

MEDIUM-FREQUENCY INDUCTION HEATER



This manual shall be made available to all users of this medium-frequency induction heater. To ensure the best results and maximum durability of this U.S. SOLID LLC (hereafter U.S. SOLID or The Company) product, read and follow all instructions carefully. Failure to do so may lead to serious bodily injury and catastrophic damage to the heater, supplies, or surrounding area. All safety suggestions must be followed closely and precautions must be taken to guarantee this heater is only used by qualified personnel who have understood this guide.

Contents

I. Specifications.....	1
II. Operating Principles.....	2
III. Getting Started.....	3
IV. Safety Instructions.....	3
V. Installation.....	4
VI. Operation.....	6
VII. Induction Coil Design.....	7
VIII. Front Panel Functions.....	8
IX. Rear Panel and Host-Extension Connections.....	9
X. PLC Touchscreen Functions.....	10
XI. Potential Applications.....	11
XII. Troubleshooting.....	11
XIII. Maintenance.....	13

I. Specifications

The following information should be checked against the nameplate and order configuration before installation. Customized machines may differ from the standard values shown below.

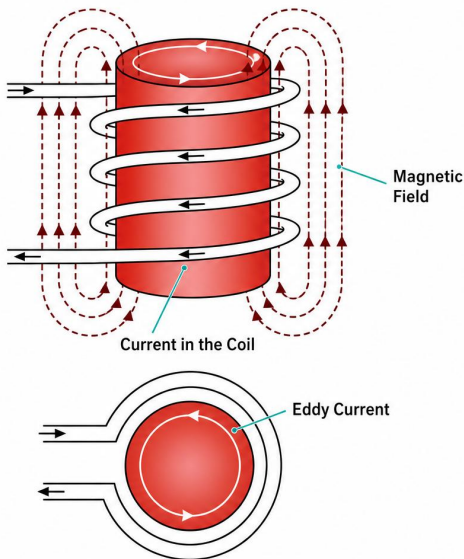
Output Power	Power Supply	Oscillation Frequency	Model
15kW	Three-Phase 380V or 480V	1-20 kHz	USS-HFIH00031
25kW	Three-Phase 380V or 480V	1-20 kHz	USS-HFIH00032
35kW	Three-Phase 380V or 480V	1-20 kHz	USS-HFIH00007
45kW	Three-Phase 380V or 480V	1-20 kHz	USS-HFIH00040
70kW	Three-Phase 380V or 480V	1-20 kHz	USS-HFIH00033
90kW	Three-Phase 380V or 480V	1-20 kHz	USS-HFIH00034
110kW	Three-Phase 380V or 480V	1-20 kHz	USS-HFIH00035

Nameplate priority: If this manual and the equipment nameplate differ, follow the nameplate and the wiring diagram supplied with the machine.

II. Operating Principles

Induction heating is a contact-free heating process. Alternating current flows through the induction coil and creates an alternating magnetic field. When a conductive workpiece is placed in or near the coil, eddy currents are induced inside the workpiece. The resistance of the material converts those currents into heat.

Medium-frequency induction heaters are suitable for applications that require deeper heat penetration than high-frequency units, such as forging, melting, larger workpieces, and some heat-treatment processes. Actual heating speed depends on the workpiece material, cross-section, coil geometry, coupling distance, and selected power setting.



Joule's first law:

$$Q = I^2RT$$

Q: Joule heat

I: Eddy current

R: Resistance

T: Time

Resistance:

$$R = \frac{\rho L}{S}$$

R: Resistance

ρ : Resistivity of the metal

L: Length

S: Cross-section

III. Getting Started

Thank you for purchasing the U.S. SOLID medium-frequency induction heater. Read this manual completely before installation or operation. Keep it available to all operators and service personnel.

The machine is intended for qualified personnel who understand electrical safety, hot-work hazards, cooling-water requirements, and the limitations of induction heating. Actual specifications and operating limits are determined by the equipment nameplate, order configuration, and supplied wiring diagram.

Nameplate priority: If this manual differs from the nameplate or wiring diagram supplied with the machine, follow the nameplate and wiring diagram.

The manufacturer may update specifications or procedures without notice. Damage caused by improper operation, incorrect repairs, unauthorized parts, or bypassed protection is not covered by the warranty.

