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INTERIM INCIDENT REPORT

NETJETS TRANSPORTES AÉREOS

HAWKER 800XP

CS-DRK

MOSCOW VNUKOVO AIRPORT
RUSSIA

February 11th, 2011

INTERIM INCIDENT REPORT Nr. 04/INCID/2011

NOTES

In accordance with Annex 13 to the Convention on International Civil Aviation Organization, Chicago 1944, with European Parliament & Council Regulation nr 996/2010, from 20/10/2010, and nr 3 of art 11th of Decree Law Nr 318/99, from 11th of August, the investigation, analysis, conclusions and recommendations of this report are not intended to apportion blame or liability but, and only, to determine the causes of such incident and formulate recommendations that may prevent its repetition and to spread the lessons retrieved and capable of prevent futures accidents.

This Interim report constitutes provisional information, based on findings gathered prior to its publication. It must be regarded as tentative and it is subject to alterations or corrections if, or when, new evidences are collected during investigation progress. The final report will be the official document containing definitive investigation results and will be published on GPIAA web page www.gpaaa.gov.pt.

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SYNOPSIS

On the 11th of February, 2011, by 10:50¹, NetJets Transportes Aéreos Hawker 800XP aircraft, s/n 258765, registration CS-DRK, flew from Warsaw (EPWA) on a position flight to Moscow Vnukovo (UUWW), from where it should initiate a commercial flight.

Approaching destination, the crew followed a visual pattern for runway 24 ILS interception, the weather being fine for such procedure. After selecting gear down, on base leg, the main gear locked down and showed two green lights, but the nose gear indicated red and alternate indication pin was not showing. Unable to configure the aircraft, after performing all recommended procedures, the crew elected to perform a controlled gear-up landing on the runway.

After landing, the crew exited through the over wing emergency window, uninjured, while the aircraft sustained minor damage.

¹ - All times referred in this report, except other information, are UTC times (Universal Coordinated Time). On that date, local time, in Portugal mainland, was equal to UTC time and in Russia it was equal to UTC+3 hours.

1. ORGANIZATION OF THE INVESTIGATION

1.1 Notification

GPIAA was notified by the operator, by phone at 13:30, with the information that a company “go-team” would leave to Moscow, that same day, by 17:00.

A few minutes later an online notification arrived (14:10) and a FAX message was sent to the Russian Investigation Authority, appointing state of registry ACCREP and notifying of company group of advisors and experts travelling to the site.

GPIAA received no answer from the Russian Investigation Authority but NetJets’ Team Leader contacted on the phone to inform that Russian Authorities will not investigate the incident and they were asking for a letter from Portuguese Investigation Authority requesting to delegate investigation powers, as per ICAO Annex 13, § 5.1.2, which was done.

Delegation of investigation powers was granted on the 14th of February.

Once delegation was obtain for the investigation, notifications were sent (that same day) to involved States’ Authorities, as per ICAO Annex 13, chap. 4.1, and to European Aviation Safety Agency (EASA), as per art 8th, nr 1, a) of Regulation (EU) Nr. 996/2010, from European Parliament & Council, inviting them to join the investigation.

Meanwhile, the Company Team, which travelled to Moscow Vnukovo Airport on the 11th of February, started the investigation on the 15th of February, after the aircraft was removed from outside and sheltered inside an hangar.

1.2 Investigation Team

On the 11th of February, 2011, air safety investigator António Alves was appointed as Accredited Representative of State of Registry, in order to assist Investigator In Charge, appointed by the State of Occurrence. Once the responsibility for the investigation was transferred to the State of Registry, he was then appointed as IIC and started to organize the investigation team, waiting for the ACCREP’s nomination.

As there were no nominations of ACCREPs, from the intervening States, and the IIC was unable to travel to Moscow, the operator’s “go-team” Leader, Mr. Nuno Aghdassi (Head of Flight Safety) was nominated to represent the IIC and lead the field investigation, reporting to the IIC. The other members (Hawker Fleet Manager, Course Administration & Scheduling Team Leader, Aircraft Maintenance Field Controller and Vice President Accounts) accompanied Mr. Aghdassi as experts and support team for initial field investigation activities.

