



AKJ
COOLING UNIT
(IMMERSION TYPE)
SERIES A

DESCRIPTION

The AKJ cooling unit series achieves high energy-saving performance thanks to its built-in DAIKIN original IPM motor. The IPM motor allows highly accurate temperature control. Power consumption can be checked on the control panel.

The AKJ cooling units are to be placed in the coolant tank. A cooling coil immersed in the fluid cools it. The tank and the circulation pump are not provided and they must be prepared separately by the Customer.

These cooling units can control the temperature in these ways:

- By set the fluid temperature according to the ambient temperature or to the machine temperature
- By hold the temperature of the fluid in the tank constant

An auto-tuning function that automatically sets the control gain according to the system installed (tank oil volume, piping, etc.) reduces adjustment time significantly at the trial run.

The AKJ cooling units are perfect in applications that demand a strict control of the temperature of hydraulic fluids, lubricants, cutting and coolant liquids for milling centres, NC lathes, grinders, electrical discharge machining, moulding machines, presses, etc.

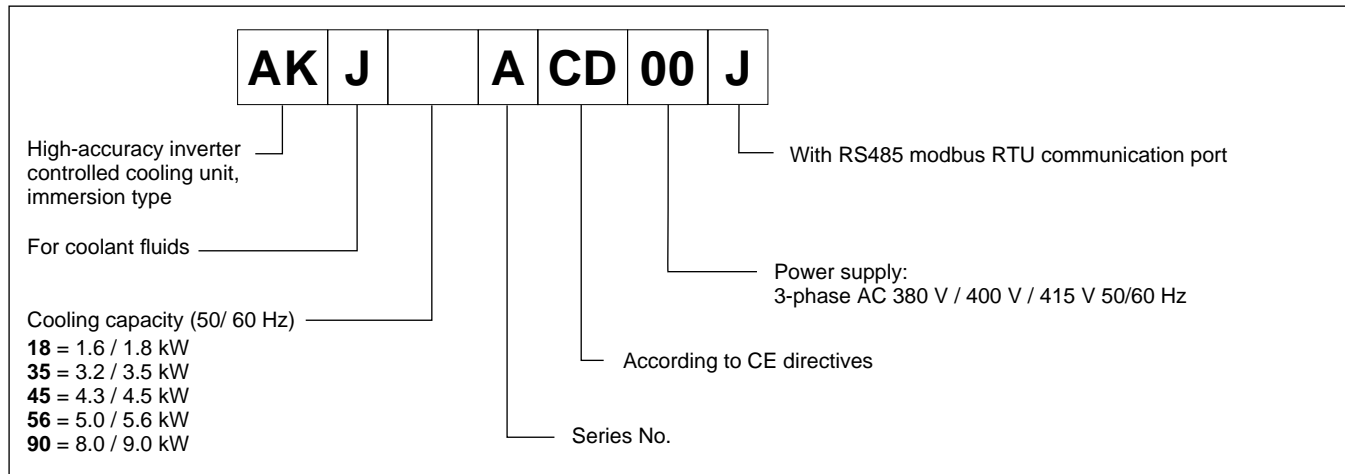
MAIN CHARACTERISTICS

Cooling capacity 50/60 Hz	kW	1.6/1.8 ÷ 8.0/9.0 (see detailed specs. on page 2)
Accuracy of the temperature control	°C	±0.1 (load range from 0% to 100%)
Supply power voltage main circuit operating circuit		three-phase 400 V AC 50/60Hz (±10%) 12/24 V DC
Power consumption (400V 50/60Hz)	kW	0.86 ÷ 2.90 (see detailed specs. on page 2)
Current consumption (400V 50/60Hz)	A	1.8 ÷ 5.1 (see detailed specs. on page 2)
Admitted fluids		Water soluble cutting and grinding fluid, cutting and grinding oil, mixtures of cooling lubricants, lubricating oil, hydraulic oil, industrial water (not applicable to chemicals, foods, and fuels)
Communication protocol		RS485 / Modbus RTU protocol
Ambient operating temperature	°C	+5 to +45
Fluid inlet temperature	°C	+5 to +50
Refrigerant gas		R410A (2090) contained in a full hermetical circuit
Relative humidity range	%RH	20 ÷ 85
Liquid viscosity	mm ² /s	0.5 to 200
Protection class Electric component housing		IP2X IP54 compatible, with proper cable glands / connectors

NOTE: Cooling water-based liquids, the cooling capacity increases by 15-20%.



1 - IDENTIFICATION CODE



2 - SPECIFICATIONS

		AKJ18	AKJ35	AKJ45	AKJ56	AKJ90
Cooling capacity 50/60 Hz (NOTE 1)	kW	1.6 / 1.8	3.2 / 3.5	4.3 / 4.5	5.0 / 5.6	8.0 / 9.0
Supply power		3-phase AC 380/400/415 V 50/60 Hz				
Supply voltage main circuit control circuit		3-phase AC 380/400/415 V 50/60 Hz 12/24 V DC				
Max power consumption (400V 50/60 Hz)	kW	1.02	1.44	1.56	2.90	3.87
Max current consumption (400V 50/60 Hz)	A	2.2	2.8	3.1	5.1	7.8
Compressor (hermetic DC swing type)	kW	0.4 max	0.75 max	1.1 max	1.5 max	2.2 max
Evaporator		open coil type				
Condenser		cross-fin coil type				
Agitator motor		φ3, 60 W, 4P				
Motor of the propeller fan		54 W	54 W	100 W	100 W	
Refrigerant control		Rotation speed control of compressor by inverter + electronic expansion valve opening				
Refrigerant gas R410A (NOTE 2) filling q.ty CO ₂ equivalents	kg	0.62 1.30	0.88 1.84	0.93 1.95	1.07 2.24	1.56 3.27
Noise level (front 1 m, height 1.55 m) (NOTE 3)	dB(A)	62			65	68
Applicable fluids		Water soluble cutting and grinding fluid, cutting and grinding oil, lubricating oil, hydraulic oil, industrial water (not applicable to chemicals, foods, and fuels)				
Exterior colour		Ivory white				
Mass	kg	43	50	52	76	96
Permissible transport vibration		Up and down vibration 14.7 m/s ² × 2.5 hr. (7.5 to 100 Hz sweep/five min.)				
Altitude		2000 mt or less (NOTE 4)				
ELCB (mandatory, in the customer's charge)	A	10			15	20

NOTE 1: Cooling capacity is the value at standard point (oil temperature: 35 °C, ambient temperature: 35 °C, fluid used: ISO VG32, 1 atm), 400V 50/60 Hz. Cooling water-based liquids, the cooling capacity increases by 15-20%. The product tolerance is approx. ±5%.

