Overhead Crane Operation Safety Training

Instructor: KUANGSHAN CRANE

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HENANMINE

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Main Content

1. Analysis of Causes for Lifting Injuries
2. Use of Hooks and Wire Ropes
3. Safe Operating Procedures for Crane Operators
4. The " Ten No-Lift” Rules
5. Crane Lifting Signal Hand Gestures.

Part 1

Case Studies and Causes of Lifting Injuries

CASE STUDY

Wire Rope Breakage, Steel Slag Splashes, One Fatality from Burns

On October 11, 2003, a steelmaking accident occurred at the No. 1 Steelmaking Plant of Dalian A Steel Company. During the operation of the No. 2 electric furnace, worker Chen prepared to lift a ladle filled with molten steel using the No. 2 overhead crane.

At around 9:45 AM, Chen secured the wire rope to the ladle inside the pit. When he moved toward the east ladder, he failed to climb out. A coworker shouted for him to come up, but Chen ignored the warning and signaled for lifting to begin.

Believing there was sufficient time, the crane operator was instructed to slowly tighten the rope. As the rope became taut and the ladle slightly shifted, the wire rope suddenly snapped. The ladle overturned, and molten steel surged eastward across the pit.

At that moment, Chen was seen standing on the ladder attempting to climb out. Due to the narrow gap between the crane and the pit wall, a high-temperature airflow rapidly rose and trapped him. He suffered severe inhalation injuries, suffocation, and burns as his clothing ignited.

Despite emergency rescue efforts, Chen later died in the hospital.

CASE STUDY

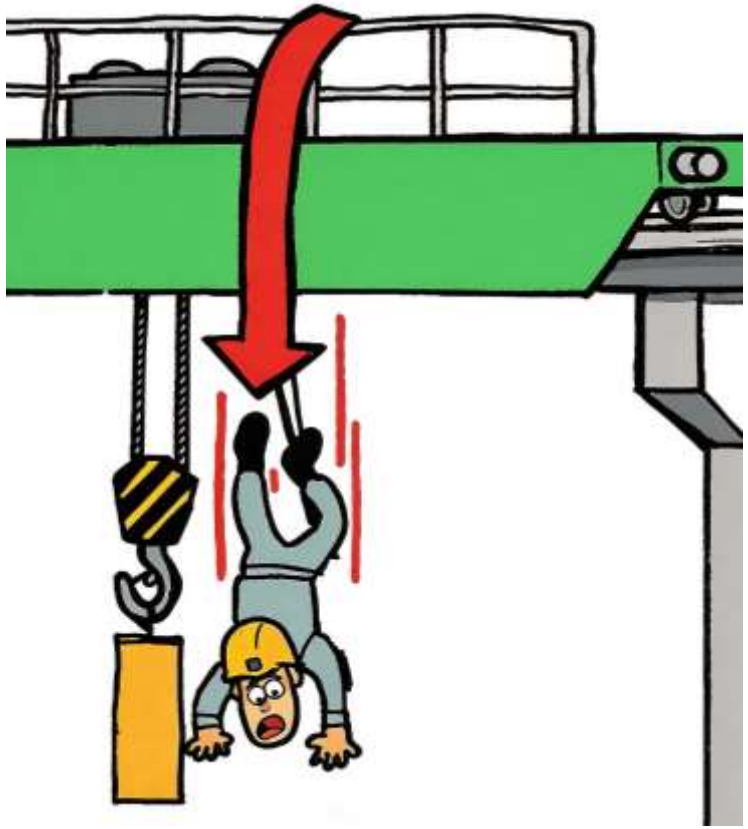
Crane Driver's Reckless Operation Causes Personnel Fall

At 10:11 on October 11, 2011, six electricians from the Electrical Power Department were installing workshop lighting facilities in the newly built 12500T workshop of the Third Aluminum Processing Plant (with the assistance of the workshop crane due to the high ceiling).

When a certain worker was installing lights on the crane trolley, another crane on the same track suddenly drove towards the operating crane. Personnel on the ground and on the crane shouted "Danger" loudly, but to no avail, causing the two cranes to collide.

The worker standing on the trolley was thrown off the crane in an instant. Fortunately, the worker had taken safety precautions during the high-altitude operation by wearing a safety helmet and seat belt, and fastened the seat belt to the trolley.

Finally, the worker suspended in the air was rescued by others. No casualties were caused.



CASE STUDY

Sling Not Raised, Crane Operator Violated Operating Eules.

On a certain day in January 2011, after the lifting operation of the No. 4 crane in a workshop of an aluminum processing plant was completed, the hook and sling were not lifted in time. Crane operator Lin continued to operate the crane forward. When passing near an extruder, the unraised sling hung on the finished product sawing and shaping small platform, instantly overturning the small platform. At that time, a worker who was performing maintenance under the small platform heard the worker shouting to dodge and immediately hid aside. The overturned small platform just hit the place where the worker had been maintaining. Fortunately, the worker dodged in time and no casualties were caused.

