



*Global Only 1. Company
for Professional Fluid Solution*

With Single & Three phase High Efficiency AC motor

High Performance Air / Oil Cooler

● FA – Series



- CE Approval
- Optimized for Industrial Hydraulic System
(Single & Three-phase Motor)

FLOWFORCE CO., LTD.

Special benefits from the World-class of Air/Oil Cooler in FA Series



Maximum cooling capacity 160,000 Kcal/h

(at ETD 40°C)

The Best Optimal Solution for the Industrial Hydraulic Cooling System!

With 28 years of business background and experience aiming to be the No. 1 in the global hydraulic cooling system technology field, FLOWFORCE CO., LTD. will implement its guaranteed, created, and shared value for the customers with FA series.

- Increase customer value and profit
- Increase durability and extend life-cycle of oil
- Easy installation and maintenance
- Global technical engineering service

It is the key to prevent unnecessary losses with the ideal temperature.

Selection of the insufficient heat exchange cooler and improper operation management of oil result in a risk of excessing energy consumption and operating maintenance costs.

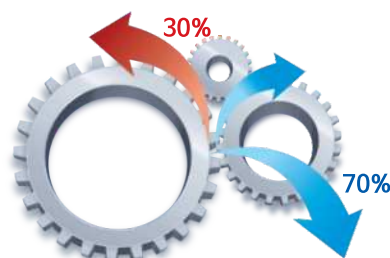
- Increase internal leakage
- High potential risk of cavitation
- Shorten the life-cycle of components



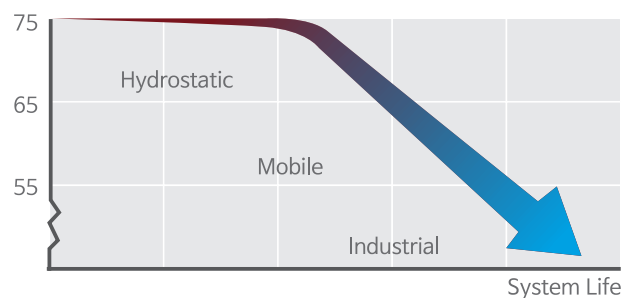
Consideration

30% energy loss in the hydraulic system is main cause raising the temperature of the operating oil.

- Friction loss occurred by hydraulic pump, control valve, etc...
- Heat generated due to the pressure drop, flow disturbance



Optimal temperature control based on the ideal of the hydraulic system



Technical consideration when selecting of oil cooler

- Hydrostatic System : 65°C
- Mobile Application : 55°C
- Industrial Application : 45°C

Remember!

- 1 ■ Oil service will be reduced by 50% when oil temperature increases 8°C based on 40°C.
- 2 ■ There is a risk of cavitation because operating oil has the air at atmospheric pressure.
- 3 ■ Hydraulic hose will have its life-time reduced by 50% when the oil temperature increases every 10°C from 60°C

Customer value-oriented product

(Clever Design + High durability components = Low operation and maintenance cost)

Product Features

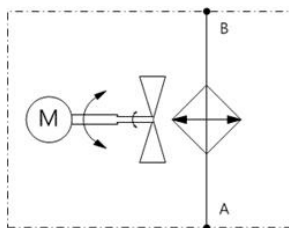
- Compact design with light weight
 - Low noise of fan & fan motor
 - Single & Three-phase high efficiency AC motor
 - Cooler matrix : With low pressure drop and high cooling capacity
- It can be equipped with multifunctional peripheral such as by-pass valve, thermo-switch, etc.

1 Environment friendly & Easy to maintenance



Main Parts

- 1 Motor / Fan, Fan Guard
- 2 Fan Housing
- 3 Cooler Matrix



Design Feature



FA Air/Oil Coolers are available in two special versions,

- FA - ATEX Version: Explosive environment
- FA - M Version : Corrosion proof in sea and marine environment

Main Applications

- Industrial hydraulic system, Power packs
- Air compressors, Heat recovery, Lubrication system
- Factory automation
- Diesel engine
- Gear box
- Hydraulic winch
- Construction machinery
- Wind power, Generator, Break cooling unit

2 How to select FA Air/Oil Cooler / Ordering code

1 FA - 2 060 - 3 4 - 4 1 - 5 00 - 6 1 - 7 0 - 8 0

1 FA = AC Motor Type		2 Cooler size	3 Number of pole
FA	=AC Motor	015, 020, 030, 040,	2 =2POLE
FD	=DC Motor	050, 060, 070, 080, 090, 100,	4 =4POLE
FH	=Hydraulic Motor	110, 120, 130, 140, 150, 160, 170	6 =6POLE
FC	=Circulation Pump Type (Off-Line)	(※ Refer to page 6, 7, 10, 11)	8 =8POLE (Special order made)
			0 =Without motor