1.3 Investigation Progress

Due the unavailability of the IIC to travel to Moscow, only company technical experts, led by Head of Flight Safety, participated in first evaluation of the situation, recovering available data and evidences, ascertaining forward steps for the investigation and defining required actions to have the aircraft flying again.

After these preliminary steps and recognizing the lack of means to progress with the investigation in Moscow, it was decided, in conjunction with manufacturer's experts, to repair the aircraft in order to perform a ferry flight (with the landing gear extended) to UK, where better conditions for dismantling and examination of nose landing gear and all associated parts could be provided.

After six months it was possible to perform that flight to Chester (UK) and park the aircraft at HBC maintenance & service plant, where it suffered a thorough inspection, with removal of the nose landing gear, which was later shipped to Hanley Smith, Ltd, for further tests, always under the oversight of the IIC representative and the participation of HBC field engineers.

Results from all those investigation steps are referred in chapter 2.

2. FACTUAL INFORMATION

2.1 History of the Flight

On the 11th of February, 2011, Hawker HS-125-800XP aircraft, s/n 258765, Portuguese registration CS-DRK, operating NetJets Flight Nr. NJE-760H, left Warsaw (EPWA) airport to Moscow Vnukovo (UUWW) airport, having on board two pilots, only.

Pilot Flying (PF) on that sector was PIC (male, 41years old, British, ATPL(A) and 1700 hours total flying experience, all on HS-125), assisted by the SIC (male, 44 years old, German, CPL(A), with 460 hours total flying experience, being 230 on HS-125), as Pilot Not Flying (PNF).

It was a nice winter day, with a light wind (240/08), visibility 8000m, scattered sky, temperature -11°C.

The crew flew a visual left hand pattern for intercepting runway 24 ILS. On base leg, landing gear was selected down but only two green lights, corresponding to main legs, lit-up, with nose gear showing red and indicator pin confirming nose gear up.

A go-around was initiated (keeping gear in position) and a “PAN” declared, requesting to proceed to a hold in VMC at 1800m altitude, to the south of the airport, where recommended AFM “Landing Gear Three Greens Not Indicated” checklist drill was initiated, being performed up to “AUX HYD SYSTEM...”

Aircraft control was handed-up to SIC and PIC established phone contact with Fleet Management to get some advice. Following that, gear was retracted and re-cycled (using normal hydraulic system), some high load manoeuvres were executed (putting positive and negative “g”) with no avail, after which a low pass was done for the tower to confirm gear position not down.

Returning to the hold, Aux. Hyd. System was used, resuming initial emergency checklist drill. When Aux. Hyd. Sys. handle was pulled, a “clunk” was felt from below the cockpit floor and the crew heard more wind noise coming from nose gear area. After some pumping (5 strokes) a hard pressure was noticed and the pump could not be actuated anymore, so the pilot stopped and checked the nose gear indication (still showing red).

In face of the situation (only two gears locked down) and having exhausted all means available to the crew to lower the nose gear, they opted for a gear up landing, restored Aux. Hyd. Sys. handle, retracted main landing gear and continued with checklist.

Tower was notified and requested to keep holding in order to burn maximum possible fuel, making the aircraft lighter for landing with a lower speed and to minimize damage.

The crew proceeded with aircraft preparation for a gear up landing, according emergency checklist, selected flaps 25 and the approach was briefed thoroughly.

Prior to start the approach a last attempt was done, trying to get all gear legs down, unsuccessfully.

Touchdown was accomplished at very low speed (820m from runway threshold) and the aircraft slid on the runway (480m), keeping centreline, but shacking hard as it was rolling on the centre lights, until it came to a stop (1700m to runway end), after which the crew evacuated the aircraft, unharmed, via emergency window, over the wing.

