SHI CRYOCOOLER SPECIFICATION

MODEL: SRDE-418D4-F50H

Cold Head Unit: RDE-418D4
Compressor Unit: F-50H

Cryogenics Division
Precision Equipment Group
Sumitomo Heavy Industries, Ltd.
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A 2018/11/9 Original T. Shiraishi Y. Mizuno M. Saito
Rev. Date Description Prepared Checked Approved
CRYOCOOLER SPECIFICATION

Cryocooler MODEL: SRDE-418D4-F50H
Cold Head Unit Model: RDE-418D4
Compressor Unit Model: F-50H
Regulation: UL, CE

New Condition

1. **Cold Head Unit (Model: RDE-418D4)**
   - Refrigeration Cycle: Modified Gifford-McMahon (2-Stage)
   - Site Condition: Indoor
   - Cooling Capacity:
     - 1st: 42/50 W at 50 K (50/60Hz)
     - 2nd: 1.8/2.0 W at 4.2K (50/60Hz)
   - Lowest Temperature: < 3.5 K -- for reference only
   - Cool Down Time:
     - < 60 min. -- for reference only
     - (300K to 4.2K, 2nd Stage)
   - Cooling Capacity Degradation:
     - < 10 % -- for reference only
     - (10,000Hrs.)
   - Orientation: Free
     - (Cooling Capacity Loss: max. 15 %)
   - Ambient Temperature Range: 5 to 35 deg.C
     - (28 to 35 deg.C with cooling capacity loss max. 5%)
   - Humidity Range: 25 to 85 %RH
     - (without dew)
Dimension: H: 554 x W: 180 x L: 306 mm
Weight: 20.0 kg

Maintenance: Shown in Table 1

Table 1 MAINTENANCE SCHEDULE FOR THE COLD HEAD UNIT

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>Frequency</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace the Inside sliding parts</td>
<td>Every 10,000 Hrs.</td>
<td>“SHI maintenance”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Return the Cold Head Unit to SHI, Ltd.</td>
</tr>
</tbody>
</table>

Notes

- The cooling capacity depends on the Flexible Gas Line length.
- The cooling capacity depends on the ambient temperature.
- The Heat Station Plated with nickel is available upon the request.
- The room should be provided to install the Cold Head Unit.
2. **Compressor Unit (Model: F-50H)**

<table>
<thead>
<tr>
<th>Cooling system</th>
<th>Water Cooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Condition</td>
<td>Indoor</td>
</tr>
</tbody>
</table>

**Electrical Requirement**

<table>
<thead>
<tr>
<th>Power Line Voltage</th>
<th>3 phase (3W+PE),</th>
</tr>
</thead>
<tbody>
<tr>
<td>50Hz</td>
<td>AC 380, 400, 415 V (+/- 10%)</td>
</tr>
<tr>
<td>60Hz</td>
<td>AC 460, 480 V (+/- 10%)</td>
</tr>
</tbody>
</table>

**Power Requirement**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>9 kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended</td>
<td>12 kVA</td>
</tr>
</tbody>
</table>

**Power Consumption**

<table>
<thead>
<tr>
<th>Power Consumption</th>
<th>Steady</th>
<th>Maximum</th>
<th>-- approx.</th>
</tr>
</thead>
<tbody>
<tr>
<td>50Hz</td>
<td>6.5 kW</td>
<td>7.2 kW</td>
<td>7.2 kW</td>
</tr>
<tr>
<td>60Hz</td>
<td>7.5 kW</td>
<td>8.3 kW</td>
<td>8.3 kW</td>
</tr>
</tbody>
</table>

**Operating Current**

| Maximum | 13 A (50/60Hz) | -- approx. |

**Starting Current**

| 75/80A (50/60 Hz) | -- approx. |

**Built-in Circuit Breaker Setting**

| 16 A |

**Ambient Temperature Range**

5 to 35 deg.C  
(28 to 35 deg.C with cooling capacity loss max. 5%)

**Humidity Range**

25 to 85 %RH  
(without dew)

**Cooling Water Requirement**

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>4 to 28 deg.C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate</td>
<td>7 to 10 liter / min. at 28 deg.C</td>
</tr>
<tr>
<td>Quality Requirement</td>
<td>Refer to the ANNEX.</td>
</tr>
</tbody>
</table>

*See the ANNEX. for more detail.
Noise Level (1m distance)  
Compressor Unit Only    Max. 60 dBA        -- approx.
*Noise level of the whole equipment may exceed 70 dBA depending on the environment it is used in.

