

Oil Cooling Unit AKZ※※9 (Inline Type for Cooling Spindle)



Features

- Enhancement of Highly Accurate Temperature Control**
 The oil temperature is controlled within $\pm 0.1^{\circ}\text{C}$ under a wider operation range than the previous model as an optional function.
- Achieving high energy-saving performance**
 Achieves high energy-saving performance with the adoption of a Daikin original IPM motor and R410A refrigerant with high COP characteristics.
 The power consumption can be checked on the operation panel.
- Extension of cooling capacity control range**
 Control with loads from 0% (no load) to 100% achieved
- Complies with RoHS Directives such as Lead-Free**
- Achieving low-noise operation in the low-load range**

Nomenclature

AKZ 14 9 - ※※※

1 2 3 4

1 Oil cooling unit identification code
AKZ: High-accuracy inverter oil cooling unit
[Circulating type, for cooling oil]

2 Cooling capacity (kW)
 14: 1.4 kW 56: 5.6 kW
 32: 3.2 kW 90: 9.0 kW
 43: 4.3 kW

3 Symbol of series (Symbol to represent model change)
 9: "9" series

4 Symbol of option type/Non-standard number
 Options and their combinations (Refer to the following table.)

Special specifications (dual pumps, specified paint colors, etc.)
 -※※※ (3-digit number), C※※※ (3-digit number), etc.
 Please consult us about detailed information.

Options and their combinations

Symbol of option type	With breaker	Compliance with CE	With heater	With tank	Different voltage type (1)	Different voltage type (2)	Different voltage type (3)
-B	✓	-	-	-	-	-	-
-C	-	✓	-	-	-	-	-
-H	-	-	✓	-	-	-	-
-T	-	-	-	✓	-	-	-
-046	-	-	-	-	✓	-	-
-047	-	-	-	-	-	✓	-
-048	-	-	-	-	-	-	✓
-D	✓	✓	-	-	-	-	-
-E	✓	-	✓	-	-	-	-
-G	✓	-	-	✓	-	-	-
-K	-	✓	✓	-	-	-	-
-M	-	✓	-	✓	-	-	-
-N	-	-	✓	✓	-	-	-
-P	✓	✓	✓	-	-	-	-
-Q	✓	✓	-	✓	-	-	-
-R	✓	-	✓	✓	-	-	-
-S	-	✓	✓	✓	-	-	-
-V	✓	✓	✓	✓	-	-	-
-001	✓	-	-	-	✓	-	-
-002	-	✓	-	-	✓	-	-
-003	-	-	✓	-	✓	-	-
-004	-	-	-	✓	✓	-	-
-005	✓	✓	-	-	✓	-	-
-006	✓	-	✓	-	✓	-	-
-007	✓	-	-	✓	✓	-	-
-008	-	✓	✓	-	✓	-	-
-009	-	✓	-	✓	✓	-	-
-010	-	-	✓	✓	✓	-	-
-011	✓	✓	✓	-	✓	-	-
-012	✓	✓	-	✓	✓	-	-
-013	✓	-	✓	✓	✓	-	-
-014	-	✓	✓	✓	✓	-	-
-015	✓	✓	✓	✓	✓	-	-

Symbol of option type	With breaker	Compliance with CE	With heater	With tank	Different voltage type (1)	Different voltage type (2)	Different voltage type (3)
-016	✓	-	-	-	-	✓	-
-017	-	✓	-	-	-	✓	-
-018	-	-	✓	-	-	✓	-
-019	-	-	-	✓	-	✓	-
-020	✓	✓	-	-	-	✓	-
-021	✓	-	✓	-	-	✓	-
-022	✓	-	-	✓	-	✓	-
-023	-	✓	✓	-	-	✓	-
-024	-	✓	-	✓	-	✓	-
-025	-	-	✓	✓	-	✓	-
-026	✓	✓	✓	-	-	✓	-
-027	✓	✓	-	✓	-	✓	-
-028	✓	-	✓	✓	-	✓	-
-029	-	✓	✓	✓	-	✓	-
-030	✓	✓	✓	✓	-	✓	-
-031	✓	-	-	-	-	-	✓
-032	-	✓	-	-	-	-	✓
-033	-	-	✓	-	-	-	✓
-034	-	-	-	✓	-	-	✓
-035	✓	✓	-	-	-	-	✓
-036	✓	-	✓	-	-	-	✓
-037	✓	-	-	✓	-	-	✓
-038	-	✓	✓	-	-	-	✓
-039	-	✓	-	✓	-	-	✓
-040	-	-	✓	✓	-	-	✓
-041	✓	✓	✓	-	-	-	✓
-042	✓	✓	-	✓	-	-	✓
-043	✓	-	✓	✓	-	-	✓
-044	-	✓	✓	✓	-	-	✓
-045	✓	✓	✓	✓	-	-	✓

Different voltage type (1) Without transformer AC 220, 230 V (50/60 Hz)
 Different voltage type (2) With transformer AC 380, 400, 415 V (50/60 Hz)
 Different voltage type (3) With transformer AC 440, 460, 480 V (50/60 Hz)

Applications

■ Examples of major applications

Machine tools: Machining centers, NC lathes, grinding machines, NC specialized machines, NC electric discharge machines, etc.
Industrial machines: .. Molding machines, presses, etc.