IV. Safety Instructions

WARNING: Induction heating combines high voltage, high current, strong electromagnetic fields, hot metal, and pressurized cooling water. Only trained personnel may install, operate, or service the equipment.

- Turn off and isolate all power before installing, wiring, connecting, adjusting, repairing, or storing the machine.
- Ground the equipment enclosure with copper grounding wire of at least 6 mm², or as required by local electrical code.
- Do not touch terminals, connecting wires, the induction coil, or the workpiece while power is on or after heating has stopped.
- Remove rings, watches, bracelets, tools, and other metal objects from hands and arms before working near the coil.
- Keep persons with pacemakers, implanted medical devices, magnetic media, watches, or sensitive electronics away from the operating equipment.
- Circulate cooling water through the host, extension, capacitor box where fitted, and induction coil before applying electrical power.
- Use clean water. Recommended inlet water temperature is 25-40 °C and typical pressure is 0.15-0.30 MPa; follow the machine nameplate if it specifies different limits.

- Never run at high power with no load and avoid prolonged no-load operation.
- Keep the work area dry, clean, ventilated, and free of corrosion, oil smoke, metal dust, combustible materials, and clutter.
- Use suitable heat-resistant gloves, eye protection, protective clothing, and safe tools. Place hot workpieces only in a designated heat-resistant area.
- After heating, continue cooling-water circulation for at least 5-10 minutes. For melting or forging furnaces, continue cooling until residual heat is safely removed.
- Do not bypass water-pressure, overcurrent, overtemperature, emergency-stop, or host-extension protection circuits.

V. Installation

Packing List:

No.	Item Description	Quantity
1	Medium-Frequency Induction Heater Set (Host and Extension)	1 Set
2	Induction Coil	1 pc
3	Foot Pedal	1 pc
4	Host-Extension High-Current Cable	1 pc
5	Signal Wire (1.5m length)	1 pc
6	Induction Coil Connection Cable	1 pc
7	Water Hose (17mm inner diameter, 13mm outer diameter, 6m length)	2 pcs
8	Water Hose (13mm inner diameter, 8mm outer diameter, 6m length)	1 pc
9	Copper Wire Lugs (60A)	4 pcs
10	Hose Clamps (10-16)	12pcs
11	User Manual	1 pc

Electrical Installation

1. Verify the voltage, phase, frequency, and rated power on the nameplate.
2. Install a dedicated distribution box and a suitable high-quality circuit breaker. The external breaker should match or be slightly larger than the equipment breaker.
3. Select cable size according to the machine rating and local code. Crimp cable lugs securely; fasten terminals with screws and leave no bare conductor exposed.

4. Connect protective ground before connecting live power. Confirm that the main switch, control-power switch, emergency stop, and breaker are accessible.
5. Before energizing, inspect the wiring, terminals, insulation, and phase sequence for loose connections or damage.

Cooling-Water Connection

- Connect inlet and outlet hoses according to the labels on the host, extension, chiller, and coil. Never reverse the inlet and outlet.
- Confirm adequate flow through the host, extension, capacitor box where applicable, and induction coil.
- Use a qualified chiller, circulation pump, or clean-water supply capable of the required flow and pressure.
- Check every hose, clamp, threaded joint, and quick connector for leaks before power is applied.
- Water shortage protection may operate below approximately 0.20 MPa on some models. Do not remove or short the water-pressure switch.

Host and Extension Connections

- Fully insert and lock the high-current quick connector. Secure the cable so movement cannot rotate or loosen the connector.
- Connect the 2-pin water-pressure plug when an extension is supplied. Removing it disables extension water-shortage protection.
- Connect the 5-pin control/protection plug. It transfers extension fault signals to the host and may be required for starting.
- Connect the extension fan power cord where the split extension receives fan power from the host.

Installation check: Do not energize the machine until wiring, grounding, water circulation, host-extension plugs, emergency stop, and induction coil condition have all been confirmed.

