

## 1.1 Introduction

This training course is based on the National High Risk Licence Unit of Competency **TLILIC0016 Licence to operate a bridge and gantry crane.**

You will learn about:

- ◆ Planning the job.
- ◆ Selecting and inspecting equipment.
- ◆ Preparing the site and equipment.
- ◆ Performing the task.
- ◆ Shutting down the job.



### 1.1.1 What is a Bridge and Gantry Crane?



**Bridge Crane** – A bridge beam, mounted at each end to an end carriage, capable of travelling along elevated runways and having one or more hoisting mechanisms arranged to traverse across the bridge.



**Gantry Crane** – A bridge beam, supported at each end by legs mounted on end carriages, capable of travelling on runways on supported surfaces or deck levels, whether fixed or not and which has a crab with one or more hoisting units arranged to travel across the bridge.

This unit includes the use of a bridge and gantry crane that is:

- ◆ Controlled from a permanent cabin or control station on the crane.

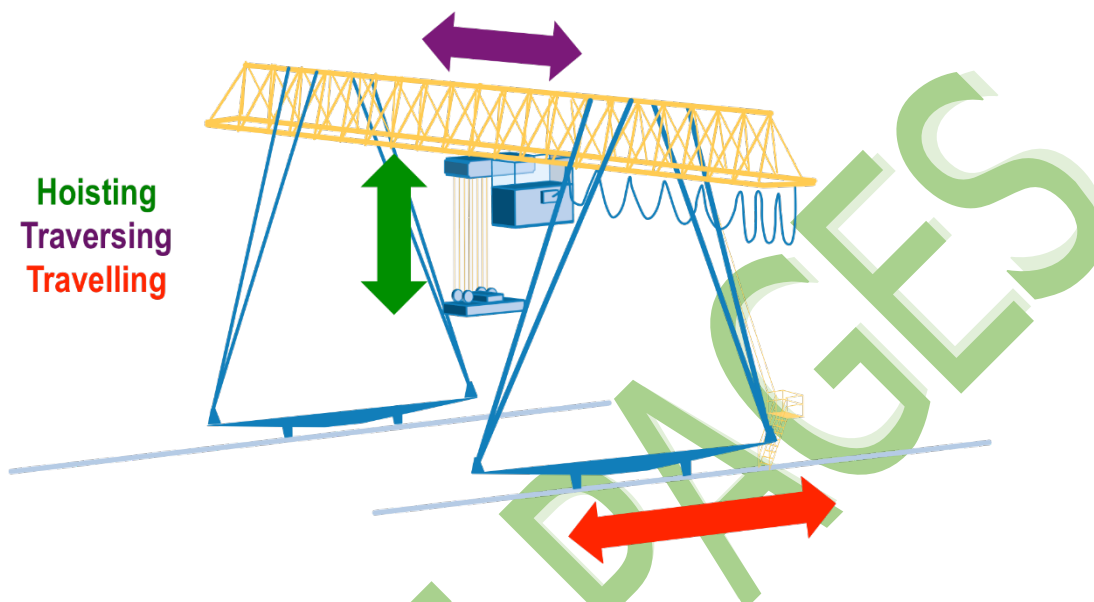
**OR**

- ◆ Remotely controlled and having more than 3 powered operations.

## 1.1.2 Crane Movements

Common crane movements that you may use when shifting loads with a bridge and gantry crane include:

- ◆ **Hoisting** – The raising and lowering of the hook block using the hoist rope.
- ◆ **Traversing** – Moving the hoisting mechanism along the bridge.
- ◆ **Travelling** – The movement of the crane along the runway. Load swing can be reduced by travelling at a minimum speed and using gentle acceleration and braking.



Other crane movements may include:

- ◆ **Rotating** – A function that allows you to control the rotation of the load.
- ◆ **Pitch and Yaw** – Load movements that may be available depending on the crane in use.

## 1.2.2 Duty of Care

Everybody in the workplace has a responsibility to keep themselves and others as safe as possible while they are at work. This is called a 'Duty of Care'.

Any licensed worker must take reasonable steps to make sure the way they work does not impact on the safety of themselves or any other worker. This is their legal duty of care. Your duty of care requires the following:

- ◆ To take reasonable care of your own safety and the safety of others.
- ◆ To cooperate with your employer in any way that ensures the health and safety of the workplace.
- ◆ To avoid taking unnecessary risks, acting dangerously or using workplace equipment in unsafe ways, or ways it is not designed to be used.