Cooling of hydraulic oil

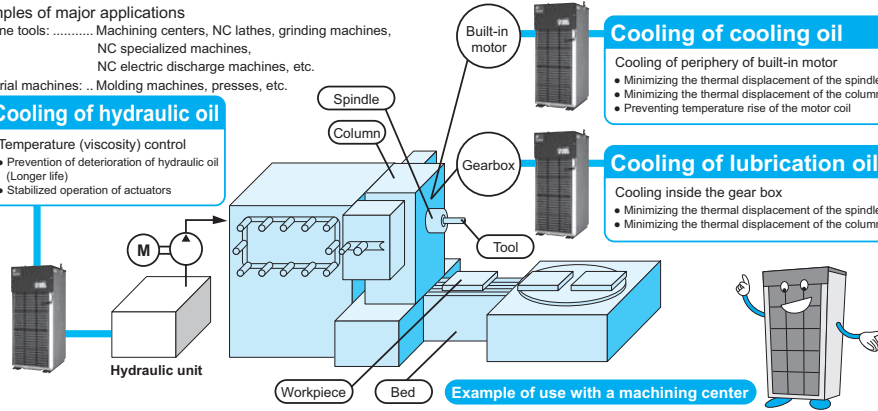
Temperature (viscosity) control
• Prevention of deterioration of hydraulic oil (Longer life)
• Stabilized operation of actuators

Cooling of cooling oil

Cooling of periphery of built-in motor
• Minimizing the thermal displacement of the spindle
• Minimizing the thermal displacement of the column
• Preventing temperature rise of the motor coil

Cooling of lubrication oil

Cooling inside the gear box
• Minimizing the thermal displacement of the spindle
• Minimizing the thermal displacement of the column



Example of use with a machining center

Specifications (AKZ149/329/439)

Oil cooling unit horsepower	HP	0.5					1.2					1.5								
		AKZ149					AKZ329					AKZ439								
Model name		Standard	-B	-C	-H	-T *9	Different voltage specifications *3	Standard	-B	-C	-H	-T *9	Different voltage specifications *3	Standard	-B	-C	-H	-T *9	Different voltage specifications *3	
Cooling capacity (50/60 Hz) *1	kW	1.3/1.4						2.8/3.2						3.8/4.3						
Heater	kW	-					1		-					1		-				
Power supply *2		Three-phase AC 200/200·220 V 50/60 Hz					*3	Three-phase AC 200/200·220 V 50/60 Hz					*3	Three-phase AC 200/200·220 V 50/60 Hz					*3	
Power voltage	Main circuit *3	Three-phase AC 200/200·220 V 50/60 Hz																		
	Operation circuit	DC 12/24 V																		
Max. power consumption Max. current consumption	200 V 50 Hz	0.90 kW/3.9 A	1.29 kW/4.1 A	0.90 kW/3.9 A				1.36 kW/4.9 A	1.49 kW/4.8 A	1.36 kW/4.9 A				1.80 kW/6.6 A						
	200 V 60 Hz	0.91 kW/3.6 A	1.32 kW/4.2 A	0.91 kW/3.6 A			*10	1.43 kW/4.8 A	1.61 kW/5.2 A	1.43 kW/4.8 A			*10	1.88 kW/6.4 A					*10	
	220 V 60 Hz	0.91 kW/3.5 A	1.43 kW/4.2 A	0.91 kW/3.5 A				1.43 kW/4.6 A	1.72 kW/5.0 A	1.43 kW/4.6 A				1.88 kW/6.1 A						
Transformer capacity		-					2.6 kVA	-					2.6 kVA	-					2.6 kVA	
External paint color		Ivory white																		
External dimensions (H × W × D)	mm	650 × 360 × 440	950 × 360 × 440	810 × 360 × 535	950 × 360 × 440			775 × 360 × 440	1075 × 360 × 440	965 × 360 × 535	1075 × 360 × 440			875 × 360 × 440	1175 × 360 × 440	1065 × 360 × 535	1175 × 360 × 440			
Compressor (Hermetic DC swing type)		Equivalent to 0.4 kW						Equivalent to 0.75 kW						Equivalent to 1.1 kW						
Evaporator		Shell-end coil type																		
Condenser		Cross-fin-coil type																		
Propeller fan	Motor	φ250, 54 W						φ300, 54 W						φ300, 54 W						
Oil pump	Motor	0.4 kW × 4-pole motor																		
	Theoretical discharge rate	L/min						L/min						L/min						
	Open pressure	MPa						MPa						MPa						
Temperature control (Selectable)	Synchronization type	Room temperature or machine temperature *4 (Set to room temperature by default)																		
	Controlled object	Oil inlet temperature or oil outlet temperature (Set to oil inlet temperature by default)																		
	Synchronization range	K																		
	Fixed type	Controlled object																		
Refrigerant control	Range	°C																		
		5 to 50																		
Refrigerant (R410A) *5 Filling volume	kg	0.49						0.72						0.98						
Protection devices		A set of overcurrent relay (for a pump motor), reverse-phase protection device, restart prevention timer, low room temperature protection thermistor, high fluid temperature protection thermistor, low fluid temperature protection thermistor, relief valve (for a pump), discharge pipe temperature thermistor, condenser temperature thermistor, refrigerant leakage detector, inverter protection device High-pressure switch (-C type only), compressor thermal protector (-C type only), overheat prevention temperature thermistor (-H type only), boil-dry protection switch (-H type only), no-fuse breaker (-B type only)																		
Operation range	Room temperature	°C																		
	Oil inlet temperature	°C																		
	Oil viscosity	mm ² /s																		
	External pressure loss	Discharge side / Suction side																		
Acceptable oils		Lubricating oil, mineral oil based hydraulic oil (except for phosphate ester hydraulic oil, water, water-soluble liquid, chemicals, food products, fuel, cutting fluid, grinding fluid, etc.)																		
Connecting pipe	Oil inlet	Rc%																		
	Oil outlet	Rc%	Rc1 ¼		Rc%		Rc1 ¼		Rc%		Rc1 ¼		Rc%		Rc1 ¼		Rc%			
	Oil drain port	Rc¼ (plugged)																		
Noise level (Value equivalent to measurement in an anechoic chamber) (Front 1 m, height 1 m)	dB (A)	62										65								
Permissible transport vibration *7		Up and down vibration 14.7 m/s ² × 2.5 hr (7.5 to 100 Hz sweep/5 min.)																		
Ingress protection *8		IP2X																		
Mass	kg	51	78	68	87		56	83	73	92		64	91	81	100					
Molded-case circuit breaker (Rated current)	A	-	10		-		-	10		-		-	10		-		-			
Oil tank (Capacity)	L	-					15	-					20	-						
Items prepared by the customer *8	Molded-case circuit breaker (Rated current)	A																		
		10 (Required for types other than -B type)																		

