BULLETIN

Serious incident

23-2-2019

Involving

Airbus EC 175 B

OY-HHV

FOREWORD

This bulletin reflects the opinion of the Danish Accident Investigation Board regarding the circumstances of the occurrence and its causes and consequences.

In accordance with the provisions of the Danish Air Navigation Act and pursuant to Annex 13 of the International Civil Aviation Convention, the safety investigation is of an exclusively technical and operational nature, and its objective is not the assignment of blame or liability.

The safety investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents and serious incidents.

Consequently, any use of this bulletin for purposes other than preventing future accidents and serious incidents may lead to erroneous or misleading interpretations.

A reprint with source reference may be published without separate permit.

TABLE OF CONTENTS

BULLETIN

General

File number:	2019-71
UTC date:	23-2-2019
UTC time:	06:00
Occurrence class:	Serious incident
Location:	Esbjerg (EKEB)
Injury level:	None

Aircraft

Aircraft registration:	OY-HHV
Aircraft make/model:	Airbus EC 175 B
Current flight rules:	Visual Flight Rules (VFR)
Operation type:	Commercial Air Transport - Offshore
Flight phase:	Standing
Aircraft category:	Helicopter
Last departure point:	Esbjerg (EKEB)
Planned destination:	Tyra E (Helideck) (EKTE)
Aircraft damage:	Minor
Engines make/model:	2 x Pratt & Whitney (Canada) PT-6C-67E

SYNOPSIS

Notification

All times in this report are UTC.

The Aviation Unit of the Danish Accident Investigation Board (AIB) was notified of the serious incident by the operator on 24-2-2019 at 16:54 hours (hrs).

The Danish AIB notified the Danish Transport, Construction and Housing Authority (DTCHA), the French Accident Investigation Board (Le Bureau d'Enquêtes et d'Analyses - BEA), the Belgian Air Accident Investigation Unit (AAIU), the Transportation Safety Board of Canada (TSB), the European Aviation Safety Agency (EASA), the Directorate-General for Mobility and Transport (DG MOVE) and the International Civil Aviation Organization (ICAO) on 27-2-2019 at 13:36 hrs.

The BEA and the AAIU appointed non-travelling accredited representatives to the AIB safety investigation.

Summary

Following a maintenance inspection, the inspections and tool control performed by the maintenance shift was not according to procedures and failed to identify a breaker bar with an attached socket on the main rotor (MR) head of the helicopter.

During the start-up sequence of engine no. 2, the breaker bar and the socket ejected from the MR head, and the breaker bar penetrated the leading edge of a moving rotor blade, while the socket ended up on the apron.

Consequential human factor effects – partly caused by an ongoing discussion with the management regarding future work shifts, organisational structure and maintenance procedures perceived by engineers as being less than optimum – might have influenced the decision-making and the effectiveness of the applied procedures of the shift.

The serious incident occurred in dark night and under visual meteorological conditions (VMC).

FACTUAL INFORMATION

History of the flight

The serious incident flight was a VFR commercial offshore flight from Esbjerg (EKEB) to Tyra E (EKTE).

On the evening prior to the day of serious incident flight, OY-HHV underwent a 50 flight hour (FH) maintenance inspection at the operator's maintenance facilities.

The evening shift (the shift), consisting of five aircraft maintenance engineers, started working at 12:00 hrs in order to attend the weekly toolbox meeting and to perform a shift handover with the day shift, who worked from 04:00 hrs until 13:00 hrs.

Four of the engineers had successfully completed type certification training on the Airbus EC 175 B helicopter, but only three of them had obtained the approved maintenance license (AML) EC 175 rating and been granted certification rights by the Part-145 organization.

Due to vacation and scheduled off-duty, neither of the two Part-145 chief engineers (CE) had been on duty since 20-2-2019. Therefore, the daily shift handover sheet had been in use for two days, meaning several shifts had already used and signed on the daily shift handover sheet.

In the absence of any CE, the operator's technical director (TD) informally hosted a toolbox meeting from 12:00 hrs until 13:00 hrs, with participation of all the engineers from the day shift and the evening shift.

Following the toolbox meeting, the TD had a chat lasting approximately one and a half hour with one engineer from the day shift and one engineer from the evening shift. The topics included possible future changes to the shift structure – i.e. new shifts composition and a changed work roster.

Simultaneously, the remaining four engineers started working on OY-HHV and other helicopters parked both inside three interconnected hangars (no. 1-3) and outside on the apron.

OY-HHV was parked in hangar no. 2 with work platforms placed on both sides of the fuselage. The platforms allowed access to the MR.

Different members of the shift worked simultaneously on the fuselage, the MR section and the tail rotor (TR) section of OY-HHV.

The necessary paperwork was obtained and tools, including a breaker bar and a 19 mm socket, were collected from a tool rack to perform work to the MR.

At approximately 15:00 hrs, the engineer, who attended the chat on future changes to shift structures, returned and joined the shift working on OY-HHV.

Among other tasks, the maintenance inspection consisted of a clearance check (wear check) of the play in spherical bearings on the MR blade dampers and pitch links. Two shift members performed this task.

The wear check on the five MR blade dampers consisted of removing one blade damper at a time, measuring the play in the bearings and reinstalling the damper. The task was a critical task and required an independent inspection to be carried out upon completion.

When installing a damper, the washers and castle nuts were hand tightened to hold the damper in place.

Upon completing the installation of all five dampers (not torqued and locked), the two shift members started a similar job on the MR pitch rods.

Simultaneously, another shift member started torquing the castle nuts from the opposite platform.

Torquing was performed using a breaker bar with a 19 mm socket to hold the bolt on top in place, while applying torque to the castle nut below using the torque wrench. Once a nut had been correctly torqued, a cotter pin was installed to lock the nut.
See appendix 1

In unison, all shift members working on the MR and TR coordinated the movement of the interconnected MR and TR when necessary to complete their respective work.

When all MR dampers were torqued and locked, the same task was performed on the MR pitch rods.

This was the last task of the 50 FH inspection on OY-HHV, and all shift members subsequently went for lunch at approximately 18:00 hrs.

Following lunch, an unforeseen situation developed due to the way the work was divided, and how the paperwork was finalized.

One certified shift member started to finalize the 50 FH work order, signing for some of the work performed to the MR by one of the two not certified shift members, and closed the associated tasks in the maintenance system software program. Consequential, he could not sign for the independent inspections of the MR dampers and pitch rods.

As both of the two remaining certified shift members had worked on the MR dampers and pitch rods, there was no "vacant" certified shift member to sign for the independent inspections of the dampers and the pitch rods.

The shift members decided, that one of the two certified shift members, who had worked on the MR (but not signed for the task), would sign for the independent inspections, as *it would take too much time to re-do the paperwork as everything had to be manually performed.*

It was the perception of all shift members, that another shift member performed the independent inspection of the MR dampers and pitch rods.

One shift member performed a visual inspection of the work performed to the MR dampers and the pitch rods from the left platform, before performing independent inspections of the work performed to the fuselage and the tail section of the helicopter.

OY-HHV was towed outside and a post maintenance engine ground test-run (at MR take-off revolutions per minute (RPM)) was performed without remarks.

Then, OY-HHV was towed to hangar no. 4 (Hangar East) located at the other side of the airport apron.

The inspection papers for the 50 FH inspection were finalized and the associated tasks were closed in the maintenance system software program.

This included signing of the "General verification checklist before certificate for release to service (CRS)" (Tool Control, General and Critical Tasks) in the work order. No tool control check had been performed at this time.

Approaching the end of the shift, at approximately 21:30 hrs, one shift member performed the hangar tool control check in hangar no. 2, and another shift member performed the tool control check in hangar no. 3.

Neither of the two shift members observed any missing tools, but neither of the two shift members signed for the tool control check on the tool rack tool control checklist.

As the compliance section for tool control procedures performed of the daily shift handover sheet had already been signed by previous shifts, neither shift member signed that section on the daily handover sheet.

The shift ended their workday at approximately 21:45 hrs and left the maintenance facilities.

In the morning of the day of the serious incident flight, the day shift started working at 05:30 hrs.

OY-HHV was towed from hangar no. 4 to the airport apron, a before first flight (BFF) check was performed by the day shift engineers, and a pre-flight inspection (PFI) was performed by the helicopter flight crew.

Shortly before 06:00 hrs, the passengers boarded OY-HHV, and the flight crew started engine no. 1 and then started engine no. 2.

During the start-up sequence of engine no. 2, the flight crew heard a loud “bang”.

The flight crew shut down both engines and the subsequent inspection revealed a breaker bar extending from the leading edge of one of the main rotor blades.

Approximately 40 meters from the helicopter, a 19 mm socket was found on the apron.

Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal			
Serious			
None	2	16	

Damage to aircraft

A breaker bar penetrated the leading edge and the forward main spar of one main rotor blade, severely damaging the blade. The impact point was approximately 4 meters from the root of the blade.

Blade with breaker bar

Blade removed from helicopter with breaker bar still inserted. Identical breaker bar showed on top for reference.

Personnel information

Part-66 Approved Maintenance Licenses

a. Engineer no. 1

Engineer no. 1 - male, 33 years - was the holder of a valid European Union Part-66 Approved Maintenance License (AML) category B1.1, B1.2, B1.3, B1.4, B3 and C issued by the DTCHA and valid until 21-9-2022.

The AML included the Eurocopter EC 175 B1.3/C and Eurocopter EC 225 B1.3 ratings.

On 17-8-2017, the latest human factors (HF) training course was completed.

On 6-11-2018, the latest continuation maintenance organisation exposition (MOE) training was completed.

Employed by the operator since 24-3-2014.

b. Engineer no. 2

Engineer no. 2 - male, 48 years - was the holder of a valid European Union Part-66 AML category B1.3 and B2 issued by the DTCHA and valid until 15-11-2022.

The AML did not include a Eurocopter EC 175 rating. However, the engineer had completed the type certification training.

The AML included the Eurocopter AS 332 B1.3, Eurocopter AS 350 B1.3/B2, Eurocopter EC 155 B1.3/B2 and Eurocopter EC 225 B1.3 ratings.

On 31-1-2019, the latest HF training course was completed.

On 5-12-2018, the latest continuation MOE training was completed.

Employed by the operator since 1-2-2009.

c. Engineer no. 3

Engineer no. 3 - male, 39 years - was the holder of a valid European Union Part-66 AML category B1.3 issued by the Civil Aviation Authority of France and valid until 22-5-2020.

The AML included the Eurocopter EC 175 B1.3, Eurocopter AS 332 B1.3 and Eurocopter EC 225 B1.3 ratings.

On 17-8-2017, the latest HF training course was completed.

On 6-3-2018, the latest contractor MOE training was completed.

Employed by the operator on ad hoc basis (contractor) since 2017.

d. Engineer no. 4

Engineer no. 4 - male, 29 years - was the holder of a valid European Union Part-66 AML category B1.1, B1.2, B1.3, B2 and B3 issued by the DTCHA and valid until 25-4-2022.

The AML included the Eurocopter EC 175 B1.3 and Eurocopter EC 155 B1.3 ratings.

On 14-2-2018, the latest HF training course was completed.

On 6-11-2018, the latest continuation MOE training was completed.

Employed by the operator since 1-7-2013.

e. Engineer no. 5

Engineer no. 5 - male, 42 years - was the holder of a valid European Union Part-66 AML category B1.3 and C issued by the DTCHA and valid until 9-9-2019.

The AML ratings did not include the Eurocopter EC 175 rating.

The AML included the Eurocopter AS 332 B1.3/C and Eurocopter EC 225 B1.3/C ratings.

On 21-6-2018, the latest HF training course was completed.

On 6-11-2018, the latest continuation MOE training was completed.

Employed by the operator since 1-6-2014 (excluding the periods from 1-1-2016 until 28-3-2016 and from 11-4-2016 until 3-7-2017).

All five engineers had held their AML for at least five years.

Aircraft information

General information

Manufacturer:	Airbus Helicopters
Type/Model:	EC 175 B
Serial number:	5006
Airworthiness review certificate:	Valid until 1-11-2019
Engine manufacturer:	Pratt & Whitney Canada
Engine type:	2 x PT6C-67E
Main rotor type:	Spheriflex, 5 blades
Maximum take-off mass (MTOM):	7800 kilos (kg)
Aircraft total flight hrs:	3023:52
Latest maintenance:	50 FH inspection performed on 22-2-2019

Organisation and management information

Organisational structure

The Esbjerg operator started operation as an offshore helicopter company in 2002 based in EKEB.

In 2014, a Belgian owned holding company acquired the operator, which then became part of the Belgian based, global helicopter group. The group specialized in business-to-business helicopter services, both offshore and onshore. The majority of the operations were concentrated in the North Sea region and in Western Africa.

While the group headquarters, the Belgian air operator certificate (AOC), the Part-M continued airworthiness maintenance organisation (CAMO), and the Part-145 maintenance organisation headquarters were located in Belgium, the Esbjerg operator and other group operators, some with individual AOCs, were located in countries primarily bordering to the North Sea.

The Belgian ownership had prompted changes in the maintenance setup for the operator, as the Danish AOC CAMO subcontracted duties to the Belgian CAMO such as planning and engineering.