Dimension        H: 591 x W: 450 x L: 485 mm*        -- approx.
*without Terminal Cover, Connectors and Screw Head.

Weight          120 kg            -- approx.

Required Space*  Refer to the ANNEX.
*with maintenance space.

Maintenance  Shown in Table 2

Table 2  MAINTENANCE SCHEDULE  
FOR THE COMPRESSOR UNIT

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>Frequency</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace the Adsorber</td>
<td>Every 30,000 Hrs.</td>
<td>“USER maintenance”</td>
</tr>
<tr>
<td>Charge the Helium Gas</td>
<td>As required</td>
<td>“USER maintenance”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Purity of 99.999% up</td>
</tr>
<tr>
<td>Reset the circuit protector(s)</td>
<td>As required</td>
<td>“USER maintenance”</td>
</tr>
<tr>
<td>Cleaning the Water Line</td>
<td>As required</td>
<td>“USER maintenance”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depending on the water conditions</td>
</tr>
</tbody>
</table>

Notes
- While carrying the compressor unit, do not tilt it by more than 30 degrees.
- While setting the compressor unit, do not tilt it by more than 5 degrees.
3. **Accessories (Standard)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible Gas Line Standard</td>
<td></td>
</tr>
<tr>
<td>20A x 20 m (F-F) (Supply)</td>
<td>x 1</td>
</tr>
<tr>
<td>20A x 20 m (F-F) (Return)</td>
<td>x 1</td>
</tr>
<tr>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>20A x 6 m (F-F) (Supply)</td>
<td>x 1</td>
</tr>
<tr>
<td>20A x 6 m (F-F) (Return)</td>
<td>x 1</td>
</tr>
<tr>
<td>+Buffer Tank</td>
<td>x 1</td>
</tr>
<tr>
<td>Cold Head Power Cable</td>
<td>6 m x 1</td>
</tr>
<tr>
<td>Input Power Cable</td>
<td>5 m x 1</td>
</tr>
<tr>
<td>Hose Nipple</td>
<td></td>
</tr>
<tr>
<td>OD:12.7mm x PT3/8 (male)</td>
<td>x 2</td>
</tr>
<tr>
<td>Tool Kit</td>
<td></td>
</tr>
<tr>
<td>Gas Charge Valve</td>
<td>x 1</td>
</tr>
<tr>
<td>Open end wrench (29mm)</td>
<td>x 1</td>
</tr>
<tr>
<td>Open end wrench (26mm)</td>
<td>x 1</td>
</tr>
<tr>
<td>Quick Wrench</td>
<td>x 1</td>
</tr>
<tr>
<td>Manual</td>
<td></td>
</tr>
<tr>
<td>Operation Manual</td>
<td>x 1</td>
</tr>
<tr>
<td>Technical Instruction for Cold Head Unit</td>
<td>x 1</td>
</tr>
<tr>
<td>Technical Instruction for Compressor Unit</td>
<td>x 1</td>
</tr>
</tbody>
</table>

**Notes**

- **Cold Head Power Cable is available up to 20 m, and Min. length is 6 m.**
4. **Annex.**

1) System Configuration  
2) Cold Head Unit DWG.  
3) Compressor Unit DWG.  
4) Electrical Schematic  
5) Cooling Water Requirement  
6) Required Space of Compressor Unit  
7) Flexible Gas Line DWG. (Standard Length)  
8) Buffer Tank DWG. (Optional)  
9) Buffer Tank Layout (Optional)  
10) Cold Head Power Cable DWG. (Standard Length)  
11) Input Power Cable DWG. (Standard Length)  
12) Hose Nipple DWG.  
13) Gas Charge Valve DWG.  
14) Typical Refrigeration Capacity.

