Cladding Technology Shanxi Co., Ltd

HSE Crane Safety Operation Procedure

Document No.: CLADDING-HSE-PD-25

1 Purpose

To standardize the operation of the Company's cranes (including overhead cranes, gantry cranes, truck cranes, and crawler cranes), clarify HSE requirements for pre-operation, in-operation, and post-operation phases, prevent accidents such as lifted object falling, equipment damage, personnel injury, and environmental pollution. This procedure ensures crane operations comply with national regulations (Safety Code for Lifting Appliances - Part 1: General Requirements GB 6067.1, Regulations on the Supervision and Administration of Special Equipment), PIPING SYSTEM PTE LTD HSE requirements, and the Company's material handling/equipment transportation business needs, so as to protect employees' life and health, equipment and property safety, and compliance of the operation area environment.

2 Scope of Application

This procedure applies to the operation, maintenance, and related activities of cranes with a rated lifting capacity ≥ 0.5t in all departments of the Company (Warehousing Center, Equipment Management Department, Procurement Department, Project Departments) and all operation scenarios, including:

2.1 Equipment Types

• Overhead Cranes: Used for loading, unloading, and stacking of heavy materials (e.g., steel, mechanical components) in indoor warehouses;

• Gantry Cranes: Used for unloading, acceptance, and transfer of large equipment (e.g., pumps, valves) in outdoor yards;

• Truck Cranes/Crawler Cranes: Used for temporary hoisting operations in outdoor areas (e.g., on-site equipment installation at Project Departments, emergency material hoisting, and transfer of large equipment).

2.2 Applicable Personnel

• Crane Operators (holding valid Special Equipment Operator Certificate);

• Crane Signalmen (holding valid special operation certificates for crane signaling);

• Riggers (qualified through professional training and assessment);

• Crane Maintenance Personnel and relevant management personnel (Equipment Management Department, Quality, Safety and Environmental Protection Department).

2.3 Operation Scenarios

• Warehouse Material Handling: Loading, unloading, and shifting of heavy materials (single weight ≥ 50kg) in indoor/outdoor warehouses;

• Equipment Acceptance and Transportation: Unloading of procured equipment (e.g., large valves, compressors) after arrival at the port, and transfer in the acceptance site;

• Temporary Hoisting Operations: On-site equipment installation at Project Departments, removal of faulty equipment, and hoisting of emergency materials (e.g., flood control equipment);

• Large Equipment Hoisting: Transfer and installation of equipment with weight ≥ 20t (e.g., pressure vessels, large motors);

• Dual-Crane Lifting: Hoisting of heavy loads (e.g., ultra-wide equipment) requiring collaboration between two cranes.

3 Terms and Definitions (Retained Original, 5 Items Added)

3.6 Crane Signalman

A dedicated personnel who holds a valid special operation certificate for crane signaling, is responsible for signal transmission, on-site coordination, and safety monitoring during hoisting operations, and must be familiar with standard command signals (hand signals, flag signals, sound signals).

3.7 Rigger

A personnel who is qualified through professional training and assessment, responsible for binding lifted objects, hanging, and selection and inspection of slings. Riggers must master the scrap standards for slings and binding techniques.

3.8 Dual-Crane Lifting

A lifting method in which two cranes collaborate to lift the same load. A special plan must be formulated to ensure that the load on a single crane does not exceed 80% of its rated load.

3.9 Sling Scrap Standards

Criteria for determining when slings (steel wire ropes, hooks, shackles, etc.) reach their service limits, such as excessive broken wires in steel wire ropes, hook opening exceeding

15% of the original size, etc. Slings that meet scrap standards must be compulsorily scrapped.

3.10 Major Hoisting Operations

Hoisting operations with a lifting weight ≥ 50t, a lifting height ≥ 20m, or involving high-risk areas (e.g., near high-voltage lines, flammable and explosive areas). A special hoisting plan must be formulated and approved.

