INSTALLATION · COMMISSIONING · MAINTENANCE MANUAL

WNS / CWNS Fire-tube Oil & Gas Boilers

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This manual covers the WNS and CWNS families of three-pass, wet-back fire-tube boilers: packaged oil and gas fired units from 0.5 to 20 t/h saturated steam at 1.0, 1.25 and 1.6 MPa, plus CWNS hot-water variants from 0.7 to 14 MW. It is written for boiler-house operators, shift supervisors and maintenance technicians responsible for safe running, scheduled inspection and annual shutdown. It assumes installation to section 2 and commissioning to section 4.

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Applies to **WNS0.5-1.0 to WNS20-1.6; CWNS0.7-14** Language **English**

1. Scope and model coverage

The WNS range is a three-pass fire-tube boiler with a corrugated furnace, wet-back reversal chamber and threaded smoke tubes. Burner, feed pump, panel and safety accessories are mounted on a common base frame before dispatch, so site work is limited to services, flue connection and commissioning. CWNS units share the same pressure parts but deliver 95/70 °C hot water and carry no low-water safety chain. The WNS steam models and CWNS hot-water units are listed below; the oil and gas boiler range page gives drawings for each size.

Model	Capacity	Design pressure / temperature	Fuel	Typical duty
WNS0.5-1.0, WNS1-1.0	0.5–1.0 t/h (0.35–0.7 MW)	1.0 MPa, 184 °C saturated	Natural gas, LPG, light oil	Laundries, small food plants, standby steam
WNS2-1.25, WNS4-1.25	2–4 t/h (1.4–2.8 MW)	1.25 MPa, 194 °C saturated	Natural gas, light oil	Food processing, greenhouses, hotels
WNS6-1.6, WNS10-1.6	6–10 t/h (4.2–7.0 MW)	1.6 MPa, 204 °C saturated	Natural gas, light oil, heavy oil on request	Dairy, paper converting, district steam
WNS15-1.6, WNS20-1.6	15–20 t/h (10.5–14 MW)	1.6 MPa, 204 °C saturated	Natural gas, light oil	Chemical plants, large laundries, hospitals

Model	Capacity	Design pressure / temperature	Fuel	Typical duty
CWNS0.7-14, CWNS1.4-14	0.7–1.4 MW	1.0 MPa, 95/70 °C	Natural gas, light oil	Small heating networks, pools
CWNS2.8-14 to CWNS14-14	2.8–14 MW	1.0 or 1.25 MPa, 95/70 °C	Natural gas, light oil	District heating, large HVAC plants

Excluded: site electrical work beyond the burner and panel terminal boxes, structural steel, chimney design, fuel storage tanks and the buried blowdown line. Capacity margin and standby policy are discussed under capacity selection. Model drawings, nozzle schedules and the burner OEM manual ship with the pressure-part file.

2. Site and utility requirements before delivery

Confirm every item before the boiler enters the building. Most delays on packaged units come from a foundation at the wrong height, an unreachable flue connection, or a gas supply sized for the old boiler. Tube-removal clearance is most often missed: both doors must open fully and the smoke tubes must withdraw straight.

Item	Requirement	Tolerance / notes
Foundation	Reinforced concrete plinth, level, capable of carrying wet weight plus 25 %	Level within 3 mm per metre; grout after alignment
Clearances	1.2 m at front door, 0.8 m at rear door, 1.0 m at sides, 1.5 m above casing for access	Tube withdrawal needs clear length equal to boiler shell plus 1 m
Boiler-house ventilation	Low-level inlet and high-level outlet sized for combustion air plus 10 % casing loss	Inlet velocity below 5 m/s; no recirculation of flue gas
Feed water	Softened make-up, hardness ≤ 0.03 mmol/L, clear and free of oil	Deaerator required above 6 t/h; feed temperature 104 °C after deaeration
Boiler water	pH 10–12, conductivity per GB/T 1576 for the drum pressure	Typically ≤ 4 000 µS/cm at 1.6 MPa; dissolved oxygen ≤ 0.05 mg/L
Fuel gas	Pressure and flow per burner data plate, typically 20–50 kPa for natural gas	Stable within ±10 %; regulator and filter upstream of the gas train
Light oil	1.5–2.0 MPa at the burner inlet, 10–40 °C, filtered to 25 µm	Day tank above pump suction; water and sediment drained weekly
Flue and chimney	−20 to −50 Pa at boiler outlet at high fire; flue tight to 1.5 kPa	Sized for 92–95 % efficiency at rated load
Electrical supply	400 V, 3-phase, 50 Hz, separate isolator at the boiler	Earth resistance ≤ 4 Ω; neutral and earth separated at panel