NOTE 2: The R410A refrigerant is contained in a full hermetical circuit. The SDS (Safety Data Sheet) for R410A refrigerant is provided. GWP: 2090. 'Global Warming Potential' (GWP) means the measure of how much 1 kg of the refrigerant applied in the vapour compression cycle is estimated to contribute to global warming, expressed in kg CO₂ equivalents over a 100-year time horizon.

NOTE 3: The fan motor speed changes with room temperature to save energy. Therefore, it's normal for the noise level to vary.

NOTE 4: If installed over 1000 mt altitude, consider a 20-30% reduction in cooling capacity. Life expectancy of electrical components may be shorten.

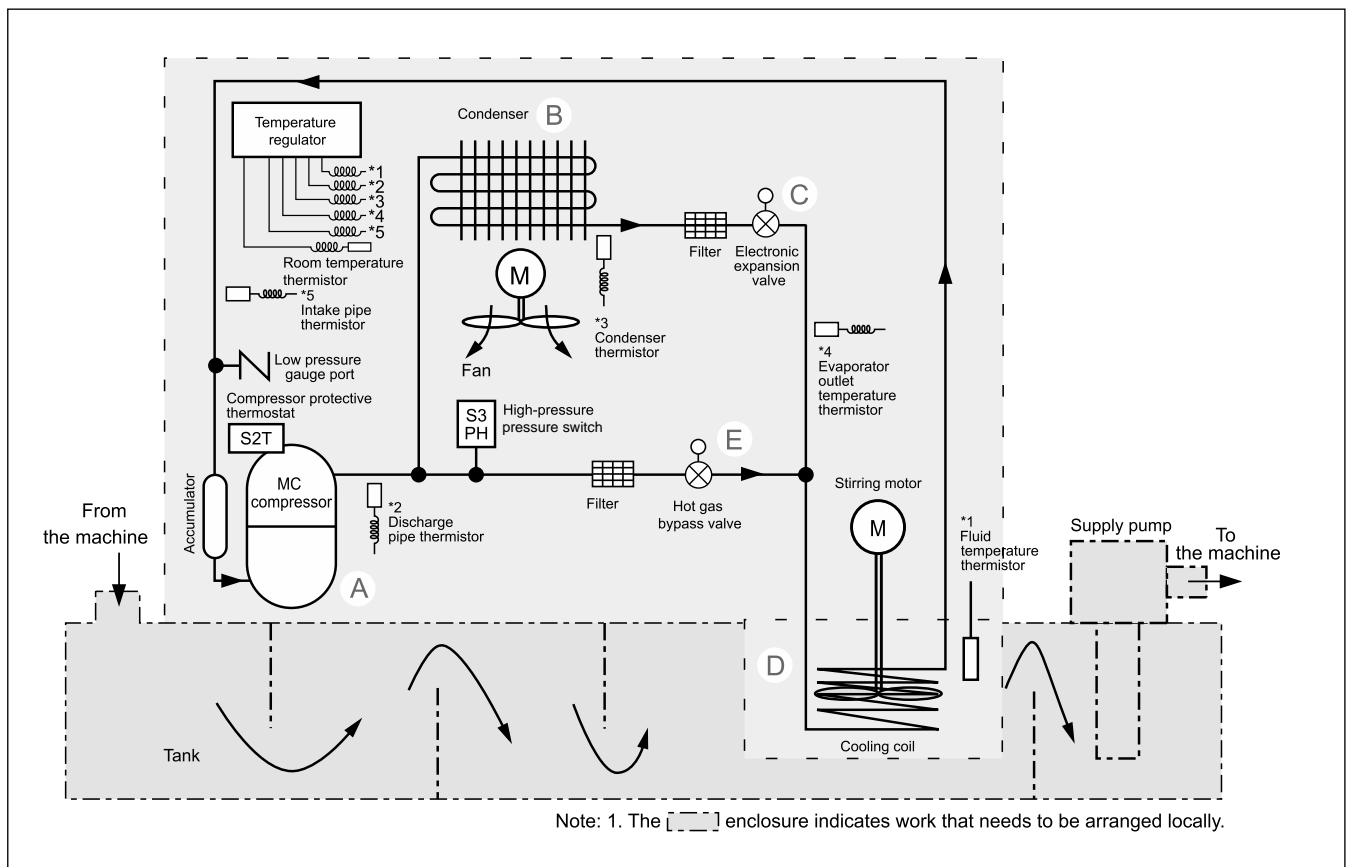
3 - TEMPERATURE CONTROL MODES

The AKJ cooling units can control the temperature of the fluid in three different modes:

- Set the fluid temperature according to the ambient temperature (operation mode n.3, set as standard):
Control is done by keeping a constant temperature difference between the fluid in the tank and the ambient (room) temperature.
The setting range is ± 9.9 °C against the ambient temperature.
- Hold the tank fluid temperature constant (operation mode n. 0):
The setting range is $5 \div 50$ °C
- Set the fluid temperature according to the machine temperature (operation mode n.4):
Control is done by keeping a constant temperature difference between the fluid in the tank and the machine temperature.
The setting range is ± 9.9 °C against the machine temperature.
This mode requires an additional thermistor to be installed directly on the machine. This thermistor must be ordered separately and its installation is in the customer's charge. See point 12.

The operating mode is selectable from the control panel. Detailed instructions can be found in the instruction manual delivered with the cooling unit.