4 Responsibility Assignment (Supplemented and Improved, 2 New Personnel Types Added)

4.1 Crane Operators (Retained Original, 1 Item Added)

• Operate strictly in accordance with command signals; no operation is allowed when there is no command signal or the signal is ambiguous;

• Other responsibilities remain unchanged.

4.2 Crane Signalmen (Newly Added)

• Work with a valid special operation certificate for crane signaling; no signaling is allowed without a certificate;

• Before operation, verify the qualifications of operators and riggers, and inspect the integrity of slings and the operation environment;

• Correctly use unified command signals (hand signals, flag signals, sound signals) with clear, accurate, and timely signals to avoid ambiguous signals;

• Monitor the safety of personnel/equipment within the lifting radius during operation; immediately stop signaling and require shutdown if irregular operations (e.g., oblique pulling/lifting) are found;

• Supervise the on-site implementation of the major hoisting operation plan to ensure operation in accordance with the plan process.

4.3 Riggers (Newly Added)

• Work after passing professional training and assessment; be familiar with the type, rated load, and scrap standards of slings;

• Before operation, select suitable slings based on the weight, shape, and material of the lifted object; inspect slings for defects such as broken wires, cracks, and excessive wear;

• Be responsible for binding lifted objects: select binding points directly above the center of gravity; place soft protective materials at sharp edges; ensure the included angle of slings ≤ 90° to avoid twisting;

• During operation, assist signalmen in monitoring the status of lifted objects (e.g., balance, looseness); after the lifted object lands, be responsible for removing and retrieving slings;

• Prohibit standing or staying under the lifted object after binding is completed.

4.4 Hoisting Operation Supervisors (Retained Original, 1 Item Adjusted)

• Cooperate with signalmen to maintain on-site order during operation; supplement the coordination mechanism between supervisors and signalmen;

• Other responsibilities remain unchanged.

4.5 Equipment Management Department (Retained Original, 2 Items Added)

• Formulate daily/monthly/quarterly inspection checklists for cranes, and clarify inspection standards (e.g., metal structures, high-strength bolts);

• Organize special training and assessment for crane signalmen and riggers to ensure 100% training coverage;

• Other responsibilities remain unchanged.

4.6 Quality, Safety and Environmental Protection Department (Retained Original, 1 Item Added)

• Be responsible for approving major hoisting operation plans and supervising the implementation of the plans;

• Other responsibilities remain unchanged.

4.7 Operation Leaders (Retained Original, 1 Item Added)

• Organize the formulation of special hoisting plans before major hoisting operations, and clarify hoisting methods, sling configuration, and risk prevention and control measures;

• Other responsibilities remain unchanged.

5 Operation Process (HSE Full-Link Control, Integrated and Supplemented)

5.1 Pre-operation Preparation (HSE Pre-Control, Supplemented and Detailed)

5.1.1 Personnel Qualification Verification (Newly Added, Led by Operation Leaders)

1. Operators and signalmen must hold valid special operation certificates, which are within the validity period and free from alteration or forgery;

2. Riggers must provide certificates of passing training and assessment, and be familiar with sling operation;
3. All operation personnel must be free from fatigue, alcohol consumption, illness (e.g., hypertension, epilepsy), and in good mental state;
4. Operation leaders organize safety technical disclosure for all personnel, clarify the division of labor between signalmen and riggers, and obtain signatures for confirmation after disclosure.

5.1.2 Environment and Site Inspection (Supplemented and Detailed)

1. Site Conditions (Retained Original, 2 Items Added):

◦ Outdoor Operations: Inspect the safety distance from overhead pipelines (e.g., cables, water pipes), and maintain a distance ≥ 3m from the crane jib/lifted object; sufficient lighting (illuminance ≥ 50lux) must be provided for night operations to avoid shadow blind spots;

◦ Other conditions remain unchanged;

2. Weather Confirmation (3 Items Added):

◦ In rainy or snowy weather, remove snow/accumulated water in the operation area, and place anti-slip steel plates under outrigger support points; stop operation immediately in thunderstorm weather, and keep the crane away from high-voltage lines; prohibit operation when visibility < 100m in foggy weather;

