Activity Hazard Analysis (AHA) — HVAC / Mechanical Equipment Installation

Overall RAC: **M** · SAMPLE formatted to EM 385-1-1 (15 March 2024) and ENG Form 6206 (SEP 2024) conventions. Adapt every step, hazard and control to actual site conditions; requires competent-person preparation, SSHO review and Government acceptance before the definable feature of work begins (EM 385-1-1 2024, para 2-6). Contracts solicited before 15 March 2024 remain governed by the 2014 edition — verify which edition your contract cites.

JOB STEPS	HAZARDS	CONTROLS	RESIDUAL RAC
Mobilization, equipment delivery, offloading, and staging of HVAC units and materials	Struck-by or crushed-by during forklift/telehandler offloading of AHUs, RTUs, and duct bundles	• Permit only operators trained, qualified, and designated according to 29 CFR 1910.178 — classroom plus practical operation, on the same type of truck used on the job — to operate forklifts or telehandlers (18-3.f, 18-8.i(3)). • Verify each forklift and telehandler meets ANSI/ITSDF B56.1 and has its rated capacity posted, clearly visible to the operator; never exceed the ratings (18-8.i, 18-8.i(2)). • Establish a marked exclusion zone around the offloading area and prohibit workers from standing between the load and fixed objects or under any raised load. • Use a trained spotter with agreed hand signals when the operator's view of the travel path or set-down point is obstructed.	L
	Back and shoulder strains from manually handling duct sections, VAV boxes, and pipe	• Train all crews on safe lifting techniques before manual handling begins (14-3.a). • Substitute mechanical handling — pallet jacks, duct lifts, carts — for manual carries wherever the route allows. • Enforce two-person lifts for duct sections and equipment over roughly 50 lb and plan carry routes clear of debris before the lift.	L
	Collapse of stacked materials or failure of storage racking in the laydown area	• Inspect storage systems, racking, blocking, and pallets per the manufacturer's instructions and remove from service any component showing deterioration or weakness (14-5.a). • Stack duct and equipment on level, compacted ground with blocking, and limit stack heights so materials cannot topple into walkways. • Inspect work and laydown areas daily for housekeeping and record the findings in daily inspection reports (14-5.c).	L
Crane and hoist operations — setting RTUs, chillers, and AHUs on roofs and pads	Dropped or shifted load from rigging failure or improper hitch during equipment picks	• Document the crane operator's certifications, qualifications, and written designation in the AHA and submit it for KO/COR acceptance before the pick (16-6.a); notify the KO or COR within 24 hours of the crane entering the site (16-5.c). • Have a CP perform and document the shift inspection of the crane before every operation, at the beginning of each shift, and after any operator change; do not lift until deficiencies are corrected (16-5.e(2)(a)). • Verify rigging capacity against the manufacturer's certified equipment weight, use safety latch-type hooks and shackles (15-5.g(8)), and control the load with tag lines (16-8.v(6)). • Immediately remove from service any LHE found unsafe until the condition is corrected (16-5.d).	M
	Workers struck by the swinging load or caught in the swing radius	• Barricade accessible areas within the swing radius of the rotating superstructure and mounted items before hoisting begins (16-8.v(11)(b)). • Prohibit all personnel from working or passing under suspended loads; sequence other trades out of the lift zone during picks. • Maintain continuous, agreed communication between the operator, rigger, and signal person using a standard signal system — hand signals within 100 ft, radio beyond or without line of sight (16-8.v(4)).	M
	Crane contact with overhead power lines or rooftop obstructions	• Identify overhead lines and rooftop obstructions in the lift planning and AHA before mobilizing the crane, and define the operating envelope for the LHE (16-8.v(8); Ch 11). • Coordinate with the installation to de-energize or maintain required clearance distances from any energized lines near the pick path, using a dedicated spotter when working near the clearance limit.	L