Prior to the change of ownership, the operator held a Danish Part-145 approval. The change of ownership had resulted in maintenance being performed on the basis of the Belgian Part-145 approval, by operator base and/or line maintenance stations. Maintenance work was performed by personnel employed by each operator but licensed through the Belgian Part-145 approval. The change of Part-145 approval had resulted in MOE procedural changes including tool control procedures.

At the time of the serious incident, the operator was operating five Airbus EC 175 B helicopters. Many of the operator employees had been employed since before the Belgian ownership of the operator.

The operator employed TD was responsible for the operator's technical operation, i.e. continued airworthiness of the fleet. Furthermore, the responsibilities included maintenance production planning in addition to having the managerial responsibilities for the engineers (work environment, contractual conditions, shift planning etc.).

Two CEs were the Belgian Part-145 local managers at the operator, and the direct daily leaders for the engineers. The CEs were accountable to the Belgian Part-145, but were employed by the operator, like the engineers.

Group structure chart.
See appendix 2

The MOE Part 1.4 described the duties and responsibilities of the maintenance management and staff.
See appendix 3

To some of the engineers, the diversion of responsibilities between the TD and the CEs were not fully transparent, and effectively they felt that the CEs reported to the TD, and that the TD was the direct daily leader for the engineers.

Several operator-employed staff at various levels at the local Part-145 in Esbjerg felt detached from the Belgian Part-145 during their daily work, and several engineers expressed slight resignation concerning the many changes and unnecessary procedures they felt that followed the Belgian take-over.

In addition, the management structure in general (group, AOC and Part-145) were perceived as confusing, incomplete or fast changing. The perceived effect was that *especially planning tasks were not always executed at the best suited department*.

Work shift

Engineer duty rooster and normal work shift

The 21-day duty rooster for the engineers included day shifts (seven), evening shifts (five) and off-duty days (nine). Working hrs were in general 0430-1430 hrs (day) and 1400-0000 hrs (evening).

The two CEs worked alternating seven-days on (0600-1600 hrs) and seven-days off duty. This allowed one CE to be present every day, except during periods of vacation, illness, or other work related duties etc. In the case of an absent CE, the TD sometimes covered the duties of the CE. However, the procedure of no CE at work was not described.

Handover between the day shift and the evening shift normally took place from 1400 hrs and until 1430 hrs allowing both the on duty CE and all engineers on both day and evening shifts to be present.

Each shift consisted of five or six engineers. None of the engineers were employed as team leader or as a substitute for a CE. Unforeseen technical issues occurring during a work shift, when no CE was on duty, was taken care of by the individual engineer or another shift member, who the shift might have decided to be "in charge" on the day.

At the time of the serious incident, the operator employed 16 full time engineers and two contractors (engineers on short-term contract).

This staffing structure was unchanged from before the Belgian acquisition of the operator, i.e. interchange of engineers between groups (shift) had been and were limited. A result of this, there was *a difference between the groups in the way things are approached and who takes ownership, but not to a degree where it raises a concern.*

Following the Belgian group takeover, the operator had employed two full time tool coordinators responsible for the tool calibration, the tool storage facilities and the tool marking.

However, the duties for the tool coordinators included many other tasks associated with the maintenance storage facility, general servicing of the helicopter fleet and ad-hoc work for the entire operator organisation.

It was the perception of some of the interviewed personnel that these other tasks had taken priority over tool-coordination at the time of the serious incident.

Future work shift structure

Due to a possible future need for a different work shift structure, an ongoing discussion of the proposed changes, involving the operator management and the engineering employees and their union representative, had taken place during the previous months.

The company had proposed changes to the shift, and the changes were considered a degradation of the current working conditions by the engineers. Based on the negative feedback to the proposed changes the TD had initiated chats with the engineers first hand rather than through the union representative.

The outcome of the chat the day before the serious incident flight, between the TD and the two participating engineers, were discussed amongst the engineers during the evening shift.

Maintenance operation

Maintenance system software, work order and work pack

Following the Belgian group acquisition of the operator, the daily maintenance at the operator tended to be more line oriented maintenance than base oriented maintenance. However, many of the

interviewed engineers felt that the maintenance procedures were better suited to base maintenance rather than line maintenance.

A maintenance software system was used to schedule maintenance. Only CAMO personnel had full permission in the system. The Belgian CAMO, under subcontract of the Danish operator CAMO, was responsible for the approved maintenance program (AMP) and for adding items to the forecast list for each helicopter at the correct interval.

The Part-145, local planners, CEs and engineers had limited permissions, but could import tasks from the forecast list into a work order, print the work orders in a MOE described format and sign off tasks.

The weekly maintenance production was prepared by the operator's administrative department with reference to the forecast list, and were available for the CEs each Monday morning.

Normally, the CEs prepared work packs for the coming shifts, adjusting for daily flight activity as per request of the operations department, availability of engineers etc.

A work pack included the daily shift handover sheet and the work orders of the different tasks, sometimes with designation of specific tasks to specific engineers. This was especially important when planning larger jobs and when planning evening and weekend shifts.

If the tasks had not been pre-designated for a shift, or if a change of people or tasks necessitated it, and neither any CE nor the TD were present, the shift engineers were supposed to divide and perform the work amongst themselves, taking MOE requirements and operational readiness of the different helicopters into consideration.

If it became necessary for an engineer to print a new work order, it could be done within a few minutes with reference to the unique work order number in the maintenance software system. All engineers had access to print a new work order.

When a task was completed and signed for in the work order, the task was subsequently closed in the maintenance software system with the performing certified engineer as signee.

An engineer closing his task or a CE could amend the task status and the task data. This was the closing comments and the signature/dates. This was registered in the log history of the task in the system.

Only CAMO personnel had privileges to perform the update process of the task in the forecast list.

Independent inspections and signing of tasks

Prior to issuing a CRS, at the end of the 50 FH inspection, it was required to perform independent inspections of all performed critical tasks according the MOE Part 2, 2.23.1.2.

The independent inspection was to be performed by a certified engineer who had not been involved in the work regarding the critical task. The independent inspection procedure should be performed in accordance with the Part-145 MOE.
See appendix 4

Company Part-145 procedures required that the engineer, who signed for a completed task in the physical work order should also be signing for the associated task in the maintenance software system. During the investigation, the AIB interviewed the involved personnel in order to establish, how it was decided amongst the engineers on the evening shift, who was to perform the various work tasks and independent inspections, and how they were performed.

All engineers generally agreed, that unless the CEs or the TD had specified, who was to perform which job, jobs were divided amongst the shift members, taking MOE requirements into consideration.

However, if during an actual shift, MOE requirements for required independent inspections were not taken into account, a situation could develop where no vacant engineer was available to perform the required independent inspections.

On the night before the serious incident flight, such a situation developed during the evening shift.

As it would take too much time to re-do the paperwork, it was decided between the shift members that one engineer signed for the independent inspections, while another performed them.

However, there was no consensus on who performed the independent inspections. Three different scenarios were revealed by three different interviewees, all of them identifying other engineers than the interviewee himself as the person performing – or supposed to perform – the independent inspection.

The visual inspection of the dampers and pitch rods performed after lunch, *was not meant as an independent inspection of the tasks, but only as a check of the bolts, nuts and safety pins of the dampers and pitch rods.*

However, all interviewees agreed that even though the paperwork and the maintenance system software did not actually reflect whom had performed what, there was no risk associated with their "workaround", because certified and/or experienced engineers had performed all work and independent inspections. The uneventful ground run was perceived as evidence to this statement.

None of the engineers remembered, who closed the engine cowlings.

It was not the first time that engineers had "worked around" procedures in order to complete required work or to have helicopters ready for flight as requested by the operations department.
According to the engineers, it was necessary, *as some of the procedures or forms were not suited to line maintenance, and because fewer people were scheduled now than before the Belgian group acquired the operator*.

Tool control safety barriers

The MOE incorporated descriptions of how the Part-145 managed tool control, both at administrative and at operational level.

While the Part-145 Maintenance Manager (group) had the overall responsibility of tool control, the CEs at the various operators had the local responsibility of implementation and adherence to tool control procedures.
See appendix 3

The engineers (Certifying staff (C.S)) were responsible to follow the guidelines given in the MOE while performing work on the helicopters according instructions given by the company.
See appendix 3

MOE Part 2.6 described the tool procedures. This included basic and special tool control in general and specifics for the various operators. The Esbjerg operator used individual tool racks in each hangar.
See appendix 5

Tool control of toolboxes/tool racks were logged on the tool control checklist form 001.
See appendix 6

Helicopter release to service (CRS) required critical task check and a complete tool check, which were recorded on the critical task checklist and on the CRS part of the work order.

A copy of the critical task (independent inspection) part of the work order of the 50 FH inspection for OY-HHV with engineer signature and stamp (removed by the AIB) recording the independent inspection of the "Correct installation and locking of damper assembly".
See appendix 7

A copy of the CRS part of the work order of the 50 FH inspection for OY-HHV with engineer signature and stamp (removed by the AIB) recording the tool control check performed.
See appendix 8

Daily shift/task handover procedures were described in MOE Part 2.26.4 (below in extract):
In case there is an early and late shift of engineer(s) at an operation, every day the "Daily shift handover" sheet FORM XXX 020 will be used to record details about the status of each operation aircraft at time of the handover.
Note: The AIB has removed the operator name and inserted XXX.

The lower right hand corner of the daily handover sheet contained the section where the *EARLY* on-going engineer and the *LATE* off-going engineer signed for *HAND OVER COMPILED AND TOOL STORE + BOXES CHECKED FOR COMPLETENESS.*

A copy of the daily shift handover sheet for 20-2-2019 with a red oval and arrow indicating the above-mentioned section. The AIB has removed the names and signatures.
See appendix 9

According to the engineers on the evening shift, there was no space left for signing for tool control on the in-use daily shift handover sheet, as this sheet already were used by previous shifts.

No new daily shift handover sheet was printed and available to the evening shift.

Basic tools could be stored on a tool rack according to MOE 2.4.1.1 (below in extract):

A tool rack is a rack on which basic tools are suspended. Each individual tool has a dedicated place on the tool rack, clearly labelled with a tool description. The tool rack must be so organized it is easy to identify each position on which a tool is required by means of shadows, suspension hook or other acceptable means.

A picture of the tool rack in hangar 2 at the operator maintenance facility showing the two empty slots, indicated by small plastic bags containing BROKEN labels.
See appendix 10

The tool control checklists form 001, for each of the three tool racks in the operator maintenance hangar no. 1-3, showed inconsistent signing and countersigning by both engineers and CEs.

It remains unclear whether a tool control check was performed by the day shift on the day of the serious incident flight. At the time of the serious incident flight, no one from the day shift had signed neither on the tool rack tool control checklists nor on the daily shift handover sheet.

Several engineers felt that some forms or acts duplicated or triplicated an action. This was for instance the case when you signed for having performed a tool control check. *You signed on the tool rack tool control checklist, on the handover sheet and on the work order. But when do you actually check, when is it serious?*

Often when you complete a small work order, you cannot close it (sign for tool control) if others are still working on other work orders of the helicopter.

According to several engineers, it was in particular an issue, when jobs ran over several shifts or days, or when tools from one tool rack were used simultaneously for work on more than one helicopter (i.e. in different hangars). The procedures and different forms/control sheets were *primarily designed for one shift completing a job on a single helicopter, as the sole user of a tool rack*.

Moreover, if you do not open and close a tool rack by signing the tool rack tool control checklist form, nothing really happens, as the CE who is supposed to countersign, often misses this part.

According to the Part-145 management the intended method (according MOE) of the tool control procedures was:

1. Physical tool control (of tool rack) was verified by signing on the tool control checklist form 001 on each toolbox at beginning and end of shift.
   The CE signature was only required when tools were broken or missing to identify the CE was made aware. It was not the purpose of the CE to countersign the tool checks each day.
2. An additional tool control check was required when a CRS was issued, as this was usually not at the same moment as the end of shift check.
3. Shift handover sheet was customized on request of the Esbjerg base. The signature for tools was only for handover purpose stating all tool control procedures were complied with. This signature was not a signature for the tool controls itself.

Quality assurance

Management visit and follow up

According to the MOE Part 1.3.2, Part 145 maintenance manager visits to all base/line stations were scheduled at least once every six months, while the Part 145 quality manager visit interval was once every third month.
See appendix 11

Safety reporting, enhancement and dissipation

All Part-145 employees could anonymously report safety related issue through a software system to the Belgian AOC/Part-145 Quality, Health, Safety, Security and Environment (QHSSE) department.

The QHSSE manager reported directly to the Part-145 accountable manager (AM), who also was the AM for the Belgian AOC (operator) and the group chief executive officer (CEO).

All reports were individually processed, and the outcome acted upon if necessary, and in addition, all reports were used for statistical analyses. If the raised issue substantiated it, the safety department

issued a maintenance memo distributed to all relevant group companies. Approximately 20 maintenance memos were issued each year.

The weekly toolbox meeting, or *toolbox talk* as it was known amongst the engineers, normally took place every Friday at the beginning of the shift handover period.
Agenda items varied but could include maintenance procedures, flight operations, contractual relations or general working conditions like shift structure.

Safety related issues - already distributed as maintenance memos via the Part-145 reporting system to the individual employee's company mail - were discussed, and implementation of new procedures were explained.

