# KGPS Induction Forging Furnace for Steel, Copper and Aluminum Billet Heating

Thyristor medium-frequency billet heating · 50–1,000 kW · 0.8–2.5 kHz · about 125–2,500 kg/h of steel to forging temperature · also drives melting furnaces

*Written by the HLQ Induction Engineering Team · Last updated October 2026 · Power, voltage, frequency, transformer, cooling water and melting data are HLQ's published KGPS series values. Forging throughput, heating times and frequency ranges are engineering estimates for planning; confirm them with a heating calculation for your billets.*

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## What is the KGPS Induction Forging Furnace?

The HLQ KGPS induction forging furnace is a high-power, thyristor-based medium-frequency induction heating system that through-heats steel, copper, brass and aluminum bars and billets to forging or extrusion temperature. A thyristor (SCR) rectifier and inverter convert the 380 V mains supply into 0.8–2.5 kHz power, which drives water-cooled induction coils that the billets pass through. The series covers 50 kW to 1,000 kW, enough to heat roughly 125 kg to 2,500 kg of steel per hour to about 1,200 °C. The same power supply can also drive a melting furnace body. It is the best fit for forging shops, rolling mills and extrusion plants that heat medium and large billets, roughly Ø40–200 mm, in continuous production, where a robust, low-frequency, high-power supply is more economical than an IGBT unit.

## Key Applications

| Application | Typical workpieces | Target temperature | Why induction is used |
|---|---|---|---|
| Closed-die hot forging | Steel billets for flanges, gears, crankshafts, connecting rods | 1,150–1,250 °C | Fast, uniform heating with little scale |
| Bar and rod end forging | Axle shafts, anchor bolts, rod ends, valve stems | 1,100–1,200 °C | Heats only the length to be formed |
| Hot rolling and ring rolling | Bars and ring blanks | 1,050–1,200 °C | Continuous feed matched to mill speed |

| Application | Typical workpieces | Target temperature | Why induction is used |
|---|---|---|---|
| Brass hot forging | Valve bodies, fittings, plumbing parts | 650–750 °C | Accurate temperature prevents cracking and overheating |
| Copper billet heating | Billets for extrusion and forging of electrical parts | 800–900 °C | Clean heating with low oxidation |
| Aluminum billet heating | Billets for extrusion and forging | 420–500 °C | Quick start, no fuel, precise temperature |
| Heat treatment | Through-hardening, normalizing and tempering of bars | 500–950 °C | In-line heating with repeatable results |
| Metal melting (with furnace body) | Steel, cast iron, copper and aluminum charges of 10–1,500 kg | Pouring temperature | One power supply, two uses |

For more process examples, see our induction forging applications.

## Suitable Materials

| Material | Forging / heating temperature | Estimated forging energy | Published melting energy (500 kg furnace) | Practical note |
|---|---|---|---|---|
| Carbon and alloy steel | 1,150–1,250 °C | About 380–420 kWh/t | 700 kWh/t | Heats efficiently up to the Curie point (about 770 °C), more slowly above it |
| Stainless steel | 1,100–1,200 °C | About 400–450 kWh/t | Not published; similar to steel | Non-magnetic from the start; needs a little more energy |
| Cast iron | Melting only | — | 650 kWh/t | Common in foundries using the same power supply |
| Copper | 800–900 °C | About 200–250 kWh/t | 480 kWh/t | Low resistivity reduces coil efficiency; use low frequency |
| Brass | 650–750 °C | About 130–170 kWh/t | Not published; at or below copper | Narrow forging window; precise temperature control is essential |
| Aluminum alloys | 420–500 °C | About 220–260 kWh/t | 620 kWh/t | Large billets heat well at 0.8–1 kHz |