JOB STEPS	HAZARDS	CONTROLS	RESIDUAL RAC
Installing ductwork, piping, and equipment at height from MEWPs, scaffolds, and ladders	Falls of 6 ft or more from MEWPs, scaffolds, mezzanines, roof edges, and floor openings	• Provide fall protection at the 6-ft (1.8 m) threshold for all work covered by the manual — 4 ft on USACE-owned or operated permanent facilities (21-8.a(1) and 21-8.a(2)). • Apply the fall protection hierarchy of controls when selecting the protective method for each task (21-8.b), preferring elimination and passive barriers such as guardrails over personal fall arrest. • Have each authorized person inspect personal fall protection equipment before each use, with documented CP inspections at least semi-annually, and remove from service any equipment subjected to a fall (21-5.a). • Verify MEWP operators have both general and equipment-specific training (22-3.d) and that the operator surveys the area and confirms a firm, level surface, manufacturer loading, and any required outriggers before elevating (22-4.c).	M
	Scaffold collapse or ejection from an incomplete or defective scaffold	• Have the scaffold CP inspect all scaffold components for visible defects before each work shift and after any occurrence that could affect structural integrity (22-5.a). • Tag every scaffold before use with the CP's name, signature, and inspection dates, stating whether it is safe, incomplete, or unsafe (22-5.c). • Train every employee who works from a scaffold on its hazards, maximum intended load, and proper material handling (22-3.a).	L
	Falls from damaged or misused ladders during hanger and trim work	• Inspect ladders for visible defects before each use and immediately tag damaged ladders 'DO NOT USE' and withdraw them from service (24-5.b). • Inspect all accessways daily to ensure they are free of hazards and obstructions (24-5.a). • Substitute podium ladders or MEWPs for extension ladders on repetitive overhead duct-hanger work where floor conditions allow.	L
Brazing, soldering, and welding of refrigerant and hydronic piping (hot work)	Fire ignition of combustible construction materials by brazing flame, sparks, or slag	• Obtain a hot work permit before hot work on federal installations unless the USACE supervisor/KO or COR indicates otherwise (10-8.d(2)). • Survey the area before starting to confirm no combustible materials within 35 ft (10.7 m) and no flammable vapors or oxygen-enriched atmospheres; move the work or the combustibles, or shield what cannot be moved (10-8.d(3), 10-8.d(4)). • Identify the CP for welding and the fire watch in the AHA; maintain the fire watch a minimum of 30 minutes after the exposure ends (10-6.d). • Keep suitable fire extinguishing equipment in the immediate vicinity, in a constant state of readiness (10-8.d(1)).	L
	Toxic fume and oxygen-displacement exposure when brazing in mechanical rooms or shafts	• Develop the AHA to identify the metals, filler alloys, and welding process in use so fume hazards can be evaluated (10-6.a, 10-6.b). • Naturally or mechanically vent all brazing so exposures stay within acceptable limits, with local exhaust ventilation in enclosed or confined spaces (10-8.c(2)); where ventilation cannot control exposure, use respiratory protection selected under the Ch 5 program (10-3.a). • Never braze on piping or vessels under pressure or containing refrigerant; recover and purge lines first.	L
	Compressed gas cylinder fire or violent release (oxy-fuel and nitrogen cylinders)	• Inspect torches, cables, shut-off valves, couplings, and tips before each use and remove defective equipment from service (10-5). • Keep oxygen cylinders, valves, regulators, and fittings free of oil and grease and never handle them with oily hands or gloves (20-8.d(17), 29 CFR 1926.350). • Secure all cylinders upright, cap them when not in regulator service, and segregate oxygen from fuel gas in storage.	L