Quality audit

Quality audit of the Part-145 organization's procedures were described in the MOE 3.1:
See appendix 12

The category "equipment & tools" had been amongst the main drivers of the internal audit findings across the different bases since the past few years (no particular issues were identified at the Esbjerg operator). Missing tools were a part of this; most findings related to a lack of properly documenting the tool control check.

In many cases, corrective/preventive action had been a reminder to the staff to comply with the existing procedures. Furthermore, tool control procedures had evolved over the years to improve the system. The latest change prior to the serious incident was an introduction of tally control boards in October 2018.

The QHSSE department had not received any reports from the Esbjerg operator employed personnel via the software reporting system concerning tool control safety barriers (procedures, checklists, equipment, maintenance software system, facilities etc.).

Human factors

MOE/HF training

Initial and recurrent MOE and HF training for engineers was an annual requirement according to the MOE Part 3.4.4.2.
See appendix 13

MOE and HF training requirements were described in the MOE Part 3.4.8.
See appendix 14

Detailed HF training was described in the MOE Part 3.13:
See appendix 15

Maintenance distraction policy

The Part 145 organisation had formulated a maintenance distraction policy in order *to establish a controlled maintenance environment where attention and communication is focused on the safe and accurate completion of helicopter maintenance tasks and ground handling tasks.*
See appendix 16

Fatigue

All the interviewed evening shift engineers stated that they felt well rested, when they started working on the day before the serious incident flight, and that they perceived the stress level as fairly low during the actual shift.

BFF check and PFI

Both the BFF check and the PFI included a ground level visual inspection of the MR head, i.e. the engineer/pilot was standing on the ground next to the helicopter while performing the inspection.

The height of the MR head was approximately 4 meters above ground level.

ANALYSIS

General

All engineers were properly qualified to perform the 50 FH maintenance inspection, i.e. AML licence and qualifications, MOE and HF training etc.

All of the engineers were experienced and most had been employed by the operator for several years.

The general physical working environment were suitable to perform the required tasks.

Evening shift planned tasks versus actually staffing of engineers and available time seemed balanced.

During the evening shift, neither fatigue nor perceived stress reached a level likely to influence the sequence of events.

Organisation

The company structure had changed over the previous years, incorporating several changes to high and low level management personnel, operator maintenance procedures and ownership. However, a major part of the operator employees, facilities and hardware, and procedures were unchanged from before the Belgian group acquisition of the operator.

To the AIB, the most important consequences expressed by the engineers following the acquisition were:

- a feeling of detachment from the Belgian Part-145 organisation
- the resignation towards the *many changes and unnecessary procedures*
- the feeling that some maintenance procedures did not suit the work performed at the operator
- the confusion of whom is my direct superior, including the unambiguity of his role
- a lack of formal shift leadership, when no CE/TD was present.

All of the above could over a period, provoke complacency towards the daily work or a feeling of uselessness towards providing input for improvement.

The inconsistent management follow up on the incomplete use of tool rack tool control checklists probably reinforced the complacency.

Some misunderstandings were revealed amongst technicians/CEs in regard to actual tool control (followed by signing the tool control checklist form 001) vs. signing for compliance with tool control procedures (signing the daily handover sheet or the CRS part of a work order).

The MOE part 2.6 “Tool control description” did not specifically explain when a CE had to sign/countersign in the right hand column of the tool control checklist form 001. This might have contributed to the misunderstandings.

The procedures were perceived as somewhat better suited for base maintenance than for line maintenance, i.e. where you start working on one work pack in the morning and completing in the evening, working on one helicopter in one hangar using one complete set of tools only.

However, despite the revealed sense of less than optimum tool control procedures, no Esbjerg employee had reported this to the QHSSE through the software reporting system.

Therefore, even though internal audit findings across different bases, excluding the Esbjerg operator, had revealed issues with tool control, the lack of Esbjerg employee formal reports might have contributed to the level of mitigating actions taken by the management.

Human factors

It is likely that the evening shift engineer, participating in the chat following the toolbox talk, was influenced by the prospect of changing working conditions, to a degree that left him distracted. This resulted in the subsequent discussion of the topic with his fellow shift members, which probably caused a loss of focus from the direct work related tasks for some or all shift members.

It seems like a natural response, but it might, unknowingly to the shift, have had a negative impact upon “anything company related”, like procedure compliance, for the remaining part of the evening.

The cohesive shift composition might also have contributed to groupthink within the evening shift (meaning that decision-making could be guided by group consensus instead of following formalised procedures or critical evaluation).

The AIB believes that groupthink influenced the shift individuals towards believing that “safety was assured” even though MOE procedures were not followed.

Tool control safety barriers

It is possible that the lack of a formal shift leader on the evening shift, due to the way the signing of tasks was initiated, contributed to the situation where there was no vacant certified engineer to perform the independent inspections of the MR dampers and pitch rods.

It is also possible that the lack of a formal shift leader, leaving no single engineer accountable, contributed to the decision of not printing a new work order and thereby free the only not involved certified engineer to perform the independent inspections.

However, there is no doubt to the AIB that this decision also was influenced by the wish of not correcting the situation by printing a new work order, as this was perceived as very time consuming. Since the shift finished working before the normal end time of the planned shift, lack of time was however not a factor for the shift.

The rationale for the chosen "workaround" - that no risk was introduced - seems influenced by consequential human factor effects.

The outcome was that the independent inspections were not formally performed, even though a visual inspection of the bolts and cotter pins were performed.

Even though, the written description of the independent inspections did not specifically include a check of the surrounding area for tools or other foreign items, the AIB would expect a certified engineer to include this in an independent inspection.

The CRS was signed following the uneventful ground run of the helicopter, which substantiated the perception of a safe conduct. Whether the supposedly performed independent inspection was perceived as a tool control check (required as a part of the CRS) remains unclear.

However, at this time no formal tool control check had taken place.

The final safety barrier was the hangar no. 2 tool control check. This check was not signed for on the tool rack tool control checklist (omitted) or for tool control procedure compliance on the handover sheet (already signed by other engineers), and the AIB has not been able to reveal, why this check failed to identify the missing breaker bar and the 19 mm socket from the tool rack in hangar no. 2.

One could argue that the markings on the tool rack were not optimum, but a missing tool at a size like the breaker bar ought to be detected as missing during a thorough visual check of the tool rack.

Both the BFF and the PFI could be viewed as indirect tool control barriers, but it was not the main purpose of these inspections, and the AIB would not expect a person, performing a visual inspection from ground level, would be able to spot a piece of tool left in the MR head area, especially at dark night.

<u>Breaker bar</u>

It has not been possible for the AIB to positively identify how, where and when the breaker bar ended up in the MR head of the helicopter.

However, it seems highly likely that it was forgotten following the torquing of the MR dampers, perhaps still attached to a damper securing bolt through the 19 mm socket.

This would have left the breaker bar in a position, where the handle could rest upon a ballast weight, which could have “locked” the breaker bar during main rotor rotation and thereby preventing it from coming loose during the post maintenance ground test-run.

The AIB sees two likely scenarios explaining how the breaker bar could impact the rotor blade during the start-up sequence of engine no. 2.

Either the transportation of the helicopter following the test-run, or a movement of the flight controls during the start-up sequence, affected the breaker bar and the 19 mm socket to a degree where they became “unlocked”.

Rotational force during start-up then ejected the breaker bar and the 19 mm socket from the MR head, and the breaker bar was hit by a moving rotor blade, while the 19 mm socket ended up on the apron.

Maintenance distraction policy

The distraction policy incorporated procedures and guidelines for both management and engineers on how to avoid a distraction to develop, and how to mitigate the effects of a distraction.

At least to a certain degree, these procedures were not applied as the chat following the toolbox talk seemingly introduced a distraction, which subsequently resulted in divided attention of the evening shift.

CONCLUSIONS

Contributing factors

The AIB safety investigation did not reveal any systemic safety issues, but the below listed safety factors likely contributed to the sequence of events:

The organisation and management:

- scheduled a maintenance production, which at times led to a lack of defined roles on a shift
- proposed a future work shift structure in a manner that produced unwanted human factor effects
- did not consistently follow up on irregular use of tool rack tool control checklists
- did not provide an updated handover sheet for the shift
- implemented mitigating actions for tool control procedures compliance that did not accomplish the desired effect.

The engineers:

- felt detached from the Belgian Part-145 organisation
- did not perceive the group/management structure as fully transparent
- showed complacency on complying with procedures
- introduced a workaround during the shift that decreased or removed the effects of the tool control safety barriers
- felt some group tool control procedures were not especially suited for the maintenance performed at the operator
- did not fully comprehend the intended process of the tool control procedures.

The maintenance procedures/equipment:

- The tool rack markings were less than optimum.

Despite of the above, procedures were in place, valid, mandatory to follow and the engineers had the necessary training to apply them properly.

Therefore, in the view of the AIB, adherence to procedures would most likely have revealed the missing breaker bar and socket, and thereby avoided the serious incident from happening.

PREVENTIVE ACTIONS

On 24-2-2019, the operator implemented a new AOC managed tool control procedure as an addition to the MOE procedures.
See appendix 17

Simultaneously, the Part-145 QHSSE department initiated an internal investigation (using Maintenance Error Decision Aid (MEDA) and bowtie analysis) of the serious incident.

The outcome of the investigation was 11 recommendations addressed to the Part-145 organisation, targeting tool control procedures, tool set-up and storage, oversight of applied procedures, clarification of roles and responsibilities, additional training and sharing of lesson learned.

Based on the recommendations, the Part-145 organisation implemented a number of changes (in extract):

- Created a dedicated tool control standard operation procedure (SOP) giving additional clarification and explanation to the MOE requirements.
- Revised and clarified existing procedures and checklists/forms/sheets, e.g. general verification checklist before CRS, shift handover sheet, tool control checklist etc.
- Revised tool storage facilities. Toolboxes with coloured shadow foam replaced all tool racks.
- Improved digital and visual tool box tool check.
- Planned additional training/refresher courses on maintenance procedures.
- Introduced a new management position, (maintenance leader (ML)), responsible for appointing a replacement/acting as replacement for CE, in case of no CE present.
- A plan and procedure to evaluate the competence of all level personnel involved in maintenance.
- A weekly reporting procedure (SOP) where CE/ML reports to the NPH Part-145 on organisational matters.
- Shared lessons learned via newsletter, maintenance memos, training and information meetings.

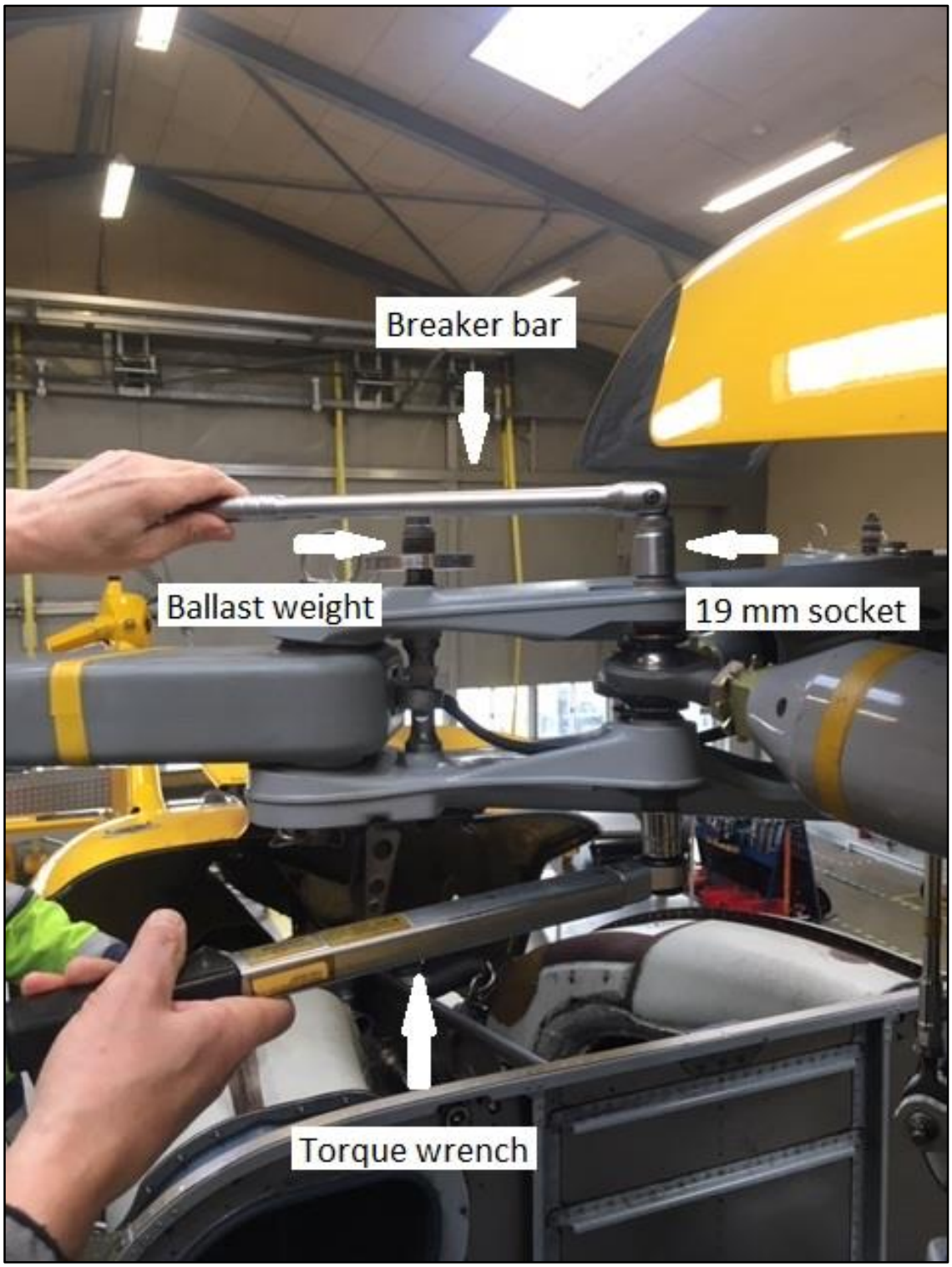
The results of the bowtie analysis were shared with the Esbjerg operator AOC Quality manager and CAMO manager.

