Transportation Safety Board of Canada | Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A12A0082

RUNWAY OVERRUN

VOLGA-DNEPR AIRLINES
ILYUSHIN IL-76TD-90VD, RA-76511
ST. JOHN’S, NEWFOUNDLAND AND LABRADOR
13 AUGUST 2012

Canada

Aviation Investigation Report

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Summary

On 13 August 2012, a Volga-Dnepr Airlines Ilyushin IL-76TD-90VD aircraft (registration RA-76511, serial number 94-08), operating as flight VDA4118, departed Prestwick, Scotland, for St. John's International Airport, Newfoundland and Labrador, on a scheduled cargo flight with 10 crew members on board. An instrument landing system approach was carried out, and at 1612 Newfoundland Daylight Time, the aircraft touched down on Runway 11. Following touchdown, the crew was unable to stop the aircraft before it reached the end of the runway. The aircraft came to rest in the grass, the nose wheel approximately 640 feet beyond the end of the pavement. There were no injuries, and aircraft damage was limited to cuts and localized rubber melting on the main tires. The accident occurred in daylight hours. The runway overrun did not cause the emergency locator transmitter to activate.

Ce rapport est également disponible en français.

Factual Information

History of the Flight

Prior to descent, the crew carried out its pre-approach checks, noting that the weather at St. John's International Airport (CYYT) was suitable for landing. During the descent, the crew obtained the automatic terminal information service (ATIS) information HOTEL, which was as follows: wind 170° magnetic (M) at 3 knots, visibility 1 ½ statute miles (sm) in mist, and ceiling overcast at 300 feet above ground level (agl). Based on this information, and on the fact that Runway 11 was the longest runway, the crew decided to carry out an instrument landing system (ILS) approach to Runway 11.

Using a projected landing weight of 140 tonnes, the crew consulted the aircraft flight manual (AFM) performance charts, and the landing distance was calculated as 4068 feet (1240 m), which included a stopping distance of 2707 feet (825 m). [1]

In accordance with the AFM, the crew calculated an approach speed of 240 km/h. [2] The crew considered the possibility of turbulence and icing; to account for this, they adjusted the approach speed to 250 km/h.

At about 1610, [3] the aircraft was established on the ILS glideslope and localizer for Runway 11. About 2 minutes later, the crew visually acquired the runway. While on final approach, the crew received updated wind information (260°M at 5 knots) from the tower. This direction and speed would have resulted in a 3-knot tail wind, which was within the aircraft's limitations. Prior to crossing the threshold, the crew noted the runway was bare and wet with no standing water.

The aircraft crossed the threshold at an approximate height of 59 feet (18 m) [4] agl at 252 km/h (136 knots), with the power levers positioned at 29%. Almost immediately, the nose-up pitch angle increased, and the vertical descent rate was reduced. Approximately 3 seconds after crossing the threshold, the power levers were increased to 35% for 2 seconds. The levers were then reduced and reached idle 8 seconds after the aircraft crossed the threshold. At this time, the aircraft was approximately 2000 feet beyond the threshold and travelling at 241 km/h (130 knots). Seven seconds later, the aircraft touched down at 219 km/h (118 knots), 3570 feet

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1 This calculation is based on the use of 2 thrust reversers only.

2 Indicated airspeed, as recorded on the flight data recorder

3 All times are Newfoundland and Labrador Daylight Time (Coordinated Universal Time minus 2.5 hours).

4 The target crossing-height tolerance is 15 +/- 5 meters.

beyond the threshold. The aircraft then bounced, and 3 seconds later, landed 4220 feet [5] beyond the threshold [6] at 210 km/h (113 knots).

Within 2 seconds of landing, maximum reverse thrust on engines 1 and 4 [7] was applied, then the spoilers (speed brakes) were deployed. [8] About 13 seconds later, at about 117 km/h (63 knots) and 7360 feet beyond the threshold (1142 feet from the end), engines 1 and 4 were reduced [9] to 50% reverse thrust for 10 seconds, and then increased to maximum reverse again. Two seconds later, maximum reverse thrust was selected on engines 2 and 3. The aircraft departed the end of the runway about 2 seconds later, travelling at a speed of 74 km/h (40 knots). Maximum reverse on all 4 engines was maintained until the aircraft came to a stop 640 feet beyond the runway end.