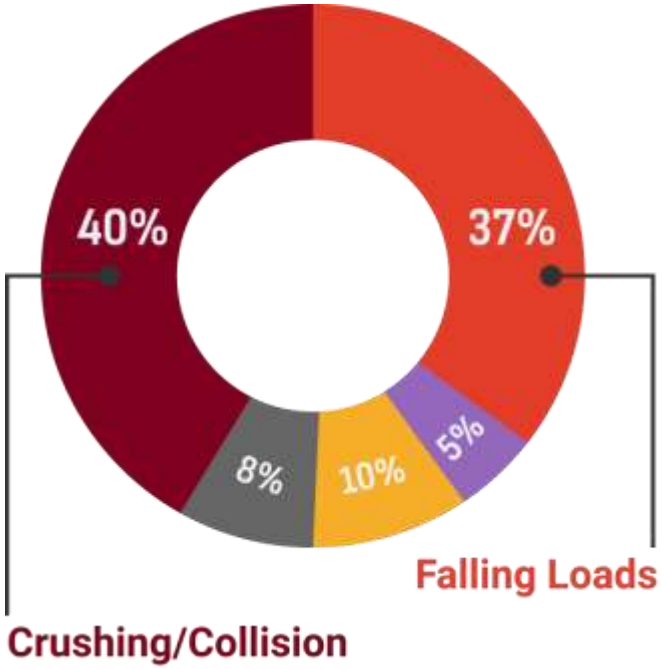
CASE STUDY

Untrained, Unauthorized Operation Leads to Tragedy

On June 5, 2007, at Wenzhou Ouhai District Sanhuang Huangyu Industrial Zone, Wenzhou Donghe Leather Co., Ltd., an operator in the production workshop (operating without a license) was using an electric single-beam crane to hoist leather rolls. Standing under the suspended object, he operated the hook to rise. When the hook block rushed to the top, there was no upper limit protection, but he still continued to operate upward, causing the electric hoist to overwind, the wire rope to break, and the hook and suspended object to fall, resulting in 1 death.

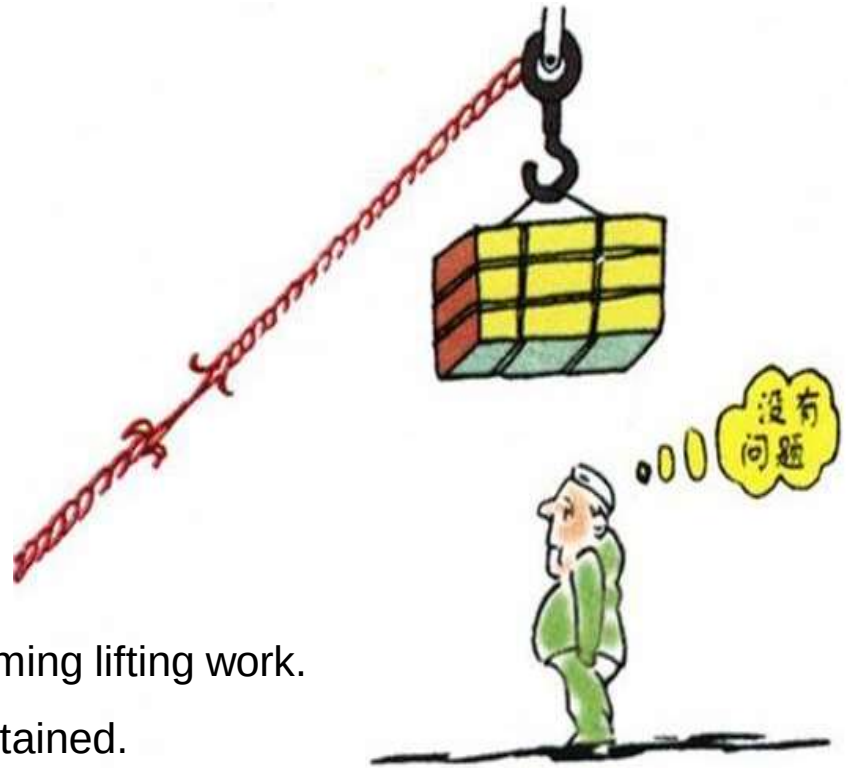
Percentage of Lifting Machinery Injury Incidents

- Crushing and Collision: 40%
- Falling Loads: 37%+4
- Overturning: 10%
- Struck by Object :8%
- Fall from Height: 5%
- Others: 8%



Hazardous Factors in Crane Operations

1. Falling load
2. Crushing and Collision
3. Crane Tipping
4. Object Striking
5. Electric Shock, etc.



Management Causes of Lifting Injury Accidents

1. Personnel operating without a license, non-crane operators performing lifting work.
2. Overloading, tandem lifting, etc., requiring work permits but not obtained.
3. Operations performed without safety briefing.
4. Safety measures not fully implemented.
5. Lifting equipment put into operation without testing or failing the test.

According to accident statistics, crushing/collision and load (tool) falling are the two most prominent types.

