

# Code of Practice on Safe Lifting Operations in the Workplaces





# Preface

As Singapore enhances the importance of Workplace Safety and Health (WSH), the management of lifting activities has been identified as a high risk operation which requires proper planning and execution. This Code of Practice (CP) has been developed to provide guidance on how to conduct such lifting operations safely. It highlights factors that need to be considered during the planning and execution of the operation, and introduces the Lifting Plan as a systematic approach towards planning a lift. The CP also outlines the roles and responsibilities of those who are involved in a lifting operation.

This CP is aimed at practitioners who are involved in lifting operations, particularly those who plan these operations and the supervisors of the personnel in the lifting team.

This CP was produced after extensive analysis of current practice in Singapore. Assembled by specialists in the field, the CP is intended to provide examples of good practices. It is not meant to be prescriptive or imply that there is only one way of doing the task, nor it is intended to replace or take precedence over recommendations, policies and procedures judged as safe as or safer than those given herein.

Individuals and companies shall use the CP as the preferred standard and that they shall continue to find ways to exceed and improve upon the practices detailed within.

There are many modes and methods of conducting a lifting operation. This CP is not intended to cover in detail, but provide guidance on the minimum expectations required during the planning and implementation of a lifting operation. The same principles can be applied to a large 500 tonne or a smaller lifting device. While this CP recognises that companies have adopted their in-house operational procedures, this CP has been developed to provide guidance in conducting safe lifting operations with a foundation in operational expectations and requirements.

Note 1: This CP replaces the Technical Advisory for Safe Operation of Lifting Equipment published by the WSH Council in May 2009.

Note 2: This revision incorporates amendments to Section 3 by moving some of the contents to Section 7. This includes information on the ownership, usage, development considerations and factors that affect the Lifting Plan.

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# 1. Introduction

## 1.1 Scope

**1.1.1** This Code of Practice (CP) shall apply to all work activities involving lifting equipment such as mobile, crawler, tower, overhead travelling, portal, jib cranes and lorry crane/ loader, etc (excluding specialised lifting operations on floating docks and barges).

**1.1.2** This CP provides guidance on safe lifting practices for personnel who are involved in the planning and execution of lifting operations. Specifically, it provides guidance on the following:

- identification of operational factors that may affect safe lifting operations; and
- development of a Lifting Plan to better manage safe lifting operations.

## 1.2 Purpose

**1.2.1** Lifting operation is an integral part of any construction, ship-building, ship-repairing or manufacturing process. Every lift carries a set of risks that needs to be managed in order to prevent an accident from occurring. Unsafe lifting operations can result in catastrophic outcomes involving multiple fatalities and serious injuries as well as extensive damage to properties and facilities.

**1.2.2** This CP has been prepared based on the collective experience from past accidents and good practices in safe lifting operation. It provides guidance for the practitioner in the planning and execution of a lifting operation. This CP is not intended to provide technical details on any specific lifting equipment; hence it is recommended to consult the manufacturer or supplier when more technical details are required.

## 1.3 Regulatory Requirements

**1.3.1** The WSH Act imposes a duty on occupiers and employers to take reasonably practicable measures to ensure the safety and health of persons at work. In addition, the Act imposes duties on suppliers and erectors of equipment such as cranes to ensure that the equipment are safe when used properly. The imposition of such duties is in addition to the more prescriptive requirements that can be found in the subsidiary legislation such as the WSH (Construction) Regulations, WSH (Shipbuilding and Ship-repairing) Regulations as well as the WSH (Operation of Cranes) Regulations.

**1.3.2** This CP is developed to help stakeholders fulfil their statutory obligations under the Act so as to achieve a higher objective of ensuring a safe lifting operation. It complements the existing Singapore Standards and Code of Practices that have been developed on safe use of lifting equipment.

# 2. Factors Affecting Safe Lifting Operations

## 2.1 General

**2.1.1** There are many factors that can affect a lifting operation and it is important that personnel involved in lifting operations are aware of such factors. Broadly, they can be classified as:

- Machine: Selection of appropriate lifting equipment for the job as well as the integrity of the equipment to perform the job;
- Material: Load that is intended to be lifted;
- Medium: Environment in which the lifting operation is to be carried out and includes the setting up and stability of the equipment;
- Man: Competency, roles and responsibilities of personnel involved in the lifting operation; and
- Method: Planning and procedures to be adopted for the lifting operation.

### Routine versus Non-routine Lifts

- A lift can be categorised as a routine lift if it is repetitive in nature and involves loads that are similar in shape, size and weight, i.e., multiple lifts of similar items. The underlying principle is that the risks involved in a routine lift are already known and mitigated.
- A non-routine lift refers to lifting operation that is complex, carried out for the first time or lifting close to the lifting capacity of the crane. For example, a tandem “tilt-up” operation (i.e., lifting using two or more cranes to tilt a long structure from horizontal position to vertical) is a complex non-routine lift. It will require a detailed risk assessment and engineering method before the lift is carried out. Specific control measures to mitigate the risks involved in such a complex operation will need to be put in place. For example, in order to address the risk of a long structure buckling during a tilt-up operation, the numbers and location of lifting lugs will need to be considered in the design and built into the structure to be lifted. In short, a non-routine lift will require extensive planning.
- Notwithstanding the above, it is a misperception to assume that as long as the weight of the load is below a certain tonnage, it can be classified as a routine lift and therefore require less planning or supervision.
- Based on past experiences, most crane accidents happened during a routine lift rather than a non-routine lift. Hence, any lifting operation whether routine or non-routine requires the same level of safety considerations.

**2.1.2** The following paragraphs outline the factors in greater detail and identify areas that must be considered before any lifting operation is carried out. It is important to note that the following areas are by no means exhaustive. Where more details are needed, users are advised to refer to the operating or maintenance manuals, or the supplier/ manufacturer of the equipment.

## 2.2 Machine

### 2.2.1 Sizing of the lifting equipment

**2.2.1.1** One of the most critical factors in planning a lifting operation is to ensure that lifting equipment selected for the job has sufficient lifting capacity and reach to handle the intended load. In the case of a tower, mobile, crawler or lorry crane, the lifting capacity is dependent on the load radius of the crane boom. Hence, it is important in the selection of the crane that the distance from the load to the crane is known. The loading and unloading points within the worksite must be carefully considered in relation to the location of the crane. For lifting operations involving multiple loads of different shapes and sizes, the capacity of the crane shall be selected based on the weight of the heaviest load to prevent overloading.

### 2.2.2 Maintenance of the lifting equipment

**2.2.2.1** Another important aspect is the maintenance of the lifting equipment to ensure its structural integrity. Based on past incidents, attention needs to be focused on the following critical load bearing parts.

- **Wire ropes**

There are many types of wire ropes for different usages and therefore, the correct type must be selected for the equipment. The wire ropes must be properly maintained to prevent the ropes from snapping during operation.

- **Braking mechanism**

The ability of the lifting equipment to lift or suspend a load is dependent on the brakes connected to the hoisting mechanism. Any failure in the brakes will result in an unintended free-fall of the suspended load.

