Building Technology Research Institute
香港建築科技研究院
Wholly Owned by the Financial Secretary Incorporated

Technical Specification for **Construction Welding Robot**



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Foreword

Construction welding is a labour-intensive activity. With an ageing skilled workforce and a shortage of new entrants, the productivity and sustainability of manual welding are increasingly constrained. Traditional welding methods also face challenges in meeting increasingly stringent requirements for accuracy, consistency and quality

Construction welding robots offer a safer, more precise and repeatable alternative

through controlled positioning, welding and integrated safety function. They improve the consistency and quality of welding operations, reduce reliance on manual work, and contribute to a safer construction environment

To facilitate wider adoption of robotic welding, there is a need to align the diverse proprietary solutions offered by different vendors and establish clear and consistent specifications to streamline procurement and deployment. This document therefore sets out common technical and safety requirements for venders, welding operators, contractors and clients, providing a consistent framework for the selection and deployment of robotic welding systems that meet defined performance and safety standards.

Building Technology Research Institute and

The Hong Kong Polytechnic University

Preface

This Technical Specification is developed based on Development Bureau Technical Circular (Works) No. 9/2025 – Adoption of Construction Robots, this specification provides a framework for deploying and operating construction welding robots for on-site construction in Hong Kong.

This specification is applicable to public and private construction projects and sets out technical and safety requirements for standardized, safe and efficient welding, supporting productivity, worker welfare and on-site safety.

This specification draws on Hong Kong construction safety regulations and emerging intelligent construction equipment specifications, setting minimum technical requirements while allowing innovation.

The Building Technology Research Institute and The Hong Kong Polytechnic University jointly developed this specification. Contributions from the following organizations are gratefully acknowledged (in alphabetical order):

(a) Governmental Organizations / Industry Associations / Institutes

- Architectural Services Department, Government of the HKSAR
- Development Bureau, Government of the HKSAR
- Hong Kong Center for Construction Robotics
- Hong Kong Construction Association
- Hong Kong Construction Robotics Technology Society
- Hong Kong Construction Sub-Contractors Association

- Hong Kong General Building Contractors Association
- Hong Kong Housing Authority
- Hong Kong Institute of Construction
- Labour Department, Government of the HKSAR
- Occupational Safety and Health Council
- The Construction Industry Council
- The Hong Kong Constructional Metal Structures Association
- The Hong Kong Welding Society
- The Hong Kong Polytechnic University
- The Hong Kong University of Science and Technology
- The University of Hong Kong

(b) Corporates

- Jumbo Construction Technology Limited
- Wo Lee Group Holdings
- O-Matic Intelligent Robot Limited

The feedback from the aforementioned organizations is instrumental in shaping both the standards and the procedures outlined in this specification.

Building Technology Research Institute and

The Hong Kong Polytechnic University

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1. Overview

1.1 On top of statutory and contract requirements applicable to construction plant, machinery, and electrical equipment, this specification sets out minimum requirements for safe, repeatable and verifiable welding-robot operation on construction sites

1.2 The specification covers product capability, site deployment, operating modes, welding performance, safety functions, environmental controls, electrical and battery safety, operator competence, site acceptance, inspection, maintenance and records.

1.3 This specification establishes a two-tier compliance framework:

(a) **Essential Requirements**: Mandatory requirements that shall be enforced through inspections, compliance checking and quality assurance.

(b) **Best Practices**: Recommended measures that can enhance system performance.

2. Extent of Application

2.1 This specification applies to robotic or automated systems used for on-site construction in Hong Kong to perform arc welding of building components made of materials the system is declared capable of welding.

2.2 A construction welding robot may be relocatable or mobile. It may use remote-controlled, semi-automated or self-navigation functions within the operating modes declared by the Vendor.

3. Effective date

3.1 This specification shall take immediate effect.

3.2 The specification shall be reviewed and revised from time to time upon technological advancement or regulatory amendment in the future.

4. Effect on Existing Specifications

4.1 This specification shall be read with applicable Hong Kong legislation and standards listed in Section 8, contract documents, project specifications, approved fixing-system requirements and manufacturer instructions.

