# To Sumitomo Electric Sintered Alloy Ltd.

**For Engineered Sintered Components Co.,Ltd.**
**Tempering Equipment**

# Instruction manual

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## Introduction

This instruction manual intends to inform you the overview of this equipment as well as its operation method and remedy in emergency. Items required for proper use of this equipment are described, and all those who operate this equipment must read it before use.
There is also an instruction manual of commercial product (such as temperature controller and recorder) in addition to this manual. Be sure to read them as well for proper use.

If any trouble or damage are caused within warranty period resulting from our design and manufacture, the parts will be offered free of charge. The replacement of parts etc. are required to be done by your company. If the trouble, damage, or accident is caused by the following items, they are out of our warranty scope.

a) Disobedience to the instruction manual
b) Modification by customer without notice
c) Use in application range different from contract or pilot run
d) Trouble/Damage by fire, natural disaster (such as earthquake, wind and flood, and thundering), pollution, salt damage, gas damage, abnormal voltage, etc.
e) Consumable goods (such as gasket and thermocouple, etc.)

Warranty period is 12 months from acceptance.

## Caution in use

- Maximum working temperature of this equipment is 250°C. Do not use this equipment above this temperature.
- Temperature on the furnace body becomes high while this equipment is operating. Watch out against burn injury.
- Do not bring your hands near the rotating machine, furnace lid, or the like while this equipment is rotating.
- Do not attach and detach the cover while this equipment is operating. Electric shock or pinching is possible.
- Do not spray water to this equipment.
- Operator of this equipment must always be fully acquainted with handling in advance.
- Be sure to turn off main power when maintaining this equipment.

## Contents

# 1. Specification

## 1) Model

Batch type air stream system electric resistance heating furnace

## 2) Application

Tempering of sintered part

## 3) Supply motive power

Electric power: 50KVA 3-phase, AC220V 60Hz
Compressed air: 0.5MPa PT10A
Nitrogen gas: 25m$^3$/Hr PT25A

## 4) Working temperature

Normal working temperature: 150 to 200°C
Maximum working temperature: 250°C
Temperature distribution precision: ±5°C (at normal working temperature, within air furnace and effective heating range)

## 5) Use environment

Ambient temperature: 0 to 45°C
Ambient humidity: 30 to 90%RH (free from condensation)

## 6) Processing capability

Processing work: Steel parts (hub wheel/hub outer wheel)
Throughput: Max 200kg(gross) ×2 tray/1 batch (including the tray weights)

## 7) Equipment configuration

Configuration: Tempering furnace 1 unit, Carry-in bed 1 unit,
Cooling and carry-out bed 1 unit, Control panel 1 unit,
Operation box 2 unit
Installation dimension: 2020W×2905H×5940L (excluding protrusion)

**8) Tempering furnace**

**i. Furnace body**

Outline dimension: 2020W×2120L×2710H
Dimension in furnace: 835W×1270L×660H
Effective heating range: 550W×1000L×500H (from the top of tray(50mm tall))
Exterior material: Made of SS steel material, finished by heat-resistant silver coating
Insulator: Rockwool thermal insulator 125mm thick
Inside panel of furnace: SS steel plate, heat-resistance silver coating finish
Muffle in the furnace: SS steel plate, heat-resistance silver coating finish
Heat source species: U-sheath heater made of SS (220V-1150W)
Heater capacity: 34.5kW－220V Sheath heater is arranged by 15 pieces each on both sides
Circulation fan: SS steel plate fan unit of φ400
Electric three-phase standard motor 2.2kW (4P 220V 60Hz)
Equipped with rotation detector
Door open/close system: Vertical open/close system by gear motor 0.4kW equipped with brake
Door clamp: Push clamp system by 4 air cylinders
Carrier roller: SS steel roller of φ60.5×650W 12 piece ×127 pitch
Roller drive: Chain drive system by motor 0.2kW equipped with brake
Load resistance: Max 400kg
Temperature sensor: Sheath (K) thermocouple, SK4.8 φ-650L 2 piece
Exhaust pipe: 65A Installed in 2 places on ceiling surface of furnace equipped with manual damper
$N_2$ suction hole: 20A Installed in 2 places on side wall of furnace respectively equipped with 2 electromagnetics, flowmeters and manometers

