HLQ

INDUCTION HEATING EQUIPMENT

# Induction Shrink Fitting of Gears onto Shafts

Heat the gear, expand the bore, drop in the shaft. Fast, flame-free interference-fit assembly and disassembly with HLQ UHF, HF and flexible-cable induction heaters.



| 3.5–120 kW | 1–5 min | 150–270 °C | No flame |
|---|---|---|---|
| UHF / HF heaters | typical gear heating time | typical fit temperatures | no oil bath, no press |

## 01 Why shrink fit gears by induction

A gear is mounted on its shaft with an interference fit: the bore is slightly smaller than the shaft. Heating only the gear expands the bore so the shaft slides in by hand or under its own weight; as the gear cools it grips the shaft with a uniform, high-torque joint. Induction heats the gear in minutes with a coil, a timer and a temperature sensor — no gas flame, no oil bath and no hydraulic press.

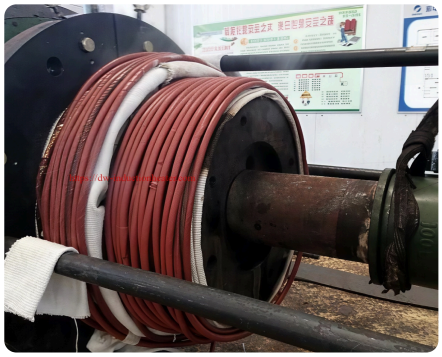
| Method | Heating time | Temperature control | Drawbacks |
|---|---|---|---|
| Induction coil | Seconds – minutes | Timer, pyrometer or thermocouple; repeatable | Coil matched to gear size |
| Oven | 30 – 120 min | Good but slow | Long cycle, high energy, large footprint |
| Oil bath | 10 – 30 min | Limited by oil flash point (≈ 200 °C) | Oil smoke, cleaning, fire risk |
| Gas torch | Minutes | Poor; local overheating | Distortion, tempering of teeth, safety |
| Hydraulic press (cold) | Seconds | — | Scoring, fretting, high force, damage risk |



Rotor assembly on its shaft.




Large gear heated with a cable coil.



Coupling heated for shaft assembly.

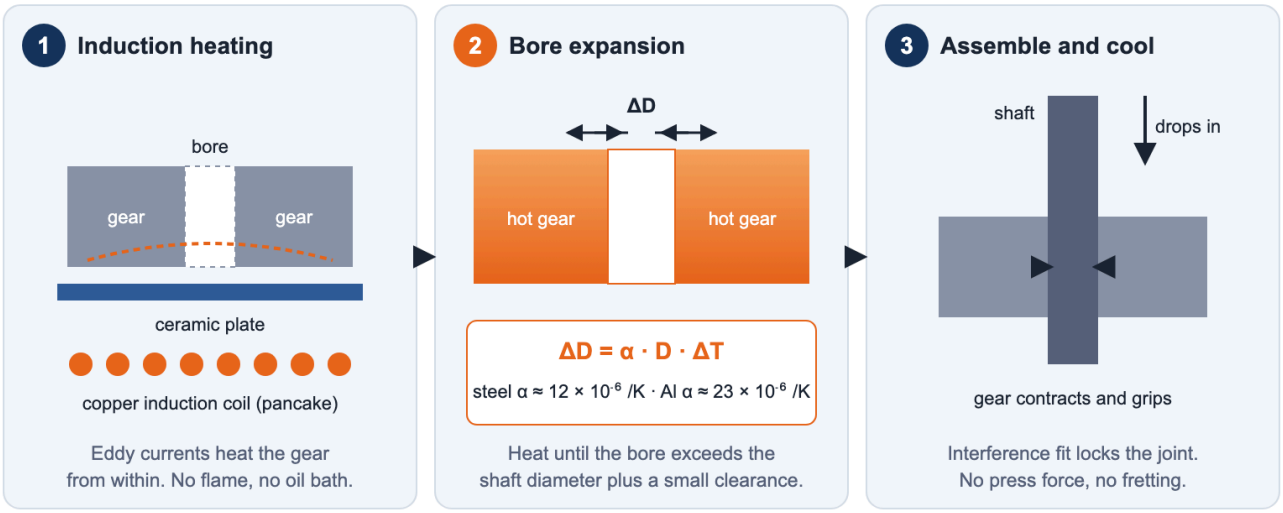
## 02 How it works

The power supply drives high-frequency current through a coil placed under or around the gear. Eddy currents heat the gear from within; the bore grows by **ΔD = α · D · ΔT**. When the bore exceeds the shaft diameter plus a small clearance, the shaft is inserted and the joint is left to cool.

