AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/8745		
Aircraft Registration	**ZS-HWH**	**Date of Accident**	1 February 2010		**Time of Accident**	1000Z	
Type of Aircraft	Hughes 269C (Helicopter)		**Type of Operation**		Training		
Pilot-in-command Licence Type	Commercial (H)		**Age**	21	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		202.9		Hours on Type	176.3	
Last point of departure	Wonderboom Aerodrome (FAWB) Gauteng						
Next point of intended landing	Wonderboom Aerodrome (FAWB) Gauteng						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Helicopter landing zone at Wonderboom Aerodrome (GPS coordinates S 25°39'35.24" E 028°12'57.52")							
Meteorological Information	Wind: southerly at 5 kts; Visibility: >10 km; Temperature: 28 ℃; Cloud cover: nil						
Number of people on board	2+0	**No. of people injured**	1+0	**No. of people killed**	0		

Synopsis

On 01 February 2010 at approximately 1000Z the pilot, accompanied by a flight instructor, were preparing for take-off on a training flight to assess the skills level of the pilot for a game rating.

During the magneto-check at approximately 3200 engine RPM, while still on the ground, the aircraft started resonating on the ground. The pilot immediately closed the throttle. The helicopter then became uncontrollable and the tail rotor blades made contact with the ground. The helicopter spun in a clockwise direction and the main rotor blades severed the tail boom from the helicopter. The rest of the helicopter was destroyed during the sequence of the accident.

No damage was caused to the helicopter landing pad.

The flight instructor sustained minor injuries during the sequence of the accident.

Probable Cause

Severe ground resonance as a result of incorrect landing gear damper pressures rendered the helicopter uncontrollable and rotor contact followed.

Contributing factor

Failure of the landing gear damper attachment points owing to the severe ground resonance.

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator : G W A Eiendomme CC
Manufacturer : HUGHES HELICOPTER CO. (Schweizer)
Model : 269C
Nationality : South African
Registration Marks : ZS-HWH
Place : Wonderboom Aerodrome
Date : 1 February 2010
Time : 10:00Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (1997) this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to establish legal liability****.*

Disclaimer:

1. FACTUAL INFORMATION

1.1 History of flight

1.1.1 On 1 February 2010 at approximately 1000Z, the pilot accompanied by an instructor was preparing for take-off on a training flight from Wonderboom Aerodrome (FAWB) to assess the skills level of the pilot for game rating.

1.1.2 While completing the before take-off checklist, at the point where they had to check the magnetos for serviceability, the engine RPM of the helicopter was increased to 3200 RPM. At this point, the pilot experienced excessive resonance of the helicopter.

1.1.3 The instructor immediately instructed the pilot to close the throttle, as there was no time for the instructor to take over control of the aircraft. The resonance made the helicopter uncontrollable for the pilot.

1.1.4 The tail rotor blades then made contact with the landing surface, the helicopter spun around and the main rotor blades severed the tail boom. The helicopter was destroyed during the sequence of the accident.

1.2 Injuries to persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	1	-	-	-
None	-	1	-	-

1.3 Damage to aircraft

1.3.1 The helicopter was destroyed during the sequence of the accident.

1.4 Other damage

1.4.1 No other damage was caused during the sequence of the accident.

1.5 Personnel information

1.5.1 Instructor pilot

Nationality	South African	Gender	Male	Age	33
Licence Number	**********	Licence Type	Commercial (H)		
License valid	Yes	Type Endorsed	Yes		
Ratings	Instructor, instrument rating, under sling rating				
Medical Expiry Date	30 June 2010				
Restrictions	Corrective lenses				
Previous Accidents	None				

Flying experience

Total hours	3900
Total past 90 days	120
Total on type past 90 days	0
Total on type	70

1.5.2 Pilot

Nationality	South African	Gender	Male	Age	21
Licence number	**********	License type	Commercial (H)		
Licence valid	Yes	Type endorsed	Yes		
Ratings	None				
Medical expiry date	31 December 2010				
Restrictions	None				
Previous accidents	None reported				

Flying experience:

Total hours	202.9
Total past 90 days	3.3
Total on type past 90 days	0.7
Total on type	176.3

1.6 Aircraft information

Airframe:

Type	Hughes 269C	
Serial number	700023	
Manufacturer	Hughes Helicopter CO.	
Year of manufacture	1987	
Total airframe hours (at time of accident)	10901.4	
Last MPI (hours & date)	10808.3	9 September 2009
Hours since last MPI	93.1	
C of A (issue date)	14 March 1990	
C of R (issue date) (present owner)	22 September 2008	
Operating categories	Standard	

Engine:

Type	Lycoming HIO-360-D1A
Serial number	L-21307-51A
Hours since new	2131.4
Hours since overhaul	842.4

1.7 Meteorological information

Wind direction	Southerly	Wind speed	5 kts	Visibility	>10 km
Temperature	28 ℃	Cloud cover	Clear Sky	Cloud base	Nil
Dew point	Unknown				

1.7.1 The meteorological information was obtained from the pilot questionnaire after the accident.

1.8 Aids to navigation

1.8.1 The aircraft was equipped with the standard navigational equipment as per the minimum equipment list approved by the Regulator. There were no recorded defects reported prior to the accident.

1.9 Communications

1.9.1 The helicopter was equipped with standard communications equipment as per the minimum equipment list by the Regulator. There were no recorded defects to

communications equipment prior to the flight. The pilot communicated his intentions to Wonderboom Tower on VHF radio frequency 120.6 before the accident.

1.10 Aerodrome information

Aerodrome location	6 km north of Pretoria	
Aerodrome Co-ordinates	S 25°39'19.1" E028°13'16.8"	
Aerodrome elevation	4095 feet	
Runway designations	11/29	06/24
Runway dimensions	1828 m x 30 m	1280 m x 22 m
Runway used	Helicopter landing zone	
Runway surface	Paved bricks (Helipad)	
Approach facilities	Not applicable	

1.11 Flight recorders

1.11.1 The helicopter was not fitted with a cockpit voice recorder (CVR) or a flight data recorder (FDR) and neither was required by regulations to be fitted to this type of helicopter.