4.2 This specification does not reduce any statutory duty. Where requirements conflict, applicable statutory requirements and any stricter contract, fixing-system, safety or manufacturer requirement shall take precedence.

5. Introduction

5.1 Traditional welding exposes welding operators to welding fumes and gases, intense heat and radiation. Welding in confined or difficult working positions may increase safety and health risks. These exposures may contribute to fatigue and other occupational hazards.

5.2 Construction welding robots mechanise or automate part of the welding tasks, reducing worker exposure to hazards and improving the consistency and repeatability of welding operations.

5.3 This specification provides a common basis for evaluating and comparing systems offered by different vendors and sets out the technical and safety requirements for their safe and effective deployment and operation.

6. Terms and Definitions

No.	Term	Definition
6.1	Welding robot system	An integrated complete assembly consisting of robot manipulator, robot controller, welding power source, wire-feeder, end-effector (welding torch), tooling/fixtures, sensing hardware, safety devices and human-machine-interface equipment for automated welding operations for structural steel members and joints.
6.2	Robot manipulator	A multi-degree-of-freedom articulated mechanical arm. The standard configuration is 6-axis; it may be extended with optional external axes for positioners, travelling gantries or mobile bases.
6.3	Robot controller	A control unit executing robot motion logic, program interpretation, I/O signal handling, safety-circuit management and communication linkage with welding peripherals.
6.4	Teach pendant (TP)	A hand-held human-machine-interface unit for robot jogging, program teaching, editing, alarm diagnosis and parameter setup; it is fitted with a physical emergency-stop button, and a trigger switch for safety-related manual operation.
6.5	End-effector	Mounted onto a robot manipulator flange, it is a tool to perform various tasks. For welding robots, this is the welding torch assembly including a torch-body, a contact-tip, a gas nozzle and a cable harness.
6.6	Payload	Maximum allowable mass of an end-effector plus attached cables and peripherals at the robot flange, including dynamic safety margin for a cyclic-duty welding operation.
6.7	Working envelope (workspace)	Three-dimensional spatial volume reachable by a robot tool-centre-point under full mechanical ranges of all axes.
6.8	Tool-centre-point (TCP)	Defined reference point on welding torch end used for robot trajectory calculation and coordinate-system calibration.
6.9	Tool coordinate system	Local coordinate frame fixed relative to welding-torch TCP, used for tool-calibration and tool-orientated jogging / motion.

No.	Term	Definition
6.10	Base coordinate system	Coordinate frame fixed relative to robot-mounting base.
6.11	Joint-axis coordinate system	Robot native coordinate system; jogging moves each robot joint independently.
6.12	External axis	An additional servo-controlled axis managed by a robot-controller, including welding positioners, turning rolls, gantry travel axes or drive axes of a mobile robot base; can be operated in a synchronized coordinated motion with a robot manipulator.
6.13	Welding positioner	A mechanical device for rotating / tilting workpieces to place weld joints into favourable flat / horizontal welding positions.
6.14	Welding fixture	A holding device to locate and clamp the workpiece stably, and to resist welding-distortion of the workpiece.

7. Technical Specification for Construction Welding Robots

Section 7 sets out the technical requirements. Section 8 lists the normative references.

7.1 Robotic welding systems

A complete robotic welding system shall consist of the following components:

a) Robot manipulator

b) Motion and positioning control systems

c) Welding electrode feeding systems

d) Sensing and tracking systems

e) Power sources and electrical systems

f) Welding interface (Human-Machine Interface)

g) Shielding gas delivery system (if necessary)

h) Other peripheral equipment including water cooler, torch cleaner and tool-centre-point locator

Typical robotic welding system is shown in Fig. 1.