4 - SYSTEM OUTLINE



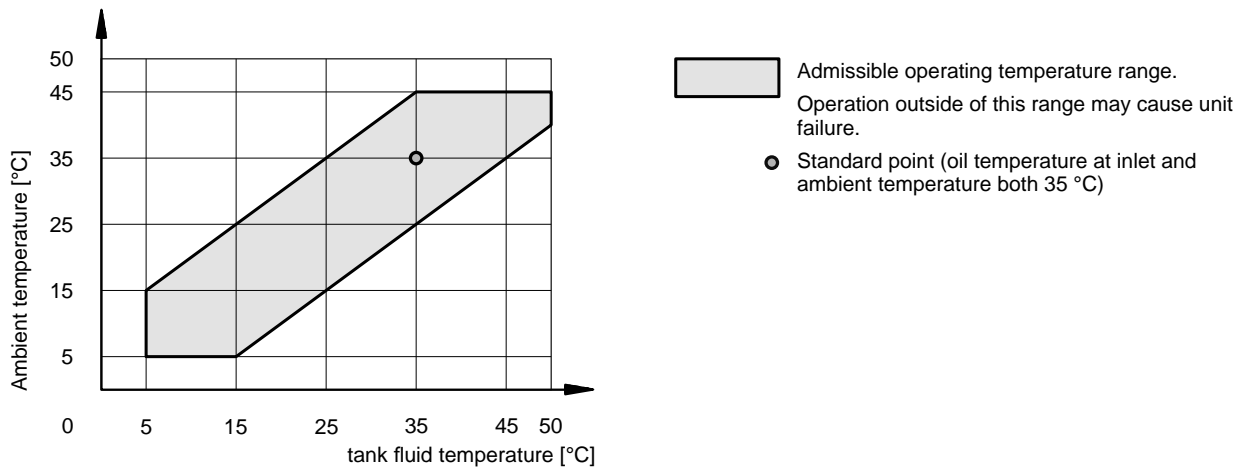
4.1 - The refrigerating cycle

- The compressor produces compressed gas at high temperature and high pressure so that the refrigerant gas can be easily cooled and liquefied in the condenser.
- The condenser cools and condenses the high temperature/high pressure gas produced in the compressor, transforming it into a high temperature/high pressure liquid.
- The electronic expansion valve reduces the liquid/gas mixture pressure so that it can evaporate easily in the cooling coil.
- Inside the cooling coil, the liquid evaporates low pressure liquid/gas mixture by absorbing heat from the fluid in the tank (cooling the coolant fluid) and transforms it into a low temperature/low pressure gas again.
- For very low load, the hot gas bypass valve automatically regulates the cooling capacity adding high temperature, high pressure gas to the mixture in order to achieve the correct proportion of gas/mixture supplied to the coil.

4.2 - Fluid circuit

The fluid to be cooled, properly filtered, comes from the machinery into a tank in which the coolant coil is immersed. The cooled fluid is returned to the machine by a supply pump. Tank and pump are in the Customer charge.

5 - OPERATING TEMPERATURE RANGE



5.1 - Applicable fluids

This equipment is intended for:

- Lubricants and hydraulic oils (mineral oils) with an autoignition temperature over 100°C, flash point of 70°C or higher but below 250 °C, and a discolouration rating of No.1 according to the "Petroleum Products - Corrosiveness to Copper - Copper Strip Test (ISO 2160)".
- Coolant fluids, such as water-soluble cutting and grinding fluid and non-water-soluble cutting and grinding fluid.
- Ethylene glycol (antifreeze liquid)
- Water (industrial water)

This equipment is not intended for use with:

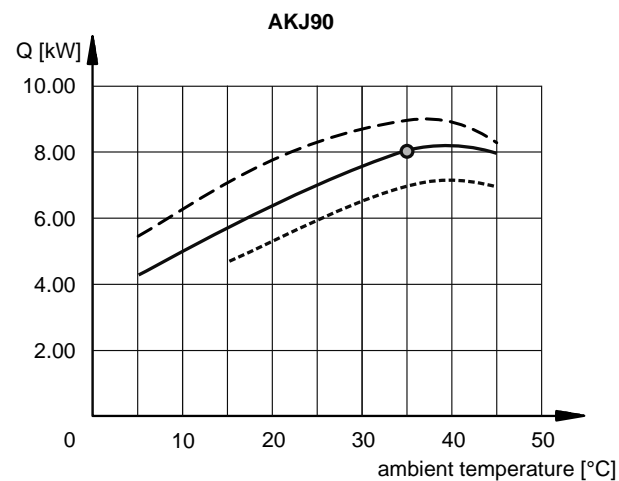
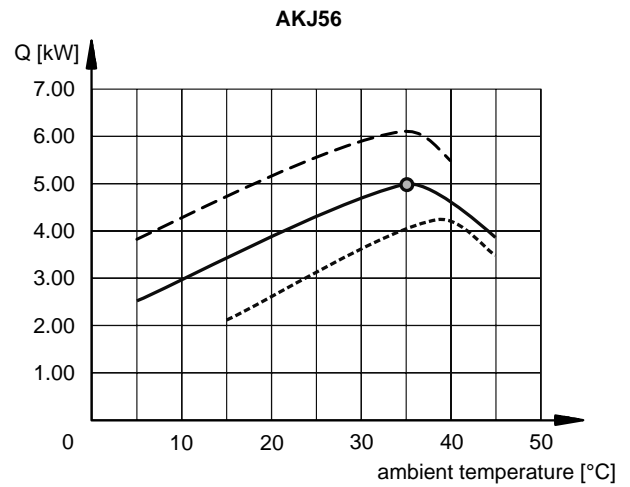
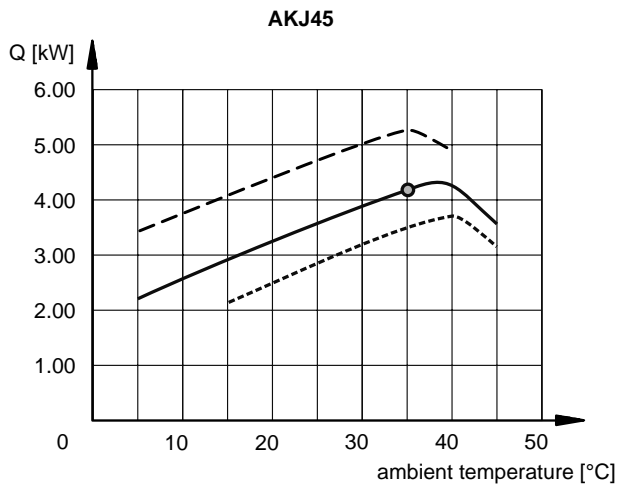
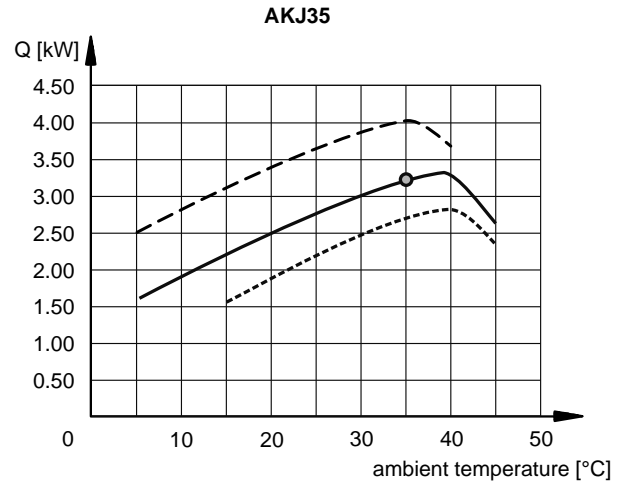
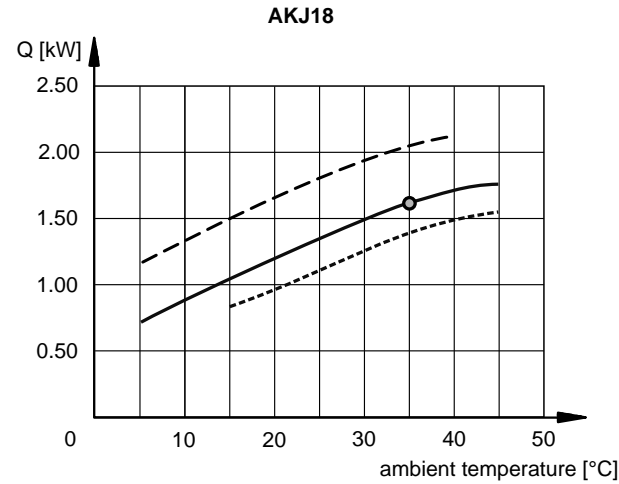
- Flame-resistant hydraulic oil (Phosphoric ester / chlorinated hydrocarbon / water + glycol / W/O, O/W emulsion type oils)
- inflammable liquids like fuels and alcohol,
- Chemicals
- Food liquids and food contact liquids (FCMs)