Item	Requirement	Tolerance / notes
Drainage and blowdown pit	Blowdown pit with cooling, discharge to drain at ≤ 60 °C	Pit volume for two full blowdowns; vented cover

3. Installation sequence

The sequence assumes the plinth has cured and the boiler house is weather-tight. Do not shorten the pressure test or flue checks to gain schedule.

1. Unload on the marked base-frame lugs only. Keep the unit level and never sling on the burner, panel or shell nozzles. Acceptance: no cladding deformation, no damaged lugs.
2. Set the boiler on the plinth and align to the drawings. Acceptance: level within 3 mm per metre in both directions, base fully supported.
3. Grout under the base frame and allow the cure time before filling. Acceptance: no voids under the frame when tapped.
4. Fit the feed-water and steam connections with the specified gaskets. Acceptance: flanges parallel, bolts torqued in crossing pattern.
5. Install feed pump, softener and deaerator where fitted, then run the pump against a closed valve to set the relief bypass. Acceptance: suction head per data sheet, discharge 0.2–0.3 MPa above drum pressure.
6. Connect the blowdown line to the pit through the cooler. Acceptance: continuous fall, no low point that can hold water.
7. Erect flue and chimney, then check draught with a manometer before firing. Acceptance: −20 to −50 Pa at the boiler outlet with the fan running.
8. Wire burner, panel, feed pump and safety devices to the terminal boxes. Acceptance: insulation resistance ≥ 1 MΩ at 500 V.
9. Prove the gas train with air or nitrogen at 1.5 times working pressure. Acceptance: no decay over 10 minutes, soap test on every joint.
10. Fill with treated water through the economiser where fitted, venting at the highest point. Acceptance: level in the glass, all air released.
11. Check burner swing clearance and door gasket compression. Acceptance: door closes by hand, no gap at the seal.
12. Check that the burner servo and air damper stroke freely through the full range. Acceptance: no binding, position feedback agrees within 2 %.
13. Hydrostatic test at 1.5 times design pressure for 30 minutes. Acceptance: no pressure drop, no weeping at seams, stays or tube ends.

Lifting and rigging

Use only the certified points on the base frame. A WNS20-1.6 weighs about 42 t dry; never lift by shell lugs, burner flange or panel frame. Keep clear of the swing radius and never work under a suspended load.

Expansion and anchorage

The shell grows 6–10 mm between cold and operating temperature. Fix one end only and let the other slide on stainless pads, or fit the flue expansion joint. Never weld the flue to both the boiler outlet and a rigid chimney without a compensator.

4. Commissioning and handover

Commissioning starts after the hydrostatic test and internal inspection. Fill slowly with softened water, vent all high points, and check that the low-water cut-out and gauge glass agree before firing. Avoid fill water below 20 °C in winter; it can shock the tube plates.

The hydrostatic test is 1.5 times design pressure: 1.5 MPa for a 1.0 MPa boiler, 1.875 MPa for 1.25 MPa and 2.4 MPa for 1.6 MPa. Hold 30 minutes with a calibrated gauge, inspect every seam, stay and tube end, then drain and dry the furnace. This follows GB/T 16508 and TSG G0001 practice; third-party inspection is available on request. Blank the safety valve during the test and refit it afterwards. Safety valves are set at or below design pressure with accumulation not above 10 %, following ISO 4126 practice.

Burner set-up follows the OEM curve. At high fire on natural gas, set O_2 to 3.0–5.0 % dry, CO_2 to 9.5–11.0 %, and CO below 50 ppm. Stack temperature should settle at 150–180 °C with an economiser or 200–240 °C without. Record low, medium and high fire; these figures become the fouling baseline in section 6. The burner range page lists gas train options.