VI. Operation

Start-up and Shutdown

1. Complete the installation inspection and turn on cooling water. Confirm stable flow, pressure, and no leaks.
2. Close the external power switch, then close the equipment breaker or rear main switch.
3. Turn on the front-panel control power switch and confirm that the power and operating indicators behave normally.
4. Position the workpiece and induction coil. Maintain the recommended coupling gap and keep the workpiece from touching the coil.
5. Set heating power, retaining power, heating time, and retaining time according to the process requirements.
6. Start heating with the panel Start key, foot pedal, remote switch, or handheld-gun start key, according to the selected configuration.
7. Stop heating with Stop, by releasing the pedal, or by allowing the automatic cycle to finish.
8. For shutdown, turn off the front-panel control power, then the external main switch. Keep cooling water running for at least 5-10 minutes before turning it off.

Manual Mode

In Manual mode, timing control is disabled and the display shows heating time. The heating-power control adjusts output oscillating current and heating speed. Press Start to heat and Stop to stop. When a pedal switch is configured, the panel Start key may be disabled; press the pedal to heat and release it to stop.

Automatic Mode

In Auto mode, the controller executes heating and retaining in sequence. Set heating power, retaining power, heating time, and retaining time, then start the cycle. Heating and retaining times are commonly adjustable from 1-99 seconds on

panel models or 1-999 seconds on PLC models; the actual range depends on configuration.

VII. Induction Coil Design

- Use round or square red-copper tube with a wall thickness greater than 1 mm. A tube diameter of 8 mm or larger is recommended unless the manufacturer specifies otherwise.
- Keep the normal coupling gap between the coil and workpiece at approximately 5-15 mm. The correct gap depends on material, geometry, frequency, and power.
- A tube that is too small or too long can create excessive resistance heating, boil the cooling water, or damage the coil.
- For copper, aluminum, and other materials with poor magnetic response, use additional turns or suitable ferrite magnetic concentrators when necessary.
- If current reaches maximum but heating is weak, the load may be too light or the gap too large. Reduce the coil size or gap, or increase turns as appropriate.
- If current drops sharply or the machine stops at higher load, the load may be too heavy, the gap too small, or the coil has too many turns. Increase the coil size or gap, or reduce turns.
- For flat heating or difficult workpiece shapes, ferrite cores can improve magnetic coupling and output efficiency.
- Coil size, turns, workpiece shape and material, coupling distance, and extension turns must be matched. Consult the manufacturer before using a nonstandard coil.

VIII. Front Panel Functions

Panel layout varies by model. The following functions are common on medium-frequency machines.



Panel Item	Function
POWER / CONTROL POWER SWITCH	Turns the control power on/off.
OPERATE	Flashes during normal operation.
OUTPUT OVER VOLT.	Indicates output overvoltage.
PHASE FAIL	Indicates phase failure.
SHORT CIRCUIT	Indicates short-circuit protection.
OVER TEMP.	Indicates overtemperature protection.
WATER LACK	Indicates insufficient cooling water.
OVER CURRENT	Indicates excessive input or output current.
INPUT OVER VOLT.	Indicates excessive input voltage.
UNFIT FREQ.	Indicates improper operating frequency.
HEAT / RETAIN TIME SET	Sets heating and retaining time.
TIME / DIGITAL DISPLAY	Displays time and selected operating parameters.
PERIOD CONVERT	Switches the operating period setting.

CONSTANT CURRENT OR VOLTAGE / CONSTANT POWER	Selects the output-control mode.
AUTO / MAN	Selects automatic or manual operation.
START / STOP	Starts or stops operation.
DISPLAY SELECT	Selects the displayed parameter.
HEAT / RETAIN POWER ADJUST	Adjusts heating and retaining power.
REMOTE SOCKET	Connects a remote-control device.

IX. Rear Panel and Host-Extension Connections



Rear Connection	Purpose / Requirement
Main power input	Connect the power supply according to the nameplate.
Main power switch	Turns the main power on or off.
Host—extension quick socket	Connects the host and extension for high-current transmission. Match the red and black terminals correctly.
Water inlet	Connects to the cooling-water supply.
Water outlet	Connects to the cooling-water return line.
Cooling fan	Connects the equipment to protective earth.
Grounding terminal	Provides fan power to the split extension when required.

X. PLC Touchscreen Functions

Handheld and intelligent models may use a PLC touchscreen. Button names and screen order vary by model, but the operating logic is generally as follows.