Just prior to departing the end of the runway, the crew manoeuvred the aircraft to the right of the centreline to avoid the multiple rows of approach lights. The aircraft damaged 5 runway threshold lights and came to rest on the Runway 11 localizer service road about 50 feet from the localizer antenna, on a heading of about 064°M (Photo 1).

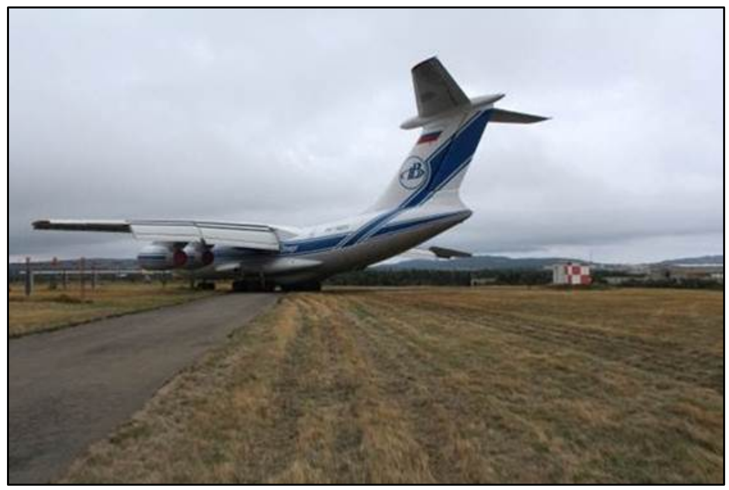

Photo 1. Occurrence aircraft in overrun area

After coming to a stop, the crew switched off the flight data recorder (FDR) and cockpit voice recorder (CVR) to preserve the information.

The CYYT rescue and firefighting services responded and were on scene about 3 minutes after the alarm sounded. [10]

Aircraft

The Ilyushin IL-76TD-90VD is a 4-engine heavy-cargo transport aircraft developed specifically for Volga-Dnepr Airlines (Volga-Dnepr). [11] The occurrence aircraft was manufactured by the Tashkent Aircraft Production Company, and Volga-Dnepr received the aircraft on

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5 The aircraft touchdown point was estimated based on flight data recorder (FDR) accelerometer data and has a tolerance of +/- 50 feet.

6 The common touchdown zone for the occurrence aircraft would be between 500 and 2000 feet from the threshold of the runway.

7 The aircraft flight manual (AFM) stipulates that reverse thrust is normally applied to the outboard engines (1 and 4).

8 The brake pressure was not recorded on the FDR.

9 The AFM requires that reverse thrust be reduced at a speed no less than 120 km/h.

10 The tower controller sounded the alarm at 1612.

11 The Volga-Dnepr Group has been involved in the IL-76TD-90VD upgrading program since 2002. The program includes outfitting the aircraft with PS-90A-76 engines and modern avionics. Volga-Dnepr is the only operator of this model aircraft.

27 April 2012. At the time of the occurrence, the aircraft had 175 flight hours and had completed 45 landings since new.

Records indicate that the aircraft was certified and maintained in accordance with existing regulations and approved procedures, and that there were no recorded deficiencies before the occurrence flight.

The aircraft was equipped with a NPO Pribor solid-state FDR (part number ZBN-1-3, serial number 0351) and a NPO Pribor solid-state CVR (part number ZBN-PTT, serial number 0039).

Aerodrome Information

St. John's International Airport has 3 asphalt runways. Runway 11/29 is 8502 feet long by 200 feet wide, and Runway 11 has a 0.27% downslope. Runway 16/34 is 7005 feet long by 200 feet wide. Runway 20/02 is 5028 feet long by 100 feet wide. Both Runways 11/29 and 16/34 are served by an ILS precision approach. Runway 11 has category 1 high-intensity approach lighting, runway centreline lighting, and a precision approach path indicator (PAPI) suitable for aircraft with an eye-to-wheel height of up to 45 feet. All these systems were serviceable at the time of the ocurrence. In addition, Runway 11 has a 60-meter unpaved runway end strip.