APPENDICES

Appendix 1 Work ergonomics
Appendix 2 Group structure chart
Appendix 3 Duties and responsibilities of the personnel (in extract)
Appendix 4 CRS and independent inspection (in extract)
Appendix 5 MOE tool control description (in extract)
Appendix 6 Tool control checklist form
Appendix 7 Critical task (independent inspection) 50 FH inspection
Appendix 8 CRS 50 FH inspection
Appendix 9 Daily shift handover sheet
Appendix 10 Hangar no. 2 tool rack
Appendix 11 Management personnel base visit interval
Appendix 12 Quality audit procedures
Appendix 13 MOE/HF training interval
Appendix 14 MOE/HF training requirements
Appendix 15 HF training
Appendix 16 Maintenance distraction policy
Appendix 17 AOC implemented tool control procedure

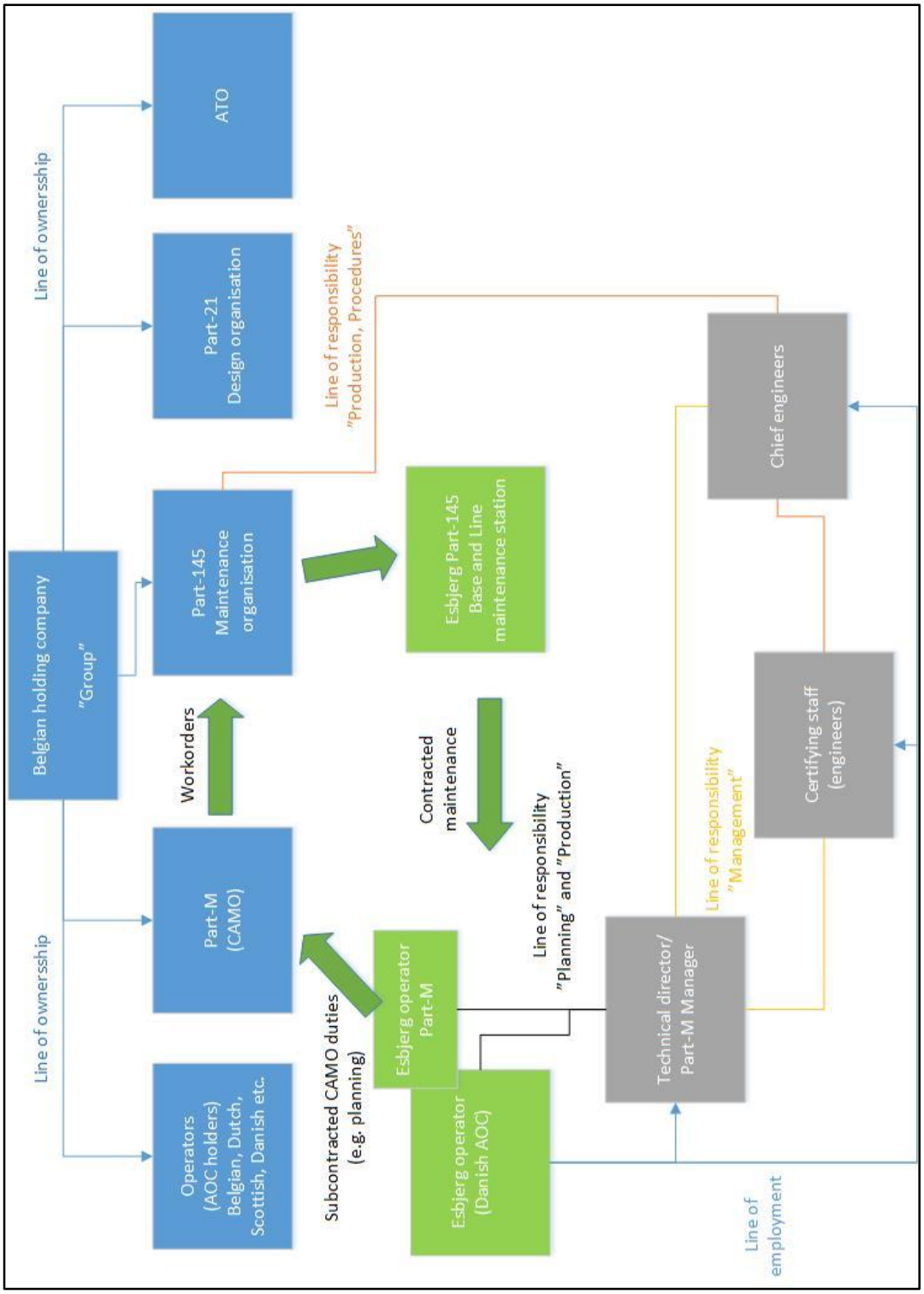
APPENDIX 1 WORK ERGONOMICS

Return to history of the flight



APPENDIX 2 GROUP STRUCTURE CHART

Return to organisational structure



APPENDIX 3 DUTIES AND RESPONSIBILITIES OF THE PERSONNEL (IN EXTRACT)

Return to organisational structure Return to tool control safety barriers

The AIB has removed the operator name and inserted XXX

1.4.1 Accountable manager:

- *As a post holder/manager function, responsible for the application & promotion of Human factors & human*
- *performance policy, only satisfied by a high standard maintenance system.*
- *The AM must ensure that the necessary finances, manpower resources and facilities are available to enable the company to perform the maintenance to which it is committed for contracted EU-OPS operators and any additional work which may be carried out i.a.w. the approval.*
- *The AM must ensure that maintenance carried out by the approved organization meets the standards required by the EASA, by Part 145.A.65(a) and by the BCAA.*
- *The AM must ensure that all the necessary resources are available to accomplish maintenance in accordance with 145.A.65(b) to support the organizations approval (145.A.30 (a)1)*
- *The AM is responsible for nominating the management staff*
- *The AM is responsible for ensuring the competence of all personnel including management personnel has been assessed.*
- *The AM must ensure that any charges prescribed by the BCAA are paid*
- *The AM must ensure that the MO has the facilities for the planned work (scope of work 1.9).*
- *The AM must ensure that the MO has office accommodation appropriate to the management of the planned work.*
- *The AM must ensure that the MO takes the necessary actions for the environment appropriate to the tasks being undertaken.*
- *The AM must ensure that the MO has the appropriate facilities for the storage of parts, tooling and equipment. The AM must ensure that all the tools, equipment and the materials are available to perform the planned works in respect of the scope of the MO.*
- *The AM must ensure that the MO has the sufficient competent staff.*
- *The AM must ensure that code of practice in relation the max-duty hours of the maintenance staff and he has taken in account the "Human Factors".*
- *The AM must ensure the necessary means for verification of costs, quality and reliability. The AM must ensure the balance in the MO budget.*
- *The AM must establish and promote the safety and the quality policy specified under chapter 1.2 and Part- 145.A.65(a).*
- *The AM must check the progress on quality rectification.*
- *The AM can demonstrate a basic understanding of this Part.*

1.4.2 Post holder Manager/Maintenance Manager

- *As a postholder/manager function, responsible for the application & promotion of human factors & human*
- *performance policy, only satisfied by a high standard*
- *The MM is responsible for ensuring that the organisation is in compliance with the existing MOE procedures. The MM has to ensure that the organisation is in compliance with the Work-Order or Maintenance Contract. The MM is responsible for reviewing any amendment of the MOE including the scope of work and capability lists. The MM has to ensure that the facilities are appropriate for the planned work i.a.w. the approval (Base maintenance & Line maintenance locations).*
- *The MM has to ensure that the office accommodations are appropriate to the management of the planned work. The MM has to ensure that the working environments are appropriate to the task being undertaken.*
- *The MM has to ensure that the MO has the appropriate facilities for the storage of parts, tooling and equipment. The MM has to ensure that all the tools, equipment and the materials are available to perform the planned works in respect of the scope of the MO.*
- *The MM has to ensure that sufficient competent personnel is available to plan, perform, supervise, inspect and certify the work being performed.*
- *Incoming inspection, tagging and storage apparatus, equipment tools, materials;*
- *The MM has to ensure that a code of practice in respect of maximum duty hours of maintenance-personnel is respected.*
- *The MM is responsible for the workshop management.*
- *The MM has to ensure all necessary airworthiness data from the EASA, BCAA and the aircraft manufacturer as appropriate to the task being performed, and/for notifying the Accountable Manager whenever deficiencies emerge which require his attention in respect of finance and acceptability of standards.*
- *The MM has to ensure that the maintenance procedures are established within the organization, to achieve good maintenance practice and compliance with BCAA's requirements. The MM is also responsible for the satisfactory completion and certification of all work required by contracted operators/customers, in accordance with the work specifications.*
- *The MM has to ensure the competence of his certifying staff engaged in the company's maintenance, and this by establishing a continuation training program using:*
- *The MM is responsible for on-the-job training (work-shops) and evaluation.*
- *He is responsible to ensure the following and updating of all data retained by the maintenance organization. The MM has to ensure that all maintenance is correctly performed, certified and that records of maintenance carried out are retained safely and securely for the statutory period.*
- *The MM has to report to the BCAA, to the manufacturers and to the operator when any condition of the aircraft or a component constitutes a safety hazard.*
- *The MM is responsible for preparing standard practices and procedures for use within the organization, derived from approved sources and keeping them up to date*

- *The MM is responsible for defect analysis in respect of aircraft undergoing maintenance so that any adverse trends are identified and responded to promptly ensuring the follow-up for life limited Parts, tools in storage. The MM is responsible for the delivery of the CRS.*
- *The MM is responsible for the Required Independent Inspection (=R.I.I.)*
- *The MM is responsible for updating the maintenance man-hour plan and presenting it to the QM for evaluation, with intervals of 3 months.*
- *The MM is responsible for the production planning.*
- *The MM is responsible for the training of the certifying staff following the schedule in chap 3. The MM is responsible for the amendment of the Critical Task Recheck list, (Form XXX 016) The MM has to ensure there are sufficient responsible personnel*
- *The MM has to ensure that the duty hours of his personnel are respected.*
- *The MM has to ensure that storage checks are done on a regular base: labelling & tagging*
- *The MM is responsible for administration: "aircraft inspection register" & inspection CARD's.*
- *The MM has to ensure management of the component history in relation to the aircraft maintenance.*
- *The MM has to ensure incoming inspections of items, equip., tools, etc...is performed.*
- *The MM is responsible for providing feedback to the Quality System about the services provided by contracted Organizations, Subcontractors*
- *The MM responsible for responding to quality deficiencies in the area of activity for which he/she is responsible, which arise from independent quality audits*
- *The MM is responsible for notifying the Accountable Manager whenever deficiencies emerge which require his attention in respect of finance and the acceptability of standards (Accountable Manager and Quality Manager to be officially informed of any lack of 25% of available man-hours over a calendar month)*
- *The MM is responsible for assessing suppliers of new and used components and materials, for satisfactory*
- *product quality in relation to the needs of the organisation.*

1.4.3 Chief Engineer:

The chief engineer (C.E.) reports functionally to the Maintenance Manager (NP) concerning all Part-145 matter and hierarchically to the Base Manager.

Reporting to the Maintenance manager (NP) is done at least on weekly basis in an agreed format.

The C.E. works with all the local responsible people such as: Base Manager, C.S., store keepers,... and local helpers.