### Induction Shrink Fitting a Gear onto a Shaft

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The gear is heated, its bore expands, the shaft slides in, and the gear grips the shaft as it cools.




**Coil options for gears**

**Pancake (face) coil**
Gear lies flat on a ceramic plate. Simple loading, small gears.

**Encircling (solenoid) coil**
Coil around the gear OD. Most uniform for gears and hubs.

**Flexible cable coil**
Wrapped on large gears and rings. On-site assembly and disassembly.

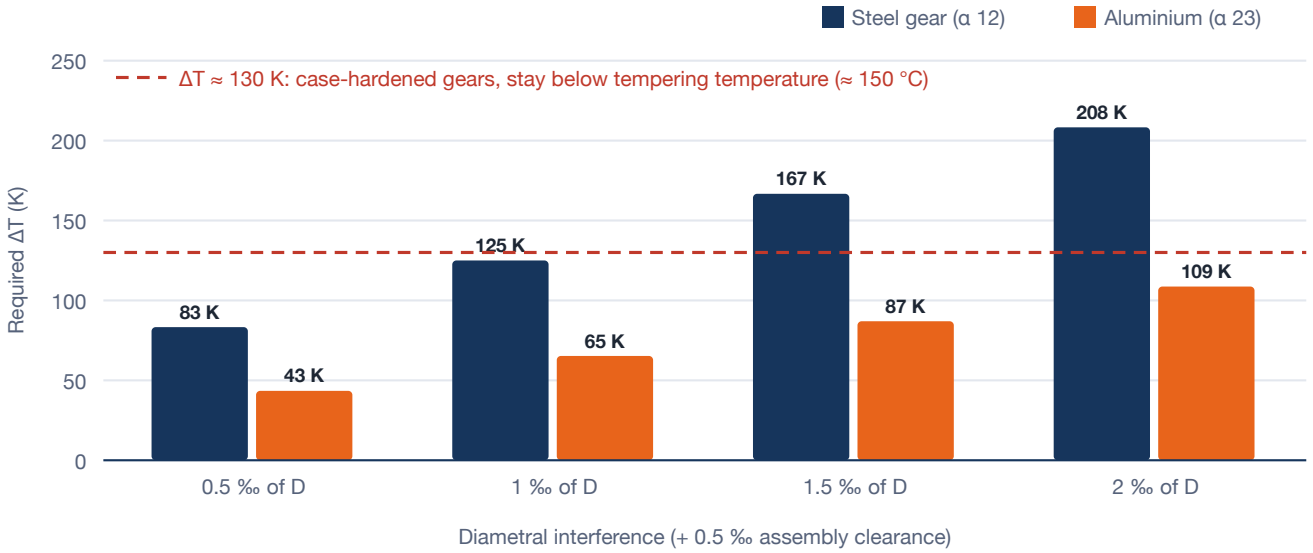
### Bore growth at a given temperature rise

| Bore D | Steel, ΔT 150 K | Steel, ΔT 200 K | Aluminium, ΔT 120 K |
|---|---|---|---|
| 25 mm | 0.045 mm | 0.060 mm | 0.069 mm |
| 50 mm | 0.090 mm | 0.120 mm | 0.138 mm |
| 75 mm | 0.135 mm | 0.180 mm | 0.207 mm |
| 100 mm | 0.180 mm | 0.240 mm | 0.276 mm |
| 150 mm | 0.270 mm | 0.360 mm | 0.414 mm |

# 03 How hot does the gear need to be?

**ΔT = (interference + clearance) / (α · D)** · steel α ≈ 12 × $10^{-6}$ /K · aluminium α ≈ 23 × $10^{-6}$ /K

## Chart B — Required temperature rise by interference




Hardened gears: keep the fit temperature below the gear's tempering temperature, or tooth hardness will drop. Ask the gear maker for the limit.

