

## **Basic Technical Training (Onshore/Offshore)**

### **Basic Mechanical Standard**

#### **Foreword**

This document has been developed in the project ATTP (Adapting a Transparent Training Programme for wind energy) with the support from EU Lifelong Learning Programme, Leonardo da Vinci. The Standard has been made together with global wind turbine owners and manufacturers (Vestas, Siemens, ENERCON, Gamesa and DONG Energy).

This Standard describes the requirements for Basic Technical Training in the wind industry that are recommended by ATTP. Where national legislation sets higher requirements for the training, the Training Provider shall incorporate these requirements in the training programme.

In this document the learning outcomes and the single elements of the lessons are all described according to Blooms taxonomy, please see appendix A.

All together there are the following three appendixes to this document:

- A. Blooms Taxonomy Action Verbs
- B. Basic Mechanical Test
- C. Checklist for Learning Outcomes

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## List of abbreviations

BTT	Basic Technical Training
WT	Wind Turbine
PPE	Personal Protection Equipment
BS	Braking System
ATTP	Adapting a Transparent Training Program for wind energy

## Introduction

This module is part of a course of training that prepares candidates for work in the Wind Power Industry both on and off shore. It is not a stand-alone qualification but can be delivered independently of the other modules.

## Target Group

The Basic Mechanical Training does not have a specific target group. It is suitable for candidates with no previous experience, but some practical and technical knowledge would be advantageous.

## **Section 1 –The Basic Technical Training (BTT) - Basic Mechanical**

### **1.1 Duration of the BTT Module “Basic Mechanical”**

The Module will need duration of approximately 28 hours and has theoretical and practical parts incorporated in it. There will be a one hour examination to assess the theoretical knowledge and ongoing assessment of the practical elements.

### **1.2 Target Group for the Module “Basic Mechanical”**

The Basic Technical Training (BTT) is designed to provide participants with the basic technical skills that – together with the needed safety courses - will enable the participants to work onsite, supervised by an experienced technician.

The Basic Mechanical training is designed to provide personnel with knowledge of the mechanical systems of wind turbines. The participants should know how the systems work and have the ability to carry out basic mechanical maintenance of a wind turbine. They should know the environmental considerations, safety procedures and the correct PPE (personal protection equipment) requirements. The training module is designed both onshore and offshore operations.

### **1.3 Participant prerequisites for the Module “Basic Mechanical”**

There are no prerequisites for this module but some sort of practical, mechanical or electrical background would be useful.

All personnel working in the wind service industry shall be medically fit and capable of performing work under demanding situations. This includes being able to

- Work at heights;
- Work in a wind turbine environment;
- Do not suffer Seasickness (offshore);

Personnel in the wind service industry must also be able to read and write technical instructions and complete the required documentation. Furthermore it is an advantage if participants are able to read, speak and write English.

Participants must have undertaken a pre-induction process to ensure they are aware of the working conditions and demands in the industry.

### **1.4 Physical and stressful demands of the Module “Basic Mechanic”**

The working environment in a wind turbine can be restricted for space, so a candidate will have to be agile enough to safely carry out maintenance tasks. Because the access to turbines off shore is by boat transfer the candidate will have to be physically fit enough to with-

stand the rigours of this, and be able to climb the ladders within the turbine when there is no elevator use available.

### **1.5 Aims and objectives of the Module “Basic Mechanical”**

The aims of this module are to give the participants the knowledge and skills to carry out basic maintenance tasks (supervised by an experienced technician), without damaging the environment, using safe working procedures and the correct PPE.

The objectives of the BTT Module Basic Mechanical are to ensure that the participants are able to:

- (a) Have the knowledge and the skills to use safety procedures specific to mechanical systems and to use the necessary PPE and appropriate tools.
- (b) Have general knowledge of the construction components; Foundation, Towers, Nacelle, Rotor and Blades, Platforms, Ladders and Lifts.
- (c) Have general knowledge of the mechanical systems and their components. Pitch system, Yaw system, Drive train, Gearbox, Coupling, and Generator.
- (d) Have knowledge of the lubrication systems the types of oil and grease used and their disposal to environmental standards. They will understand Oil Cleanliness rating and its impact on component performance.
- (e) Understand the principles of threads and threaded components; and the maintenance processes for bolted connections.
- (f) Understand Force, Torque, Power, Energy, Wind Velocity and Wind direction.
- (g) Use spanners, torque wrenches, screwdrivers, mallets, a Laser alignment tool, feeler gauges, calipers and dial gauges to carry out prescribed checks.
- (h) Understand and use technical drawings and diagrams, maintenance repair and service manuals.
- (i) Inspect the various components for wear, leaks, damage, corrosion and malfunction.
- (j) Perform basic planned maintenance operations.
- (k) Document the condition of components and communicate the information to the appropriate personnel.