Airport fire services came immediately and sprayed foam on runway, under and around the aircraft, to avoid risk of fire (*picture nr 1*).



Picture Nr 1

2.2 Wreckage & Impact

First photos, taken on the runway show the aircraft almost intact, with cabin, wings, tail and engines undamaged (*pictures nr 1 & 2*). The aircraft slid for about 480m, on its belly, with wings levelled, on runway centreline and being subjected to abrasion effects, only.



Picture Nr 2

After the aircraft had been lifted and standing on its gear it was possible to access belly damage. Wings, fuselage (nose & rear sections), tail and engines didn't contact the ground and suffered no damage, only mid fuselage under skin was in contact with tarmac and impacted with runway centre lights, becoming eroded and losing some small metal parts, detached and spread along the runway, together with some antennas and drains located underneath the fuselage (*picture nr 3*).



Picture Nr 3

2.3 Tests & Research

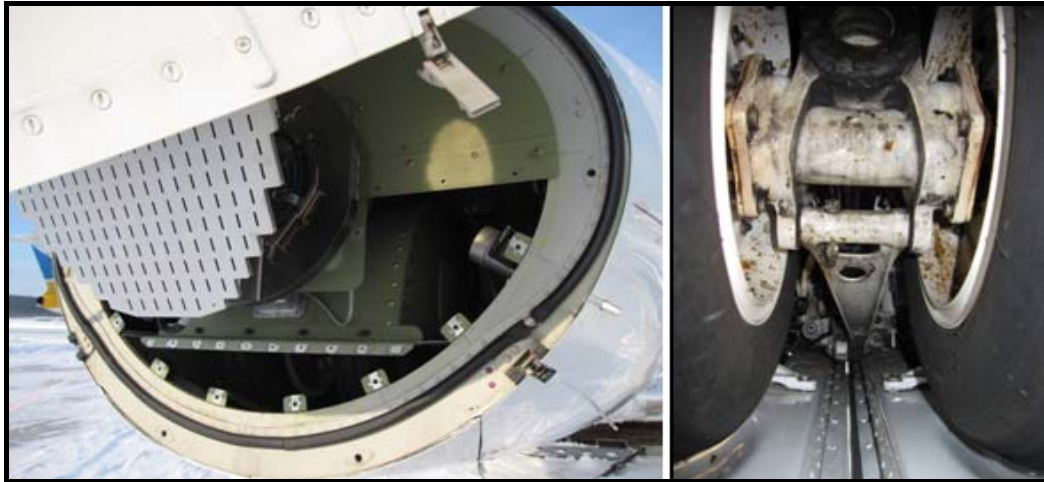
2.3.1 Moscow Examination & Preparation for Ferry Flight

The aircraft was recovered from the runway by means of a crane and skid which allowed the aircraft to be towed to a parking stand. However, in order to place the aircraft in a hangar, the gears had to be extended and this was done with the application of air cushions and jacks to raise the aircraft off the ground (*picture nr 4*).



Picture Nr 4

Before the aircraft was disturbed, the team on-site wanted to ascertain whether there were any visible defects or discrepancies with the nose landing gear in the wheel well. For this purpose, it was decided that access could be gained to that area by removing a panel forward and just below the weather radar antenna, which would allow investigators to look through and see the state of the retracted NLG (*picture nr 5*).



Picture Nr 5

Inspection of the NLG inside the wheel well did not reveal any damage or obstruction and the wheels were centred. Once the aircraft was ready for the gear to be extended, and upon the selection of the 'gear-down' command, the main landing gears initiated their normal extension sequence whilst the nose landing gear remained retracted. A firm tap on the external structure caused the NLG to suddenly extend and achieve full extension.



Picture Nr 6

Once the aircraft was positioned inside a hangar, a preliminary examination of the NLG was carried-out. To note, only the wear marks observed on the rear hinges of the NLG doors (*pic-*

ture nr 6). No other discrepancies were noted from both the visual inspection and the gear-swings performed in Moscow.