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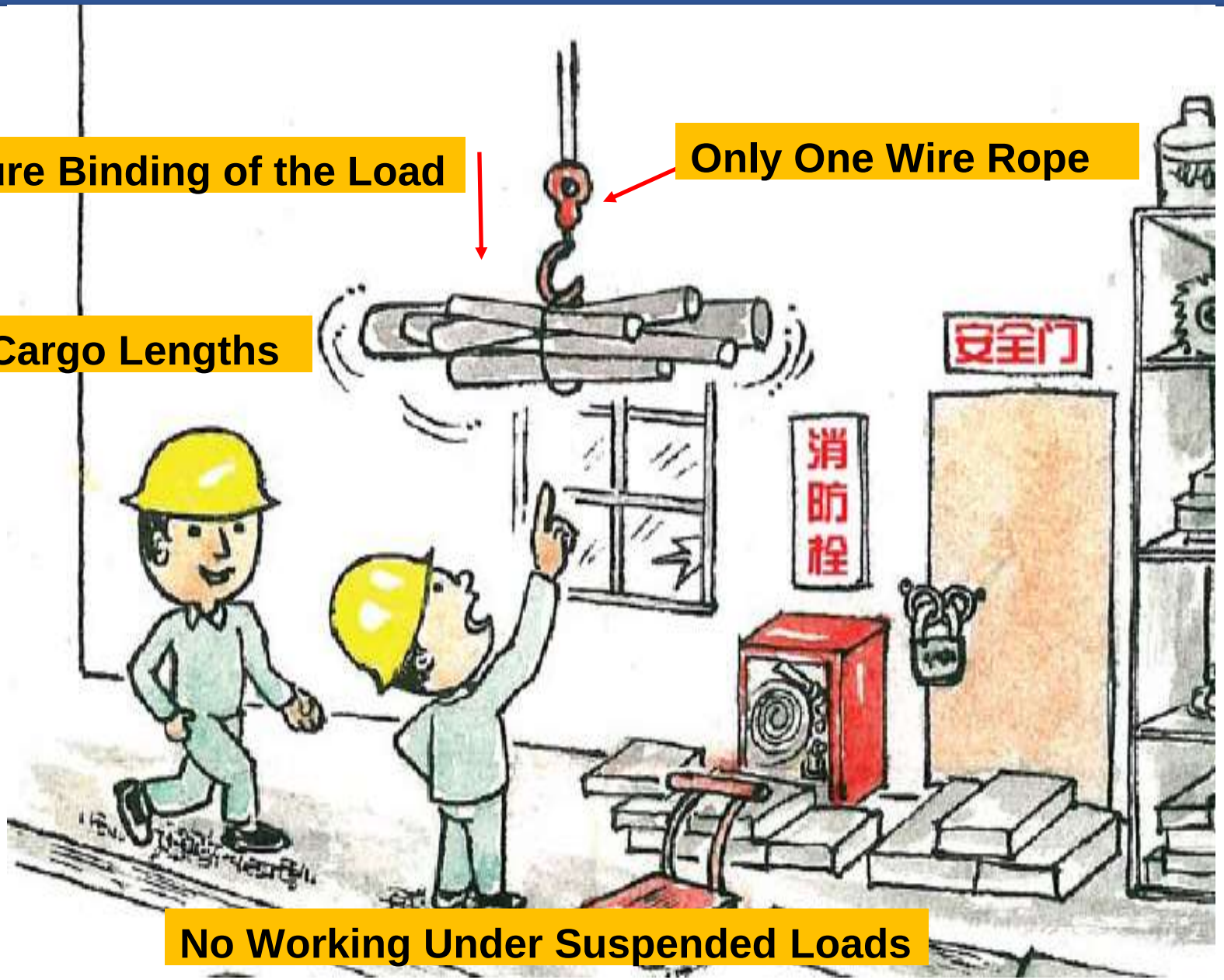
Direct Causes of Lifting Injury Accidents:

- No one or unfamiliar with command signals when the crane is lifting objects, the object descends too fast, causing decoupling.
- Wire ropes not inspected regularly, excessive force on the lifted object causes breakage and injury.
- Improper hooking makes the object unstable and sway, hitting piled objects or surrounding personnel.
- Insufficient awareness of hazards in the operating environment, causing crushing and collision with people during the inertial movement of the lifted object.
- Incorrect lifting method, insecure binding, leading to falling of the lifted object and injury to ground personnel.
- Inaccurate estimation of the lifted object's weight, overloading, causing crane brake failure.
- Personnel lack lifting knowledge, have low skills, and operate in violation of regulations.
- Multi-trade collaborative construction work areas lack unified command, improper coordination between personnel, causing injury during lifting operations.
- Crane tools and equipment are only used but not maintained, used with faults, leading to lifting accidents.
- Improper selection of wire ropes, chains, shackles, etc., by lifting personnel, insufficient or no safety factor, causing falling objects to injure people and damage equipment.