### **1.6 Learning Outcomes of the BTT Module “Basic Mechanical”**

#### **Lesson 1 Introduction**

30 min

The aim of this lesson is to give the participants the required information to make them aware of the course content and the facilities involved. The participants will know what to expect and what is expected of them.

To successfully complete this Module participants shall be aware of:

- 1) Who the instructor and other participants are

- 2) Facilities
- 3) The aims and main learning objectives
- 4) On-going assessment
- 5) Motivation on the course

**Note: The administrative part of the registration must be carried out before the course commences.**

## **Lesson 2 Mechanical introduction**

120 min

The aim of this lesson is to give the participants sufficient basic knowledge of mechanical systems in a WTG.

To successfully complete this module participants shall be able to:

- 1) Understand the different designs of wind turbines, their applications, advantages and disadvantages.
- 2) Explain the main components of the structure
- 3) Explain the main mechanical systems
- 4) Explain how a wind turbine works, including the physics which influence the output of wind turbines. Including power, energy, wind velocity and wind direction.
- 5) Comply with the safety procedures for working on a wind turbine and the importance of working to approved working procedures. Including correct use of the required PPE for working on a wind turbine.

## **Lesson 3: The principle of threads, threaded components and the maintenance of bolted connections.**

180 min

The target of this lesson is to impart basic knowledge of threads and bolted connections and their maintenance.

To successfully complete this module the participants will be able to:

- 1) Explain the principles of threaded components
- 2) List the location of important bolted and welded connections and explain the importance of maintaining bolted connections
- 3) Explain the hazards and risks associated with maintaining bolted and welded connections.
- 4) Explain how a damaged weld is recognized.
- 5) Check the tightness of a bolt and use a torqueing tool safely and correctly.
- 6) Recognize other damage by visual inspection (paint damage, corrosion, leaks and cracks)

#### **Lesson 4: Use of tools and measuring equipment for wind turbine maintenance**

240 min

The target of this lesson is to impart knowledge and practical skills of the tools used in wind turbine maintenance.

To successfully complete this module participants will be able to:

- 1) Select and use the correct spanners for bolted connections.
- 2) Select and use the correct screw drivers for screwed connections.
- 3) Correctly set and use a torque wrench.
- 4) Select and use the correct mallet for freeing components.
- 5) Accurately gauge gaps between components using feeler gauges.
- 6) Measure thickness of components and bore sizes using a caliper.
- 7) Check the run out of a disc using a dial indicator.
- 8) Align a shaft to a gear box using a laser alignment tool.

#### **Lesson 5: Gearbox and (Main-) Bearing**

240 min

The target of this lesson is to impart basic knowledge about the gearbox and the bearings to include types, functional design, visual inspection, damage and basic maintenance routines.

To successfully complete this module the participants will be able to:

- 1) Describe the main function of the gearbox and the (main-) bearing. The importance of correct alignment and the measuring tools used to achieve it.
- 2) Describe the operating principle of a gearbox.
- 3) Describe where and how damage can occur, complete the documentation and communicate it to the appropriate personnel.
- 4) Recognize the dangers of working on the gearbox/main bearing and know how to minimize them. Use safe working practices and appropriate PPE to safeguard themselves, colleagues and to protect the environment.
- 5) Carry out an inspection of the gearbox and the (main-) bearing using a technical manual (check hoses, seals, oil level, take oil sample, visual inspection for friction). Complete the necessary documentation.

#### **Lesson 6: Braking System (BS) and Coupling**

240 min

The target of this lesson is to impart basic knowledge of the coupling and the two braking systems in a wind turbine. The main focus being on the disc braking system.

To successfully complete this module the participants will be able to:

- 1) Describe the main task and function of the disc, and the rotor braking system, and to be able to describe the two different types of the rotor brake.

- 2) Describe the task and the function of the coupling.
- 3) Describe the functional design and the fail-save system of the brake disc.
- 4) Explain where the disk brake is positioned and why.
- 5) Describe where and how damage can occur (BS and Coupling). Recognize a worn out disc brake. Complete the necessary documentation and inform the appropriate personnel.
- 6) Recognize the dangers of working on the braking system and know how to minimize them. Use safe working practices and appropriate PPE to safeguard themselves, others and to protect the environment.
- 7) Perform the inspection of the BS and the coupling with the aid of a technical manual (a visual inspection to check hoses, fittings, hydraulic fluid, disc surface and general friction). Complete the necessary documentation.

### **Lesson 7: Yawing System**

150 min

The target of this lesson is to impart basic knowledge of the yawing system and the sensors which influence the system.

To successfully complete this module the participants will be able to:

- 1) Explain what “yawing” means.
- 2) Describe the components and their functions (yawing gear, motors, wind sensor, anti-twist protection).
- 3) Recognize the dangers of working on the yawing system and know how to minimize them. Use safe working practices and appropriate PPE to safeguard themselves, others and to protect the environment.
- 4) Perform an inspection of the yawing system with a technical manual (a visual inspection of the yawing gear, slide bearing, lubrication system). Including to carry out practical checks to gauge the gaps between the gear and driving cog, to recognize any damage, complete the appropriate documentation and inform the correct personnel.

