrun at the Jackson Hole Airport (JAC), Jackson, Wyoming. The airplane was registered to Net Jet's Sales Inc., Oklahoma City, Oklahoma, and operated by Net Jets Inc., Columbus, Ohio, under Title 14 Code of Federal Regulations Part 91. The airline transport rated captain, who was the flying pilot and airline transport rated first officer were not injured. Instrument meteorological conditions prevailed and an instrument flight rules (IFR) flight plan was filed for the repositioning flight. The cross-country flight originated from Bozeman, Montana, at 0837, with an intended destination of JAC.

In a written statement, the captain reported that earlier in the morning the flight was delayed due to the weather and runway surface friction report values (MU) in the 20s at JAC. About an hour later, the flight crew received company clearance for the flight, noting MU values were in the 40s. Following an uneventful flight, the flight crew received the weather conditions at JAC from the airport's automated terminal information service (ATIS), noting that weather and runway conditions were acceptable for the approach and landing. The flight crew continued the approach to the airport and changed frequencies to the air traffic control tower (ATCT). The captain stated that a previous aircraft on approach reported that they had descended out of the clouds about one and one-half miles from the airport and that runway braking action was fair.

The captain further reported that upon landing on runway 19, they deployed the thrust reversers and noted that all of the ground/air slat indication lights were green and that the anti-skid system began to pulse; however, the airplane was not slowing. The captain said that he applied maximum thrust reverse with no effect on slowing down. As the airplane approached the departure end of runway 19, he realized that the airplane was not going to stop before exiting the end of the runway and initiated a slight turn to the right to avoid runway approach lighting. Subsequently, the airplane came to rest about 25-feet beyond a 338-foot long blast pad.

In a written statement, the first officer reported during the flight to JAC, the flight received delayed vectors for traffic sequencing and obtained runway MU values of 41, 37, and 36, and completed the approach and arrival checklists in addition to calculating landing distances. The first officer stated that about 10 minutes prior to landing on runway 19, the tower reported that runway braking action was a MU reading of 40, 42, and 40. Upon landing, ground airbrakes and thrust reversers were deployed and brakes were applied. The first officer noted

that deceleration was slow despite maximum thrust-reverse. Following the runway overrun, the flight crew conducted the after landing and shutdown checklists, and exited the airplane. Upon exiting the airplane the first officer conducted a walk-around, noting no damage and that the airplane was on a hard surface. He then walked to the departure end of runway 19 to evaluate the runway surface conditions and noted that the runway appeared to be covered by clear ice as far down the runway as he could see.

The flight crew reported no mechanical malfunctions or failures with the airplane that would have precluded normal operation.

Review of the ATCT recordings revealed that about 5 minutes 47 seconds prior to the runway overrun, the airport Saab vehicle (vehicle used to take runway friction measurements) operator reported to the ATCT controller that the MU values were 40, 42, and 40, with patchy thin snow over patchy thin packed snow and ice. The flight crew contacted the controller about 54 seconds after the updated runway conditions were reported.

About 3 minutes 48 seconds prior to the runway overrun, a pilot of a Piper Meridian reported the runway was “a little bit slick out here” and that braking action report of was poor to fair. The flight crew of the Gulfstream acknowledged the pilot report 28 seconds later to the ATCT controller. About 1 minute 23 seconds before the runway overrun, the controller informed the crew of the Gulfstream that MU’s were in the 40s, however braking action reports were not quite reflecting that. The crew of The Gulfstream acknowledged the controller's transmission shortly thereafter. The flight crew reported obtaining visual contact about 1.8 miles from the runway at an altitude of 7,000 feet mean sea level (msl). During the landing overrun, the flight crew reported braking action nil to poor.

Review of recordings from the cockpit voice recorder revealed that the flight crew discussed the airport conditions and verified that they had sufficient landing distances. The flight crew estimated that a worst case scenario for landing distance was 5,877 feet with a landing configuration of 40 degrees of flaps, de-ice and anti-ice on.

The Jackson Hole Airport (JAC) features a single 6,300-foot long and 150-foot wide runway, which was paved with porous friction course (PFC) asphalt, and had high-intensity runway edge lighting installed. The runway also had precision instrument markings, medium intensity approach lighting systems (MALS), and precision approach path indicators (PAPI, set at 3 degrees), for operations on both Runway 01 and Runway 19. Runway 19 was equipped with an instrument landing system (ILS). The runway had lighted distance remaining signs, every 1,000 feet, in both directions. Both runway ends had runway safety areas measuring 500 feet by 1,000 feet beyond the thresholds. The runway also had 300-foot concrete blast pads extending beyond the thresholds at both ends. The runway slope was -0.6 percent, from north to south, with a drop in elevation of 38 feet over the 6,300 foot runway length. JAC utilizes two devices to assess runway friction values, including a Saab 9-5 SFT vehicle and Tapley decelerometer. The results of friction tests are subsequently relayed to the air traffic control tower.

Review of airport snow removal operations by a National Transportation Safety Board Survival Factors Specialist revealed that snow removal activities at JAC had been ongoing due to the snow and that “brooms and plows” were used. Review of Notices to Airman issued by JAC revealed that at 0630, runway 19 MU values were reported as 41, 37, 36 with patchy thin snow over patchy thin packed snow and ice on the runway surface. At 0920, MU values were reported as 40, 42, 40, with patchy thin snow over patchy thin packed snow and ice on the runway surface. Review of printouts from the Saab SFT revealed that at 0936, MU values for runway 19 were recorded as 34, 33, and 23.