4		5		6	
Voltage & Frequency		Thermo contact		Cooler matrix	
0	=Without motor	00	=Without thermo contact	0	=Without matrix
1	=Three-phase 220/380V 60Hz	40	=40℃ -WIRE TYPE	1	=Standard
2	=Three-phase 440V 60Hz	50	=50℃ -WIRE TYPE	2	=Two pass
3	=Three-phase 220/380V 50Hz	60	=60℃ -WIRE TYPE	X	=Special
4	=Single-phase 110V 50/60Hz	41	=40℃ -DIN CONNECTER TYPE	(※ Refer to page 5)	
5	=Single-phase 220V 50/60Hz	51	=50℃ -DIN CONNECTER TYPE		
6	=Three-phase 230/400V 50Hz	61	=60℃ -DIN CONNECTER TYPE		
X	=Special	XX	=Special		

7 Matrix protect guard		8 Standard / Special	
0	=Without guard	0	=Standard
S	=Stone guard	CE	=CE approval
D	=Dust guard	Special	=ATEX or M
T	=Dust and Stone guard		

3 General technical specification



■ FLUID COMBINATIONS

- Mineral oil HL/HLP according to DIN 51524
- Oil/Water emulsion HFA, HFB according to CETOP RP 77 H
- Water glycol HFC according to CETOP RP 77 H
- Phosphate ester HFD-R according to CETOP RP 77 H

■ MATERIAL / SURFACE PROTECTION

- Cooler matrix : Aluminum powder coated
- Fan blades : Fiber-glass reinforced polypropylene
Standard: PPG (-10°C ~ 90°C)
Option: PAG (-40°C ~ 120°C)
- Hub & Fan boss: Aluminum
- Cooler housing : Steel
- Fan guard : Steel / Zinc plating
- Others : Steel
- Surface treatment : Electro statically powder-coated

■ TECHNICAL DATA for COOLER MATRIX

- Maximum test pressure : 21bar
- Dynamic operating pressure : 14bar
- Heat transfer tolerance : ± 6%
- Maximum operating oil temperature : 120°C
- Ambient temperature : -20°C ~ 40°C (standard)
- Painting specification : Epoxy RAL 9005
- Testing standard : ISO/DIS 10771-1

■ TECHNICAL DATA for 3-PHASE MOTOR

- 3-Phase motors in accordance with IEC 34-1 and IEC 72 in accordance with DIN 57530/VDE 0530
- Insulation class : F
- Rise of temperature: B
- Protection class IP : 55

■ TECHNICAL DATA for SINGLE MOTOR

- Insulation class : B
- Rise of temperature: B
- Protection class IP : 44

■ COOLING CAPACITY CURVE

The cooling capacity curves in this technical data sheet are based on tests in accordance with EN 1048 and have been produced using oil type ISO VG46 at 60°C.

■ CONTACT FLOWFORCE for Special Order

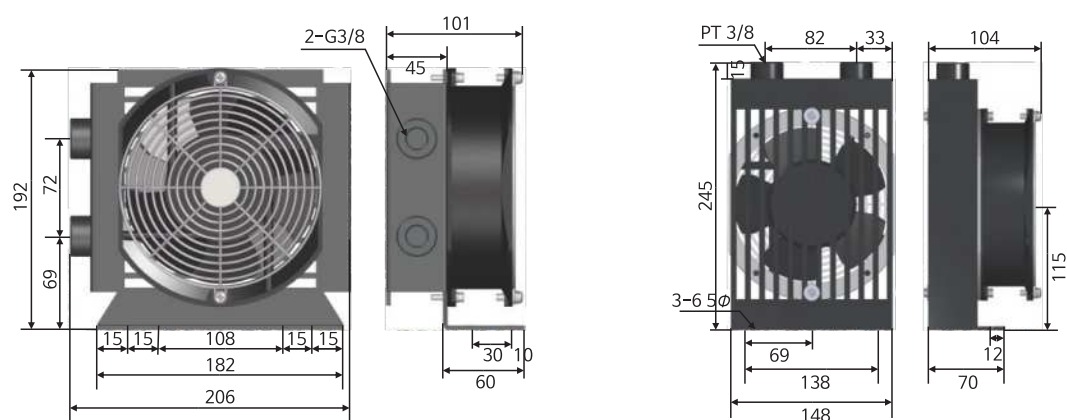
- Oil Temperature > 120 °C
- Oil Viscosity > 100 cSt
- High-altitude and harsh environment

※ Caution

Please contact FLOWFORCE if the temperature difference is more than 50°C between inlet oil temperature and the ambient temperature.