Refer to Page L-5 for explanatory notes.

Specifications (AKZ569/909)

Oil cooling unit horsepower		2.0					3.0						
Model name		AKZ569					AKZ909						
		Standard	-B	-C	-T ^{*9}	-H	Different voltage specifications ^{*3}	Standard	-B	-C	-T ^{*9}	-H	Different voltage specifications ^{*3}
Cooling capacity (50/60 Hz) ^{*1}	kW	5.0/5.6					8.0/9.0						
Heater	kW	-					2	-					
Power supply ^{*2}		Three-phase AC 200/200·220 V 50/60 Hz					*3	Three-phase AC 200/200·220 V 50/60 Hz					*3
Power voltage	Main circuit ^{*3}	Three-phase AC 200/200·220 V 50/60 Hz											
	Operation circuit	DC 12/24 V											
Max. power consumption Max. current consumption	200 V 50 Hz	2.22 kW/7.7 A			2.50 kW/8.4 A		*10	4.25 kW/13.6 A			*10		
	200 V 60 Hz	2.30 kW/7.6 A			2.57 kW/8.1 A			4.30 kW/13.5 A					
	220 V 60 Hz	2.30 kW/7.3 A			3.00 kW/8.9 A			4.28 kW/13.0 A					
Transformer capacity		-					4.0 kVA	-					6.0 kVA
External paint color		Ivory white											
External dimensions (H × W × D)	mm	1110 × 470 × 560	1375 × 470 × 580	1410 × 470 × 560	1360 × 470 × 590	1220 × 560 × 680	1485 × 560 × 700	1520 × 560 × 680	1470 × 560 × 659				
Compressor (Hermetic DC swing type)		Equivalent to 1.5 kW					Equivalent to 2.2 kW						
Evaporator		Brazen plate type											
Condenser		Cross-fin-coil type											
Propeller fan	Motor	φ400, 100 W					φ455, 100 W						
Oil pump	Motor	0.75 kW × 4-pole motor	0.7 kW × 4-pole motor	0.75 kW × 4-pole motor			0.7 kW × 4-pole motor	0.75 kW × 4-pole motor					
	Theoretical discharge rate	L/min 30/36											
	Open pressure	MPa 0.6											
Temperature control (Selectable)	Synchronization type	Standard	Room temperature or machine temperature ^{*4} (Set to room temperature by default)										
		Controlled object	Oil inlet temperature or oil outlet temperature (Set to oil inlet temperature by default)										
	Fixed type	Synchronization range	K -9.9 to +9.9 against the standard temperature (Set at 0.0 by default)										
		Controlled object	Oil inlet temperature or oil outlet temperature										
Range	°C 5 to 50												
Refrigerant control		Rotation speed control of compressor by inverter + Opening rate control of electric expansion valve											
Refrigerant (R410A) ^{*5} Filling volume	kg	1.02					1.48						
Protection devices		A set of overcurrent relay (for a pump motor), reverse-phase protection device, restart prevention timer, low room temperature protection thermistor, high fluid temperature protection thermistor, low fluid temperature protection thermistor, relief valve (for a pump), discharge pipe temperature thermistor, condenser temperature thermistor, refrigerant leakage detector, inverter protection device High-pressure switch (-C type only), compressor thermal protector (-C type only), overheat prevention temperature thermistor (-H type only), boil-dry protection switch (-H type only), no-fuse breaker (-B type only)											
Operation range	Room temperature	°C 5 to 45											
	Oil inlet temperature	°C 5 to 50											
	Oil viscosity	mm ² /s 1.4 to 200 (ISO VG2 to 32)											
	External pressure loss	Discharge side 0.5 MPa maximum Intake side No lower than -30.7 kPa											
Acceptable oils		Lubricating oil, mineral oil based hydraulic oil (except for phosphate ester hydraulic oil, water, water-soluble liquid, chemicals, food products, fuel, cutting fluid, grinding fluid, etc.)											
Connecting pipe	Oil inlet	Rc1 ¼	Rc1	Rc1 ¼	Rc1 ¼	Rc1	Rc1 ¼						
	Oil outlet	Rc1 ¼											
	Oil drain port	Rc¼ (plugged)											
Noise level (Value equivalent to measurement in an anechoic chamber) (Front 1 m, height 1 m)	dB (A)	65					67						
Permissible transport vibration ^{*7}		Up and down vibration 14.7 m/s ² × 2.5 hr (7.5 to 100 Hz sweep/5 min.)											
Ingress protection ^{*6}		IP2X											
Mass	kg	82	115	100	145	97	132	122	175				
Molded-case circuit breaker (Rated current)	A	-	15	-	-	20	-	-	-				
Oil tank (Capacity)	L	-	50	-	-	-	70	-	-				
Items prepared by the customer ^{*8}	Molded-case circuit breaker (Rated current)	15 (Required for types other than the -B type)					20 (Required for types other than the -B type)						

Note: *1 The cooling capacity indicates the value at the standard point (inlet oil temperature: 35°C, room temperature: 35°C, oil used: ISO VG32).