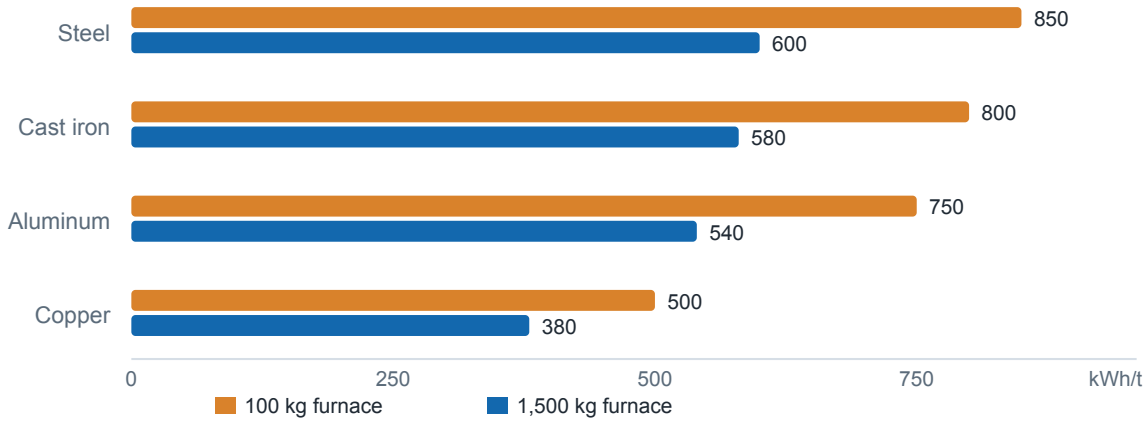



Figure 1. Published melting energy for the KGPS series: larger furnaces use less energy per tonne.

## Working Principle

"KGPS" is the Chinese abbreviation for a thyristor medium-frequency power supply. The system works in four stages:

1. **Rectification:** a three-phase thyristor bridge converts the 380 V, 50/60 Hz supply into adjustable DC.
2. **Smoothing:** a DC reactor keeps the current steady and protects the inverter.
3. **Inversion:** a thyristor inverter switches the DC into medium-frequency AC (0.8–2.5 kHz) and automatically tracks the resonant frequency of the load.
4. **Heating:** the capacitor cabinet and induction coil form a parallel resonant circuit. The coil's alternating magnetic field induces eddy currents inside the billet, and the billet heats itself from the inside of its skin layer, while conduction carries the heat to the core.

Frequency sets how deep the current flows. KGPS units operate at relatively low frequencies, which give deep current penetration. That makes them well suited to large-diameter billets, where uniform core temperature matters more than surface speed.

| Output frequency | Typical steel billet diameter | Typical copper / aluminum billet diameter |
|---|---|---|
| 2.5 kHz | About Ø35–70 mm | About Ø40–80 mm |
| 1 kHz | About Ø60–130 mm | About Ø60–150 mm |
| 0.8 kHz | About Ø80–200 mm | About Ø100–200 mm |

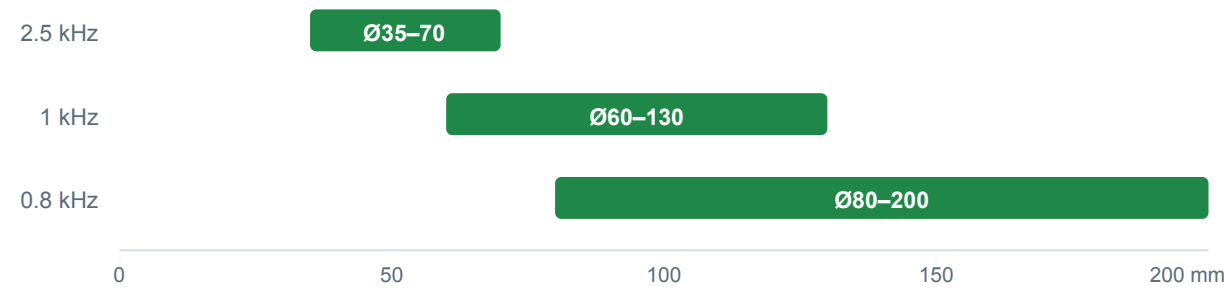



Figure 2. Typical steel billet diameter covered by each KGPS output frequency.

## Technical Specifications

| Parameter | Specification | Notes |
|---|---|---|
| Power supply type | KGPS thyristor (SCR) medium-frequency power supply | Parallel resonant inverter |
| Rated power range | 50–1,000 kW | Nine standard ratings |
| Input voltage | 380 V, 3-phase | 600 kW and 1,000 kW use a dual 380 V input |
| Transformer capacity | 60–1,500 kVA | Dedicated supply transformer recommended |
| Output voltage | 750 V (up to 250 kW), 1,500 V (450 kW), 2,500 V (600–1,000 kW) | Medium-frequency coil voltage |
| Output frequency | 2.5 kHz (50 kW), 1 kHz (100–450 kW), 0.8 kHz (600–1,000 kW) | Automatic frequency tracking |
| Cooling water | 3–25 t/h | Closed-loop cooling tower recommended |
| Control | Digital, relay-free control with automatic load matching | Runs without operator intervention |
| Protections | Over-current, over-voltage, phase loss, low water pressure | Faults do not damage power components |
| Temperature control | Optional pyrometer feedback with closed-loop power control | With automatic sorting of billets |
| Interfaces | Optional PLC and HMI connection | Integration with feeders and presses |
| Main components | Power cabinet, capacitor cabinet, induction coils or furnace body, water distributor, water-cooled cables | Copper connectors and busbars |
| Optional equipment | Supply transformer, HV switchgear, cooling system, furnace changeover switch, leak alarm, lining ejector | Changeover switch allows one supply to serve two loads |