JOB STEPS	HAZARDS	CONTROLS	RESIDUAL RAC
Electrical rough-in and equipment tie-ins to building power	Shock or arc flash from unexpected energization while connecting units, VFDs, and disconnects	• Before any tie-in on a system that produces, uses, or stores hazardous energy, develop the Site-Specific Energy Control Plan with its Hazardous Energy Isolation Procedures (HIPs) and AHAs and obtain KO or COR acceptance; all Authorized Individuals must review them (12-8.a(3)). • Lock out every energy isolating device capable of being locked out; use tagout with equivalent supplementary protection only where lockout is not possible (12-8.b(1)). • Assign electrical connections only to Qualified Persons trained at a minimum to NFPA 70E, with documented, verifiable training (11-3.b). • Verify zero energy at the point of work with a rated tester before contact, per the accepted isolation procedure and 29 CFR 1926.417.	M
	Shock from damaged cords and temporary power feeding drills, threaders, and vacuum pumps	• Provide GFCI protection for personnel on all 125-volt, 15-, 20-, and 30-amp receptacle outlets supplying temporary power and on all circuits serving portable and semi-portable electric tools (11-8.l(9)). • Inspect all portable flexible cords and cables before use on each shift and remove damaged cords from service (11-5.d). • Test GFCIs monthly, and test temporary distribution systems for polarity, ground continuity, and ground resistance before initial use and after modification (11-5.e).	L
Work inside air plenums, ducts, crawl spaces, and mechanical pits	Hazardous atmosphere or engulfment/entrapment in confined spaces (plenums, large ducts, pits)	• Evaluate and classify each plenum, duct section, crawl space, and pit against the Ch 34 confined space criteria before anyone enters; identify all existing and potential hazards in the AHA (34-6.a). • For permit-required spaces, have the Entry Supervisor develop and submit a written Site-Specific Confined Space Plan — including the permit process, atmospheric monitoring procedures, communication methods, and rescue plan — for acceptance before work begins (34-7.b). • Conduct documented pre-entry inspections of atmospheric testing and monitoring equipment, including calibration records, plus ventilation, retrieval, and rescue equipment (34-5.a through 34-5.j). • Train all personnel working in or around confined spaces before first assignment and at least annually, including permit completion and rescue exercises (34-3.a, 34-3.b).	M
	Contact with unidentified in-duct hazards (energized heaters, rotating dampers/fans) during interior duct work	• Apply the SSECP and equipment-specific isolation procedures to lock out duct heaters, fan motors, and damper actuators before interior work (12-8.a(3)). • Instruct all incidental personnel in the prohibition against restarting or reenergizing locked- or tagged-out equipment (12-3.d).	L
Pressure testing of refrigerant piping and hydronic systems	Violent release of stored energy — fitting blow-off, pipe whip, or projectile failure during pneumatic testing	• Do not use pressurized gases or air for structural integrity or leak testing except when permitted by the manufacturer's specifications or an applicable code (20-8.e(1)); use hydrostatic testing where the system allows. • Have a CP develop the test procedures, submit them to the KO or COR for acceptance, and supervise the testing; all workers performing the test must know the procedures, hazards, and controls (20-8.e(2)). • If acceptance testing occurs two or more months after the initial piping preparatory meeting, conduct a supplemental preparatory meeting to re-review the test procedures and AHA before testing (20-8.e(3)). • Barricade an exclusion zone around the test section sized to the stored energy, and never exceed design pressure or defeat relief devices (20-8.a(3), 20-8.a(4)).	M
	Failure of regulators, hoses, or gauges on nitrogen test rigs	• Inspect and performance-test pressurized equipment before placing it in service and after any repair or modification (20-5.a(1)). • Have a CP perform and document visual inspections of temporary or portable pressurized equipment at least every six months (20-5.a(3)). • Tag any pressurized equipment found unsafe as 'UNSAFE PRESSURIZED SYSTEM - DO NOT USE' at the controls and remove it from service until corrected (20-8.a(1)).	L

JOB STEPS	HAZARDS	CONTROLS	RESIDUAL RAC
System startup, refrigerant charging, commissioning, and demobilization	Refrigerant release causing frostbite injury or oxygen displacement in mechanical rooms	• Charge and recover refrigerant only with trained technicians using recovery equipment rated for the refrigerant, following the SDS handling requirements. • Ventilate mechanical rooms during charging and monitor enclosed spaces where a large release could displace oxygen (see Ch 34 for enclosed-space evaluation). • Wear insulated gloves and eye protection when connecting or breaking charging hoses.	L
	Contact with rotating fans, belts, and drives during commissioning checks	• Apply the accepted hazardous energy isolation procedures before removing guards or working on drives; only Authorized Individuals may perform LOTO (12-8.b(2)). • Reinstall all guards and verify interlocks before functional testing, and keep hands, tools, and clothing clear during rotation checks.	L
	Slips, trips, and lacerations during cleanup and demobilization	• Inspect work areas daily for adequate housekeeping and record findings in the daily inspection reports (14-5.c). • Remove scrap duct, banding, and pipe cutoffs to designated containers daily; sheet metal edges are cut-resistant-glove work. • Inspect accessways daily to keep exit routes clear through demobilization (24-5.a).	L

Equipment To Be Used

• Mobile crane / material hoist for setting rooftop and pad-mounted units (Ch 16)

• Forklift / telehandler for offloading and staging (Ch 14, 18-8.i)

• Mobile elevating work platforms (MEWPs) — scissor and boom lifts (22-8.m)

• Scaffolds and ladders for duct and piping runs (Ch 22, Ch 24)

• Rigging hardware with safety latch-type hooks and tag lines (15-5.g(8), 16-8.v(6))

• Oxy-fuel brazing/torch outfits with regulators and flashback arrestors (Ch 10, 29 CFR 1926.350)

• Nitrogen cylinders, regulators, gauges, and manifolds for pressure testing (Ch 20)

• Personal fall arrest systems and anchorages (Ch 21)

• GFCI-protected temporary power, cords, and portable electric tools (11-8.l(9))

• Lockout/tagout locks, tags, and isolation devices (12-8.b)

• Calibrated multi-gas atmospheric monitor, ventilation blower, and retrieval equipment for confined space entries (34-5)

• Fire extinguishers staged at each hot work location (10-8.d(1))

Training Requirements

• Crane/hoist operator certification, employer qualification, and written designation (16-3.a, 16-3.c)

