INSTALLATION · COMMISSIONING · MAINTENANCE MANUAL

Autoclaves, Steam Storage & Pressure Vessels

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This manual covers the operation, inspection and maintenance of Henan Yongxing Special Equipment Co., Ltd. pressure vessels: single-door, pass-through and vertical saturated-steam autoclaves, steam storage vessels, expansion tanks, air receivers and oxygen storage tanks. It is written for plant operators, maintenance fitters and the authorised inspector who signs the periodic inspection record. It covers pressure-vessel law essentials, foundation and seismic restraint, door interlock testing, gasket and safety-valve care, cycle validation, and the daily-to-annual maintenance schedule. Where this text and the registration certificate differ, the certificate governs.

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Applies to Autoclaves, steam storage, expansion and receiver tanks **Language** English

1. Scope and model coverage

The family covers quick-opening autoclaves for saturated-steam sterilisation at 121 °C and 134 °C, with the static vessels that sit beside them in a steam plant. Chamber design pressure starts at 0.6 MPa, a wide margin over the 0.21 MPa gauge needed for a 134 °C cycle, and rises to 2.5 MPa for high-pressure receivers. Jackets are rated 1.0 MPa unless the nameplate states otherwise.

Model family	Capacity range	Design pressure / temperature	Heating medium	Typical duty
YX-AU-S single-door autoclave	0.6–12 m³ chamber	0.6 / 1.0 MPa, 150 °C	Saturated steam	Batch sterilisation of instruments, media and glassware
YX-AU-P pass-through autoclave	1.5–20 m³ chamber	0.6 / 1.0 MPa, 150 °C	Saturated steam	Clean-side / dirty-side transfer in barrier facilities
YX-AU-V vertical autoclave	0.1–1.5 m³ chamber	0.6 MPa, 150 °C	Saturated steam or electric	Small laboratories, media preparation, waste kill cycles
YX-SSV steam storage vessel	2–30 m³	1.0 / 1.6 MPa, 200 °C	Boiler steam	Peak-demand buffer, surge suppression, wet-steam knock-out

Model family	Capacity range	Design pressure / temperature	Heating medium	Typical duty
YX-EXT diaphragm expansion tank	0.5 m³–10 m³	0.6 / 1.0 MPa, 120 °C	System water	Volume compensation in hot-water and jacket circuits
YX-AR air receiver	1–20 m³	1.0 / 1.6 / 2.5 MPa, 80 °C	Compressed air	Compressor buffering, instrument air, door actuation reserve
YX-O2 oxygen storage tank	5–50 m³	2.5 MPa, 80 °C	Gaseous oxygen	Oxygen header storage, vaporiser buffer, peak supply

Excluded: site electrical works beyond the terminal box, the boiler and cooling plant, room ventilation, cleanroom pressure regimes, and the sterile barrier wall of a pass-through installation.

Every vessel carries a nameplate showing design pressure, design temperature, volume, medium, manufacturer, date and registration number. Register the vessel before use, keep the certificate on site, present it at each periodic inspection, and use only an authorised inspection body and trained operators. The certificate states the inspection interval and governs over this manual.

2. Site and utility requirements before delivery

Confirm every item below before delivery. A short foundation or a wet steam supply delays handover and cannot be fixed on site. Hold the room at 15–30 °C, frost-free and dry, with six air changes per hour.

Steam quality matters more than quantity. Carry a dedicated line from the boiler header and fit a separator and trap at the lowest point; wet steam carries non-condensable gas into the chamber and lengthens the cycle.

Item	Requirement	Tolerance / notes
Foundation / plinth	Reinforced concrete, cube strength ≥ 25 MPa at 28 days, mass at least 1.5× vessel empty mass	Flat to ±3 mm over 3 m; plinth at least 100 mm above finished floor
Clearances	Door swing plus 1.2 m at the loading face; 0.8 m at the service face	Tube withdrawal space per GA drawing
Steam supply	Dry saturated, 0.4–0.6 MPa at the battery limit, sized for peak cycle	Separator and trap within 3 m of the inlet; 40-mesh strainer
Cooling water	0.2–0.3 MPa at the jacket inlet, ≤ 30 °C, ≥ 2 m³/h per m³ of chamber	Chloride ≤ 25 mg/L for stainless chambers; strainer fitted
Compressed air	0.5–0.7 MPa, dew point ≤ 2 °C, oil-free	Filter-regulator and lockable isolation at the vessel