### KGPS series ratings

| Rated power (kW) | Transformer (kVA) | Output voltage (V) | Frequency (kHz) | Cooling water (t/h) | Melting capacity (kg) | Melting time (min) | Forging output, steel (kg/h, est.) |
|---|---|---|---|---|---|---|---|
| 50 | 60 | 750 | 2.5 | 3 | 10–50 | 10–40 | ≈ 125 |
| 100 | 120 | 750 | 1 | 5 | 100–150 | 10–50 | ≈ 250 |
| 130 | 150 | 750 | 1 | 7 | 250 | 20–50 | ≈ 325 |
| 180 | 200 | 750 | 1 | 8 | 350 | 20–50 | ≈ 450 |
| 250 | 315 | 750 | 1 | 10 | 500 | 20–50 | ≈ 625 |
| 450 | 500 | 1,500 | 1 | 15 | 750 | 25–55 | ≈ 1,125 |
| 600 | 800 | 2,500 | 0.8 | 18 | 1,000 | 30–60 | ≈ 1,500 |
| 1,000 | 1,500 | 2,500 | 0.8 | 25 | 1,500 | 30–60 | ≈ 2,500 |

Forging output is estimated at 0.40 kWh per kg of carbon steel heated to about 1,200 °C. The 100 kW rating is published for both 100 kg and 150 kg melting furnaces.

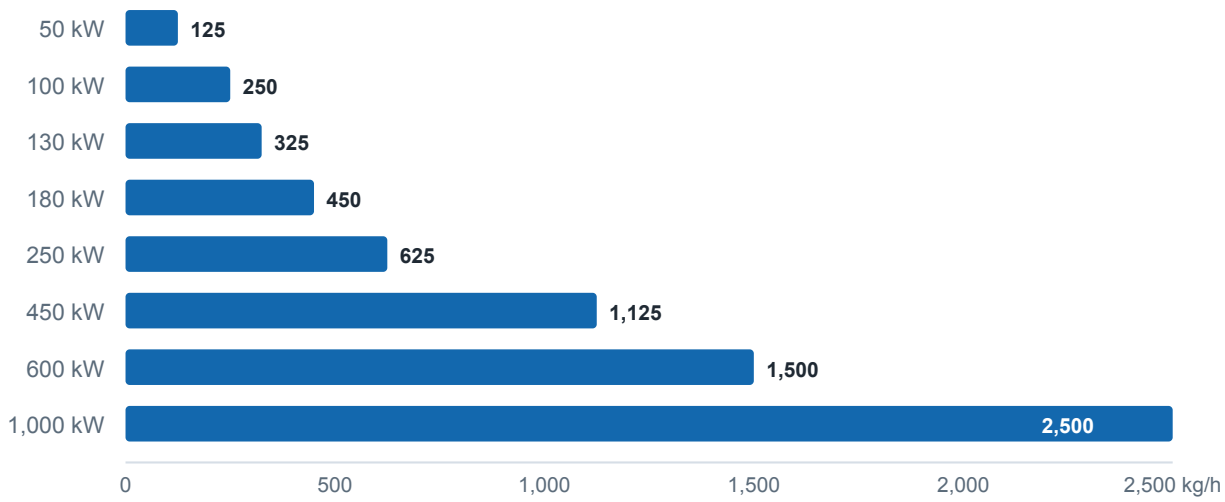



Figure 3. Estimated carbon steel forging output per hour for each KGPS rating (about 1,200 °C).