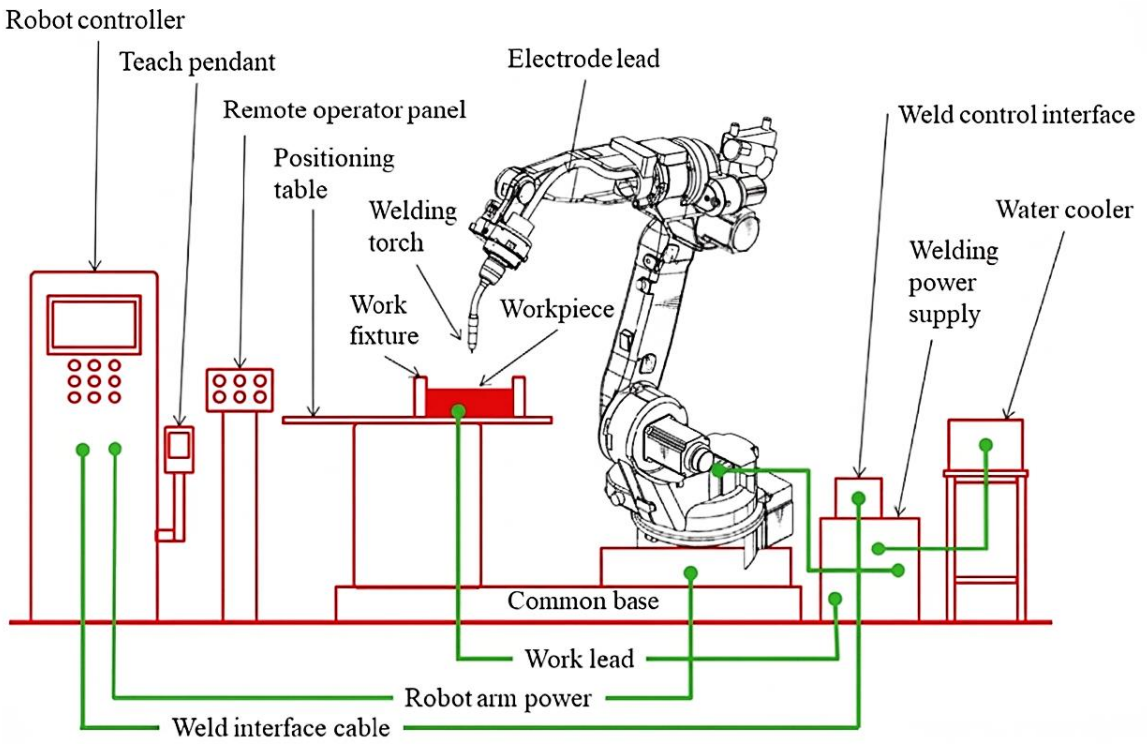


Fig. 1. Schematic illustration of typical robotic welding system

a) Robot manipulator

Essential Requirements

7.1.1 The manufacturer shall declare the intended uses, excluded uses, operating environment constraints, supported materials, electrodes, weld positions (i.e., flat, horizontal, vertical, overhead), types of welded joints (i.e., fillet weld, butt weld) or any combination of these functions.

7.1.2 All parts, guards, covers, fasteners, hoses, cables and connectors shall be securely installed and connected before operation.

7.1.3 The rated payload of the robot shall accommodate the total weight of a welding torch, a cable harness, a gas hose and other end-effector peripherals, with an adequate dynamic safety margin for structural welding.

7.1.4 The working envelope of the robot manipulator shall fully cover all target weld joint zones of the intended workpieces. The reach shall allow the tool-centre-point to access every weld joint at the required welding orientation. Maximum operational reach of the robot manipulator shall be declared by the manufacturer.

7.1.5 Adequate physical working clearance shall be provided for full three-dimensional movement of the robotic welding arm throughout its complete working envelope. No permanent fixed obstacles, structural steelwork or fixture components shall intrude into the 3-D motion volume of the robot manipulator.

7.1.6 The mechanical structure, gearboxes and drive systems of the robot manipulator shall be suitable for continuous cyclic-duty operations under practical welding environments (spatters, dusts, and temperature variations). Mechanical braking shall be in positive acting type and function reliably for holding positions upon motor power-off or emergency-stop events. After motor power-off or emergency-stop events, the robot shall not be restarted automatically. Such restart shall require the operator approval via the Opertor Interface after ensuring that hazard or faults are resolved.

7.1.7 The robot shall declare the permitted operating conditions, including ambient temperature, relative humidity and altitude.