5. **Scope of Supply**

The followings are included.
1) Cold Head Unit  
2) Compressor Unit  
3) Input Power Cable  
4) Flexible Gas Lines (Supply and Return) (+Buffer Tank)  
5) Cold Head Power Cable  
6) Hose Nipple  
7) Tool Kit  
8) Operation Manual

The followings are not included in this spec.
1) Thermometer  
2) Temperature indicator  
3) O-ring between Cold Head Unit and Vacuum Chamber  
4) Vacuum Chamber  
5) Vacuum Pump  
6) Bolts
6.  **Warranty** <Sale and Purchase of New Machines>

**Warranty Period**
Warranty period for the newly supplied Machines shall be eighteen (18) months from the date of shipment of the Machines from Sumitomo’s works or twelve (12) months from the date of the operation and use of the Machines by the customer, whichever comes earlier.

**Warranty Conditions**
During the warranty period, should any defects are found in the Machines irrespective of the fact that the Machines are properly installed, connected and maintained in conformity to the instructions manuals and are properly operated under the conditions as instructed in the specifications and operation manuals, Sumitomo will, at its discretion, repair or replace free of charge the Machines except for the cases which fall under the category of the warranty exception as enumerated below.

Provided, however, that in the event the Machines are connected with the customer’s other equipment, the costs for the removal from and re-installation of the Machines to such equipment, and other costs incidental to such work, including transportation charges thereto and so on shall be borne by the customer.

The scope of Sumitomo’s liability pursuant to the warranty shall be limited to the repair or replacement of the Machines.

Sumitomo shall not compensate any expenses, fees or charges for repair or replacement of the Machines or parts thereof incurred by the customer or third parties other than Sumitomo or Sumitomo’s authorized servicing companies without prior written consent of Sumitomo or Sumitomo’s authorized servicing companies.

SUMITOMO MAKES NO WARRANTIES OF MARCHANTABILITY OR FITNESS FOR ANY PARTICULAR USE AND PURPOSE OF THE CUSTOMER, NOR ARE ANY OTHER WARRANTIES MADE, EXPRESS OR IMPLIED, UNLESS OTHERWISE SPECIFICALLY AGREED IN WRITING.

**Warranty Exception**
The warranty shall not apply to the following cases.
1. Any defects caused by improper installation of the Machines or improper connection with other related equipment by the customer or third party other than Sumitomo or Sumitomo’s authorized servicing companies.
2. Any defects caused by insufficient maintenance or improper handling of the Machines by the customers.
3. Any defects caused by the operation of the Machines outside the specifications or operation and use conditions beyond Sumitomo’s expectation by the customer.
4. Any defects caused by the modification or alteration to the Machines by the customer or third parties other than Sumitomo or Sumitomo’s authorized servicing companies.
5. Any defects of the Machines caused by the parts supplied or specified by the customer.
6. Any damage caused by Force Majeure, such as earthquakes, fires, floods, salt damage, gas damage, thunder and other causes beyond the control of Sumitomo.
7. Any other defects caused by the events not attributable to Sumitomo.

**Limitation of Damages**
Any damages, if any, to be compensated to the customer due to the defects of the Machines attributable to Sumitomo shall be limited to the direct damages actually incurred by the customer and shall not exceed the contract price of the Machines.

**Indemnification**
Sumitomo shall not be responsible for the following damage irrespective of the causes or reasons for the claims made by the customer.
1. Any losses of profits and operation opportunity and other consequential or indirect loss or damage of any kind incurred by the customer in connection with the Machines.
2. Any damage to the Machines caused by any special circumstance on the part of the customer which is attributable to the customer irrespective of whether such damage is foreseeable or not by Sumitomo.
3. Any damage incurred by the customer resulting from the damages claimed by third party for which Sumitomo is not responsible.
4. Any damage incurred by the customer due to collection and improvement of the same kind of machines or similar to the Machines caused by recall of those machines.

**Maintenance**
The maintenance work of the Machines shall be recommendable to be performed at an interval which is described in the above sentence.

**Parts Supply**
Unless otherwise specified in the contract documents, Sumitomo shall keep any parts for the Machines for a period of seven (7) years from the delivery date of the Machines to the customer.

**Notes:** Specifications subject to change or delete without notice.
WATER COOLED SYSTEM

SYSTEM CONFIGURATION

Sumitomo Heavy Industries, Ltd
RDE-418D4 COLD HEAD

COLD HEAD UNIT

Sumitomo Heavy Industries, Ltd.
ELECTRICAL SCHEMATIC (AC CIRCUIT)

Sumitomo Heavy Industries, Ltd
ELECTRICAL SCHEMATIC (DC CIRCUIT)

NOTE:
1. WIRING SIZE IS AWG18 FOR CN12 AND CN13.
2. WIRING COLOR OF 24V DC CIRCUIT IS BLUE.