1.12 Wreckage and impact information

1.12.1 Impact damage

The aircraft was on the ground when the accident occurred. Marks on the ground indicated that the tail rotor blades had made contact with the brick paved surface of the helicopter landing pad. Broken pieces of the tail rotor blades were found in line and approximately 20 metres away from the marks on the ground. Marks on the landing surface clearly indicated the helicopter had spun clockwise on the helicopter landing zone. Small pieces of debris were found in a radius of approximately 25 metres from the main wreckage.

1.12.2 Fuselage

The fuselage was destroyed during the sequence of the accident. **(See Figure 1.)** The tail boom was severed from the fuselage and was found approximately 2 metres from the main wreckage. The left-hand rear landing gear damper's bottom attachment point on the landing gear skid was broken while the left-hand front gear damper's top attachment point on the damper was broken. **(See Figure 2.)** These broken attachment points were caused by the accident sequence.

Figure 1 Damage caused to the fuselage of the helicopter

(a) (b)

Figure 2 Damage to the left-hand rear (a) and left-hand front (b) damper attachment points

1.12.3 Main rotor blades

The rotor blades were still attached to the rotor mast although all three main rotor drag dampers were destroyed. Damage to the main rotor blade tips indicated that the main rotor blades had made contact with the brick-paved helicopter landing pad. Impact damage marks were visible on all three main rotor blades. The tail rotor blades were destroyed during the accident sequence. Marks indicating that the tail rotor blades had made contact with the landing surface were clearly visible on the landing surface. **(See Figure 3.)**

(a) (b)

Figure 3 Damage to the tail rotor blades (a) and contact marks (b) with the landing surface

1.12.4 Engine
There was no visible damage to the engine.

1.12.5 Cockpit seats
There was no damage to either of the helicopters seats.

1.13 Medical and pathological information

1.13.1 The flight instructor sustained a laceration to his head but was discharged from hospital on the same day.

1.14 Fire

1.14.1 There was no pre- or post-impact fire.

1.15 Survival aspects

1.15.1 This accident was regarded as survivable due to the low impact forces on the cockpit area and because the occupants were both wearing safety harnesses.

1.16 Tests and research

1.16.1 The four landing gear dampers were removed from the wreckage and were forwarded to the helicopter manufacturer for load stroke tests. The tests were conducted under supervision of the Federal Aviation Administration (FAA). A load stroke test is a compression test of the dampers. It is essentially a static test since it takes about a minute and a half to make the compression from free, extended, to fully compressed. The compression dimensional change (stroke) is measured and the compression load during the stroke cycle and extension cycle is documented and graphed. Comparison of standard dampers and mishap units shows if the subject units were properly serviced.

1.16.2 The tests revealed that all four landing gear dampers were improperly charged.

Three of the four dampers were in excess of full stroke limits and the fourth was out of limits for the intermediate range. The effect of excessive pressure in the dampers is a loss of damping and a lack of attenuation of main rotor oscillations. **(See Appendix A** for complete report.)

1.16.3 For a description of the damper operation **see Appendix B**.

1.17 Organizational and management information

1.17.1 This was a training flight.

1.17.2 The last mandatory Inspection was certified on 10 September 2009 at 10808.3 hours by a CAA-approved Aircraft Maintenance Organization (AMO) in possession of a valid approval certificate.

1.18 Additional information

1.18.1 The pilot operating handbook (POH) page 7-14 paragraph 7-12 recommends the following daily inspection on the landing gear dampers:

"7-12 LANDING GEAR DAMPERS – INSPECTION

"Four poppet type nitrogen charged hydraulic units in the landing gear assembly dampen landing shock and prevent ground resonance. The dampers are mounted between the helicopter centerframe section and the landing gear skids (two for each skid, left- and right-hand sides). Perform the following check during each Daily Inspection to ensure proper extension of dampers.

Note: Ensure that the helicopter is in an empty-weight configuration (no passengers or cargo aboard) but with full fuel load.

Visually inspect landing gear dampers for leakage. Replace damper if loss of hydraulic oil is noted.

Observe stance of the helicopter. If stance is nose down or if extension of the aft dampers appears to be unusual, perform the following checks.

Raise and lower the tail boom above and below the normal at-rest position three times.

On the last cycle, slowly lower the tail boom to an at-rest position and observe stance of helicopter. If stance of helicopter or extension of aft dampers still appears unusual, perform the following steps.
Measure distance from shoulder of damper upper cap to top edge of damper bottom cap on all dampers. Replace any damper measuring less than the following dimensions in Table 7-3."

1.18.2 The four landing gear dampers are attached between the outboard ends of the crossbeams and the skid strut assembly. The landing gear dampers absorb and dissipate landing shocks and recoil shocks that are produced when the helicopter takes off; they also help prevent ground resonance and serve as structural

members to support the weight of the helicopter during engagement, disengagement and while static.

1.18.3 The pilot mentioned to the investigator on the last landing before the accident that he experienced some resonance during landing. The pilot then inspected the helicopter after the landing but could not find any abnormalities.

1.18.4 Damper operation

See Appendix B for a description of the damper operation.

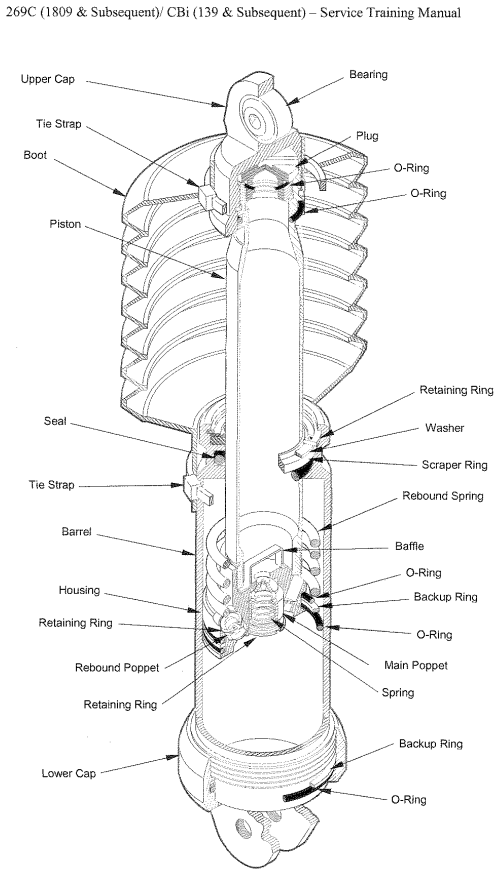

Figure 4 Damper cross section

Table 7-3. Landing Gear Damper Dimensions

	With main tank only		*With Auxiliary Tank Kit Installed*	
	Left	*Right*	*Left*	*Right*
Aft	*8.4*	*8.0**	*8.0**	*8.0**
Forward	*9.1*	*8.7*	*8.7*	*8.7*
******* *When dimensions are less than 8.0 inches, recheck extension per 100-hour inspection method (Refer to HMI) before replacing aft damper.*				