This unit has about ±5% of product tolerance.

*2 Use a commercial power supply for the power source. The use of an inverter power supply may cause burn damage to the machine. The voltage fluctuation range should be within ±10%. If it is more than ±10%, please consult us.

*3 There are three different types of voltage specifications depending on the power source: -046, -047 and -048 units. -047 and -048 units deal with the different voltage by featuring a transformer.

The main circuit voltage is the transformer's secondary side voltage of AC 200 V, 50/60 Hz.

(-046 units have no transformer and therefore have the same external dimensions and mass as standard units. Their main circuit voltage is AC 220/230 V, 50/60 Hz.)

*4 The machine temperature synchronization thermistor available as an option is required for this function. (Refer to Page L-30 for details.)

*5 The MSDS (Material Safety Data Sheet) of refrigerant R410A is attached to the -C type.

*6 Electric component box ingress protection: IP54 or equivalent (However, use piping conduits etc. rated at least IP54 at wiring ports.)

*7 The specifications for permissible transport vibration are those of a standard unit.

*8 The molded-case circuit breaker is not supplied with this product. Please prepare it yourself.

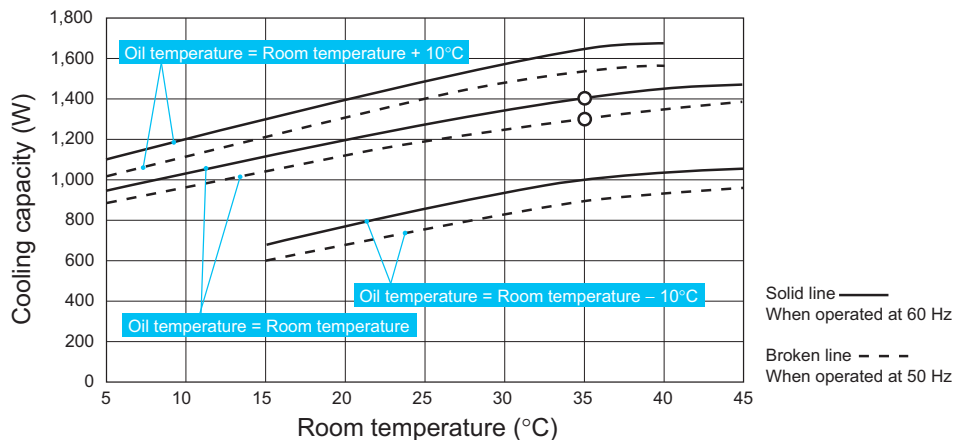
*9 The yellow line on the tank oil level gauge shows the highest oil level and the red line the lowest oil level.

*10 The maximum power consumption/maximum current consumption of different voltage specifications are shown in the tables below.

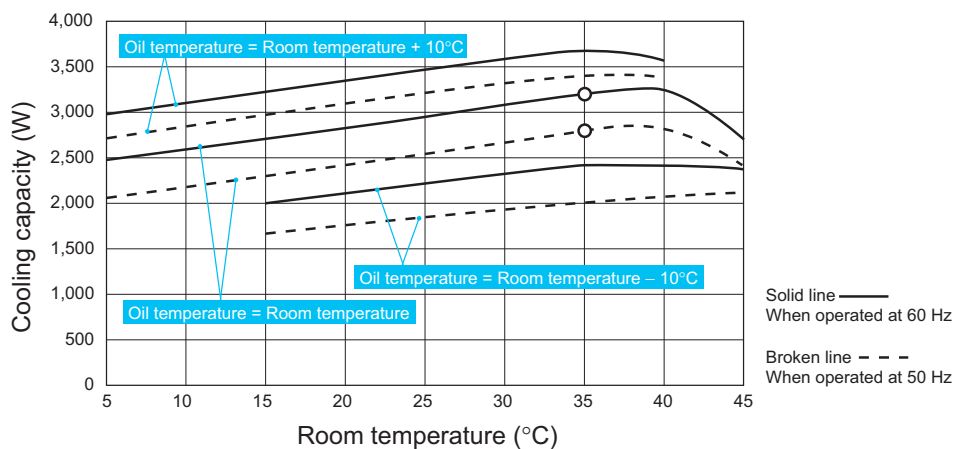
AKZ149			AKZ329			AKZ439			AKZ569			AKZ909		
Supply power	Power/current		Supply power	Power/current		Supply power	Power/current		Supply power	Power/current		Supply power	Power/current	
380 V	0.92 kW	2.1 A	380 V	1.38 kW	2.6 A	380 V	1.82 kW	3.4 A	380 V	4.0 A		380 V	7.1 A	
400 V	1.9 A		400 V	1.44 kW	2.5 A	400 V	1.89 kW	3.3 A	400 V	3.8 A		400 V	6.8 A	
415 V	0.93 kW		415 V	1.46 kW	2.4 A	415 V	1.90 kW	3.1 A	415 V	3.6 A		415 V	6.5 A	
440 V	1.8 A		440 V	1.38 kW	2.3 A	440 V	1.82 kW	3.0 A	440 V	3.4 A		440 V	6.2 A	
460 V	0.92 kW		460 V	1.44 kW	2.2 A	460 V	1.89 kW	2.9 A	460 V	3.3 A		460 V	5.9 A	
480 V	0.93 kW	1.7 A	480 V	1.46 kW	2.1 A	480 V	1.90 kW	2.7 A	480 V	3.1 A		480 V	5.7 A	