6 - CHARACTERISTICS OF AKJ* MODELS

Values obtained and rated for standard point with ambient temperature: 35 °C and fluid temperature: 35 °C, 50 Hz. Fluid used: ISO VG32 mineral oil.

6.1 - Temperature control

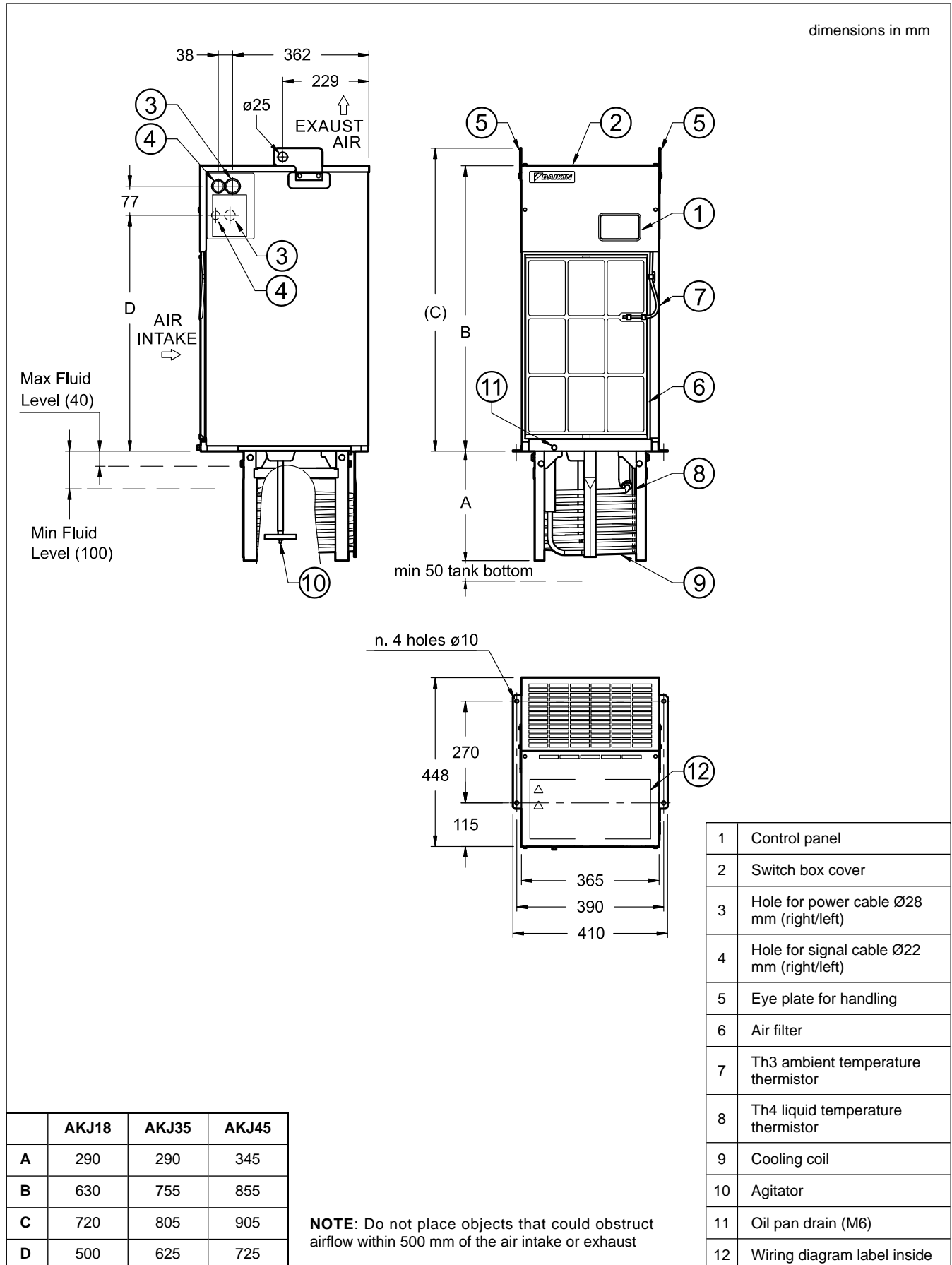
Cooling capacity (kW) according to the ambient temperature.



