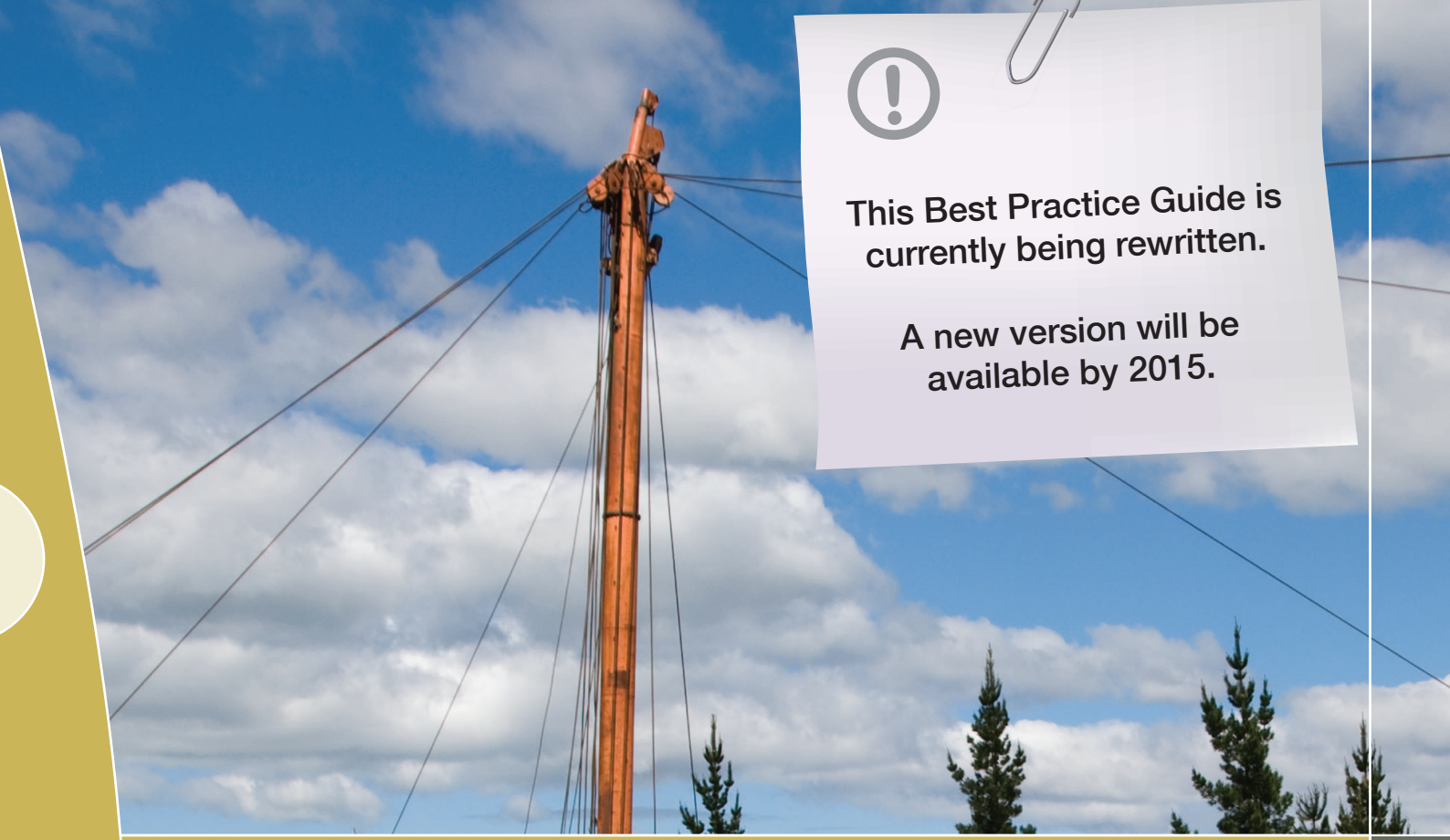

This Best Practice Guide is currently being rewritten.

A new version will be available by 2015.

Best practice guidelines for

Maintenance inspections of yarder towers

Vision, knowledge, performance

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Competenz
SKILLS FOR INDUSTRY

He Mihi

Nga pakiaka ki te Rawhiti.	*Roots to the East.*
Nga pakiaka ki te Raki.	*Roots to the North.*
Nga pakiaka ki te Uru.	*Roots to the West.*
Nga pakiaka ki te Tonga.	*Roots to the South.*
Nau mai, Haere mai	*We greet you and welcome you.*
ki te W̃aonui o Tane	*To the forest world of Tane.*
Whaia te huarahi,	*Pursue the path,*
o te Aka Matua,	*of the climbing vine,*
i runga, I te poutama	*on the stairway,*
o te m̃atauranga.	*of learning.*
Kia rongo ai koe	*So that you will feel,*
te mahana o te rangim̃arie.	*the inner warmth of peace.*
Ka kaha ai koe,	*Then you will be able,*
ki te t̃u whakaiti,	*to stand humbler,*
ki te t̃u whakahi̇̃.	*yet stand proud.*
Kia Kaha, kia manaw̃anui	*Be strong, be steadfast.*

Tena koutou katoa.

First edition September 2002

Revised edition September 2005

These Best Practice Guidelines are to be used as a guide to maintenance inspections of yarder towers. They do not supersede legislation in any jurisdiction or the recommendations of equipment manufacturers.

FITEC believes that the information in the guideline is accurate and reliable; however, FITEC notes that conditions vary greatly from one geographical area to another; that a greater variety of equipment and techniques are currently in use; and other (or additional) measures may be appropriate in a given situation.

Other Best Practice Guidelines included in the series:

- Cable Logging
- Chainsaw Use
- Fire Fighting and Controlled Burnoffs
- Ground-based Logging
- Land Preparation
- Loading
- Manual Log-making
- Mechanised Harvesting and Processing
- Mobile Plant
- Personal Protective Equipment
- Road and Landing Construction
- Silvicultural Pruning
- Transport
- Tree Felling
- Tree Planting
- Working with Helicopters

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Best Practice Guidelines for Maintenance Inspections of Yarder Towers

Foreword

The forestry industry can be a high risk sector.

Helping to keep the industry as safe as possible for all those involved is the main aim of these best practice guidelines. They form part of a series of best practice guidelines developed by the industry in partnership with the Department of Labour.

These guidelines combine industry training standards and best practice information to provide a reference manual for yarder owners and inspectors. They add to the provisions of the Approved Code of Practice for Safety and Health in Forest Operations. Along with other manuals in the series, the guidelines will directly assist those who have responsibilities under the Health and Safety in Employment Act 1992 in managing hazards in the forestry work environment.

I appreciate the industry's commitment in proactively assisting with the update of this valuable resource.

Mike Cosman
Chief Advisor, Health and Safety
Department of Labour

Contents

Introduction

Purpose of these guidelines

The Best Practice Guidelines for Maintenance Inspection of Yarder Towers have been designed by FITEC to improve the safety of workers on yarder landings. The guidelines combine industry training standards and best practice information to provide a valuable reference manual for yarder owners and inspectors.

These guidelines provide direct reference to integral fixed and free-standing towers, and swing yarders. Many of the principles and procedures presented are applicable to alternative yarder systems, such as excavator yarders and independent spar yarders.

They should be read in conjunction with the Approved Code of Practice for Safety and Health in Forest Operations (Section 16: Rules for Cable Logging).

These guidelines also provide reference material for the following unit standard registered on the NZQA framework:

Unit 19722 - Inspect forest cable hauler / yarder and associated components

Kia tipu te Tohungatanga i roto i o matou mahi ngahere katoa
"That the highest order of professionalism be nurtured with all our work in the forests"

How to use these guidelines

These guidelines have been arranged in three main sections:

- **Principles of maintenance inspections of yarder towers** provides an overview of the strength characteristics of tower materials, repair and maintenance requirements, and health and safety issues associated with completing tower inspections.
- **Maintenance inspection procedures** provides a detailed description of the best practice for carrying out tower inspection. This section provides a step-by-step approach to completing the inspection.
- **Example inspection forms** are presented to provide a framework for operational checklists and documentation.

The **Glossary of Terms** gives the meaning of terms used throughout these guidelines.

Terminology

The term "yarder" refers to integral and free-standing tower haulers and swing yarders.

Acknowledgments

FITEC acknowledges the assistance of the New Zealand Forest Owners Association (Tower Inspection Working Group), Brightwater Forest Equipment, Work Smart Forestry, the Occupational Safety and Health Service, and numerous forest industry trainers, forestry contractors, and forest company staff in the development of these Best Practice Guidelines.

Principles of maintenance inspections of yarder towers

Purpose of tower maintenance inspections

The collapse of a yarder tower during set-up and operation poses a significant hazard for the yarder operator, skid workers, and breaker-outs. If a working rope should fail during operation, the tower should remain standing.

However, this may not be the case where:

- The guylines and/or anchors are poorly configured and/or of inadequate strength
- The structural integrity of the tower has been weakened through wear, damage, or inappropriate repairs and modifications

Operational procedures contribute to the greatest proportion of yarder tower collapses. Damaged or defective tower components do contribute to tower collapses, the most common being the sudden telescoping down of the tower during yarder set-up or operation.

The purpose of a maintenance inspection is to check the integrity of the tower and operating components. This is a formal, systematic process to be performed by experts, similar to the warrant of fitness required for vehicles.

The routine maintenance inspection is just one means of managing potential hazards associated with yarder tower collapse. It is not a replacement for safe operation of the yarder on a day-to-day basis.

For further information on yarder rigging and operation refer to the **Best Practice Guidelines for Cable Logging**.

Frequency of inspections

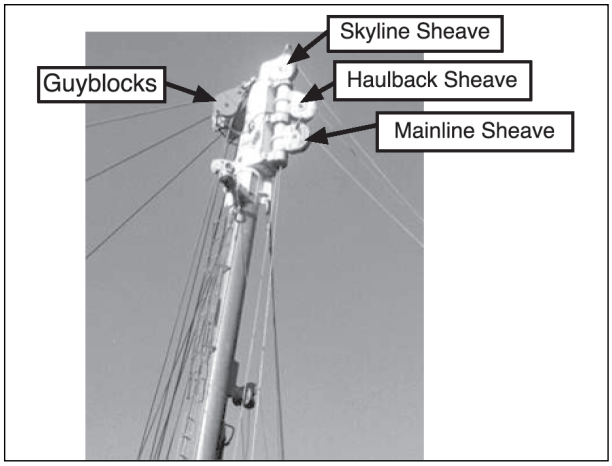
Tower inspections shall be performed:

- Three years from the commissioning (new) date and then annually thereafter
- Before a newly imported second-hand yarder starts work
- Before commencing work where a machine has been idle and the tower inspection certificate has expired