None of the runways at St. John's International Airport have a grooved surface or runway end safety area (RESA), nor are these required by regulations.

Main Wheel Tires

The aircraft was equipped with 4 main landing gear struts, each with 4 – 300 × 480 Model 1A tires.

According to the IL-76TD-90VD aircraft maintenance schedule (AMS), during the autumn-winter season (typically from 01 November to 30 April of the next year), it is recommended that at least 8 of the main tires have a tread pattern in which the 3 middle groove tracks have no less than 1-mm depth of tread remaining. The AMS does not identify a minimum tread depth for the main tires when the aircraft is operated during the spring-summer season (May to October).

Volga-Dnepr's master minimum equipment list (MMEL) [12] requires that at least 8 of the main tires—a minimum of 2 tires per landing gear strut—meet the AMS serviceability requirements.

In accordance with the AMS, tires are considered to be serviceable when they have no:

- mechanical damage or punctures in the outer rubber and cords;
- protector wear exposing cords;
- delamination of outer rubber;
- carcass delamination;
- chafing (identified during internal inspection);

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[12] A master minimum equipment list (MMEL) is an approved document created specifically to regulate the dispatch of an aircraft type with inoperative equipment. It establishes the aircraft equipment allowed to be inoperative under certain conditions for a specific type of aircraft.

- damaged carcass wires;
- cracks in outer rubber, exposing cords.

Prior to departing Prestwick Airport, Scotland, the condition of the tires was checked in accordance with the AMS requirement. No unacceptable damage was noted, and all of the tires were considered serviceable. Although the main wheel tires met the serviceability requirements, the Transportation Safety Board of Canada (TSB) noted that all 16 tires were worn to, or below, the tire tread wear indicators (Photo 2).

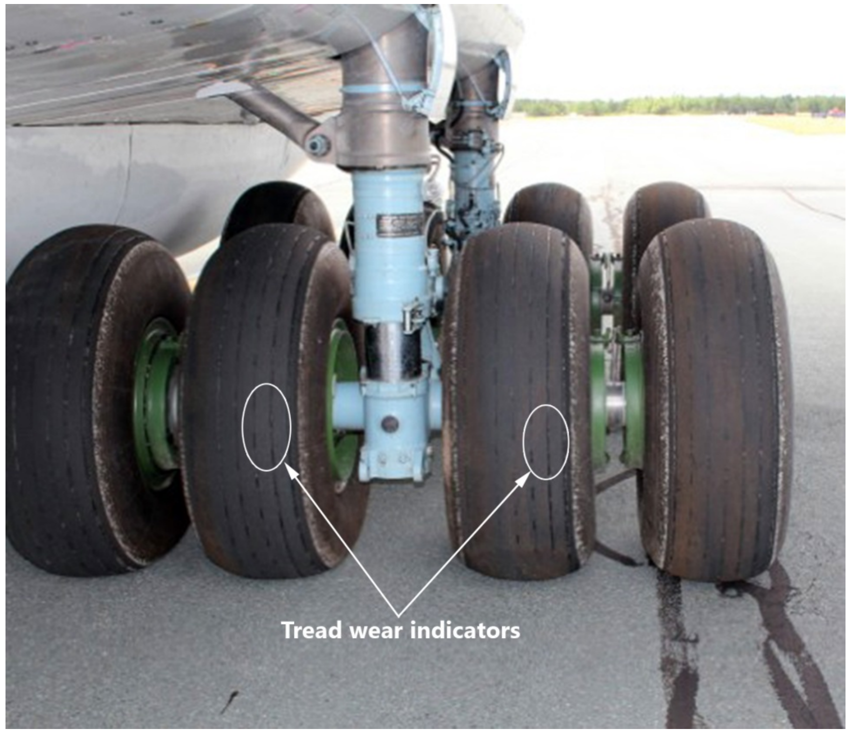

Photo 2. Right-side tires of the occurrence aircraft (after occurrence)

The tire/wheel positions are numbered from 1 to 8, from the left front row to the right front row, and 9 to 16, from the left rear row to the right rear row. A visual examination of the tires after the overrun identified signs of reverted rubber hydroplaning on 8 main tires: 2, 3, 5, 8, 10, 11, 14, and 15.