### **Lesson 8: Cooling- and Lubrication system**

180 min

The target of this lesson is to impart basic knowledge of the lubrication and cooling system. It is important that the participants understand how and why the both systems are connected to each other. And why both systems (especially the lubrication) are fundamental for a long operational life span.

To successfully complete this module the participants will be able to:

- 1) Describe which components in a WT have to be cooled and why.

- 2) Explain the single components of the cooling system and how they are connected to each other.
- 3) Describe the single components of the lubrication system and explain which parts need to have oil levels maintained and why.
- 4) Describe how a mal-functioning or damaged cooling / lubrication system influences other parts of a WT.
- 5) Recognize the dangers of working on the cooling/heating system and know how to minimize them. Use safe working practices and appropriate PPE to safeguard themselves, others and to protect the environment.
- 6) Perform an inspection of the cooling and lubrication system using a technical manual (a visual inspection to check hoses and fittings for leaks, the quantity and quality of the cooling liquid, the quantity and quality of the oil, the cleanness of heat exchanger and cooling pipes). Complete the necessary documentation.
- 7) Recognize damaged parts, complete the necessary documentation and inform the appropriate personnel.

## **Lesson 9 Mechanical Theory Test**

60 min

The aim of this lesson is to test the participants' theoretical knowledge of Mechanical systems, and to discuss the result of the test with the participants.

A proposal for the mechanical theory test is shown in appendix B.

## **Lesson 10 Evaluation**

30 min

The aim of this lesson is to summarize the Module and to give the participants the opportunity to conduct an open-minded review of the training and the instructor.

To successfully complete this Module, participants shall be able to demonstrate:

- 1) Active participation in the evaluation

## **1.7 Participant Performance Assessment**

Assessment of learning outcomes:

Participants will be assessed according to the learning outcomes stated in section 1.6 by means of

- Direct observation including supplementary oral questions when appropriate
- A written test to cover the mechanical theory

At least 70% of the questions in the written test must be answered correctly in order to pass the test.

The direct observation is to be conducted by practical scenarios on a WTG environment where practicable.

Each participant is to demonstrate:

- a) Correct use of appropriate PPE
- b) Safe working procedures for mechanical work
- c) Correct and proper methods of working with mechanical systems

Appendix C includes a checklist, which the training staff might use for the direct observation of each participant.

The formal assessment shall be in accordance with the written theoretical test and the Practical Assessment Measures in section 3.5.

Training provider shall have a documented procedure in place for dealing with persons not meeting the stated learning outcomes.

### 1.8 Time Table, BTT Module Basic Mechanical

Lesson		Element		Approximate Duration
1	Introduction	1.1	Introduction	
		1.2	Facilities	
		1.3	Aims and main learning objectives	
		1.4	On-going assessment	
		1.5	Motivation	
			Total	
2	Mechanical introduction	2.1	Types of wind turbines	
		2.2	Main components of the structure	
		2.3	Main mechanical systems	
		2.4	How a turbine works and the physics involved.	
		2.5	Safe Working Procedures on a wind turbine*	
			Total	

			<b>Total</b>	<b>2 hours</b>
3	The principles of threads, threaded components and the maintenance of bolted connections	3.1	The principles of threaded components.	
		3.2	The locations of important bolted and welded connections.	
		3.3	Hazards and risks associated with bolted and welded joints	
		3.4	The inspection of welded joints.*	
		3.5	Checking bolt connections and correct tools to tighten them*	
		3.6	Recognize damage by visual inspection	
			<b>Total</b>	<b>3 hours.</b>
4	Use of tools and measuring equipment for wind turbine maintenance	4.1	Spanners*	
		4.2	Screwdrivers*	
		4.3	Torque wrench*	
		4.4	Mallets*	
		4.5	Feeler gauges*	
		4.6	Calipers*	
		4.7	Dial indicator*	
		4.8	Laser alignment tool*	
			<b>Total</b>	<b>4 hours</b>
5	Gearbox and Main bearing	5.1	The function of the gearbox and the importance of alignment with the main shaft through the coupling.	
		5.2	Operating principle of a gearbox.	
		5.3	Damage that can occur to a gearbox	
		5.4	Hazards and risks associated with the gearbox and coupling	
		5.5	Inspection using the maintenance manual*	