It was decided that, in order to perform further testing, the aircraft would have to be positioned to a location where type expertise and resources were readily available. The aircraft was repaired by technicians from the manufacturer's own maintenance service centre in preparation for an all-gears-down ferry flight to their facilities in Chester where further examination would take place. Explicit instructions were issued to avoid any interference with the NLG assembly during the repair in Moscow.

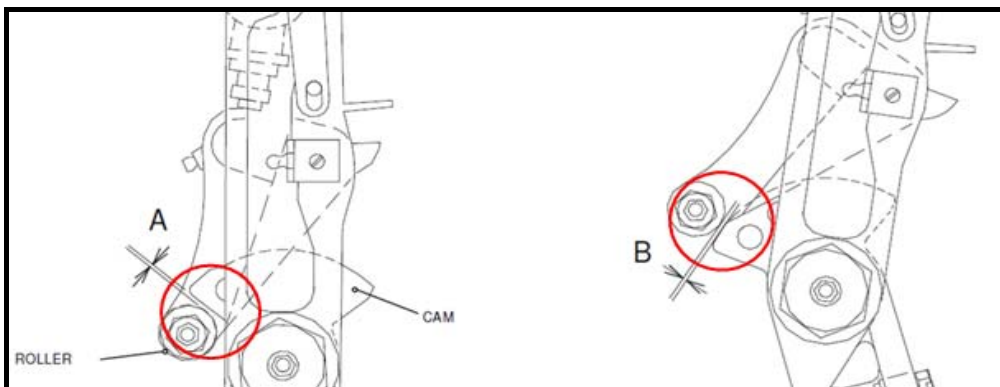
2.3.2 Reception at Chester & NLG General Inspection

Upon arrival in Chester, the aircraft was inspected by technicians from the manufacturer's local maintenance service centre. In addition to the wear marks observed on the rear hinges of the NLG doors, they also noted some scratch marks on the upper surface of the drag stay cam. Subsequent inspection also revealed similar marks on the end-face of the cam (*picture nr 7*).



Picture Nr 7

These scratch marks appear in the same region that one would expect tooling contact when rigging the drag stay roller clearances (A and B) set in the corresponding Aircraft Maintenance Manual (*picture nr 8*).



Picture Nr 8

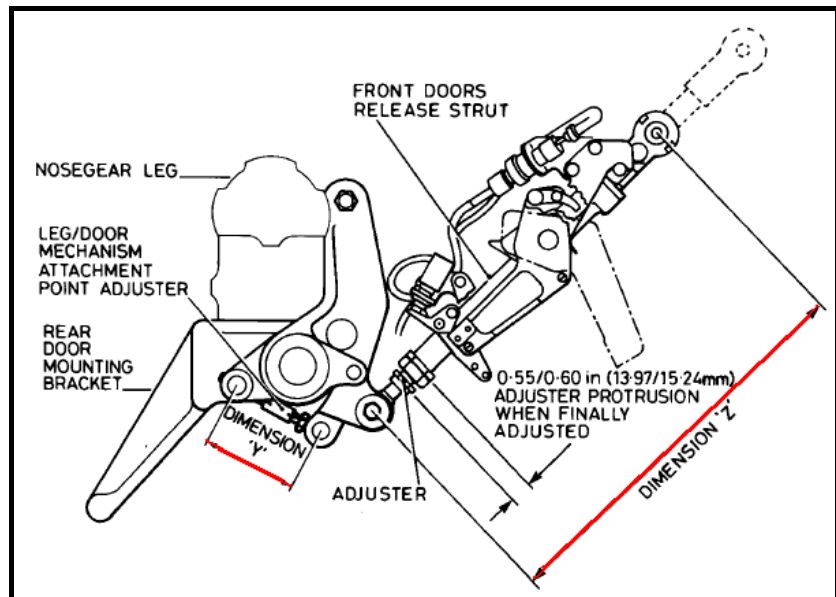
These scratch marks are likely to have been caused due to the use of incorrect tooling or technique when setting clearances A and B. Furthermore, it is unlikely that they would have any significant bearing on the event.