Display / Button	Description
Pump indication	Green indicates the pump is running; red indicates the pump is stopped.
Heating indication	Green indicates heating output is active; red indicates heating is stopped.
Frequency / Current / Voltage / Power	Shows the current operating values.
Water temperature	Shows actual cooling-water temperature.
Heating / retaining power	Shows or sets output percentage for each stage.
Heating / retaining time	Shows or sets the automatic-cycle time.
Alarm display bar	Shows the active fault or protection message.
Manual / Auto	Selects untimed manual operation or automatic timed operation.

Parameter Settings

- Water temperature setting: factory default is typically 25 °C; recommended range is 20-30 °C unless the process requires otherwise.
- Temperature compensation: calibrates the sensor when displayed and actual water temperatures differ.
- Temperature difference: defines the positive or negative difference that starts the chiller.
- Parameter storage: depending on configuration, workpiece numbers 0-99 can store process recipes. Save the current settings under a workpiece number and recall them before the next run.
- I/O monitoring: displays input and output signal status for troubleshooting. On many screens, red indicates ON and green indicates OFF.

XI. Potential Applications

Application	Typical Use
Heating	General preheating or localized heating of metal workpieces.
Brazing	Joining metal parts using filler metal after cleaning the joint surfaces.
Quenching	Heating followed by rapid cooling to improve hardness.
Melting	Melting suitable metals in a crucible or melting-furnace configuration.
Forging	Heating billets or parts before deformation or forming.
Annealing	Reducing hardness or internal stress in suitable metals.

XII. Troubleshooting

Problem / Alarm	Possible Causes	Corrective Actions
Overtemperature	Water too hot; insufficient flow; blocked passage; fan or pump fault.	Keep water below the specified limit, increase flow, remove blockage, check pump/fans, and allow cooling before restart.
Overvoltage	Input voltage too high or wiring incorrect.	Turn off power and verify supply voltage, phase, terminals, and wiring diagram.
Phase failure	Missing phase; loose terminal; supply imbalance.	Isolate power, check all incoming phases and terminals, and inspect the distribution box.
Overcurrent at high output	Gap too small; too many coil turns; inadequate grid capacity; internal fault.	Inspect coil and gap, reduce turns if appropriate, verify supply capacity, and contact service if repeated.
Overcurrent immediately at start	Coil short circuit; coil touching workpiece;	Isolate power, inspect coil spacing and insulation, and

	internal power-component fault.	restart only after the cause is removed.
Water shortage	Low pressure; leak; blocked hose; pump fault; disconnected pressure switch.	Check water source, hoses, filter, pump, pressure, and protection plugs. Never bypass the protection.
Weak heating / light load	Load too light; coil too large; gap too large; wrong material or setting.	Reduce the gap, adjust coil turns, use a suitable concentrator, and increase power gradually.
High or low frequency	Coil inductance outside the suitable range.	Adjust turns, tube diameter, lead-out length, or coil gap according to the coil-design guidance.
Machine will not start	Breaker off; fuse blown; no supply; loose cable; emergency stop engaged; protection plug missing.	Check the supply and breaker, replace only the specified fuse, release emergency stop, and reconnect required plugs.
Quick connector heats	Connector not fully inserted; cable movement; damaged contact surface.	Turn off power, tighten and secure the connector, and replace damaged parts.
PLC alarm	Protection or I/O signal abnormal.	Read the alarm bar, check the I/O monitoring page, and apply the related corrective action above.

Service caution: If a fault repeats after the recommended checks, stop using the equipment and contact qualified service personnel. Do not bypass protection circuits or continue operating with abnormal noise, smell, heat, leakage, or arcing.

XIII. Maintenance

Interval	Maintenance Item
Before each use	Check power cables, grounding, water flow, leaks, coil insulation, quick connectors, emergency stop, and panel indicators.
Daily	Keep the work area clean and confirm that no combustible material or metal debris is near the coil.
Weekly	Clean the exterior and ventilation openings with power disconnected; inspect hoses, clamps, and connectors.
Monthly	Inspect terminals, fan operation, pump/chiller function, water quality, and protection indicators.
As required	Replace or filter cooling water to prevent scale, rust, and blockage. Inspect the coil for overheating marks, deformation, cracks, and insulation damage.
Long-term shutdown	Disconnect power, drain or protect water circuits where freezing/corrosion is possible, clean the machine, and store it dry and covered.