1.18.4 This prescribed inspection was not done before the accident flight.

1.19 Useful or effective investigation techniques

1.18.1 None

2. ANALYSIS

2.1 Verification of the pilot's personal file confirms he was in possession of a valid commercial pilot license (helicopter). The pilot had a total of 176.3 hours on the Hughes 269 helicopter. At the time of the accident, the pilot was in possession of a valid medical certificate that imposes no restrictions.

2.2 Both occupants survived the accident with only the instructor sustaining a head laceration during the sequence of the accident.

2.3 The accident helicopter was properly certified, equipped, and maintained in accordance with prescribed regulations. The recovered components showed no evidence of any pre-existing system, structural or power plant failure.

2.4 A landing gear damper load stroke test done on all four dampers after the accident revealed all four dampers were improperly charged. The left-hand front and rear damper mounting points were broken after the accident because of the accident sequence.

2.5 The effect of excessive pressure in the dampers is a loss of damping and a lack of attenuation of main rotor oscillations.

2.6 Marks indicating that the tail rotor blade had made contact with the landing surface were clearly visible on the scene of the accident.

2.7 The engine was found attached to the helicopter with no evidence of fire, structural damage or foreign object damage.

2.8 According to the weather information obtained from the pilot's questionnaire, the weather was fine with clear sky at the time of the accident.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot was properly certified and qualified according to current regulations.

3.1.2 The accident aircraft was properly certified, equipped and maintained in accordance with current regulations. Recovered components showed no evidence of structural, engine or system failure other than those as a result of the accident sequence.

3.1.3 Although the aircraft was destroyed during the sequence of the accident, the accident was regarded as survivable due to the low impact forces on the cockpit area.

3.1.4 It would appear that the incorrect pressure of the landing gear dampers caused the out of control resonance of the helicopter. The effect of incorrect pressures in the dampers is a loss of damping and a lack of attenuation of main rotor oscillations.

During this resonance, the left-hand dampers both failed, causing the tail rotor blades to make contact with the landing surface. This contact destroyed the tail rotor blades, causing the helicopter to spin around, out of control, with the resultant damage to the helicopter.

3.1.5 The weather did not contribute to the accident.

3.2 Probable cause/s

Severe ground resonance as a result of incorrect landing gear damper pressures rendered the helicopter uncontrollable and rotor contact followed.

3.3 Contributing factor

Failure of the landing gear damper attachment points as a result of the severe ground resonance.

4. SAFETY RECOMMENDATIONS

4.1 It is recommended the Airworthiness Department within the SACAA inform all maintenance providers of the Hughes 296 Helicopter to completely overhaul the dampers and not “recharge” them. (This was recommended by the manufacturer within the report after the load stroke tests.) Overhaul facilities need to ensure that the fluid levels and gas pressures are matched and appropriate for the damper configuration being assembled.

5. APPENDICES

5.1 Appendix A Component Examination Report.

5.2 Appendix B Description of the damper operation.

Report reviewed and amended by the Advisory Safety Panel on18 May 2010

-END-

Schweizer Aircraft Corp.

Elmira, New York

Component Exam Report

Report number: **2010/269C/002**

Model: **269C**

Title: **Component Exam Report**

Report date: **Mar 3, 2010**

PREPARED BY: _____

Name: Steven Gleason
Title: Chief Accident Investigator

REVIEWED BY: _____

Name: Sharon Evans
Title: Director Contracts and Compliance
Date: Mar 10, 2010

Model	269C
Serial number	700023 (Hughes)
Registration	ZS-HWH
Accident date	2-1-2010
Accident location	South Africa
Investigators:	
Steve Gleason	Schweizer Aircraft Corp.
Randall Steele	FAA Rochester FSDO
Marybeth Moran	FAA Rochester FSDO

SNYOPSIS

1. FACTUAL INFORMATION

History of Flight / Operation
Report from the South African CAA stated the pilot had experienced ground resonance during landing but landed safely. During the next take off the pilot with instructor, experienced ground resonance, struck the tail rotor and aircraft was destroyed during the incident. Photos show a typical ground resonance damage pattern. The landing gear dampers were shipped through the FAA Flight Standards District Office in Rochester NY and brought to Schweizer Aircraft Corporation for testing.

Fatalities / Injuries
There were no fatalities or serious injuries reported.

Aircraft Damage
Aircraft was reported to be destroyed.

Property Damage
No other property was reported damaged.

Wreckage Distribution
Photos indicate the debris was co-located at the site of the event.

Wreckage / Component Examination
Landing gear dampers load stroke tested at Schweizer Aircraft Corporation. Dampers were received with boots removed, two caps were removed and other two were loose. All 4 had masking tape identifying aircraft location. CAA reported "I had the landing gear dampers checked by Precision Aviation Services in South Africa. Unfortunately they only make sure the dampers were under pressure and not deflated." It is unknown what tests were performed during this check.
The two aft dampers were identified with serial numbers S1448 left and S972 right. The forward dampers had no serial number tags installed, they were arbitrarily assigned S01 right and S02 left for identification on the test charts.