Best Practices

7.1.8 Site layout drawings should be provided which clearly define and document the unobstructed working envelope for deployment of the robot.

b) Motion and positioning control system

Essential Requirements

7.1.9 The robot shall be able to support joint interpolations, linear interpolations and circular interpolations for generation of welding paths.

7.1.10 Acceleration-deceleration-profiling and shake-suppression-control functions shall be available to minimize path-deviation during welding.

7.1.11 Tool-coordinate calibration workflow shall be available for definition of welding torch tool frame.

7.1.12 Work-holding fixtures for structural members or joints shall provide rigid clamping to resist welding distortion of the workpieces;

c) Welding electrode feeding systems

Essential Requirements

7.1.13 Wire feeder performance shall satisfy the welding speed requirements of welding procedure specifications for the workpiece.

Best Practices

7.1.14 Synchronised external-axis positioners / turning rolls should be deployed for heavy structural members to achieve optimised flat / horizontal welding positions.

d) Sensing and tracking systems

Essential Requirements

7.1.15 Feedback signals of arc, voltage and current shall be available for

process-fault-detection (such as arc-dropout and short-circuit fault events).

Best Practices

7.1.16 If the robot is equipped with a seam-tracking sensor, the outputs of the sensor should feed real-time positional correction offsets to the robot controller so that the welding-trajectory is updated continuously to reduce deviations during welding.

e) Power sources and electrical systems

Essential Requirements

7.1.17 Digital welding power sources shall support real-time communications with robot controller and enable setting of welding parameters. Systems shall support standard protocols (e.g., EtherCAT, PROFINET) for interfacing with external monitoring tools and ensure data logging of parameters including but not limited to voltage, current, and speed.

7.1.18 Welding power shall deliver voltage and current within ranges as stipulated in the approved welding procedure specification (WPS) (e.g., 20–30 V, 150–300 A).

7.1.19 Wiring, grounding, and insulation shall meet the requirement of Cap. 406E, including overcurrent protection, fault detection, and isolation switches.

7.1.20 Emergency-stop interlocks shall be available to cut the power of the robot and avoid welding-power-source output on safety-trigger events.

Best Practices

7.1.21 Electrical equipment of the robot should be assessed against IEC 60204-1 or

GB/T 5226.1 where applicable to the supplied machinery configuration.

7.1.22 Data logging of the power source should be available to record time histories of welding current and voltage for traceability of structural welding quality.

f) Welding interface (Human-Machine Interface)

Essential Requirements

7.1.23 The robot shall support different operating modes, including automatic control, manual control or remote control, which shall be declared by the manufacturer.

7.1.24 The Human-Machine Interface (HMI) and teach pendant shall provide clear visual signals to indicate the active control source and system status, such as "power on" or "fault detected".

7.1.25 HMI design shall consider operator line-of-sight and ergonomics to ensure clear visibility of the robot application during manual intervention.

7.1.26 The interface shall be able to display the operational data, including but not limited to its operating mode, operation start/end times, position coordinates, planned area, processed area, fault events, warning and alarm logs, end effector speed and wire-feeding speed.

Best Practices

7.1.27 The user interface for robotic control should support language displays in Traditional Chinese and English.

7.2 Operation guidelines

Essential Requirements

7.2.1 Before deployment, the operator shall ensure safety of the access route and operating zone, including floor capacity, clearances, headroom, openings, loose materials, cables and other hazards that may affect safe movement or stability. The access route and operating zone shall be kept tidy and adequately lit for safe movement, inspection and supervision. Control measures such as use of mechanical ventilation and ensuring a safe working environment are effective means to control the hazards. The use of personal protective equipment (PPE) would also protect the workers concerned against the hazards during the welding operation. The use of PPE shall include but not limited to:

(a) protection against electric shock;

(b) eye and face protection;

(c) respiratory protection;

(d) skin and body protection; and

(e) hearing protection.

7.2.2 The operator shall control access to the hazard zone using barriers, exclusion zones, warnings or other suitable site controls identified by the risk assessment. Access and egress shall be kept unobstructed, and the site layout or emergency escape route shall be displayed or otherwise communicated where required by the site emergency arrangements. Welding operation shall be halted if any

uncertified person has gain access to the hazard zone.