Cooling capacity characteristic chart

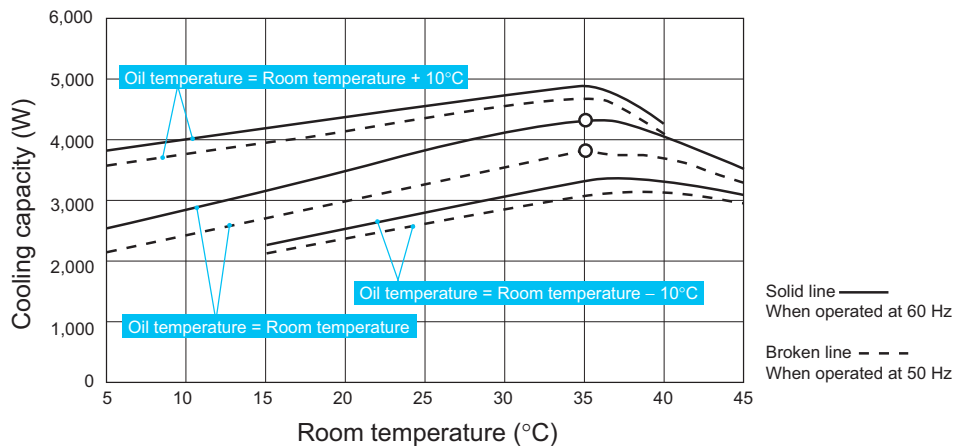
AKZ149



AKZ329

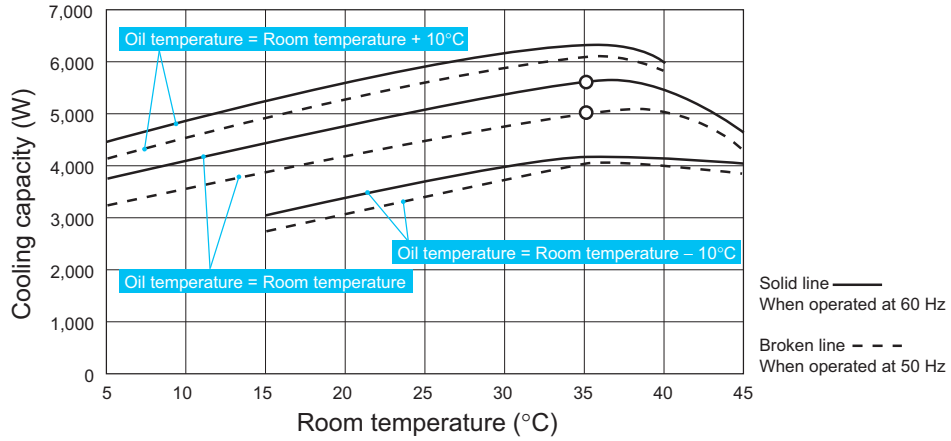


AKZ439

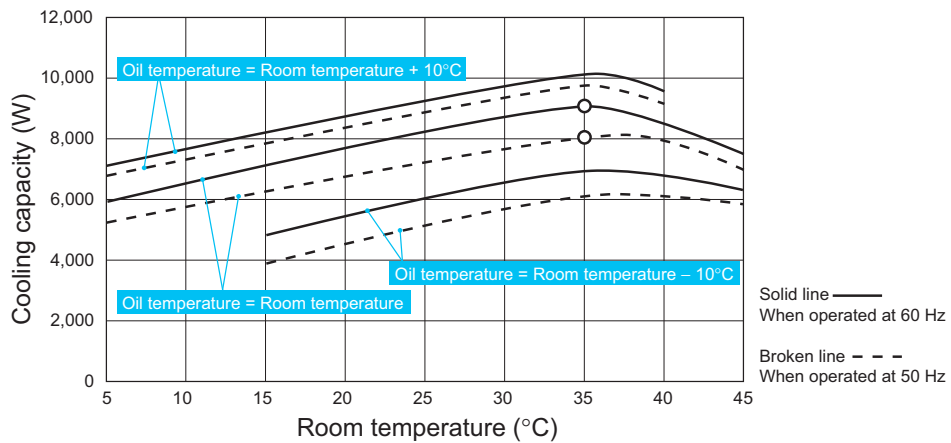


Cooling capacity characteristic chart

AKZ569




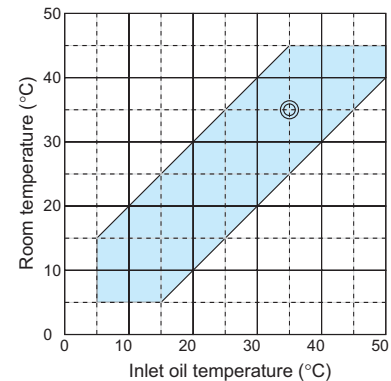
AKZ909



1. The mark "O" shows the standard point.
(Room temperature: 35°C/Oil inlet temperature: 35°C/Oil used: ISO VG32)
2. The cooling capacity varies depending on conditions such as room temperature, oil inlet temperature, oil dynamic viscosity and other factors.

