

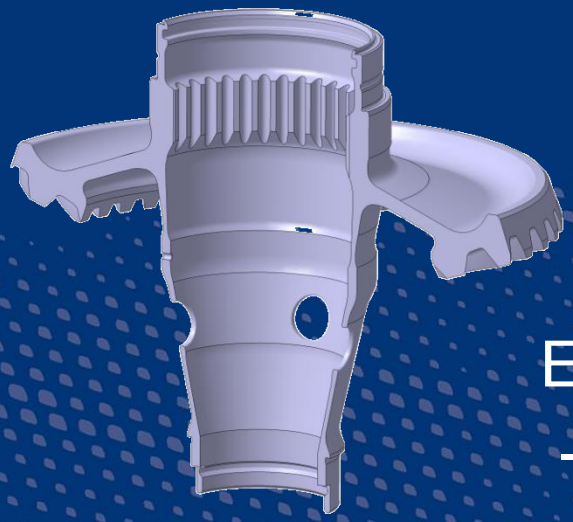

EC225 Bevel Wheel Vertical Shaft - Lessons Learnt

Andrew Dettl – Aberdeen Customer Support Director and Site Manager

4 June 2014

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Scope

Recap of the Problem

Recap of the Solutions

Lessons Learnt

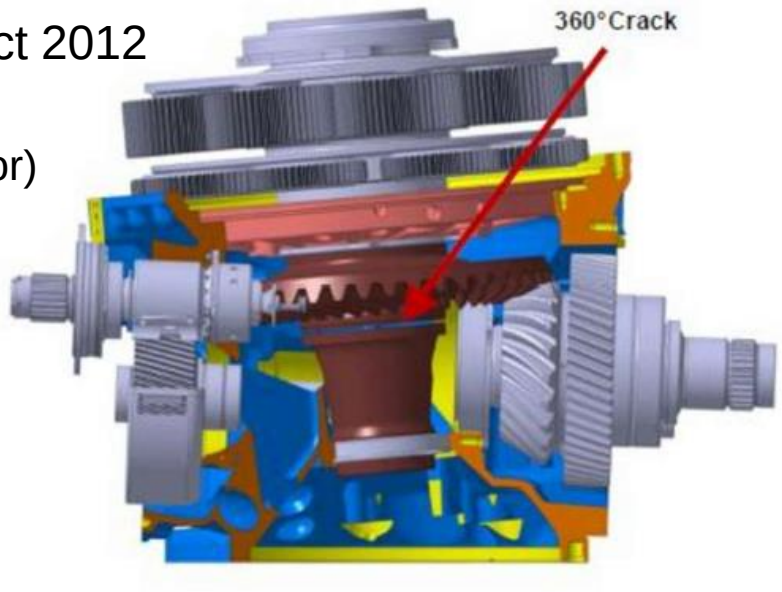
- Management
- Communications
- Engineering/analysis
- Support/logistic

Conclusion

Recap of the Problem

Two EC225 controlled ditchings in May and Oct 2012 due to two separate problems:

- failure of Bevel Wheel Vertical Shaft (causal factor)
- indication of EMLUB failure (contributing factor)



Detailed (~6 month) investigation of 149 potential root causes revealed the cause to be a combination of:

- **Active Corrosion** due to trapped moisture
- **Residual Stress** due to manufacturing process
- **Stress Concentration** (Hot Spots) due to shaft geometry (shape)

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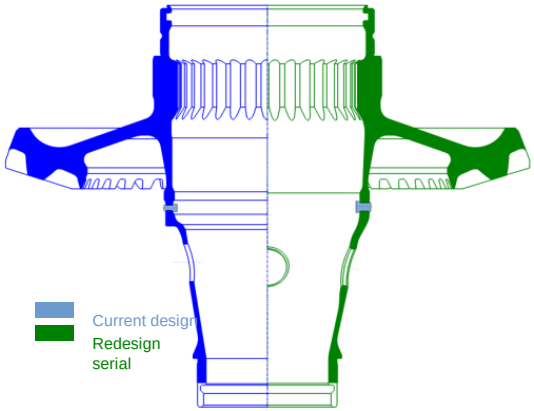
Recap of the Solutions

Mid 2013 - Short Term Preventive and Protective Safety Measures implemented to address the root causes and minimise the likelihood or consequence of failure:

- suspect batches (non-conforming hole/chamfer) removed from service
- manual and automatic (oil jet) cleaning
- US NDI – detects a crack on the ground
- MOD45 Monitoring – detects a crack in-flight

Mid 2014 - Permanent Redesign implemented to eliminate all root causes



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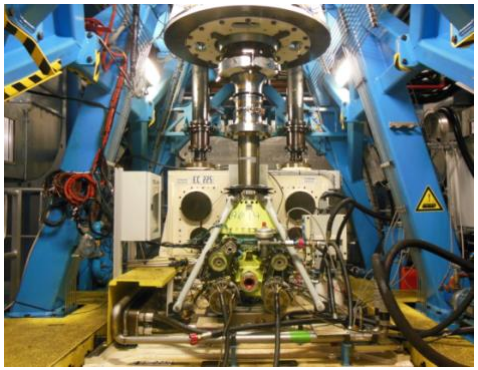
Lessons Learnt - Management