◦ Other conditions remain unchanged;

3. Warning Setup (Retained Original).

5.1.3 Equipment and Sling Inspection (Supplemented and Detailed, Divided into Daily/Monthly)

1. Daily Inspection (Collaboration between Operators and Riggers, 3 Items Added):

◦ Crane Body: Inspect that there is no deformation of metal structures and no cracks in welds; check that high-strength bolts are not loose (focus on jib and frame connection parts);

◦ Slings: The number of broken wires in steel wire ropes ≤ 5 pieces/10m (single strand); the diameter wear ≤ 7% (adjusted from original 10% to 7%, in line with new standards); hooks have no cracks, opening ≤ 15% of the original size, and torsion deformation ≤ 10°; shackles have no cracks and no loose pins;

◦ Electrical System: Inspect that there is no damage to the insulation layer of cables, no water or debris in the electrical cabinet, and insulation resistance ≥ 0.5MΩ (low-voltage system);

◦ Other inspection items remain unchanged;

2. Monthly Inspection (Led by Equipment Management Department, Newly Added):

◦ Metal Structures: Detect the deformation of main load-bearing components (e.g., main beams, outriggers) in accordance with GB 6067.1 requirements;

◦ Hydraulic System: Inspect that the oil level in the hydraulic oil tank is normal, there is no leakage of seals, and the hydraulic oil contamination level ≤ NAS 8;

◦ Operating Mechanism: Inspect that the wheel flange wear ≤ 15% of the original size, and the track joints are flat and free from misalignment;

◦ Fill in the Monthly Crane Inspection Record (Appendix A) after inspection;

3. Load Confirmation (Retained Original, 1 Item Added):

◦ For major hoisting operations, recheck the weight of the lifted object (e.g., weighing) to avoid estimation errors; overloading is strictly prohibited;

5.1.4 Hoisting Plan Preparation (Newly Added, for Major Hoisting Operations)

1. For operations with a lifting weight ≥ 50t, a lifting height ≥ 20m, or involving high-risk areas, a special hoisting plan must be formulated, including:

◦ Project Overview (parameters of lifted objects, operation environment);

◦ Hoisting Methods (single-crane/dual-crane lifting), crane selection, and sling configuration;

◦ Load Calculation (load on single crane, sling force), and stability check;

◦ Operation Process (binding, test lifting, lifting, traveling, lowering);

◦ Risk Prevention and Control Measures (anti-overturning, anti-collision, anti-electric shock) and emergency plans;

2. The plan shall be implemented after review by the Equipment Management Department and approval by the Quality, Safety and Environmental Protection Department; safety technical disclosure shall be provided to all personnel before operation.

5.2 Start-up Operation (HSE Start-up Control, Supplemented with Signal Specifications)

1. Power-on and Self-inspection (Retained Original);

2. Signal Confirmation (2 Items Added):

◦ Operators and signalmen confirm the signal method: give priority to the combined signal of "hand signals + sound signals"; walkie-talkies (dedicated channel, no interference) can be used for long-distance outdoor operations; clarify the meaning of sound signals (one short beep = lift, two short beeps = lower, one long beep = stop, continuous short beeps = emergency stop);

◦ Signalmen, riggers, and supervisors confirm the signal transmission process to avoid signal delay or mistransmission;

◦ Other contents remain unchanged.