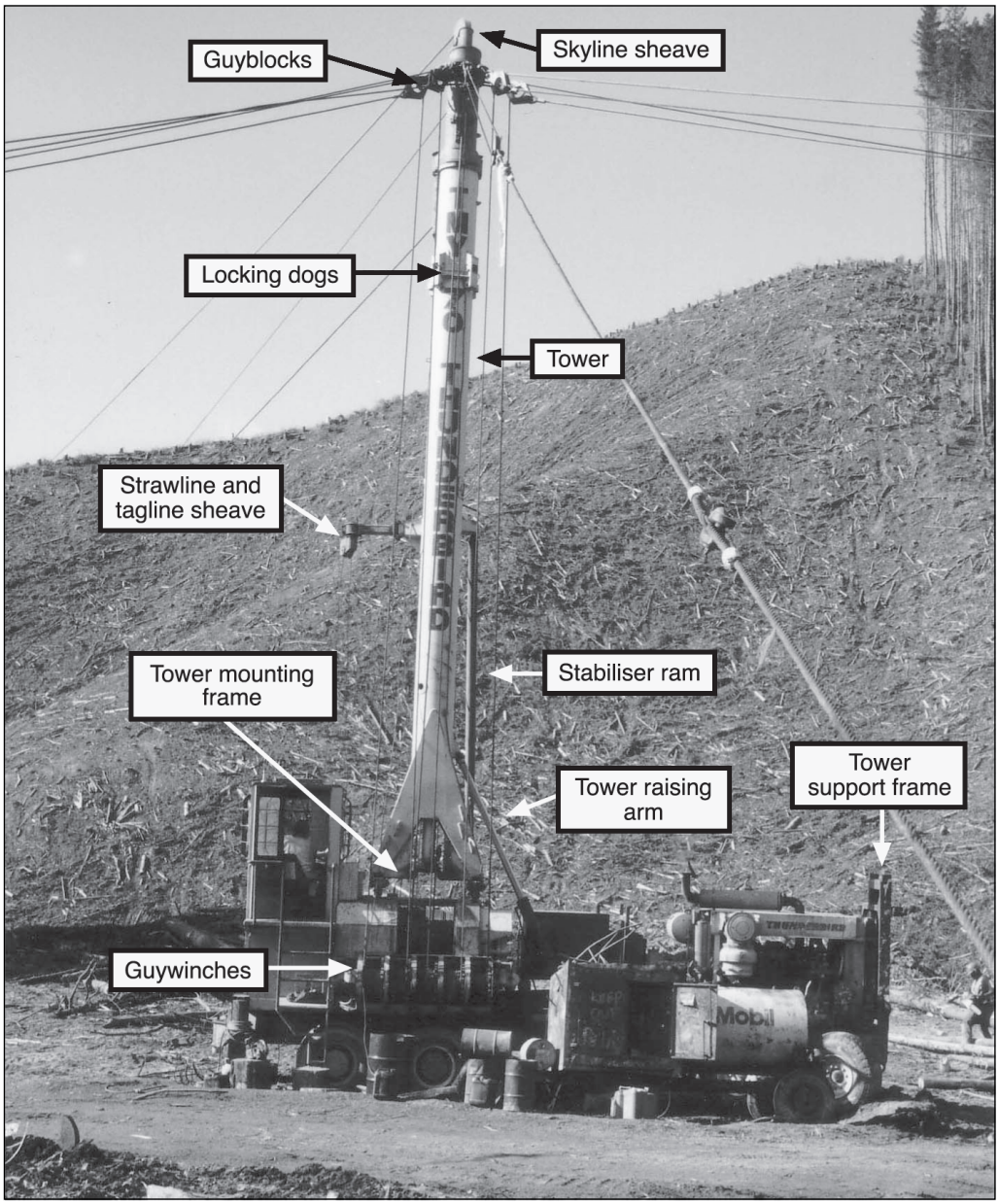
After the initial inspection, subsequent inspections are repeated annually. To ensure that the tower has a current yarder tower certificate at all times, the repeat inspections should be scheduled to allow any repairs to be made before the previous certificate expires.

Yarder tower components

The main yarder tower components for tower and swing yarders are shown below.

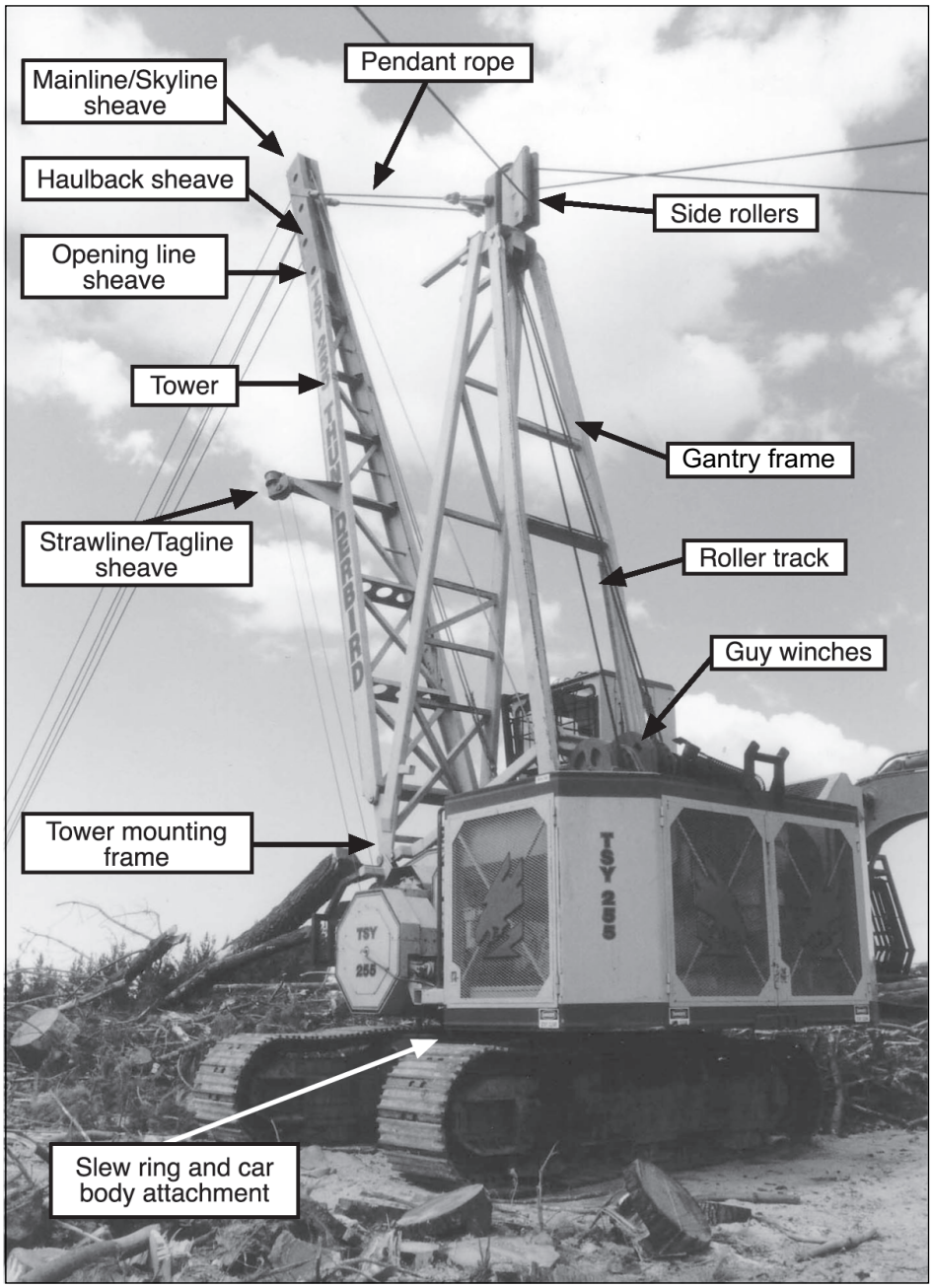


Tower yarder



Major components of a fixed tower yarder

Swing yarder



Major components of a swing yarder

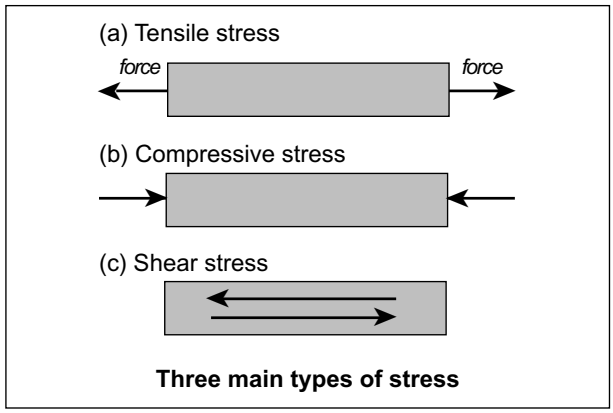
Basic strength of materials

Stress-strain relationship

Stress is defined as the unit force per unit area. It is often expressed as newtons per metre squared (or pounds per square inch). There are three main types of stress:

- Tensile stress – where the stress tends to stretch a material
- Compressive stress – where the stress tends to shorten or compress a material
- Shear stress – where the stress tends to shear a material *(see right)*

Strain relates to the amount of dimensional change when a material is subjected to a stress.



Three main types of stress

Metals (and other solid materials) react to stress in different ways according to their strength properties (yield strength and ultimate strength).

The **Yield Strength** relates to the stress at which a metal permanently deforms after the stress has been released. This occurs above the elastic limit. Below this, the material recovers to its original dimensions with no adverse affects.

The **Ultimate Strength** of a metal corresponds to the stress at which the material fails. Applied stresses that exceed the yield strength result in permanent deformation. The greater the stress and/or the greater the number of stress applications, the more severe the permanent deformation. This also results in a reduction in the ultimate strength. This is significant for yarder tower structures that are subjected to high degrees of cyclic loading.

Fatigue

Fatigue failures are potentially dangerous because they occur without warning and at a stress much lower than the ultimate stress for the material. Such failures are most commonly associated with shafts and other rotating components, but any equipment subjected to cyclic loading is susceptible.

A fatigue failure usually has its origin in some surface imperfections (sometimes an imperfection below the surface can be the cause). These imperfections can be due to:

- Manufacturing methods
- Heat treatment
- Handling
- Residual stresses and surface coatings
- Surface finish
- Environment
- Raw material production

Failure begins with the development of a small surface crack, at right angles to the direction of the tensile stress (fatigue does not occur where components are only ever loaded in compression). Because the load is alternating, the crack is continually opened and closed; this motion causes the adjacent faces to rub against one another, making these surfaces both smooth and polished in appearance. The remaining intact material is finally reduced to such a small area that it can no longer withstand the load and so it suddenly breaks. The final area appears as a grey, granular structure conveying the **false** impression that a brittle fracture has taken place (the “crystallised” fracture of engineering legend).

The **Fatigue Strength** of a component is the maximum “completely reversed” (i.e., cycled back and forth) stress at which the component will fail after it has experienced this loading **for a specified number of cycles**. The **Endurance Limit** is the maximum, completely reversed stress for which it is assumed a material will “never” fail, regardless of the number of stress cycles. It is generally accepted that ferrous (iron and steel) components that survive 10 million cycles of stress reversals will have an infinite life. Non-ferrous materials such as brass, copper, copper alloys, aluminium, and magnesium do not have an endurance limit (i.e., they will eventually fail due to fatigue).

When considering the likelihood of fatigue failure of any structural steel component of a yarder tower it is important to understand how the component is loaded during operation:

- Components that are loaded only in compression will not fail due to fatigue
- Components loaded cyclically in tension are at some risk of fatigue failure
- Components alternately compressed and then tensioned repeatedly are very vulnerable to fatigue failure.