**9) Carry-in bed**

External dimension: 885W×1487L×740H
Exterior material: Made of SS steel material, finished by heat-resistant silver coating
Carrier roller: SS steel roller of φ60.5×650W 12 piece ×127 pitch
Roller drive: Chain drive system by motor 0.2kW equipped with brake
Load resistance: Max 400kg
Load presence detector: Phototube switch ×2
Smoke exhaust hood: 1200W×985H×700L Made of SS steel
Installed in 1 place on ceiling surface ☐500 equipped with exhaust hole

**10) Cooling and carry-out bed**

External dimension: 885W×2757L×740H
Exterior material: Made of SS steel material, finished by heat-resistant silver coating
Carrier roller: SS steel roller of φ60.5×650W 22 piece ×127 pitch
Roller drive: Chain drive system by 2 motor 0.2kW equipped with brake
Load resistance: Max 400kg
Load presence detector: Phototube switch ×2
Cooling fan: Pressure ventilator of φ500
Electric three-phase standard motor 0.4kW (4P 220V 60Hz)
Smoke exhaust hood: 1200W×985H×700L Made of SS steel
Installed in 1 place on ceiling surface ☐500 equipped with exhaust hole
Hood shutter: Opened and closed in an air cylinder up and down

**11) Control panel**

| | | | | |
|---|---|---|---|---|
| Model: | Free-standing type double opening control box | | | |
| Outline dimension: | 1400W×1950H×500D | | | |
| Coating color: | Exterior 2.5YR9/2 (Munsell), Interior 2.5YR6/13 (Munsell) | | | |
| Temperature controller: | Digital indication controller | SDC25 | [azbil] | 1 unit |
| Temperature monitoring machine: | Digital indication controller | SDC15 | [azbil] | 1 unit |
| Temperature recorder: | Hybrid recorder | SR106 | [azbil] | 1 unit |
| Power controller: | 3-phase thyristor regulator | APR-N | [Fuji Electric] | 1 unit |
| Sequencer: | MELSEC-Q | Q00CPU | [Mitsubishi] | 1 unit |

**12) Control**

- Temperature is controlled by continuous proportional control combining the temperature controller and thyristor regulator.
- Equipped with abnormal excessive temperature detector
- Equipped with retention timer function (During automatic operation)
- Tray presence is detected by phototube and limit switch.
- Human body intrusion is detected by area sensor during entrance door, entrance door clamp and carry-out shutter operating.
- This equipment is operated in automatic operation mode and manual operation mode.
- When any trouble occurs in automatic operation, automatic operation is canceled.
  Take action in individual operation.
- When manual mode is set during automatic operation, all operation is stopped.
- Equipment abnormality is alarmed by signal tower and buzzer.
- Heater can be operated only when door and door clamp is operating properly.
- Door clamp can be operated only when door is fully closed.
- Door can be operated only when door clamp is fully open.

## 2. Operation procedure

### 1) Operation setup

[1] Supply primary power (3φ 220V 60Hz, positive phase).
Check the voltage with a terminal on primary side of ELB1 in the control panel.

[2] Turn on [MAIN BREAKER](ELB1) breaker.

[3] [POWER] lamp turns on.

[4] Turn on other breakers.

[5] Set [OP.POWER OFF-ON] select switch to “ON”.
[OP.POWER] lamp turns on.

### 2) Automatic operation

#### i. Automatic operation setup

[1] Set [MAN.－AUTO.] select switch on the control panel to “MAN.”.

[2] When workpiece is inside the furnace or the cooling bed, remove the workpiece by manual operation.

[3] When the door is opened, fully close the door by manual operation.