5.3 In-operation Operation (HSE Process Control, Supplemented with Core Requirements)

5.3.1 Hoisting Operation (Supplemented and Detailed, Integrating "Ten 'No-Lifting' Principles")

1. Hooking and Test Lifting (2 Items Added):

◦ After completing binding, riggers report "binding ready" to signalmen; signalmen send the test lifting signal to operators after confirmation;

◦ During test lifting, lift to a height of 10-20cm, stay for 10 seconds, and inspect the sensitivity of the brake, balance of the lifted object, and stress state of slings; stop immediately if tilting is found, and riggers adjust the binding position;

2. Lifting and Traveling (3 Items Added):

◦ Strictly implement the "Ten 'No-Lifting' Principles" (Appendix B): No lifting when the command signal is unclear, no lifting when overloaded, no lifting when binding is not firm, no lifting when there are people on the lifted object, no lifting when safety devices are faulty, no lifting when the object is buried/connected to other objects, no lifting when visibility is poor, no lifting when sharp edges have no protection, no lifting when pulling obliquely, no lifting when molten material containers are overfilled;

◦ Dual-Crane Lifting Operations: Use cranes of the same model; signalmen provide unified command; ensure synchronized actions (consistent lifting/traveling speed); the load on a single crane ≤ 80% of its rated load; set traction ropes to control the swing of the lifted object;

◦ Large Equipment Hoisting: The lifting/traveling speed ≤ 2m/min; decelerate to ≤ 1m/min when approaching the target position; use traction ropes (length ≥ 1.5 times the lifting radius) to control the swing of the lifted object and avoid collision with surrounding equipment;

3. Lowering Operation (Retained Original, 1 Item Added):

◦ Before the lifted object lands, signalmen send the "inching lowering" signal; operators lower slowly; riggers observe the landing position from the side to avoid tilting of the lifted object;

5.3.2 Special Working Condition Operation (Newly Added)

1. Severe Weather Operation Control:

◦ Stop outdoor operations when the wind speed ≥ 10.8m/s (Level 6 wind); slowly lower the lifted load and prohibit suspending it in the air;

◦ During rainy or snowy operations: regularly remove snow/ice from the jib and tracks; add anti-slip steel plates under outrigger support points; reduce the lifting/traveling speed;

2. Operation near High-voltage Lines:

◦ Maintain a safe distance from live parts: ≥ 5m for voltages below 10kV, ≥ 8m for 35kV, ≥ 10m for 110kV; prohibit operation without safety protection measures;

◦ Arrange dedicated personnel to monitor the distance from high-voltage lines during operation, and use altimeters to monitor the jib height in real time;

5.4 Post-operation Closure (HSE Closed-loop Control, Supplemented with Maintenance Requirements)

1. Equipment Shutdown (2 Items Added):

◦ Overhead/Gantry Cranes: Park the trolley at the designated position at the end of the track; lift the hook to the upper limit (distance ≥ 1m from the jib/beam); Truck/Crawler Cranes: Retract outriggers and jibs; park on a flat site and pull the handbrake tightly;

◦ Fill in the Crane Operation Record (Appendix C), recording the operation time, load, and equipment abnormalities (e.g., abnormal noise, leakage);

2. Sling and Site Cleaning (2 Items Added):

◦ Riggers retrieve slings and store them by category: coil steel wire ropes on dedicated supports; hang hooks on hook racks; prohibit random stacking; inspect the status of slings; mark slings with excessive wear/broken wires as "to be scrapped" and hand them over to the Equipment Management Department for disposal;

◦ Clean oil stains in the operation area: use oil-absorbing cotton to clean hydraulic oil leakage traces; put waste oil-absorbing cotton into hazardous waste collection barrels; prohibit random disposal;

3. Daily Maintenance (Newly Added):

◦ Operators clean the cab and inspect whether the console buttons and indicator lights are normal; the Equipment Management Department conducts lubrication maintenance (steel wire ropes, wheel bearings, slewing mechanisms) on cranes weekly and fills in the Crane Maintenance Record (Appendix D);

6 HSE Special Safety Requirements (Integrated and Supplemented)

6.1 Health Protection Requirements (Retained Original, 1 Item Added)

• In addition to anti-slip gloves and goggles, riggers must wear waist protectors when handling heavy slings (e.g., ≥ 20kg) to avoid waist injuries;

• Other requirements remain unchanged.