Examples of components subject to fatigue		
Fatigue failure risk	**Component**	**Nature of loading**
Low	Free-standing tower base connections	Fluctuating compression
Medium	Guyline to tower attachment	Fluctuating tension
High	Leaning tower base connections	Fluctuating tensile and compressive loads when the yarder is operating at the extremes of its yarding radius. As the load varies on the working lines, the tower hinges are subject to loading alternately in the direction of the working lines and then (to a lesser extent) the opposite direction as the working lines surge and relax.

Any nicks, cuts, welds, drilled holes, or other "shape modifications" to components which are subject to fatigue loadings, can have the effect of concentrating stresses in the component and decreasing the time before the component fails. If there is any suspicion that such components are damaged or modified, or that a crack is being initiated, then competent engineering advice must be sought.

Types of failure

In the context of yarder towers, metal can fail through a combination of stretching, compressing, or shearing. These modes of failure occur at the molecular level in the metal. Visually, these failures are exhibited through deformation or cracking.

Risk indications

Visual inspection of yarder tower structures relies on being able to see deformation, wear, and cracking of the metal components.

Failure started at the keyways where the transverse cracks grew to be so large that the remaining material could no longer sustain the load and the shaft finally broke. Note the shiny surface from the keyways to the break, which is granular in appearance.

Repairs to yarder towers

Structural repairs to a yarder tower may be classified as either minor or major. This distinction is important as the class of repairs to be undertaken will dictate the repair and sign-off process that must be followed.

A minor repair is one that if not completed does not contribute directly to tower failure. Examples of minor repairs are the removal and replacement of a single diagonal member in a swing yarder boom, repairs to a bent or cracked sheave side plate, or repairs to the strawline or tagline mounts.

Conversely, a major structural repair is one that if not completed may directly contribute to the failure of the tower. Examples of major repairs are repairs to the tower mounts, or guyblock mounts or lugs.

Minor repairs must be completed in accordance with industry best practice by experienced and qualified personnel. The repairer must supply a certificate to this affect.

A yarder tower inspector may oversee and approve minor structural repairs providing he/she feels competent to do so.

The yarder tower inspector should seek advice from a suitably experienced Chartered Engineer (CPEng):

- Where a repair is beyond the competence of the yarder tower inspector, or
- When a major structural repair is to be undertaken.

The Chartered Engineer will be either a mechanical or structural engineer holding a current Practising Certificate, and should be familiar with the type of work to be undertaken.

The Chartered Engineer will assess the repair and issue specifications and inspection requirements for the work in accordance with AS/NZS1554.1 and/or AS/NZS1554.6.

Modifications to yarder towers

Acceptable modifications are those within the specification of the yarder as new. Where a modification is beyond this scope, a suitably experienced Chartered Engineer (CPEng) is required to certify the modification.

Examples of unacceptable modifications (requiring certification) are the addition of extra plating to strengthen a mount, the addition of extra sheaves, or modification of the tower mounts.

There should be evidence of modificaton kept with the yarder logbook. This is particularly important for certified modifications where the details need to be available for OSH inspectors and the tower inspection agent.

Training requirements

Inspectors should be qualified in accordance with industry best practice, by:

- Holding a National Certificate in Heavy Fabrication (Level 4), a National Certificate in Maintenance and Diagnostic (Level 4), or equivalent qualification, or
- Being a suitably experienced Chartered Engineer (CPEng).

They should also hold the following Unit Standards:

- Unit 19722 – Inspect forest cable hauler / yarder and associated components
- General Requirements (Unit 17769)
- Emergency First Aid (Units 6401 and 6402)

Knowledge of hazards

People carrying out maintenance inspections must be aware of the hazards they face and the controls they should make use of to avoid being harmed by those hazards.

Inspections carried out on a work site within the forest are under the control of the contractor or representative for the site.

Before starting an inspection, those involved must formally identify known hazards associated with the work site and the tasks to be completed. Once identified, each hazard must have a corresponding control measure designed so that it can be avoided, protected against, or isolated. The hazards and control measures must be documented.

The two main hazard categories are health hazards and operational hazards.

Health hazards

Individuals working in forestry operations need to be physically and mentally capable of doing their tasks without endangering themselves or others around them.

To maintain performance levels and prevent accidents, ensure that you:

- Take adequate rest breaks
- Maintain an adequate level of hydration and diet
- Keep physically fit
- Get adequate sleep
- Do not let drugs or alcohol impair your judgement

Health hazards

Hazard	Control
Fatigue (mental and physical)	• Build short, frequent, rest breaks into your day • Take at least two evenly spaced 30-minute rest breaks during the working day
Lack of sleep, tiredness	• Ensure that you have at least 5 hours' continuous sleep every 24 hours • Use power-naps (short sleeps of 20–30 minutes duration)
Alcohol abuse	• Avoid drinking alcohol for at least 24 hours before carrying out any hard physical work
Poor nutrition	• Start each day with a high carbohydrate breakfast such as porridge, cereal, toast, bananas, pasta, or potatoes • Eat high protein foods such as lean meat, chicken, eggs, milk and cheese at night • Eat at the start of a break, and rest to allow digestion
Noise	• Use hearing protection where the noise level is above 85dB.
Exposure to sun	• Wear sun block (SP30+) • Install a neck flap on your helmet • Wear tinted UV protective eyewear • Carry out regular health checks of moles, freckles, etc
Drugs	• Avoid all non-prescription drugs as they seriously affect both your mental and physical ability to work • If you are on long-term medication for a serious health complaint, inform the boss of your condition in case you are involved in an emergency at work
Hypothermia/chills	• Polypropylene clothing (thermal underwear) is excellent for cold, wet weather • If necessary also wear a warm hat or balaclava • Put a hat and warm clothes on when you stop for a break • Have wet weather clothing handy
Lack of hygiene/infection	• Clean and dress any cuts or scratches received on the job as soon as possible and keep them covered • Make sure the first-aid kit is kept fully stocked • Carry water and soap on the job to wash hands before smokos
Dehydration	• Regularly drink fluids before you feel thirsty

Operational hazards

Operational hazards associated with maintenance inspections of yarder towers relate to:

- Driving on forestry roads
- General activities at the work site or landing
- The specific task of completing a tower inspection

Operational hazards and controls associated with each of these are detailed below.

Operational hazards

Driving hazard	Control
Other traffic	• Travel at a speed that allows your vehicle to stop within half the length of clear road you can see ahead • Obey all rules of the Road Code, even when travelling on private forestry roads • Travel with headlights on dip • Contact the forest owner and/or site manager to ascertain truck movement • If required, use a traffic control radio channel to alert other road users of your intentions (this will be specific to each forest owner)
Road and driving conditions	• Contact the forest owner and/or site manager to determine if there are any road-related hazards on your expected route to the work site • Travel at a speed that allows your vehicle to stop within half the length of clear road you can see ahead (the distance will be affected by road and weather conditions) • Obey all signs, this includes road and operational signs
Using a mobile phone or radio while travelling	• Pull over to a safe position on the side of the road when using a mobile phone or radio

Operational hazards (cont...)

Work site hazard	Control
Ineffective personal protective equipment (PPE)	• Wear the required PPE when working in operational areas (landings) • Ensure that your hi-vis garments retain their high visibility either clean or replace as appropriate • Replace worn or damaged PPE • Ensure that the life of your protective helmet has not expired - if it has expired, replace the helmet
Moving machines	• Ensure that the crew foreman is aware of your visit • Do not proceed into an area where machines are working before being instructed to by the machine operator (usually loader operator) • Park your vehicle in a safe position away from working areas unless work has ceased • Do not approach a working machine without first getting the attention of the operator. Move towards the machine only when instructed • Wear the required personal protective equipment (hi-vis makes you easier to see)
Other workers	• Keep clear of other landing workers (skiddies and log-maker) when they are doing their job • Do not approach within two tree lengths of felling operations • If you need to approach other workers, ensure you have their attention first and they have given you the OK
Moving/loaded ropes	• Keep clear of any ropes that are moving or are/will be under load during the operation of the yarder • Keep clear of ropes that may move when hit by a machine or falling tree • Do not stand under an elevated rope or in front of a rope/anchor when that rope is loaded or there is a risk of the rope moving
Unstable log stacks	• Keep clear of the front of log stacks • Do not walk on log stacks

Operational hazards (cont...)

Inspection hazard	Control
Falling from yarder	• Inspect the tower components while the tower is down. Use a ladder to access the tower (*see below*) • Use binoculars if necessary to observe the operation of the locking dogs • Use an approved fall restraint when positioned above 3 m height
Falling from a ladder	• Use an approved fall restraint when positioned above 3 m height • Ensure the ladder is firmly positioned on the ground and against the yarder (the tower will need to be laid down to complete this) • Secure the top of the ladder (using a rope or strap) to ensure stability when working off the ladder
Hands/fingers/loose clothing jammed	• Do not operate any part of the yarder while completing the inspection, unless required to for the purpose of the inspection • Do not wear loose clothing which can also catch when climbing • Communicate clearly and concisely with the operator when you direct him/her to operate the yarder
Handling wire rope	• Avoid hand injuries from sprags by wearing protective gloves • Have any sprags removed with side-cutters • Ensure your footing is stable when handling wire rop

Personal protective equipment (PPE)

The Approved Code of Practice for Safety and Health in Forest Operations requires that people working in or visiting harvesting operations wear the following personal protective equipment:

- Hi-vis helmet
- Protective eyewear, unless it creates a greater hazard
- Safety footwear providing ankle support
- Hi-vis shirt, vest, or jacket
- Hearing protection when noise levels exceed 85dB

Other useful equipment:

- Gloves (leather or thick cotton)
- Small first-aid kit

Further information on PPE standards and care is provided in the **Best Practice Guidelines for Personal Protective Equipment**.

Maintenance inspection procedures

Planning the inspection

Arranging access

Before entering the forest to complete a tower inspection, contact the contractor (or his/her agent) to specify an inspection time and location. Also, contact the forest owner to ascertain their entry requirements.

Most forest owners require visiting service providers to have obtained an access permit or access licence. This may involve submitting details about your company, vehicle, and the purpose of the visit. In some cases, the inspector (or employer) will have to submit an accepted Health and Safety Plan, carry specified safety equipment in the vehicle, and have access to specific road control radio channels.

Presentation of the yarder tower

To perform a visual tower inspection, ensure that:

- The yarder is in a clean condition to allow any evidence of damage or wear to be seen
- The yarder is not being used operationally for the duration of the inspection
- The tower can be raised or lowered during the inspection to allow observation of the raising/ lowering mechanisms

During most of the inspection the tower should be down to allow safe access to the tower and tower components.

Equipment and documentation requirements

Before inspecting the tower ensure you have the following equipment and documentation available:

Equipment

- Personal protective equipment
- Wire brush
- Measuring tape
- Rope gauge
- Flash light
- Binoculars (to observe operation of the tower when the tower is up)
- Spray paint
- Camera (to document findings)
- Brake cleaning fluid
- Extension ladder
- Rags
- Approved harness if working in an elevated position more than 3 m from the ground

Documentation

- Inspection forms
- The yarder logbook (Including details and dates of repairs, modifications, maintenance, new ropes, and previous tower inspections)

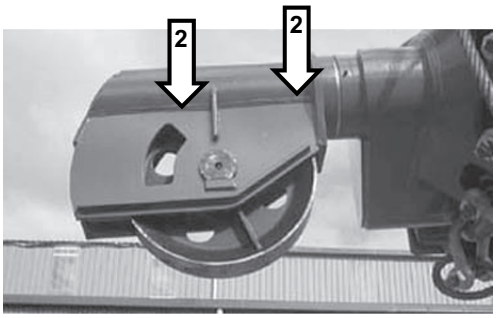
Inspecting towers

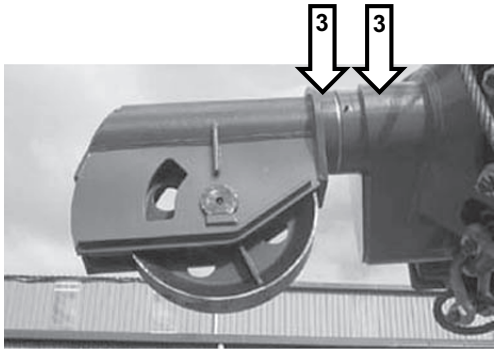
The following section provides a step-by-step procedure for visually inspecting yarder towers. The components outlined are generic to both tower and swing yarders. Tower components specific to swing yarders are covered in the next section (Inspecting Swing Yarders).