- **Safety devices**

Most lifting equipment are equipped with safety devices such as limit switches or sensors. The safety devices will stop or prevent the lifting equipment from entering into an unsafe mode of operation. For example, an anti two-blocking device on a crawler crane prevents the hook block assembly from coming into contact with the boom sheave assembly. It is therefore critical to ensure that such safety devices are functioning properly. They shall never be by-passed during a normal operation.

**2.2.2.2** Further explanation is provided in Section 4 of this CP.

## 2.3 Material

**2.3.1** There are key factors to consider in lifting a load.

### 2.3.2 Weight

**2.3.2.1** This is the most important parameter that must be determined to prevent overloading of the lifting equipment. When the load is part of an assembled item, the weight of each component can be determined from the engineering drawings. Other times, one must rely on the calculation of the density and volume of the load that is being carried such as the concrete or rebars. Special attention is essential when the load comprises different materials such as a rubbish bucket containing waste and debris. It is safer to be extra careful and estimate a heavier weight than assuming a lighter one.

### 2.3.3 Centre of gravity (CG)

**2.3.3.1** During lifting operation, it is critical to maintain the CG of the load directly beneath the load-line, i.e., the hook. Otherwise when the load is lifted, it will cause danger to anyone close-by to get hit by the swinging load. Depending on the shape and size of the load, the CG may or may not be obvious. If in doubt, it is advisable to consult an engineer.

### 2.3.4 Method of rigging

**2.3.4.1** There are different methods of rigging that are well established in the industry. The objective of the rigging method is to ensure that the load is stable throughout the lifting operation. For loose items such as bricks and bags of concrete, it is critical that they are secured using an appropriate receptacle such as safety nets or metal cage to avoid any accidental dislodgement in mid-air.

## 2.4 Medium

**2.4.1** Once the lifting equipment is selected and the load is determined, the planning must then focus on the environment in which the lifting equipment is operating in and how the lifting equipment is set up. Besides environmental weather conditions, every worksite will have to consider the specific localised hazards which have to be eliminated or mitigated to ensure a safe lifting operation. The following factors which must be considered in lifting a load are presented using an acronym **GOLDEN** for ease of reference.

### 2.4.2 Ground

**2.4.2.1** The stability of the lifting equipment is highly dependent on the ground condition of the location where the lifting equipment will be set up. Special care must be taken to ensure that the ground is level and has sufficient bearing capacity. Cranes that are equipped with outriggers shall be evenly and fully extended. In addition when using mobile or crawler cranes, it is recommended that steel plates with adequate strength and size are used to provide a firm ground support for the crane outriggers in order to prevent any crane toppling incidents.

### 2.4.3 Obstacles

**2.4.3.1** Any fixed or temporary installations such as buildings, MRT tracks, overhead power lines, bridges or underground utilities/ pipelines that are within the proximity of the operation zone are considered as obstacles during a lifting operation. There is a risk of the lifting equipment or load coming into contact with the installations which can result in an accidental dislodgement of the load. Such obstacles can also refer to blind spots or entrapment points during manoeuvring of the load or lifting equipment, especially in congested areas.

### 2.4.4 Lighting condition

**2.4.4.1** Adequate lighting particularly during a night operation is very crucial. Depending on the lift, the operator, rigger or signaller will need to see the suspended load clearly in order to guide it to its safe destination.

### 2.4.5 Demarcation

**2.4.5.1** The zone of operation shall be clearly demarcated to inform and prevent persons who are not involved in the lifting operation from entering into the zone unintentionally. In areas where tower, dockside and overhead travelling cranes are continuously in operation and span a wide area, it is important to designate the affected zone of operation. In addition to that, other measures shall also be taken to prevent any person from walking under the suspended load. Such measures include deployment of more signallers to guide the load or installing audible alarm to warn workers about the on-going lifting operation.

### 2.4.6 Environment

**2.4.6.1** Weather conditions such as heavy rain, haze or glaze will impact the visibility of the lifting crew. Other weather conditions that can impact the stability and safety of the lifting operations include strong winds, thunderstorms or lightning situation. It is also important to remember that wind speed is stronger at higher ground. During the planning of any lifting operation, the anticipated wind speed at the site must be taken into consideration and refer to the crane manufacturer operation manual for the wind speed limit. It is advisable to stop all lifting operations when the weather condition deteriorates.

## 2.5 Man

**2.5.1** It is important that every single member of the lifting crew (operator, rigger, signaller and lifting supervisor) is adequately trained and competent to carry out his duties properly. They must also be fully conversant with the actual lifting procedures applicable to the lifting operation and not just the generic procedures. Here are factors that shall be considered.

## **2.5.2 Fit for duty**

**2.5.2.1** Besides the prerequisite for competency (i.e., ability to read load capacity charts), the fitness of the personnel, preexisting medical conditions or number of working hours that can adversely affect his ability to discharge his duties must also be considered.

## **2.5.3 Roles and responsibilities**

**2.5.3.1** The roles and responsibilities of each individual involved in the lifting operations must be clear. There must be proper leadership within the lifting crew so that instructions are relayed appropriately. In addition, all personnel shall be empowered to stop work if the operation is or has become unsafe.

## **2.5.4 Communications**

**2.5.4.1** Providing communication devices such as radio walkie-talkie or application of standard crane hand signals will ensure there is a common understanding between members of the lifting crew. Employers must take into consideration the local workforce which comprises workers from various countries with different languages when forming the lifting crew.

**2.5.5** Further explanation is provided in Section 5 of this CP.

## **2.6 Method**

**2.6.1** Most general type of lifting operations rely on established procedures after determining factors such as Machine, Medium and Man as discussed earlier. These types of lifts are categorised as routine lifting operations. Whether the lift is routine or not, there are other important factors in the life-cycle of a lifting operation that needs to be considered.

### **2.6.2 Knowing the weight of the load and the load radius**

**2.6.2.1** If the weight of the load is unknown, the general rule of thumb is not to lift the load as it could lead to overloading and toppling of the lifting equipment.

### **2.6.3 Securing the load using appropriate lifting gears such as slings, nets or receptacles**

**2.6.3.1** If the load is not properly rigged or loose, there is a risk that the load will be dislodged and dropped while being transferred from one location to another.

### **2.6.4 Conducting a test lift to ensure stability and no overloading**

**2.6.4.1** A test lift is simply lifting the load just slightly off the ground and stopping to observe for any abnormalities. This is a critical discipline that all operators must abide by.

### **2.6.5 Maintaining the centre of gravity (CG) of the load directly beneath the load-line i.e., the hook**

**2.6.5.1** If the CG is not directly beneath the load-line, the load will swing when it is lifted off the ground. In addition, it is dangerous and will destabilise the crane if the load is being pulled or dragged.

### **2.6.6 Stability of the suspended load during movement/ slewing of the crane**

**2.6.6.1** While moving or slewing the crane, the load shall be prevented from jerking or swinging at all times.

### **2.6.7 Lowering / releasing of the suspended load**

**2.6.7.1** Towards the end of the lifting operation, the load must be placed on a stable ground. If the load is placed at a height, extra care must be taken to ensure there is no risk of the load falling off the edge. Often times, the load is lifted beyond the line of sight of the operator. Under such circumstances, the signalman and/ or lifting supervisor is responsible to ensure the stability of the suspended load.