7.2.3 If deployment of the welding robot requires lifting appliances and lifting gear (LALG) and/or other supporting plant or fixture, risk management and operational planning shall be conducted in accordance with Factories and Industrial Undertakings Ordinance (Cap.59) and Occupational Safety and Health Ordinance (Cap. 509).

The supporting structure for the welding robot shall be designed and certified by registered professional engineer with relevant engineering discipline. Relevant safety requirements on LALG shall comply with the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations (Cap. 59J).

7.2.4 Prior to creation of a structural welding program, welding operators shall perform torch tool coordinate calibration and validate datum reference points (Fig.2). Program steps shall define welding trajectory points, interpolation mode, travel speed, welding parameters matching approved welding procedure specification for respective steel grade, gas flow and fixture-clamp-unclamp logic.

7.2.5 Welding parameters including welding current and voltage, wire feed rate, linear travel speed, shielding gas flow rate, torch position and attitude, and weaving amplitude and pattern shall be calibrated by welding operators prior to welding execution.

Best Practices

7.2.6 After program-editing, dry-run trajectory check (without welding arc) should be completed prior to weld execution. Dry-run should verify consistent travel-speed performance along the preset welding path.

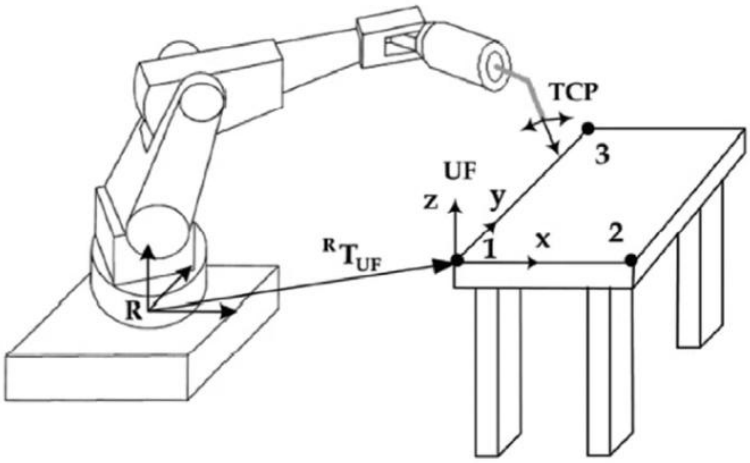


Fig.2. Calibrating a robot user frame with the robot

7.3 Programming and setup

Essential Requirements

7.3.1 Task programming shall be performed through lead-through positioning or a teach pendant.

7.3.2 A task program shall consist of all motion and auxiliary instructions defining the intended application, including the control of collaborative equipment such as positioners.

7.3.3 In automatic mode, all configured safety functions shall be active, and any detected stop condition must result in a stop of all moveable parts.

7.3.4 Manual mode shall be provided for setup, teaching, and program verification to protect personnel within the safeguarded space.

7.4 Welding operation

Essential Requirements

7.4.1 Pre-start-up inspection shall be conducted by the welding operator to verify functionality of the robotic welding system and clear the workspace before power enable. The operator shall perform both visual and functional inspection on various components of the robot manipulator, control system and safety functions.

7.4.2 The welding operator shall set up the parts to be welded, the apparatus (power source, robot, robot program, etc.), and the weld parameters, along with the type of gas and electrode wires before welding execution.

7.4.3 The welding robot shall produce completed welds with an accuracy tolerance of +5 % / −0 % on all weld-related dimensions. Compliance shall be verified by physical measurements on completed weld joints.

7.4.4 If deployment of the welding robot is required in a confined space, relevant requirements about the safety and health of workers under the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap.59AE), Code of Practice: Safety and Health at work for Manual Electric Arc Welding and Code of Practice for Safety and Health at Work in Confined Spaces shall be complied with.

Best Practices

7.4.5 If a predefined programme is used, the welding operator should conduct calibration of the welding process.

7.5 Safety protocols

Essential Requirements

7.5.1 The manufacturer shall establish a risk assessment system in accordance with ISO 10218-1. Risk assessment shall identify potential safety and health hazards and risks to the operator and the surrounding of the robot's working area, during the set-up, operation, maintenance and disassembly of the robot.