Photos/Videos

Fig. 1 General view of wreckage at site (CAA Photo)

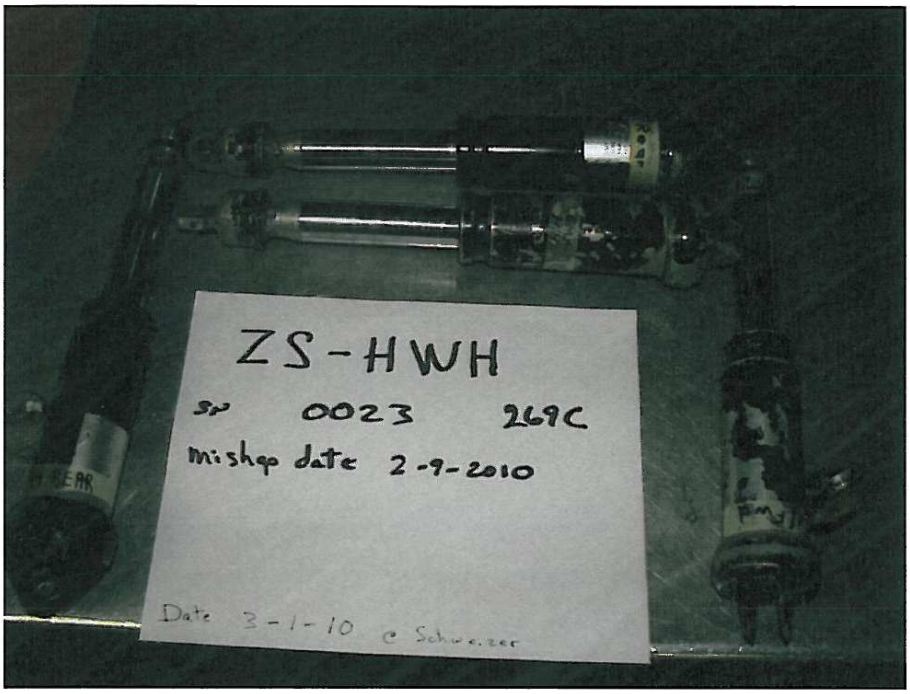

Fig 2 Dampers as received at Schweizer for load stroke testing

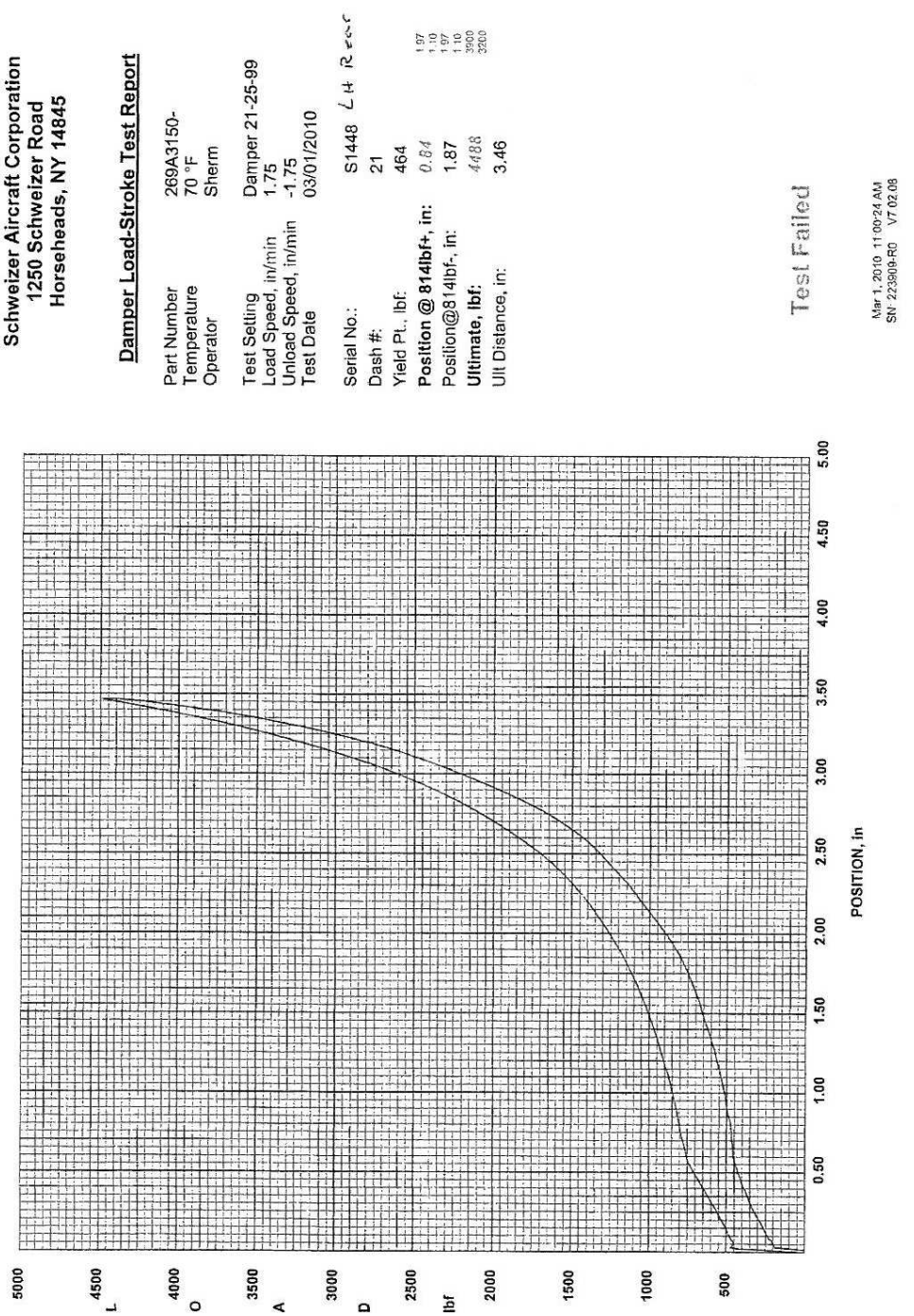

Fig 3 Left rear damper load stroke chart

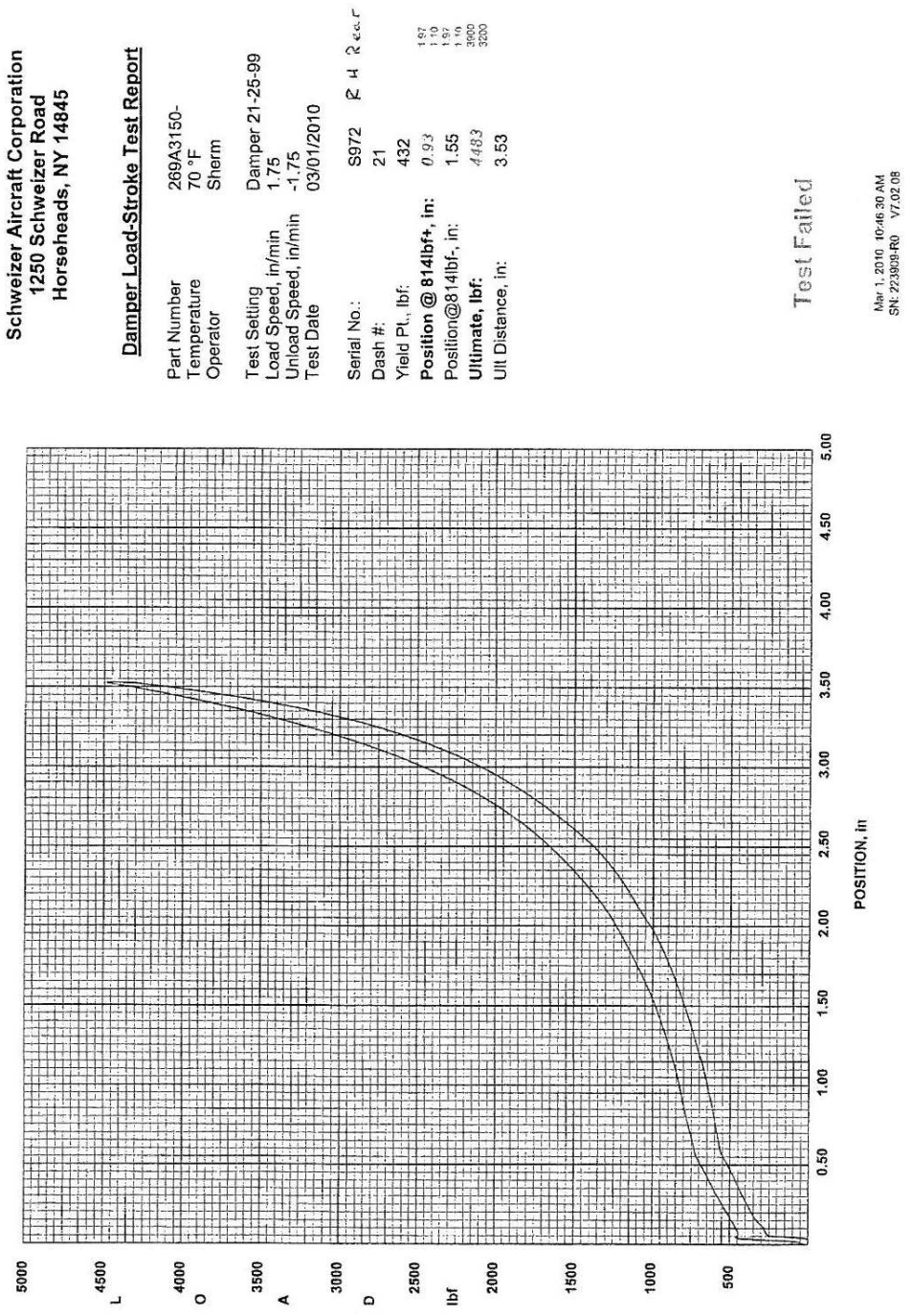

Fig 4 Right rear damper load stroke chart

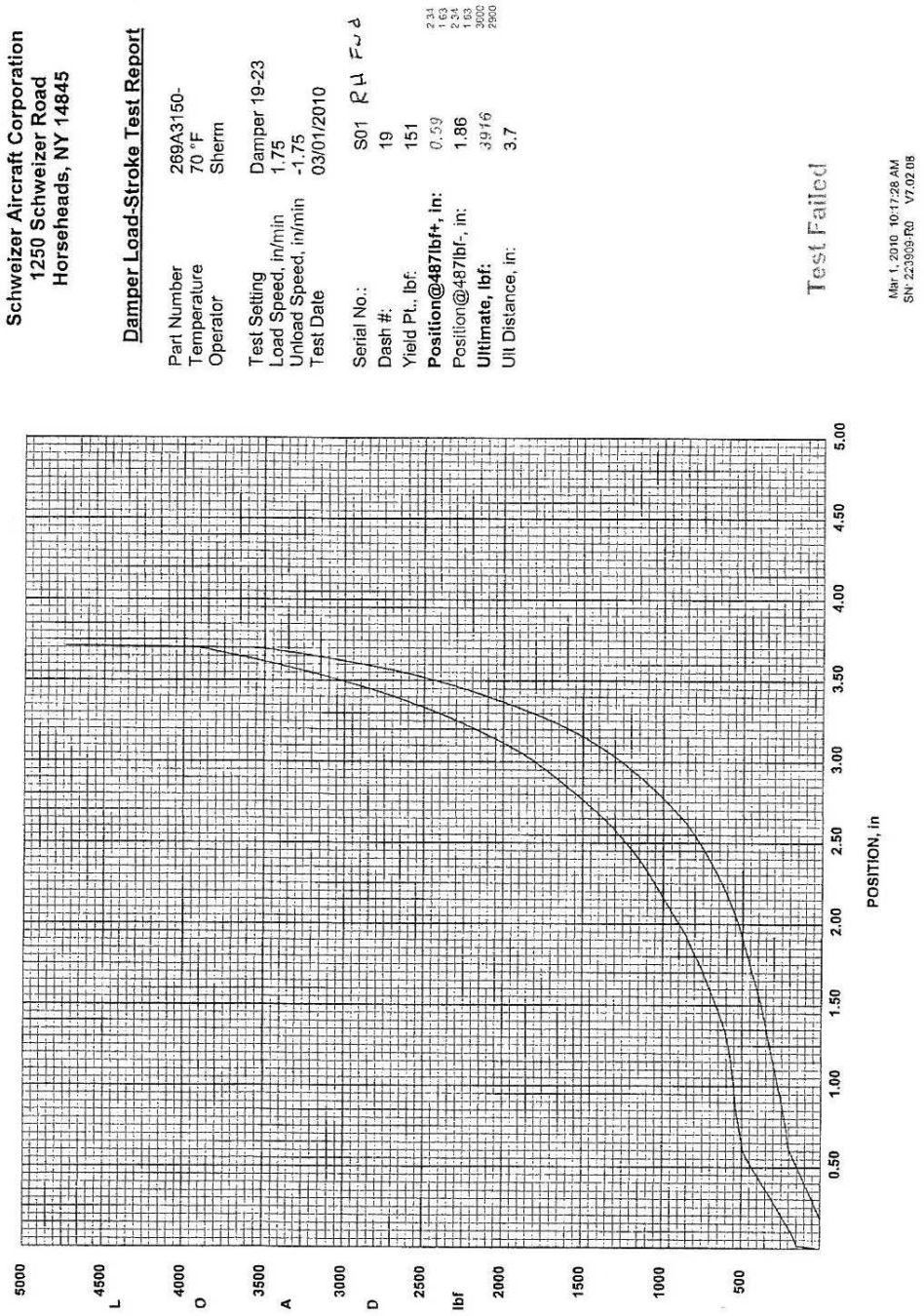

Fig 6 Right forward damper load stroke chart

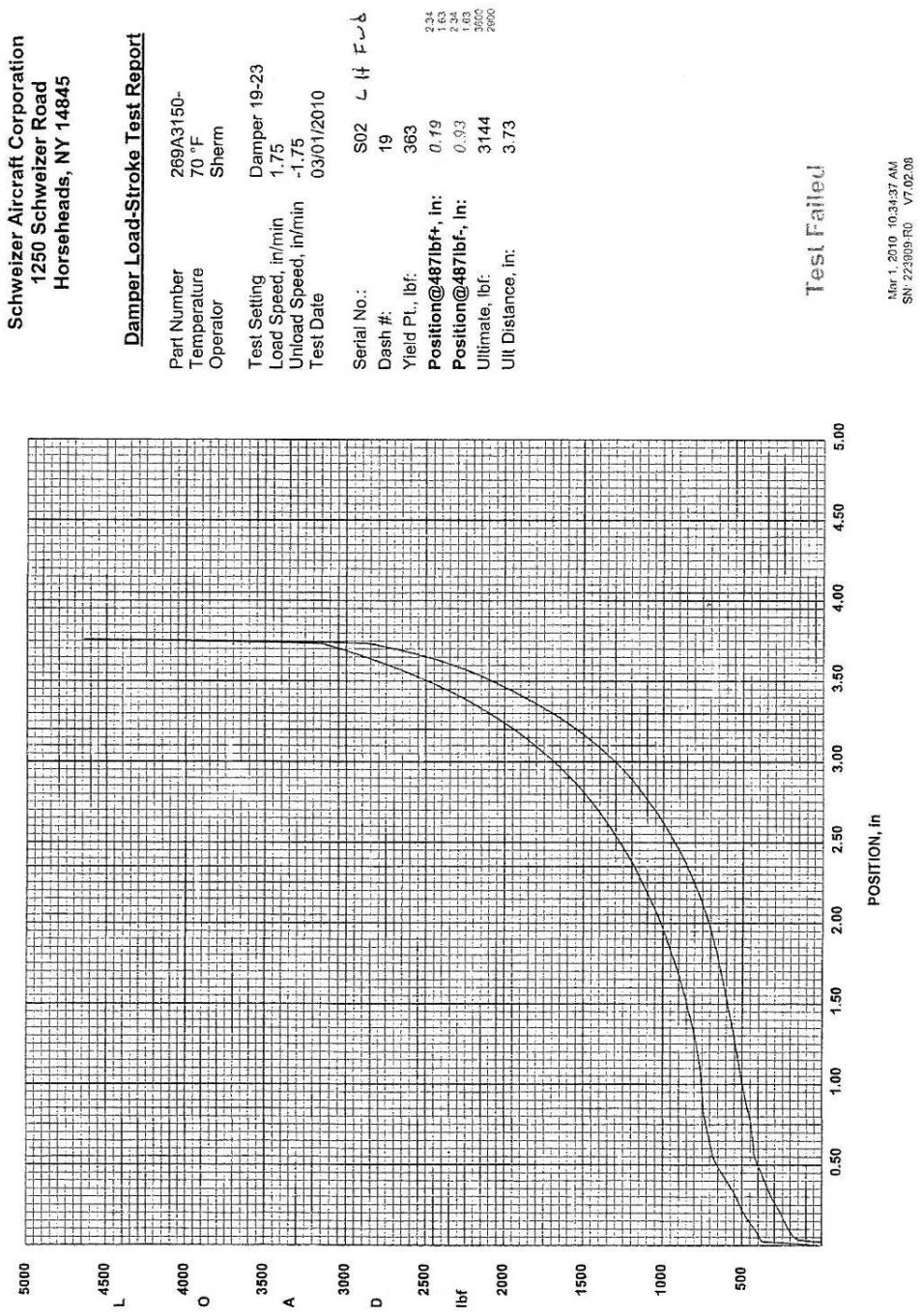

Fig 7 Left forward damper load stroke chart

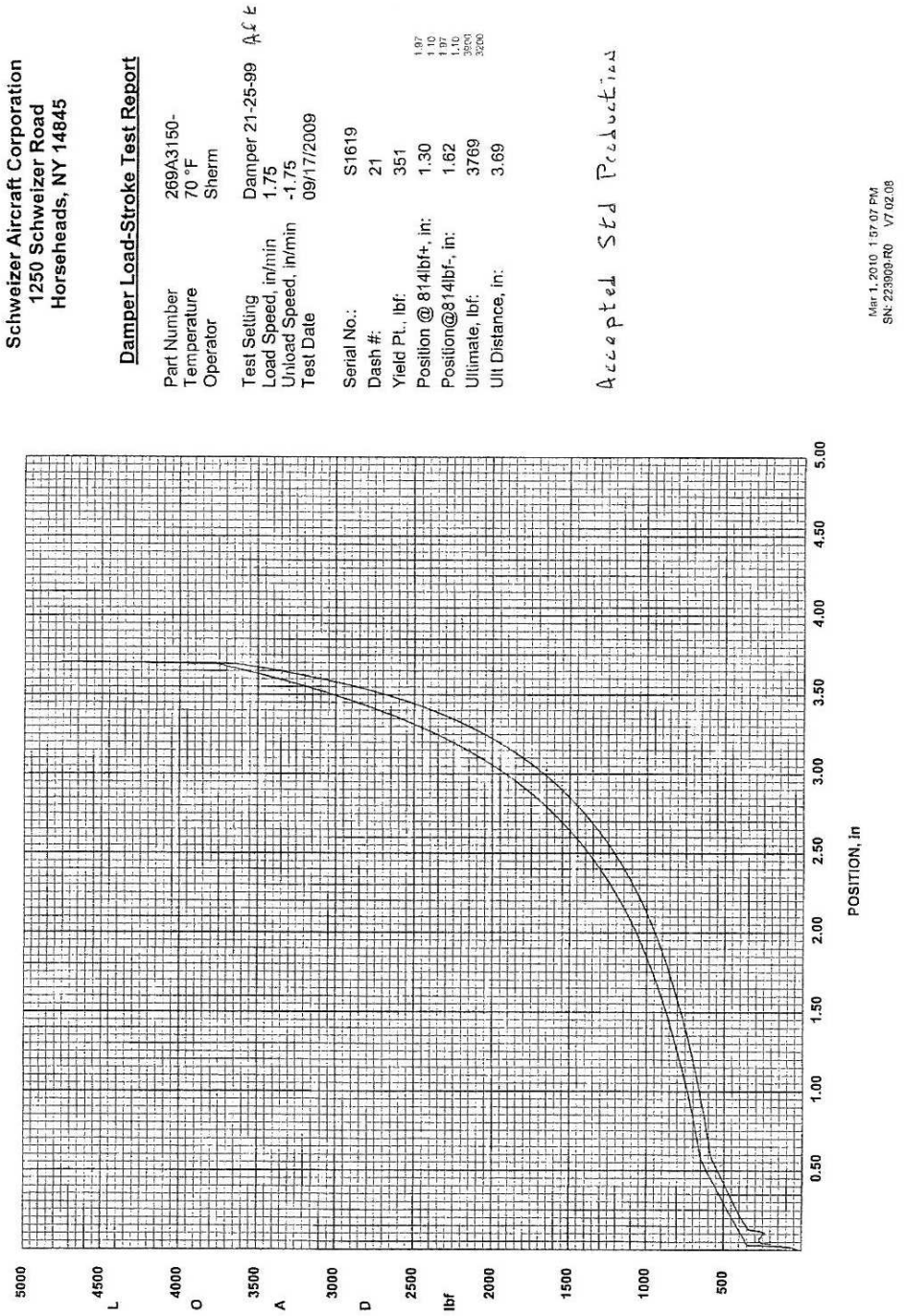

Fig 8 Acceptable aft damper load stroke chart

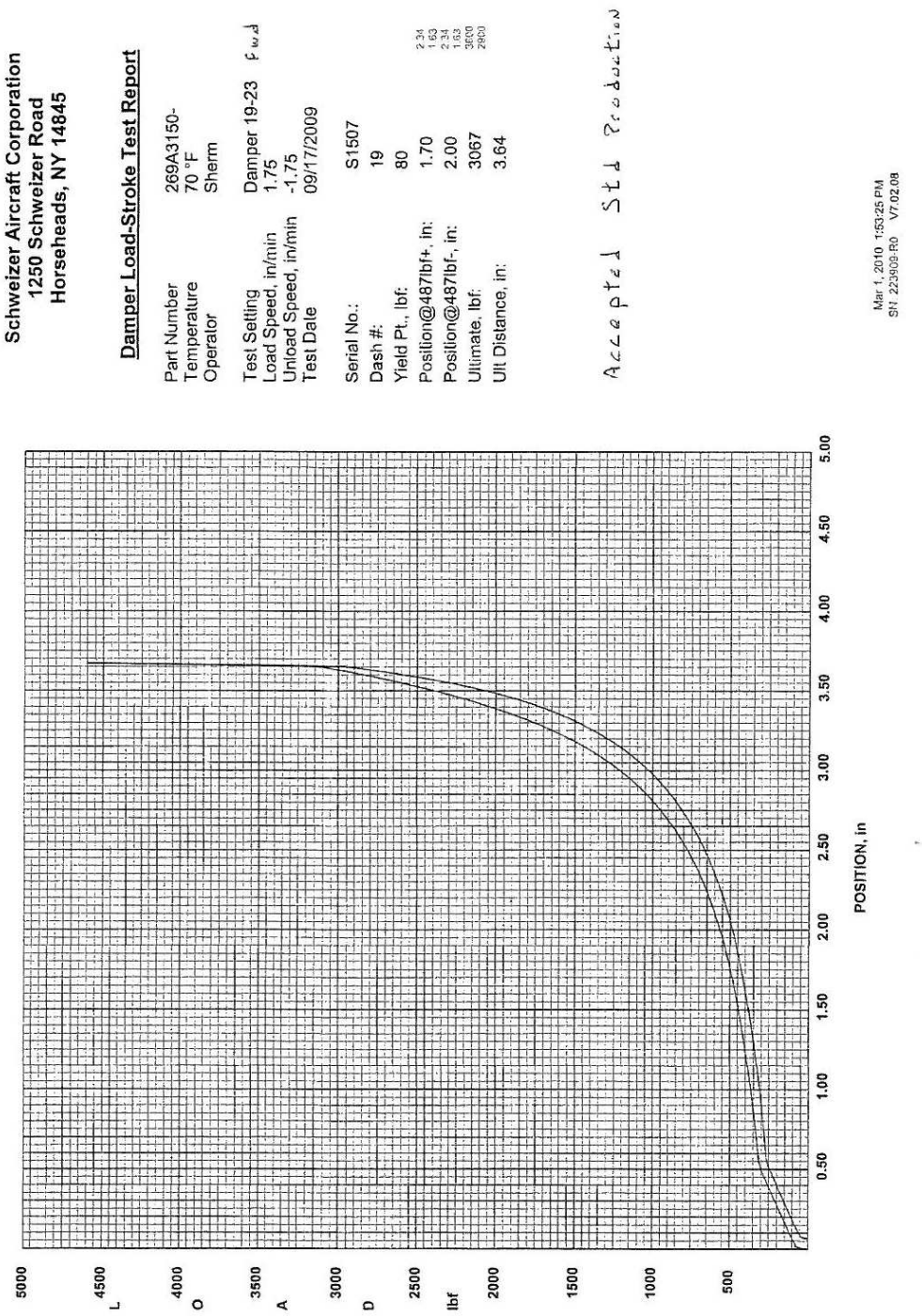

Fig 9 Acceptable forward damper load stroke chart

FPSF-001

Survival Aspects
Historically ground resonance is normally a survivable event. This event was survivable.
Personnel Information
N/A
Aircraft Information
Aircraft serial number 700023 was manufactured in July 1970, by Hughes Helicopter. Records indicate that in 1985, then owner the Kansas City Police Dept reported the aircraft had accrued 9256 hours of operation. CAA reports that records in South Africa indicate the aircraft was manufactured in 1987, possibly the import date. South African registration website indicates the aircraft was registered 1-31-1990. CAA reported aircraft time as 1436 hours.
Meteorological Information
Not a factor
Test/TDR Reports