F-50L, F-50H
F-60L, F-60H
ELECTRICAL SCHEMATIC 1/2
COOLING WATER REQUIREMENT

The typical flow characteristics are shown in following Figures, and the cooling water quality requirement is shown in following Table.

For Antifreeze
Operating with Antifreeze (50/50 % mixture of water and ethylene glycol or propylene glycol), the flow rate shall be larger than the water. The larger circulating pump will be required for the Antifreeze.

For Water

For Antifreeze (50/50 % mixture of water and ethylene glycol or propylene glycol.)
The larger circulating pump will be required for the Antifreeze

Pressure Drop and Temperature Rise (Typical)

Figure COOLING WATER TYPICAL FLOW CHARACTERISTICS

Sumitomo Heavy Industries, Ltd
## Table  COOLING WATER SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[4.0 ~ 28.0] (39.2 ~ 82.4)</td>
<td>[0.10 ~ 0.69] (14.5 ~ 100)</td>
<td>[4.0 ~ 10.0] (1.1 ~2.6)</td>
<td>[0.025 ~ 0.085] (3.55 ~ 12.1)</td>
<td>&lt;Steady State&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[&lt; 6.5] (&lt; 22180) for 50Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[&lt; 7.5] (&lt; 25590) for 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[&lt; 7.2] (&lt; 24570) for 50Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[&lt; 8.3] (&lt; 28320) for 60Hz</td>
</tr>
<tr>
<td>QUALITY</td>
<td>pH Value</td>
<td>6.5 to 8.2 at 25 deg.C (77 deg.F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical Conductivity</td>
<td>&lt; 80 mS / m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chloride Ion</td>
<td>&lt; 200 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sulfate Ion</td>
<td>&lt; 200 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M-Alkalinity</td>
<td>&lt; 100 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Hardness</td>
<td>&lt; 200 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calcium Hardness</td>
<td>&lt; 150 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ionic Silica</td>
<td>&lt; 50 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iron</td>
<td>&lt; 1.0 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Copper</td>
<td>&lt; 0.3 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sulfide Ion</td>
<td>None, Not detectable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ammonium ion</td>
<td>&lt; 1.0 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Residual Chlorine</td>
<td>&lt; 0.3 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Free Carbon Dioxide</td>
<td>&lt; 4.0 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stability Index</td>
<td>6.0 to 7.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suspended Matter</td>
<td>&lt; 10 mg/liter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Particle Size</td>
<td>&lt; 100 μm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Open out at least two faces

REQUIRED SPACE OF COMPRESSOR UNIT
20A x 20m (F-F) FLEXIBLE GAS LINE

Sumitomo Heavy Industries, Ltd
BUFFER TANK
COLD HEAD POWER CABLE (6 m)

PLUG
MS3106B14S-2S

CABLE (UL-APP)
AWG16 (1.3") x 4

PLUG
MS3106B14S-2P

MAX. φ30

MAX. φ36

6000°120

Sumitomo Heavy Industries, Ltd
**NOTE**

(1) MOUNTING HOLE SIZE : MIN Ø22.00mm.
(2) FOUR CABLES TO BE INSERTED IN THE CONDUIT.

**INPUT POWER CABLE (HIGH VOLTAGE)**
F-50H, F-50HC, F-60H, F-60HC

**INPUT POWER CABLE (5 m)**

Sumitomo Heavy Industries, Ltd.
HOSE NIPPLE  OD:12.7mm x PT3/8 (male)

Material: Brass
GAS CHARGE VALVE
TYPICAL REFRIGERATION CAPACITY*

*Reference data for new condition

---

RDE-418D4_Load Map at 50Hz

- **2nd Stage Temperature [K]**
- **1st Stage Heat Load [W]**
  - 0W
  - 20W
  - 40W
  - 60W
  - 80W

- **1st Stage Temperature [K]**

RDE-418D4_Load Map at 60Hz

- **2nd Stage Temperature [K]**
- **1st Stage Heat Load [W]**
  - 0W
  - 20W
  - 40W
  - 60W
  - 80W

- **1st Stage Temperature [K]**

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* Sumitomo Heavy Industries, Ltd