The C.E.'s main responsibility areas are the following:

Planning

- *The C.E. is responsible to establish a hangar visit plan and to organize the works on the maintenance floor in regards to this plan. The hangar visit plan is drafted based on the operator (CAMO) requested work and takes into consideration the workload on the base.*
- *In case the workload is higher than capacity, the C.E. can request contractors i.a.w. the contractor sourcing procedure. Fatigue management procedures as detailed in this MOE are taken into account and exceedances must be reported. The C.E. will nominate dock chiefs for each maintenance project. It is the aim to guarantee continuous follow-up for the project and in that respect, dock chiefs should change as little as possible during the project. Therefore, in some cases, people can be withdrawn from their OFF-period.*
- *The C.E. supervises the production planning (consumables, products, tools, qualified personnel, parts, etc…) and supervises communication with the operators (CAMO) maintenance planning.*
- *The C.E. is responsible to supervise correct handling of all unscheduled maintenance and repairs in communication with the operators CAMO.*
- *The C.E. in agreement with the maintenance manager (NP) is the only person that can decide on the sub-contracting to other Part-145 if the contract with the operator allows to do so. This taking into account the applicable MOE procedures.*
- *The C.E. supervises adherence to contractual agreements with customers. For example to respect AOG reaction timings.*
- *The C.E. organizes regular toolbox meetings and ensures written summary reports of topics discussed and participating people.*
- *The C.E. organizes written shift handovers with bullet points of items discussed and signature of outgoing and incoming shifts.*

Personnel

- *The C.E. manages qualifications and experience of each staff member engaged and performs competence assessments as required.*
- *The C.E. manages numbers of certifying staff on shift in regards to the required workload. In case contractors and/or trainees are working as well, the C.E. ensures sufficient C.S. are supervising the works performed.*

Tooling

- *The CE is responsible for storage of all tools (basic tools, special tools and calibrated tools), keeping them complete and serviceable and quarantine unserviceable tools.*
- *The CE is responsible for the tool control procedures and starting the missing tools procedure as the situation occurs. The CE is responsible for the control of POL products and the expiry checks.*

Documentation

- *The C.E. ensures current and applicable documentation is used for all maintenance works.*
- *The C.E. ensures all works performed are documented in an unambiguous manner as per the MOE procedures. The C.E. ensures the latest revision of MOE forms are used.*
- *The C.E. acknowledges new documents in Q-pulse on a regular basis and advises the engineers during the toolbox meetings.*

Facilities

- *The C.E. ensures that adequate infrastructure for the intended maintenance is available and reports to the Base Manager and Maintenance Manager if this would not be the case.*
- *The CE is responsible for the organization and cleanliness of the maintenance facility*.

Components

- *The C.E. is responsible to ensure unserviceable parts are quarantined and separated from the serviceable parts.*
- *The C.E. communicates with the Supplychain manager on adequate solutions for parts in quarantine such as overhaul / repair etc.*

Workshops

- *The C.E. manages approved (internal) workshops in regards to manning, qualifications, workload, tools, etc…*
- *The C.E. ensures that the workshop equipment is available and in good working condition, as well as being stored at all times in a responsible and appropriate manner.*

Quality

- *The C.E. assists in audits on his facility including BCAA, customers and all other audit teams.*
- *The C.E. keeps the quality standard high and promotes this policy to the people engaged on the maintenance floor.*
- *The C.E. promotes Human Factors awareness and Safety awareness.*
- *The C.E. is responsible for delegated quality findings, to work out solutions enabeling a timely closure of the findings.*
- *The C.E. is aware of applicable ERP on the base.*

1.4.4 Quality Manager:

- *As a post holder/manager function, responsible for the application & promotion of Human factors & human performance policy, only satisfied by a high standard quality program & system.*
- *The QM is responsible for establishing an independent quality system to monitor compliance with EASA requirements and maintain a close liaison with the BCAA on all matters affecting the approval.*
- *The QM is responsible for complementing a quality audit program in which compliance with all maintenance procedures is reviewed at regular intervals in relation to each type of aircraft or component maintained. Any observed non-compliance or poor standards are brought to the*

attention of the person concerned via the manager, with a time scale for remedial action to be completed.

- *The QM has direct access to the Accountable Manager on matters concerning the Quality system The QM is responsible that the maintenance equipment is checked.*
- *The QM is responsible for prompt corrective action to remedy any deficiencies in the organisation.*
- *The QM should establish regular meetings with the Accountable Manager to appraise the effectiveness of the quality system. This will include details of any reported discrepancy not being adequately addressed by the relevant person or in respect of any disagreement concerning the nature of a discrepancy.*
- *The QM is responsible for assessing external specialist services required to be used by the company in the performance of maintenance.*
- *The QM is responsible for assessing suppliers of new and used components and/or materials, for satisfactory product quality in relation to the needs of the organisation.*
- *The QM has to present supplier complaints reports to the AM for supplier evaluation.*
- *The QM is responsible for submission of the MOE and any associated amendments, to the competent authority for approval (which includes completion of and submission of EASA Form(s) 2, EASA Form(s) 4 or equivalent). The QM is responsible for the authorisation of certification privileges within the organisation.*
- *He/she is responsible for issue /renewal/cancellation of certifying staff authorisations. The QM is responsible for the evaluation of contractors.*
- *The QM has to assure that the authorized certifying staff has been educated on Part 145 procedures and the procedures described in the maintenance organization's MOE.*
- *It's the duty of QM, with intervals of 3 months to evaluate the maintenance man-hour plan. The QM has to follow up the audit reports and keep records of all the files and the progress.*
- *The QM is responsible for the studying, preparing and application of improvements in the maintenance organisation procedures in due time.*
- *The QM is responsible for coordinating action on airworthiness occurrences and for initiating any necessary further investigation and follow-up activity (145.A.60, AMC M.A.202.a).*
- *The QM is responsible for establishing feedback from maintenance incidents/issues and feeding these back into the continuation training program.*
- *The QM is responsible for attending the pre- and after audit meetings to evaluate the audits.*

1.4.5 Quality auditor:

- *The Quality auditor has to works fully independent of the maintenance manager.*
- *The Quality auditor is responsible for checking, by performing sample checks, the maintenance organizations ability to perform the works to a predefined standard.*

1.4.7 Certifying staff:

- *C.S. is responsible to perform the work on aircraft and aircraft materials as dictated by the company, whilst obeying the restrictions in their personal certificate and guidelines given in the MOE.*
- *C.S. is responsible to ensure that the workplace is kept clean and tidy.*
- *C.S. must ensure that all safety regulations are followed, in order to ensure that the health and safety of himself or others is not jeopardized.*
- *C.S. are responsible for keeping tools and equipment, used for maintenance work, in good working order and report to the CE in case of defects observed.*
- *C.S. is responsible for performing maintenance work in accordance with the correct documentation.*
- *C.S. is obliged to keep themselves informed of the routines and instructions used within the organization, as described in the MOE.*
- *C.S. must contribute to the organizations Quality System to ensure that it functions in accordance with the intentions described in MOE chap. 3.*

1.4.8 Store coordinator:

- *The SC is responsible for Accepting & approving all incoming material including new components, tools and standard parts.*
- *The SC is responsible for labelling of incoming items.*
- *The SC is responsible for the processing in the logistic database when accepting or releasing items.*
- *The SC is responsible for the reception of materials/parts by complying with the incoming inspection checklist (FORM 010).*
- *The SC is responsible for evaluating suppliers in co-ordination with the quality manager, who presents the final suppliers evaluation report to the accountable manager.*
- *The SC is responsible for supervising, recording and keeping up-to-date shelf life limitation records in the logistic database, so that the shelf life times are never exceeded.*
- *The SC has to maintaining inventory levels within the agreed targets.*
- *The SC is responsible for keeping up-to-date the "calibrated tools list" + checks the due date list at regular intervals and send them for calibration to approved calibration organisation.*
- *The SC is responsible for the publication of all MSDS (Maintenance safety datasheet) in the vicinity of the maintenance floor.*

APPENDIX 4 CRS AND INDEPENDENT INSPECTION (IN EXTRACT)

Return to independent inspections and signing of tasks

The AIB has removed the operator name and inserted XXX

2.23 Critical maintenance tasks and error-capturing i.a.w. 145.A.48

2.23.1.1 General verification check before CRS.

After completion of a line- or base maintenance work pack and before the issue of the CRS, a general verification check shall be carried out to ensure that the aircraft is clear of all tools, equipment and any extraneous parts or material. Additionally, it shall be verified that all removed access panels and covers have been refitted. Compliance with this check is recorded by completing the "General Verification Checklist before CRS" 5.1.18 - Form XXX016: General verification checklist before CRS.

2.23.1.2 Definitions

Independent inspection definition (RII)

An independent inspection is an inspection performed by an independent Certifying Staff / Support Staff of a task carried out by another Certifying Staff / Support Staff, taking into account that:

- *The Certifying Staff / Support Staff who performs the task or supervises the task assumes the full responsibility for the completion of the task in accordance with the applicable maintenance data;*
- *The independent Certifying Staff / Support Staff performs the independent inspection and attests the satisfactory completion of the task and that no deficiencies have been found.*
- *The independent Certifying Staff / Support Staff must not have participated in any part of the task subject to the RII. This includes the re-assembly or installation of the next higher assembly. However, it is allowed to be involved in other tasks of the same work order.*

Re-inspection definition.

The re-inspection procedure is a comparable procedure as the independent inspection procedure, except that the Certifying Staff / Support Staff performing the maintenance task is also acting as Certifying Staff / Support Staff performing the inspection.

Re-inspection is used as an error capturing method to control identical maintenance tasks in duplicate systems.

The re-inspection method is not allowed as an alternative for the independent inspection. If an independent inspection requirement is determined applicable, regardless if it concerns an identical task in duplicate systems, the MOE procedure for independent inspection shall apply.

APPENDIX 5 MOE TOOL CONTROL DESCRIPTION (IN EXTRACT)

Return to tool control safety barriers

The AIB has removed the operator name and inserted XXX

MOE Part 2.6 (in extract)

2.6 Use of tools and equipment by the staff (Including alternative tools)

In order to maintain a high standard of maintenance quality and safety it is mandatory that all personnel understands and knows the procedures, first how to obtain and secondly how to use tools and equipment.

2.6.1 Control of tools and equipment's

The principle is that, when finishing work, everyone can check easily if tools are missing and who is responsible for the missing tools. Trackless tools can cause a critical safety risk for a maintained aircraft if it's left in or on the aircraft.

Tool control is essential in the quality assurance of the maintenance organisation.

2.6.1.2 Procedures for basic & special tools (in extract)

General:

All -, special- & calibrated tools are located in areas with limited access such as the bonded store workshops.

Basic tools can be in roll cabs, toolboxes or tool racks. Some toolboxes or tool racks are located in the hangar. In case those toolboxes or tool racks are not lockable, an appropriate tool control check is required before first use of the day and after last use of the day.

Note: At line maintenance stations, where no dedicated store keeper is available, the chief engineer in charge will grant access to the tools.

Tool control procedure for toolbox and tool rack

At the start of the first shift of the day, the toolbox is checked for completeness and the opening of the toolbox is logged on the tool control check list form XXX 001.

At the end of the last shift of the day, the toolbox is again checked for completeness and the closing of the toolbox is logged on the tool control check list form XXX 001.
Before a helicopter is released for flight, the critical task checklist shall be completed and a complete tool check performed. Recording of the tool check shall be done on the critical task checklist.

- *If a tool is found missing, the missing tool procedure i.a.w. MOE 2.6.1.6 - Missing Tool procedure shall be started.*
- *If all tools are accounted for when opening the toolbox, the first check of the day part of the tool control form can be signed.*
- *If all tools are accounted for when closing the toolbox at the end of the day, the second part of the line on the tool control form can be signed.*
- *If a tool is missing, the "missing tool" procedure shall be started.*
- *If a tool seems broken, the "broken tool" procedure must be started.*

All discrepancies, before or after use, must be reported to the Local maintenance Manager or Chief Engineer.

Basic tools:

Basic tools are ALL fitted with a shadow foam or suspension hook tool location system. This ensures that tools are kept in their correct locations and allows the toolbox or tool rack to be checked quickly for completeness.

Esbjerg Base & Line station specific procedures:

Roll cabs with basic tooling in the hangar: locked roll cabs with a set of basic tools are situated in the hangar. Each roll cab is locked when not in use.

One controlled tool rack with basic tooling in the hangar.

Each engineer working in the hangar is responsible for the tools he uses. Before first use of the day, the tool rack is checked for completeness and signed for acceptance on tool control form "company" 001.*

At the end of the shift or before release to service of the helicopter, these tools must be returned to the tool rack and the line on the tool control form XXX 001 closed, confirming all tools present.

Specific procedures for deviations of the general procedures for basic & special tools

In general, toolboxes and general tools are provided by XXX to the engineers. Personal toolboxes are not allowed.

Only in specific cases, such as works where expert tooling is required, on remote locations where no tooling is foreseen or in case of OEM or contractor working teams, an exception to the general rule can be made.
The use of a personal toolbox can be authorized by the chief engineer on behalf of the maintenance manager (NPH). The C.E. has to personally inspect the toolbox and confirm to the maintenance manager in writing that the toolbox has an acceptable tool control system in place. When the works are finished and before the release to service of the helicopter, the chief engineer has to confirm that all tools are present and make a note in the helicopters' work pack.
(Critical task checklist, table 'other').

An acceptable tool control system is a system which allows to determine visually that all tools are present when the toolbox is inspected, such as shadow boards. This includes the exact quantities of all tools and accessories. No loose or uncontrolled items are allowed.

In case the toolbox does not have a satisfactory tool control system in place, the toolbox cannot be used.

In case a tool or accessory is missing, the lost tool procedure as per XXX MOE must be started.

Line maintenance station procedures:

Line maintenance toolboxes are not digitally controlled. A log sheet attached to the toolbox will identify when the toolbox was opened/used, by whom and to work on what aircraft.

After ensuring the condition of the toolbox is as described in the inventory log book, the "issue log sheet" must be signed by the engineer to accept responsibility for the toolbox.