Item	Requirement	Tolerance / notes
Electrical supply	400 V three-phase plus neutral and earth, dedicated isolator at the door	Disconnection within 0.4 s; bonding ≤ 0.1 Ω
Drainage	Blowdown pit or trench with air gap, capable of 90 °C discharge	Pipe slope ≥ 1:100 toward the pit; no lift in the drain line
Environment	15–30 °C, ≤ 85% RH, no corrosive vapour	Oxygen tanks: ≥ 5 m from oil storage, no ignition source

3. Installation sequence

1. Survey the plinth before unloading. Check strength records, level to ±3 mm over 3 m and anchor bolt positions; stop if out of tolerance.
2. Lift only at the marked lugs with certified slings and a rated spreader beam. Doors locked; never lift by the door frame, locking ring or a nozzle.
3. Set the vessel on 25–50 mm grout pads and level to ±2 mm/m in both axes. Confirm the door face is square to the trolley rails.
4. Fit anchor bolts and seismic brackets. Tighten to the drawing torque after the grout reaches 75% strength, then re-check level.
5. Connect steam through an isolation valve, 40-mesh strainer and trap set. Support the pipework independently so no load reaches the nozzle.
6. Pipe the safety valve outlet full bore to a safe point with no intervening valve; drill a 6 mm drain hole at the low point.
7. Connect chamber and jacket drains to the pit through an air gap, falling at least 1:100 with no low pockets.
8. Connect cooling water through a strainer and pressure-reducing valve; set the jacket inlet to 0.2–0.3 MPa and confirm return flow.
9. Connect instrument air at 0.5–0.7 MPa through a filter-regulator with a lockable isolation valve.
10. Complete the electrical termination and bond the vessel to the earth bar; verify ≤ 0.1 Ω and route signal cables clear of steam lines.
11. Fit insulation only after the hydrostatic test, leaving the door flange, nameplate, safety valve and instruments clear.
12. Hydrostatic test at 1.5× design pressure for 30 min: no leakage, no deformation, no drop beyond gauge error; then drain and dry.
13. Prove every interlock in section 4, record the results, and hand over the registration documents before the first production cycle.

Lifting and rigging

A loaded autoclave is top-heavy and its centre of gravity moves toward the door end. Use a spreader beam, keep personnel outside the swing radius, and never stand under a suspended vessel. A dropped vessel is a pressure-boundary defect: do not return it to service until the shell and door ring are inspected and the inspection body accepts it in writing.

Anchor points and expansion

Fix the vessel at the door end and let the far end slide on PTFE pads, or use slotted holes, so thermal growth of 1–2 mm/m does not load the shell. Seismic brackets are shimmed to 1 mm clearance and carry load only during an event. Never weld brackets or supports to a stressed shell without written approval.

4. Commissioning and handover

Hydrostatic test pressure is 1.5× the nameplate design pressure: 0.9 MPa for 0.6 MPa, 1.5 MPa for 1.0 MPa, 2.4 MPa for 1.6 MPa and 3.75 MPa for 2.5 MPa. Hold for 30 min after shell and water equalise in temperature, per GB/T 150 and the TSG 21 registration regime; boiler-side parts of a packaged supply follow GB/T 16508 and TSG G0001. Use water with chloride ≤ 25 mg/L, vent all high points, and never use the safety valve as a test vent.

Fill the jacket and chamber, vent until a steady stream runs, raise pressure in 25% steps with a 2 min hold at each, then drain and dry; standing water pits the gasket seat.

Set the steam supply so the chamber reaches 134 °C within the ramp time on the cycle card, normally 8–15 min for 2 m³. Check inlet steam quality with a conductivity meter or calorimeter; below 0.95 dryness means the separator or trap is not working. Compare chamber temperature with the saturation temperature for the measured pressure: a difference above 0.5 °C indicates air trapping.