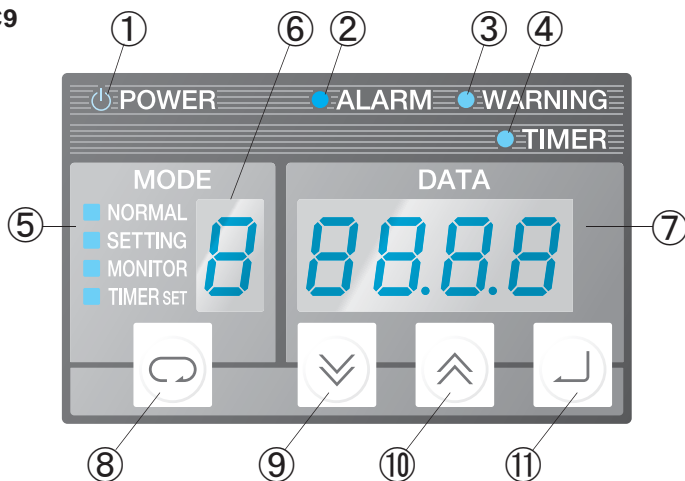
Operation range

- Note: 1. The mark © shows the standard point.
2. Be sure to use the unit within the range of use specified in .
(Use outside this range may cause unit failure.)

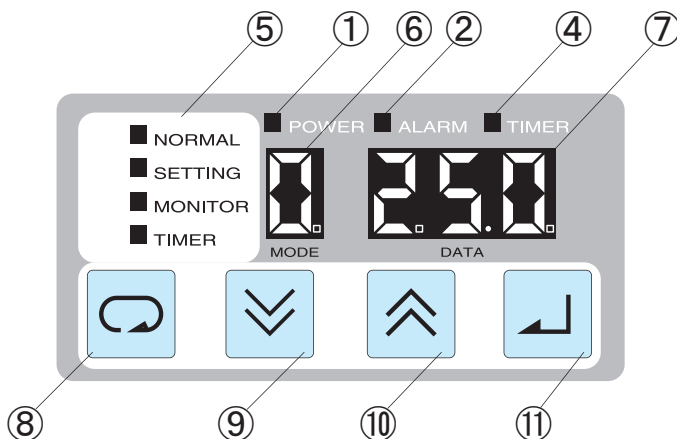


Names and functions of the components on the control panel

AKZ9, AKC9



AKZJ8



No.	Item	Description
①	Power lamp (Green)	The lamp is continuously on while power is supplied.
②	Error warning lamp (Red)	When an error occurs Level 1 alarm: The lamp keeps blinking. Level 2 alarm: The lamp is continuously on.
③	Warning lamp (Green)	When a warning occurs Level 1 warning: The lamp keeps blinking. Level 2 warning: The lamp is continuously on. (Only with "9" series)
④	Timer mode lamp (Red)	The lamp keeps blinking while the machine is at a stop in the timer mode.
⑤	Operation mode display	Displays the mode of the control panel. NORMAL: Normal mode SETTING: Operation setting mode MONITOR: Monitor mode TIMER SET: Timer setting mode
⑥	Operation mode/ Data No. display	Displays the current operation mode (Normal mode, Operation setting mode) or data number of the data currently displayed on the data display.
⑦	Data display	Displays various data. The data displayed differs depending on the operation mode and data number.
⑧	[SELECT] (Select) key	Selects the operation mode.
⑨	[DOWN] key	Decrements the value of the operation mode, data number or data by 1. When held for two seconds or longer, decrements the values by 10.
⑩	[UP] key	Increments the value of the operation mode, data number or data by 1. When held for two seconds or longer, increments the values by 10.
⑪	[ENT] (Confirm) key	Confirms the edited operation mode/data number/data.

Refer to the individual product catalog and instruction manual for details of the operation modes and setting procedures.

Refer to "Cautions on Using Oil Controllers and Inverter Chillers" at the beginning of this catalog for the notes to be observed.

Notes to be observed at the main machine side (AKZ9/AKZJ8 series)

• Important notes to be observed regarding the main machine side (machine tools and industrial machinery)

- When rough transport conditions are expected while transporting the machine overseas or elsewhere, special precautions should be taken in the packaging and transportation method so as to avoid the application of excessive force on the oil cooling unit (this unit).
- The oil cooling unit (this unit) does not have a flow switch for checking the oil supply or a temperature switch for abnormal temperature of supplied oil (high temperature or low temperature). So, please provide a protective device such as a flow switch and a temperature switch at the main machine side.

Notes on operation and cooling capacity

- Do not use the oil cooling unit to chill a fluid from 50°C or higher. Start to operate the oil cooling unit at the same time as the main machine or before the fluid temperature rises to 40°C.
- Do not place an object that hinders ventilation within 500 mm of the air-intake or exhaust.
- If the air filter is clogged, the cooling capacity should be diminished. Clean the air filter (wash with warm water or clean with air) periodically once every two weeks to prevent clogging.
- If cutting chips and powder-like chips deposit on and adhere to the cooling coil (evaporator) in the AKZJ8 series, the cooling capacity should be diminished and it could cause failure. To avoid the adherence of deposits on the cooling coil, install an efficient return filter on the return side (fluid inlet) of the tank and periodically clean the tank inside.