If due to dimensions some tools are loose in a drawer, at least an inventory list of these tools or a picture book is present in the drawer for verification purpose.

2.6.1.3 Special- & calibrated tools (in extract):

Special- & calibrated tools are always stored in areas with limited access for engineers, in the bonded store. If a store area with store keeper is present, he/she is in charge of the tools. If not, the Local maintenance manager or chief engineer is in charge of these tools.

All special- & calibrated tools are listed in the digital control system (see chapter 2.4.1 – Tool & equipment categories & resources).

Esbjerg Base & Line station specific procedures:

All special- & calibrated tools are listed in the digital tool control system. If a tool is broken, it must be labelled with a red tag before return to store.

If a tool is unserviceable due to out-of-calibration or sent out for repair, the status in the system is indicated as such. In that case it's impossible to issue the tool.

In addition a system with numbered tallies is installed for several workshops and tool stores. When an engineer takes a tool from these locations a numbered tally is put in the empty location instead. On removal of a tally from the tally board, the aircraft on which the tool is to be used and the trigram of the person to whom the tool is issued, is to be annotated on the tally board. This gives traceability between the tally in the empty location and the engineer using the "missing" tool.

2.6.1.6 Missing Tool procedure

If a tool goes missing, the individual using the toolbox must inform the Chief engineer immediately. All efforts must be made to recover the missing tool and there can be no doubt about the tool being left inside an aircraft. The missing tool procedure must be started in accordance with the missing tool checklist in MOE Form XXX 004B: Lost tools checklist. An ATL entry must be made as per procedure described on the form. The MOE Form XXX 004B must be submitted to XXX maintenance and quality mail.

If the tool is recovered an ATL entry must be made on the same registration.

Only when the Chief engineer is satisfied that the tool is not on board of any aircraft, he will complete the "list of broken/missing tools" and a replacement tool will be ordered.

In the digital tool list the tool will be marked as "unavailable". Put a "MISSING" label into the standard location of the tool (in toolbox or store location).

When the replacement tool has been delivered, the chief engineer will update the "list of broken/missing tools", remove the "MISSING" label from the empty location and place the new tool instead.

CAUTION: Frequent loss of tools will not be tolerated.

APPENDIX 6 TOOL CONTROL CHECKLIST

Return to tool control safety barriers

The AIB has removed the operator name and inserted XXX

Form XXX 001: Tool control check list

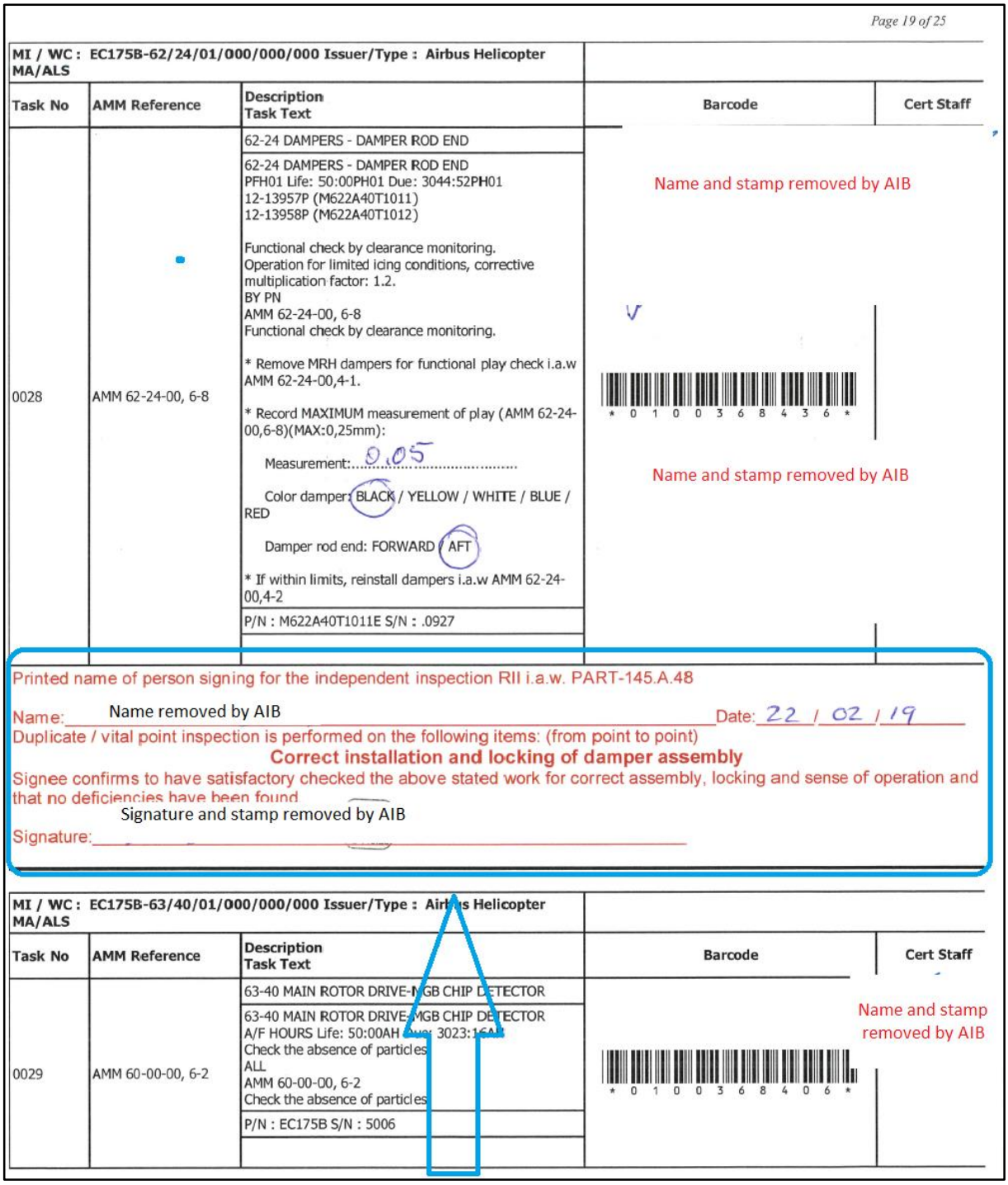
TOOLBOX "XXX": …..

TOOL CONTROL CHECKLIST

Date	First check of the day				Used on A/C	Last check of the day				CE trigram & sign
	Toolbox opened by (Trigram)	Signature	Missing tools?*	Missing tool procedure started		Toolbox closed by (Trigram)	Missing tools?*	Signature	Missing tool procedure started	
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			
…/…/20..			☐ No / ☐ Yes				☐ No / ☐ Yes			

APPENDIX 7 CRITICAL TASK (INDEPENDENT INSPECTION) 50 FH INSPECTION

Return to tool control safety barriers



MI / WC : EC175B-62/24/01/000/000/000 Issuer/Type : Airbus Helicopter MA/ALS

Task No	AMM Reference	Description Task Text	Barcode	Cert Staff
		62-24 DAMPERS - DAMPER ROD END		
0028	AMM 62-24-00, 6-8	62-24 DAMPERS - DAMPER ROD END PFH01 Life: 50:00PH01 Due: 3044:52PH01 12-13957P (M622A40T1011) 12-13958P (M622A40T1012) Functional check by clearance monitoring. Operation for limited icing conditions, corrective multiplication factor: 1.2. BY PN AMM 62-24-00, 6-8 Functional check by clearance monitoring. * Remove MRH dampers for functional play check i.a.w AMM 62-24-00,4-1. * Record MAXIMUM measurement of play (AMM 62-24-00,6-8)(MAX:0,25mm): Measurement: 0,05 Color damper: BLACK / YELLOW / WHITE / BLUE / RED Damper rod end: FORWARD / AFT * If within limits, reinstall dampers i.a.w AMM 62-24-00,4-2	Name and stamp removed by AIB V * 0 1 0 0 3 6 8 4 3 6 * Name and stamp removed by AIB	
		P/N : M622A40T1011E S/N : .0927		

Printed name of person signing for the independent inspection RII i.a.w. PART-145.A.48

Name: Name removed by AIB Date: 22 / 02 / 19

Duplicate / vital point inspection is performed on the following items: (from point to point)

Correct installation and locking of damper assembly

Signee confirms to have satisfactory checked the above stated work for correct assembly, locking and sense of operation and that no deficiencies have been found

Signature and stamp removed by AIB

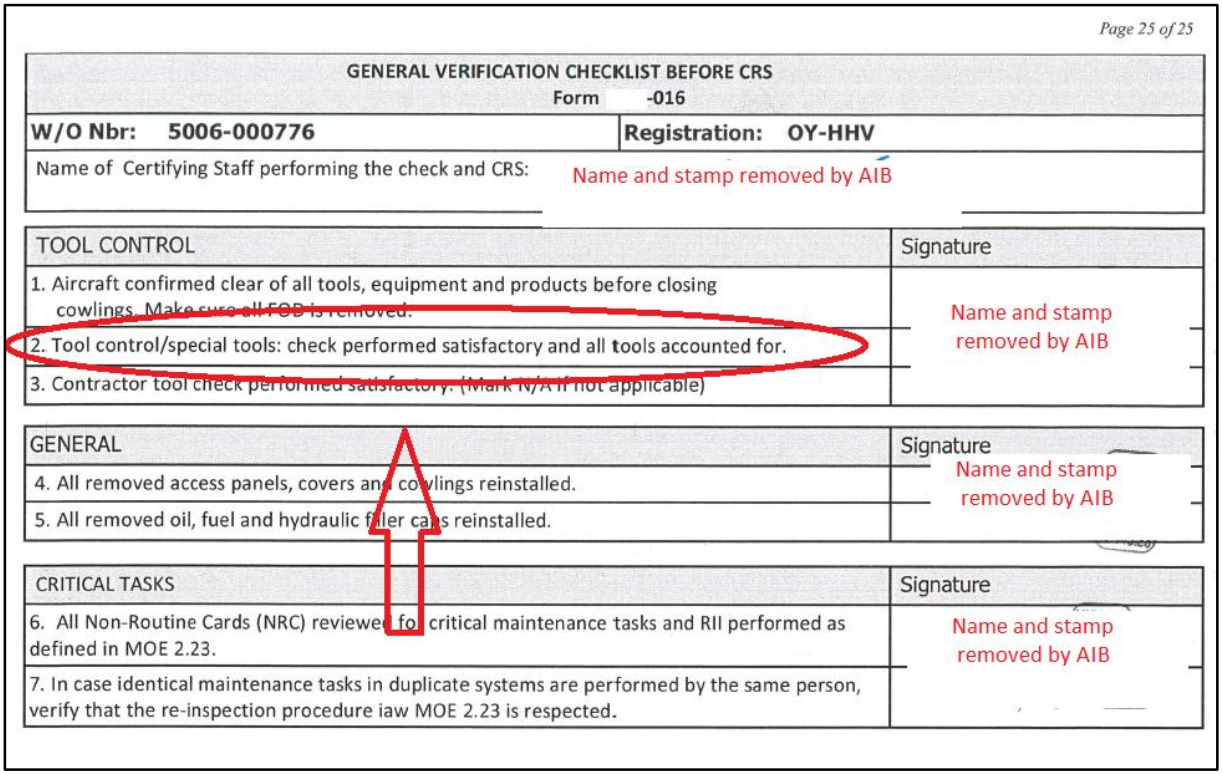
Signature:

MI / WC : EC175B-63/40/01/000/000/000 Issuer/Type : Airbus Helicopter MA/ALS

Task No	AMM Reference	Description Task Text	Barcode	Cert Staff
		63-40 MAIN ROTOR DRIVE-MGB CHIP DETECTOR		
0029	AMM 60-00-00, 6-2	63-40 MAIN ROTOR DRIVE-MGB CHIP DETECTOR A/F HOURS Life: 50:00AH Due: 3023:16AH Check the absence of particles ALL AMM 60-00-00, 6-2 Check the absence of particles	* 0 1 0 0 3 6 8 4 0 6 *	Name and stamp removed by AIB
		P/N : EC175B S/N : 5006		

APPENDIX 8 CRS 50 FH INSPECTION

Return to tool control safety barriers



Page 25 of 25

GENERAL VERIFICATION CHECKLIST BEFORE CRS
Form -016

W/O Nbr: 5006-000776	**Registration: OY-HHV**
Name of Certifying Staff performing the check and CRS: Name and stamp removed by AIB	

TOOL CONTROL	Signature
1. Aircraft confirmed clear of all tools, equipment and products before closing cowlings. Make sure all FOD is removed.	Name and stamp removed by AIB
2. Tool control/special tools: check performed satisfactory and all tools accounted for.	
3. Contractor tool check performed satisfactory. (Mark N/A if not applicable)	