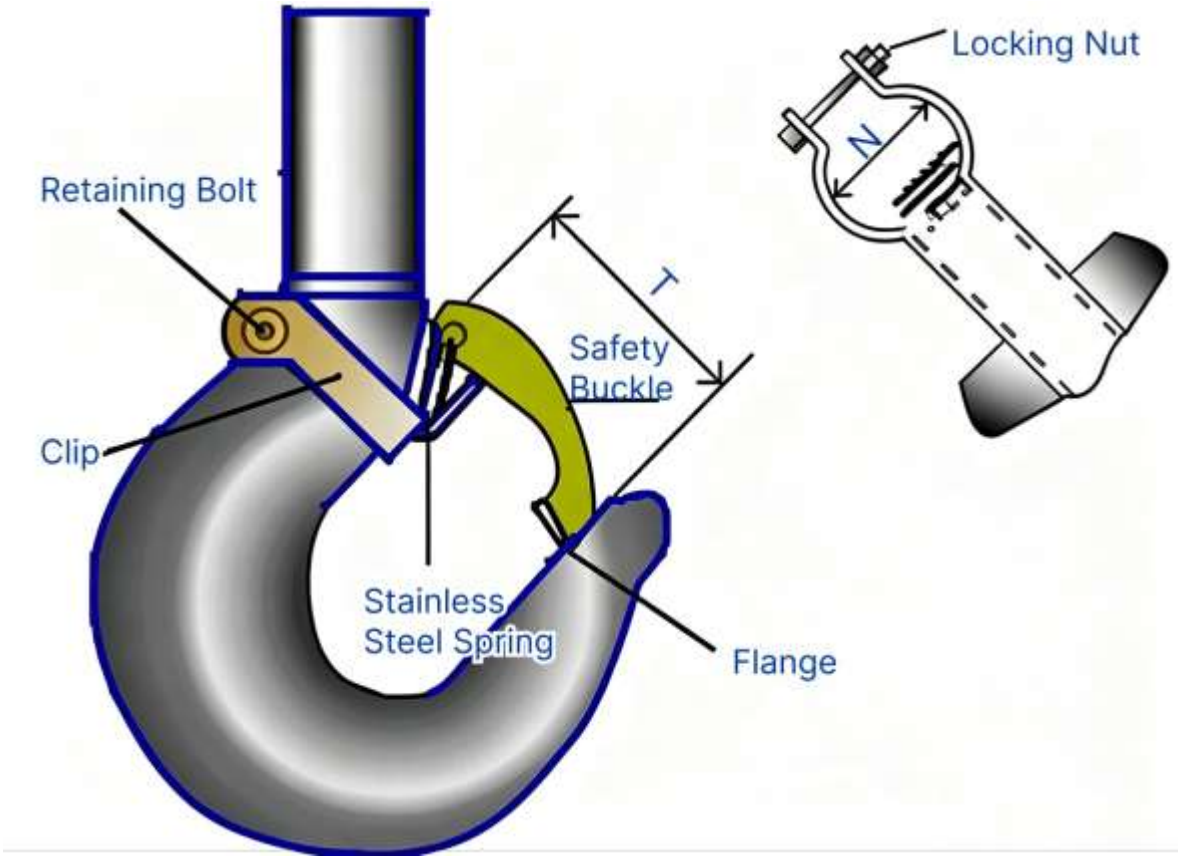

Unsecure Binding of the Load
Only One Wire Rope
Inconsistent Cargo Lengths
安全门
消防栓
No Working Under Suspended Loads

Part 2

Precautions and Scrap Standards for the Use of Crane Hooks and Wire Ropes

Precautions for Crane Hook Use

- Cast hooks are forbidden; ensure secure fixing, flexible rotation, no cracks; welding repairs are prohibited.
- Safety latches must be installed to prevent accidental unhooking.



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Crane Hook Scrap Standards

The hook shall be scrapped if any of the following conditions occur:

1. Cracks;
2. Wear at the critical section reaching 10% of the original dimension;
3. Opening increased by 15% compared to the original size;
4. Twist deformation of the hook body exceeding 10°;
5. Plastic deformation at the critical section or hook neck;
6. When liner wear of a plate hook reaches 50% of the original size, the liner shall be replaced;
7. When pin wear of a plate hook reaches 5% of the original size, the pin shall be replaced.

Note: Cracks or wear on the hook shall not be repaired by welding.

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Characteristics of Wire Ropes

Advantages:

Good winding ability, high strength, large load capacity, shock resistance, smooth winding, low noise at high speeds, reliable operation, and cost efficiency.

Disadvantages:

Stiffness, wear, corrosion, and potential breakage if not properly selected, maintained, and used, leading to severe accidents.

Waviness

Strand Protrusion

Knotting

Wire Protrusion

Basket (Birdcage) Deformation

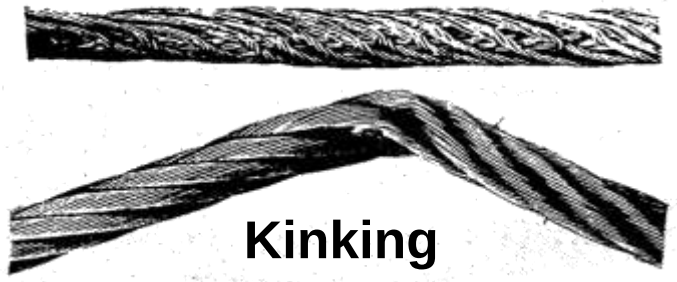
Flattening

Visible Deformities of Wire Ropes (Discard Criteria)

Local increase in diameter of Lang lay wire rope

Local increase in wire rope diameter

Localized reduction in diameter



Kinking

Visible Deformities of Wire Ropes (Discard Criteria)

Part 3

Safety Operating Procedures for Crane Operators

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Basic Requirements for Operators

1. Must be professionally trained, assessed, and hold a valid operation certificate.
2. Must be 18+ years old, with no disqualifying conditions (e.g., color blindness, hypertension, vertigo).
3. Must understand crane mechanisms, electrical systems, and fire safety.
4. No smoking, eating, reading, or mobile phone use during operation.
5. Familiar with all command signals.

Basic Operating Requirements for Crane Operators

1. **Steady -** Smooth start/stop; no swinging of load or hook.
2. **Accurate -** Precise positioning and landing.
3. **Efficient -** Optimize cycles to improve productivity.
4. **Safe -** Zero accidents to personnel or equipment.
5. **Rationale -** Correct and logical use of controllers.

1. Pre-operation Requirements

1. Wear insulated rubber-soled shoes (no hard/plastic soles); keep laces tied. Wear a safety helmet and "Three-Tight" (tight cuffs, hem, and collar) work clothes.
2. Use ladders; no jumping or crossing. Keep hands free (no carrying tools by han
3. Do not close the circuit if anyone is on the crane. Follow maintenance personnel during repairs.
4. Perform a comprehensive inspection and dry-run before starting the shift; record any issues.

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2. Operating Requirements

1. In the following situations, the operator must sound a warning signal:

① Before the crane starts moving;

② When approaching another crane on the same level;

③ During lifting or lowering of a load;

④ When the load passes near or over personnel on the ground;

⑤ When the crane approaches another crane within the same or adjacent bay;

⑥ When passing areas with limited visibility, sound the bell continuously;

⑦ If the crane malfunctions during load handling;

⑧ During lifting operations, the operator must remain at the post, stay focused, follow instructions, and refrain from talking or causing distractions.

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2. Operating Requirements

2. Always face the crane and observe the load; signal and stop immediately in emergencies.
3. Shift from "Zero" step-by-step; no skipping gears or sudden reversals. Prohibit using 5th gear for direct high-speed lifting.
4. Maintain a 0.5m clearance above the highest obstacle.
5. Align precisely before lowering; unhook only after the "stable" signal.
6. Do not operate if the upper limit switch is faulty.
7. No side-pulling. Tension the rope gradually to prevent swinging.
8. No climbing or maintenance while in operation.
9. Do not leave loads suspended; operators must not leave their posts.
10. Follow the swing direction to neutralize inertial forces and stabilize the hook.
11. Strictly follow the “10 Scenarios Not to Lift.”