7.5.2 The robot shall have self-diagnostic function when powered on, and issue warning upon any system faults.

7.5.3 The robot shall be fitted with collision-detection sensors capable of stopping its robot motion upon detection of physical collisions between the manipulator, the torch and surrounding objects or workpieces.

7.5.4 The robot shall be equipped with flashing alarm devices that issue warning to operators upon any abnormal conditions, where the robot shall be able to automatically stop and enter a safe state. Such abnormal conditions include but are not limited to:

(a) Before collision with surrounding obstacles;

(b) Communication signal loss;

(c) LiDAR fault or positioning error;

(d) Moving outside its specified safe working zone;

(e) System driver fault;

(f) Motor overload or overspeed;

(g) Robotic arm fault;

(h) Wire-feeding system fault;

(i) Shielding gas leakage;

(j) Battery fault or overtemperature;

(k) Low battery level.

7.5.5 The robot shall be equipped with a braking system or equivalent function capable of holding or restraining the robot. In case of any obstacle, unbalancing motion or overspeed is detected, such braking function shall be able to slow down or stop the robot for preventing uncontrolled movement and motion.

7.5.6 An emergency stop function shall be designed to comply with the controlled stopping requirements under the Stop Category 1 in ISO 13850 or GB/T 16754.

7.5.7 The robot shall be equipped with a protective stop function, manually by pressing a button on the robot, or remotely via a wireless controller. The robot shall also have an independent, manually initiated emergency stop function, which shall provide unobstructed access to the operator. Such stopping functions shall be designed to comply with ISO 10218-1 and IEC 60204-1.

7.5.8 Gas hoses and gas cylinders that transport shielding gases shall be located and secured. Requirements on gas installation and associated piping shall comply with Code of Practice: Safety and Health at Work for Manual Electric Arc Welding. An example of a restraint for a gas hose is a mechanical clamp located to prevent “whipping” of a loose hose.

<u>Best Practices</u>

7.5.9 A cybersecurity threat assessment should be conducted. If the cybersecurity

threat assessment identifies that a threat can result in safety risks, cybersecurity measures shall be provided to prevent unauthorized access to the control system of the robot plus its hardware, software, application software and related configuration data.

7.5.10 When collaborative tasks involving both human workers and robots working in collaboration are implemented, the robot should adopt advanced safety functions such as speed and separation monitoring (SSM) and power and force limiting (PFL) to ensure a safe working environment alongside on-site personnel.

7.5.11 The robot should be equipped with flashing alarm devices that issue audible warnings to alert operators and nearby personnel upon any abnormal conditions, to ensure immediate notification to affected workers as soon as an abnormal condition occurs, and to enable emergency arrangement to reduce the risk of injuries.

7.5.12 If the robot is capable of powered travel or powered maneuvering of its base, including remote-controlled, semi-automated or self-navigation travel, it should be equipped with appropriate non-contact protective functions (such as proximity sensors) to identify surrounding obstacles and initiate the required protective response.

7.6. System testing, inspection and maintenance

Essential Requirements

7.6.1 Before deployment, systems shall undergo pre-production testing according to ISO 15614-1 to verify mechanical and electrical performance under site conditions, including load tests and parameter stability checks.

7.6.2 The robot shall be safely unloaded on-site, and the electrical system setup shall be connected and tested by a Registered Electrical Contractor (REC) and a Registered Electrical Worker (REW).

Owners of electrical installations shall have their installations inspected, tested and certified periodically to confirm that the requirements of the Electricity Ordinance (Cap 406) have been met. Periodic test certificate (Form WR2 or WR2(A)) shall be provided.

7.6.3 The manufacturer shall provide operation and maintenance instructions covering set-up, operation, operating modes, safety functions, emergency response, tool change, power and charging, inspection, maintenance and fault recovery. The instructions shall state the required site conditions and resources and shall provide emergency contact or support arrangements where applicable.