The Federal Aviation Administration (FAA) Aeronautical Information Manual, Chapter 4, section 3, part 4-3-9, subpart B, states "The greek letter MU (pronounced "myew"), is used to designate a friction value representing runway surface conditions. " Subpart C states in part "…MU (friction) values range from 0 to 100 where zero is the lowest friction value and 100 is the maximum friction value obtainable. For frozen contaminants on runway surfaces, a MU value of 40 or less is the level when the aircraft braking performance starts to deteriorate and directional control begins to be less responsive. The lower the MU value, the less effective braking performance becomes and the more difficult directional control becomes. " Subpart G states in part "...No correlation has been established between MU values and the descriptive terms "good," "fair," "poor," and "nil" used in braking action reports."

Review of the company Flight Operations Manual (FOM) revealed that in section 2.4.10, Additional Requirements – Takeoff and/or Landing Operations, part 2, subpart B, states in part "… if current weather or runway surface conditions, the aircraft's status, or any other relevant factor, has worsened significantly from that used in landing distance planning (for release), and the worsened condition(s) would have a significant negative impact on the 'Actual Landing Distance' ...the Flightcrew shall calculate the 'Actual Landing Distance' for the current existing conditions, using AFM data. To this calculated 'Actual Landing Distance' is added a 15% safety margin. The 'actual landing distance' plus the 15% safety margin must allow for landing within the available length of the intended runway." In addition, part 4 states in part "...any 'braking action report' used to make a determination affecting landing of a NJA, Inc. aircraft must be from a similar aircraft. This would encompass turbojet powered aircraft of at least similar size to a Citation V up to and including Gulfstream IV/V or; a turboprop aircraft of at least similar size to a Beech/Raytheon King Air up to and including commuter-type turboprop powered airplanes."

Review of recorded weather data at JAC revealed a special weather observation report (SPECI) was recorded at 0920, reporting wind from 180 degrees at 11 knots, visibility one-half statute mile, light snow, blowing snow, broken ceiling at 500 feet, overcast cloud layer at 2,500 feet, temperature -7 degrees Celsius, dew point -9 degrees Celsius, and an altimeter setting of 29.60 inches of Mercury. At 0955, the recorded weather observation indicated wind from 200 degrees at 13 knots, visibility one-half statue mile, light snow, blowing snow, broken ceiling at 500 feet, overcast cloud layer at 1,400 feet, temperature -6 degrees Celsius, dew point of -9 degrees Celsius, and an altimeter setting of 29.61 inches of Mercury.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	54,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	September 14, 2010
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 1, 2010
Flight Time:	10194 hours (Total, all aircraft), 2067 hours (Total, this make and model), 7563 hours (Pilot In Command, all aircraft), 32 hours (Last 90 days, all aircraft), 2 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Airline transport; Commercial	**Age:**	39,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	February 24, 2010
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 10, 2010
Flight Time:	6431 hours (Total, all aircraft), 1190 hours (Total, this make and model), 4031 hours (Pilot In Command, all aircraft), 95 hours (Last 90 days, all aircraft), 41 hours (Last 30 days, all aircraft), 7 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	ISRAEL AIRCRAFT INDUSTRIES	**Registration:**	N718QS
Model/Series:	GULFSTREAM 200	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	136
Landing Gear Type:	Retractable - Tricycle	**Seats:**	19
Date/Type of Last Inspection:	September 24, 2010 AAIP	**Certified Max Gross Wt.:**	35800 lbs
Time Since Last Inspection:	125 Hrs	**Engines:**	2 Turbo fan
Airframe Total Time:	3511 Hrs at time of accident	**Engine Manufacturer:**	P&W CANADA
ELT:	Installed, not activated	**Engine Model/Series:**	PW306A
Registered Owner:	NETJETS SALES INC	**Rated Power:**	6040 Lbs thrust
Operator:	NETJETS SALES INC	**Operating Certificate(s) Held:**	On-demand air taxi (135)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	JAC,6451 ft msl	**Distance from Accident Site:**	
Observation Time:	09:20 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	500 ft AGL	**Visibility**	0 miles
Lowest Ceiling:	Overcast / 2500 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	180°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.6 inches Hg	**Temperature/Dew Point:**	-7°C / -9°C
Precipitation and Obscuration:	N/A - Blowing - Snow		
Departure Point:	Bozeman, MT (BZN)	**Type of Flight Plan Filed:**	IFR
Destination:	Jackson, WY (JAC)	**Type of Clearance:**	IFR
Departure Time:	08:37 Local	**Type of Airspace:**	

Airport Information

Airport:	Jackson Hole Airport JAC	**Runway Surface Type:**	Asphalt
Airport Elevation:	6451 ft msl	**Runway Surface Condition:**	Ice;Slush covered;Snow;Wet
Runway Used:	19	**IFR Approach:**	ILS
Runway Length/Width:	6300 ft / 150 ft	**VFR Approach/Landing:**	Full stop;Straight-in

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	None
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	43.607223,-110.737503(est)

Administrative Information

Investigator In Charge (IIC):	Cawthra, Joshua
Additional Participating Persons:	Bruce Hansen; FAA FSDO; Casper, WY Paul McClaskey; Net Jets; Columbus, OH Suzy Danielson; Net Jets Association of Shared Aircraft Pilot's; Columbus, OH
Original Publish Date:	March 27, 2012
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=77858