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2. Operating Requirements

12. Tandem Lifting:

① Distribute load proportionally.

② Keep ropes vertical and movements synchronized.

③ Load must not exceed 80% of rated capacity for each crane.

④ If a fault occurs, lower the load immediately (if possible) and cordoned off the danger zone.

3. Post-operation Procedures

① 1. Park at the designated spot; move the trolley to the end of the bridge; raise the hook; reset all handles to "Zero"; cut main power.

② 2. Clean and wipe the crane.

③ 3. Perform routine lubrication.

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Safe Operation of Hoist and Trolley Mechanisms

1. The crane operator must be familiar with the hoist and trolley performance, including travel speed and braking characteristics.
2. When starting the hoist or trolley, gradually move the controller handle, stepwise removing resistance, so that the hoist/trolley reaches rated speed within 10–20 seconds to ensure smooth operation. Sudden starts or rapid acceleration are prohibited. Reverse braking is forbidden; if reversing is required, return the handle to zero, wait for the crane to stop, then start in the opposite direction.
3. Ensure “Three Stabilities” (Stable Start, Stable Travel, Stable Stop):

① Stable Start: After starting, return the handle to zero once. When the load swings forward, quickly follow the load once to align the load’s center of gravity with the wire rope, eliminating swing.

② Stable Travel: If swinging occurs during travel, accelerate the crane in the swing direction to catch up with the load, achieving balance and damping the swing.

③ Stable Stop: Before reaching the designated position, gradually return the controller handle to reduce speed. After returning to zero, briefly energize to follow the load once more, then brake slowly to stop, eliminating swing.

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Emergency Procedures for Brake Failure

In some cases, due to poor crane management and maintenance, the brake may fail during hoist operation if key components, such as the main spring or brake shoes, break or fall off. This can cause

the suspended load to drop freely at high speed when the operator returns the controller to zero.

In such sudden and unexpected failures, the operator must remain calm and clear-headed. The controller should be moved decisively to the first upward notch to lift the load at the slowest speed. As it nears the upper limit, switch the handle to the fifth downward notch to lower the load slowly, repeating this process.

During this short period, the operator should move the crane or trolley as needed to transfer the load to a clear area and then safely lower it to the ground.

Key Points for Brake Failure

1. Exercise caution to avoid operational mistakes or false perceptions (e.g., mistaking the first notch for zero, giving a false sense of brake failure).
2. On detecting brake failure, immediately keep the controller in a working notch to delay the load's descent; do not leave it at zero.
3. Continuously sound the warning bell while moving the load and operating the crane/trolley to alert ground personnel and create safe conditions for load transfer.
4. Monitor upper and lower limits during crane/trolley movement, leaving sufficient clearance to prevent collisions with limiters or equipment.
5. In this dangerous situation, avoid tripping the main contactor. Operate the hoist/trolley handle gradually; never jerk it quickly, which could cause the load to fall freely.

Crane Electrical Fire

Electrical fires on cranes are usually caused by poor maintenance or overloads leading to short circuits, overheating, or sparks. Cranes must be equipped with proper fire-fighting equipment.

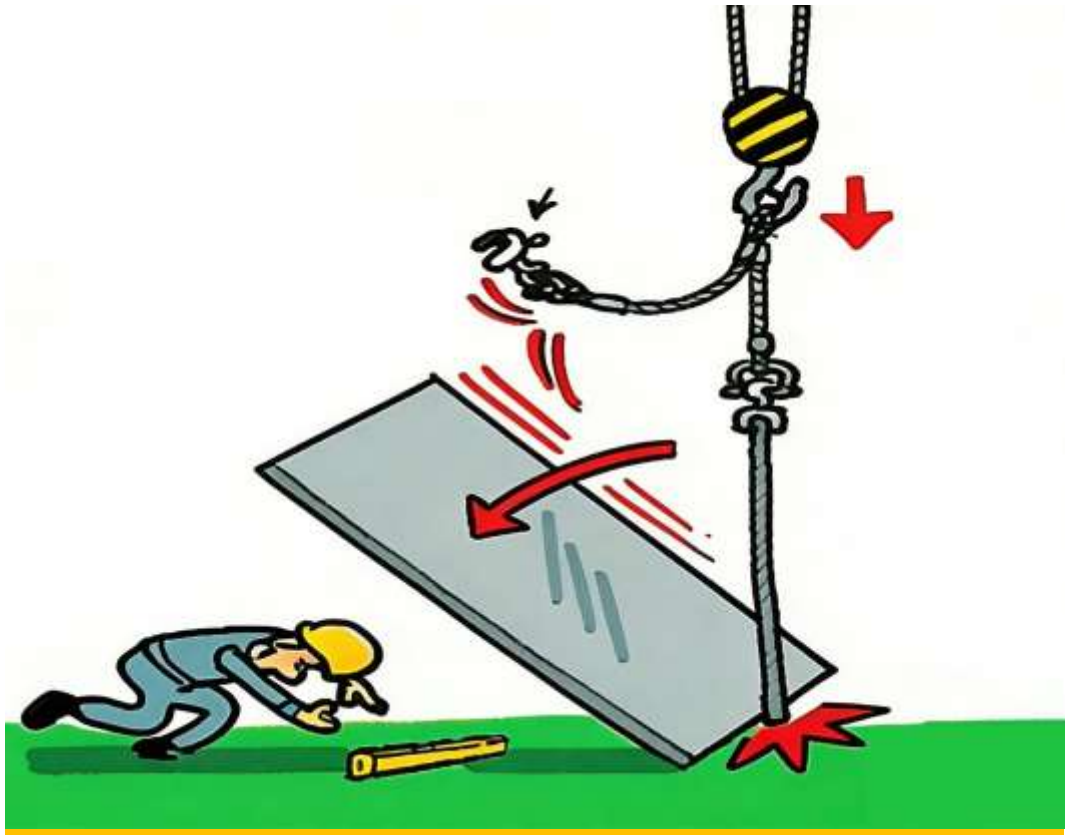
1. Short circuit – Can ignite combustible materials, including wire insulation.
2. Overload – Prolonged operation beyond rated load or faulty operation (e.g., missing one phase in a three-phase supply).
3. Poor contact – Improperly installed or damaged resistors can accumulate heat.
4. Lack of lubrication – Oil shortage in the system may trigger fire.
5. Welding or sparks near the crane rails, roof structures, or skylights can ignite fires.