## Recommended Model Selection

| Application | Material | Recommended Power | Frequency |
|---|---|---|---|
| Bar end heating, Ø40–60 mm, about 120 kg/h | Carbon steel | 50 kW | 2.5 kHz |
| Billet forging, Ø50–80 mm, about 250 kg/h | Carbon and alloy steel | 100 kW | 1 kHz |
| Billet forging, Ø60–100 mm, about 450 kg/h | Carbon and alloy steel | 180 kW | 1 kHz |
| Billet forging, Ø80–120 mm, about 600 kg/h | Carbon and alloy steel | 250 kW | 1 kHz |
| Billet forging, Ø90–130 mm, about 1.1 t/h | Carbon and alloy steel | 450 kW | 1 kHz |
| Large billet forging and rolling, Ø100–160 mm, about 1.5 t/h | Carbon and alloy steel | 600 kW | 0.8 kHz |
| Large billet forging and rolling, Ø120–200 mm, about 2.5 t/h | Carbon and alloy steel | 1,000 kW | 0.8 kHz |

| Application | Material | Recommended Power | Frequency |
|---|---|---|---|
| Brass hot forging, Ø40–80 mm, about 400 kg/h | Brass | 100 kW | 1 kHz |
| Copper billet heating, Ø80–120 mm, about 800 kg/h | Copper | 250 kW | 1 kHz |
| Aluminum billet heating, Ø100–180 mm, about 900 kg/h | Aluminum alloy | 250 kW | 1 kHz |
| Melting furnace, 250 kg | Steel and cast iron | 130 kW | 1 kHz |
| Melting furnace, 500 kg | Copper and brass | 250 kW | 1 kHz |

For smaller bars, or where a compact cabinet and high power factor are priorities, compare our 300 kW IGBT induction generator. For complete lines with automatic feeding, see our induction billet heaters.

## Process Workflow

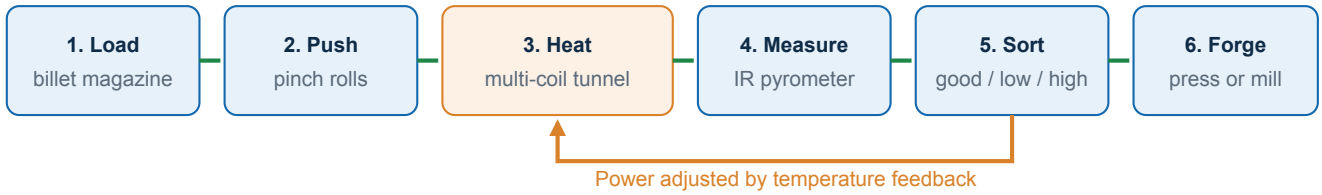



Figure 4. A typical KGPS billet heating line: only billets at the correct temperature reach the press.

| Step | Action | Key control point |
|---|---|---|
| 1. Load | Billets are placed in a magazine or on a step feeder | Consistent billet length and diameter |
| 2. Push | Pinch rolls or a hydraulic cylinder push billets through the coils at a set rhythm | Feed rate matched to the press cycle |
| 3. Heat | Billets pass through a series of coils and reach forging temperature at the exit | Constant power and stable feed |
| 4. Measure | An infrared pyrometer measures each billet at the coil exit | Pyrometer kept clean and calibrated |
| 5. Sort | A three-way sorter separates good, under-heated and over-heated billets | Only billets in the temperature window go forward |
| 6. Forge | Good billets go straight to the press, hammer or rolling mill | Short transfer time to limit heat loss and scale |

### Start-up and shutdown

- **Start-up:** start cooling water first, check the pressure and flow at the water distributor, then start the power supply at low power and fill the coil line.
- **Line stop:** when the press stops, reduce power to a holding level or empty the coil line to prevent over-heating.
- **Shutdown:** switch off the power supply first and keep the cooling water running for at least 15–30 minutes while the coils and cabinets cool.

## Coil and Fixture Design

The coil line decides how much of the generator's power reaches the billet and how evenly the billet heats. Each coil set is designed for a range of billet sizes and a production rate.

| Design factor | Guideline | Reason |
|---|---|---|
| Coil inner diameter | Billet diameter + about 30–50 mm (liner and air gap) | Smaller gaps improve efficiency; larger gaps tolerate bent billets |
| Diameter range per coil | About ±10–15% of the nominal billet size | Outside this range, efficiency and uniformity fall |
| Heated length | Line speed × required heating time | Sets the number of coils in the line |
| Coil sections | Several coils in series, sometimes with different power | Fast heating at the entry, gentle soaking at the exit |
| Billet guides | Water-cooled stainless steel or ceramic rails | Support billets and resist wear and scale |
| Refractory liner | Castable or tube liner inside each coil | Protects the copper and insulates the hot billet |
| Quick-change design | Coils on a trolley with quick water and power connections | Faster changeover between billet sizes |

### Typical through-heating time for steel to about 1,200 °C

| Billet diameter | Typical heating time | Typical frequency |
|---|---|---|
| Ø50 mm | About 1.5–2.5 min | 2.5 kHz |
| Ø80 mm | About 3–5 min | 1 kHz |
| Ø100 mm | About 5–7 min | 1 kHz |
| Ø150 mm | About 10–14 min | 0.8 kHz |

**Worked example:** a Ø100 mm steel billet weighs about 61.7 kg per metre. To heat 1 t/h, the line must move about 16.2 m of billet per hour (0.27 m/min). With a 6-minute heating time, the coils need about 0.27 × 6 ≈ 1.6 m of heated length, typically split into two or three coils.