[4] When the door clamp is opened, fully close the door clamp by manual operation.

[5] When the cooling door is opened, fully close the cooling door by manual operation.

[6] Set the processing temperature on the temperature controller [THERMO CONTROLLER].
Set the temperature per degree Centigrade.

[7] Set the temperature at which excessive temperature rise trouble on the excessive temperature alarm [OVERHEATING METER]
Set the temperature per degree Centigrade.

[8] Set the retention time on [KEEP TIMER]
Set the timer per minute. It can be set up to 99 hours 59 minutes.

[9] Set the cooling time on [COOLING TIMER]
Set the timer per minute. It can be set up to 99 hours 59 minutes.

[10] Set [MAN.－AUTO.] select switch to “AUTO.”.

[11] Press [AUTO. (ON)] pushbutton.
The indication lamp [AUTO.CYC.] and the green indication lamp on the signal tower turn on, and automatic operation starts.

* The condition where automatic operation is available is that a work piece is not inside the furnace and on the cooling bed, the door and shutter are fully closed, the door clamp is fully closed, smoke exhaust processing device is operation properly and Nitrogen pressure is proper.

### ⅱ. Automatic operation

[1] Place the first processing work (tray) on the carry-in bed.
[2] Press [FORWARD] and [AUTO. COMMON] button simultaneously.
The tray moves to the intermediate position of the carry-in bed.
[3] Place the second processing (tray) work on the carry-in bed, and connect the second processing work to the first processing work with the coupling fitting.
[4] Press [FORWARD] and [AUTO. COMMON] button simultaneously.
The tray moves to the front of the carry-in bed. [CYC. START] button flashes on and off.
[5] Press [CYC. START] and [AUTO. COMMON] button simultaneously.
When the work piece is not in the furnace, the work piece on the carry-in bed is carried into the furnace.
[6] The door clamp is opened, and the door opens. The work piece (tray) moves into the furnace, and the door and door clamp are fully opened.
[7] Nitrogen purge is started. [N2 PURGE] lamp turns on.
When the purge is completed, [N2 PURGE] lamp turns off.
[8] Circulation fan starts operating. [CIRCURATING FAN] lamp turns on.
[9] Energization to the heater starts. [HEATER] lamp turns on.
[10] When the furnace temperature rises to the set value, retention timer starts timing.
Remaining time is displayed on the timer.
[11] When [KEEP TIMER] is timed out, energization to the heater is stopped and agitation fan stops. [HEATER] and [CIRCURATING FAN] lamp turn off.
[12] When the work piece is not on the cooling bed, the door clamp is opened, and the door opens. The work piece (tray) moves to the cooling bed, and the door and door clamp are fully closed.
[13]After a certain period of time, the cooling fan starts operation, and cooling timer starts timing.
Remaining time is displayed on the timer.
[14]When cooling timer is timed out, the cooling fan stops.
[15]When the work piece is not on the carry-out bed and [CARRYING OUT COMP.] button is pressed, carry-out shutter opens, the work piece moves to carry-out bed, and the shutter is closed.
[16][ CARRYING OUT COMP.] button turns on.
[17]Press [FORWARD] and [CARRYING OUT COMMON] button simultaneously, and remove the work piece.
[18]Press [CARRYING OUT COMP.] and [[CARRYING OUT COMMON] button simultaneously. [CARRYING OUT COMP.] button turns off, and the next work piece can be carried out.

* Retention time refers to the time until the heater is turned off after the furnace temperature reaches preset temperature.
* If any trouble occurs during automatic operation, carrying operation stops. Indicator lamp of corresponding trouble item turns on and the trouble alarm sounds.
Trouble alarm is stopped by [BUZ. STOP] pushbutton.
Clear the cause of trouble and press [RESET] pushbutton to cancel the trouble.
* When [MAN.－AUTO.] select switch is set to “MAN.” while automatic operation is running, automatic operation is canceled, and individual operation mode starts.