Notes on usable fluids with oil cooling units

- The fluid usable with the oil cooling unit is listed in the table below for each series.
- Do not use fluid listed below as “unusable”

	Description	AKZ9 Series	AKZJ8 series
Lubrication oil Mineral hydraulic oil	<ul style="list-style-type: none"> Oil that is classified as third class petroleum or fourth class petroleum of the fourth group hazardous materials stipulated in the Fire Defense Law and that corresponds to discoloration No. 1 in the copper corrosion test method (JIS K 2513) of petroleum products Oil that satisfies pollution level NAS 10 	✓	✓
Nonflammable hydraulic oil <ul style="list-style-type: none"> Ester phosphate series Chlorinated hydrocarbon series Water - Glycol series W/O • O/W emulsion series (High-aqueous hydraulic oil) 	—	Unusable	Unusable
Coolant fluid <ul style="list-style-type: none"> Water-soluble cutting and grinding fluid Non water-soluble cutting and grinding oil 	—	Unusable	✓
Ethylene glycol (Antifreeze liquid)	Fluid not including any ingredient that corrodes the SUS304 material used for the evaporator coil	Unusable	✓
Water (Industrial water)		Unusable	✓
Inflammable liquids like fuel	Liquids that are classified as special flammables, alcohol, third class petroleum or fourth class petroleum of the fourth group hazardous materials stipulated in the Fire Defense Law	Unusable	Unusable
Chemicals	—	Unusable	Unusable
Liquids for food products	Drinking water, water for cooling food products, etc.	Unusable	Unusable

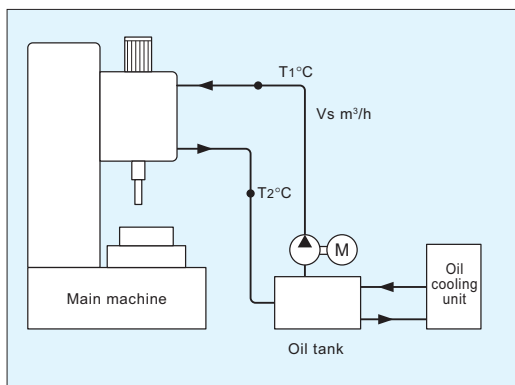
Selection method for oil cooling units (AKZ9 series)

1. Select an oil cooling unit with a cooling capacity 20 to 30% larger than the amount of heat generated from the machine tool.
2. Since the cooling capacity of an oil cooling unit varies with the change of fluid temperature (fluid inlet temperature) and room temperature, the fluid temperature and room temperature conditions must be clarified in order to select the appropriate oil cooling unit.
3. Three methods are shown below as a guide to estimating the amount of heat generated from the machine tool. Ultimately, tests have to be conducted to determine the exact amount of heat generation for selecting the appropriate oil cooling unit.

● Calculation of the heat load from the main machine (as a general guide)

(1) For cooling the spindle of a machining center

● Method 1: To estimate the heat load from the temperature difference between the inlet and outlet oil



$$Q = 2.778 \times 10^{-7} \cdot C_p \cdot \gamma \cdot V_s \cdot \Delta T$$

Q: Heat load (kW)

C_p: Constant pressure specific heat (J/kg°C) ... 1967.4 J/kg°C

γ: Weight volume ratio (kg/m³)...876 kg/m³

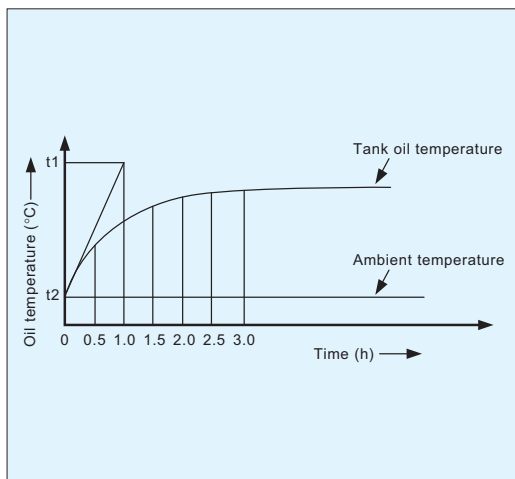
V_s: Oil flow rate (m³/h)

ΔT: Temperature difference (°C)...T₂ – T₁

E.g.) When "V_s" is 18 m³/h (30 L/min) and "ΔT" is 5°C

$$Q = 2.778 \times 10^{-7} \times 1967.4 \times 876 \times 1.8 \times 5 \\ = 0.479 \times 1.8 \times 5 \approx 4.3 \text{ kW}$$

● Method 2: To estimate the heat load from the rate of increase of the oil temperature in the tank



To find the maximum gradient of the oil temperature rise, it is necessary to measure Δt every minute during the first 10 minutes.

$$Q = 2.778 \times 10^{-7} C_p \cdot \gamma \cdot V \cdot \Delta t / H$$

Q: Heat load (kW)

C_p: Constant pressure specific heat (J/kg°C) ... 1967.4 J/kg°C

γ: Weight volume ratio (kg/m³) ... 876 kg/m³

V: Total oil volume (m³)

Δt: Temperature difference (°C) ... t₁ – t₂

H: Time (h)

E.g.) When the total oil volume is 300 L (0.3 m³) and "Δt" is 10°C.