Interlock	Simulated condition	Expected result
Door open with pressure	Raise to 0.05 MPa; attempt to release the locking ring by hand and by control	Door stays locked; ring does not move; alarm sounds above 3 kPa
Door not locked, steam admitted	Leave the door ajar by 10 mm and call for a cycle	Steam valve stays closed; cycle refuses to start with a door fault
Pressure switch failure	Disconnect the switch signal during a hold phase	Cycle aborts, steam valve closes, vent opens, alarm sounds
Over-temperature	Force the sensor reading 3 °C above set point	Steam valve closes within 2 s; no re-admission until reset
Safety valve	Raise to set pressure with the door closed and chamber empty	Lifts at set pressure, reseats below 90% of set, accumulation ≤ 10%

Interlock	Simulated condition	Expected result
Vacuum breaker	Cool a sealed chamber from 134 °C with the vent closed	Opens at −3 to −5 kPa; vacuum never below −10 kPa
Emergency stop	Press the E-stop during the sterilisation hold	Steam and air isolate, vent opens, cycle logged as aborted

Validate with thermocouples in the coldest loaded position and with biological indicators of *Geobacillus stearothermophilus* at 10^6 spores per carrier. Three consecutive cycles must show $F_0 \geq 15$ min at 121 °C, a chamber spread within ±1 °C and no growth. Record the load pattern; validation applies only to that load.

Run a 4 h and then a 24 h trial at production load, logging ramp, hold temperature, jacket pressure, cooling time and condensate flow per cycle. Handover documents: registration certificate, nameplate rubbing, GA and pressure-boundary drawings, material certificates, weld and NDT reports, hydrostatic record, safety valve and calibration certificates, interlock record, validation report, spare gasket set and this manual.

5. Normal operation

Start-up from cold. Open the chamber drain and confirm it is clear. Open the steam isolation valve slowly and warm the jacket to 0.1 MPa over 10 min. Clean and dry the gasket seat, load below the marked load line, close and lock the door, confirm the lock indicator, then start the validated cycle.

Start-up from hot standby. Confirm jacket pressure and trap discharge. Vent the chamber for 60 s before loading, then close the drain. Do not open a hot door onto a cold load; thermal shock distorts the door ring and shortens gasket life.

Running log. Record each cycle: 0.11 MPa at 121 °C or 0.21 MPa at 134 °C, hold within ±1 °C, jacket 0.3–0.6 MPa, inlet steam 5–10 °C above saturation, cooling water ≤ 30 °C, and cycle time within 10% of the validated value. Rising temperature with falling pressure means non-condensable gas; a hold short of set point means a fouled trap or wet load.

Normal shutdown. Complete the cycle, vent to zero, confirm the gauge reads zero and the vent is open, then release the interlock and open the door. Close the steam isolation valve, drain the jacket if idle, and leave the door ajar.

Emergency shutdown. Press the E-stop, close the manual steam valve, and leave the chamber sealed until the gauge reads zero. Do not force the door. If pressure does not fall within 15 min, treat it as a blocked vent; never open a fitting on a pressurised shell.

Expansion tank. Set the nitrogen pre-charge to 0.1 MPa below the system static pressure before filling, and re-check it quarterly with the tank isolated and drained.

Lay-up over 30 days. Wet: fill with demineralised water at pH 10–11, add oxygen scavenger to 200 mg/L and circulate monthly. Dry: drain, dry with warm air, add 1 kg of silica gel per m³ through the inspection

opening, and blank the connections. Leave the safety valve fitted and tagged, never gagged. Renew the gasket and re-prove the interlock before return to service.

6. Maintenance schedule

The schedule assumes daily production use. Increase frequency where steam quality is poor, the load is corrosive or the room is humid. Internal work requires a cold, vented, isolated and gas-free vessel under permit.