## Control System and Automation

| Function | Standard | Optional upgrade |
|---|---|---|
| Power control | Digital, relay-free thyristor control with automatic load matching | Recipe memory for each billet size |
| Frequency | Automatic resonant-frequency tracking | — |
| Temperature | Manual power setting | IR pyrometer with closed-loop power control |
| Billet sorting | — | Three-way sorter that sends only qualified billets to the press |
| Line control | Start/stop and power controls on the cabinet | PLC + HMI controlling feeder, pusher, power and sorter |

| Function | Standard | Optional upgrade |
|---|---|---|
| Protections | Over-current, over-voltage, phase loss, low water pressure | Furnace leak alarm (melting), water temperature monitoring |
| Data | Panel meters | Temperature and production logging for quality records |

## Common Problems and Solutions

| Problem | Likely cause | Solution |
|---|---|---|
| Power supply fails to start or inverter trips | Coil and capacitor mismatch, capacitor fault, loose connection | Check the capacitor bank and connections; re-tune the load |
| Billet surface hot but core cold | Heating time too short, frequency too high for the diameter | Lengthen the coil line or slow the feed; use a lower frequency |
| Billets over-heated or burnt | Press stopped while power stayed on | Interlock power with the press; use holding power or empty the line |
| Heavy scale and stuck billets | Long heating time, worn guide rails | Shorten heating time where possible; replace rails and clean scale regularly |
| Low output power | Billet too small for the coil, large air gap | Use a coil matched to the billet size range |
| Low water pressure alarm | Blocked filter, scale in coils, pump fault | Clean filters, descale, use softened water in a closed loop |
| Interference with other plant equipment | Harmonic currents from the thyristor rectifier | Dedicated transformer; 12-pulse input or harmonic filter |
| Transformer overheating | Undersized transformer, high harmonics | Use at least the published transformer capacity |

## Engineering Selection Guide

### Four-step sizing

| Step | Calculation | Example: Ø90 mm 42CrMo billets, 1 t/h |
|---|---|---|
| 1. Power | Output (kg/h) × specific energy (kWh/kg) | 1,000 × 0.40 = 400 kW → **450 kW** |
| 2. Frequency | From billet diameter | Ø90 mm → 1 kHz |
| 3. Coil length | Line speed × heating time | Ø90 mm ≈ 50 kg/m → 20 m/h; 5.5 min → about 1.8 m |
| 4. Utilities | Transformer and cooling water from the ratings table | 500 kVA transformer; 15 t/h cooling water |

### KGPS (thyristor) vs IGBT induction power supply

| Criterion | KGPS thyristor | IGBT |
|---|---|---|
| Typical power range | 100 kW to several MW | From a few kW to several hundred kW |
| Frequency | Low to medium (about 0.5–8 kHz) | Medium to high (about 1–100 kHz and above) |
| Best billet size | Medium and large (about Ø40–200 mm) | Small and medium bars |

| Criterion | KGPS thyristor | IGBT |
|---|---|---|
| Power factor | High at full load, lower at part load | Consistently high |
| Harmonics | Higher; 12-pulse input or filters may be needed | Lower |
| Robustness | Very tolerant of overloads and short circuits | Needs careful protection |
| Cost per kW at high power | Lower | Higher |
| Cabinet size | Larger | Compact |

### Induction forging vs gas-fired furnace

| Criterion | KGPS induction forging furnace | Gas or oil furnace |
|---|---|---|
| Start-up time | Minutes | One to several hours |
| Scale loss | About 0.5–1% | About 2–3% |
| Temperature control | Every billet measured and sorted | Depends on the operator |
| Floor space | Compact coil line | Large furnace and burners |
| Workshop conditions | No flame or flue gas | Hot, with combustion emissions |

### Information to send for a quotation

- Material grade, billet diameter (or section) and length
- Required temperature and output in kg/h or pieces per hour
- Full-length or partial (end) heating
- Press or mill cycle time
- Supply voltage, available transformer capacity and cooling water conditions