## Typical fit temperatures

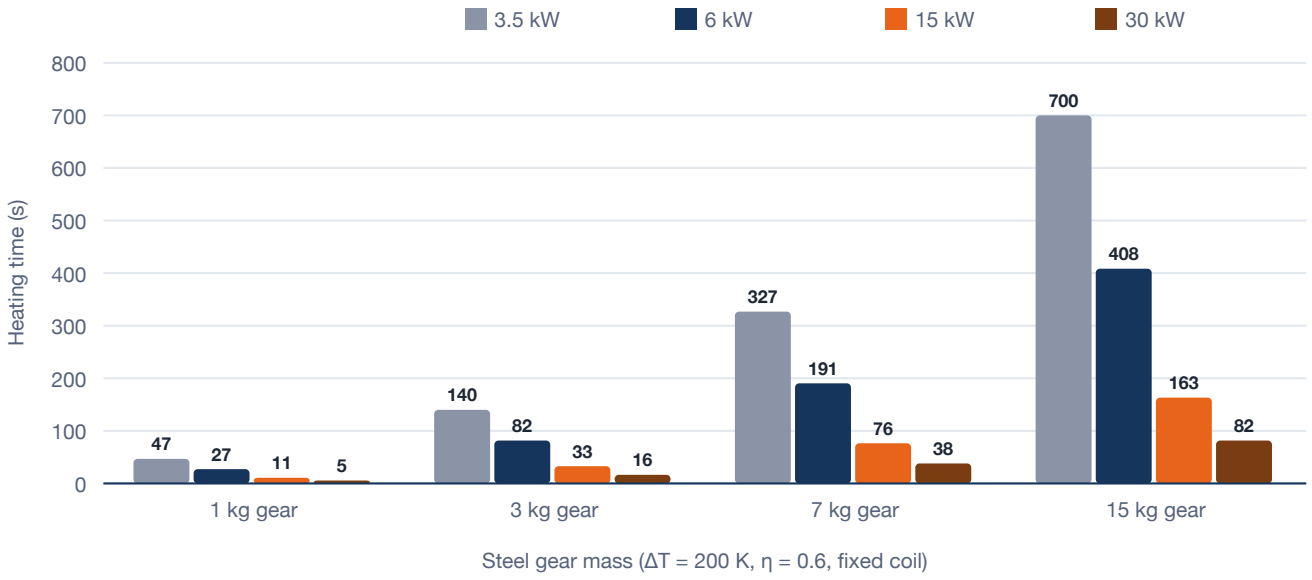
| Gear | Typical fit temperature | Limit to respect |
|---|---|---|
| Through-hardened or soft steel gear | ≈ 200–270 °C | Avoid > 300 °C (scale, distortion) |
| Case-hardened / induction-hardened gear | ≈ 120–150 °C | Below tempering temperature (often 150–180 °C) |
| Aluminium gear or hub | ≈ 120–160 °C | Alloy ageing limit |
| Gear with bearing or seal attached | ≈ 100–120 °C | Bearing/seal maximum |

# 04 Equipment and model selection

| Family | Power | Frequency | Coil | Best for |
|---|---|---|---|---|
| HLQ UHF heaters (DW-UHF) | 3.5–7.5 kW | ≈ 100–400 kHz | Pancake or helical, custom | Small gears up to ≈ Ø150 mm |
| HLQ HF heaters (DW-HF) | 6–120 kW | 30–80 kHz | Solenoid, pancake, internal | Gears and hubs Ø50–400 mm, production lines |
| MF flexible-cable heaters | 10–160 kW | 2–36 kHz | Water- or air-cooled cable | Large gears, girth gears, couplings, on site |