Rapid Acceptance of Responsibility:

- Eurocopter CEO visited Aberdeen accepting responsibility and expressing concern
- Regular presence of executive management in Aberdeen at appropriate times



Dedicated Crisis Team:

- Dedicated crisis team leader with full authority
- Dedicated staff for engineering, support, communications, sales
- Dedicated senior manager and communications manager on-site in Aberdeen
- Daily coordination meetings

Lessons Learnt – Management

RTS Process:

- more dependent upon O&G Company ‘change’ processes than Helicopter Operator readiness
- AH didn’t have a good appreciation of the RTS process followed by individual O&G companies (due to lack of direct contact)

Lessons Learnt - Communications

Accessing the Workforce via Step Change's HSSG

- Seen as aligned and independent – therefore trustworthy
- Town Hall sessions gave all stakeholders the opportunity to ask questions

Strengthened Relationship with the Helicopter Operators:

- Main conduit to O&G Companies
- Pilot Briefings provided the real situation 'from the horses mouth' which could then be relayed to passengers

Involving Independent Experts:

- Turbomecca – high speed shaft instrumentation
- Shainin – root cause analysis methodology and verification
- GTRI – crack propagation behaviour
- Professor Burdekin – independent opinion to HSSG

Lessons Learnt - Communications

Transparency:

- Factual updates released via SIN and IN
- Four Aberdeen stakeholder visits to Marignane
- Dozens of dedicated briefings in Aberdeen
- Materials available on the web-site

Speed of Communication:

- Risky to make public investigation updates due to remaining uncertainty
- Partially overcome by communications with key stakeholders under NDA arrangements

Standard Messages:

- Very detailed technical information was demanded
- Standard Q&A assembled from briefings
- A limited number of selected briefers were deployed world-wide

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Lessons Learnt - Communications

Terminology - eg “most probable root cause”:

- Used to respect AAIB constraints and the fact that the investigation was not complete or verified
- Was interpreted as hiding behind words in case we got it wrong

Forecast RTS Timeframes:

- Keen to provide good news to the market
- Resulted in some optimistic RTS forecasts
- More realistic planning communicated for redesign and retrofit

Power of the Media:

- Possibly the biggest influencer of passenger confidence


The Press and Journal

ABERDEEN

LOCAL NEWS SINCE 1747

Wednesday, June 5, 2013 60P

VICKI BUTLER-HENDERSON'S EMBARRASSING MOTORING MOMENTS

FREE YOUR CAR PULL-OUT

PLAY THE OPEN WITH STEPHEN GALLACHER

CHANCE OF A LIFETIME PAGE 67

Nine in 10 oilmen fear flying in Super Pumas

Max: 14c
Min: 7c

Police in plea over fatal crash on A90

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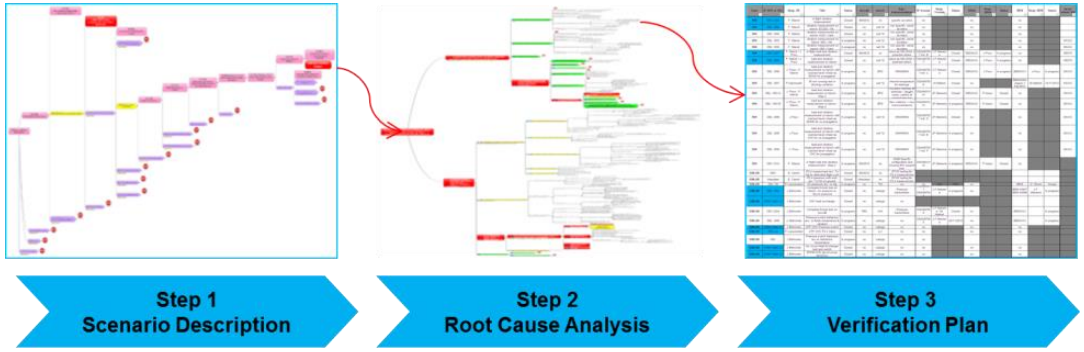
Lessons Learnt - Engineering

The Company's Highest Priority

- significant impact on other programmes
- >100 staff dedicated to finding and solving the problem
- EMLUB investigation was not complete before 2nd ditching



Exploitation of HUMS Capabilities:

- Both shaft failures that led to the ditchings were detectable (before failure) by HUMS
- New or revised thresholds set on all indicators
- MOD45 in-flight monitoring applied as a safety barrier