## Advantages

- **High power at low cost per kW:** thyristor technology is the economical choice from about 100 kW to 1,000 kW.
- **Deep, uniform heating:** 0.8–2.5 kHz frequencies through-heat large billets with a small core-to-surface difference.
- **Robust and forgiving:** tolerant of load changes, short circuits and harsh forge-shop conditions.
- **Automatic operation:** frequency tracking and load matching need no operator intervention.
- **Every billet checked:** with pyrometer feedback and sorting, only correctly heated billets reach the press.
- **One supply, two uses:** with a changeover switch, the same power supply can serve a forging coil line and a melting furnace.
- **Lower scale and cleaner workshop** than fuel-fired furnaces.

## Limitations

- **Not for small parts:** the low frequency is inefficient for bars under about Ø30–35 mm; use an IGBT supply instead.

- **Power quality:** the thyristor rectifier creates harmonics and its power factor falls at part load, so a dedicated transformer is recommended.
- **Size-specific coils:** each coil set covers a limited diameter range; several billet sizes need several coil sets.
- **Infrastructure:** needs 60–1,500 kVA of transformer capacity and 3–25 t/h of cooling water.
- **Larger footprint** than an IGBT cabinet of the same power.

## Why Choose HLQ Induction Equipment?

- **Both technologies:** we build KGPS thyristor and IGBT power supplies, so we recommend the right one for your billet size and budget rather than the one we happen to sell.
- **Complete lines:** power supply, capacitor cabinet, coil line, feeder, pyrometer, sorter and cooling system from one supplier.
- **Application engineering:** heating time, coil length and power are calculated for your material, diameter and output before quotation.
- **Forging and melting:** the same series also powers steel and iron melting furnaces from 10 kg to 1,500 kg.
- **Export support:** custom voltages, English documentation, commissioning support and spare parts.

## Core FAQs

### 1. What is a KGPS induction forging furnace?

It is a thyristor-based medium-frequency induction heating system that heats metal bars and billets to forging temperature as they pass through water-cooled coils. "KGPS" is the Chinese abbreviation for a thyristor medium-frequency power supply. HLQ's series covers 50–1,000 kW at 0.8–2.5 kHz.

### 2. How much steel can a 250 kW KGPS forging furnace heat per hour?

About 600–650 kg of carbon steel per hour to around 1,200 °C, based on roughly 0.40 kWh/kg. The exact output depends on billet diameter, coil design and how well the feed matches the press.

### 3. Which frequency should I choose for my billet diameter?

For steel, 2.5 kHz suits about Ø35–70 mm, 1 kHz about Ø60–130 mm and 0.8 kHz about Ø80–200 mm. Larger billets need lower frequencies for deeper current penetration and a uniform core temperature.

### 4. Should I choose a KGPS or an IGBT power supply?

Choose KGPS for high power (about 100 kW and above) and large billets, where it offers the lowest cost per kW and high robustness. Choose IGBT for smaller bars, higher frequencies, compact installation and a consistently high power factor.

### 5. Can the same power supply be used for melting?

Yes. Connected to a furnace body, the series melts 10–1,500 kg charges, with published energy use of about 600–900 kWh/t for steel, 580–850 kWh/t for cast iron, 540–780 kWh/t for aluminum and 380–500 kWh/t for

copper. A changeover switch lets one supply serve both a forging line and a furnace.

### 6. What transformer and cooling water do I need?

Transformer capacity ranges from 60 kVA for the 50 kW model to 1,500 kVA for the 1,000 kW model, and cooling water from 3 t/h to 25 t/h. A dedicated transformer and a closed-loop cooling tower with softened water are recommended.

### 7. How long does it take to heat a Ø100 mm steel billet?

About 5–7 minutes to around 1,200 °C at 1 kHz. The billets move continuously through the coil line, so a new billet leaves the coil at the press cycle rate even though each billet spends several minutes inside.

### 8. Can it heat copper, brass and aluminum billets?

Yes. Typical targets are 800–900 °C for copper, 650–750 °C for brass and 420–500 °C for aluminum. These metals have low electrical resistivity, so coils are designed with low frequency and tight air gaps to keep efficiency up.

**Planning a new forging line or replacing a gas furnace?** Send your material, billet size, temperature and hourly output to sales@dw-inductionheater.com or WhatsApp +86-13155965571, and our engineers will size the power supply, coil line and utilities for you.