It is important to note that no lifting equipment or lifting gear shall be loaded beyond its safe working load except by an authorised examiner or inspector for the purpose of testing such items.

# 3. Risk Assessment and Permit-To-Work for Lifting Operations

## 3.1 General

**3.1.1** Under the law, it is mandatory to conduct a risk assessment<sup>1</sup> on the safety and health risks posed to any person who may be affected by the lifting operation in the workplace. The contractor involved is also responsible to take all reasonably practicable steps to eliminate any foreseeable risk to any person. In addition, there are legislative requirements for lifting operations involving tower, mobile or crawler crane in any workplaces to implement a Permit-To-Work system in order to effectively control lifting operations.

## 3.2 Risk Assessments and Permit-To-Work

### 3.2.1 Risk Assessment

**3.2.1.1** By definition, Risk Assessment (RA) is the process of evaluating the probability and consequences of an injury or illness from exposure to an identified hazard and determining the appropriate measures for risk control. As such, there are three basic steps to RA.

#### 3.2.1.2 Step 1 - Hazard Identification

Identifying the hazards associated with each work activity and the type of potential accidents/ incidents that can result from the hazards is the first step to RA. Some of the hazards associated with lifting operations such as poorly maintained wire ropes have already been discussed in Section 2.

#### 3.2.1.3 Step 2 - Risk Evaluation

Risk evaluation is the process of estimating the severity of an injury or damage and the likelihood of the occurrence. For example, the risk level of workers working underneath a suspended pre-cast component shall be assessed as a high risk hazard as the consequences of the load dropping can result in killing the workers underneath.

#### 3.2.1.4 Step 3 - Risk Control

This is a critical last step as it identifies appropriate risk control measures to reduce the risk level to an acceptable level. Following from the previous example of a suspended pre-cast component, an appropriate risk control measure will be to prohibit workers from working directly underneath a suspended load. The lifting zone shall also be demarcated to prevent any unauthorised entry.

### 3.2.2 Permit-To-Work

**3.2.2.1** A Permit-To-Work System (PTW) is a formalised system of controlling certain types of hazardous work (lifting operations included). A proper PTW involves the contractor applying for permission to carry out a certain work activity. In the application, he is required to state the scope and conditions in which the work will be carried out. An independent inspection is then conducted on-site to verify that appropriate control measures have been taken to mitigate any foreseeable risks. After confirming that the measures have been taken, the application will be approved by an authorised person (i.e., the project manager). The authorised person shall have an oversight on the entire work process so as to avoid any conflicting or incompatible work that is carried out at the same time. The work can commence only after the permit has been approved.

<sup>1</sup>Workplace Safety and Health (Risk Management) Regulations 2006

### 3.3 Changes to Risk Assessment and Permit-To-Work

3.3.1 As the RA and PTW are developed based on a pre-determined set of parameters and considerations, any significant changes shall result in a temporary stoppage of the lifting operation and a review of the RA and PTW. The following scenarios shall result in a review of the RA and PTW.

- Changes to the type and capacity of lifting equipment used.
- Changes to the sequence of operations.
- Changes requiring reconfiguration of the crane (boom/ jib length, outrigger beam length reduction, parts of hoist line, etc).
- Changes in the rigging details which could result in a reduction in rigging strength or significant increase in rigging weight.
- Changes in surrounding environment such as sudden presence of a temporary structure obstructing the operation.
- Changes in the weather and environmental conditions which have an adverse impact to the lifting operation.
- Changes to safety-critical personnel.

# 4. Equipment

## 4.1 General

**4.1.1** This section provides guidance for the selection, maintenance and other aspect of the lifting equipment.

## 4.2 Selection of Equipment

**4.2.1** An equipment assessment must be completed as part of the RA. The objective of the equipment assessment is to identify the hazards and assess the risks associated with the equipment for the foreseeable range of lifting operations. For example, the applications, loads and configurations of the equipment that will be used. Based on this assessment, the appropriate lifting equipment for the lifting operation may then be selected.

**4.2.2** The equipment assessment shall consider, but not necessarily be limited to the following.

- Is the equipment designed for the intended type of lifting operation?
- What is the age of the lifting equipment?
- Was there any authorised modifications made to the equipment?
- What are the dismantling and assembly process?
- How are components of the lifting equipment transported to site for assembly?
- What type of pre-erection examination or Non-Destructive Testing (NDT) is required?
- How is the lifting equipment controlled e.g., via pendant or within the operator cabin?
- What are the access and egress for the operator to reach the cabin?
- What are the dismantling and storage requirements?
- What transportation methods to use for continued integrity?

**4.2.3** Owners of lifting equipment must not install additional components that may affect the structural integrity of the lifting equipment e.g., adding counterweights beyond what is specified in the manual. In general, structural modification of a lifting equipment shall not be undertaken except by a competent party. If the lifting equipment has to be modified, a detailed engineering design must be undertaken in consultation with the manufacturer or a professional body. The design must take into account prevailing design codes, standards and practices as well as compliance with all applicable regulations.

## 4.3 Equipment Positioning and Installation

**4.3.1** For the purpose of this CP, the term 'positioning' refers to mobile equipment being set up in a particular location to carry out lifting operations. The term 'installation' refers to the assembling of lifting equipment at the selected location.

**4.3.2** A process shall be established to ensure that the contractor reviews the positioning/ installation of the lifting equipment to eliminate or mitigate the risks. All hazards identified in relation to the position/ installation of the equipment shall be addressed in the RA and Lifting Plan. Lifting equipment must be positioned or installed in order to:

- eliminate or reduce the risks to public or buildings in the immediate vicinity of the lifting operation;
- avoid having the load being manoeuvred over people;
- avoid striking, trapping or crushing persons;
- avoid striking any other structures such as buildings;

- ensure that entrance and exit paths of existing passageways are not compromised by risks arising from the lifting operations;
- avoid collision with other lifting equipment being used simultaneously; and
- provide suitable gates/ barriers to prevent inappropriate/ unsafe access to any hoist area.

**4.3.3** The above list is not exhaustive. Any lifting equipment must be positioned or installed such that the risks of injuring people or damaging assets are minimised during a lifting operation.

**4.3.4** In general, whenever lifting equipment are disassembled and reassembled, they shall be subjected to a thorough re-inspection and load tested as per legal requirements by an Authorised Examiner. This is to ensure the integrity and stability of the equipment during the reassembly process.

## **4.4 Identification of Lifting Equipment**

**4.4.1** Every lifting equipment and its component parts shall be identified with a visible marking including the safe working load (SWL). The markings serve the following purposes.

- Communicate clearly the maximum SWL of the equipment.
- Communicate clearly the maximum number of persons it can carry if it is used for lifting people.
- Facilitate the identification of the equipment and its component including whether it is genuine and compatible with the equipment.

**4.4.2** Where practicable, the SWL shall be marked on the equipment prominently. However where this is not possible (i.e., a small lifting gear), a coding system can be used to provide the user with the required information. Examples of such systems include colour coding or attaching some form of label.

**4.4.3** Where a number of lifting accessories are assembled to form a single lifting equipment which is not dismantled after use, the assembly shall be marked to indicate its safety characteristics to users.