Four landing gear dampers 269A3150-xx were received at Schweizer on March 1, 2010. Each was installed on the test machine and load stroked. Charts of the load and stroke were recorded and printed, charts of new production dampers were also printed. The subject dampers charts were compared with previous test charts of known incorrectly serviced dampers.
The subject aft dampers exceeded the maximum load rating to reach full stroke (compression). The intermediate reference points were also exceeded. These conditions indicate the dampers were likely serviced with an excess amount of hydraulic fluid but charged near the standard gas pressure of 725 psi.
The right forward damper exceeded the full stroke load value. The intermediate reference points were also exceeded. These conditions indicate excessive gas pressure.
The left forward damper full stroke load fell within the allowable limits. The intermediate reference points were exceeded. This condition is comparable to an aft damper with proper fluid and low gas charge.
Normal overhaul procedures for dampers require specific fluid level settings with the piston completely bottomed and specified gas pressures for the particular damper (forward or aft). Forward dampers require a fluid reduction of .5 inches from the top of the piston and charge pressure of 350psi. The aft dampers require a fluid reduction of 1.4 inches and gas charge of 725psi. For this aircraft the Schweizer Handbook of Maintenance Instructions Appendix C Part 6 contains the overhaul and charge instructions.
Acceptable charts and those from the subject dampers are included here as Figs. 3 through 9.
Navigational Aids
N/A
Airport Data
Ramp was hard surface interlocking paving stones.