### ⅲ. Finishing automatic operation

[1] Press [AUTO. (OFF)] button.
If heat treatment is in progress, automatic operation will be terminated when the processing is completed.
[2] The indication lamp [AUTO.CYC.] and the green indication lamp on the signal tower turn off.

**3) Individual operation**

**i. Heating system**

[1] Set the [MAN.－AUTO.] select switch on the control panel to “MAN.”.

[2] Set a processing temperature on the temperature controller [THERMO CONTROLLER].
Set the temperature per degree Centigrade.

[3] Set the temperature at which excessive temperature rise trouble on the excessive temperature alarm [OVERHEATING METER]
Set the temperature per degree Centigrade.

[4] Press [CIRCURATING FAN ON] button.
Circulation fan starts operation, and [CIRCURATING FAN] lamp turns on.

[5] Press [HEATER ON] button.
Energization to the heater starts and [HEATER] lamp turns on.

[6] Press [HEATER OFF] button.
Energization to the heater stops and [HEATER] lamp turns off.

[7] Press [CIRCURATING FAN OFF] button.
Circulation fan stops operation and [CIRCURATING FAN] lamp turns off.

* When a trouble occurs, indicator lamp of corresponding trouble item turns on and trouble alarm sounds.
Trouble alarm can be stopped by [BUZ. STOP] pushbutton.
Clear the cause of trouble and press [RESET] pushbutton to cancel the trouble.
* The heater is energized as long as the circulation fan is operating. Therefore when the circulation fan stops while the heater is operating, the heater also stops.
* When the door clamp and door are opened while the heater is operating, energization to the heater stops.

**ii. Transport system**

[1] Set [MAN.－AUTO.] select switch on the control panel to “MAN.”.

[2] Press [DOOR CLAMP (ON)] button and [MAN. COMMON] button simultaneously. The door clamp is released.

[3] Press [DOOR CLAMP (OFF)] button and [MAN. COMMON] button simultaneously. The door is clamped.

[4] Press [DOOR (OPEN)] button and [MAN. COMMON] button simultaneously. The door opens.

[5] Press [DOOR (CLOSE)] button and [MAN. COMMON] button simultaneously. The door is closed.

[6] Press [CONV. (FORWARD)] button and [MAN. COMMON] button simultaneously. The rollers are rotated forward

[7] Press [CONV. (RETREAT)] button and [MAN. COMMON] simultaneously. The rollers are rotated backward.

* When a trouble occurs, indicator lamp of corresponding trouble item turns on and trouble alarm sounds.
Trouble alarm can be stopped by [BUZ. STOP] pushbutton.
Clear the cause of trouble and press [RESET] pushbutton to cancel the trouble.
* The door operates only when the door clamp is fully opened.
* Door clamp closing operates only when the door is fully closed.
* When [EMERGENCY STOP] pushbutton is pressed during operation, all operation stops.
* When a work piece (tray) is carried in/out, rotate furnace roller and preparation bed simultaneously and in the same direction

## 3. Various setting items

### 1) THERMO CONTROLLER

#### i. Setting of processing temperature

Set the processing temperature in SP value item of temperature controller.
Setting range is from 0 to 250°C.

To set the temperature,
[1] Press [enter] key.
[2] SP value (the second display) flashes.
[3] Change to the setting value with key [<], [∨], [∧].
[4] Press [enter] key for setting.

See the separate “Digital indication adjusting meter SDC25” instruction manual for detail.

#### ii. Setting of event

Control by the contents of event of temperature controller (EV1 – EV3).
All events are deviation events. Set the deviation from processing temperature (SV value) as a value.

EV1: Timing start temperature of retention timer.
When the temperature rises to this setting value, processing timer and monitoring timer start.
EV2: Unused
EV3: Unused

See the separate “Digital indication adjusting meter SDC25” instruction manual for setting procedure.

<Ex> To start the retention timer when the furnace temperature reaches at 148°C with the processing temperature (SV value) set to 150°C, set “-2” in EV1.