**4.4.4** Where there are other characteristics which may cause a lifting accessory to become unsuitable for use in a particular application, this information shall be marked or otherwise made available to the user.

## **4.5 Lifting Equipment with Variable Safe Working Load**

**4.5.1** Some lifting equipment are designed to operate with variable SWL. Examples of such lifting equipment include mobile crane equipped with a telescopic jib that can be raised or lowered. Tower cranes are also designed to have variable SWL. In principle, the closer the load is to the body of the crane, the higher will be the SWL of the equipment.

**4.5.2** For such lifting equipment, besides the mandatory load capacity chart, they must be equipped with a load radius indicator to indicate to the operator the SWL of the crane at that configuration (load radius). It shall also provide a visual and audible warning to the operator if the load lifted is close to the SWL. Consequently, due to the variable SWL, the crane operator must exercise extreme care whenever he lowers the jib or telescope the boom outwards with a load. This will lead to a reduction of the SWL and will result in crane overloading.

**4.5.3** For lorry cranes, if the load radius indicator is not feasible, it must be equipped with fully hydraulic protection valves and pressure relief system to prevent crane overloading.

**4.5.4** Some modern cranes are designed such that a different load capacity chart will apply depending on whether the outriggers are fully or partially extended. Under such circumstances, the operator must be fully aware of the configurations and make the necessary adjustment to the parameter settings of the indicator. Information on how changes to the configuration can affect the SWL must be provided in the operator's cabin. The information shall be placed in the operator's cabin and not in the office as it needs to be easily retrieved by the operator while carrying out a lifting operation.

## 4.6 Pre-use Checks

**4.6.1** Prior to use, the operators of lifting equipment and accessories shall perform a pre-use check in order to identify any faults in the equipment. This shall be a daily check at the start of each shift. This daily inspection is not intended to replace the periodic preventive maintenance checks by the mechanics. Sample checklists for various cranes are provided in Appendix 2, 3, 4 and 5 for reference.

### Useful tools

As it is insufficient to solely rely on the crane electronic system, it is recommended that all mobile and crawler cranes be equipped with the following tools to allow the lifting team to use them during crane setup/ or pre-use checks:

- **Measuring tape**  
As the crane's rated capacity depends on the radius of the load which is the distance between the load to the crane, the simplest and most accurate means of determining a radius is a tape measure. Without a tape measure, a crane operator is forced to guess the lifting radius or use a less accurate boom angle determination to verify the crane's capacity.
- **Calculator**  
The mathematics necessary to determine if a crane will be lifting 78% or 91% of its rating chart for a specific lift can be a challenging problem for many crane operators. A calculator circumvents this problem allowing the operator to focus on the details of the lifting rather than arithmetical errors.
- **Spirit level gauge**  
One cannot just rely on the spirit level gauge that is provided with the crane. At times, it may not even be accurate when the crane set up is level. The additional portable spirit level gauge that can be purchased from a do-it-yourself (DIY) shop will give additional verification and ensure level of balance from front and rear of crane.
- **Calliper**  
The crane operator uses the calliper to do daily crane checks to ensure that the crane wire rope provided is according to crane manufacturer specification. The checks include whether the wire rope has a reduction in diameter that can be caused by abrasion, corrosion or a local failure of the rope core due to its prolonged use.

# 5. Personnel Roles and Responsibilities

## 5.1 General

5.1.1 This section outlines the responsibilities of all personnel and entities that are involved in a lifting operation.

## 5.2 Contractor

5.2.1 The overall responsibility to ensure the lifting operation is carried out safely and in accordance with legislative requirements rests with the contractor undertaking the lifting operation. The contractor (termed as a “responsible person” in the WSH (Operation of Cranes) Regulations) could be the employer or the principal of the operator under whose direction he operates the crane. The contractor shall:

- ensure a safe system of work is implemented, all foreseeable risks are identified and control measures are implemented to eliminate or mitigate the risks through the implementation of a Lifting Plan and PTW system;
- ensure that the worksite is physically safe for the lifting operation e.g., there is no physical obstruction in the path of the load;
- ensure that the lifting equipment to be used is properly maintained and certified in accordance with legislative requirements;
- ensure that the lifting operation has the necessary resources to carry out the lift safely e.g., receptacle for lifting loose items;
- ensure that personnel deployed as part of the lifting team are suitably trained, competent and certified, and that they have been briefed on the lifting operation;
- ensure that only competent sub-contractors are used; and
- ensure that all accidents, near misses, equipment failure or damage are reported and recorded.

5.2.2 The contractor may appoint a competent person such as a WSH Officer to assist in the identification of any hazards related to the lifting operation and recommend suitable actions to eliminate/ mitigate the risk.

## 5.3 Lifting Team

### 5.3.1 Selection of Lifting Team

5.3.1.1 The Lifting Team refers to a group of personnel that are appointed to be directly involved in a lifting operation. For simple routine lifts, it typically includes the site supervisor, lifting supervisor, crane operator, riggers and signalmen. For more complex lifting operations, it shall include other personnel such as the appointed person who had planned for the lift, banksmen who will serve to coordinate other equipment or personnel movement near the zone of operation. Key factors to consider in selecting a Lifting Team include:

- **Competency**

Only suitably trained and competent personnel shall be deployed as part of the Lifting Team. During the lifting operation, if any personnel in the team is not confident of carrying out the lift e.g., rigger may be unsure on how to rig up the odd-shaped item with the limited lifting gears that he has, he must stop the operation and request for assistance.

- **Composition**

It is good practice to try to maintain the same group of individuals in a Lifting Team so that the trust and rapport among team members can be built up over time. Trust becomes very important when the operator does not have a line of sight to the load and has to rely on the instructions that he received from his teammates. There are many things that can go wrong in a lifting operation hence it is important that the Lifting Team is familiar with one another. This is especially critical in an emergency situation. Care shall be taken to ensure that new members to a lifting team are appropriately inducted and briefed on the procedures. To facilitate identification, members of the Lifting Team shall be clearly identifiable by use of reflective vest or other conspicuous clothing or marking.

- **Communication**

The Lifting Team must use a common language that all members can understand. Any miscommunications can result in accidents. Hence care shall be taken when forming a Lifting Team involving individuals from different countries and nationalities. Although it is important that the Lifting Team adopts the standard crane hand/ voice signals to facilitate the lifting operation, it is not possible to use crane hand signals when the operation involves lifting an item from the ground to the rooftop of a tall building.

### **5.3.2 Lifting Supervisor**

**5.3.2.1** The lifting supervisor shall be appointed in writing by the contractor. This position is defined as the person who is in-charge with actively supervising the lifting operation on site. The person could be a foreman, shift supervisor or other similar capacity. The appointed lifting supervisor shall be attired in such a way that he/ she will be distinctively identified as the lifting supervisor.

**5.3.2.2** In general, all lifting operation must be supervised by the appointed lifting supervisor as he is the main person leading and coordinating the operation. A lifting supervisor may be allowed to supervise more than one lifting operation at any point in time provided that he is able to discharge his duties appropriately e.g., when the two operations are side by side within close proximity. If so requested by the contractor, the lifting supervisor shall assist to develop the Lifting Plan and seek approval from the contractor's management.