			Total	4 hours
6	The braking system and coupling	6.1	The function of the braking system, including the disc brake	
		6.2	The function of the coupling.	
		6.3	Fail safe system.	
		6.4	Position of the brake.	
		6.5	Wear, damage and documentation of the brake system and coupling	
		6.6	The hazards and risks associated with the brake system.	
		6.7	Inspection of the braking system and coupling using the maintenance manual. *	
			Total	4 hours
7	The Yawing System	7.1	Function of the Yawing system	
		7.2	Components and their functions	
		7.3	Hazards and risks associated with the Yawing system	
		7.4	Inspection using the maintenance manual*	
			Total	2.5 hours
8	Cooling and Lubrication System	8.1	Components requiring cooling and why.	
		8.2	Interconnection of individual components	
		8.3	Components of the lubrication and maintenance of levels.	
		8.4	Effect of malfunctions on the operation of the turbine systems.	
		8.5	Hazards and risks	
		8.6	Inspection using the manual	
		8.7	Recognizing damage, completing the documentation and informing the appropri-	

			ate personnel*	
			Total	3 hours
9	Mechanical Theory Test		Test	1 hour
			Total	24 hours
10	Evaluation		Summary and evaluation certificates	
			Total	30 min
<b>Grand Total</b>				<b>24.5 hours</b>

\* The element includes a practical workshop for the participants

## 1.9 ELEMENTS, BTT Module Basic Mechanical

### Lesson 1: Introduction

#### ELEMENT 1.1 Introduction

Training staff is to **give**:

- 1.1.1 A short presentation of himself including his background as an instructor

Participants are to **give**:

- 1.1.2 A short introduction of themselves including (former) job function and expectation for the course

Training staff is to **explain**:

- 1.1.3 The programme of the Module including time of breaks and meals

#### ELEMENT 1.2 Facilities

Training staff is to **explain**:

- 1.2.1 General description of the on-site facilities (Administration, dining area, restrooms, toilets, etc.)

#### ELEMENT 1.3 Aims and main objectives

Training staff is to **explain**

- 1.3.1 Scope and main objectives of the module

#### ELEMENT 1.4 On-going assessment

Training staff is to **explain**:

- 1.4.1 The reasons for the on-going assessment
- 1.4.2 Control Measures and their use

#### ELEMENT 1.5 Motivation

Training staff is to **explain**:

### 1.5.1 The importance of personal involvement

## **Lesson 2: Mechanical introduction**

### **Element 2.1 Types of wind turbine.**

Training staff is to **explain**:

- 2.1.1 The different types of wind turbines.
- 2.1.2 Their advantages and disadvantages.

### **Element 2.2 Main components of the structure.**

Training staff is to **explain**:

- 2.2.1 Foundation,
- 2.2.2 Transition piece,
- 2.2.3 Tower sections,
- 2.2.4 Nacelle,
- 2.2.5 Rotor and Blades,
- 2.2.6 Platforms, Ladders and Lifts.

Participants will **engage in discussions** of:

- 2.2.7 Construction components of a wind turbine.

### **Element 2.3 Main mechanical systems.**

Training staff is to **explain**:

- 2.3.1 Pitch system,
- 2.3.2 Yaw system,
- 2.3.3 Drive train,
- 2.3.4 Gearbox,
- 2.3.5 Coupling,
- 2.3.6 Generator.

Participants shall **engage in discussions of**

- 2.3.7 The basic mechanical systems in a wind turbine

### **Element 2.4 How a turbine works and the physics involved.**

Training staff is to **explain**:

- 2.4.1 Energy changing from linear to rotational motion and to electrical energy.
- 2.4.2 Power
- 2.4.3 Wind velocity and direction
- 2.4.4 Shape of the blades.
- 2.4.5 Control of the rotation of the turbine using the pitching system.

Participants shall **engage in discussions of**

- 2.4.6 Power, Energy, Wind velocity and Wind direction

### **Element 2.5 Safe Working Procedures on a wind turbine.**

Training staff is to **explain**:

- 2.5.1 The safety procedures for working on a wind turbine
- 2.5.2. The importance of working to approved working practices
- 2.5.3 The PPE requirements for working on a wind turbine.

Participants shall **practice and demonstrate**

- 2.5.4 Safe working procedures, using the necessary PPE and appropriate tools

### **Lesson 3 The principle of threads, threaded components and the maintenance of bolted connections.**

#### **Element 3.1 The principles of threaded components.**

Training staff is to **explain**:

- 3.1.1 The meaning of pitch of a thread.
- 3.1.2 The angle of a thread.
- 3.1.3 The outside and core diameters of threads.
- 3.1.4 Right and left hand threads.
- 3.1.5 Multi start threads.
- 3.1.6 Strength proportional to size.
- 3.1.7 Strength due to material.
- 3.1.8 Function and types of washers.
- 3.1.9 Force x length with reference to spanners.
- 3.1.10 Importance of correct torque.

Participants shall **engage in discussions of**:

- 3.1.11 Bolts, threads, and strengths of materials.
- 3.1.12 Force and torque

#### **Element 3.2 The locations of important bolted and welded connections.**

Training staff is to **explain**:

- 3.2.1 Connection between tower and transition piece.
- 3.2.2 Connections between sections of the tower.
- 3.2.3 Platforms in the main shaft.
- 3.2.4 Ladders in the main shaft.
- 3.2.5 Guard rails on the transition piece.
- 3.2.6 Bolted connections holding cranes.
- 3.2.7. Bolted connections with the Fall Arrester system.
- 3.2.8 Bolted connections on the rotor, coupling, gearbox and generator.