Interlock	Simulated condition	Expected result
Low water cut-out	Drain the float chamber with the burner at low fire	Burner stops within 5 s, lockout and alarm, no restart until level restored and reset
High steam pressure	Lower the set point below running pressure	Burner stops at set point, restarts at reset differential
Flame failure	Close the manual gas cock during firing	Flame scanner sees loss, gas valves close within 3 s, lockout
Gas low pressure	Throttle the gas supply below the switch setting	Burner stops before flame instability, lockout and alarm
Combustion air proving	Stop the forced-draught fan or trip the air switch	Gas valves close immediately, no ignition permitted

Interlock	Simulated condition	Expected result
High stack temperature	Lower the limit to below the running value	Alarm first, then burner trip at the upper limit
Feed pump failure	Stop the pump with the burner running	Level falls to the cut-out, burner stops, alarm raised

After the interlocks pass, run 4 hours at rated load and log pressure, level, stack and flue analysis every 30 minutes. Then run 24 hours covering 50–100 % load swings and three automatic start-stop cycles. Handover documents: pressure-part and material certificates, hydrostatic record, safety valve certificates, burner manual, wiring diagrams, PLC backup, interlock sheets and this manual with the serial number entered.

5. Normal operation

The large water volume lets a WNS respond quickly, but the furnace and tube plates do not tolerate fast temperature change. Warm through at low fire for at least 20 minutes, and never raise pressure faster than 0.1 MPa per minute.

Start-up from cold. Check the level and confirm feed and blowdown valves are set for operation. Open the air vent and start the feed pump to mid-glass. Run the fan for a pre-purge of at least 60 seconds at 25 % air, then light the burner at low fire. Hold low fire until the shell is warm and stack temperature has stabilised, then raise in steps with the servo gas train while watching flame and level. Close the vent at 0.05 MPa.

Start-up from hot standby. Keep the boiler at 0.3–0.5 MPa on low fire, or use the standby pressure control if fitted. Before returning to service, blow down the gauge glasses, confirm both agree, and compare stack temperature with the last log. If idle under pressure for more than 24 hours, test the low-water cut-out before firing.

Running log. Record the following at least every two hours, and every hour during load changes; the touch panel trend screens hold 30 days of history.

Parameter	Normal band	Action if outside
Steam pressure	Set point ± 0.05 MPa	Check burner modulation and pressure transmitter
Water level	Middle third of gauge glass	Check pump, control valve and level electrodes
Feed water temperature	20–30 °C cold, 102–105 °C deaerated	Check deaerator pressure and vent
Stack temperature	Baseline ± 10 °C at same load	Rise above 30 °C indicates fouling; plan cleaning
Flue O_2 / CO_2	O_2 3–5 %, CO_2 9.5–11 % (gas)	Re-trim burner air damper

Parameter	Normal band	Action if outside
Feed pump discharge	0.2–0.3 MPa above drum pressure	Check suction strainer and impeller wear

Normal shutdown. Reduce to low fire, stop the burner and let the fan purge the furnace for 3–5 minutes. Close the main steam stop and feed valves. Leave the boiler full and under pressure if restarting within 24 hours; otherwise follow the lay-up procedure.

Emergency shutdown. Press the emergency stop, closing the gas valves and stopping burner and fan. Close the main gas cock by hand. Do not open the furnace doors until the boiler is below 60 °C and purged. Find the trip cause before resetting.

Lay-up over 30 days. For wet lay-up, fill to the top of the gauge glass with water at pH 10–12 dosed with an oxygen scavenger, and hold 0.1–0.2 MPa of nitrogen. For dry lay-up, drain, dry the interior with warm air, place trays of quicklime or silica gel in furnace and shell, and seal all openings. Inspect monthly and renew spent desiccant.

6. Maintenance schedule

Intervals assume continuous duty on treated water and clean gas. Shorten them for hard raw water, heavy oil, or above 80 % load for more than 16 hours a day. A task is complete only when its acceptance value is recorded.