The order in which the tower components are inspected will be based on personal preference.

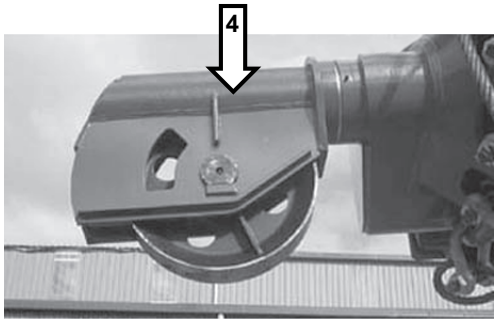
Skyline sheave

1. Visually check the alignment of the sheave with the tower. Check whether the sheave housing is bent away from its original angle. If so, the rope may be rubbing on the sides of the sheave pulley or on the sheave housing itself.
2. Check for cracks or damage where the cheek plates attach to the base plate and tube.

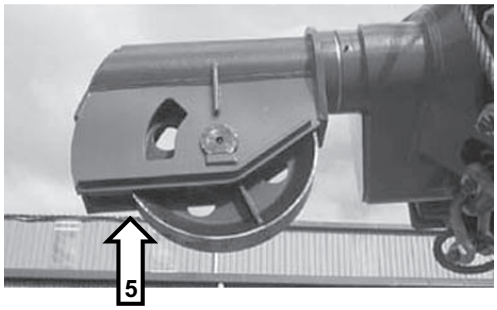




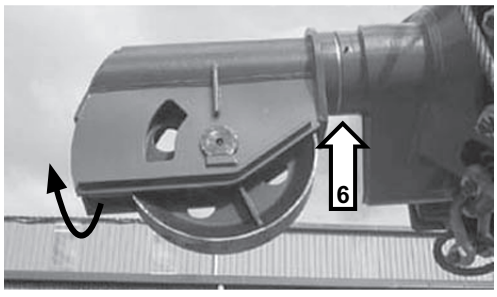
3. Check for cracks or damage around the pivot tube and pivot tube bosses, gussets, and mounting plates that attach them to the tower.



4. Check the back of the sheave housing for cracks.

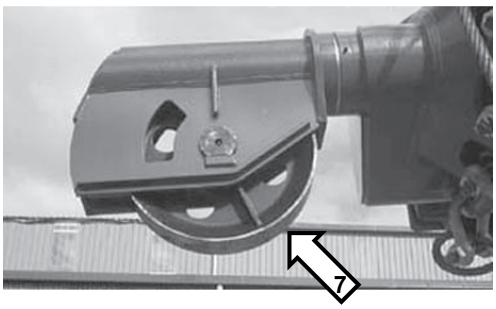


5. Check for damage to the front of the cheek plates (such as spreading).

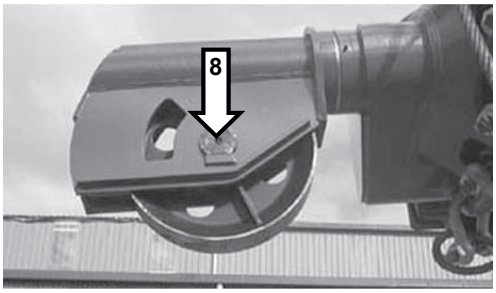


6. Check the condition of the pivot bushes or bearings. This does not mean dismantling them. Check for free play (with the use of a bar) and that the sheave rotates freely.

7. Check the condition of the sheave, looking for cracks, dents, rope marks, and the correct rope groove diameter for the rope (<±5% of each other).

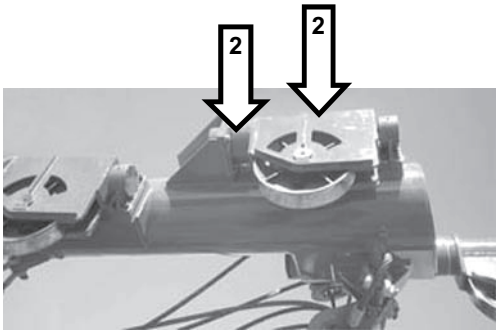


8. Check the condition of sheave bearings, bearing axle, locking nut, and washer. To check sheave bearings, rotate the sheave to see that it rotates freely. Then use a bar between the sheave and sheave housing side plate to see if there is free play in bearings.

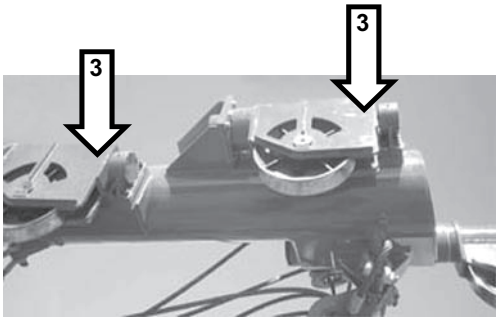


Mainline and haulback sheaves

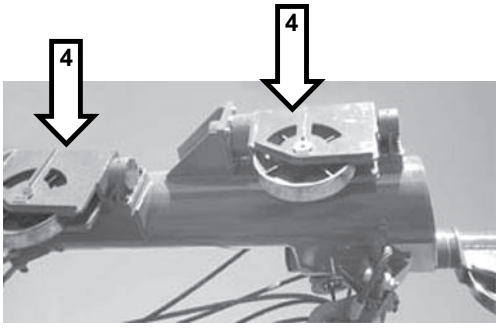
1. Visually check the alignment of the sheaves with the tower.
2. Check for cracks or damage where the cheek plates attach to the base plate and tube. For pedestal mounted sheaves, check for cracks and damage around the pivot tube, pivot tube bosses, gussets and mounting plates.

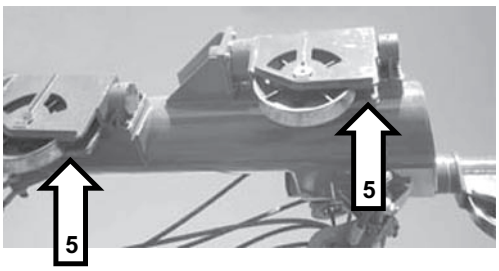


3. Check for cracks where the cheek plates join the top plate and pivot pin.

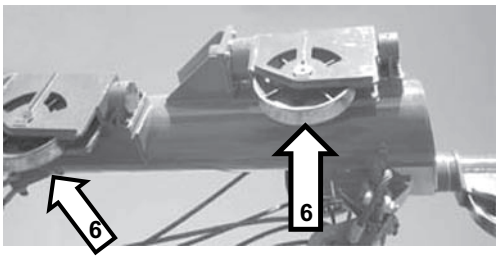


4. Check the back of the sheave housings for cracks.

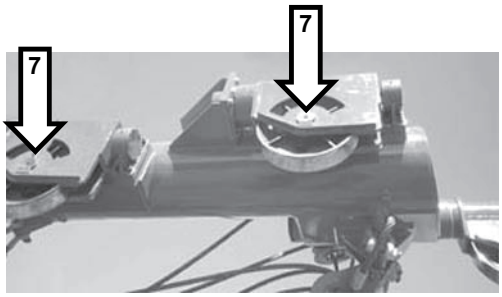




5. Check for damage to the front of the cheek plates (such as spreading).

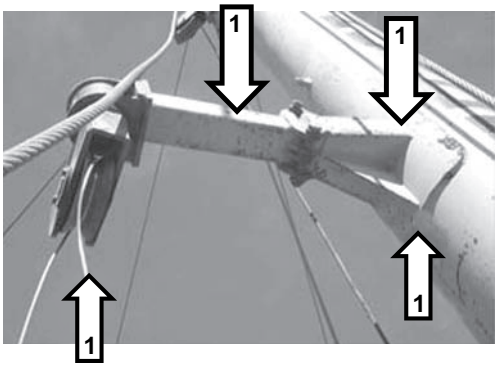


6. Check the condition of the sheave, looking for cracks, dents, rope marks, and the correct rope groove diameter for the rope (<±5% of each other).

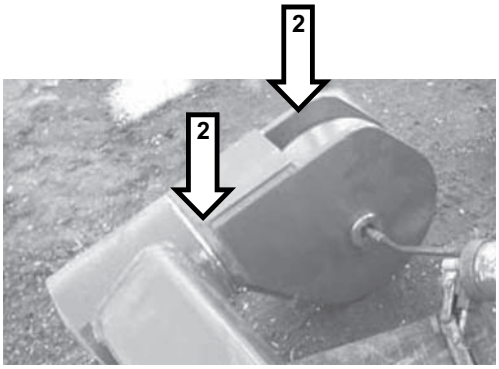


7. Check the condition of sheave bearings, bearing axle, locking nut, and washer.

Strawline and tagline sheaves (where applicable)

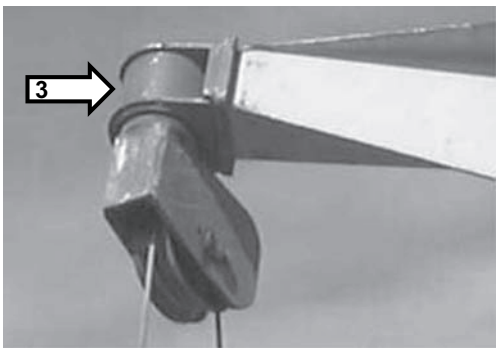


1. Visually check for alignment with the tower. Check that the support arm is not bent or cracked where it attaches to the spar. Also check that the sheave is in a direct line with the strawline or tagline drum. Strawline and tagline sheaves are often extended off to one side of the tower, and are therefore prone to damage. Misalignment could cause the sheave to rub on the side plates causing damage to the rope.

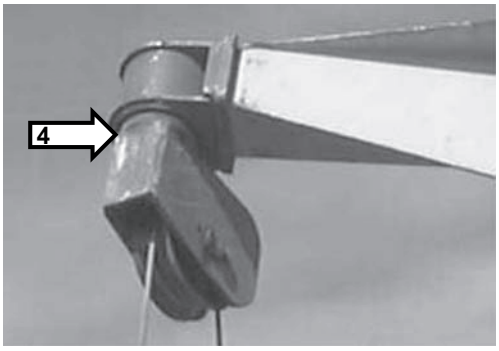


2. Check the cheek plates for cracks or damage.

3. Check for cracks around the pivot tube and pivot tube boss.



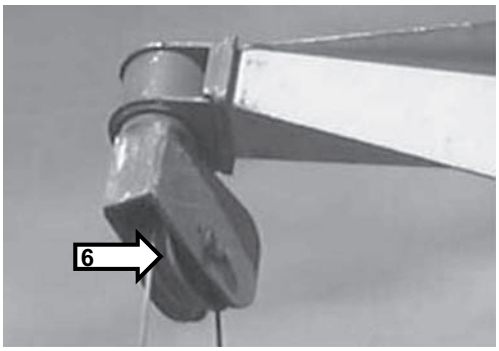
4. Check the condition of the pivot bushes or bearings.