### iii. Other parameters

See “Digital instruction adjusting meter SDC25” instruction manual for detail of other parameters.

It is allowed to change parameters as necessary, but please use parameters at the time of delivery for operation unless any inconvenience of control is found because the optimum value is set at the time of delivery.

The following are the parameters set at the time of delivery. Any other parameter applies the initial value of corresponding instrument.

| ***Bank*** | ***Item*** | ***Display*** | ***Setting*** |
|---|---|---|---|
| Event (Ev) | Internal event1 main setting | E1 | 0 |
| PID(PId) | Proportional band 1 setting | P-1 | 2.0 |
| PID(PId) | Integration time 1 setting | I-1 | 240 |
| PID(PId) | Derivative time 1 setting | d-1 | 60 |
| Parameter (PArA) | Control method | CtrL | 1 |
| Parameter (PArA) | PV bias | bI | -1 |
| Extension tuning (Et) | JF overshoot suppression factor | JF.ov | 20 |
| Event assignment (EvCF) | Operation type of internal event1 Configuration1 operation type | E1.C1 | 4 |
| Setup (StUP) | PV input range type | C01 | 5 |
| Setup (StUP) | PV range high limit | C06 | 400 |
| Setup (StUP) | SP high limit | C08 | 250 |
| Setup (StUP) | Preset MANUAL value | C20 | 0.0 |
| Setup (StUP) | User level | C79 | 0 |

## 2) OVERHEATING METER

### i. Setting of monitoring temperature

Set the temperature at which excessive temperature rise trouble in the temperature controller.
Setting range is from 0 to 250℃.

To set the temperature,
[1] Use the key [∨] and [∧].
[2] SP value (the 2nd display) flashes.
[3] Change to the setting value with the key [<],[∨], [∧].
[4] SP value (the 2nd display) lights up and is set after a short time.

See the separate “Digital indication adjusting meter SDC15” instruction manual for setting procedure.

### ii. Other parameters

See “Digital instruction adjusting meter SDC15” instruction manual for detail of other parameters.
It is allowed to change parameters as necessary, but please use parameters at the time of delivery for operation unless any inconvenience of control is found because the optimum value is set at the time of delivery.
The following are the parameters set at the time of delivery. Any other parameter applies the initial value of corresponding instrument.

| ***Bank*** | ***Item*** | ***Display*** | ***Setting*** |
|---|---|---|---|
| Parameter (PArA) | Control method | CtrL | 0 |
| Parameter (PArA) | PV bias | bI | 0 |
| Event assignment (EvCF) | Operation type of internal event1 Configuration1 operation type | E1.C1 | 4 |
| Event assignment (EvCF) | Operation type of internal event2 Configuration1 operation type | E2.C1 | 4 |
| Event assignment (EvCF) | Operation type of internal event3 Configuration1 operation type | E3.C1 | 4 |
| Setup (StUP) | PV input range type | C01 | 5 |
| Setup (StUP) | PV range high limit | C06 | 400 |
| Setup (StUP) | SP high limit | C08 | 260 |

## 4. Trouble display

### i. PC battery fall [BATT. TROUB.]

The battery of the sequencer is exhausted. Exchange the battery.

Load in excess of specification was applied to the drive motor of agitating fan, cooling fan, door opening/closing, and dolly transport.

It may possibly be caused by hooking to protrusion or the like, or increase of drive force due to deterioration of bearing.

### ii. Emergency stop [EMERGENCY STOP]

The emergency stop button was pressed.

### iii. Fan thermal trip [CIRC.FAN MOTOR TRIP]

Load in excess of specification was applied to the drive motor of agitating fan.
It may possibly be caused by hooking to protrusion or the like, or increase of drive force due to deterioration of bearing or V belt.