Braking System

On each main landing gear strut, hydraulic pressure is supplied from a single supply line to both inboard brakes, and by a separate supply line to the outboard brakes. When the brake system’s antiskid function detects an impending skid, the system is designed to release the brake pressure to the skidding tire and the mated pair.

During the company’s inspection of the aircraft’s braking system, which was completed after the occurrence, it was noted that when the antiskid protection function signaled a brake pressure release to an outboard wheel pair, the pressure was being released to the inboard wheel pair. Similarly, when the brake pressure release was signaled to the inboard wheel pair, the pressure was released to the outboard wheel pair.

Although the hydraulic pressure supply lines to the inboard and outboard brakes had been installed in accordance with the Tashkent Aircraft Production Company’s design assembly chart, the lines were installed incorrectly; the inboard brakes were connected to the hydraulic pressure supply line for the outboard brakes, and vice versa. Consequently, during antiskid operations, overall effective braking capability would be reduced, as the pressure would be released to wheels with effective braking.

Flight Crew

The captain and first officer held valid Russian pilot licences and medical certificates.There was no indication that incapacitation, physiological factors, or fatigue affected the crew's performance.

The captain had approximately 11 000 flight hours, including 3000 hours on type and 200 hours in the last 90 days. The first officer had approximately 7000 hours, including 2000 hours on type and 40 hours in the last 90 days.

This was the first time the crew had been to CYYT in almost a year, and the first time the captain had landed on Runway 11.

Volga-Dnepr

Established in 1990, Volga-Dnepr operates chartered freight services world-wide. Its fleet includes 10 Antonov An-124-100 Ruslan and 5 Ilyushin IL-76TD-90VD aircraft.

In 2002, Volga-Dnepr implemented a quality management system based on the International Organization for Standardization (ISO) 9001:2000 [13] international standard. In 2007, Volga-Dnepr was the first Russian airfreight company to pass the International Air Transport Association (IATA) Operational Safety Audit (IOSA) for compliance with new IATA standards. The company passed this audit for the second time in 2011 and obtained renewal of the IOSA registration until April 2013.

Regulatory oversight is carried out by the Russian Federation Federal Air Transport Agency (FATA).

Weather

At 1551, a special weather report (SPECI) was issued, but had not yet been uploaded to the ATIS. The report included the following information: wind 220°M at 2 knots, visibility 4 sm in mist, and ceiling broken at 500 feet agl. However, at 1612, prior to landing, the crew was provided with the following updated information : wind 260°M at 5 knots.

Tail Wind

FDR data indicated that the aircraft landed with an actual tail wind of about 13 knots. [14] Although this information is available on the aircraft's multi-function display, Volga-Dnepr

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[13] "ISO 9001:2000 specifies requirements for a quality management system where an organization needs to demonstrate its ability to consistently provide product that meets customer and applicable regulatory requirements […]" (International Organization for Standardization, ISO 9001:2000, "Quality management systems – Requirements)

[14] The average tail-wind component speed during the 15 seconds prior to initial touchdown was 12.95 knots.

required crews to use the automatic terminal information service and air traffic control information during their pre-landing preparations.

In accordance with the AFM performance charts, with a 13-knot tail wind, the actual landing distance would be 5184 feet (1580 m), which includes a stopping distance of 3608 feet (1100 m). Landing with the 13-knot tail wind would have increased the stopping distance by 901 feet (275 m).

The IL-76TD-90VD aircraft is certified to a maximum tail wind component of 5 meters per second (about 10 knots).

Hydroplaning

Hydroplaning occurs when a layer of water builds up between the aircraft tires and the runway surface, leading to a loss of traction. This build-up prevents the aircraft from responding to control inputs such as steering or braking. Smooth tread tires will induce hydroplaning with lower water depths. [15]

If the braking demand exceeds the tire/pavement friction capability, the tire loses its grip with the pavement and rapidly spins down to a locked-wheel condition. Prolonged wheel lockup can result in reverted rubber hydroplaning. This type of hydroplaning generates enough heat to change water into steam and to melt the tire rubber to its original uncured state (revert). Only this type of hydroplaning produces a clear burn mark on the tire tread and can leave steam cleaning marks on the runway.