**5.3.2.3** Thereafter, the appointed lifting supervisor shall:

- coordinate all lifting activities in accordance with the Lifting Plan;
- brief all lifting team members on the Lifting Plan, safe lifting procedure and RA;
- ensure that only registered crane operators, appointed riggers and appointed signalmen participate in any lifting operation involving the use of mobile and tower cranes;
- ensure that the ground conditions are safe for any lifting operation to be performed;
- be present during all lifting operations to ensure that the lift is carried out in accordance with the lifting plan;
- keep within his/her sight and view of all the lifting operations; and
- take suitable measures to rectify unsafe conditions so that the lifting operation can be conducted safely.

### **5.3.3 Lifting Equipment Operator**

**5.3.3.1** There are different types of lifting equipment and the operator is one of the most important personnel of the Lifting Team as he is in-charge of the lifting equipment. One of the key competencies of the crane operator of mobile, crawler or tower cranes is the ability to read and understand the load capacity chart, and to differentiate the Gross Capacity and Net Capacity of the lift. The operator needs to know the SWL of the crane relative to the radius in order to prevent overloading of the crane.

**5.3.3.2** The appointed lifting equipment operator shall:

- carry out the lifting operation in accordance with the Lifting Plan;
- inspect the lifting equipment prior to use to check for abnormalities;
- check that load radius indicator and other safety devices are functioning properly;
- ensure that the ground is stable and the surrounding is free from any structures or materials that may obstruct the lifting operation;
- carry out lifting operation only when a lifting supervisor is present on site;
- disengage from any manoeuvre that is dangerous;
- monitor environmental effects such as thunderstorm and strong wind that will affect the safe operations of the lift;
- report any defects immediately to the lifting supervisor, and record such defects in maintenance log records;
- stop the lift whenever unsafe conditions occur; and
- check the crane wire rope to ensure it is still within safe use.

### **5.3.4 Signalmen**

**5.3.4.1** The appointed signalmen shall be attired in such a way that he/ she will be distinctively identified as the signalman.

#### **5.3.4.2** The appointed signalmen shall:

- ensure the load is correctly rigged up prior to giving signals to commence the lift;
- give correct and clear signals to the lifting equipment operator to manoeuvre the load safely from the point of lift to the destination;
- ensure communication is maintained with the lifting equipment operator throughout the lift in accordance with the lifting plan;
- ensure the lift is controlled throughout the duration of the operation;
- ensure that the immediate areas within the lift (start point and final position) are clear of any hazards during the manoeuvre;
- maintain his/ her position so as to ensure line of sight during the controlled phase of the lift and to ensure this position is free of danger; and
- refrain from handling load/ rigging simultaneously when giving signal to the crane operator.

#### **5.3.5 Riggers**

**5.3.5.1** The appointed rigger shall be attired in such a way that he/ she will be distinctively identified as the rigger.

**5.3.5.2** The appointed riggers shall:

- ensure all slings, webbings, shackles and other lifting gears used to rig the load are within the SWL of the lift, in good condition and duly certified;
- ensure that the load is rigged up in a such a manner that it is stable, balanced (centre of gravity beneath the hook) and secured (i.e., no loose items);
- ensure that the lifting equipment operator has been informed of the weight of the load;
- establish tag lines to control the load as it is being manoeuvred; and
- report any defect in the lifting/ rigging and materials to the lifting supervisor.

### **5.4 Erection and Maintenance of Lifting Equipment**

**5.4.1** The integrity of the lifting equipment to perform its task is highly dependent on how well it is being erected and maintained. Therefore, it is important that the contractor appoints qualified and experienced mechanics to carry out the erection and maintenance of the lifting equipment, particularly if such activities are to be conducted in-house.

#### **5.4.2 Adherence to manufacturer's specification**

**5.4.2.1** It is critical that the lifting equipment is erected, altered or maintained in accordance with the manufacturer's specification as laid out in the operational and maintenance manual. This includes using all genuine components. As with all machines to ensure that it can function properly, the lifting equipment is subject to periodic preventive maintenance (i.e., daily, monthly or quarterly). It is essential that adequate downtime is built into the operation schedule to allow effective maintenance to be carried out and to ensure that maintenance personnel are not under pressure to complete the work.

#### **5.4.3 Competency of mechanics/ erectors**

**5.4.3.1** Such personnel shall be provided with training relevant to the type of lifting equipment that they are handling (preferably by the manufacturer or their agents).

#### **5.4.4 Record keeping**

**5.4.4.1** A record of all preventive or corrective maintenance shall be kept. This includes records of all testing and certification. Any defects reported shall also be recorded into the log book.

**5.4.4.2** For erection, alteration of mobile or tower cranes, only Approved Crane Contractors can undertake such activities.

# 6. Emergency and Contingency Planning

## 6.1 General

- 6.1.1** All lifting operations shall have a documented Emergency Response Procedure (ERP) that covers all aspects of the operations. The ERP identifies the requirements and actions to be carried out for any foreseeable emergency (with or without any casualty) in a clear and precise manner. These include:
- toppling of the lifting equipment;
  - structural failure of the lifting equipment such as boom fracture;
  - dislodgement of the suspended load;
  - entanglement of load with nearby structures; and
  - recovery of injured personnel in locations where access is limited such as within a tower crane.
- 6.1.2** The ERP must include the emergency contact details of relevant persons and agencies. The contingency procedure shall outline all possible emergency situations and identify the recovery actions to be taken if they occur.
- 6.1.3** The documented procedures shall be tested by conducting ERP drills involving all lifting operation personnel. Such ERP drills must be documented and recorded as part of the safe system for work. The drills may be conducted as a desk top review which includes all relevant personnel in the table top exercise. However, a physical exercise and drill shall be carried out whenever possible.

## 6.2 Emergency Response Procedures

- 6.2.1** The contractor shall develop and document an ERP for the lifting operation. This ERP must be communicated to all personnel involved in the lift and made available at prominent locations at the workplace. The ERP shall include but not be limited to:
- details of emergency personnel and their contacts including first-aiders;
  - emergency communication flowchart;
  - roles and responsibilities of the emergency management team;
  - emergency services contact details;
  - managing injured persons; and
  - frequency of exercise and drill to be carried out.
- 6.2.2** Lifting operations may be carried out from the ground level or at a high point such as on the top of a multi-storey building or in confined areas such as in a tunnel or factory. Each location provides specific challenges for the provision of medical and evacuation support. As such, the ERP shall as much as possible identify access to the location so as to facilitate expeditious medical and evacuation support.

# 7. Lifting Plan

## 7.1 General

The Lifting Plan is a set of plans which is created for use in any crane lifting operation. All lifting operations shall be accompanied by a lifting plan supported by a risk assessment, a safe work procedure and/or method statement, and PTW. Frequent or routine lifting operations may only require a basic lifting plan (Appendix 1) supported by an on-site risk assessment and briefing to related personnel. High risk or complex lifts however, requires additional engineering design efforts to ensure that the lifting is conducted safely.

## 7.2 Importance of Lifting Plan

The lifting plan aims to facilitate consensus amongst all stakeholders including the lifting crew for a safe outcome. The lifting plan encapsulates all the important information that must be considered in a lifting operation thus ensuring that the lifting operation is carried out safely.