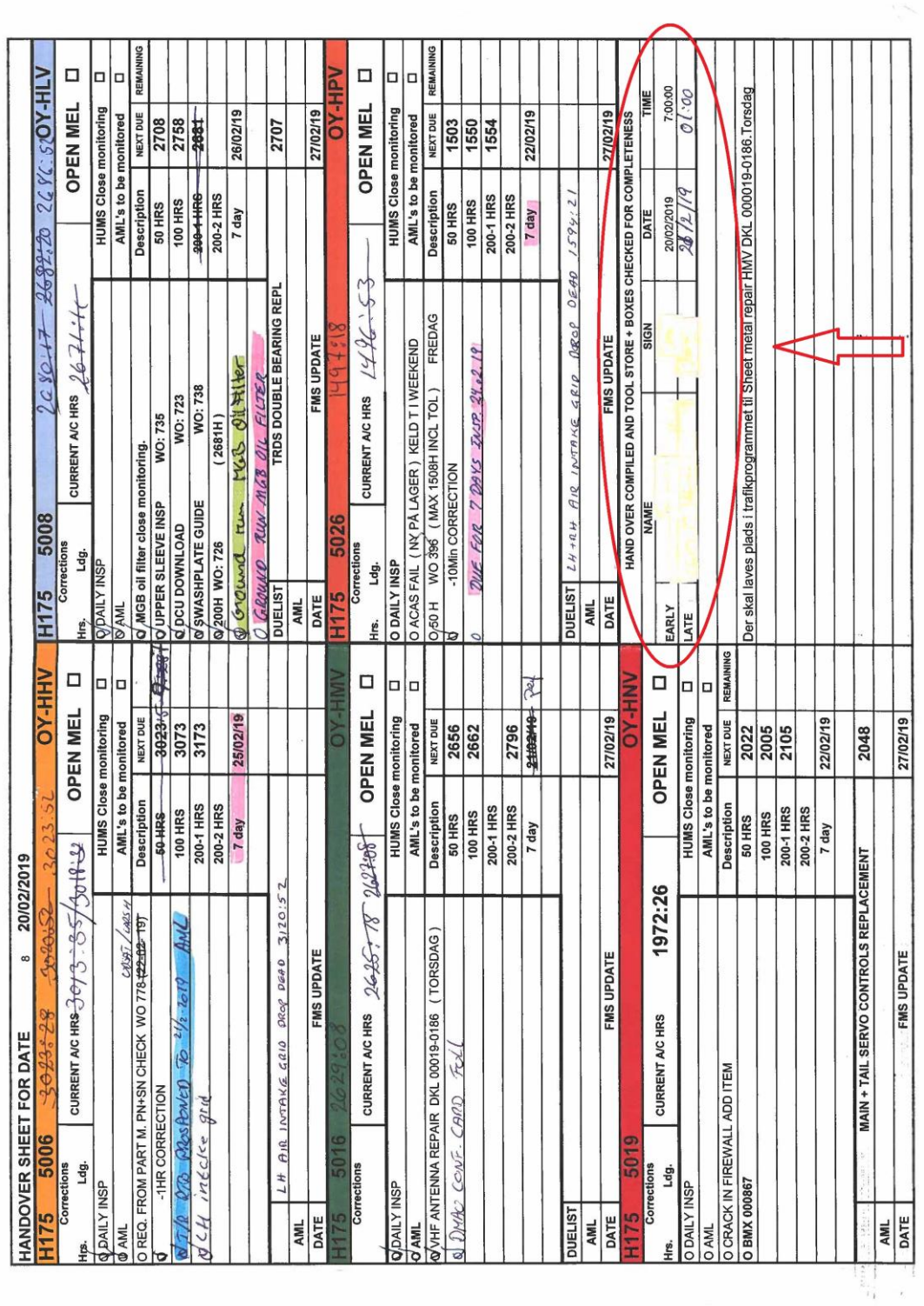
GENERAL	Signature
4. All removed access panels, covers and cowlings reinstalled.	Name and stamp removed by AIB
5. All removed oil, fuel and hydraulic filler caps reinstalled.	

CRITICAL TASKS	Signature
6. All Non-Routine Cards (NRC) reviewed for critical maintenance tasks and RII performed as defined in MOE 2.23.	Name and stamp removed by AIB
7. In case identical maintenance tasks in duplicate systems are performed by the same person, verify that the re-inspection procedure iaw MOE 2.23 is respected.	

APPENDIX 9 DAILY SHIFT HANDOVER SHEET

[Return to tool control safety barriers]

The AIB has removed names and signatures the in red oval



APPENDIX 10 HANGAR NO. 2 TOOL RACK

Return to tool control safety barriers

APPENDIX 11 MANAGEMENT PERSONNEL BASE VISIT INTERVAL

Return to management visit and follow up

1.3.2 Management personnel

The Maintenance Manager (and/or his depute) will visit the BMX stations on regular intervals (minimum once every 6 months) and organize regular communication such as conference call on a weekly basis. The C.E. is the representative of the Maintenance Manager (NP) on site with the duties and responsibilities as described in ***1.4.3 - Chief Engineer:***

The Quality Manager (and/or his depute) will visit the base regular every 3 months to assure:

- *Continuous monitoring of compliancy with all EASA PART-145 requirements.*
- *Regular reporting the Accountable manager about non-conformities with the EASA requirements.*
- *Follow up of the findings, raised by the quality auditor during scheduled audits.*
- *Evaluate corrective actions proposed and implemented by the Maintenance Manager.*
- *Evaluation of the maintenance man-hour plan.*

APPENDIX 12 QUALITY AUDIT PROCEDURES

Return to quality audit

The AIB has removed the operator name and inserted XXX

3.1 Quality audit of the XXX Part 145 organisation's procedures

The company has a Compliance Monitoring Manual (CMM document with internal reference ID COP-003), describing all quality related procedures. This manual covers all Quality requirements of chapter PART 145.A.65, and is approved by the BCAA.

3.1.1 Objectives:

See Compliance Monitoring Manual chapter 2 General and the Safety, Health and Environmental policy is described in the Compliance Monitoring Manual chapter 2.1

3.1.2 Quality audit independency:

See Compliance Monitoring Manual chapter 4.4.2

3.1.3 Quality Audit:

See Compliance Monitoring Manual chapter 4 Compliance monitoring programme

The audit is an objective process of routine sample checks of all aspects of the organizations' ability to carry out all maintenance to the required standards. It includes some product sampling as this is the end result of the maintenance process.

3.1.4 Frequency of the audits:

All chapters of the PART-145 regulation are covered on all maintenance locations, at least once a year. A 12-months program of audits through the entire organization is scheduled at the start of the year and accordingly performed during the year.

- *For the PART-145 organization, the 12-months program includes all aspects of the regulation on:*
- *The Base maintenance stations*
- *The Line maintenance stations The Line maintenance locations*
- *A product audit on at least 2 important helicopter types of the fleet*
- *A product audit on an end product of each approved workshop*

Also see Compliance Monitoring Manual 4.6: Compliance monitoring programme

3.1.5 Procedure:

See Compliance Monitoring Manual chapter 4.7 Monitoring and corrective actions.

According to CMM paragraph 4.3.3.2, for each audit scope a low-level checklist is available. For each question the corresponding PART-145 regulation chapter is indicated in the checklist. With that information for each audit scope + the annual audit plan, it can be proved all chapters of the regulation are covered through the whole maintenance organization (incl. line stations/locations)

Next checklists for audit scopes are available as annex to the Compliance Monitoring Manual:

- *Line maintenance station*
- *Base maintenance station (supplement questions on line maintenance station)*
- *Product audit*
- *Workshops (battery shop, avionic shop, floatation shop…)*

3.1.6 The follow-up/feedback:

See Compliance monitoring programme chapter 4.7.3: Follow-up of the corrective action.

3.1.7 Audits by the CAA:

Continued validity of approval is dependent of the Authority being granted access to the facility to determine compliance with the Part 145. During the audit visits, findings by the Authority surveyors are confirmed in writing to the organisation.

Upon receiving such reports, the organisation shall reply within a reasonable time or as required by the Authority. Corrective Actions, Follow-up and Responsibility are the same as for internal auditing reports.

Proposed corrective actions are first to be accepted by the Quality manager. After implementation a description of the corrective action and implementation date is completed on the corrective action report. The completed and signed report is finally sent to the BCAA to close the finding.

Also see Compliance monitoring programme chapter 4.10 Actions to be taken for non-compliance findings issued by the BCAA.

APPENDIX 13 MOE/HF TRAINING INTERVAL

Return to MOE/Human Factors (HF) training

Initial and recurrent training

All maintenance staff should initial and recurrent training adapted to their job content. The following training should be provided:

Training	***MO admin staff***		***Certifying staff & support staff***	
	Initial	*Recurrent*	*Initial*	*Recurrent*
MOE training	*Y*	*2Y*	*Y*	*1Y*
HF training	*Y*	*2Y*	*Y*	*1Y**
Technical refresher training	*N*	*N*	*Y*	*2Y***
SMS training	*Y*	*3Y*	*Y*	*3Y*
Logistics and maintenance software system training	*Y*	*2Y*	*Y*	*2Y*

** Contractors: valid HF certificate required before employment; ** Contractors: Technical refresher training valid before employment. Proof of recent experience on relevant type.*

Other relevant training should be provided if applicable to the Certifying staff and support staff: i.e. locally specific Operator procedures, CAM procedures (MEL, completion of ATL,...), local agreements,...

APPENDIX 14 MOE/HF TRAINING REQUIREMENTS

Return to MOE/Human Factors (HF) training

The AIB has removed the operator name and inserted XXX

MOE Part 3.

3.4.8 Training of the certifying staff

The Part 145 organization is responsible through the maintenance manager that all personnel employed in the certifying staff meets the requirements to fulfil the job. In order to meet these requirements the staff receives initial and recurrent training.

The Accountable manager shall ensure that sufficient means are available for the qualification and recurrent training. It is the responsibility of the Quality Manager that the training procedures are completed following a program as described below.

Training of certifying staff may be performed by the Part 145 approved organization and or by any other institute selected by the organization and approved by the BCAA.

The Part 145 organisation needs to establish the curriculum and standards for training as well as pre-qualification standards for the personnel intended for training. Pre-qualification standards are intended to ensure that the trainee has a reasonable chance of successfully completing any course.

Each training course will be ended by an examination in order to have proof that the person meets the Part 145 requirements. In case of HF and MOE a minimum of 70% is required to pass the examination. In case the person failed the examination, a new training course and examination is required. A report of the examination can be found in the personal records file.

For HF and MOE a certificate will be awarded by the XXX training instructor to confirm successful accomplishment.

3.4.8.1 Continuation training program

It is a very important two way process of information between the MO & the Quality department.

First it will ensure that certifying staff remains current in terms of:

- *Company procedures (MOE)*
- *Human factors*

- *Technical knowledge (recurrent technical training)*

Secondly it provides the possibility for the PART-145 organisation to receive feedback from certifying staff on the adequacy of its instructions and procedures.

The quality department is actively involved in audit findings, analyses results of occurrence reports (like staff failed to follow procedures), management of the MOE procedures... For that reason it's very important there is a good communication line installed between the quality- and PART-145 training departments, to make that two way process working.

At least once in every 24 month period the content of the continuation training will be reviewed, related to relevant quality audit findings, received feedback from staff…

All elements of the continuation training must be completed by each certifying staff member, spread over a 24 months Period (= validity period of the company authorisation). After that period the quality manager will assess the training status before re-issue the company authorisation.

3.4.8.2 Essential elements of the continuation training

1. Maintenance organisation procedures (MOE)

- *Refresher of all relevant procedures for mechanics*
- *Extra attention for all new and changed procedures*
- *Instances where staff failed to follow procedures and the reasons why particular procedures are not always followed. Refer to quality audit findings.*
- *The HF training will be provided by a dedicated XXX instructor.*

2. Human factors

See chapter 3.13 - Human factors training procedures (PART 145.30 (e)) for further details.

- *The need to receive initial human factors training should be assessed, as this could have been integrated into previous completed training packages.*
- *However the human factors continuation training must be completed in any case. The purpose is primarily to remain current in terms of human factors and to collect feedback on human factors issues from the staff.*
- *The HF training will be provided by a dedicated XXX instructor. The quality department will be involved in this training to ensure necessary action is initiated.*

3. Technical knowledge

Refresher courses related to the certification privileges of the engineer: Tape ratings on airframe, engine, component maintenance, non-destructive inspections (boroscope)...

The method of training is a flexible process, evaluated based on the personal needs:

- *A Part 147 continuation training course*
- *Aeronautical college course, seminar...*
- *Internal organised short duration courses (content and duration well documented)*

4. Actual maintenance experience

All certifying staff and category B1 and B2 support staff must be involved in at least 6 months of actual relevant aircraft or component maintenance experience in the last 24 months period. To comply with this requirement the engineer must and/or:

- *Exercise the privileges of his certification authorisation = sign for maintenance tasks*
- *Carry out maintenance on at least some of the aircraft type systems specified in his certification authorisation.*

Spread over a 24 months period, all these training elements are planned by the PART-145 organisation. The information database system "Q-pulse" will be used for planning to keep all certifying staff up to date. At all times the status of the continuation training elements can be consulted from this system.

APPENDIX 15 HF TRAINING

Return to MOE/Human Factors (HF) training

The AIB has removed the operator name and inserted XXX

MOE Part 3.

3.13 Human factors training procedures (PART 145.30 (e))

3.13.1 What means "HUMAN FACTORS":

HF means the principles which apply to aeronautical design, certification, training, operations & maintenance and which seek safe interface between the human and other system components by proper consideration of human performance.

The Human performance means human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

3.13.2 Objectives for the HF training:

Enhancing maintenance personnel's awareness of individual and organisational human factors issues, both positive and negative, that may affect airworthiness.