Failing to work safely can result in the health and safety regulator:

- ◆ Suspending or cancelling your licence.
- ◆ Refusing to renew your licence.
- ◆ Ordering that you are reassessed to ensure you are competent.
- ◆ Take legal action to prosecute you.

Your employer must take steps to ensure that the workplace is as safe as possible for you and other workers. In order to do this they can:

- ◆ Provide a safe workplace with minimal risks.
- ◆ Provide and maintain safe plant, equipment and structures.
- ◆ Provide and maintain safe systems/procedures for work.
- ◆ Provide facilities that are adequate for the personnel on site.
- ◆ Provide instruction, training, supervision and information for any work to be undertaken safely, **including any time you are required to use an unfamiliar piece of equipment.**
- ◆ Take action to ensure all equipment, plant & substances used on site is handled and stored in a safe way.

## 1.4 Identify and Control Hazards

Before you start work, you need to check for any hazards or dangers in the area. If you find a hazard or danger you need to do something to control it. This will help to make the workplace safer.

Part of your job is to look around to see if you can find any hazards before you start any work.

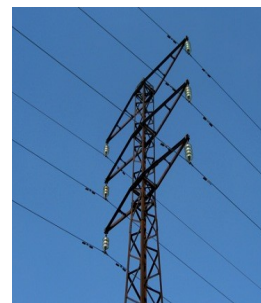
A **hazard** is the thing or situation with the potential to cause injury, harm or damage.

When you start checking for hazards, make sure you look everywhere. A good way to do this is to check:

- ◆ **Up high** above your head.
- ◆ All around you **at eye level**.
- ◆ **Down low** on the ground (and also think about what is under the ground).

Some common workplace hazards related to bridge and gantry crane operations include:

- ◆ Overhead hazards such as power lines, service lines, and service pipes.
- ◆ Underground services.
- ◆ Ground surfaces and conditions including:
  - ◇ Surfaces that may not bear the weight of the crane or other equipment.
  - ◇ Recently filled trenches.
  - ◇ Slopes.
- ◆ Bad weather conditions, such as strong winds, lightning or storms.
- ◆ Insufficient lighting/lack of illumination.
- ◆ Vehicle traffic.
- ◆ Plant and equipment.
- ◆ Pedestrians and workers.
- ◆ Site specific hazards, such as dangerous materials.
- ◆ Trees.
- ◆ Buildings, facilities and other surrounding structures.
- ◆ Obstructions or obstacles.
- ◆ Unusual or difficult terrains.
- ◆ Working at heights.



### 1.4.3 Control Hazards

The best way to control hazards is to use the Hierarchy of Hazard Control. The Hierarchy of Hazard Control is the name given to a range of control methods used to eliminate or control hazards and risks in the workplace.

You start at the top of the list and see if you can take away (eliminate) the hazard or danger.

If you can't take it away you move down the list to see if you can swap it for something safer (substitution).

Keep working through the list until you find something that controls that hazard or danger.



This table shows you the 6 different types of controls in order from best to worst:

| Hierarchy Level                         | Action                                                                    |
|-----------------------------------------|---------------------------------------------------------------------------|
| <b>1. Elimination</b>                   | Completely remove the hazard. This is the best kind of hazard control.    |
| <b>2. Substitution</b>                  | Swap a dangerous work method or situation for one that is less dangerous. |
| <b>3. Isolation</b>                     | Isolate or restrict access to the hazard.                                 |
| <b>4. Engineering Controls</b>          | Use equipment to lower the risk level.                                    |
| <b>5. Administrative Controls</b>       | Site rules and policies attempt to control a hazard.                      |
| <b>6. Personal Protective Equipment</b> | The least effective control. Use PPE while you carry out your work.       |

Hazard control measures need to be put in place before you start your work, or as soon as you see a hazard while you are doing your work. Hazard controls can sometimes be listed in your work instructions or you can ask your boss or supervisor for help.

Talk to the other workers in the area to make sure they are aware of the control measures you have put in place.

Once a hazard control is in place you will need to check to make sure it is working well to control the hazard or danger.