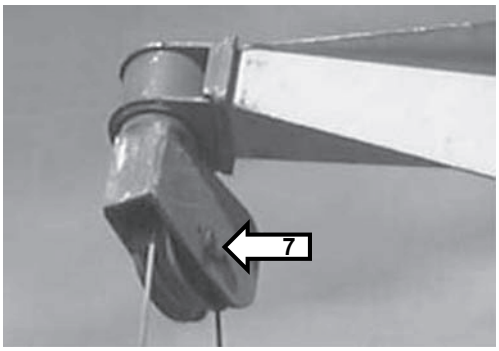
5. Check for damage to the front of the cheek plates (such as spreading).

6. Check the condition of the sheaves for cracks, dents, rope marks.

   Note: The strawline sheave does not have to be in as good condition as the tagline sheave, but it still has to be mechanically sound enough not to fail.

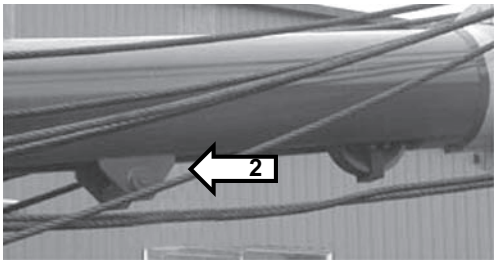


7. Check the condition of the sheave bearings, bearing axle, locking nut, and washer. To check the sheave bearing, rotate the sheave to see that it rotates freely. Then use a bar between the sheave and the sheave housing side plate to see if there is free play in the bearings.

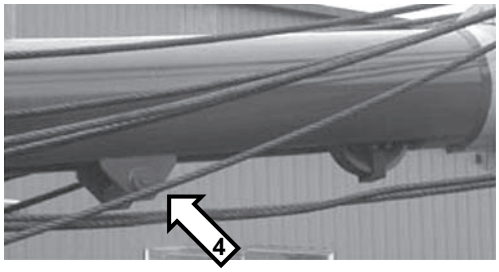


Deflection (or breaker) sheaves (where applicable)

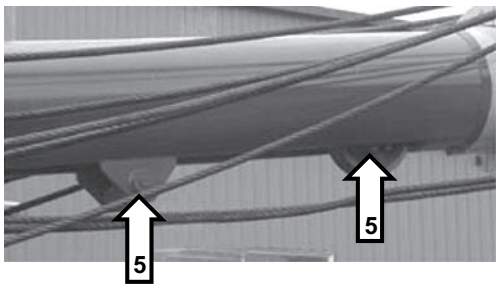
1. Visually check for alignment with the tower by looking to see if the sheave is in a direct line with its mating sheave and the drum. Deflection sheaves are high-speed working sheaves. Misalignment of the sheave could make it rub on the side plates, causing damage to the rope.
2. Check the cheek plates for cracks or damage where they attach to the tower.



3. Check for damage to the front of the cheek plates (such as spreading).



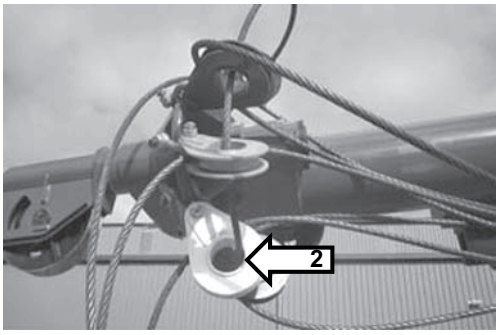
4. Check the condition of the sheave for cracks, dents, rope marks, and grease. Also check that the sheave has the correct rope radius for the rope size (<±5% of each other).



5. Check the condition of the sheave bearings, bearing axle, locking nut, and washer. To check the sheave bearing, rotate the sheave to see that it rotates freely. Then use a bar between the sheave and the sheave housing side plate to see if there is free play in the bearings. Check that the mounting bolts are tight.

Guyline blocks

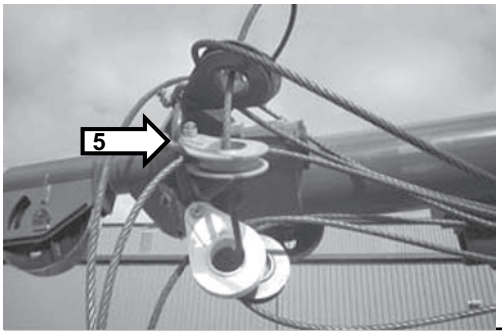
1. Check if the blocks are original equipment or an after-market design.



2. Check the condition of the sheave axle, looking for loose nuts, cracked welds, or general damage. Check the sheave bush or bearings by rotating the sheave to see that it rotates freely. Then use a bar between the sheave and the sheave housing side plate to see if there is free play in the bush or bearings.

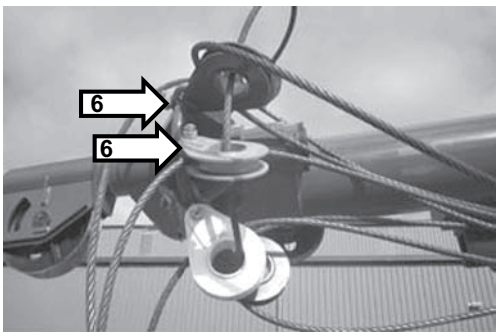
   Note: These sheaves are not fast moving.

3. Check the cheek plates for cracks or damage (such as spreading).
4. Check the condition of the sheave for cracks, dents, rope marks, and grease. Also check that the sheave has the correct rope radius for the rope size (<±5% of each other).

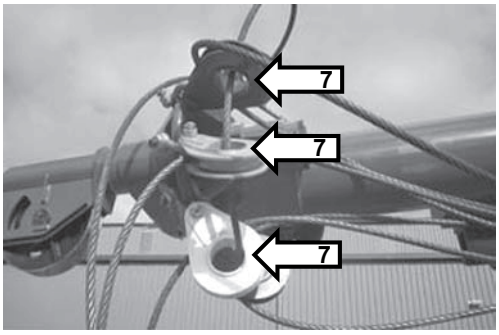


5. Check the mounting pin at the shackle connection. This pin should have no damage or bend at all.

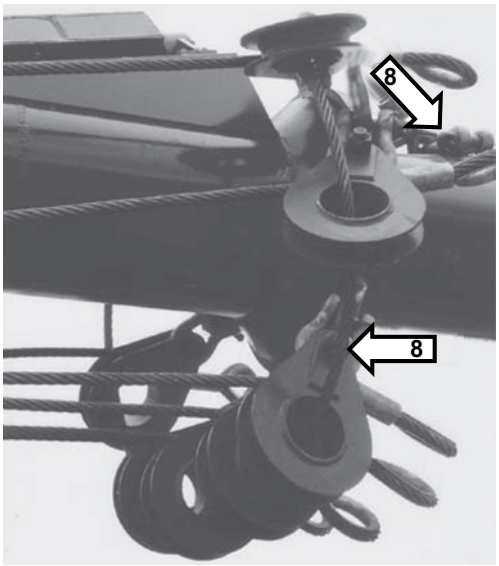
6. Check the guyblock shackles. Is there a bend in the shackle or shackle pin? Does the shackle have the required safe working load? Is the nut adequately secured?



7. Check the condition of the guyblock at the safety strop connection.



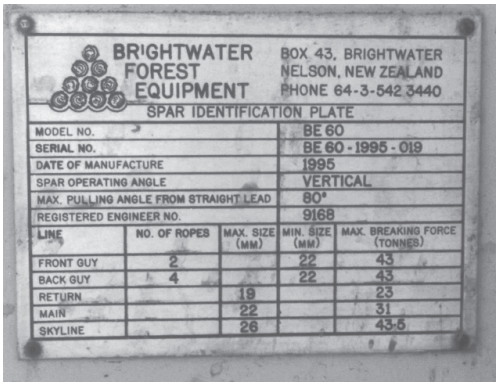
8. Check the condition of the safety strop and safety strop connection or shackle. The diameter of the safety strop shall be equal to that of the largest working rope (skyline or mainline).



Tower (spar)

1. Check the tower identification plate is visible and that the rope sizes are in accordance with the identification plate.

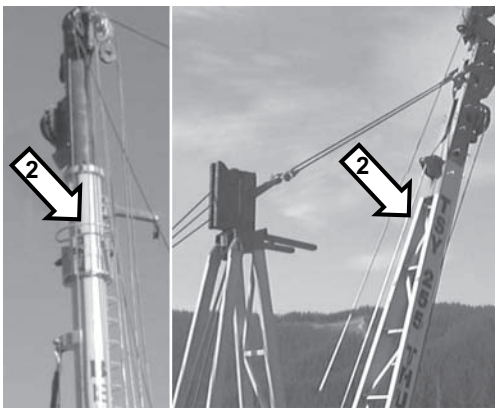
   Note: If the skyline rope size is exceeded, a fuse link the same size as or smaller than the guy ropes must be used.


BRIGHTWATER FOREST EQUIPMENT
BOX 43, BRIGHTWATER
NELSON, NEW ZEALAND
PHONE 64-3-542 3440

SPAR IDENTIFICATION PLATE

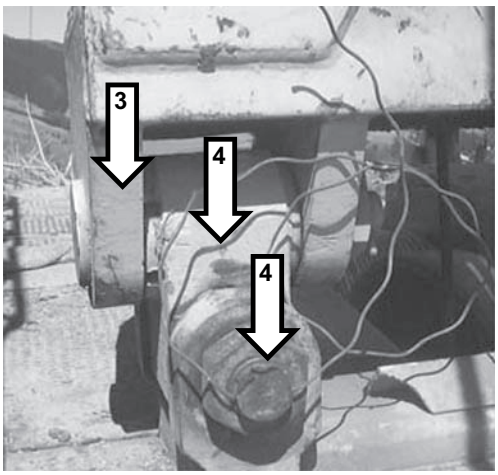
MODEL NO.	BE 60
SERIAL NO.	BE 60 - 1995 - 019
DATE OF MANUFACTURE	1995
SPAR OPERATING ANGLE	VERTICAL
MAX. PULLING ANGLE FROM STRAIGHT LEAD	80°
REGISTERED ENGINEER NO.	9168

LINE	NO. OF ROPES	MAX. SIZE (MM)	MIN. SIZE (MM)	MAX. BREAKING FORCE (TONNES)
FRONT GUY	2		22	43
BACK GUY	4		22	43
RETURN		19		23
MAIN		22		31
SKYLINE		26		43.5

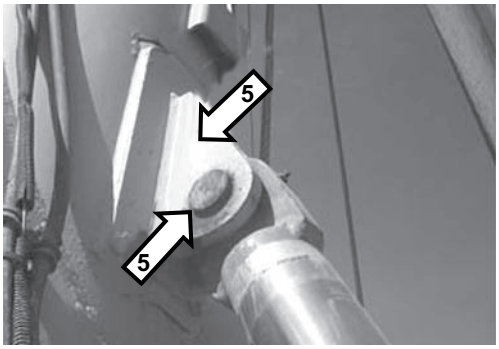


2. Check the tower tube or frame (visual). Note any bends, dents, etc. (give measurements, location, photos).

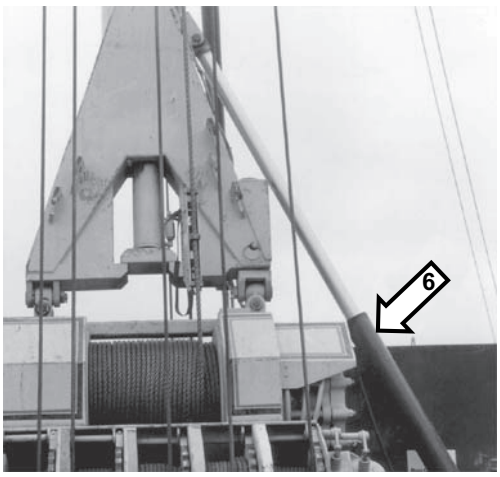
   Note: When laid down, the tower will deflect and show a bend - this is normal. We are looking for an extraordinary bend.