Participants shall **engage in discussions of**:

3.2.9 Importance of Maintenance and maintenance processes for bolted connections.

### **Element 3.3 Hazards and risks associated with bolted and welded joints.**

Training staff is to **explain**:

3.3.1 That these joints will be at height in enclosed spaces or both and the appropriate PPE such as fall arresters, harnesses, hard hats and other PPE must be worn.

3.3.2 That Approved Working Procedures for the task must be followed. For instance isolations, setting barriers, informing other personnel of the work.

3.3.3 Disposal of waste to safeguard self and the environment.

Participants shall **engage in discussions of**:

3.3.4 Safety issues concerned with inspection of connections.

### **Element 3.4 The inspection of welded joints.**

Training staff is to **explain/demonstrate**:

3.4.1 What a good weld is and how to recognize it.

3.4.2 What a damaged weld is and how to recognize it.

3.4.3 How to clean a suspect weld using sand paper and use a dye penetrant spray to check it.

3.4.4 Documentation required in the event of identifying a damaged welded joint.

Participants shall **practice and demonstrate**:

3.4.5 Recognition of damaged welded joints.

3.4.6 Cleaning paint from a weld and using a dye penetrant spray using safe working practices.

### **Element 3.5 Checking bolt connections and correct tools to tighten them.**

Training staff is to **explain and demonstrate**:

3.5.1 How to check if a bolt is loose.

3.5.2 What the correct tool is for tightening bolts.

3.5.3 How to set and use a torqueing tool.

Participants are to **practice and demonstrate**:

3.5.4 Setting and using a torqueing tool for checking the tightness of a bolt.

### **Element 3.6 Recognize damage by visual inspection.**

Training staff is to **explain**:

3.6.1 How to recognize paint damage.

3.6.2 How to recognize corrosion.

3.6.3 How to recognize cracks.

3.6.4 How to recognize leaks.

3.6.5 What documentation to complete and the personnel to send it to.

Participants are to **engage in discussions of:**

3.6.6 Recognition of damage, corrosion and leaks of bolted or welded connections and the consequences of not repairing them.

#### **Lesson 4 Use of tools and measuring equipment for wind turbine maintenance.**

##### **Element 4.1 Select and use the correct spanners for bolted connections.**

Training staff is to **explain and demonstrate:**

- 4.1.1 Types of spanners.
- 4.1.2 Correct application of spanner types
- 4.1.3 Use of correct size of spanner
- 4.1.4 Consequences of incorrect spanner use.

Participants shall **practice and demonstrate:**

- 4.1.5 Selecting and using spanners

##### **Element 4.2 Select and use the correct screw drivers for screwed connections.**

Training staff is to **explain and demonstrate:**

- 4.2.1 Types of screw driver
- 4.2.2 Correct application of screw driver type.
- 4.2.3 Consequences of incorrect use.

Participants shall **practice and demonstrate:**

- 4.2.4 Selecting and using screw drivers

##### **Element 4.3 Correctly set and use a torque wrench.**

Training staff is to **explain and demonstrate:**

- 4.3.1 How to read the setting from the manual.
- 4.3.2 How to set the correct reading.
- 4.3.3 How to use the torque wrench.

Participants shall **practice and demonstrate:**

- 4.3.4 Setting and using torque wrenches.

##### **Element 4.4 Select and use the correct mallet for freeing components.**

Training staff is to **explain and demonstrate:**

- 4.4.1 Correct selection of mallet
- 4.4.2 Correct use of mallet
- 4.4.3 Consequences of incorrect selection or use

Participants shall practice and demonstrate:

- 4.4.4 Correct use of mallets.

##### **Element 4.5 Accurately gauge gaps between components using feeler gauges**

Training staff is to **explain and demonstrate**:

- 4.5.1 How to use feeler gauges.
- 4.5.2 How to care for feeler gauges to prevent damage

Participants shall **practice and demonstrate**:

- 4.5.3 Correct use and care of feeler gauges.

#### **Element 4.6 Measure thickness of components and bore sizes using a caliper.**

Training staff is to **explain and demonstrate**:

- 4.6.1 How to care for calipers
- 4.6.2 How to measure the thickness of a component.
- 4.6.3 How to measure a bore.

Participants shall **practice and demonstrate**:

- 4.6.4 Measuring thicknesses and bores using a caliper.

#### **Element 4.7 Check the run out of a disc using a dial indicator.**

Training staff is to **explain and demonstrate**:

- 4.7.1 How to use a dial indicator.
- 4.7.2 How to check the run out of a disc using a dial indicator.

Participants shall **practice and demonstrate**:

- 4.7.3 Using a dial indicator.