7.6.4 The operator shall perform regular inspection and maintenance according to the maintenance instructions provided by the manufacturer every three months to ensure precision and consistency of the robot. After maintenance or repair affecting a safety function, accuracy of welding parameters and wire-feeding speed, positioning, tooling retention, electrical protection or protective sensing,

the affected function shall be checked before return to service.

7.7 Robot certification and qualification

Essential Requirements

7.7.1 The robot's components, including electronic control cabinets, motors, robotic arms and end effector, shall meet IP54 protection rating in accordance with IEC 60529 or GB/T 4208. The welding machine shall meet IP21 or IP23 protection rating in accordance with IEC 60529 or GB/T 4208. A waterproof cover shall be provided to the welding machine if robotic welding needs to be performed under unpredictable weather.

7.7.2 For any lithium-metal or lithium-ion cell or battery being transported, the manufacturer shall provide the UN Manual of Tests and Criteria subsection 38.3 test summary for each cell or battery type, including the required manufacturer and test-laboratory particulars, transport classification, state-of-charge and packaging evidence applicable to the mode of transport.

7.7.3 For any radio transmitter within the State Radio Regulatory Commission (SRRC) type-approval scope, the manufacturer shall submit a valid Radio Transmitting Equipment Type Approval Certificate for the radio components.

7.7.4 For radio transmitting equipment used in Hong Kong, the manufacturer shall classify the equipment under the Hong Kong Telecommunications Equipment Evaluation and Certification (HKTEC) Scheme in OFCA I 421(24).

(a) For equipment under the Compulsory Certification Scheme, the manufacturer shall have obtained a certificate before marketing or use.

(b) For equipment under the Voluntary Certification Scheme, the

manufacturer shall submit an accredited test report/declaration, along with documentary evidence of compliance with the Telecommunications Ordinance (Cap. 106).

7.8 Training and qualification of welding personnel

Essential Requirements

7.8.1 Welding operators and weld setters shall have received adequate and specific training for the welding robots provided by the manufacturer or qualified trainers, including

(a) Theoretical learning courses on functional knowledge on welding robot and welding technology;

(b) Practical trial operations in training grounds;

(c) Competency assessments, with written tests and practical tests.

Welding operators and weld setters shall only perform welding operation under the supervision of a registered semi-skilled welder under Construction Workers Registration System (CWRS) of the Construction Industry Council.

7.8.2 Welding operators shall hold valid Certificate for Gas Welding issued under Factories and Industrial Undertakings (Gas Welding and Flame Cutting) Regulation (Cap.59AI).

7.8.3 For welding operators and weld setters, qualification testing and acceptance criteria shall be based on test pieces in accordance with BS EN ISO 14732. Assessment records, certification documents and training records shall be kept on-file for audit and project acceptance purposes. Welding operators and weld setters shall only perform tasks within the scope defined by their qualification certificate.

7.8.4 If a member of welding personnel is required to work in a confined space , he/she is required to attend an approved safety training courses in connection with confined space work and holds a valid certificate as a certified worker in accordance with the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE).

If a member of welding personnel is required to carry out the duties in a confined space as a competent person, he/she is required to attend an approved safety training course in connection with confined space work and holds a valid certificate as a competent in accordance with the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE).

7.8.5 Welding operators shall be trained in the safety and health aspects of work under normal operation as well as in emergencies according to Code of Practice: Safety and Health at Work for Manual Electric Arc Welding. Welding operators and weld setters shall hold valid Certificate for Electric Arc Welding Safety Training Course.

7.8.6 Re-training or re-assessment of welding operators and weld setters shall be carried out by the manufacturer or suitably qualified trainers at appropriate intervals, or when circumstances arise that may affect the welding operators' or weld setters' previously demonstrated competence, including significant system change, relevant incident, unsafe operation or extended period without use.