Steam cleaning marks and fragments of melted tire rubber were found at various locations along Runway 11, which is indicative of reverted rubber hydroplaning.

Tire Tread Depth and Aircraft Braking

The National Aeronautics and Space Administration (NASA) conducted wet-runway braking tests in 1965. [16] On a wet runway, a gradual degradation of braking effectiveness was experienced up to about an 80%-worn tire-tread condition. Thereafter, the wet-runway friction coefficients decreased markedly. At higher speeds, the completely worn tire was observed to develop only about half of the braking effectiveness of a new tire.

The TSB has previously identified that tires worn in excess of 80% have contributed to a runway overrun. [17]

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15 Charles E. Dole, *Flight Theory for Pilots*, 2nd ed. (Institute of Safety and Safety Management, University of Southern California, USA).

16 National Aeronautics and Space Administration (NASA), *An Investigation of the Influence of Aircraft Tire-Tread Wear on Wet-Runway Braking* (1965).

17 TSB Aviation Investigation Report A11A0035.

Runway Friction

Transport Canada (TC) requires airport operators to periodically measure the friction characteristics of the runway surface. It is left up to the airport operators to conduct their own runway friction tests and establish the frequency of testing based on the unique history and circumstances of their site.

Both the macrotexture and microtexture characteristics of a pavement surface can significantly affect measured friction values. [18] Bulk water drainage through the macrotexture of the pavement delays hydroplaning to much higher speeds of travel than pavements with no or poor macrotexture. A good pavement microtexture is an important way of combating viscous hydroplaning. [19]

Runway surface testing at a speed of 65 km/h determines the overall condition of the pavement surface's macrotexture, while testing at a speed of 95 km/h provides an indication of the condition of the surface's microtexture. [20] Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5320-12C and the International Civil Aviation Organization (ICAO) *Airport Services Manual* recommend that a complete runway survey should include tests at both 65 km/h and 95 km/h. Both the FAA and ICAO identify a test water depth of 1.0 mm. [21] However, TC only requires that the test be carried out using a surface friction tester operating at 65 km/h under self-wetting conditions with a water depth of 0.5 mm.

The TSB has previously indicated that an incomplete runway friction survey increases the risk of wet runway hydroplaning because the runway's overall friction characteristics have not been fully assessed. [22]

In May 2012, runway friction testing was carried out at CYYT. The average full-length friction values on Runway 11-29, measured under TC test conditions, ranged between 57 and 79, depending on centreline offset. At a 6-m offset, which is more applicable to wide-body aircraft, the average friction value was 66.

Table 1. Transport Canada Maintenance Guidelines

Transport Canada maintenance guidelines	Average runway friction less than
Maintenance planning level	60
Maintenance action level	50

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18 The macrotexture is the coarse texture (e.g. aggregate) or an artificially-applied texture, such as grooving. The microtexture is the texture of the individual stones.

19 National Aeronautics and Space Administration (NASA), *Status of Runway Slipperiness Research*, 1976.

20 Federal Aviation Administration, Advisory Circular (AC) 150/5320-12C, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*, 1997.

21 International Civil Aviation Organization, *Airport Service Manual* (DOC 9137); Federal Aviation Administration, AC 150/5320-12C, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*, 1997.

22 TSB aviation investigation reports A10H0004, A11A0035, and A11H0003.

Testing was also performed with a water film depth of 1 mm. The average full-length friction values ranged from 53 to 74, depending on the centreline offset. At a 6-m offset, the average friction number was 65.

In August 2012, following the occurrence, expanded runway friction testing was conducted in accordance with TC test conditions and in relation to established FAA and ICAO guidelines. This testing was carried out with water film depths of 0.5 and 1.0 mm, at distances of 3 m, 6 m, and 15 m, left and right of the centreline. These tests were carried out at 65 km/h. For Runway 11/29, the average full-length friction values with a water film depth of 0.5 mm ranged from 54 to 79. In the case of a water film depth of 1.0 mm, the values ranged from 51 to 77, which are above the ICAO and FAA minimum action level of 50.