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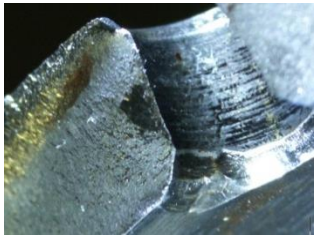
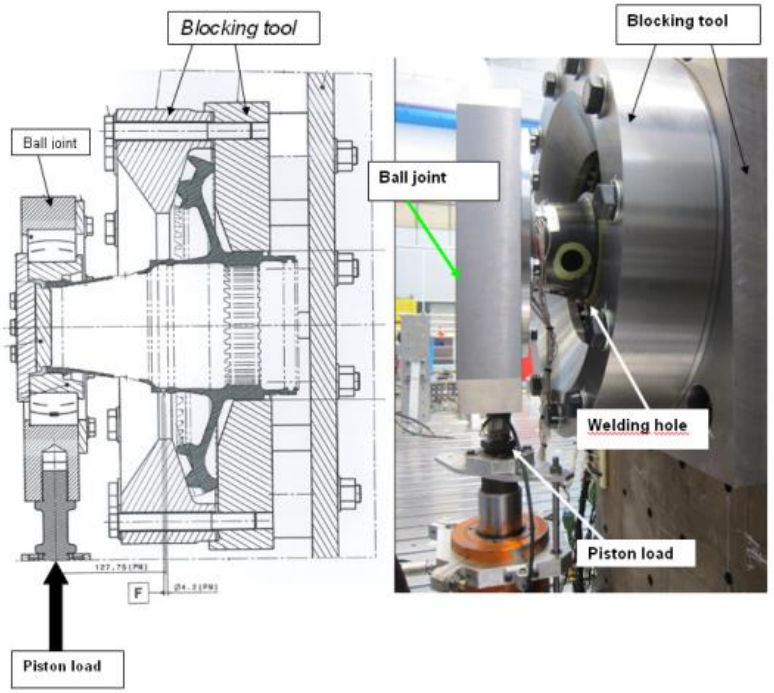
Lessons Learnt - Engineering

Robust Root Cause Analysis Methodology

- Conditions to generate an initiating corrosion pit (outside of the weld plug hole) not imagined before the 2nd ditching
- 'Aberdeen factor' needed to be fully investigated
- Positive verification if potential root causes did or didn't contribute to the failure
- Novel experiments
- Replicating the phenomena

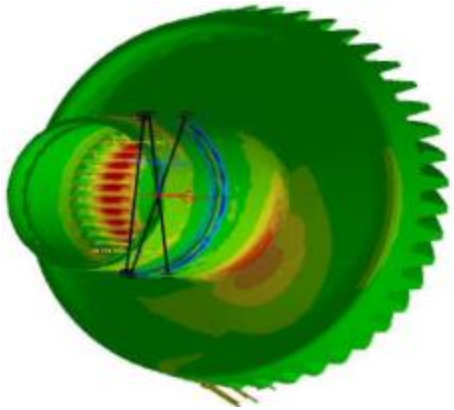


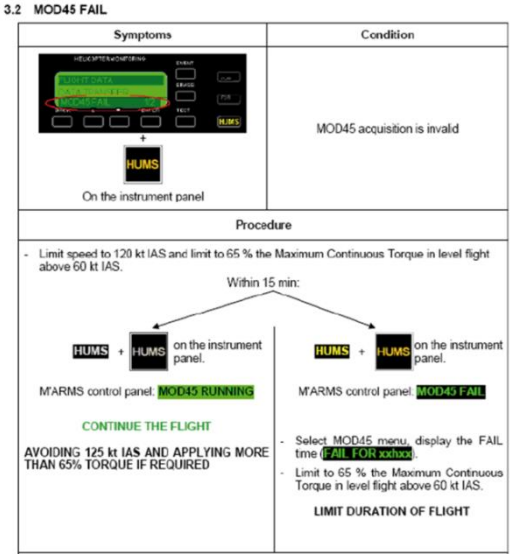


Lessons Learnt - Engineering

Rigorous Testing Exceeding Certification Requirements

- Reliance on stress computation via analysis and not measurement in the initial design:
  - Measurements taken during investigation and redesign
  - All related gearboxes also checked and OK





- Initial MOD45 In-flight display software release:
  - HUMS messages were expected by AH test pilots, but not fully documented or explained to line pilots
  - Caused some MOD45 ‘false alarms’ upon RTS
  - Initially corrected through training and documentation, and later via a SW update

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Lessons Learnt – Support/Logistics

Transparent World-wide Priorities and Commitments:

- AH developed a plan and then negotiated it with separate helicopter operators
- Fine adjustments made during weekly planning meetings
- 1st deliveries made concurrently to avoid priority disputes
- All Safety Measure retrofit kits delivered according to the plan
- Risks and conservative assumptions incorporated into the planning to provide a high degree of confidence
- Similar process is being followed for shaft retrofits

Lessons Learnt – Conclusion

Transparent, factual communications was the key to restoring confidence in the product and company, especially by demonstrating:

- Commitment to find and correct the problem – priority and resources
- High degree of technical expertise applied
- Transparency
- Meeting kit delivery promises

Additional Information

Additional information can be obtained from:

- ‘new shaft’ poster and leaflets
- Airbus Helicopters’ knowledge centre

http://www.ec225news.com

- Step Change in Safety knowledge centre

http://www.stepchangeinsafety.net/knowledgecentre

Airbus Helicopters remains available to assist with briefings and briefing materials and has cut-away examples of the old and new shafts available for viewing in its facilities in Dyce.

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