3. Check for cracks in the tower base plates and plate welds.
4. Check the bosses, pins, knuckles, and locking pin or clip (where applicable) for damage, cracks, or wear.



5. Check the tower-raising ram mounts and pins on both the tower and the chassis for cracks or damage. Have the pins got retainer clips, bolts, or washers fitted to stop them working loose? In the case of a tower-raising rope, check the raising rope, rope sheaves, and rope winch for cracks, damage, or wear.



6. Check tower-raising ram, hoses, and fittings for oil leaks, and check that the ram has a safety valve (counter balance valve) to stop the tower from coming down if a hydraulic hose blows.

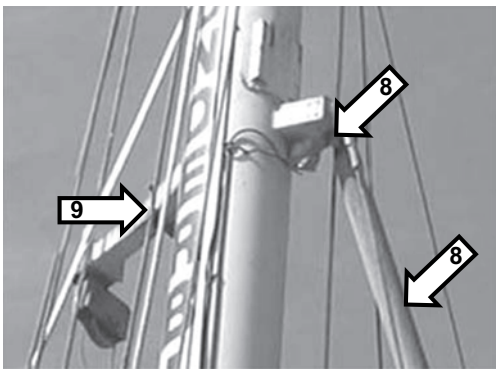
   Note: Some yarders don't have a tower-raising winch, in which case one of the working rope drums is used. The band brakes on that drum should be checked to see if the brake is capable of holding the tower.

7. Check the band brakes on the winch drum where the winch drum is used to raise and lower the tower.

8. Check the stabiliser ram for oil leaks. Check the ram mounts and pins on both the tower and the winch set for cracks or damage. Have the pins got retainer clips, bolts, or washers fitted to stop them working loose?

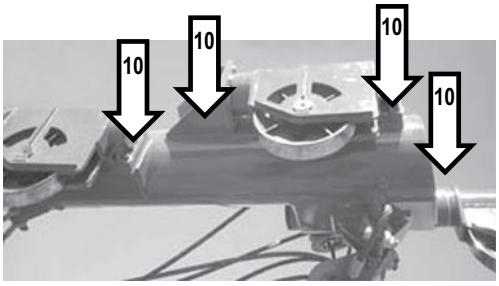
   Where a safety strop has been fitted to the stabiliser ram, check the condition of the rope, shackles, and the mounts. For yarders that have static guy ropes, check the age and condition of the static guy ropes, and the condition of shackles and mounts.

   Note: Static guy ropes have a safe life span of 7 years from new (as recorded in the logbook). After this, they **must** be tested to ensure they are within manufacturers specifications or replaced.



9. Check for damage or cracks around attachment points to the tower of the strawline and tagline sheaves (where applicable).

10. Check for damage or cracks around attachment points to the tower of the skyline, and the mainline and haulback sheaves (where applicable).

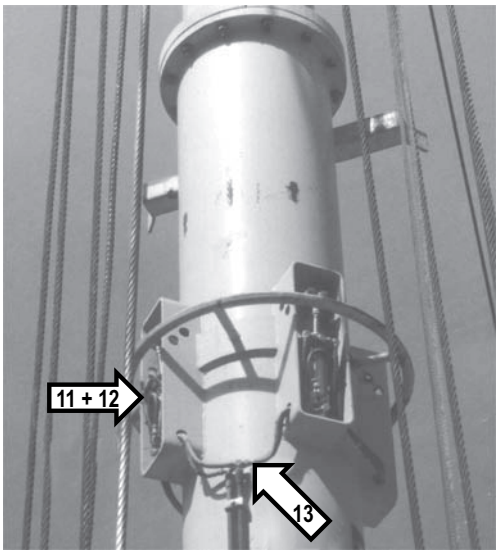


11. Check the tower locking dogs and flags for damage or cracks.

12. Check the dogs are easily visible (i.e., they are either a different colour or have a different coloured background - repaint if necessary).

13. Check air rams and air pipes for leaks or damage.

14. Check operation of telescopic tower air dogs.

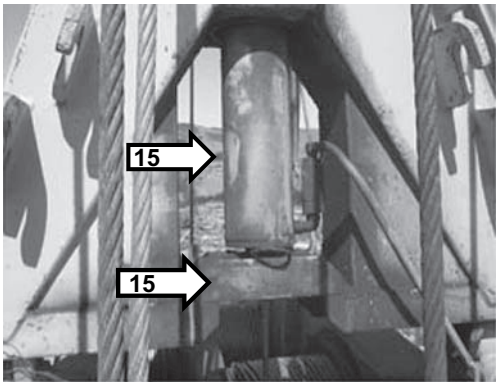


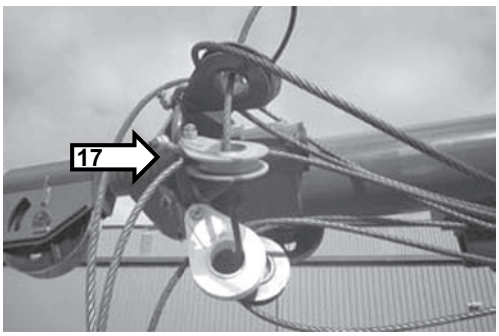
15. Check the tower telescope ram for oil leaks. Check the ram mounts and pins on both the top and the bottom sections of the tower for damage. Have the pins got retainer clips, bolts, or washers fitted to stop them working loose? Check their operation.

    Note: These are multi-stage rams and will leak or weep even after they have been resealed.

16. Check the tower telescope rope, rope winch, and sheaves and sheave mounts for damage or cracks. Check their operation.

    Note: Lifting ropes must be replaced 2 years from the “new” date recorded in the logbook.



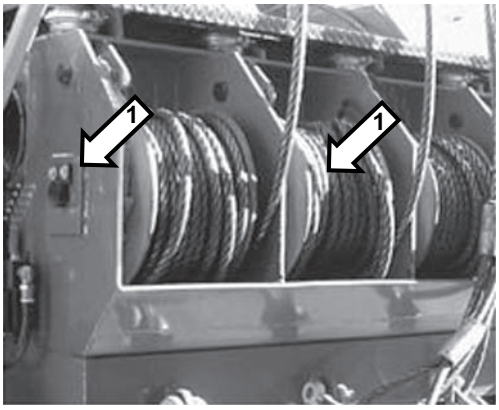


17. Check guy ring or guy lugs where they attach to the tower for damage or cracks.

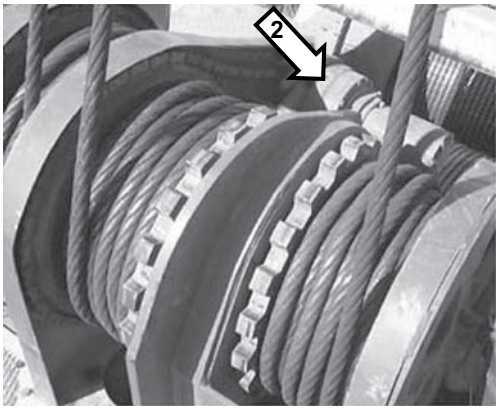
    Note: This is a very critical area.

18. Check ladder rungs for damage which would not allow safe access up the tower.

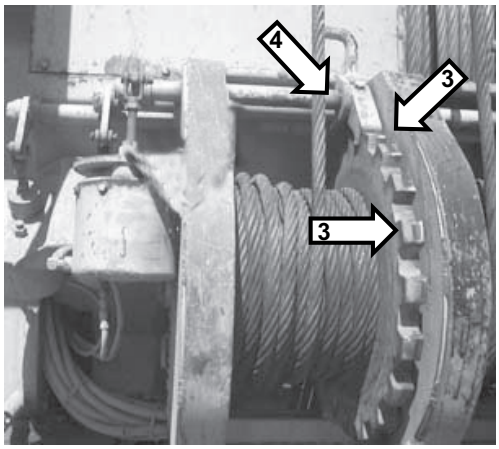
Guywinch



1. Check the guywinch drum and drum shaft for damage or wear. Check that the retaining clip, bolt, or washer is fitted to stop the shaft working loose.



2. Check the guywinch drum drive (sprockets, chain, and hydraulic motor) for damage or wear. Check the guywinch clutches where applicable.



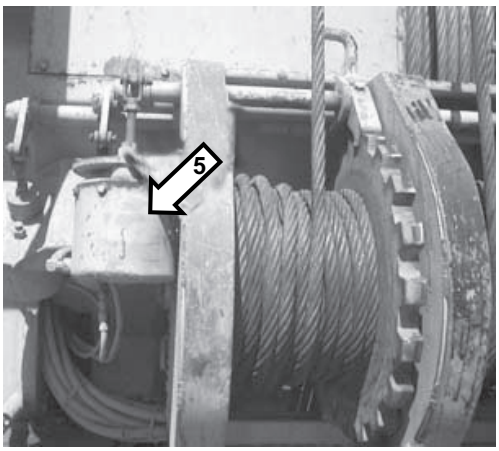
3. Check the guywinch ratchet wheels for cracks, wear, or damage. Check that the ratchet wheel meshes correctly with the ratchet pawl.

4. Check the guywinch pawls and pawl pins for damage or wear.

5. Check the pawl actuator for damage or wear. Check operation of the pawl.
6. Check the age and condition of the guyline and anchor points.

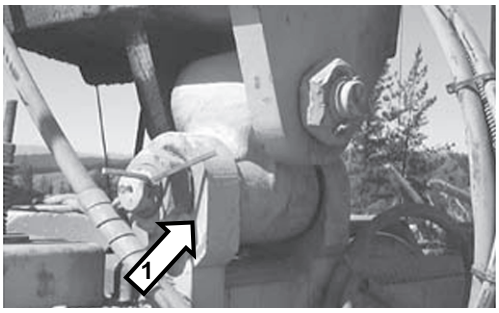
   Note: The guylines have a safe life span of 7 years for a tower yarder, and 5 years for a swing yarder (as recorded in the logbook). After this, they **must** be tested to ensure they are within manufacturers specifications or replaced.
7. Check the ages and condition of the guyline extensions.

   Note: Guyline extensions also have a safe life span of 7 years for a tower yarder, and 5 years for a swing yarder, as recorded in the logbook. After this they **must** tested to ensure they are within manufacturers specifications or replaced.