## 7.3 Ownership and Usage of the Lifting Plan

**7.3.1** Every member of the Lifting Crew shall be familiar with the Lifting Plan and ensure that the operation is carried out according to the plan. The Lifting Supervisor must take ownership of the lifting plan and make it available to other members of the Lifting Crew. This is to allow common understanding amongst the lifting crew for a safe outcome. The underlying principle is that all foreseeable risks had been assessed and eliminated or mitigated.

**7.3.2** The lifting plan can be developed by persons who have the expertise and relevant knowledge of the intended lift. After which, the team involved has to sign and agree upon the developed lifting plan.

## 7.4 Elements of a Lifting Plan

The lifting plan shall include but not be limited to the following considerations:

- The personnel required
- The personnel's roles, responsibilities and competencies
- Compliance to statutory requirements and manufacturer's operation manual for the lifting equipment
- Permit-to-Work system which is mandatory for all lifting operations.
- Nature and weight and dimension of load – including the NET and GROSS weights.
- Type and location of lifting / rigging points.
- Selection of appropriate lifting equipment, lifting gear and appliances.
- Application of the correct lifting methods
- Position of lifting equipment, personnel and of the load, before and after the lift operation.
- The work site operation including proximity of other lifting equipment and work activities.
- Requirements to erect / dismantle the lifting equipment.
- Assessment of the need for tagline to control movement of the suspended load.
- Means of communication during lifting operations.
- Environmental factors detrimental to the lifting operations such as ground conditions, adverse weather, wind, and poor illumination.
- Ensuring a system for reporting any defects is in place.
- Provision of a safe place of work for all personnel during lifting operations.

- The necessity to cordon off or not the area where lifting is being carried out and in particular where members of the public (anyone not concerned with the lifting operation) may be present.

## 7.5 Factors that Affect Lifting Plan

7.5.1 The factors which may affect lifting plan include:

- Load
- Rigging Methods
- Equipment
- Physical and Environmental Factors
- Means of communication
- Sequence/special precautions
- Sketch of zone of operation
- Personnel involved in the lifting operation

7.5.2 It is important to note that the factors above are not exhaustive and personnel involved in planning lifting operations must consider other factors that are specific to the situation, especially in complex lifting operations.

## 7.6 Harmonisation of the Lifting Plan vis-à-vis Risk Assessment and Permit-To-Work

7.6.1 A RA for lifting operation shall specify control measures such as appointment of competent personnel, usage of appropriately maintained lifting gears, demarcation of the lifting zone, and taking into account the physical environment. These factors are necessary and useful for the RA.

7.6.2 The Lifting Plan and the PTW are part of the Risk Control stage of the RA process. The purpose of a proper Lifting Plan/ PTW is to verify that the necessary control measures have been taken. They are complementary and shall not be seen as mere paper exercises.

7.6.3 If the sample of basic Lifting Plan/ PTW template recommended in Appendix 1 is used properly, it would meet the legislative requirements for basic Lifting Plan and PTW.

## 7.7 Changes to Lifting Plan

In any case where the actual information presented at the lifting site does not tally with or deviate from the Lifting Plan, any stakeholder in the Lifting Operation has the right to cease further progress of the Lifting Operation until the plan is reviewed according to the operation's requirements.

Never vary from the approved Lifting Plan without another full review and final approval by the responsible persons who approved the original Lifting Plan

# 8. References

## References

- Workplace Safety and Health Act (Cap.354A)
- Workplace Safety and Health (Risk Management) Regulations (Cap. 354A, Rg 8)
- Workplace Safety and Health (Incident Reporting) Regulations (Cap. 354A, Rg 3)
- Workplace Safety and Health (General Provisions) Regulations (Cap. 354A, Rg 1)
- Workplace Safety and Health (Operation of Cranes) Regulations 2011
- Workplace Safety and Health (Shipbuilding and Ship-repairing) Regulations 2008
- Workplace Safety and Health (Construction) Regulations 2007
- Code of Practice for Workplace Safety and Health (WSH) Risk Management, First revision 2012
- SS536 : 2008 Code of Practice for Safe Use of Mobile Cranes
- SS559 : 2010 Code of Practice for Safe Use of Tower Cranes
- CP 63 : 2005 Code of Practice for the Lifting of Persons in Work Platforms Suspended from Cranes
- SS 497 : 2011 Code of Practice for Design, Safe Use and Maintenance of Gantry, Overhead Travelling Cranes and Monorail Hoists
- CP 35 : 1996 The Selection, Care and Maintenance of Steel Wire Ropes for Hoisting
- SS 297 : 1996 Steel Wire Ropes for Hoisting
- SS 343-1 : 2001 Lifting Gears
- SS 343-2 : 1989 Hooks
- SS 343-3 : 1990 Shackles
- SS506 : Part 1 and 2 : 2009 Occupational Safety and Health (OSH) Management Systems
- SS531 : Part 1 : 2006, Part 2 : 2008 and Part 3 : 2008 Code of Practice for Lighting of Work Places
- Guidebook for Lifting Supervisors, First revision 2013
- Worker's Safety Handbook for Crane Operator, 2011
- Worker's Safety Handbook for Rigger and Signaller, 2011
- Worker's Safety Handbook for Lorry Crane Operator, 2012

# Appendix 1: Sample of Basic Lifting Plan / Permit-To-Work

## 1. General

Project			
Location of lifting operation			
Contractor carrying out the lifting operation		Date/ time of lifting operation	
		Validity period of lifting operation	

## 2. Details of the Load/s

Description of load/s			
Overall dimensions			
Weight of load	Kg / tonne	<input type="checkbox"/> Known weight	<input type="checkbox"/> Estimated weight
Centre of gravity	<input type="checkbox"/> Obvious	<input type="checkbox"/> Estimated	<input type="checkbox"/> Determined by drawing

## 3. Details of the Lifting Equipment/ Lifting Gears

Type of lifting equipment			
Maximum SWL as certified on the LM cert		Date of last certification	
Max boom / Jib length	m	Fly jib / offset	
Intended load radius	Distance between the load and the crane	SWL at this radius	
Type of lifting gears	Slings / webbing / chains / shackles / spreader beam / receptacle		
Combined weight of the lifting gears	Kg / tonne	Certification of lifting gears	<input type="checkbox"/> Yes
SWL of LG	Kg / tonne		<input type="checkbox"/> No

## 4. Means of Communications

Can the operator see the loading and unloading point for the load from his position?

Yes  No

What are the means of communication between the lifting crew?