#### **Element 4.8 Align a shaft and gear box using a laser alignment tool.**

Training staff is to **explain and demonstrate**:

- 4.8.1 How to use a laser alignment tool.
- 4.8.2 How to align a gearbox and shaft.

Participants shall **practice and demonstrate**:

- 4.8.3 Using a laser alignment tool to align a gearbox and shaft.

### **Lesson 5 Gearbox and main bearing.**

#### **Element 5.1 The function of the gearbox and the importance of alignment with the main shaft through the coupling.**

Training staff is to **explain**:

5.1.1 That the main function of the gearbox is to increase the revolutions per minute (RPM) of the rotor in order to revolve the generator fast enough to generate electricity.

5.1.2 That the gear box is connected to the generator main shaft via the coupling and the importance of their correct alignment.

#### **Element 5.2 The operating principle of a gearbox.**

Training staff is to **explain**:

5.2.1 How gear ratios are used to increase or decrease the revolutions of shafts.

5.2.2 How torque is increased or decreased in proportion with the gear ratio.

### **Element 5.3 Damage that can occur to a gearbox.**

Training staff is to **explain**:

5.3.1 Where damage can occur to a gearbox.

5.3.2 What possible causes there are.

5.3.3 What documentation to fill in and where to send it.

Participants shall **engage in discussions** of

5.3.4. The damages that may occur, and how to communicate it

### **Element 5.4 Hazards and risks associated with the gearbox and coupling.**

Training staff is to **explain**:

5.4.1 The importance of locking the system so that it cannot turn. (LOTO)

5.4.2 The hazards associated with gearbox oil.

5.4.3 The control measures to limit the risks.

5.4.4 The correct PPE.

5.4.5 The safe working procedures to be followed.

### **Element 5.5 Inspection using the maintenance manual.**

Training staff is to **explain**:

5.5.1 How to carry out an inspection of the gearbox and coupling using the manual.

5.5.2 Checking hoses, what to look for.

5.5.2 Checking seals, what to look for.

5.5.3 Checking the oil level.

5.5.4 How to take an oil sample and why.

5.5.5 How to visually inspect for damage.

Participants shall **practice and demonstrate**

5.5.6 The correct and safe working procedures and the appropriate use of PPE to safeguard themselves, colleagues and to protect the environment

5.5.7 How to inspect the gearbox and coupling according to a maintenance manual.

5.5.8 Completing the required documentation.

## **Lesson 6 The braking system and coupling**

### **Element 6.1 The function of the braking system, including the disc brake.**

Training staff is to **explain**:

- 6.1.1 The purpose of the braking system.
- 6.1.2 The consequences of it not functioning.
- 6.1.3 The operating principle of the disc brake
- 6.1.4 The operating principle of the mechanical brake.
- 6.1.5 The necessity for 2 systems.

#### **Element 6.2 The function of the coupling.**

Training staff is to **explain**:

- 6.2.1 The function of the coupling.
- 6.2.2 The maintenance of the coupling.

#### **Element 6.3 The fail safe system.**

Training staff is to **explain**:

- 6.3.1 The functional design and operation of the fail safe system.
- 6.3.2 The consequences of not having fail safe.

#### **Element 6.4 The position of the brake**

Training staff is to explain:

- 6.4.1 The position of the brake.
- 6.4.2 The reason for the position.

Participants will **engage in discussions of**:

- 6.4.3 Reasons for the dual brake system and issues surrounding failure.

#### **Element 6.5 Wear, damage and documentation of the brake system and coupling.**

Training staff is to **explain**:

- 6.5.1 Where damage can occur to the braking system and coupling.
- 6.5.2 How to recognize a worn out disc brake,
- 6.5.3 What documentation to complete and where to send it

#### **Element 6.6 The hazards and risks associated with the brake system.**

Training staff is to **explain**:

- 6.6.1 The hazards of hydraulic fluids under pressure.
- 6.6.2 The necessity for LOTO
- 6.6.3 Specific PPE for working with hydraulic fluids.
- 6.6.4 Approved working procedures.

#### **Element 6.7 Inspection of the braking system and coupling using the maintenance manual.**

Training staff is to **explain**:

- 6.7.1 How to visually inspect hoses.

- 6.7.2 How to visually check fittings.
- 6.7.3 Hydraulic fluid (covered in the hydraulics module).
- 6.7.4 How to check the disc surface for wear and scuffing due to excess friction.
- 6.7.5 How to check the disc brake pads for wear.
- 6.7.6 How to check the gap between the pads and the disc.
- 6.7.7 How to complete the required documentation.

Participants shall **practice and demonstrate**:

- 6.7.8 Checking the thickness of the brake pads.
- 6.7.9 Checking the gap between the pads and the disc
- 6.7.10 Measuring thickness of disc
- 6.7.11 Checking for run out of the disc using a dial indicator
- 6.7.12 Correct working practices and use of PPE
- 6.7.13 Completing the necessary documentation.