Communications
N/A
Flight/Voice Recorder Information
N/A

2. ANALYSIS

Aircraft Examination/Reports
N/A
Aircrew Activities
N/A
Other
The South African CAA reports no recent maintenance. Aft dampers were reported to have 710 hours since overhaul and 605 since recharge. Forward dampers had no record of work in last 1000 hours. There is no process for "recharge" approved or documented by Schweizer, all references require overhaul if

damper fails checks. A translation of the pilot's statement indicates the magnetos were checked at operational RPM, then the ground resonance started.

3. CONCLUSIONS AND FINDINGS

All four landing gear dampers were improperly charged. Three were in excess of full stroke limits and the forth was out of limits for the intermediate range. The affect of excessive pressure in the dampers is a loss of damping and a lack of attenuation of Main Rotor oscillations.

Checking the magnetos at operational RPM is not a standard procedure. If collective was applied during this check, the light on the skids condition combined with any rotor instability (oscillations) would tend to be aggravated by out of limits landing gear dampers and lead to ground resonance.

The pilot or instructor should have notified maintainers of ground resonance at landing and had repairs made prior to next flight.

4. RECOMMENDATIONS

Maintenance providers need to completely overhaul the dampers and not "recharge" them. Overhaul facilities need to assure the fluid levels and gas pressures are matched and appropriate for the damper configuration being assembled.