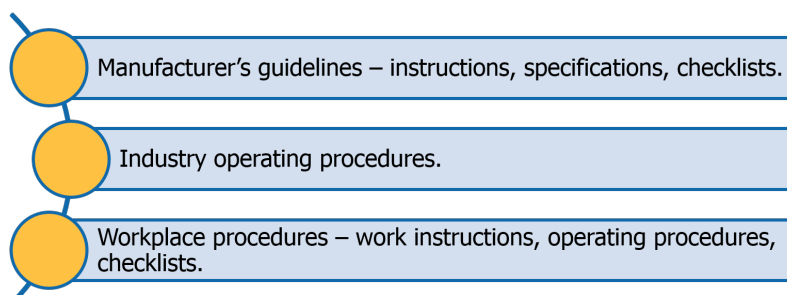
Talk to your supervisor or safety officer if you are not sure if it is safe enough to carry out your work. If you think the hazard is still too dangerous you should not try to do the work.

## 1.6 Communications

As a crane operator you need to be able to communicate effectively with those around you while you work. This may include workers such as doggers and riggers.

It is important that you are able to understand all the instructions necessary to use all relevant equipment safely.

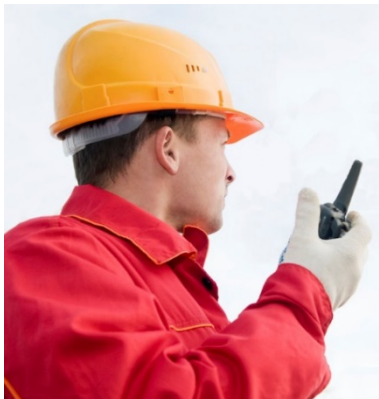
These can include:



Select appropriate communication methods while planning and preparing for crane operations, before work is started.

Communication methods may take the form of:

- ◆ Verbal and non-verbal language.
- ◆ Listening.
- ◆ Questioning to confirm understanding.
- ◆ Written instructions.
- ◆ Signage.
- ◆ Making and interpreting hand signals.
- ◆ Whistle, bells or buzzer signals.
- ◆ Appropriate worksite procedures.



Choosing the most appropriate communication method for the job will depend on the specific circumstances you may encounter during operations.

For instance, if the crane operator remains constantly in view of the person dogging the load then hand signals would be an effective communication method. If however the load is not always going to be in sight of the crane operator then whistle signals could be employed.

Fixed channel two-way radios can be used when they are going to prove more effective than other methods.

They are particularly useful when the operator is out of view of the load and whistle signals could not be heard or would prove confusing due to other crane operations in the area.

### 1.6.1 Following Communication Signals

You will often be communicating with the person directing the crane, most likely a licenced dogger or rigger. To direct you they will use one of the following communication methods:

- ◆ Hand signals.
- ◆ Whistle signals.
- ◆ Two-way radios (fixed channel).
- ◆ Verbal communication.

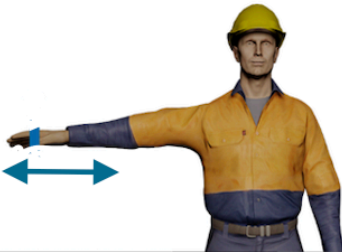
Verbal communication will be used particularly when planning the move or discussing the work.

The method of communicating should be chosen when planning the work.

Some cranes may have additional movements or functions. It is important that a series of hand/whistle signals is decided on before you start to move the crane.

If at any point you are unsure of the directions being given to you, stop all crane motions and confirm the instructions with the person giving them (dogger, spotter or observer).

Shown here are the signals used in Australia for directing bridge and gantry cranes:

| HAND SIGNALS                                                                                                                                                    |                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hoisting Raise                                                                                                                                                  | Hoisting Lower                                                                                                                                                |
|  <div>Whistle, Bell<br/>&amp; Buzzer Signals</div> <div>2 Short<br/>..</div>   |  <div>Whistle, Bell<br/>&amp; Buzzer Signals</div> <div>1 Long<br/>—</div> |
| Traverse/Travel (East – West) Cross Travel                                                                                                                      |                                                                                                                                                               |
|                                                                                |                                                                             |
| Travel (North – South) Long Travel                                                                                                                              |                                                                                                                                                               |
|                                                                              |                                                                           |
| Stop                                                                                                                                                            |                                                                                                                                                               |
| <div>Whistle, Bell<br/>&amp; Buzzer Signals</div> <div>1 Short<br/>•</div>  |                                                                                                                                                               |
| Creep Speed: Appropriate hand signal for motion with hand opening and closing.                                                                                  |                                                                                                                                                               |

Other signals that may be used are:

- ◆ Rotate.
- ◆ Lower.