The drag stay clearances A and B were measured in Chester as per AMM XP 32-20-21-601 and the following values were recorded (*table nr 1*):

Clearance	Measured Value (in)	Tolerance (in)
A	0.010"	0.003 – 0.008"
B	0.026"	0.005 – 0.012"

Table Nr 1

Measurements were also taken of the nose gear door mechanism as per AMM 32-20-12-501 (*picture nr 9*). The release strut (Dimension Z) was found to be 11.197" (Tolerance 11.2 +/- 0.010"). Dimension Y was measured to be 2.197" (Tolerance 2.79 +/- 0.010"). The latter was out of tolerance.



Picture Nr 9

2.3.3 NLG Leg & Drag Stay Investigation

The NLG leg and Drag Stay were sent to an authorised and independent service centre for inspection. This took place with representatives of the manufacturer, their Chester service centre and the operator all present.

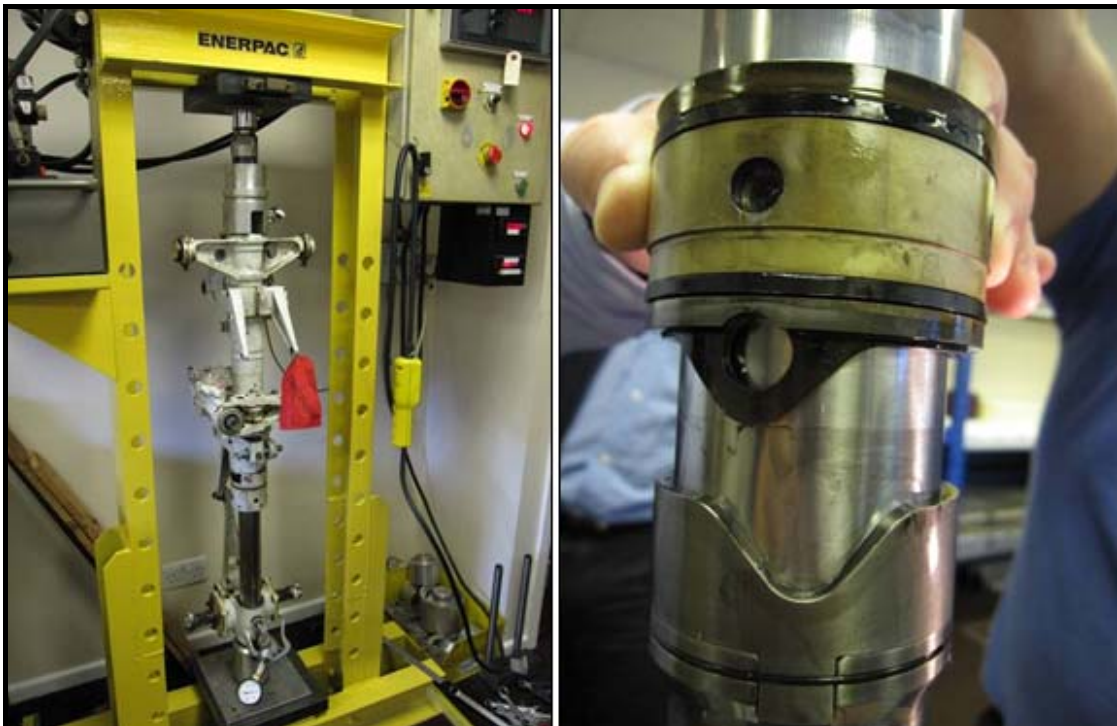
The drag stay was visually inspected with the only discrepancy being the LH stop bolt free to rotate together with the shim/pack/nut/split pin. The drag stay moved freely when operated by hand throughout its expected range of movement. The drag stay was tested as defined in AMM Chapter 32-20-40. It was found that clearances A and B were in accordance with which was measured on the aircraft at Chester. Diameter of the roller was measured and found to be within limits. LH upper bushing internal diameter was 1.5019 - 1.5021" and RH upper bushing internal diameter was 1.5015 - 1.5018".