6.2 Safety Prohibition Requirements (Red-line Clauses, Integrating "Ten 'No-Lifting' Principles")

1. Retain the original 7 prohibition requirements;
2. Add the "Ten 'No-Lifting' Principles" (Appendix B) as core clauses of prohibition requirements to strengthen implementation;

6.3 Environmental Compliance Requirements (Retained Original)

7 Emergency Disposal (HSE Risk Response, Supplemented and Detailed)

7.1 Common Accident Types and Disposal Measures (2 Types Added)

7.1.4 Sling Breakage (Newly Added)

1. Operators immediately cut off the power supply and stop all actions;
2. Signalmen/supervisors evacuate personnel in the operation area and set up a warning zone to prevent secondary injuries from broken slings/lifted objects;
3. Operation leaders inspect the damage of the lifted object and assess whether it affects surrounding equipment; prioritize on-site cleaning if no personnel are injured;
4. Report to the Equipment Management Department; analyze the cause of sling breakage (e.g., excessive wear, wrong selection); replace with qualified slings before resuming operation.

7.1.5 Electric Shock Accidents (Newly Added)

1. Immediately cut off the crane power supply; do not directly touch the electrocuted person; use insulating tools (e.g., insulating gloves, bamboo poles) to separate the electrocuted person from the live part;
2. Check the consciousness and breathing of the electrocuted person; perform cardiopulmonary resuscitation immediately if there is no breathing; call 120 for emergency rescue;
3. Report to the Quality, Safety and Environmental Protection Department; inspect electrical system faults (e.g., cable damage, poor grounding); resume operation only after repair and qualification.

7.2 Emergency Contact and Drills (1 Item Added)

• Add 1 special drill (dual-crane lifting failure, electric shock disposal) to emergency drills every year to improve emergency response capabilities for special working conditions;

• Other contents remain unchanged.

8 Supplementary Provisions (Retained Original)

Appendices (Integrated and Newly Added, Replacing Original Attachments)

Appendix A: Monthly Crane Inspection Record (Template)

Inspection Date	Equipment No.	Equipment Type	Inspector	Inspection Item	Inspection Standard	Inspection Result	Handling Measure
		Truck Crane	Zhang San	Metal Structure (Jib)	No deformation, no cracks in welds	□Qualified □Unqualified	Repair cracks by welding
				High-strength Bolts (Outrigger Connection)	No looseness, no rust	□Qualified □Unqualified	Tighten bolts
				Hydraulic System	No leakage, normal oil level (1/2-2/3 of oil gauge)	□Qualified □Unqualified	Add hydraulic oil
				Electrical Insulation Resistance	≥0.5MΩ (low-voltage system)	□Qualified □Unqualified	Replace cables
				Wheel Flange Wear	≤15% of original size	□Qualified □Unqualified	To be scrapped

Inspection Conclusion	A total of 8 items inspected, 6 qualified, 2 unqualified; rectification arranged						
Signature Confirmation	Inspector: Zhang San Equipment Supervisor: Li Si Date: YYYY-MM-DD						

Appendix B: Ten "No-Lifting" Principles (Standard Expression)

1. No lifting when the command signal is unclear or the command is in violation of regulations;
2. No lifting when the weight of the lifted object is unknown or overloaded;
3. No lifting when the lifted object is not firmly bound (e.g., loose slings, deviated binding points);
4. No lifting when there are people on or under the lifted object;
5. No lifting when crane safety devices (limiters, load moment limiters) are faulty;
6. No lifting when the lifted object is buried underground or connected to other objects (e.g., ground, equipment);
7. No lifting when the operation environment is dark or visibility is low (e.g., heavy fog, no lighting at night);
8. No lifting when the lifted object has sharp edges without soft protective measures;
9. No lifting when pulling or lifting the object obliquely (non-vertical lifting);
10. No lifting when molten material containers (e.g., molten steel ladles) are overfilled (exceeding 90% of the container volume).