Discuss with the person directing the load what signals will be used for these movements BEFORE the job is started.

## 2.1 Assess the Load

### 2.1.1 Common Load Weights

The table below lists the weights of common loads:

| Material             | Weight                |
|----------------------|-----------------------|
| Aluminium            | 2.7t per cubic metre  |
| Bricks (1000 bricks) | 4.0t per              |
| Bronze               | 8.5t per cubic metre  |
| Cast Iron            | 7.2t per cubic metre  |
| Cement (25 bags)     | 1.0t                  |
| Clay                 | 1.9t per cubic metre  |
| Coal                 | 864kg per cubic metre |
| Concrete / Cement    | 2.4t per cubic metre  |
| Copper               | 9.0t per cubic metre  |
| Earth                | 1.9t per cubic metre  |

| Material          | Weight                |
|-------------------|-----------------------|
| Granite           | 2.6t per cubic metre  |
| Gypsum            | 2.3t per cubic metre  |
| Iron, ore         | 5.4t per cubic metre  |
| Lead              | 11.2t per cubic metre |
| Mild Steel        | 7.85t per cubic metre |
| Poly Pipe         | 1.1t per cubic metre  |
| Timber (hardwood) | 1.1t per cubic metre  |
| Timber (soft)     | 0.6t per cubic metre  |
| Water             | 1.0t per cubic metre  |

### 2.1.2 Determine the Weight of the Load

In most cases loads aren't always a perfect cubic metre and you will need to find the volume of the load before determining the weight:

#### Step 1 – Determine Load Volume

For Square/Rectangle loads use the formula:  
**Volume = Length x Width x Height**  
For Round/Circular loads use the formula:  
**Volume = Radius x Radius x  $\pi$  x H**

#### Step 2 – Determine Load Weight

Multiply the load volume by the density of the load material using the formula:  
**Weight = Volume x Density**

Using the above formula and table we can work out the weight of most loads.

#### Example 1

What is the weight of a rectangular block of solid concrete measuring 3.5m long, 0.8m wide and 0.6m high?

We know that a cubic metre of concrete weighs 2.4 tonnes (2400k).

#### Step 1 – Volume

$$\begin{aligned}\text{Volume} &= \text{Length} \times \text{Width} \times \text{Height} \\ &= 3.5\text{m} \times 0.8\text{m} \times 0.6\text{m} \\ &= \mathbf{1.68\text{m}^3}\end{aligned}$$

#### Step 2 – Weight of the Block

$$\begin{aligned}\text{Weight} &= \text{Volume} \times \text{Density} \\ &= 1.68\text{m}^3 \times 2.4\text{t/m}^3 \\ &= \mathbf{4.032\text{t}}\end{aligned}$$

Therefore, the total load weighs **4.032 tonnes** or **4032 kg**.

## Example 2

We can use this process to work out more complex weights. For example, we can work out a load with the following characteristics:

|                         |                  |
|-------------------------|------------------|
| <b>Material</b>         | Aluminium Sheets |
| <b>Number of Sheets</b> | 20               |
| <b>Length</b>           | 5m               |
| <b>Width</b>            | 2m               |
| <b>Height</b>           | 30 mm (or 0.03m) |

The first step is to work out how much **each sheet** weighs:

### Step 1 – Volume

$$\begin{aligned}\text{Volume} &= \text{Length} \times \text{Width} \times \text{Height} \\ &= 5\text{m} \times 2\text{m} \times 0.03\text{m} \\ &= \mathbf{0.3\text{m}^3}\end{aligned}$$

### Step 2 – Weight of Each Sheet

$$\begin{aligned}\text{Weight} &= \text{Volume} \times \text{Density} \\ &= 0.3\text{m}^3 \times 2.7\text{t/m}^3 \\ &= \mathbf{0.81\text{t}}\end{aligned}$$

Once we know how much each sheet weighs individually we can work out how much the total weight of the load will be. This is done by multiplying the number of sheets by the weight of each sheet:

$$\begin{aligned}\text{Total Load Weight} &= \text{Number of Sheets} \times \text{Weight of Each Sheet} \\ &= 20 \times 0.81\text{t} \\ &= \mathbf{16.2\text{t}}\end{aligned}$$

Therefore, the total load weighs **16.2 tonnes** or **16200 kg**.