The drag stay was dismantled to allow the adjustments to be made to bring back to within AMM limits using additional shim washers, with 0.006” being added to LH arm assembly and 0.002” being added to RH arm assembly. The drag stay fully met AMM requirements after adjustment.

The NLG leg was received in a fully deflated condition but it was noted that the leg would not fully compress by approximately 0.750” as air/nitrogen had entered the oil chamber.

The leg was charged with nitrogen as defined in CMM Chapter 32-20-35 page 104 para 3B (1) and (2) but to a requested pressure of 200 PSI. The 12 hour stand was not carried-out but the leg was tested to CMM Chapter 32-20-35 page 104 paragraph 3C (1 through to 9). The only observations were note (2) pressure 1890 to 2090 PSI was recorded at 1700 (probably due to the initial pressure of 200 PSI – note 7). When the oil filler plug was loosened, a small amount of air escaped, which was a likely cause stopping the leg fully compressing as received.

The self-centring check was carried-out satisfactorily during the above. The leg assembly was tested numerous times through its normal operating range with no adverse results. The leg assembly was dismantled sufficiently in accordance with CMM 32-20-35 to allow removal of the plunger tube and axle barrel assembly. There were no adverse findings and all was in compliance with the CMM. It was estimated that approximately 100ml of hydraulic fluid was required to fill the leg after the removal of trapped air (*picture nr 9*).



Picture Nr 9

2.3.4 Other Tests and Research

The selector valve and NLG actuator were sent to the manufacturer of the components for acceptance testing. Both units passed the tests and no defects were reported (*picture nr 10*)



Picture Nr 10

When removing the selector valve, technicians took an uncontrolled sample of the residual hydraulic fluid.

The sample taken was insufficient for the laboratory to perform the particle count, however high water content was detected, suggesting that the clear fluid was either water or water-based (*picture nr 11*).



Picture Nr 11

Additional controlled samples were taken from the main and auxiliary hydraulic reservoirs.

Laboratory results did not show any water content and were consistent in composition when compared to a clean sample (Aeroshell Fluid 41).

The 2 hydraulic pumps were also sent for testing at a certified facility. On both units the pressure output was found to be slightly high although no other defects were noted. The pumps are of the variable output type and regulate the fluid volume maintaining the pressure. A small increase in output pressure would not have any noticeable effect on the operation.

While carrying-out a H800/750 fleet inspection of the NLG door mechanism, the operator discovered various instances of the NLG doors being stiff to operate and would only open partially in free fall. There appear to be some common factors causing additional friction in the NLG door mechanism, particularly the stiffness or even, in some cases, seizure of the upper (self-lubricating) bearing on the NLG Door struts (*picture nr 12*).



Picture Nr 12

This was also observed on CS-DRK in addition to the stiffness of the bearings of the Nose Gear Door Release Struts (*picture nr 13*).



Picture Nr 13

These items will be carefully analysed to ascertain the nature of their defect.

2.4 Manufacturer's Response to the Event

The manufacturer was informed of this incident by the operator and manufacturer's field engineers were involved in all tests and inspections carried-out on the aircraft. Even the works needed for the aircraft to fly with gear down to UK and performed in Moscow were suggested and performed by manufacturer's maintenance experts.

After this event a Mandatory Service Bulletin was issued by Hawker Beechcraft (BS 32-4068) on July, 2011, justified by field reports of slow extension of the Nose Landing Gear (NLG), where Hawker Beechcraft Corporation (HBC) identified the drag stay assembly as the contributor to the NLG extension delays, causing resistance of the NLG extension mechanism, due the influence of following main contributory factors:

- the rigging of the overcenter angle;
- sensitivity of overcenter angle to build variations;
- differences in thermal expansion of the component parts.