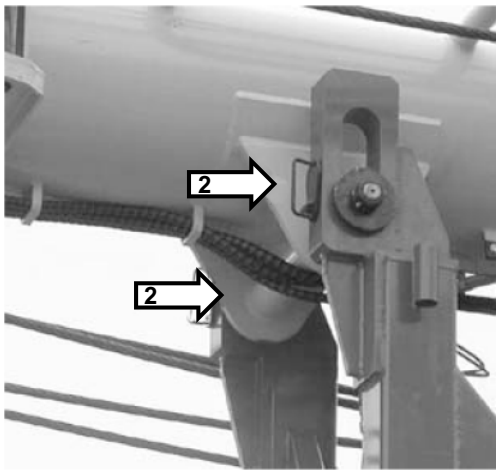


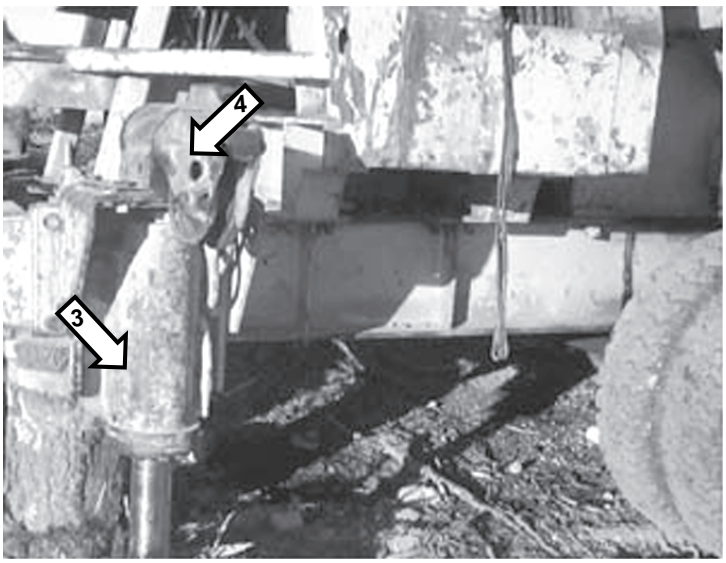
Tower (spar) mounting frame

1. Check the tower-mounting frame for damage, wear, or cracks in welds.



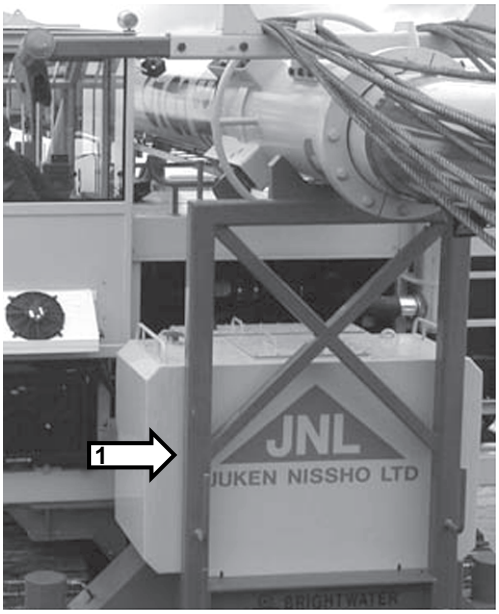
2. Check the tower-mounting bosses for damage, wear, or cracks in welds.





3. Check the levelling ram cylinders for leaks.
4. Check levelling ram cylinder mounts for damage or cracks. Check ground support frame or plate.

Tower (spar) transport frame

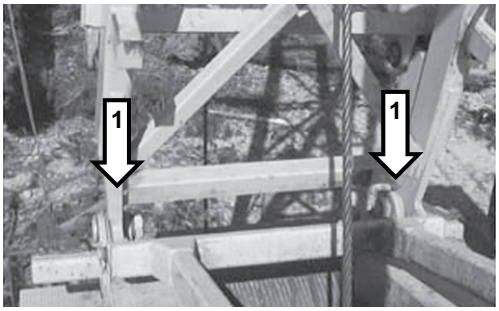


1. Check the tower support frame for damage, wear, or cracks in welds.

Inspecting swing yarders

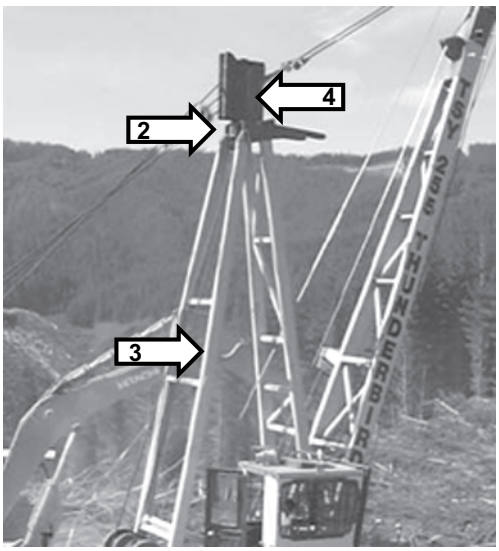
The following tower components are specific to swing yarders.

Gantry frames



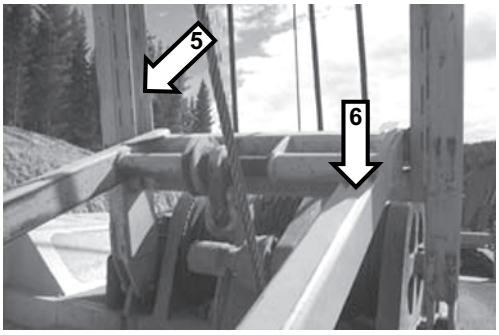
1. Check the pins and lugs at the bottom of the gantry legs for cracks or damage. Also check the locking pins.

2. Check the pins and lugs at the top of the gantry legs for cracks or damage. Also check the locking pins.
3. Check the gantry frames for damage or cracks; check that the gantry legs are straight.
4. Check guyline fairlead housing and the base pivot for damage or cracks. Check that the guyline sheave rotates freely.



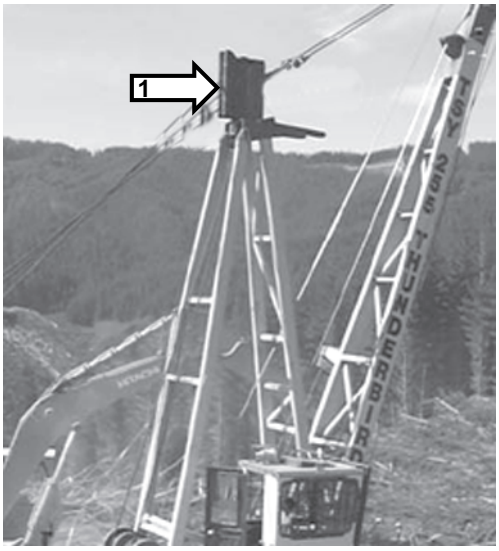
5. Check the roller tracks and stops on the rear gantry frame for damage or cracks.
6. Check the roller frame connecting the front and rear gantry frames for damage or cracks.
7. Check the pins, pin mounts, and rollers on the roller frame for damage or cracks.
8. Check the gantry-raising rope, rope winch or winch drum band brake, sheaves, and rope anchor point for damage or cracks.
9. Check the pendant rope or ropes connecting the gantry to the tower.

   Note: Pendant ropes have a safe life span of 2 years from new (as recorded in the logbook). After that they **must** be replaced.
10. Check the pendant rope anchor points for damage or cracks.
11. Check the ladder rungs for damage that would not allow safe access up the tower or gantry.

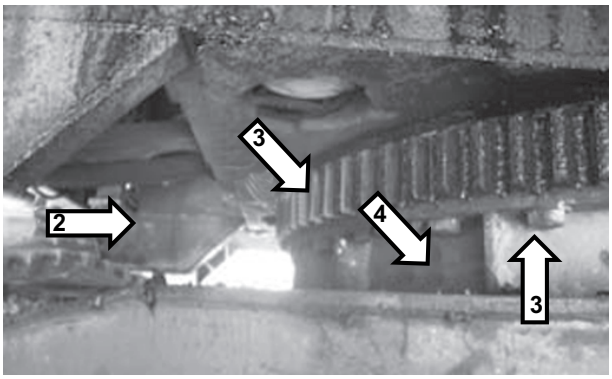


Side rollers (tower and gantry)

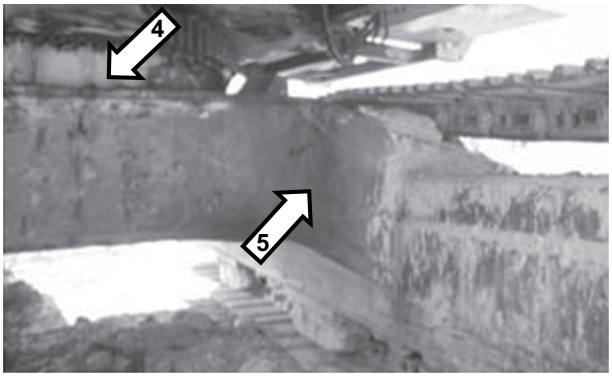
1. Check for worn rollers, worn roller axles (pins), axle retainers.
2. Check that the rollers turn freely on the bearings.
3. Check the shaft (pins) and retainers.
4. Check the shaft mounting lugs for damage or cracks.



Slew ring and car body attachment



1. Check the slew ring mechanism for wear and that it works.
2. Check the slew motor pinion for damage or cracks.
3. Check the slew ring gear for damage or cracks. Check bolt tightness.



4. Check for damage or cracks where the slew ring attaches to the car body.
5. Check the car body for weld cracks or damage.

Record keeping and reporting

A record of each inspection should be supplied to the contractor (or agent) by the yarder tower inspector (a copy will also be retained by the inspector). This record will include the date of the inspection, yarder details, inspector name and details (including valid inspector TI number), and the inspection results.

There are two possible results of a tower inspection:

1. The yarder tower achieved the industry standard
2. Specific repairs need to be completed before the yarder tower can achieve the industry standard.

Once the yarder tower achieves the industry standard (i.e., it passes), an inspection certificate (label, plate, sticker) will be issued by the tower inspector. This certificate must display the following information:

- Machine/tower serial number
- Expiry date
- Inspector “TI number”
- Inspector name/company details
- Inspector certificate number

The expiry date on the certificate will be 12-months after the last full inspection of the tower. This means that if repairs took one month to complete and a full reinspection was not done, the expiry date will be based on the initial inspection date.

Once a certificate and associated paperwork is issued, the contractor (or agent) is reponsible for ensuring that the certificate is displayed on the yarder and that the details of the inspections (and any repairs) are recorded in the logbook.

Example inspection forms

Presented below are examples of forms that can be completed while an inspection is being carried out. A separate form is presented for each major machine component and represents the minimum inspection requirement.

Because of the differences between integral fixed tower yarders and swing yarders, a complete inspection will comprise a different combination of forms. A guideline is presented below, with the corresponding form number to allow easier compilation.