6.1 Daily (each shift)

Task	What to check / acceptance	Tool or reference	Who
Blow down both gauge glasses	Water returns quickly, glasses agree within 5 mm, no weep at glands	Gauge glass procedure	Shift operator
Check feed pump running	Discharge 0.2–0.3 MPa above drum pressure; seal dry, no drip	Pump data sheet	Shift operator
Observe flame and scanner signal	Stable flame, no lift, scanner signal steady, no flicker alarm	Sight glass, PLC trend	Shift operator
Log stack temperature	Within 10 °C of baseline at the same load	Flue thermometer	Shift operator
Check fuel supply pressure	Within the burner data-plate band, ±10 %; no gas smell or oil leak	Gas/oil pressure gauges	Shift operator
Surface blowdown by conductivity	Conductivity within the GB/T 1576 limit after blowdown	Conductivity meter	Shift operator
Test softened water hardness	Outlet hardness ≤ 0.03 mmol/L	EDTA titration kit	Water chemist

6.2 Monthly

Task	What to check / acceptance	Tool or reference	Who
Low-water cut-out test	Drain the float chamber; burner trips before the glass empties; refill and reset	Interlock test sheet	Maintenance technician
Manual lift of safety valve	Valve opens and reseats, no wire drawing or leakage; record set pressure	Lifting lever, valve log	Shift supervisor, witnessed
Clean flame scanner and photo-cell	Lens clean, signal within OEM range, no soot on the sight tube	Soft cloth, isopropyl alcohol	Burner technician
Clean ignition electrodes and set gap	Gap 2.5–4.0 mm per burner OEM; insulator free of carbon tracking	Feeler gauge, OEM manual	Burner technician
Check modulating level control	Level stable within ±10 mm at steady load; pump cycles not excessive	Trend screen, level transmitter	Instrument technician
Burner valve proving test	Automatic proving sequence passes with no pressure decay in the test period	Burner OEM procedure	Gas engineer
Full water chemistry panel	Hardness, alkalinity, pH 10–12, conductivity and dissolved O_2 ≤ 0.05 mg/L all in limit	Laboratory analysis	Water chemist
Flue gas analysis at high fire	O_2 3–5 %, CO ≤ 50 ppm, CO_2 9.5–11 % on natural gas	Combustion analyser	Burner technician

6.3 Quarterly / semi-annual

Task	What to check / acceptance	Tool or reference	Who
Strip and clean burner head	Diffuser and swirler clear, nozzle or gas ports clean, electrodes reset; combustion re-trimmed to O_2 3–5 %	OEM kit, analyser	Burner technician
Check pump and fan bearings	Vibration ≤ 4.5 mm/s RMS; grease per OEM interval; no abnormal noise	Vibration meter, grease gun	Maintenance fitter
Full interlock functional test	Each of the seven interlocks in section 4 trips and locks out as specified	Interlock test sheet	Instrument technician
Overhaul gauge glasses and try-cocks	Glasses clear, gaskets renewed, both glasses agree within 5 mm, no weep	Gauge glass set, spanner	Maintenance fitter
Inspect blowdown and check valves	Seats tight, no passing when closed, check valve holds against backflow	Visual, pressure test	Maintenance fitter
Clean economiser and check bypass	Fins clear, flue gas outlet temperature back within 15 °C of baseline, damper strokes fully	Water jet, temperature gauge	Service crew

Task	What to check / acceptance	Tool or reference	Who
Thermal survey of casing	Surface ≤ 60 °C at 1 m height in access areas; no hotspot above 80 °C	Infrared thermometer	Maintenance engineer

6.4 Annual shutdown inspection

Task	What to check / acceptance	Tool or reference	Who
Internal inspection of pressure parts	No cracks at tube plates or wet-back; wall thickness at 12 furnace points within drawing minimum	Borescope, ultrasonic gauge	Inspector, third party
Brush and wash fire tubes and smoke tubes	All tubes clear, scale below 0.5 mm, baffles and turbulators intact	Tube brush, high-pressure water	Service crew
Inspect refractory and wet-back	Cracks below 3 mm, no spalling, burner throat sound; cure per schedule after repair	Crack gauge, visual	Refractory technician
Overhaul and bench-test safety valves	Set pressure ≤ design pressure within ±3 %; accumulation ≤ 10 %; certificate issued	Valve shop, test bench	Authorised valve shop
Hydrostatic test after major repair	1.5 × design pressure held 30 min, no drop, no weeping	Test pump, calibrated gauge	Inspector
Burner annual overhaul	Gaskets, nozzle, photo-cell and gas valve seats renewed; combustion re-commissioned	OEM annual kit	Burner technician
Feed pump overhaul	Mechanical seal renewed, coupling alignment ≤ 0.05 mm, no leak at run	Pump OEM manual, dial gauge	Maintenance fitter
Calibrate instruments and back up PLC	Pressure and temperature loops within ±1 % of span; program archived off-site	Calibrator, laptop	Instrument technician
Clean flue and measure draught	Draught −20 to −50 Pa at outlet at high fire; no leakage at flue joints	Manometer, smoke test	Service crew