Additionally, tests were carried out at 95km/h, at a distance of 3 m left and right of Runway 11/29's centreline with a water film depth 1.0 mm. The average full-length friction value was 36, which is above the ICAO minimum action level of 34.

Runway End Safety Area

In March 2010, and again in June 2012, the TSB issued its Watchlist, which identifies the safety issues investigated by the TSB that pose the greatest risk to Canadians. Landing accidents and runway overruns was one of the safety issues identified. To mitigate the risk of runway overruns, the Watchlist highlights the importance of adequate safety areas beyond the end of the runway.

TC's technical publication entitled *Aerodromes Standards and Recommended Practices* (TP 312E) defines a RESA as, "an area symmetrical about the extended runway center line and adjacent to the end of the strip," intended "to reduce the risk of damage to an aeroplane undershooting or overrunning the runway and facilitate the movement of rescue and fire fighting vehicles." [23]

Current TC requirements for a RESA do not meet ICAO's 90-m standard practice, nor do they meet the 240-m recommended practice. TC has indicated its intention to harmonize its requirements with the current ICAO standard and has proposed a regulatory change. However, as of this writing, many airports throughout Canada lack the safety buffer provided by a RESA or an alternative means of stopping the aircraft that provides an equivalent level of safety, such as an engineered material arresting system.

Runway 11/29 at CYYT does not have a RESA, nor is this required by regulation.

Grooved Runways

TC has released AC No. 300-008, which provides information and guidance regarding the grooving of runway pavements. In particular, the document outlines factors determining the need for grooving, as well as grooving techniques, specifications, maintenance, and winter operations.

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[23] Transport Canada, *Aerodromes Standars and Recommended Practices* (TP 312) (1993).

Cutting or forming grooves in existing or new runways is a proven and effective technique of improving drainage, minimizing skids and drift, improving braking, and reducing the risk of hydroplaning. [24]

None of the runways at CYYT have grooved surfaces, nor are these surfaces required by regulation.

In numerous previous overrun occurrences, the TSB has identified that the use of non-grooved runways increases the risk of wet runway overruns due to a reduction in braking characteristics. [25]

TSB Laboratory Reports

The following TSB Laboratory report was completed:

LP 153/2012 – FDR/CVR Data Recovery and Analysis

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24 International Air Transportation Association, "Preventing Runway Excursions Landing on Wet/Contaminated Runways," 2011

25 TSB aviation investigations A05H0002, A10A0032, A10H0004, A11H0003, and A11A0035.

Analysis

The aircraft touched down with 4282 feet of runway remaining. The analysis will focus on why the aircraft was unable to stop in the remaining distance.

Landing

The runway lighting, precision approach path indicator, and instrument landing system were functioning normally. The approach was considered to be normal. After the aircraft crossed the runway threshold, touchdown did not occur in the recommended touchdown area and was delayed due to the crew-induced pitch change. The power levers did not reach idle until the aircraft was approximately 2000 feet beyond the threshold, resulting in a touchdown at 4220 feet. Reverse thrust was reduced when the aircraft was travelling at a speed of 63 knots, which is consistent with the aircraft flight manual instructions. However, at this time, the aircraft was about 1000 feet from the end of the runway. Subsequently, the crew used maximum reverse thrust on all 4 engines. This was not sufficient to stop the aircraft before it reached the end of the runway.

Tail Wind

Using a projected landing weight of 140 tonnes, and based on the wind information provided by the automatic terminal information service (170°M at 3 knots), the crew calculated the landing distance to be 4068 feet (1240 m), which included a stopping distance of 2707 feet (825 m). While on final approach, the crew received updated wind information (260°M at 5 knots) from the tower. This direction and speed would have resulted in a 3-knot tail wind, which was within the aircraft's limitations.

Based on data from the flight data recorder, the TSB determined that the aircraft actually experienced a 13-knot tail wind, which would have required a landing distance of 5184 feet, including a stopping distance of 3608 feet. The 13-knot tail wind would have increased the stopping distance by 901 feet.

Information on the tail wind was available to the crew via the multi-function display. This wind was in excess of the aircraft's tail-wind limitation.