## 2.3 Crane and Equipment Checks

Before using a bridge and gantry crane or item of equipment you will need to inspect it and check that it is in safe working order and is suitable for the task.

The crane operator has the responsibility for inspecting the crane itself.

Routine checks include:

### Pre-Start Checks

Visual checks done before the crane is started up.

### Operational Checks

Checks made after the crane is started up.

Turn on the isolation switch before carrying out an inspection of the crane.

If you find a danger/safety tag attached to the crane or an item of equipment while carrying out an inspection you must leave it in place.

The only people who are allowed to remove the tag is:

- ◆ The person who put it there.
- Or**
- ◆ A person authorised to remove it according to workplace safety procedures.

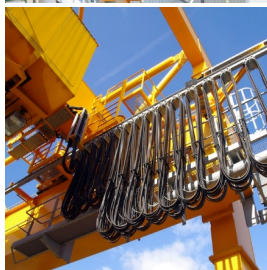
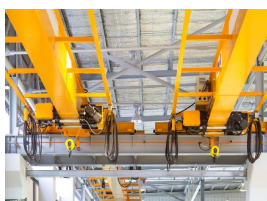
**Do not** remove the tag or use the crane or equipment, unless you have been authorised to do so.



### 2.3.1 Pre-Start Checks

Pre-start checks make sure the crane is safe to use. Routine pre-start checks should be carried out according to procedures including:

- ◆ The manufacturer's guidelines. This may include a range of instructions and specifications, including the operator's manual or appropriate checklists.
- ◆ Industry operating procedures.
- ◆ Workplace procedures, instructions, operating procedures and checklists.



Routine pre-start checks of the crane include:

- ◆ Visual inspection of the bridge and gantry crane to check the beams and crane structure.
- ◆ Mains isolation switch – check that there are no danger tags attached to it and that the electrical boxes/doors are closed.
- ◆ Electrical collector wires.
- ◆ Lifting hook.
- ◆ Storm brakes (if fitted).
- ◆ Hoist limit switches.
- ◆ Collector basket/buzz bars/bus bars (if visible).
- ◆ Isolator panels/circuit breakers.
- ◆ Hoist rope (FSWR).
- ◆ Sheaves.
- ◆ Anchorages – serviceable and in good condition.
- ◆ Winch drum – serviceable and in good condition.
- ◆ Signs/signage and labels (or notices) are present, correct and legible.
- ◆ No obstructions in the path of travel.
- ◆ No obstructions visible on the beams.
- ◆ Safety chains or gates are in place at exits and in working order.
- ◆ Lifting equipment.
- ◆ Pendant control – strainer wires are secure and serviceable.

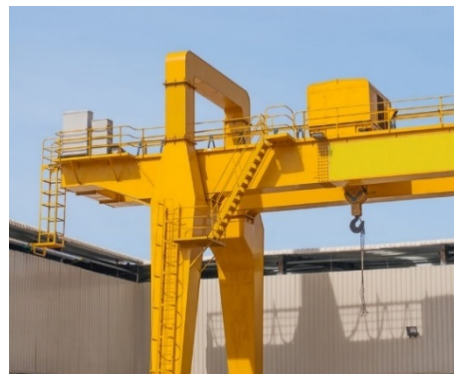
The first action of the pre-start checks process is to switch on the isolation switch.

### 2.3.1.1 Boom and Superstructure Checks

The boom and superstructure of the crane must be checked to ensure there are no defects that would make the crane unsafe to use.

Boom and superstructure defects to check for include:

- ◆ Cracks – particularly in the boom, superstructure or welds.
- ◆ Bends or twists in the bridge and gantry or superstructure.
- ◆ Flaking paint.
- ◆ Loose or missing bolts.
- ◆ Rust visible on the joints or welds.
- ◆ Oil leaks.