In face of such findings, HBC determined:

- **the reaming of upper arm bushing assemblies** – to provide increased dimensional tolerance;
- **replacement of overcenter linkage roller with a smaller version** – to reduce drag stay assembly's sensitivity to build variations and improve the rigging of the overcenter angle.

The implementation of these measures should improve the overall performance of the NLG extension mechanism.

2.5 Similar Events Reported

Checking in our database, from same operator reported 14 events related to landing gear, during the last two years, 6 of them concerning HS-125-800XP aircrafts, two were selected:

- 1st - MSN 258829, on 23-02-2011, when approaching LOWI, being flying at very low temperatures and descending through icing conditions, nose gear failed to deploy on normal system. The crew recycled the gear and tried some "G" manoeuvres without success. After holding for quite a long time the gear was lowered on alternate system;
- 2nd – MSN 258730, on 03-01-2012, on final approach to UUWW, after a long flight at FL 410 and a descent through icing conditions, nose gear failed to deploy. Crew performed a go-around and proceeded to a hold where a successful recycling was done, the gear being lowered on normal system.

Both mishaps took place in winter, after flying at very low temperatures, in icing conditions and only nose landing gear was affected. After normal gear down selection the crew never felt the movement of gear doors and never heard the characteristic noise of the air flow inside wheel well bay, which means there was some blockage of gear leg, or gear doors, preventing its movement.

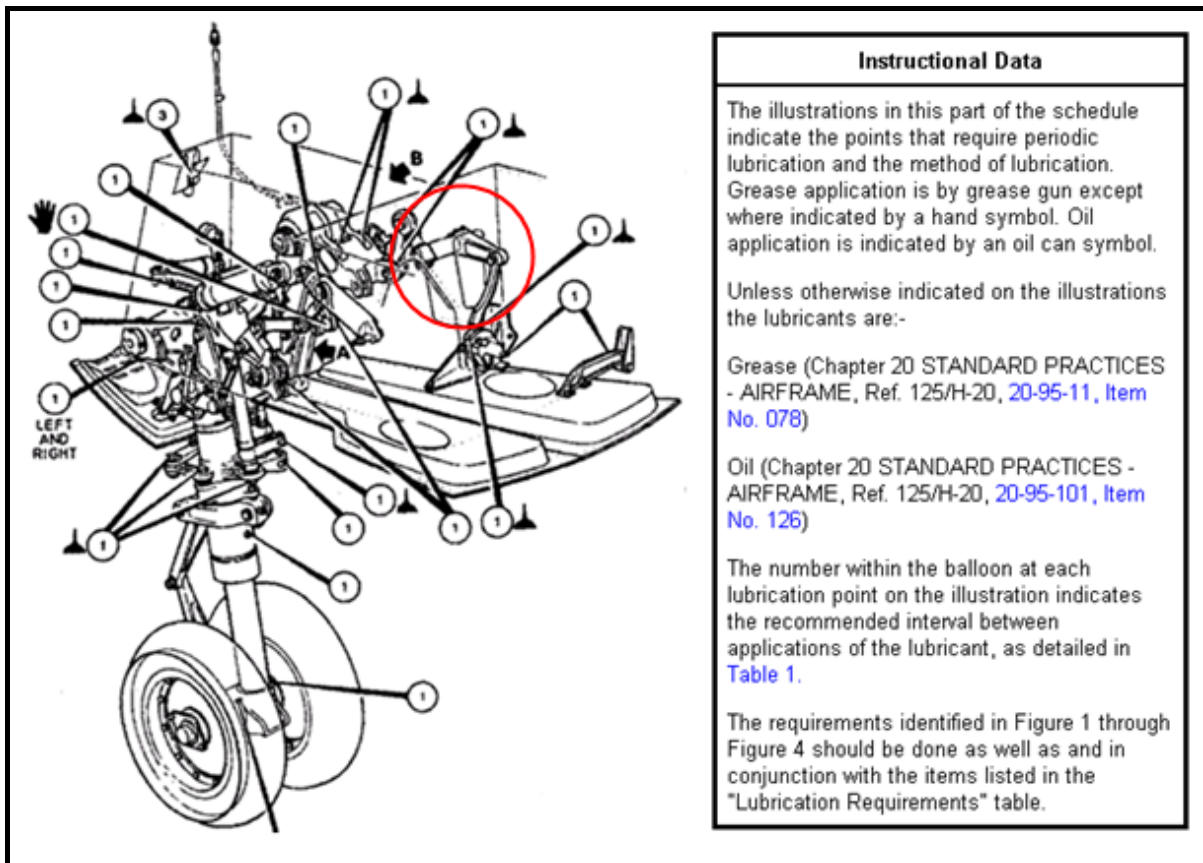
After the second event, considering that all recommended actions had been performed, complying with manufacturer's Service Bulletin N° SB 32-4068, Fleet Maintenance Chief Engineer ordered an inspection (EO 2.1.39) to nose gear assembly and NLG doors hinge pins replacement of HS 800/750 entire fleet, searching for any evidence of mechanical restriction to doors & leg movement, causing the gear to become stuck on retracted position.