6.1 Daily (each shift)

Task	What to check / acceptance	Tool or reference	Who
Door seal visual	No cuts or hardening; seal uniform in its groove; no steam plume at the door edge	Torch, cycle log	Operator
Zero-pressure interlock check	At zero gauge, door opens only with the vent open and lock indicator clear; no bypass key	Function check, SOP-04	Operator
Pressure gauge reading	Zero before start; tracks the controller within 0.02 MPa	Gauge, HMI display	Operator
Steam trap	Intermittent discharge, not live steam; trap body hot both sides	Infrared thermometer	Operator
Chamber drain strainer	Blow down 5 s; flow free, water clear, no scale	Drain valve	Operator
Insulation surface	Cladding intact; surface ≤ 60 °C at 1 m height, ≤ 45 °C on door faces	Contact thermometer	Operator
Cycle record	Ramp, hold and F_0 within 10% of validated; aborts logged with cause	Chart or HMI export	Operator

6.2 Monthly

Task	What to check / acceptance	Tool or reference	Who
Safety valve manual lift	Lift the lever at ≥ 75% of set; opens and reseats cleanly, no simmer or leak	Lever, set-pressure card	Maintenance fitter
Gauge comparison	Compare with a master gauge of 0.4 class; deviation ≤ 1.6% of full scale, otherwise replace	Master gauge, calibration tag	Instrument technician
Gasket and door ring	Compression even, no flattening beyond 25%; ring and groove clean, no wire drawing	Straight edge, 10× loupe	Maintenance fitter

Task	What to check / acceptance	Tool or reference	Who
Hinge and locking lubrication	Hinge pin and locking-ring teeth greased; door swings with one hand; no binding at the last 20°	High-temperature grease, OEM list	Maintenance fitter
Vacuum breaker	Remove, clean and test the disc; opens at −3 to −5 kPa, seals at zero	Vacuum test rig	Instrument technician
Interlock pressure switch	Switch changes state at 3 kPa rising and 2 kPa falling; repeatability within 0.5 kPa	Hand pump, multimeter	Instrument technician
Air receiver drain	Drain until clear; no oil carry-over; auto-drain timer at 4 h	Drain valve, timer log	Operator

6.3 Quarterly / semi-annual

Task	What to check / acceptance	Tool or reference	Who
Gasket replacement	Replace if hardness > 70 Shore A, compression set > 25% or age > 12 months; silicone to 200 °C, EPDM below 150 °C; torque in three passes at 50/80/100% of 45 N·m in a cross pattern	Durometer, torque wrench	Maintenance fitter
Door hinge and pin wear	Pin and bush clearance ≤ 0.2 mm; replace bush if the door drops more than 1 mm at the free edge	Vernier, dial gauge	Maintenance fitter
Chamber temperature mapping	Nine-point map within ±1 °C at 121 °C; coldest point on the cycle card	Calibrated thermocouples	Validation engineer
Safety valve pop test	Lift pressure within ±3% of set; reseat pressure ≥ 90% of set; no leakage at 90% of set	Test bench or steam rig	Authorised test body
Condensate drainage	Drain line fall ≥ 1:100; no sagging; trap strainer clean; blowdown pit free of scale	Level, visual	Maintenance fitter
Insulation and cladding	No damp patches, no gaps at flanges; surface temperature re-checked at three points	Thermal camera	Maintenance fitter

6.4 Annual shutdown inspection

Task	What to check / acceptance	Tool or reference	Who
Internal inspection	No cracks or pitting > 0.5 mm; welds sound; scale < 0.3 mm	Borescope, wet fluorescent MT	Authorised inspector
Hydrostatic test	1.5× design, 30 min; no leak or deformation, drop within gauge error	Test pump, calibrated gauge	Authorised inspector

Task	What to check / acceptance	Tool or reference	Who
Wall thickness check	Readings at the marked grid; wall ≥ design plus corrosion allowance, and above retirement thickness	UT thickness gauge	NDT technician
Door locking ring NDT	Dye penetrant or magnetic particle on teeth and threads; no indication > 2 mm	PT / MT kit	NDT technician
Safety valve certification	Strip, clean, lap seat, re-set; certificate with lift and reseat pressures	Valve workshop	Authorised test body
Gauge calibration	Calibrate to 1.6 class; certificate within 12 months; red line at set pressure	Dead-weight tester	Instrument technician
Full interlock test	All seven section 4 tests repeated and signed; no bypass; E-stop functional	Test record	Maintenance engineer

Every three years, extend the annual thickness check to a full survey: a marked grid at 200 mm pitch on the shell, heads, door ring and jacket, recorded against the previous survey. Loss above 0.1 mm/year triggers a review of water treatment; a wall near retirement thickness requires re-rating or replacement. The comprehensive inspection interval is that on the registration certificate, normally not more than three years for a quick-opening autoclave.