Aircraft Brakes

During the landing roll, the aircraft experienced reverted rubber hydroplaning on 8 of the main tires. Because the hydraulic pressure supply lines were reversed, brake pressure was maintained on the tire that was skidding, but was released to the tires that had effective braking. The incorrect brake line installation reduced the effective braking capability, thereby extending the stopping distance.

Tread Wear

In this occurrence, all 16 of the main tires were worn in excess of 80%. Using tires that are more than 80% worn reduces wet runway traction, thereby increasing the risk of hydroplaning and possible runway overruns.

Runway Friction

Both the macrotexture and microtexture characteristics of a pavement surface can significantly affect its friction values. Both the Federal Aviation Administration (FAA) and the International Civil Aviation Organization (ICAO) recommend that a complete runway friction survey include tests at both 65 km/h (macrotexture condition) and 95 km/h (microtexture condition) at a water depth of 1.0 mm. However, Transport Canada (TC) does not require a water depth of 1.0 mm or microtexture condition testing to be carried out. Not carrying out a runway friction survey in accordance with ICAO and FAA criteria increases the risk of wet runway hydroplaning because the runway's overall friction characteristics have not been fully assessed.

Runway End Safety Area

Runway overruns are identified in the TSB's Watchlist as one of the top safety issues requiring further action. The Board has identified that an adequate safety area beyond the runway's end is a key measure to prevent damage and injuries resulting from overruns. While TC has indicated its intent to meet the current ICAO standard, this has not yet occurred. The lack of adequate runway end safety areas, or other engineered systems designed to stop aircraft that overrun, increases the risk of aircraft damage and passenger injuries.

Findings

Findings as to Causes and Contributing Factors

1. The occurrence aircraft landed with a tail wind that exceeded the aircraft manufacturer's limitations.

2. The combination of the tail wind and the fact that power levers were not reduced to idle until the aircraft was about 2000 feet beyond the threshold resulted in the aircraft landing approximately 4220 feet from the threshold, which reduced the available runway length to stop.

3. Excessive tread wear, a wet runway, and existing runway friction values resulted in hydroplaning, which reduced the effective braking capability.

4. The incorrect brake line installation reduced the effective braking capability, thereby extending the stopping distance.

5. Although the crew used maximum reverse thrust on all 4 engines with 1000 feet of runway remaining, this action was not sufficient to stop the aircraft before the end of the runway.

Findings as to Risk

1. Using tires that are more than 80% worn reduces wet runway traction, thereby increasing the risk of hydroplaning and possible runway overruns.

2. Not carrying out a runway friction survey in accordance with the International Civil Aviation Organization and the Federal Aviation Administration criteria increases the risk of wet runway hydroplaning because the runway's overall friction characteristics have not been fully assessed.

3. The lack of adequate runway end safety areas (RESA), or other engineered systems designed to stop aircraft that overrun, increases the risk of aircraft damage and passenger injuries.

Other Findings

1. The Ilyushin IL-76TD-90VD aircraft maintenance schedule does not identify a minimum tread depth for the main tires when the aircraft operates during the spring-summer season (May to October).

Safety Action

Safety Action Taken

Volga-Dnepr

Volga-Dnepr is working with the Tashkent Aircraft Production Company to resolve the discrepancy between what is shown on the brake line assembly chart and what is identified in the system design.

Volga-Dnepr introduced the following requirements: flight crews are to monitor the heading and wind speed using the multi-function indicator during the glideslope descent; a go-around is to be carried out whenever the tail wind limitations have been exceeded; and the captain will make a decision on the use of reverse thrust on all 4 engines in special cases.

St. John's International Airport Authority

In early October 2012, the airport authority performed runway texture improvement work (runway re-texturing) using specialized shotblasting equipment, which is designed to chip away at the runway surface to expose the aggregate.

After the runway re-texturing was completed, surface friction testing was again carried out. The measured average runway friction values on Runways 11/29 and 16/34 were significantly higher than the values from the previous test. The large increase in friction levels was attributed to the runway re-texturing, which was a successful way of restoring the surface texture.

Following the llyushin IL76 overrun of Runway 11, the St. John's International Airport Authority expanded its runway friction testing to meet criteria that are consistent with both Federal Aviation Administration and International Civil Aviation Organization practices.

This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 18 December 2013.

Visit the Transportation Safety Board's website (www.tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.