Standard hand signals  Radio  Others \_\_\_\_\_

### 5. Personnel Involved In Lifting Operation

Position	Name	Qualification/ Experience
Site Supervisor		
Lifting Supervisor		
Crane Operator/ Lifting Equipment Operator		
Rigger		
Signalman		
Others (please state)		

### 6. Physical and Environmental Consideration (please include any details in the space provided)

Ground conditions	Is the ground made safe (e.g., placing steel plate)? _____	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Are the outriggers evenly extended? _____	<input type="checkbox"/> Yes <input type="checkbox"/> No
Obstacles	Are there any overhead obstacles such as power lines? _____	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Are there nearby buildings or structure, equipment or stacked materials that may obstruct lifting operation from being carried out safely? _____	<input type="checkbox"/> Yes <input type="checkbox"/> No
Lighting	Is the lighting condition adequate? _____	<input type="checkbox"/> Yes <input type="checkbox"/> No
Demarcation	Has the zone of operation been barricaded (with warning signs and barriers) to prevent unauthorised access? _____	<input type="checkbox"/> Yes <input type="checkbox"/> No
Environment	Do not proceed with the lifting operation under the following circumstances: <ul style="list-style-type: none"> <li><input type="checkbox"/> Thunderstorm and lightning strikes in the area. The ground condition must be checked after a thunderstorm.</li> <li><input type="checkbox"/> Strong winds that may sway the suspended load.</li> <li><input type="checkbox"/> Other circumstances (please specify).</li> </ul>	

### 7. Sequence / Special Precautions

### 8. Sketch of the Zone of Operation:

*(It is recommended that you include the initial location of the load, the final location and path of the load. It is also important to indicate any obstructions or equipment that may obstruct the lifting operation).*

Applied by: Name:	Signature:	Date: Time:
Prepared by: Name:	Signature:	Date: Time:
Assessed by: Name:	Signature:	Date: Time:
Approved by: Name:	Signature:	Date: Time:

**Note:**

1. This is only a sample Lifting Plan/ PTW, the content is by no means comprehensive. Users would have to include key critical document and information such as load capacity chart, range diagram, rigging method, sling angle, etc to ensure safe lifting operations.
2. Further guidance can be obtained from the following collaterals:
  - Guidebook for Lifting Supervisors
  - Worker’s Safety Handbook for Crane Operator
  - Worker’s Safety Handbook for Rigger and Signalman

## Appendix 2: Sample Checklist for Mobile / Crawler Crane

This checklist provides an overview of the basic requirements to be checked which would help to ensure that a mobile/ crawler crane is safe for use. Mobile/ crawler crane users shall consult manufacturers, suppliers and owners to check on minimum requirements and address any concerns before using the equipment. These items in this checklist are non-exhaustive and users are recommended to make the necessary modification and customisation to suit your work processes and conditions at the workplace.

S/N	Items	Yes/ No	Remarks
<b>A. Mobile/ Crawler Crane Approved for Use</b>			
1.	The mobile/ crawler crane age is within limits set by MOM.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2.	The mobile/ crawler crane has a valid Lifting Machine (LM) certificate (issued less than 12 months ago).	<input type="checkbox"/> Yes <input type="checkbox"/> No	
<b>B. General Requirements</b>			
3.	The mobile/ crawler crane is provided with markings of the Safe Working Load, and LM number.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4.	Proper and safe access and egress (with proper foot and hand holds/ supports) are provided to the crane operator.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5.	A load capacity chart is displayed in the operator cabin.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6.	Operator crane cabin is provided with a locking mechanism so as to prevent unauthorised entry.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7.	An approved fire extinguisher is provided in the operator cabin.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8.	An Operation and Maintenance log book is available in the operator cabin.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9.	A Manufacturer Operating Manual and Maintenance Manual are made available.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10.	Crane hook is provided with a safety catch to prevent displacement of the sling or load from the hook.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
11.	Main and auxiliary wire ropes are well lubricated and that there are no visible defects such as broken wires, kinks, excess wear, crushing etc.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
<b>C. Safety and Operational Devices</b>			
12.	A load radius indicator with warning alarm is installed.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
13.	An effective hoist and derricking braking mechanism are maintained.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
14.	A swing lock or swing brake capable of preventing unintended rotation is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
15.	Limit switch to prevent over-hoisting of the hook (i.e., anti-two block device) is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
16.	Limit switch to prevent over-derricking of boom (for crawler crane) is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
17.	Load Moment Limiter to prevent over-turning moment is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	

### D. Maintenance

18.	The mobile/ crawler crane has a regular maintenance programme that is in accordance with manufacturer's specifications.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
19.	Maintenance work on the mobile/ crawler crane is carried out by Competent Persons.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Inspected by: Crane Operator		Supervised by: Lifting Supervisor	
Signature / Date		Signature / Date	

## Appendix 3: Sample Checklist for Tower Crane

This checklist provides an overview of the basic requirements to be checked which would help to ensure that a tower crane is safe for use. Tower crane users shall consult manufacturers, suppliers and owners to check on minimum requirements and address any concerns before using the equipment. These items in this checklist are non-exhaustive and users are recommended to make the necessary modification and customisation to suit your work processes and conditions at the workplace.

S/N	Items	Yes/ No	Remarks
<b>A. Tower Crane Approved for Use</b>			
1.	The tower crane is of type-approved by MOM.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2.	The tower crane has a valid Lifting Machine (LM) certificate (issued less than 12 months ago).	<input type="checkbox"/> Yes <input type="checkbox"/> No	
<b>B. General Requirements</b>			
3.	The tower crane is provided with markings of the safe working load, tower crane serial number and LM number.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4.	Proper and safe access and egress (with proper foot and hand holds/ supports) are provided to the crane operator.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5.	A load capacity chart is displayed in the operator cabin.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6.	Operator crane cabin is provided with a locking mechanism so as to prevent unauthorised entry.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7.	A safety bar is fitted across the operator's cabin window where there is likelihood of the operator falling through it.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8.	An approved fire extinguisher is provided in the operator cabin.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9.	An Operation and Maintenance log book is available in the operator cabin.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10.	A Manufacturer Operating Manual and Maintenance Manual are made available.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
11.	Crane hook is provided with a safety catch to prevent displacement of the sling or load from the hook.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12.	Wire ropes are well lubricated and that there are no visible defects such as broken wires, kinks, excess wear, crushing etc.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
<b>C. Safety and Operational Devices</b>			
13.	A load radius indicator with warning alarm is installed.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
14.	A jib angle indicator is provided (for luffing jib tower crane).	<input type="checkbox"/> Yes <input type="checkbox"/> No	
15.	An emergency stop button, which will terminate the operation of the crane engine, is installed in the operator cabin and correctly identified.	<input type="checkbox"/> Yes <input type="checkbox"/> No	

16.	Effective braking mechanisms for the following are maintained: (a) Hoisting (b) Derricking (c) Slewing (d) Trolley Travelling	<input type="checkbox"/> Yes <input type="checkbox"/> No	
17.	Hoisting limiter to prevent over-hoisting of the hook block is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
18.	Trolley travelling limiter to prevent over-travelling of trolley is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
19.	Limit switches to prevent over-derricking and over-lowering of jib (for luffing jib tower crane) is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
20.	Slewing limiter to restrict slewing of crane is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
21.	Overload limiter to prevent overloading of crane is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
22.	Load moment limiter to prevent over-turning moment is functional.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
23.	Anti-collision devices are tested to stop the tower crane's operation such that the crane-to-crane interference must be maintained at not less than three metres.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
24.	Wind anemometer is installed and is in good working condition.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
25.	Adequate aircraft warning lights and/ or chequered white and red flags are provided.	<input type="checkbox"/> Yes <input type="checkbox"/> No	

#### D. Maintenance

26.	The tower crane has a regular maintenance programme that is in accordance with manufacturer's specifications.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
27.	Maintenance work on the tower crane is carried out by Competent Persons.	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Inspected by: Crane Operator

Supervised by: Lifting Supervisor

Signature / Date

Signature / Date

## Appendix 4: Sample Checklist for Overhead Travelling Crane

This checklist provides an overview of the basic requirements to be checked which would help to ensure that an overhead travelling crane is safe for use. Overhead travelling crane users shall consult manufacturers, suppliers and owners to check on minimum requirements and address any concerns before using the equipment. These items in this checklist are non-exhaustive and users are recommended to make the necessary modification and customisation to suit your work processes and conditions at the workplace.