7.9 Documentation

Essential Requirements

The following information shall be provided by the manufacturer:

(a) Operation manuals for the manipulator and controller

(b) Test records to demonstrate dimensional tolerance

(c) Test records to demonstrate uniformity of welding speed

7.9.1 The operator shall maintain relevant documents containing the declared robot functions and project information, including but not limited to:

(a) Business Registry or other legal documents as a proof of registry as a legal entity;

(b) Safety-related Risk Assessment and Safety Precaution measures;

(c) Manual / Procedure for Set-up including Mounting of Construction Robot and relevant Records;

(d) Manual / Procedure for Disassembly of Construction Robot and relevant Records;

(e) Manual / Procedure/ Handbook for Operation with Emergency Control measures;

(f) Manual / Procedure/ Handbook and Schedule for Maintenance and relevant Records;

(g) Authorization Documents / Records;

(h) Key Production Procedures and Records;

(i) Internal Quality Assurance Procedures and Quality Control Records;

(j) Pre-work Risk Assessment Record (on-site);

(k) Product Quality and Safety Inspection Record (on-site);

(l) Product Catalogue (latest version);

(m) Technical Specification Data Sheet (latest version);

(n) Drawings / Electrical Circuit Diagram (where applicable);

(o) Test Reports;

(p) Test Certificates;

(q) Training Records of Robot Operator, Robot Users and Company Representative;

(r) Safety-related Incident or Accident Occurrence Reports and follow-up;

(s) Quality performance related nonconforming issues;

(t) Post-delivery Complaint received;

(u) Warning Letter or Summit received regarding offence of local statutory or regulatory regulations, and violence of contractual requirements.

7.9.2 Before each document is created or updated, it shall be reviewed and approved to ensure appropriate identification and description are established, including title, date, author, reference number, language, software version, graphics, media format.

7.9.3 The documents and records shall be stored, preserved, adequately protected against loss of confidentiality, improper use, loss of integrity and unintended alterations.

7.9.4 The manufacturer shall implement measures in the operator interface to prevent unauthorized data access, data manipulation or data loss, including but not limited to role-based access control and authentication to the operator interface, data backup and recovery functions.

7.9.5 The documents and records shall be kept for a retention period not less than 3 years from the date of project completion.

7.9.6 The operational data logs shall be retained for at least 30 days.

7.9.7 The operational data logs shall be exportable to a readable format such as TXT.

8. Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the editions cited shall apply. For undated references, the latest editions of the referenced documents, including any amendments, shall apply.

1. Buildings Department of HKSAR Government – Code of Practice for the Structural Use of Steel 2011;
2. Buildings Department of HKSAR Government – Code of Practice for Site Supervision 2009;
3. Development Bureau of HKSAR Government – Technical Circular (Works) No. 9/2025: Adoption of Construction Robots;
4. Electrical and Mechanical Services Department of HKSAR Government – Code of Practice for the Electricity (Wiring) Regulations;
5. Electricity Ordinance (Cap. 406);
6. Electricity (Wiring) Regulations (Cap. 406E);
7. Occupational Safety and Health Ordinance (Cap. 509);
8. Factories and Industrial Undertakings Ordinance (Cap.59)
9. Construction Sites (Safety) Regulations (Cap.59I)
10. Factories and Industrial Undertakings (Electricity) Regulations (Cap. 59W);
11. Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations (Cap. 59J);
12. Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE);

13. Factories and Industrial Undertakings (Gas Welding and Flame Cutting) Regulation (Cap.59AI);
14. Occupational Safety and Health Branch, Labour Department - Code of Practice: Safety and Health at Work for Manual Electric Arc Welding.
15. Occupational Safety and Health Branch, Labour Department - Code of Practice for Safety and Health at Work in Confined Spaces.
16. EN ISO 9283:1998, Manipulating industrial robots — Performance criteria and related test methods.
17. EN ISO 10218-1:2025 - Robotics — Safety requirements. Part 1: Industrial robots.
18. EN ISO 10218-2:2025, Robotics - Safety requirements - Part 2: Industrial robot applications and robot cells.
19. ISO 12100:2010, Safety of machinery — General principles for design — Risk assessment and risk reduction.
20. ISO 13849-1:2023, Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design.
21. ISO 13850:2015, Safety of machinery — Emergency stop function — Principles for design.
22. ISO 14118:2017, Safety of machinery — Prevention of unexpected start-up.
23. ISO 14119:2024, Safety of machinery — Interlocking devices associated with guards — Principles for design and selection.
24. IEC 60204-1: Electrical equipment of machines — Part 1: General requirements.
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