### 2.3.1.2 Electric Collector Wires and Electrical Control Box Checks

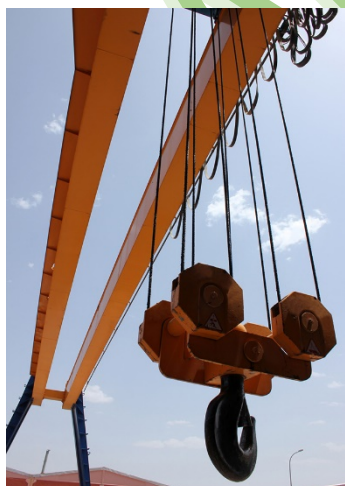
Make sure that the electric collector wires (also called bus bars) and the electrical control box are checked and inspected to ensure they are safe for use.

Inspect the electric collector wires and the electrical control box to make sure that:

- ◆ No collector wires are broken.
- ◆ All wires are connected to the insulators.
- ◆ Nothing is on the electrical collector wires (e.g. materials leaning on them).
- ◆ Nothing is on the electrical control box (e.g. loose materials, debris).

### 2.3.1.3 Lifting Hook and any other Attachments

Make sure the lifting hook has the rated capacity stamped or marked on it. The hook should be fitted with a safety latch.



Inspect the lifting hook or any other attachments you are using for damage or excessive wear. Defects that would render equipment unusable include:

- ◆ Cuts or gouges of more than 10%.
- ◆ Bill is stretched more than 5%.
- ◆ Cracks or twisting in the hook.
- ◆ Exposure to excessive heat.
- ◆ Missing safety latch.
- ◆ Hook swivel for visible damage.
- ◆ Rated capacity not marked.

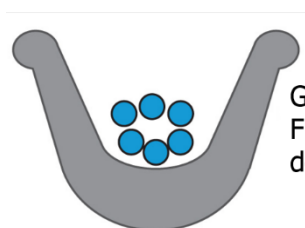
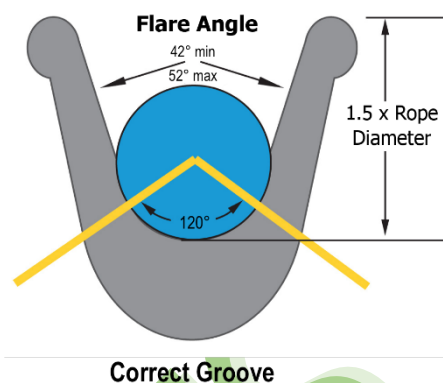
### 2.3.1.4 Sheaves

Sheaves lead the rope over the head of cranes and hoists and are used in pulley systems to gain a mechanical advantage.

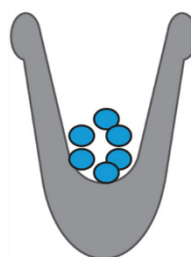
Make sure that the Flexible Steel Wire Rope (FSWR) sits neatly in the base of the sheave groove. The amount of FSWR sitting in the groove should be either one third ( $\frac{1}{3}$ ),  $120^\circ$  or as per manufacturer's specifications.

The groove depth of a sheave should not be less than 1.5 times the diameter of the FSWR (or in accordance with manufacturer's specifications).

If the grooves are too large then the rope will be flattened and deformed. If the grooves are too small the rope will be pinched and abraded. Any damage to the FSWR may lead to its failure.



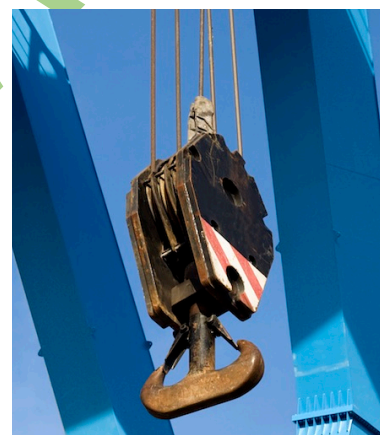
Groove too large.  
Flattens and  
deforms the FSWR.



Groove too small.  
Pinches and  
abrades the FSWR.

Inspect the sheaves for damage or excessive wear. Defects that would make a sheave unusable include:

- ◆ Sheave is twisted or deformed out of shape.
- ◆ Excessive wear in the groove.
- ◆ Damage (e.g. cracks) in the flange.
- ◆ Worn sheave or hinge pins.
- ◆ Damage to the cheek plates or the cheek plate wall/partition is too far or too close from the sheave.



### 2.3.1.7 Check the Crane Logbook

The crane logbook is used to record information about the crane operation, servicing and repairs, the daily safety checks that are completed and to report defects and whether the defects have been rectified.