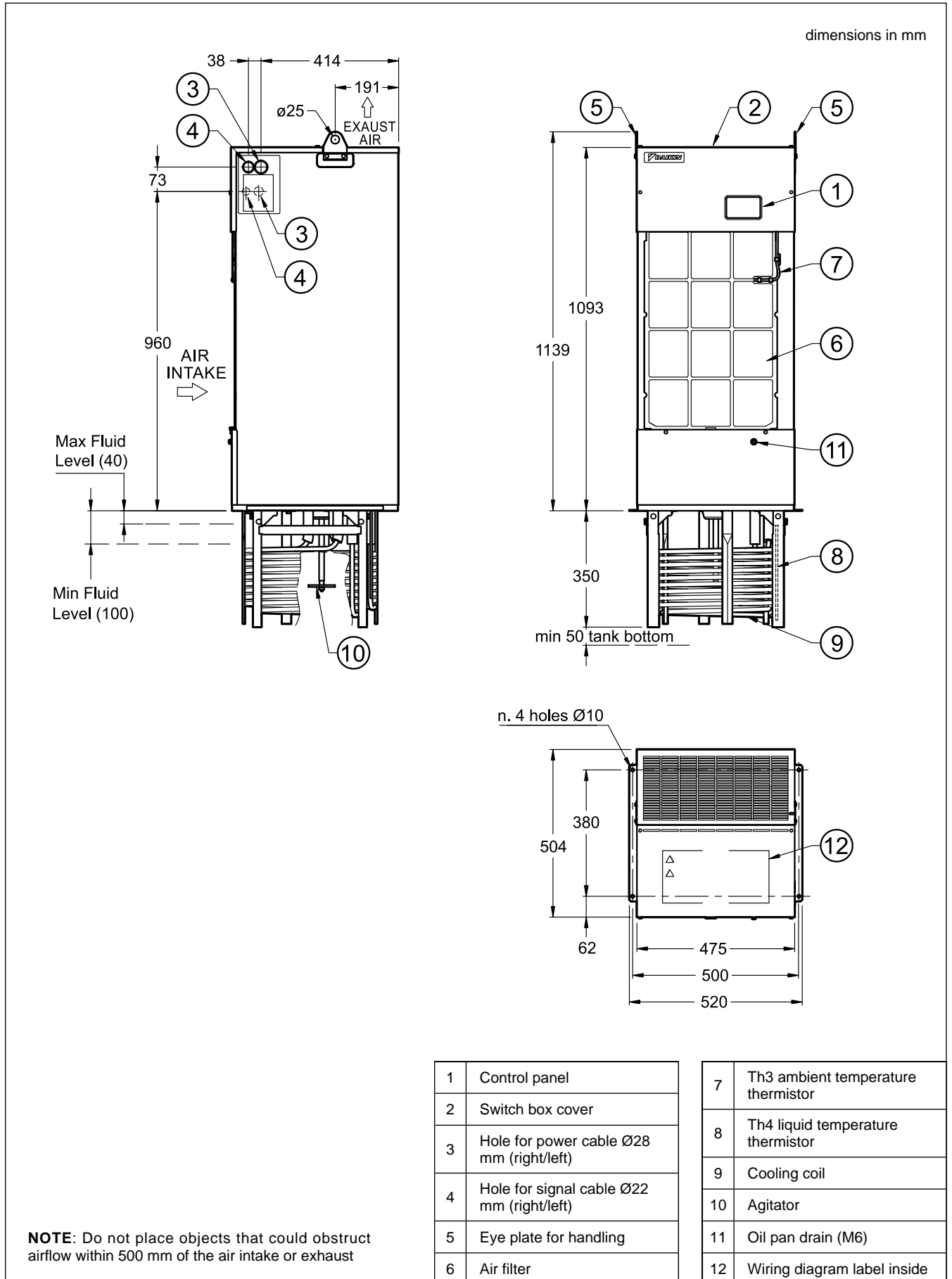
- fluid temperature in the tank = ambient temperature
- - fluid temperature in the tank = ambient temperature +10 °C
- ... fluid temperature in the tank = ambient temperature -10 °C
- standard point (tank fluid temperature and ambient temperature both 35 °C; ISO VG32 oil)