Pilots should perform prefight inspections in accordance with the flight Manual paragraph 7-13.

5. ACTIONS

6. DISTRIBUTION

Review copy provided to:

Aviation and Product Safety:
Director APS
File

Pilots Office:
Chief Pilot

Engineering:
Director Engineering
Director Engineering Test

Quality:
Director Quality

Landing Gear Damper operation: Service Training Manual Chapter 4 page 9.

4-5. DAMPER OPERATION

Landing gear damper compression occurs on landing as impact loads are applied to the landing gear. During compression, displacement of hydraulic fluid and compression of nitrogen combine to absorb the impact loads. Nitrogen compression and fluid displacement determine the rate and limit of damper compression and provided controlled resistance.

At initiation of the compression stroke, the piston housing applies pressure to hydraulic fluid in the lower area of the barrel chamber. Resulting fluid pressure forces the main poppet up into the seat in the center of the piston housing and unseats both rebound poppets at the sides. During continued compression, relatively incompressible hydraulic fluid is forced up through only the 0.070 inch center orifice of the main poppet to compress pressurized nitrogen inside the piston. Simultaneously, fluid flows up through the three angular side vanes of both rebound poppets and the 0.050 inch relief port into the upper area of the barrel chamber. The unseated rebound poppets offer little resistance to fluid flow and the relief port also meters fluid flow into the upper area of the barrel chamber

As compression continues, the nitrogen is compressed into a smaller volume in the piston and nitrogen pressure increases. Increasing nitrogen pressure opposes and decreases fluid flow rate to progressively decrease the speed (rate) of damper compression, in proportion to piston housing travel. Nitrogen pressure rises to approximately 4000 psi by full damper compression.

At removal of the compression force, nitrogen pressure against the top of the piston and the surface of hydraulic fluid forces the piston upward. As the piston housing assembly moves up, the fluid unseats the main poppet valve and is forced from the piston to the lower area of the barrel chamber at a high rate of flow through the center orifice and the eight angular side orifices in the main poppet valve. As the housing moves upward, the fluid pressure in the upper area of the barrel chamber holds both rebound poppets seated. Fluid flows from the upper chamber to the lower chamber through only the relief port at a metered rate to control the rate of damper extension. As nitrogen pressure decreases, the rate of fluid flow and extension progressively decreases proportionally. The anti-extension spring provides a cushioned (damped) stop at maximum damper extension.

With the helicopter on the ground, the internal fluid and nitrogen pressure support the weight of the helicopter. In flight, the weight of the landing gear extends the damper and the barrel top rests on the top of the anti-extension spring.