The crane logbook may also be called the:

- ◆ Service book or service logbook.
- ◆ Logbook.
- ◆ History record.



You should check the logbook to make sure:

- It is applicable to the crane.
- The crane owner is recorded.
- Previous daily safety checks have been carried out and recorded.
- There are not any reported defects that haven't been fixed (rectified).
- All repairs and defect rectifications are recorded.

All defects must be recorded in the crane logbook, along with any action taken to return the crane to service.

As the crane operator you must record all crane defects in the logbook (crane operator's logbook) and according to any other workplace procedures.

Do not start up the crane if previously reported defects have not been fixed.

### 3.3 Operate the Bridge and Gantry Crane

Once you are satisfied that the load is ready to be moved safely you can begin lifting operations.

If new or unforeseen hazards appear while operations are being carried out you will need to stop and control them before carrying on with your work.



Follow all appropriate procedures and standards when transferring loads. Make sure all crane movements are controlled and smooth. Quick or jerky movements may cause the load to swing.

Always operate the bridge and gantry crane according to the procedures set out by the manufacturer. Following the manufacturer's specifications will help ensure that the crane is not overloaded or operated in a way that is unsafe.

Do not operate the crane beyond the limits set down in the manufacturer's specifications.

## 3.5 Conclude Operations



Once the job has been completed you will need to conclude operations in accordance with site procedures and manufacturer's specifications. Generally this will involve:

- ◆ Parking the crane.
- ◆ Stowing the crane and equipment.
- ◆ Shutting down and securing the crane.

Do not leave the crane controls until you have taken the following precautions:

- ◆ Made sure the crane is not still carrying a load.
- ◆ Raised the crane hook to a safe height.
- ◆ All relevant motion locks and brakes have been applied.
- ◆ Shut down the crane according to the manufacturer's specifications.
- ◆ Secured the crane against unauthorised use or access.

If you are going to leave a bridge and gantry crane unattended overnight you will need to:

- ◆ Remove the load and all lifting equipment.
- ◆ Raise the hook to a safe height.
- ◆ Restrict access to the crane.

## 3.6 Conduct Post-Operational Checks

After completing all shutdown procedures it is important that all post-operational checks are completed.

Carry out all post-operational checks according to the manufacturer's instructions and relevant site procedures.

A routine post-operational check of a bridge and gantry crane may involve:

- ◆ Checking for any crane damage including:
  - ◆ Structural damage.
  - ◆ Signs of obvious damage to the crane.
- ◆ Checking all fluid levels and for any signs of leaks.
- ◆ Making sure loose items are stowed or secured.
- ◆ Using load restraints if and when necessary.
- ◆ Checking that the hook/lifting assembly has been raised clear of obstructions.
- ◆ Any applicable controllers are in neutral.
- ◆ Any other checks as specified in the manufacturer's instructions.
- ◆ Removing any hazard controls (if any are still in place and if required).

Refer to the service logbook or inspection checklist for a list of items that should be checked on the crane.

Always inspect the crane after you have finished operations so that you can check it for any damage or defects that may have occurred during use.

### 3.6.1 Remove Hazard Control Measures

Any hazard control measures that are no longer required should be removed from the work area (e.g. removal of temporary fences/barricades or signage).

### 3.6.2 Record and Report Damage and Defects

Record and report any faults that you find during the post-operational checks for corrective action, or according to workplace procedures. Generally, this will involve:

- ◆ Isolating the crane or faulty equipment and attaching a danger tag to it.
- ◆ Recording the fault as per site procedures (e.g. in the crane logbook or service logbook).
- ◆ Reporting the fault to an authorised person for corrective action.



### 3.6.3 Completing Records

All information related to crane operations should be accurately recorded in the appropriate documents.

Records may include:

- ◆ Work Method Statements (WMS).
- ◆ Logbooks.
- ◆ Inspection checklists.
- ◆ Maintenance records.
- ◆ Hazard reports.
- ◆ Supply and delivery documents.
- ◆ Permits.

Use the approved forms and documents for the workplace and make sure the required documents are completed correctly and on time.

Use clear and concise language so that they can be easily understood. Avoid unnecessary repetition and overly technical terminology. Inaccurate, missing or misleading information can cause delays, hazards or legal issues.

Make sure records are passed on to the appropriate person or filed as required.