During that inspection (three aircrafts had been inspected so far – MSN 258686, 258730, HB-21), it was discovered that the bushings on the door rear hinge assembly have migrated from the casting and cause stiffness in the operation of the hinge. Particularly on airplane HB-21, the lower slide arm bearing was almost solid, causing a great deal of friction during the door movement (*picture nr 14*). The force required to move the door, by hand, was 12lbs.



Picture Nr 14

In fact checking XP AMFS (JUN.11 version), looking for lubrication schedule and instructions we verified that, on diagram, NLG sliding rod bearing is not lubricated (*picture nr 15*).



Picture Nr 15

That bearing was found stiff on two of the three aircrafts inspected so far, following the Inspection program, as per EO 2.1.39.

3. FOLLOW-UP ACTIONS

After the evidences found during the investigation and considering;

- the operator suffered several gear operation malfunctions and the major issues happened during winter operation and in the same region (with extremely cold climates);
- the manufacturer's recommendations and proposed actions expressed on SB 32-4068, seems to be not enough to solve the problem and needs to be more substantiated;
- the operator has some more similar aircrafts in its fleet, operating in the region, winter season is in progress and he needs to grant a continuous and smooth operation;

the Investigation Team agreed to request substantiated information and clarification, from manufacturer, on the following matters:

- 1st SB 32-3274 was issued after a clearance greater than that indicated in AMM was discovered on an aircraft which suffered difficulties on nose gear deployment, being too large for the actuator to move the drag stay out of over-centre position. Considering the tolerance found on MSN 258765, it would be important to know what is the limit maximum force delivered to the actuator (on normal and auxiliary operation) and the maximum roller clearance it can overcome, if different from that indicated in AMM.
- 2nd Nose gear doors couldn't be opened by normal system and it seems there was a slight movement when using auxiliary system, even if they never opened completely. During inspection carried out on MSN HB-21 a 12lbs force was needed to overcome door stiffness. Could HBC confirm the maximum available force at door opening linkage, with and without Mod 25F624B installed?
- 3rd Does HBC have an explanation for why the upper bearing on the NLG Door struts does not need to be lubricated and what can cause the stiffness of the bearings of the Nose Gear Door Release Struts? Is HBC aware of other failure modes or in-service instances affecting these components?
- 4th Does HBC have an explanation for why the door hinge bushings are migrating from their seats? Is HBC aware of other failure modes or in-service instances affecting these components?
- 5th Is HBC aware of other cases of increased or abnormal stiffness affecting the nose landing gear door mechanism of this aircraft type (and derivative models)?
- 6th Has HBC developed any studies in order to determine the possible implication of low temperatures on the operation of the nose landing gear door mechanism and to which extent, if it can be quantified?

Lisbon, February the 21ST, 2012

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(IIC)