Records

Keep log sheets, chemistry results, interlock tests and inspection reports for three years, or for the life of the boiler where the pressure-part file requires it. Any anomaly repeating twice in a month, or a stack rise above 30 °C, goes to the maintenance engineer in writing the same shift.

7. Troubleshooting

Work through the checks in order and record what changed before the fault. Most lockouts trace back to water level, flame signal or fuel pressure, not the PLC.

Symptom	Likely cause	Check	Remedy
Burner locks out on start	Electrode gap wrong, photo-cell dirty, gas pressure low	Gap 2.5–4.0 mm, lens, gas gauge at train	Reset gap, clean cell, restore gas pressure
Flame failure during run	Water in oil, flame lift, scanner vibration	Oil day tank drain, flame shape, scanner mount	Drain water, re-trim air, reseat scanner
Steam pressure below set point	Fouled tubes, burner stuck at low fire, gas pressure low	Stack temperature, servo position, supply pressure	Clean tubes, free actuator, raise supply pressure
Stack temperature high	Scale on tubes, excess air, economiser fouled	Compare with baseline at same load; flue O_2	Brush tubes, trim air, clean economiser
Low water alarm with normal glass	Float chamber blocked, electrode fouled, wiring fault	Blow down chamber, inspect electrode, check continuity	Clean chamber and electrode, repair wiring
Priming or foaming	High conductivity or alkalinity, oil contamination, level too high	Chemistry panel, gauge glass level	Blow down, dose, find oil source
Water hammer in feed line	Check valve passing, air in line, pump cavitation	Check valve seat, vent, suction strainer	Replace check valve, vent line, clean strainer
Feed pump noisy or leaking	Low suction head, worn seal, misalignment	Suction pressure, seal face, alignment	Raise tank, renew seal, realign to 0.05 mm

8. Spare parts and service

Hold these first-year spares on site. Critical items stop the boiler if they fail; factory lead time is four to six weeks.

Item	Recommended quantity	Note
Gauge glass set with gaskets	2 sets	Critical; one set per glass
Level electrode or float switch	1	Critical, match panel input
Flame scanner / photo-cell	1	Critical
Ignition electrodes and leads	1 set	Set gap before fitting
Oil nozzle or gas orifice set	1 set	Size per commissioning record
Burner gasket and seal kit	1	Renew at every strip-down
Feed pump mechanical seal	1	Match pump model
Pressure gauge, 0–2.5 MPa	2	Calibrated, with siphon
Safety valve spare	1	Bench-set before fitting

Consumables: gauge glass tube, softener resin, hardness and alkalinity reagents, oxygen scavenger, burner filter elements and gasket sheet. Order by model, serial number and drawing number; the serial plate sits on the front tube plate below the burner. The manual library holds the current revision and wiring drawings.

Service contact

Henan Yongxing Special Equipment Co., Ltd. responds to a boiler-down call within 24 hours and to a scheduled service request within five working days. Have the serial number, the last log sheet and the PLC alarm history ready when you call. Annual shutdown inspections can be booked with third-party inspection included.

9. Document control

Each revision is hash-verified: the SHA-256 and file size are published on the verification page, so you can confirm that a downloaded copy is unaltered.

Rev	Date	Change
A	2024-03-15	First issue for WNS0.5 to WNS20 and CWNS0.7-14.
B	2025-06-02	Added CWNS 1.25 MPa variants, economiser checks, revised interlock table.
1.0	2026-11	Current issue. Maintenance intervals aligned with GB/T 16508 and TSG G0001 practice.

Compare the SHA-256 of your copy with the value at the verification page. If they differ, discard the file. The pressure-part file and safety valve certificates are controlled separately.

This manual covers the family as a whole. For the site version with your model, serial number, nozzle schedule and burner settings, send the serial and drawing number through the contact form.

Request the site-specific manual