Emergency Measures:
Immediately cut off the power. If power cannot be fully disconnected, use appropriate extinguishers (dry powder or CO_2) to prevent electric shock, as electrical equipment may energize the metal framework.

Part 4

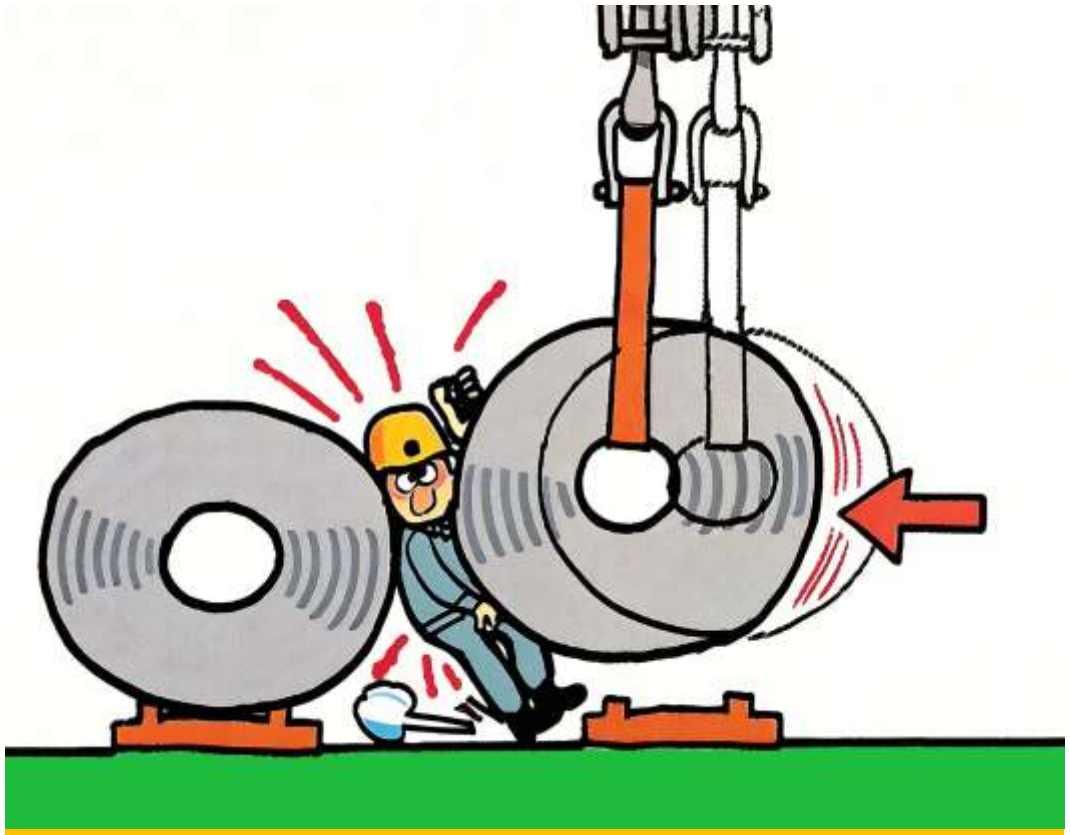
The "10 Scenarios Not to Lift"

Do not lift overloaded or overweight loads.



Do not lift if signals are unclear or if there is unauthorized/violating instruction.

Do not lift if the load or workpiece is not properly secured or fails to meet safety requirements.



Do not lift in poor lighting or when visibility is obstructed.

Do not lift if the load or workpiece is slanted or improperly hung.

Do not lift if people are on the load or if loose items are placed on it.

Do not lift if safety devices are incomplete, insensitive, or ineffective.

Do not lift objects with sharp edges, gaps, or without anti-cutting measures.