## Chart A — Heating time by gear mass and heater power

**t = m · c · ΔT / (P · η)** · steel c = 0.49 kJ/kg·K · fixed-coil efficiency η ≈ 0.6



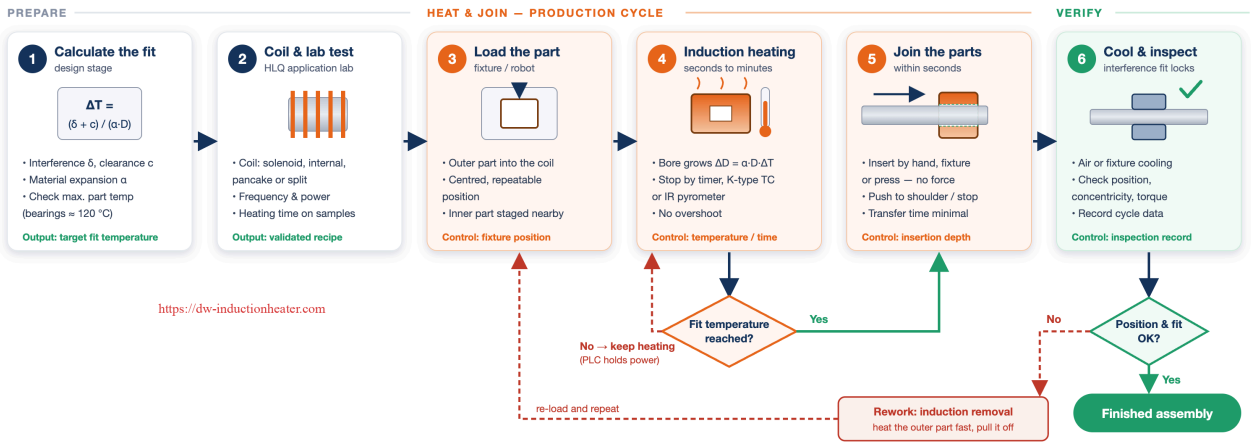

## Recommended selection

| Gear | Recommended heater |
|---|---|
| Steel gear ≤ 3 kg, cycle 1–4 min | UHF 3.5–7.5 kW |
| Steel gear 3–15 kg in production | HF 15–30 kW |
| Gear 15–100 kg or fast takt | HF 30–120 kW |
| Large gears, rings, on-site work | MF flexible-cable heater |

# 05 Process workflow and station layout

## Induction Shrink Fitting Process Flow

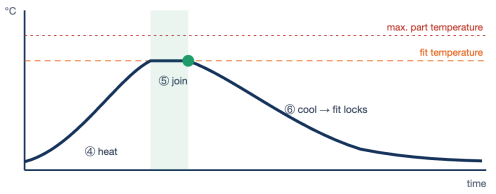
Production assembly with HLQ UHF / HF induction heaters, from fit calculation to a finished, inspected assembly.




### Key process parameters

| Parameter | Typical value / rule |
|---|---|
| **Fit temperature** | 120–300 °C (aluminium lower, steel higher) · bearings ≈ 120 °C max |
| **Required ΔT** | $\Delta T = (\delta + c) / (\alpha \cdot D)$ · steel $\alpha \approx 12$, aluminium $\alpha \approx 23 \times 10^{-6}$ /K |
| **Heating time** | $t = m \cdot c \cdot \Delta T / (P \cdot \eta)$ · e.g. 5 kg steel, 15 kW, ΔT 150 K ≈ 41 s |
| **Frequency** | UHF ≈ 100–400 kHz (small) · HF 30–80 kHz · MF 2–36 kHz (large) |
| **Control** | Timer · K-type thermocouple · IR pyrometer · PLC / line interlock |

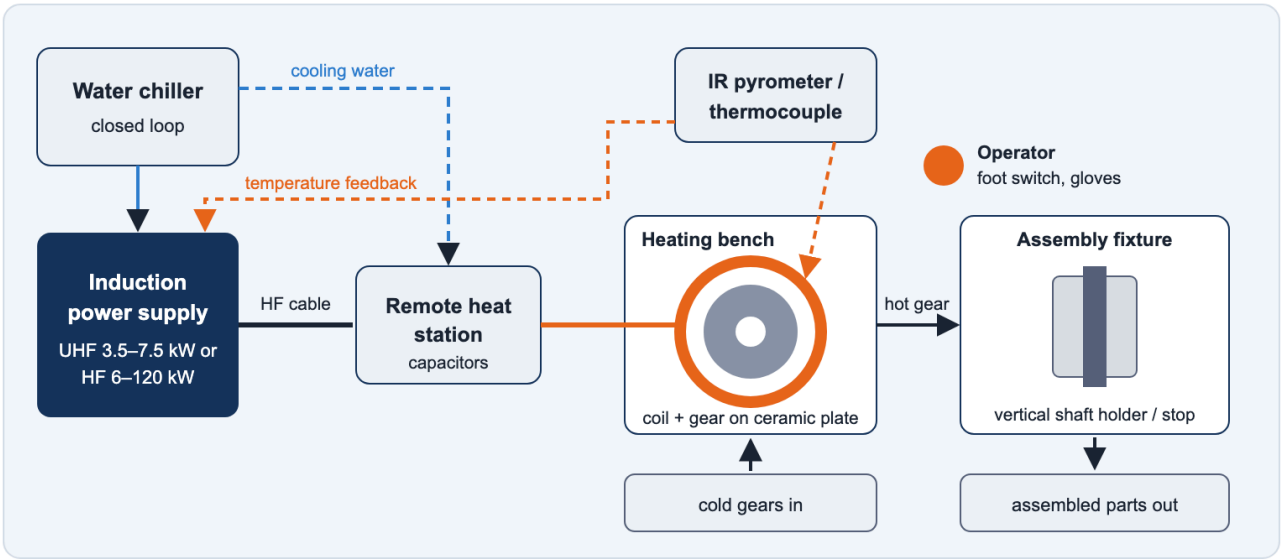
### Temperature of the outer part




dw-inductionheater.com · Illustrative process flow — values are typical; follow your fit drawing and part limits.