Records

Keep cycle logs, interlock sheets, calibration certificates and inspection reports for at least three years, longer where the authority requires. Escalate any anomaly affecting the pressure boundary, interlock or validated cycle the same shift; never sign off a deviation as "monitor" without a written decision.

7. Troubleshooting

Symptom	Likely cause	Check	Remedy
Steam leaks at the door during hold	Gasket worn, hardened or badly seated; door ring damaged	Seal groove, gasket hardness, ring surface	Replace gasket and torque in three passes; replace ring if grooved
Chamber will not reach 134 °C	Wet steam, blocked trap, air pocket, low steam pressure	Inlet pressure and temperature, trap discharge, NCG	Clear trap, vent chamber, raise header pressure, fit separator
Temperature and pressure disagree	Non-condensable gas in the chamber	Saturation table comparison; air-removal time	Extend venting, check vacuum breaker seal, service trap

Symptom	Likely cause	Check	Remedy
Vacuum will not hold after cooling	Door seal leak, breaker stuck open, drain passing	Leak test at −50 kPa, breaker disc	Replace seal, clean breaker seat, reseat drain valve
Slow cooling	Fouled jacket, low water flow, air lock	Jacket inlet/outlet temperature, flow	Descale jacket, vent high point, clean strainer
Safety valve weeps at normal pressure	Dirt on seat, spring relaxation, low set pressure	Seat condition, set-pressure certificate	Clean and lap seat, re-set and certify; never exceed design pressure
Water hammer in steam line	Condensate pooling, trap failed closed, sagging pipe	Trap function, pipe fall, low-point drains	Replace trap internals, correct fall to 1:100, add drain pocket
Door interlock will not release	Residual pressure, switch stuck, vent blocked	Gauge reading, vent flow, switch state	Vent fully; replace switch; clear vent line. Never force the door
Pressure falls overnight on a receiver	Leaking fitting, failed check valve, open drain	Soap test on joints, drain position	Remake joints, replace check valve, close drain
Gauge reads high at zero pressure	Pointer shifted, blocked impulse line	Master gauge comparison, impulse line	Replace gauge, clear impulse line, recalibrate

8. Spare parts and service

Hold these first-year spares on site. Items marked critical stop a cycle after a single failure.

- Door gasket set per chamber size, plus a spare for the pass-through transfer door (critical).
- Safety valve of the same set pressure and bore, with certificate (critical).
- Vacuum breaker assembly and two replacement discs.
- Interlock pressure switch and one door-position limit switch.
- Pressure gauge, 1.6 class, correct range, red set-pressure line.
- Steam trap internals kit and 40-mesh strainer element.
- Door hinge bush and pin set; locking-ring lubricant to the OEM list.
- Chamber and jacket thermocouples, plus one spare probe.
- Consumables: gasket sheet, O-rings, graphite packing, descaler, biological indicators and indicator tape.

Order by model, serial number, drawing number and item position on the drawing. Gaskets and safety valves are not interchangeable between sizes. State design pressure and medium when ordering a valve; an air receiver valve must never be fitted to a steam vessel.

Service contact: Henan Yongxing Special Equipment Co., Ltd. service desk, quoting the serial number from the nameplate. Remote support answers within one working day; a site visit for a pressure-

boundary or interlock fault is scheduled within three working days. Annual inspection and hydrostatic testing can be booked with the third-party inspection body through the same desk. See the manual library for the current revision and the product range for model data.

9. Document control

Rev	Date	Change
A	2026-05-12	First issue for the pressure-vessel family
B	2026-11-25	Added pass-through interlock tests, 3-year thickness survey and oxygen tank siting note

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Related reading: capacity and sizing notes, steam and vessel calculators and energy benchmarks. For the autoclave range see autoclaves and steam sterilizers; for water treatment see softeners and feed pumps. Safety devices follow ISO 4126; receiver sizing follows US DOE guidance.

This is the generic family manual. The site-specific manual carries your serial number, registration data, validated cycle card and as-built drawing list.

Request the site-specific manual and quote the nameplate serial number.