## **Lesson 7 The Yawing system.**

### **Element 7.1 The function of the Yawing system.**

Training staff is to **explain**:

- 7.1.1 What yawing means.
- 7.1.2 How it is achieved.
- 7.1.3 When and why the turbine is yawed out of the wind.

### **Element 7.2 The components of the yawing system and their functions.**

Training staff is to **explain**:

- 7.2.1 The yawing gear and its function.
- 7.2.2 The yawing gear motors and their function.
- 7.2.3 The wind sensor and its function.
- 7.2.4 The anti-twist protection mechanism.

### **Element 7.3 Hazards and risks associated with the Yawing system.**

Training staff is to **explain**:

- 7.3.1. The importance of LOTO.
- 7.3.2 Required PPE.
- 7.3.3 Approved working procedures.

Participants are to **engage in discussions of**:

- 7.3.4 The dangers connected with the yawing system and how to minimize them.

### **Element 7.4 Inspection using the maintenance manual.**

Training staff is to **explain**:

- 7.4.1 How to carry out a visual inspection of the yawing gear.
- 7.4.2 How to check the gap between the gear and pinions.
- 7.4.3 How to check the slide bearing.
- 7.4.4 How to check the lubrication system.
- 7.4.5 What documentation to complete

Participants shall **practice and demonstrate**:

- 7.4.6 Correct use of PPE
- 7.4.7 Use of correct working practices
- 7.4.8 Checking the gap between gear and pinions.
- 7.4.9 Completing the documentation.

## **Lesson 8 Cooling and Lubrication system.**

### **Element 8.1 Components that require cooling and why.**

Training staff is to **explain**:

- 8.1.1 That heat is produced by turning the gearbox.
- 8.1.2 That heat is produced in the generator.
- 8.1.3 That heat is produced by pressurizing the hydraulic system.
- 8.1.4 That overheating can make the machines become inefficient.
- 8.1.5 That failure to control the temperature can result in failure of the system.

### **Element 8.2. Interconnection of individual components.**

Training staff is to **explain**:

- 8.2.1 That all the components of the turbine are reliant on each other.
- 8.2.2 That heat can be transferred from component to component.
- 8.2.3 That expansion due to heat can cause failure of the system.

### **Element 8.3 Components of the lubrication and the maintenance of levels.**

Training staff is to **explain**:

- 8.3.1 That oil and grease reduce friction and lower the production of heat.
- 8.3.2 That oil is pumped around the gearbox to keep the temperature down.
- 8.3.3 The use of heat exchangers and radiators to reduce the heat in a system.
- 8.3.4 That some systems have a cooling system that employs a cooling liquid in a discrete circuit.
- 8.3.5 That grease pumps are used to keep the yaw and pitch systems lubricated to reduce friction and corrosion.
- 8.3.6 The importance of maintaining the correct levels in the systems.
- 8.3.7 How to check what the correct oil or grease is for a specific application.

### **Element 8.4 The effects of malfunctions on the operation of the turbine systems.**

Training staff is to **explain**:

- 8.4.1 The consequences of a gearbox failure.
- 8.4.2 The consequences of a pitch system failure.
- 8.4.3 The consequences of a yaw system failure.
- 8.4.4 The consequences of the generator overheating.

Participants shall **engage in discussions of**:

- 8.4.5 Consequences of not using the appropriate oil or grease.

#### **Element 8.5 Hazards and risks associated with the lubrication and cooling systems.**

Training staff is to **explain**:

- 8.5.1 Hazards of pressurized systems.
- 8.5.2 Hazards of oils and greases.
- 8.5.3 Hazards of hot components.
- 8.5.4 PPE to be used.
- 8.5.5 Correct procedure for the disposal of waste oils and greases.

Participants shall **engage in discussions of**:

- 8.5.6 Reasons for maintenance on the mechanical systems of a wind turbine.
- 8.5.7 Consequences of not following approved working procedures and safe

working practices.

#### **Element 8.6 Inspection of the lubrication and cooling systems using the manual.**

Training staff is to **explain**:

- 8.6.1 How to visually check hoses for chaffing and leaks.
- 8.6.2 How to visually check fittings for leaks.
- 8.6.3 How to check the quantity and quality of the cooling liquid.
- 8.6.4 How to check the quantity and quality of the oil.
- 8.6.5 How to check the cleanliness of the heat exchanger and coolant pipes.

Participants are to **engage in discussions of**

- 8.6.6 Oil Cleanliness rating and its impact on component performance

Participants shall **practice and demonstrate**:

8.6.7 Correct use of PPE and working procedures for inspecting cooling and lubrication systems.

8.6.8 Inspection for damage on components of cooling and lubricating systems using a technical manual.

#### **Element 8.7 Recognizing damage, completing the documentation and informing the appropriate personnel.**

Training staff is to **explain**:

- 8.7.1 What damage to look for on hoses.
- 8.7.2 What damage to look for on fittings, washers and seals.
- 8.7.3 What damage to look for on heat exchangers.