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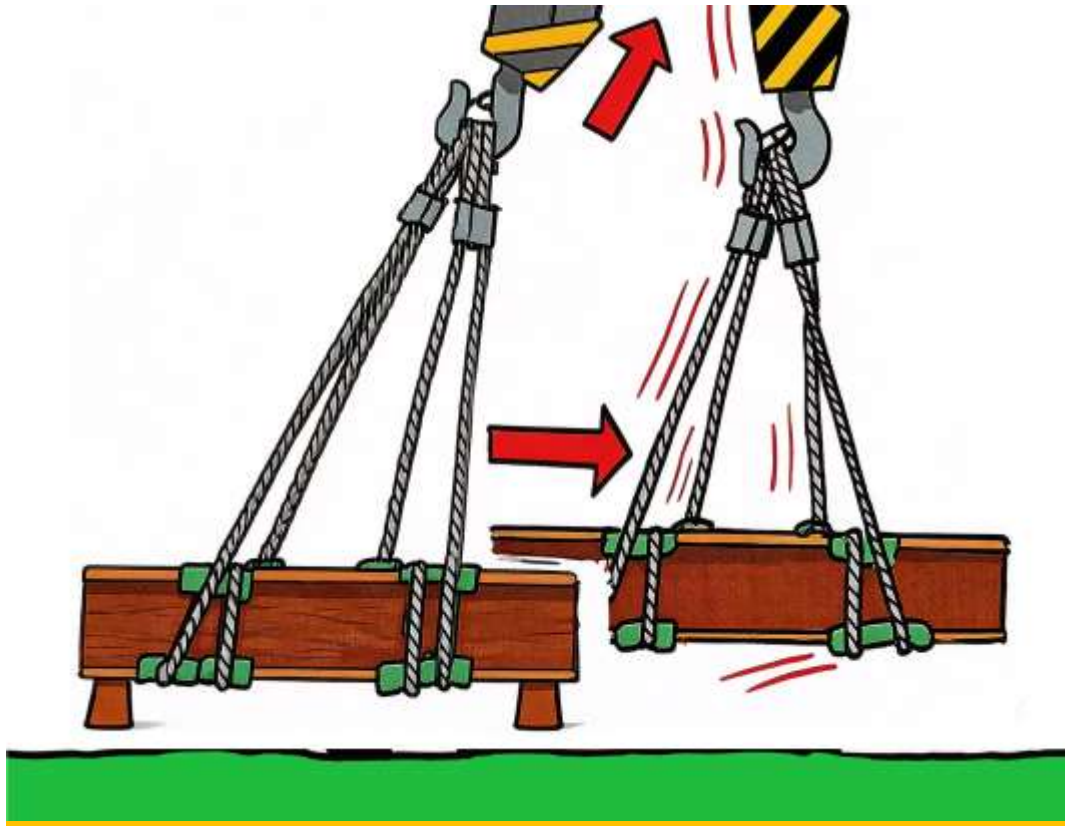

Do not lift if the load weight is unclear.

Do not lift objects buried underground or hooked to ground buildings/equipment.

Part 5

Lifting and Hoisting Command Signals

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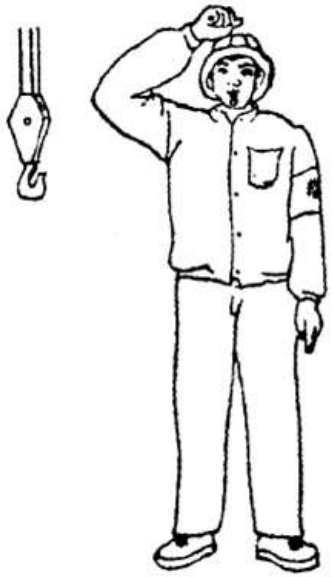
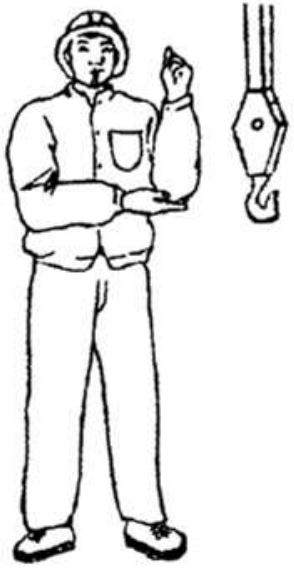
Prepare

Arm straight, raised above head, five fingers naturally spread, palm facing forward and held still.



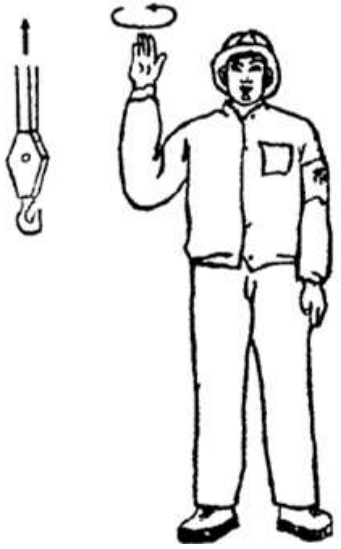
Use Main Hook

One hand naturally clenched into a fist, placed on the head, lightly touching the top of the head.



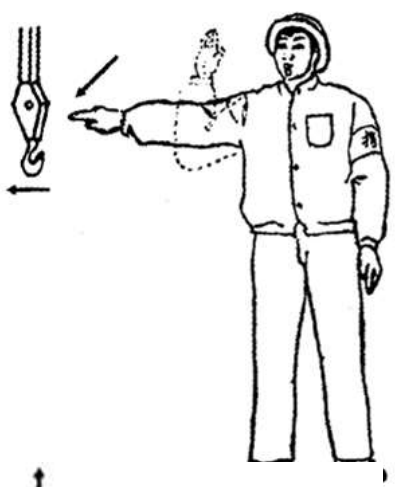
Use Auxiliary Hook

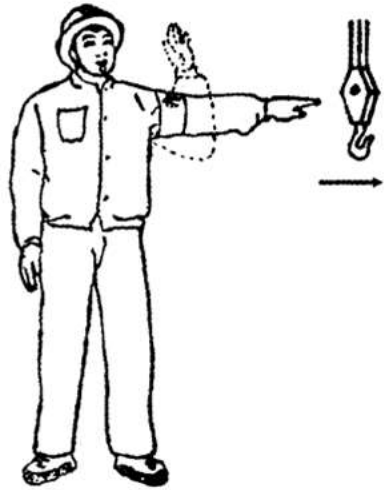
One hand clenched into a fist, forearm raised and still, the other hand extended, palm lightly touching the elbow joint of the first hand.



Hook Up

Forearm straight to the side and up, five fingers naturally spread, above the shoulder, rotating around the wrist.