Machine Type	Forms Required	Form Number
Tower yarder	Inspection summary	1
	Skyline sheave	2
	Mainline sheave	3
	Haulback sheave	4
	Strawline sheave	5
	Tagline sheave (where applicable)	6
	Deflection or breaker sheaves (where applicable)	7
	Guyline blocks	8
	Tower	9
	Guywinch	10
	Tower mounting frame	11
	Tower transport frame	12
Swing yarder	Inspection summary	1
	Skyline sheave (where applicable)	2
	Mainline sheave	3
	Haulback sheave	4
	Strawline sheave	5
	Tagline sheave (where applicable)	6
	Deflection or breaker sheaves (where applicable)	7
	Guyline blocks	8
	Tower	9
	Guywinch	10
	Gantry frame	13
	Side rollers	14
	Slew ring and car body attachment	15

If you would like an electronic copy of any of these forms please send your request to forestindustries@fitec.org.nz

FORM 1 – **INSPECTION SUMMARY**

Customer:		Date inspected:	
Machine Model:		Inspected by:	
Tower Serial No.:		Inspector TI No.:	
Machine Serial No.:			

General comments:

Inspector's signature:		Inspection Certificate No.:	
		Expiry date:	

FORM 2 – SKYLINE SHEAVE

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check the alignment with the tower				
2. Check for cracks where the cheek plates attach to the base plate and tube				
3. Check for cracks and damage around the pivot tube, pivot tube bosses, gussets and mounting plates				
4. Check the back of the sheave housing for cracks				
5. Check the front of the cheek plates for spreading or other damage				
6. Check the condition of the pivot bushes or bearings				
7. Check the condition of sheave (rope marks, cracks, greased well), check radius is correct for rope (<±5% of each other).				
8. Check the condition of the sheave bearings, bearing axle, locking nut and washer (loose, worn, bearing condition)				

FORM 3 – MAINLINE SHEAVE

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check the alignment with the tower				
2. Check for cracks where the cheek plates attach to the base plate and tube. For pedestal-mounted sheaves, check for cracks and damage around the pivot tube, pivot tube bosses, gussets and mounting plates.				
3. Check for cracks and damage where the cheek plates join the top plate and pivot pin.				
4. Check the back of the sheave housing for cracks				
5. Check the front of the cheek plates for spreading or other damage				
6. Check the condition of sheave (rope marks, cracks, greased well), check radius is correct for rope (<±5% of each other).				
7. Check the condition of the sheave bearings, bearing axle, locking nut and washer (loose, worn, bearing condition).				

FORM 4 – HAULBACK SHEAVE

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check the alignment with the tower				
2. Check for cracks where the cheek plates attach to the base plate and tube. For pedestal-mounted sheaves, check for cracks and damage around the pivot tube, pivot tube bosses, gussets and mounting plates				
3. Check for cracks and damage where the cheek plates join the top plate and pivot pin				
4. Check the back of the sheave housing for cracks				
5. Check the front of the cheek plates for spreading or other damage				
6. Check the condition of sheave (rope marks, cracks, greased well), check radius is correct for rope (<±5% of each other)				
7. Check the condition of the sheave bearings, bearing axle, locking nut and washer (loose, worn, bearing condition)				

FORM 5 – STRAWLINE SHEAVE

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check the alignment with the tower. Check the support arm is not bent				
2. Check the cheek plates for cracks where they join the base plate and tube				
3. Check for cracks around the pivot tube and pivot tube boss				
4. Check the condition of the pivot bushes or bearings				
5. Check the front of the cheek plates for spreading or other damage				
6. Check the condition of sheave (rope marks, cracks, greased well). Check radius is correct for rope (<±5% of each other)				
7. Check the condition of the sheave bearings, bearing axle, locking nut and washer (loose, worn, bearing condition)				

FORM 6 – TAGLINE SHEAVE

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check the alignment with the tower. Check the support arm is not bent.				
2. Check the cheek plates for cracks where they join the base plate and tube				
3. Check for cracks around the pivot tube and pivot tube boss				
4. Check the condition of the pivot bushes or bearings				
5. Check the front of the cheek plates for spreading or other damage				
6. Check the condition of sheave (rope marks, cracks, greased well). Check radius is correct for rope (<±5% of each other)				
7. Check the condition of the sheave bearings, bearing axle, locking nut and washer (loose, worn, bearing condition)				

FORM 7 – DEFLECTION OR BREAKER SHEAVES

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check the alignment with the tower				
2. Check for cracks where the cheek plates attach to the tower				
3. Check the front of the cheek plates for spreading or other damage				
4. Check the condition of sheave (rope marks, cracks, greased well). Check the sheave size				
5. Check the condition of the sheave bearings, bearing axle, locking nut and washer (loose, worn, bearing condition). Check that the mounting bolts are tight				

FORM 8 – GUYLINE BLOCKS

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Are the blocks after-market or original designs?				
2. Check sheave axle (loose nuts, cracked welds, general damage)				
3. Check the cheek plates for cracks or damage (spreading)				
4. Check the condition of guyblock (rope marks, cracks, greased well)				
5. Check mounting pin at the shackle connection				
6. Check the condition of the guyblock shackles. Make sure the nut is secured.				
7. Check the condition of block at the safety strop connection				
8. Check the condition of the safety strop and safety strop connection				

FORM 9 – TOWER

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check tower identification plate is visible and the rope sizes are in accordance with the identification plate				
2. Check the tube or frame (visual). Note any bends, dents, etc. (give measurements, location, and photos if possible)				
3. Check the tower base plates and plate welds for cracks or damage				
4. Check tower base bosses, pins, and knuckles for damage or wear				
5. Check tower-raising ram mount or raising rope sheave mounts for cracks where they attach to the spar				
6. Check tower-raising rams, or spar-raising rope and rope winch for damage or wear				
7. Check band brakes on the winch drum where the winch drum is used to raise and lower the tower				
8. Check the stabiliser ram and safety strop, or static guy ropes and static guy mounts for wear and damage				
9. Check strawline and tagline fairlead mounts where they attach to the tower for damage or cracks				

FORM 9 – **TOWER** (CONTINUED)

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
10. Check mainline, haulback, and skyline mounting plates where they attach the tower for damage or cracks				
11. Check the tower locking dogs and flags for damage and cracks (where applicable)				
12. Check the locking dogs are easily visible (Repaint if necessary)				
13. Check the air rams and air pipes for leaks or damage				
14. Check the operation of the tower locking dogs				
15. Check tower telescope rams for leaks or damage (check operation). Check ram mounts for damage or cracks				
16. Check tower telescope rope, sheave, sheave mounts and winch for cracks and damage (check operation). Check the rope age as recorded in the log book (limit of 2 years from new)				
17. Check guy ring or guy lugs attachment point on the tower for damage or cracks				
18. Check ladder rungs for damage (not allowing safe access up the tower)				

FORM 10 – GUYWINCH

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check guywinch drum and drum shaft for damage or wear. Check the retaining clip, bolt, or washer				
2. Check guywinch drum drive (sprockets, chain, and hydraulic motor) for damage or wear				
3. Check guywinch ratchet wheel for cracks, wear, or damage. Check it meshes correctly with the pawl				
4. Check the guywinch pawls and pawl pins for damage or wear				
5. Check the guywinch pawl actuator for damage or wear (check operation of pawl)				
6. Check guylines and rope anchor points for damage or wear. Check the rope age recorded in the logbook (limit of 5 years for swing yarder, 7 years for tower yarder)				
7. Check the age (as recorded in the log book) and condition of any guyline extensions				

FORM 11 – TOWER MOUNTING FRAME

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check the tower mounting frame for damage, wear, or cracks in the welds				
2. Check the tower mounting bosses for damage, wear, or cracks in the welds				
3. Check the levelling ram cylinder for leaks				
4. Check the levelling ram cylinder mounts for damage or cracks. Check ground support frame or plate				

FORM 12 – TOWER TRANSPORT FRAME

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check the tower support frame for damage, wear, or cracks in the welds				

FORM 13 – GANTRY FRAMES

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check pins and lugs at the bottom of the gantry legs for damage or cracks. Check locking pins				
2. Check pins and lugs at the top of the gantry legs for damage or cracks. Check locking pins				
3. Check the gantry frame for damage or cracks. Check that the legs are straight				
4. Check guyline fairlead housing and base pivot for cracks or damage. Check the guyline sheave				
5. Check roller track and stops on the rear gantry frame for cracks and damage				
6. Check the roller frame connecting the front and rear gantry for cracks or damage				
7. Check the pins, pin mounts, and rollers on the roller frame for cracks or damage				
8. Check the raising rope, winch, sheave, and rope anchor point for cracks or damage				
9. Check the condition and age of the pendant rope or ropes connecting the gantry to the spar as recorded in the logbook (limit of 2 years from new)				
10. Check the pendant rope mounts for cracks or damage				
11. Check ladder rungs for damage which would not allow safe access up the tower				

FORM 14 – SIDE ROLLERS (TOWER AND GANTRY)

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check for worn rollers				
2. Check that the rollers turn freely on their bearings				
3. Check shaft (pins) and retainers				
4. Check the shaft mounting lugs for damage or cracks				

FORM 15 – SLEW RING AND CAR BODY ATTACHMENT

Description of items to be checked	Condition and Comments	Pass	Repair	Replace
1. Check the slew ring mechanism for wear, and that it works.				
2. Check the slew motor pinion for damage or cracks				
3. Check the slew ring gear for damage or cracks, check bolt tightness				
4. Check where the slew ring attaches the car body for cracks or damage				
5. Check the car body for weld cracks or damage				

Glossary of terms

Breaker-outs	Workers who connect the strops onto the stems for extraction by the yarder.
Car body	The undercarriage of a swing yarder capable of propelling and swinging the main body and tower.
Certified welder	A welder who holds current welding certification approved to NZS 4711 (or equivalent) in the position(s) appropriate to the welding task.
Compressive stress	A stress that tends to shorten a material.
Elastic limit	The stress that a material can withstand before permanent deformation occurs when the stress is released.
Excavator yarder	An excavator-based machine fitted with a drum set for cable extraction.
Fatigue	A mode of failure that can occur without warning and at a stress much lower than the ultimate stress for the material. Often associated with shafts and other rotating components, but any equipment subjected to cyclic loading is potentially susceptible. Usually has its origin in some surface imperfections (sometimes an imperfection below the surface can be the cause).
Guyline configuration	The guyline angles (vertical) and spacing relative to the direction of pull.
Independent spar yarder	A yarder winch (one or two drums) with a separate guyed spar or tower.
Integral fixed tower yarder	A yarder with a built-in tower not capable of swinging relative to the chassis or car body.
Registered mechanical /structural engineer	A qualified mechanical/structural engineer registered under the Engineers Registration Act 1924 or as a Chartered Professional Engineer (after 1 January 2003).
Shear stress	A stress which tends to shear a material.
Skid worker (Skiddy)	A worker on the landing typically involved with trimming, cutting up stems, and quality control.
Strain	A change in a material's dimensions when a stress is applied.
Stress	The load transmitted per unit area of cross-section, usually expressed in MPa (megapascals).
Swing yarder	An integral tower yarder capable of swinging the tower relative to the car body.
Tensile stress	A stress which tends to stretch a material.
Ultimate strength	A property of a material that corresponds with the maximum stress that a material can withstand before failing.
Yield strength	A property of a material that corresponds with the maximum stress that a material can withstand before permanent deformation (dimensional change) occurs.

Poroporoaki

Whaia te huarahi	*Pursue the path*
o te mātauranga	*of learning.*
Ka piki ake koe,	*The higher you climb,*
ka whānui atu nga pae.	*the wider the horizons.*
Rapuhia nga pae	*Seek also the horizons*
i roto, I tōu nei ngakau.	*within your self.*
E tipu, e awhi, e tū.	*Grow, embrace, stand tall.*

Vision, knowledge, performance

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