7 - OVERALL DIMENSIONS AND MOUNTING

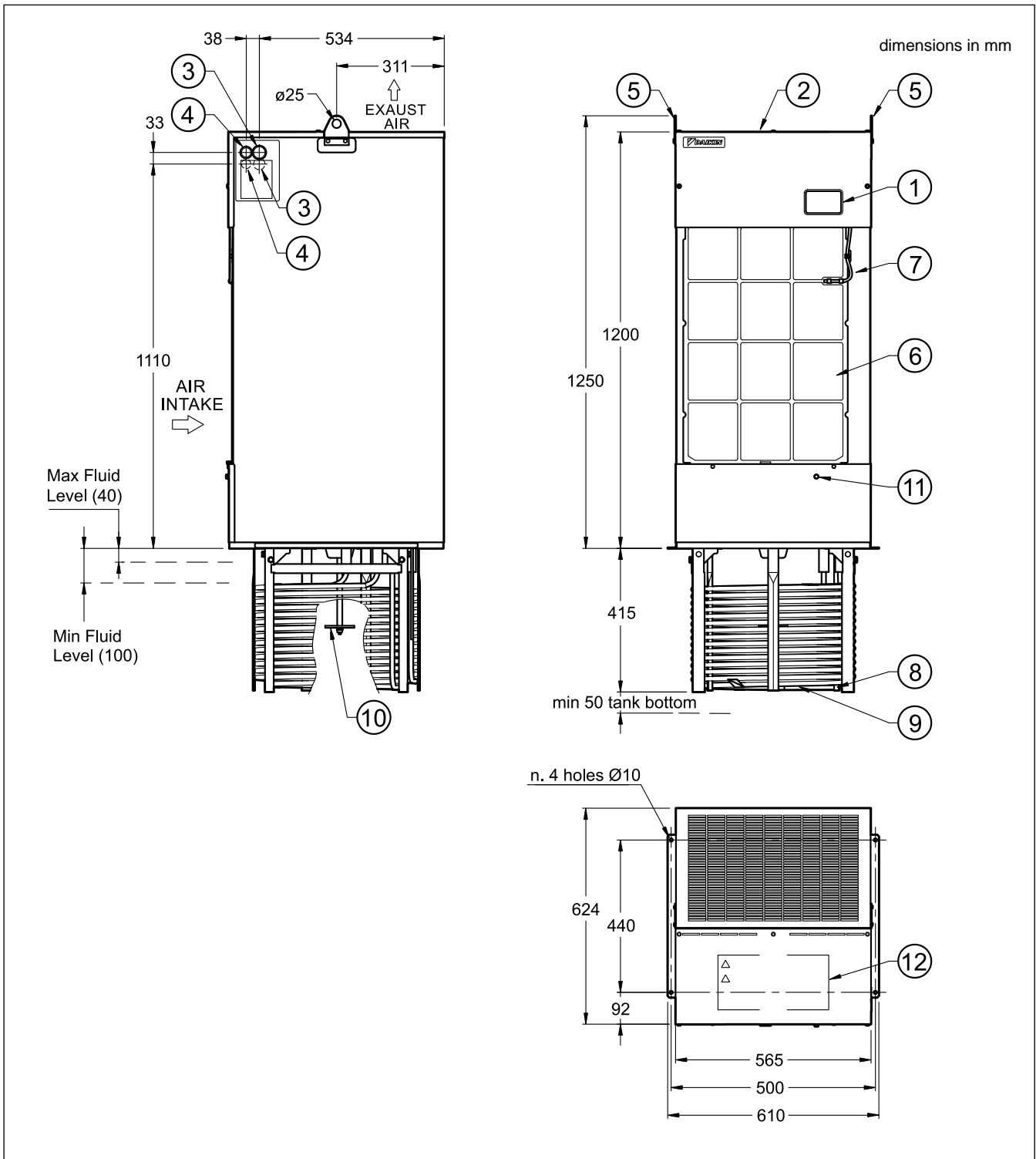
7.1 - AKJ18ACD00J, AKJ35ACD00J and AKJ45ACD00J



7.2 - AKJ56ACD00J



7.3 - AKJ90ACD00J



NOTE: Do not place objects that could obstruct airflow within 500 mm of the air intake or exhaust

1	Control panel	7	Th3 ambient temperature thermistor
2	Switch box cover	8	Th4 liquid temperature thermistor
3	Hole for power cable $\varnothing 28$ mm (right/left)	9	Cooling coil
4	Hole for signal cable $\varnothing 22$ mm (right/left)	10	Agitator
5	Eye plate for handling	11	Oil pan drain (M6)
6	Air filter	12	Wiring diagram label inside

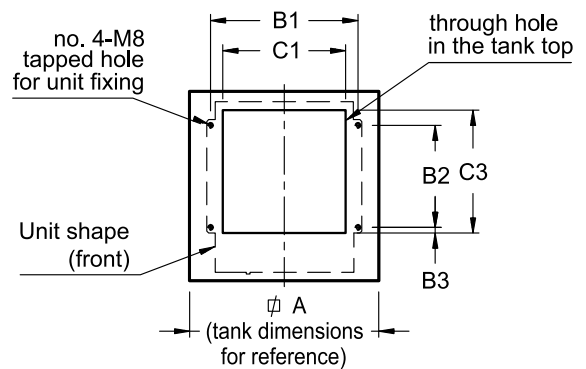
8 - INSTALLATION NOTES

8.1 - Tank requirements

- Separate the fluid tank into at least three sections. Use the over-flow system and take measures so that foreign matter such as cutting chips and debris does not get into the suction line directly.
- Arrange and locate the partition plates and piping position properly so that high-temperature fluid returned from the machine and low-temperature fluid cooled by the AKJ cooling unit are evenly mixed.
- Design the tank so that the tank inside can be cleaned easily (for instance, the tank upper plate should be removable).
- Material: stainless steel is recommended, but compatibility with the cooling fluid should be adequately considered. Some grinding fluid tanks are made of general structural steel with the interior coated with epoxy resin.

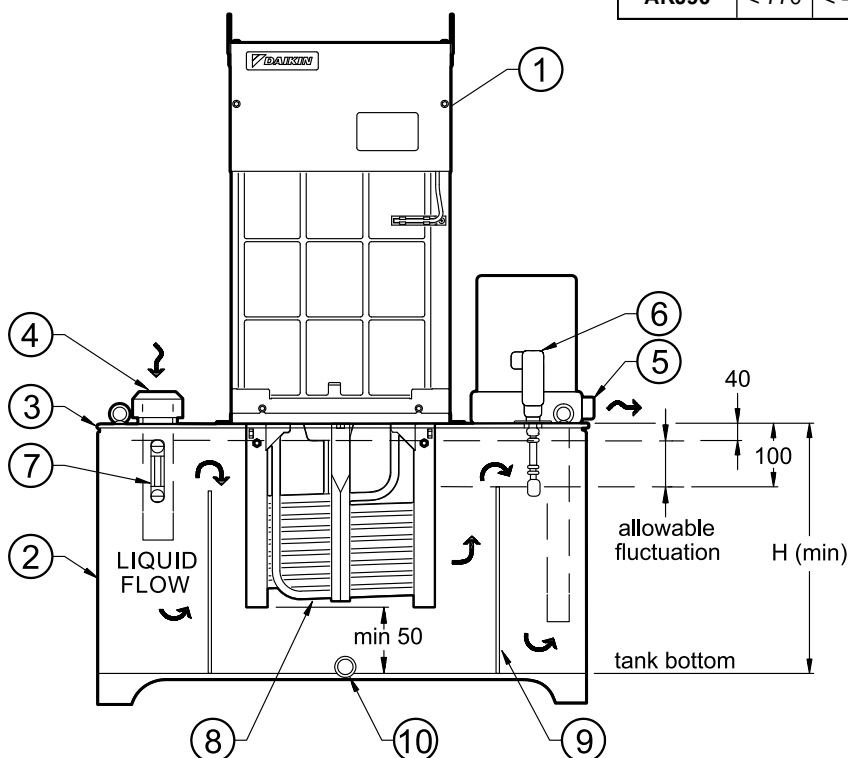
NOTES ON TANK DESIGN:

- The cooling units protrude approximately 50 mm from the front of the tank. It is important to check that there are no obstructions at the front.
- If the 'long life filter' accessory (catalogue 90 661) is fitted, the additional obstruction at the front of the cooler must be taken into account.
- Baffles must be higher than the minimum allowable liquid level.
- The liquid level variation inside the tank must be between 40 and 100 mm from the tank top.
- The coolant coil must remain completely submerged in the liquid throughout the operating cycle.



dimensions in mm

Tank for:	size	depth	tank hole pitch			trough hole	
	A	H	B1	B2	B3	C1	C2
AKJ18	< 500	< 340	390	270	15	325	325
AKJ35		< 395					
AKJ45							
AKJ56	< 690	< 400	500	380	45	440	440
AKJ90	< 770	< 465	590	440	30	500	500



1	AKJ unit
2	Tank body
3	Tank top plate
4	Return liquid connection with filter
5	Liquid outlet from Supply pump
6	Float switch
7	Oil level gauge
8	Cooling coil
9	Baffle
10	Tank drain

9 - EMC 2014/30/EU COMPLIANCE

The AKJ cooling units are classified as auxiliary machines of over-voltage category II, main machine. Install a main power switch as required by EN60204-1 on the control panel of the main machine. Carry out power supply through a transformer provided with basic insulation (IEC Code 60335-1)

- Be sure to connect the earth leakage circuit breaker (ELCB) of specified capacity (to be prepared by the customer) to the main power. (Other measures against earth leakage must be taken when using the moulded case circuit breaker (MCCB)).
- Be sure to install an Earth conductor. Due to a noise filter being mounted, there is a danger of electrical shock unless earth connection is provided.
- Be sure to disconnect power supply before opening the cover of the electrical panel. **Leave it out for 5 minutes**, waiting for the discharge of the internal high voltage to be completed. Do not connect power supply while the electrical equipment box is open.

To avoid the effect of electrical noise, cut off the power cable to a proper length when connecting, so that no surplus wire will come in contact with control circuit board, etc.

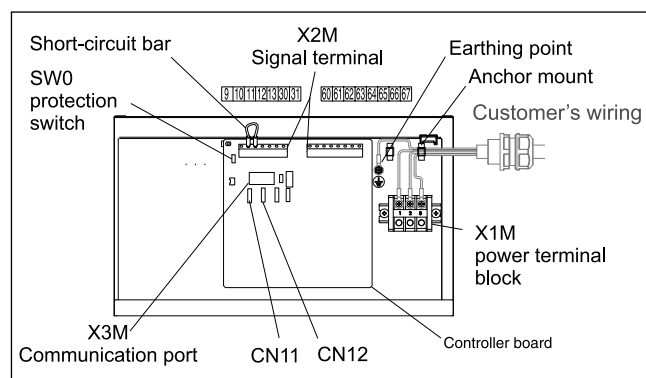
10 - WIRING

To begin wiring the electrical components, open the cover, ensuring that the special screws used to seal it are kept safe and the gasket around the edge is not damaged. These screws will be reused to close the cover once wiring is complete.

Use conduits with IP54 or higher for wiring intake to allow the electric component box to have a protective structure equivalent to IP54.

Customer have to wire for: power source (X1M), for signals (X2M), and for communication with the main machine (X3M)

Please refer to the *Instruction manual* for detailed instructions for wiring and to the *PIM00605B_Modbus communication function instruction manual_EN.pdf*



10.1 - Ground point

Connect the ground cable to the (ground) terminal. Use green/yellow ground cable.

10.2 - Power source (X1M terminal block)

AKJ90: screw terminal M5. Use cables with 4-wires, with section $\geq 4 \text{ mm}^2$.

other models: screw terminal M4, M5. Use cables with 4-wires, with section $\geq 2.5 \text{ mm}^2$.

10.3 - Signals (X2M terminal block)

Use bar solderless terminal connection; use the stranded wire. 2-core cable, wires with section 0.5 to 1.5 mm^2 . If using stripped wires, make the stripped length 9 to 10 mm. Shielded cables are recommended for thermistors with leads longer than 10 m and in areas with electrical noise.

load	function / notes
NC	Unused
min load: 12 V DC 5 mA	To perform remote control, remove the short-circuit wire between [10] and [11] and install an operation switch (customer's charge)
	The AKJ unit can activate an alarm by receiving an output signal from external protection devices (e.g. flow switch, level switch). Parameter [n002]
	If thermistor cable length exceeds 15 mt or in noisy environments, use a shielded cable.
min load: 5 V DC 1 mA max load: 24V 1A	The output settings for the alarm output depends on the value set for parameter number [n001]. Contact capacity 30 V DC, 2A Please refer to the <i>Instruction manual</i> for setting options.
NC	Unused
min load: 5V DC 1 mA max load: 24V 1A	The output settings for the warning output depend on the value set for parameter number [n001], for NORMAL status (run), 1st level warning (LOCK), 2nd level warning, POWER FAILURE

Terminal	Description
9	Unassigned (Do not connect)
10	Remote control short-circuited at factory
11	
12	Optional protection equipment (OP)
13	
30	Optional Th1 thermistor for machine synchronization mode
31	
60	Normal Agitator run
61	
62	
63	
64	Error or power failure
65	
66	Warning output
67	

Terminal	Function / Notes
60-63	Alarm level output OFF: Level 1 ON: Level 2

10.4 - Communication function (X3M terminal block)

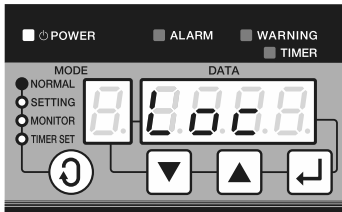
This feature allows the communication through the RS485 interface to enable data transmission/reception with a host computer, PLC (programmable logic controller), touchscreen, etc. The maximum permissible length for communication wiring is 200 m (total extension).