### iv. Door motor thermal trip [DOOR MOTOR TRIP]

Load in excess of specification was applied to the drive motor of door opening/closing.
It may possibly be caused by hooking to protrusion or the like, or increase of drive force due to deterioration of bearing or roller chain.

### v. Transport motor thermal trip [CONV. MOTOR TRIP]

Load in excess of specification was applied to the drive motor of transport.
It may possibly be caused by hooking to protrusion or the like, work overload or increase of drive force due to deterioration of bearing or roller chain.

### vi. Door overrun [DOOR OVER TRAVEL]

The door or the dolly ran in excess of stop end.

It may possibly be caused by trouble of end detecting limit switch or deterioration of brake of drive motor.

### vii. Excessive temperature rise [OVER HEAT]

Temperature in the furnace reached more than the temperature set on the excessive temperature alarm.
It may possibly be caused by lowering of circulation air volume in the furnace, defect of air circulation in the furnace, malfunction of the temperature controller or the thyristor unit, defect of thermocouple or etc.

### viii. Thyristor trouble [POWER REGULA TROUB.]

A trouble occurred in the thyristor unit. Check the trouble on the instruction manual of the thyristor unit.

### ix. Nitrogen pressure trouble [N2 PRESS TROUB.]

Supply of nitrogen gas stopped.
It may possibly be caused by closed valve or malfunction of nitrogen supply device.

### x. Fan rotating trouble [CIRC.FAN TROUB.]

Circulation fan is not operating (rotating) normally.
It may possibly be caused by inverter trouble, breakage/disengagement of fan belt or failure to turn on the circuit breaker.

### xi. Cycle trouble [CYCLE TROUB.]

Operation of the door or roller transport was not completed in a specified time.
It may possibly be caused by damage to the chain, hooking to protrusion or the like slippage of drive part or etc.

## 5. Maintenance/Check

Perform the following items periodically for using this equipment long in a good condition.

### i. Grease job of fan bearing unit

Greasing system bearing unit is used for agitation fan unit. Perform a grease job periodically for maintaining the performance of fan unit.
Use grease SH44M made by Dow Corning Toray Co.,Ltd. (base oil: silicone oil, thickening agent: lithium soap) or equivalent.
Feed grease every week.

### ii. Check of fan belt

V-pulley and V-belt are used for rotation transmission of each fan unit. Check them periodically for maintaining the performance of fan unit.
Check for crack and breakage of V-belt, and check whether the belt is properly tensed.
Check it every two months.

### iii. Grease job of furnace roller bearing unit

Greasing system bearing unit is used for rotating the furnace roller. Perform a grease job periodically for maintaining the performance of fan unit.
Use grease SH44M made by Dow Corning Toray Co.,Ltd. (base oil: silicone oil, thickening agent: lithium soap) or equivalent.
Feed grease every week.

### iv. Check and greasing of roller drive chain

Roller chain and sprocket are used for moving the carrier roller. Check them periodically for maintaining the operation performance.
Check for crack and breakage of roller chain, whether the chain is properly tensed, and crack and breakage of sprocket tooth tip.
Check them every two months.
In addition, grease with a lubricator or brush periodically.
Use lubricant DET oil HH made by Mobile Oil or equivalent.
Feed grease to chain for furnace roller every two weeks and for preparation roller every month.

### v. Check and greasing of door traction chain

Roller chain and sprocket are used for moving the door and dolly. Check them periodically for maintaining the operation performance.
Check for crack and breakage of roller chain, whether the chain is properly tensed, and crack and breakage of sprocket tooth tip.
Check them every two months.
In addition, grease with a lubricator or brush periodically.
Use lubricant DET oil HH made by Mobile Oil or equivalent.
Feed grease every month.

## 6. Consumable goods

Consumable goods of this this equipment is as follows:

[1] Door gasket (φ10　Round bar made of silicon robber)
Exchange it when large amount of oil smoke leakage from the door comes out.
[2] Gaskets for air cylinder and air solenoid valve
Exchange it when air leakage from the air cylinder or air solenoid valve comes out.