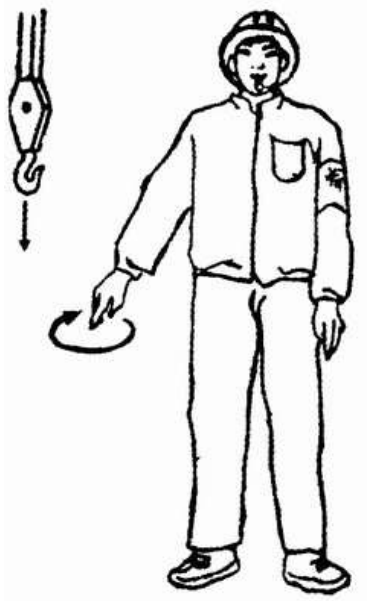


Hook Horizontal Movement

Forearm straight to the side and up, five fingers together, palm facing outward, waving down in the direction the load should move to a position level with the shoulder.

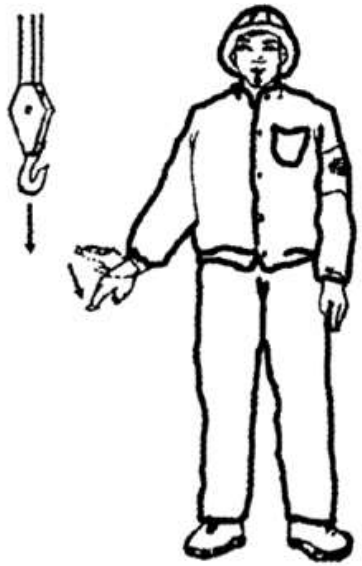
Hook Slightly Up

Forearm extended to the side and forward, palm up above the shoulder, repeating upward palm swings around the wrist.



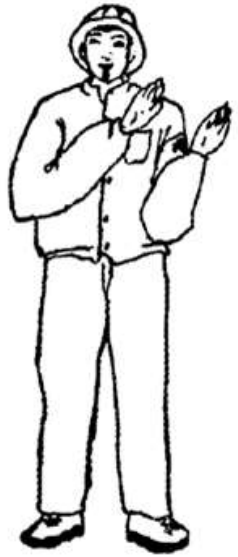
Hook Down

Arm extended to the side and forward, at an angle of about 30° to the body, five fingers naturally spread, rotating around the wrist.



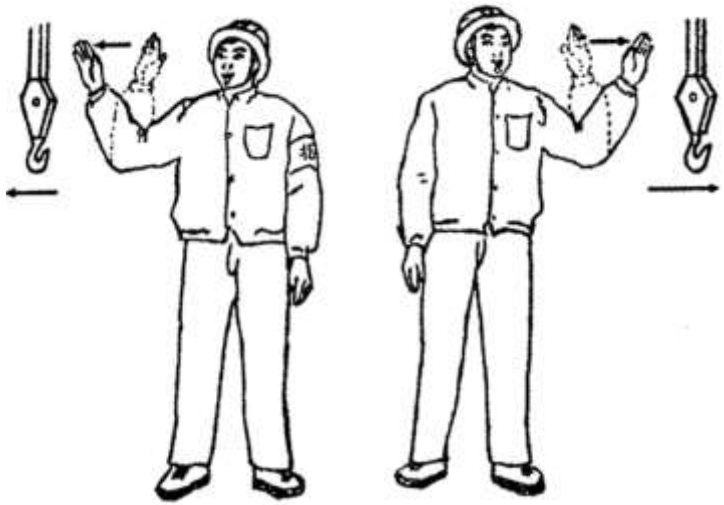
Hook Slightly Down

Arm extended to the side and forward, at an angle of about 30° to the body, palm down, repeating downward palm swings around the wrist.



Micro-movement Range

Both forearms bent, extended to one side, five fingers straight, palms facing each other, the distance between them close to the distance the load needs to move.



Hook Horizontal Micro-movement

Forearm naturally extended to the side and up, five fingers together, palm facing outward, repeating slow horizontal movements in the direction the load should move.

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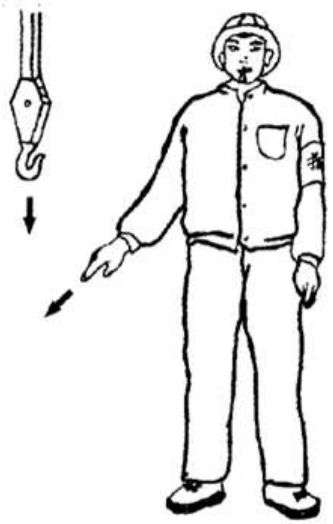
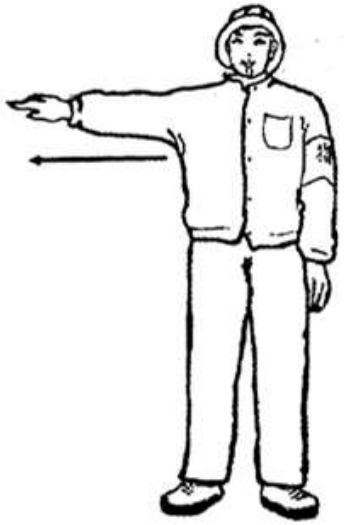


Indicate Landing

Five fingers straight, pointing to the position where the load should land.

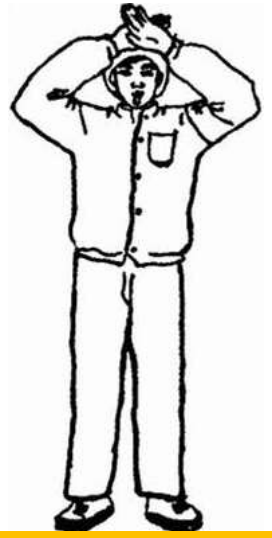


Stop

Forearm horizontal in front of the chest, five fingers spread, palm down, waving horizontally to one side.

Emergency Stop

Both forearms horizontal in front of the chest, five fingers spread, palms down, waving horizontally to both sides at the same time.



Work End

Both hands with five fingers spread, crossed in front of the forehead.

Note: Always maintain clear visibility and follow standard safety protocols during operations.

Thank You for Your Attention

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