The communication data format is defined according to the Modbus protocol. The cooling unit operates as a slave station.

10.5 - Erroneous operation prevention switch (SW0)

The AKJ cooling units are equipped with an erroneous operation prevention switch that makes settings from control panel ineffective. The factory default setting of this switch is OFF but some nonstandard units may be set to ON.

11 - DEVICE SETUP



The AKJ cooling units are configurable via the display, from which it is always possible to set and monitor parameters and alarms. AKJ cooling unit units allow also the remote control from the main machine control board.

As the machine is preset to LOCK mode (STOP mode) at the time of factory shipment, carry out the unlocking operation via the control panel. Unlocking method is given in the *Instruction Manual*.

12 - ACCESSORIES

12.1 - Hybrid-win software

The Hybrid-win software is a service tool that allows to monitor the operating data in real time through a graphical interface. It has to be installed on devices with Microsoft Windows OS.

Connection is by harness, directly to the main board inside the chiller. The cable connection kit AKPC (made of USB converter + special cable + harness) is to be ordered separately. Refer to catalogue 90 661 for details

The Hybrid-win software can be downloaded easily from the product section at Diplomatic Motion Solution website:

<https://diplomaticmotionsolutions.com/en/ak.html>

12.2 - Other accessories

Accessories are sold separately and their assembly on the oil cooling unit / machine is in the Customer's charge. Please refer to the catalogue 90 661 - ACCESSORIES FOR COOLING UNITS for details about thermistors, long life filter and Cable Kit for Hybrid-Win tool.

13 - INSTRUCTION FOR SAFE OPERATION

General instructions

- Use the equipment only in accordance with the intended specifications (specified in brochure, specification sheet, operation manual, and caution plates).
- Never operate the equipment in an explosive atmosphere.
- Do not disassemble, repair or modify the equipment by yourself.
- Always comply with the laws and regulations for safety (Industrial Safety and Health Law and Fire Defence Law).
- Caution in the event of refrigerant leak:
 - Ventilate the room adequately (to avoid the risk of suffocation)
 - Avoid direct contact of the refrigerant with skin (to avoid the risk of cryogenic burns).
 - In the event of inhalation of a great deal of refrigerant, contact with skin, or refrigerant in the eye, seek medical attention immediately.
- Install a flow switch and a temperature switch on the machine to protect the spindle and other components.
- Do not get on the equipment or place an object on the equipment.
- Use the unit at an altitude of up to 2,000 m. At altitudes over 1,000 m the cooling capacity decreases by around 20 to 30%, so please select a model with adequate leeway in terms of cooling capacity.

Instructions for transportation

- When hoisting the equipment, check its weight and use the eye plates and hangers on it properly.
- When hoisting the equipment, do not do so while it is fitted with a tank or anything else that you have provided.
- Do not approach the equipment while it is being hoisted and moved.
- When moving the equipment, take appropriate measures for fall prevention.
- Do not tilt the equipment 30 degrees.

In the event of an abnormal condition, stop operation promptly, investigate the cause of the problem and take appropriate remedial measures.

- Do not use the unit outdoor or in atypical environments (locations subject to high temperatures, high humidity, or a lot of dust, contamination, steam, oil mist or corrosive gases: H₂S, SO₂, NO₂ or Cl₂).



Instructions for installation

- Install the equipment on a rigid, level foundation and secure it appropriately.
- Do not place an object near the suction port or discharge port of the equipment.

Instructions for wiring and piping installation

- Wiring and piping installation should be performed by a person with specialized knowledge and skills.
- Always use a commercial power supply for the power source: the use of an inverter power supply may cause burn damage.
- Connect the wiring for power supply in accordance with the electric wiring instruction diagram of the specification sheet and operation manual.
- Ground the equipment properly.
- Install the wiring in accordance with the standard by checking the electric wiring diagram.
- Always install a dedicated all-pole (3-pole) earth leakage breaker appropriate for the capacity of the cooling unit on the main power supply on site.
- Check to see that the fluid piping has a pressure resistance of 10 bar or more and install the piping appropriately.

Instructions for trial run

- Check that the machine is in a safe status (not activated) before starting the trial run.
- Check that the oil piping and the electric wiring are correctly connected to the machine and that there is no leakages in connections and joints.
- Disable the operation lock of the cooling unit before starting the main machine.
- Check that the fluid piping system contains the required amount of fluid, and that the piping is not blocked part way through.

Instructions during operation

- Do not splash water or liquid on the cooling unit.
- Do not push your finger or an object into gaps of the oil cooling unit.
- Do not touch the heated exhaust port of the oil cooling unit.

Instructions for maintenance and inspection

- Perform maintenance and inspection of the oil cooling unit in a properly ventilated environment. Working in a closed environment may result in suffocation due to the leak of refrigerant.
- Always turn off the main power supply before starting maintenance and inspection.
- Wait for **five minutes** after turning off the main power supply before starting maintenance and inspection operation.
- Do not operate the oil cooling unit with its cover opened.
- Wear protective gear such as gloves and an eye protector when performing maintenance, inspection and cleaning.
- Clean the air filter periodically (once every two weeks in general).
- Ensure that the oil cleanliness meets the standards at all times.
- Check the fluid level in the tank and ensure that it is between the yellow line and the red line.
- Inspect the underneath (drain pan) of the oil cooling unit once every six months, and if fluid has accumulated, discharge it through the drainage port.

Selection Method for cooling units

- Select a cooling unit with a cooling capacity 20 to 30% larger than the amount of heat generated by the machine tool.
- Since the cooling capacity of cooling units varies with changes in the fluid temperature and ambient temperature, the fluid temperature and ambient temperature conditions have to be clarified to select the appropriate cooling unit.