$$Q = 2.778 \times 10^{-7} \times 1967.4 \times 876 \times 0.3 \times 10 \\ = 0.479 \times 0.3 \times 10 \approx 1.4 \text{ kW}$$

● Method 3: When the motor output loss is considered to be the heat load

$$Q = H \cdot \frac{\eta}{100}$$

Q: Heat load (kW)

H: Motor output (kW)... For driving the spindle

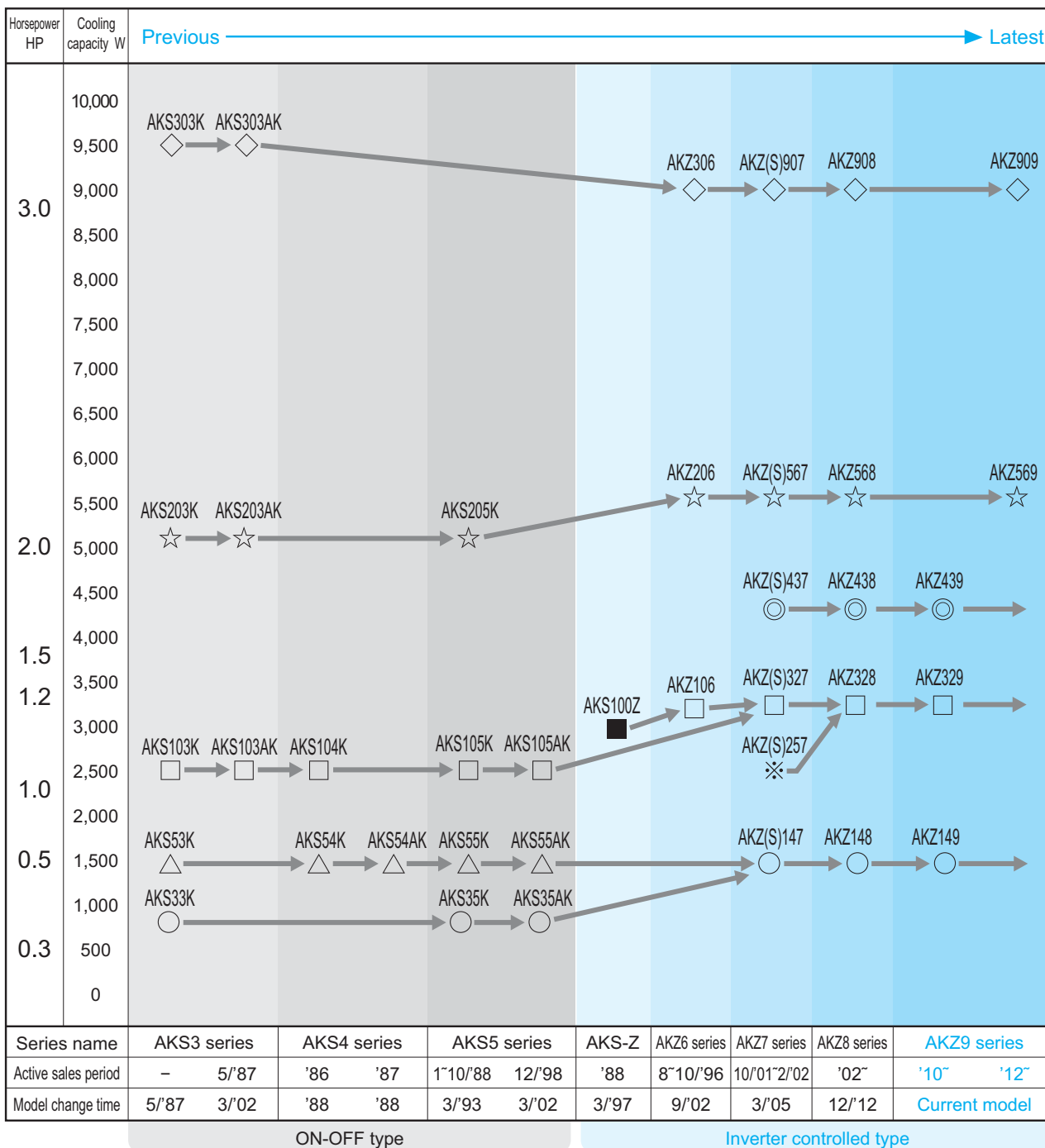
η: Motor output loss (%)

E.g.) When the output loss is 30% with a motor output of 7.5 kW → The output loss is 30% or so in general (cooling of spindle head)

$$Q = 7.5 \times 0.3 = 2.3 \text{ kW}$$

Time line of inline type oil cooling units for spindles and lubrication oil

AKS → AKZ



Note: 1. A larger number at the last digit of the model name denotes a more recently designed model in the series (for example, AKS35K is more recently designed than AKS33K) Further, AK as the last alphabetic characters denotes a more recently designed model than K. (For example, AKS35AK is more recently designed than 35K)
 2. The cooling capacity value is under standard conditions and with the power supply at 60 Hz for all models.
 3. Take care about dimensional differences on some newly designed models compared to previous ones. Check the dimensions of the model with a brochure or specification drawings.
 Further, when planning to retrofit a new unit, check the specifications of the existing unit in detail.
 4. All models have been changed to the Inverter control model since 2002.
 5. R407C refrigerant is used on the AKZ(S) "7" series and R410A is used on the AKZ8 and AKZ9 series. R-22 was used on the other models.
 6. Conventional models of the 1 HP class such as AKS105AK and AKZ(S)257 were unified with AKZ328 in the 1.2 HP class.