S/N	Items	Yes/No	Remarks
1.	Power supply data: voltages, frequency is correct with the power source	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2.	Bolted connections in particular high-tensile bolts on end carriage (high-tensile washers checked for correct fit: bevel facing bolt head/ nut)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3.	Guide roller spacing adjusted, screwed connection (torque) checked	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4.	Crane, crab and runway end buffers installed and correctly positioned	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5.	Crane and crab end approach dimensions checked (according to layout drawing)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6.	Hook height checked (according to layout drawing) and reset if necessary	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7.	Gearbox checked for leaks, air vent screws fitted	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8.	Chain/ rope reeving, rope mounting checked (rope wedge, rope clamp)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9.	Chain/ rope lightly oiled	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10.	Chain/ rope and cable deflectors mounted (if part of crane equipment)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
11.	Emergency and operating limit switches (for lifting and lowering) adjusted and operational	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12.	Long and cross travel limit switches adjusted and operational	<input type="checkbox"/> Yes <input type="checkbox"/> No	
13.	Optical crane distancing adjusted (if applicable)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
14.	Control pendant height and remote control strain relief (if applicable) checked	<input type="checkbox"/> Yes <input type="checkbox"/> No	
15.	Control panel symbols match actual crane travel movements	<input type="checkbox"/> Yes <input type="checkbox"/> No	
16.	Direction of movement symbols attached (for remote control units only)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
17.	Accessibility, marking and availability of "mains connection switches" and "emergency-off switches"	<input type="checkbox"/> Yes <input type="checkbox"/> No	

18.	Check protective earth conductor along entire length for correct marking and connection checked	<input type="checkbox"/> Yes <input type="checkbox"/> No	
19.	Cable entry glands in terminal boxes correctly wired	<input type="checkbox"/> Yes <input type="checkbox"/> No	
20.	Control and regulating devices (if applicable)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
21.	Overload cut-off devices (load measuring devices if applicable)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
22.	Relay settings	<input type="checkbox"/> Yes <input type="checkbox"/> No	
23.	Resistor settings	<input type="checkbox"/> Yes <input type="checkbox"/> No	
24.	Check and tighten terminals (not clamp terminals, however)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
25.	Safety distances to other parts of the building and machinery are maintained	<input type="checkbox"/> Yes <input type="checkbox"/> No	
26.	Smooth running over splices in the runway and of power supply lines	<input type="checkbox"/> Yes <input type="checkbox"/> No	
27.	Brake check carried out: lifting and lowering	<input type="checkbox"/> Yes <input type="checkbox"/> No	
28.	Brake check carried out: long and cross travel	<input type="checkbox"/> Yes <input type="checkbox"/> No	
29.	Speed checks: lifting, lowering, long and cross travel	<input type="checkbox"/> Yes <input type="checkbox"/> No	
30.	Paint coat checked and touched up where required	<input type="checkbox"/> Yes <input type="checkbox"/> No	
31.	Operation of wind drift safety device (for cranes operating outdoors) tested	<input type="checkbox"/> Yes <input type="checkbox"/> No	
32.	Cable drum (for cranes with load handling attachments) checked	<input type="checkbox"/> Yes <input type="checkbox"/> No	
33.	Warning devices (if available)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
34.	A valid Lifting Machine (LM) certificate	<input type="checkbox"/> Yes <input type="checkbox"/> No	
35.	Manufacturer Operating & Maintenance Manual	<input type="checkbox"/> Yes <input type="checkbox"/> No	

**Comments / Remarks**

Inspected by: Crane Operator	Supervised by: Lifting Supervisor
Signature / Date	Signature / Date

## Appendix 5: Sample Checklist for Lorry Crane

This checklist provides an overview of the basic requirements to be checked which would help to ensure that a lorry crane is safe for use. Lorry crane users shall consult manufacturers, suppliers and owners to check on minimum requirements and address any concerns before using the equipment. These items in this checklist are non-exhaustive and users are recommended to make the necessary modification and customisation to suit your work processes and conditions at the workplace.

A. Equipment Approved For Use		Suggested Evidence	Yes/ No	Remarks
1.	Lorry crane is registered with MOM.	LM Certificate or equivalent	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2.	Lifting gear is registered with MOM.	LG Certificate or equivalent	<input type="checkbox"/> Yes <input type="checkbox"/> No	
B. Risk Requirements		Suggested Evidence	Yes/ No	Remarks
3.	Risk assessment is conducted for the various work processes (e.g., use, maintenance).	Completed risk assessment form for the various work processes	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4.	Risk assessment team comprises of representatives from the occupier, equipment supplier, equipment operator etc.	Risk assessment form indicating the composition of risk assessment team	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5.	Safe work procedures are developed and implemented before work is being carried out.	Safe work procedures implementation plan  Inspection to verify implementation of safe work procedures	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6.	Safe work procedures are effectively communicated to all relevant parties (e.g., crane operator, lifting supervisor, signalman, rigger, etc).	Records of briefing / training to relevant parties	<input type="checkbox"/> Yes <input type="checkbox"/> No	
C. Operation of crane		Suggested Evidence	Yes/ No	Remarks
7.	Only trained and competent persons are to be involved in the lifting operation (i.e., crane operator, lifting supervisor, signalman and rigger).	Crane operator registration card, training records and certificate  Lifting supervisor, signalman and rigger's training records and certificates	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8.	Lifting Plan is developed and made available to all persons involved in the lifting.	Written Lifting Plan and acknowledgement from persons involved in the lifting	<input type="checkbox"/> Yes <input type="checkbox"/> No	

9.	Manufacturer's operating manual and operation log book are made available to the crane operator.	Manufacturer's operating manual Crane operator log book	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10.	Crane operator to conduct pre-operational checks at the start of the work shift. The checks shall include but not limiting to the following areas <ul style="list-style-type: none"> <li>• Check all limit switches</li> <li>• Check all warning devices</li> <li>• Visually check, by inspecting relevant levels and/or components</li> <li>• Check all hoses and pipes</li> </ul>	Pre-operation inspection checklist based on manufacturer's instruction Record of completed checklist by operators	<input type="checkbox"/> Yes <input type="checkbox"/> No	
<b>D. Maintenance</b>		<b>Suggested Evidence</b>	<b>Yes/ No</b>	<b>Remarks</b>
11.	Lorry crane has a maintenance programme that is based on manufacturer's instructions.	Written maintenance programme by supplier / maintenance service provider Maintenance record and service report	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12.	Maintenance is carried out by competent person.	Training record or relevant document of competency	<input type="checkbox"/> Yes <input type="checkbox"/> No	
Inspected by: Crane Operator		Supervised by: Lifting Supervisor		
Signature / Date		Signature / Date		

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