## Shaft–Gear Shrink Fitting Workstation Layout

Top view of a typical manual or semi-automatic station.



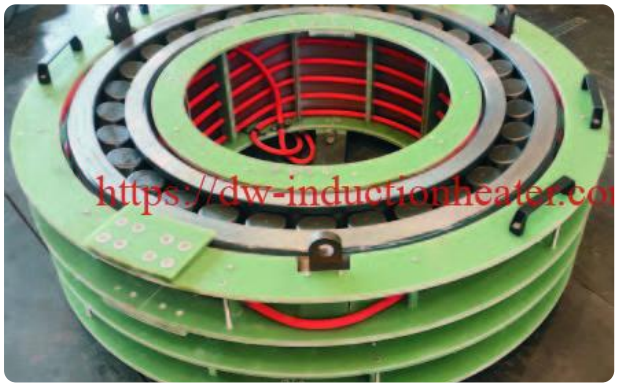

Keep the coil leads short, keep steel tooling away from the coil field, and place the fixture within one step of the coil so the gear is assembled before it cools.

# 06 Application example and use cases

## Camshaft gears, Ø152 × 51 mm (6 × 2 in)

| Item | Steel gear | Aluminium gear |
|---|---|---|
| Target temperature | ≈ 270 °C (518 °F) | ≈ 160 °C (320 °F) |
| Power supply | DW-UHF-3.5 kW | DW-UHF-3.5 kW |
| Frequency | 151 kHz | 158 kHz |
| Heating time | 3 min | 4 min |
| Grip after insertion | 30 s | 30 s |
| Total cycle | 3.5 min | 4.5 min |

Coil: pancake coil under a ceramic plate, remote heat station with one 0.66 µF capacitor; temperature checked with a K-type thermocouple.




**Large rings and gears**

Multi-turn coil sized to the part for even expansion.




**Site assembly**

Portable heaters for gears and couplings in the field.

## Typical use cases

| Industry | Assembly |
|---|---|
| Automotive / engines | Camshaft and crankshaft gears, timing gears |
| Gearboxes and reducers | Gears and pinions on output shafts |
| Electric motors | Rotor cores, fans and gears on shafts |
| Mining, cement, marine | Girth gears, couplings, propeller hubs (assembly and removal) |

# 07 Frequently asked questions

**How hot must the gear be?**

Enough for the bore to clear the shaft: ΔT = (interference + clearance) / (α · D). Steel gears are often 200–270 °C, hardened gears ≤ 150 °C.

**Will heating soften a hardened gear?**

Not if the temperature stays below the gear's tempering temperature. Use a pyrometer or thermocouple and a set-point cut-off.

**Which coil is best?**

Encircling coils give the most uniform heating; pancake coils are simple for small flat gears; flexible cables suit large gears.

**How long does it take?**

About 1–5 min for small gears with 3.5–7.5 kW; larger gears use 15–120 kW HF heaters (see Chart A).

**Can it remove gears?**

Yes. Heat the gear rim and hub quickly so it expands before heat reaches the shaft, then pull it off.

**Do I need water cooling?**

UHF and HF heaters and fixed coils are water-cooled with a closed-loop chiller; some flexible-cable systems are air-cooled.

## Why choose HLQ

**Full power range**

3.5 kW UHF to 120 kW HF and MF flexible-cable heaters.

**Application testing**

Coil and cycle proven on your gear in the lab.

**Custom coils**

Pancake, encircling, split and cable designs.

**Temperature control**

Timer, pyrometer or thermocouple cut-off.

**Assembly and removal**

One heater for mounting and dismounting.

**No flame**

Clean, safe and repeatable.

# Request an application test

Send your gear and shaft drawings or samples. Our lab will design the coil, confirm heating time and recommend the right heater.

**Email**
sales@dw-inductionheater.com

**Tel / WhatsApp / Telegram**
+86 131 5596 5571

**Website**
dw-inductionheater.com

**Factory address**
Jiangbei Village, Wusha Area, Chang'an Town, Dongguan City, Guangdong Province, China 523859

### Please include in your inquiry

- Gear drawing: material, hardness, OD, bore, width, weight
- Shaft diameter and interference (fit class)
- Maximum allowed gear temperature
- Cycle time, parts per hour, manual or automated
- Power supply available