8.7.4 What documentation is to be completed and the personnel to send it to.

Participants shall **practice and demonstrate**:

8.7.5 Completing the necessary documentation.

## Section 2 - Resources for Basic Mechanical

### 2.1 Trainer/Participant Ratio

- (a) The ratio shown for theory sessions indicates the maximum number of participants that shall attend the course
- (b) The ratio shown for practical sessions indicates the maximum number of participants to be supervised by one instructor during each practical workshop
- (c) Practical sessions must always be supervised by an instructor, while supervision of an instructor is not mandatory to all theoretical sessions

Unit	Sessions	Ratio
<b>BTT Basic Mechanical</b>	<b>Theory</b>	<b>1:12</b>
	<b>Practical</b>	<b>1:6</b>

### 2.2 Facilities

It is important to ensure that the full range of facilities is made available to ensure that the participants benefit most from their training. The following criteria shall be adhered to.

**Administration arrangements** appropriate for the enrolment and certification of participants and all aspects of the delivery of training shall be in accordance with this document.

**Theory training area(s)** shall be designed to enable each participant to see, hear and participate fully in the taught subject matter.

A room is required that has projection facilities, a white board and desks for the participants to write on.

**Practical training area(s)** shall be designed to enable each participant to see, hear and participate fully in the taught subject matter.

A practical workshop is required that has enough space to accommodate 6 candidates, with a respective work area each of approximately 3 square meters.

### 2.3 Equipment

A workshop with at least 6 workbenches where mechanical maintenance and mechanical measurement can be facilitated using:

- a) The required PPE for mechanical work: goggles, gloves, overalls, boots and hard hat.
- b) Spanners, Screwdrivers, Torque wrenches, Hexagon keys, Mallets, Feeler gauges, Dial, Vernier or Digital Callipers, Dial Type Indicators, Laser alignment tools.
- c) Sets of the above tools.
- d) A hydraulically operated disc brake where participants can take measurements of disc and pad thicknesses and can practice and demonstrate replacement of parts.
- e) A suitably sized gear box where participants can practice and demonstrate checking alignment of gears and oil changing.
- f) A rig where alignment of generators and gearboxes can be practised and demonstrated.

- g) An area where hydraulic torqueing and tensioning of bolts and bolted connections typical of wind turbine generators can be practised and demonstrated.
- h) Torque multiplier.
- i) Hydraulic pump with associated torque cassettes.
- j) Hydraulic pump with associated tensioning cylinders.
- k) A supply of bolts.

## **Section 3 - Administration and certification**

### **3.1 Participant Performance Assessment**

Participants shall be assessed according to the learning outcomes by means of direct observation including oral questions where appropriate, and by a theoretical test.

Training Providers shall have a documented procedure in place for dealing with persons not meeting the stated learning outcomes.

### **3.2 Certification**

Training Providers are responsible for issuing a certificate directly to the participant upon completion of the programme and to a sponsoring company when required. Each certificate shall indicate that the participant has been assessed according to the learning outcomes and shall contain the following:

- (a) Training Provider's name
- (b) Full course title
- (c) Name of the participant
- (d) Course dates
- (e) Training Provider's signature

### **3.3 Records**

The Training Provider shall keep a record of the participants that have completed the BTT Module Basic Mechanical for a period of min. 5 years.

On request from a relevant body, The Training Provider shall be able to verify the training and competence records of any participant by name.

### **3.4 Measures**

The Trainer keeps the Control Measures Forms until the completion / evaluation of the Module. If a participant fails to meet the demands, they shall attend a new BTT Module Basic Mechanical.

### **3.5 Control Measures**

Please find the Control Measures Form on next page.

## Practical Assessment Measures

**Name:** \_\_\_\_\_

**Course:** BTT Module Basic Mechanical

**Date:** \_\_\_\_\_ **Training Provider:** \_\_\_\_\_

Scenario Organisation	Violation of Assessment Measures			0-2 Passed/ 3 Failed	Instructor Remarks
Aware of personal and group safety at all times					
Organized and utilized correct equipment for given scenario					
Organized individuals and groups as required					
<b>Scenario Management</b>					
Established and maintained control of the exercise scenario at all times					
Fully participated in the exercise scenario					
Followed directions when required					
Demonstrate correct and safe manual handling in exercise scenario					

<b>Knowledge and Understanding</b>					
Applied subject knowledge correctly in given scenario					
Demonstrated understanding of subject					
<b>Total Marks</b>	<b>0 – 9</b>	<b>Pass</b>			
	<b>10 – 27</b>	<b>Fail</b>			

**Instructor:** \_\_\_\_\_ Pass/ Fail (Delete as appropriate)

The practical Assessment Measures Form is a final evaluation tool for the instructors to assess participants during practical elements. It allows measurement of the number of violations in regard to safety, competency, or attitude. It can be used as a progressive evaluation tool to discuss the performance of a participant in guiding them to success and it also serves as supporting documentation when the participant fails the module.