To develop human factor skills (such as communication, effective teamwork, task management, situational awareness, writing of procedures) as appropriate to the job, in order to make a positive impact on the safety and efficiency of maintenance operations.

To encourage a positive attitude towards safety and to discourage unsafe behaviour and practices.

3.13.3 For who is the HF policy applicable:

The HF are applicable for all of the following functions/tasks/jobs in the frame of the Part-145 Maintenance organisation:

- *Post holders, managers & supervisors*
- *Certifying staff, engineers & mechanics*
- *Technical support personnel such as planners, engineers & technical record staff*
- *Quality control/assurance staff*
- *Specialised services staff*
- *Human factors staff/ Human factors trainers*
- *Store department staff, purchasing department staff*

- *Ground equipment operators*
- *Contract staff in the above categories*

3.13.4 Initial training

In respect to the understanding of the application of HF and human performance issues, maintenance, management and quality audit personnel are assessed for the need to receive initial HF training.

Initial HF training covers all the topics of the XXX training syllabus either as a dedicated course or else integrated within other training. This syllabus has been adjusted from the one mentioned in the GM 145.A.30(e), to meet the particular nature of the XXX organisation.

The initial training is provided to all personnel within 6 months after joining the XXX MO.

Temporary staff is trained shortly after joining the MO to cope with the duration of the employment.

Personnel recruited from another Part-145 MO and temporary staff are assessed for the need to receive any additional HF training to meet the new Part-145 MO HF training standard. A certificate to prove previous completed HF training can be accepted.

3.13.5 Continuation training:

The purpose of HF continuation training is primarily to ensure that staff remains current in terms of HF and also to collect feedback from the staff on Human Factors issues. Within the XXX MO it's the aim that the quality department (Manager) is involved in the training content. Therefore the trainer will formally pass any feedback to the quality department to initiate action where necessary.

HF continuation training is of sufficient duration in each two years period in relation to the relevant quality audit findings and other internal/external sources of information available to the organisation on human errors in maintenance.

The continuation training for HF is conducted by the XXX MO itself (by means of a dedicated trainer)

The use of independent trainers or any other training organisation can be considered if they are acceptable to the BCAA.

3.13.6 The HF training procedure (PART 145 & GM 145.A.30(e))

The syllabus for HF training will at least cover the following items (see ANNEX 2):

1. General/introduction to Human Factors
2. Safety culture/Organisational factors

3. Human error
4. Human performance & limitations
5. Environment
6. Procedures, Information, Tools & practices
7. Communication
8. Teamwork
9. Professionalism and integrity
10. Organisations HF program.

APPENDIX 16 MAINTENANCE DISTRACTION POLICY

Return to maintenance distraction policy

The AIB has removed the operator name and inserted XXX

2.24.1 XXX Maintenance distraction policy

Definition

The XXX maintenance Distraction policy seeks to establish a controlled maintenance environment where attention and communication is focused on the safe and accurate completion of helicopter maintenance tasks and ground handling tasks. Any engineer working on the helicopter in this controlled maintenance environment should not be distracted by visitors, personal electronics, own staff,… unless there is a clear reason to do so.

Distractions are incredibly common and can damage productivity, focus, employee morale and can have a huge impact on the safety of the personnel and the Helicopter.

This policy seeks to establish a standard that minimizes the causes of distraction while performing maintenance or ground ops tasks.

Guidelines

Following guidelines are applicable to all Part-145 maintenance personnel while on duty:

- *The use of a MOBILE PHONE is strictly prohibited when using ground ops equipment such as a tow truck, shopper spotter, airside vehicle or other ground ops equipment. Ref. GOM §2.10. Parking of vehicles and ground equipment.*
  The same applies when using any lifting equipment or when working at height and in all refueling areas.

- *For safety reasons and to avoid distraction, you are not allowed to make phone calls while performing a complex maintenance task on a helicopter. Unless the phone call is related to the task being performed.*
  Personal phone calls are to be done on a more appropriate moment in the administration desk, maintenance office or cantina, but NOT in the maintenance hangar.

- *When receiving a personal phone call while performing maintenance on the helicopter, return the call at a more appropriate moment. This when the task is finished or at a moment when the task can be interrupted safely.*

Noncompliance with these guidelines will incur a safety investigation (MOR) and will result in a written warning. Self- awareness among engineers following these guidelines is of vital importance. If an engineer is seen not following these guidelines, the observing engineer must make him aware of the consequences and dangers of not following these guidelines.

Distraction event process

A distraction event can be defined as follows:

- *Any form of interruption not related to the task in hand that may cause the engineer involved to lose concentration.*
- *When an engineer is being called away from a safety critical or complex task in hand to a more urgent problem.*

In case of a distraction event, the engineer must repeat/re-confirm the previous three steps prior to the distraction event. If the engineer was working on a complex staged task, he must go back to the last recorded and signed-of item on the task card. Maintenance manual print-outs of task whom do not fall under 'Complex tasks' can help minimize distraction based maintenance errors.

Responsibilities

Management:
Management are responsible for the effective implementation of this policy within the maintenance area under their control.

Chief engineers:
Chief engineers are required to take necessary steps to prevent the distraction of engineers working under their supervision. They need to be aware of critical maintenance tasks taking place and should aid engineers to minimise any distraction caused by visitors. Chief engineers must also create self-awareness among the engineers to prevent them from being distracted.

Engineers:
Engineers are responsible for complying with the applicable parts of this policy, this includes

- *Carrying out the Distraction Event Process should they be distracted.*
- *Minimising distractions to others in the workplace.*

Point of entry – Staff:

- *Be aware of and understand their responsibilities with respect to the distraction free maintenance environment policy.*

- *Ensure that visitors fully understand their responsibility not to distract those working in a distraction free maintenance environment.*
- *Only enter a distraction free work area if absolutely necessary. Minimize disruption to engineers working in distraction free areas.*

<u>Employees/Visitors to the workplace:</u>

- *Comply with the requirements of this policy.*
- *Any visitors entering a distraction free maintenance environment must be aware of signage to identify a distraction free work area where safety critical or complex work is being performed and ensure that they do not distract the engineers involved.*
- *Hold discussions/phone calls away from the area to minimise distractions.*
- *Be aware of distraction free maintenance areas to avoid creating a distraction event.*

Hangar Facilities and Signage

All hangars and workshops where personnel are engaged in aircraft maintenance should be classed as Distraction Free Areas. This requires appropriate signage to inform personnel and visitors they are entering a Distraction Free Area and should act responsibly, in accordance with the points listed in the 'Responsibilities' section. The following should be provided to allow visitors/personnel to comply with this policy:

- *Wall/Door mounted signs should be displayed at all entrances to maintenance hangars informing visitors they are entering a Distraction Free Maintenance Area, that engineers should not be disturbed and contact details for persons responsible for maintenance within the area.*
- *Posters should be displayed adjacent to aircraft work bays promoting distraction free maintenance and control of personal items.*

APPENDIX 17 AOC IMPLEMENTED TOOL CONTROL PROCEDURE

Return to preventive actions

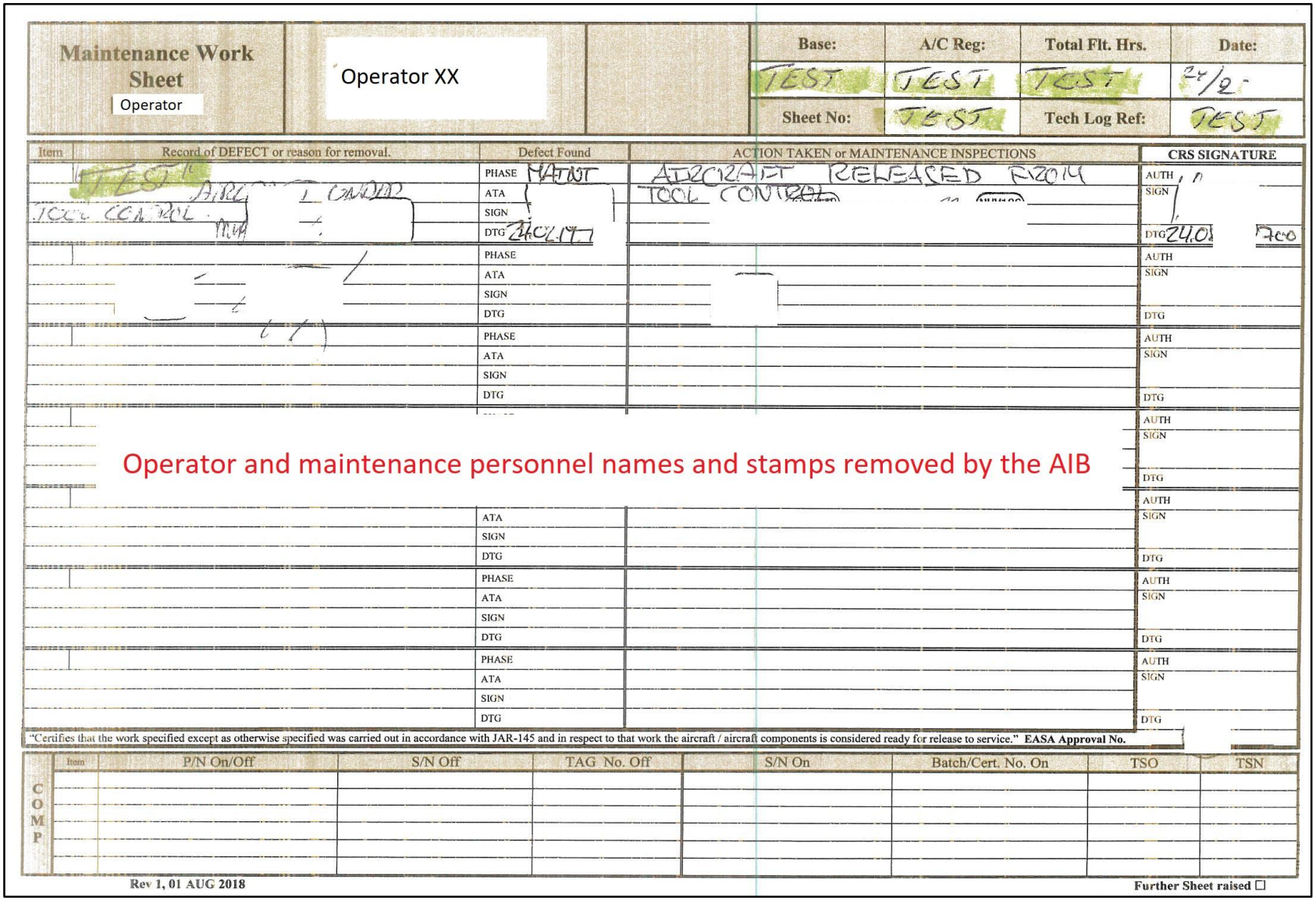
New AOC implemented procedure

In order to maintain flight safety it has been decided, from an Operator AOC perspective, to initiate a new temporary tool control procedure. ***This procedure is additional to what you have in the MOE today,*** *but this new AOC procedure is mandatory and have been implemented starting today.*

The proces is:

- *At all times, when an aircraft is being worked at with tools, the engineer will open an ATL entry with the text "AIRCRAFT UNDER TOOL CONTROL"*
- *Every engineer who actively working on this aircraft with tools is obligated to sign and stamp in the left hand side of the ATL / MWS, confirming he is working on the aircraft with tools and in compliance with Company tool control procedures.*
- *Before aircraft can be released to service, all engineers who sign and stamped in left hand side of the ATL MWS, they have to sign and stamp in the RH side of the ATL/ MWS, confirming they have removed all tools from aircraft and performed Company tool control.*
- *The below example describe how we, for now, want you to comply with this new AOC procedure, in the example below, you will see one stamp and signature missing, in the RH side of the ATL, means the aircraft cannot be released to flight.*

For example – see next page



Maintenance Work Sheet

Operator

Operator XX

Base:	A/C Reg:	Total Flt. Hrs.	Date:
TEST	TEST	TEST	24/2
Sheet No:	TEST	**Tech Log Ref:**	TEST

Item	Record of DEFECT or reason for removal.	Defect Found	ACTION TAKEN or MAINTENANCE INSPECTIONS	CRS SIGNATURE
	TEST A/RC 1 CANNOT TOOL CONTROL	PHASE MAINT ATA SIGN DTG 24.02.17	AIRCRAFT RELEASED FROM TOOL CONTROL	AUTH SIGN DTG 24.02
		PHASE ATA SIGN DTG		AUTH SIGN DTG
		PHASE ATA SIGN DTG		AUTH SIGN DTG
				AUTH SIGN DTG
		ATA SIGN DTG		AUTH SIGN DTG
		PHASE ATA SIGN DTG		AUTH SIGN DTG
		PHASE ATA SIGN DTG		AUTH SIGN DTG

Operator and maintenance personnel names and stamps removed by the AIB

"Certifies that the work specified except as otherwise specified was carried out in accordance with JAR-145 and in respect to that work the aircraft / aircraft components is considered ready for release to service." **EASA Approval No.**

COMP	Item	P/N On/Off	S/N Off	TAG No. Off	S/N On	Batch/Cert. No. On	TSO	TSN

Rev 1, 01 AUG 2018

Further Sheet raised ☐