Appendix C: Crane Operation Record (Template)

Date	Equipment No.	Operation Task	Weight of Lifted Object	Operation Duration	Operator	Signalman	Equipment Status	Abnormality Record
YYYY-MM-DD	QZ-001	Warehouse Steel Handling	10t	2h30min	Wang Wu	Zhao Liu	Normal operation, no abnormal noise	-
YYYY-MM-DD	QZ-002	On-site Equipment Installation (Dual-Crane Lifting)	35t	4h15min	Sun Qi	Liu Ba	Slight abnormal noise in slewing mechanism, reported to Equipment Department	Abnormality Location: Slewing Bearing
Remarks	Dual-crane lifting operation implemented in accordance with the special plan; load distributi							

	on meets requirements							
Signature Confirmation	Operator: Wang Wu Signalman: Zhao Liu Date: YYYY-MM-DD							

Appendix D: Crane Maintenance Record (Template)

Maintenance Date	Equipment No.	Maintenance Type	Maintainer	Maintenance Item	Maintenance Content	Maintenance Result	Next Maintenance Time
YYYY-MM-DD	QZ-001	Weekly Maintenance	Zhang San	Steel Wire Rope Lubrication	Apply special steel wire rope grease to cover all strands	□Qualified □Unqualified	YYYY-MM-DD+7d
				Wheel Bearing Lubrication	Fill with lithium-based grease (Model 3#)	□Qualified □Unqualified	YYYY-MM-DD+7d
				Brake System Inspection	Adjust brake pad clearance; ensure	□Qualified □Unqualified	YYYY-MM-DD+7d

					sensitive braking		
Maintenance Conclusion	All maintenance items are qualified; the equipment can operate normally						
Signature Confirmation	Maintainer: Zhang San Equipment Supervisor: Li Si Date: YYYY-MM-DD						

Appendix E: Crane Command Signal Comparison Table (Template)

Operation Action	Hand Signal	Flag Signal	Sound Signal
Lift	Extend the forearm upward, fingers together, palm forward, swing up and down	Raise the green flag; keep the red flag hanging down naturally	One short beep ("Di")
Lower	Extend the forearm downward, fingers together, palm forward, swing up and down	Lower the green flag; keep the red flag hanging down naturally	Two short beeps ("Di-Di")

Stop	Extend the forearm horizontally, fingers together, palm forward	Hold the red flag horizontally; keep the green flag hanging down naturally	One long beep ("Di——")
Emergency Stop	Cross both hands in front of the chest, fingers together	Cross both red and green flags above the head	Continuous short beeps ("Di-Di-Di")
Slewing (Left)	Swing the forearm to the left, palm forward	Swing the green flag to the left; keep the red flag still	One short beep + left slewing hand signal
Slewing (Right)	Swing the forearm to the right, palm forward	Swing the green flag to the right; keep the red flag still	One short beep + right slewing hand signal

Appendix F: Sling Scrap Standards (Template)

F1 Steel Wire Rope Scrap Standards

1. The number of broken wires in the steel wire rope within one lay length meets the following requirements:

Steel Wire Rope Structure	Safety Factor ≤6	Safety Factor 6-7	Safety Factor ≥7
6×19+FC	12 pieces	14 pieces	16 pieces
6×37+FC	22 pieces	26 pieces	30 pieces

1. The diameter wear of the steel wire rope exceeds 7% of the original diameter;
2. The steel wire rope is twisted, flattened, broken, or severely rusted (surface rust area ≥30%);
3. The fixed end of the steel wire rope is loose or broken.

F2 Hook Scrap Standards

1. The wear of the dangerous section of the hook reaches 10% of the original size;
2. The opening of the hook exceeds 15% of the original size;
3. The torsion deformation of the hook exceeds 10°;

4. Cracks (regardless of size) or welding marks appear on the hook surface;
5. The hook locking device is damaged or invalid, failing to prevent slings from falling off.

F3 Shackle Scrap Standards

1. Cracks appear on the shackle body or pin;
2. The wear of the shackle body exceeds 10% of the original size;
3. The shackle pin is deformed or its thread is damaged, failing to be installed normally;
4. The shackle surface is severely rusted, affecting its strength.