• Powered industrial truck / telehandler operator training and certification per 29 CFR 1910.178, on the same type of truck used on the job (18-3.f, 18-8.i(3))

• MEWP operator training with general and equipment-specific familiarization; occupant instruction in emergency lowering procedures per ANSI A92.24 (22-3.d, 22-3.e)

• Scaffold user training by a person qualified in the subject matter; 8-hour minimum CP scaffold training (22-3.a, 22-3.b)

• Fall protection training for Authorized Persons conducted by a CP before use of the equipment; CP for fall protection with a 24-hour minimum initial course (21-3.d, 21-3.c)

• Welder designation in writing with proof of qualification attached; training in safe welding practices, respirator use, and fire protection (10-3.a, 10-3.b)

• Electrical safety training for all exposed employees; Qualified Persons trained at a minimum to NFPA 70E with documented, verifiable training (11-3.a, 11-3.b, 11-3.g)

• Hazardous energy control training for Authorized Individuals, Affected Persons, and Incidental Individuals per the SSECP (12-3.a through 12-3.d)

• Confined space training before first assignment and at least annually, including permits, monitoring equipment, and rescue exercises (34-3.a, 34-3.b, 34-3.c)

• Safe lifting techniques for all material handling crews (14-3.a)

Inspection Requirements

• CP shift inspection of all load handling equipment before every operation, each shift, and after operator changes — documented and kept 12 months or life of contract (16-5.e(2)(a))

• KO/COR notification within 24 hours of any LHE entering the site (16-5.c)

• Scaffold CP inspection before each work shift with documented scaffold tags (22-5.a, 22-5.c); MEWP pre-operation survey and setup checks by the operator (22-4.c)

• Personal fall protection: user inspection before each use; documented CP inspection at least semi-annually and after any fall (21-5.a)

• Ladders inspected for visible defects before each use; accessways inspected daily (24-5.b, 24-5.a)

• Welding/brazing equipment — torches, cables, valves, couplings, tips — inspected before each use (10-5)

• Flexible cords inspected each shift; GFCIs tested monthly; temporary distribution systems tested before initial use and after modification (11-5.d, 11-5.e)

• Pressurized equipment inspected before placing in service and after repair; CP visual inspections of temporary/portable pressure equipment at least every six months (20-5.a(1), 20-5.a(3))

• Atmospheric monitors and confined space entry equipment inspected with documented calibration before each entry (34-5.a)

• Daily housekeeping inspections recorded in daily reports (14-5.c)

Competent / Qualified Person Requirements

• Designated crane/hoist operator (written designation) and CP for LHE shift inspections; Lift Director where lift plans are required (16-3.a, 16-3.b, 16-5.e(2)(a))

• CP for welding and fire watch, identified by name in the AHA (10-6.d)

• CP for fall protection (21-3.c) and CP for scaffolding (22-3.b)

• Qualified Person (electrical) with verifiable credentials for all electrical tie-ins (11-3.b)

• Authorized Individuals for lockout/tagout under the accepted SSECP (12-3.b, 12-8.b(2))

• CP to develop and supervise pressure test procedures submitted for KO/COR acceptance (20-4.b, 20-8.e(2))

• Confined space Entry Supervisor, plus trained Entrants and Attendants, for plenum/pit entries (34-3, 34-7.b)

• All CP/QP designations must be documented in writing by name in the AHA (2-6.d(4)(g))

References

• EM 385-1-1 (2024) Ch 14 — Material Handling, Storage, Disposal, and Conveyors

• EM 385-1-1 (2024) Ch 16 — Load Handling Equipment

• EM 385-1-1 (2024) Ch 10 — Welding and Cutting

- EM 385-1-1 (2024) Ch 11 — Electrical
- EM 385-1-1 (2024) Ch 12 — Control of Hazardous Energy
- EM 385-1-1 (2024) Ch 20 — Pressurized Equipment and Systems
- EM 385-1-1 (2024) Ch 21 — Fall Protection
- EM 385-1-1 (2024) Ch 22 — Working Platforms and Scaffolding
- EM 385-1-1 (2024) Ch 24 — Safe Access
- EM 385-1-1 (2024) Ch 34 — Confined Space
- 29 CFR 1926 Subpart K — Electrical (1926.404(b)(1) GFCI/AEGCP, 1926.405 wiring methods)
- 29 CFR 1926.350-.354 — Subpart J — Welding and Cutting (gas welding, arc welding, fire prevention, ventilation)
- 29 CFR 1926.500-.503 — Subpart M — Fall Protection
- 29 CFR 1926 Subpart H — Materials Handling, Storage, Use, and Disposal (1926.250-.252)
- 29 CFR 1926.417 — Lockout and Tagging of Circuits