1. FA 015 - 020 Series (Small size of Air / Oil Cooler)



1 Dimension & Specification

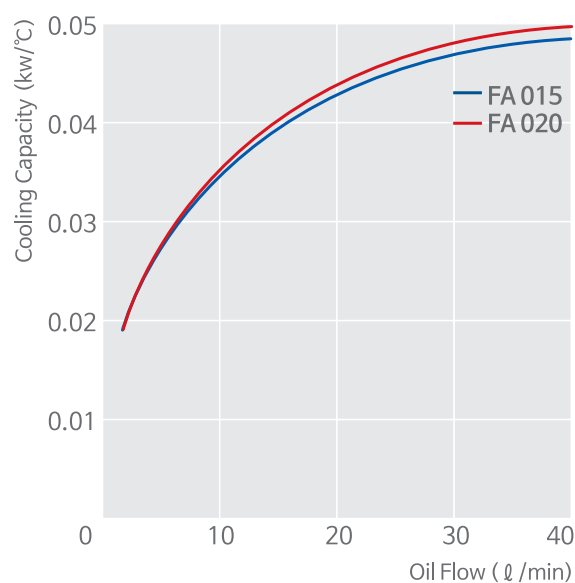
FA 015

- Flow rate : Max. 40 l / min ($\Delta P=1$ bar)
- Working pressure : Max. 14 bar
- Isulation class : B
- Noise level : 50 dB(A)
- Motor spec : Single-phase 110V 50/60Hz
37/36W @50/60Hz
Single-phase 220V 50/60Hz
34/33W @50/60Hz
- Weight : 2.5 kg

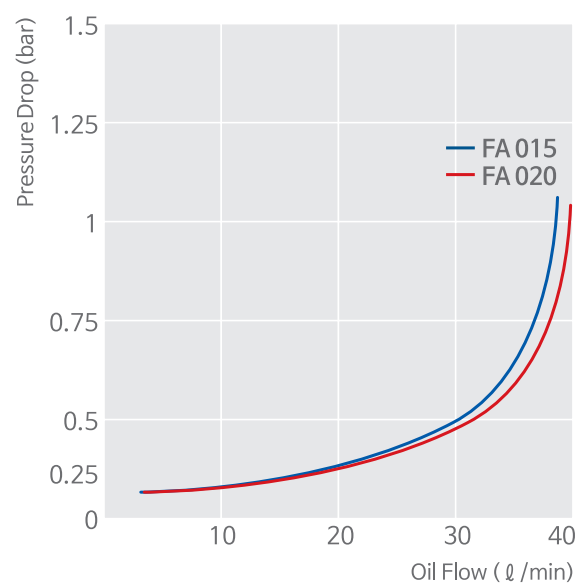
FA 020

- Flow rate : Max. 40 l / min ($P=1$ bar)
- Working pressure : Max. 14 bar
- Isulation class : B
- Noise level : 50 dB(A)
- Motor spec : Single-phase 110V 50/60Hz
37/36W @50/60Hz
Single-phase 220V 50/60Hz
34/33W @50/60Hz
- Weight : 3 kg

2 Cooling Capacity

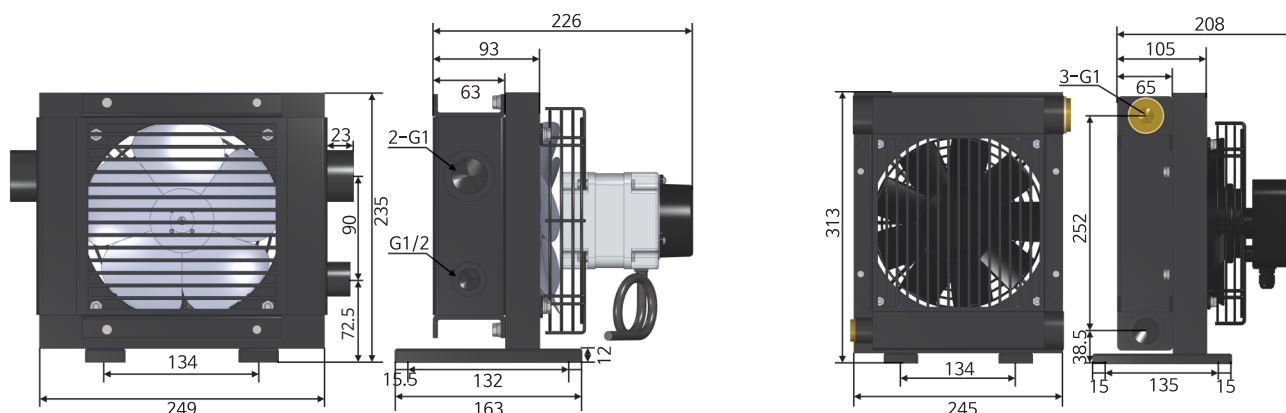


3 Pressure Drop at 30cSt



- Cooling capacity (kw) / $\Delta T(^{\circ}\text{C})$
- The performance curves are based on ETD at 40°C (Inlet oil temperature= 60°C , ambient temperature= 20°C)
- Suction is the standard type but in case you need a blow type, please contact FLOWFORCE.

2. FA 030 - 040 Series (Small size of Air / Oil Cooler)



1 Dimension & Specification

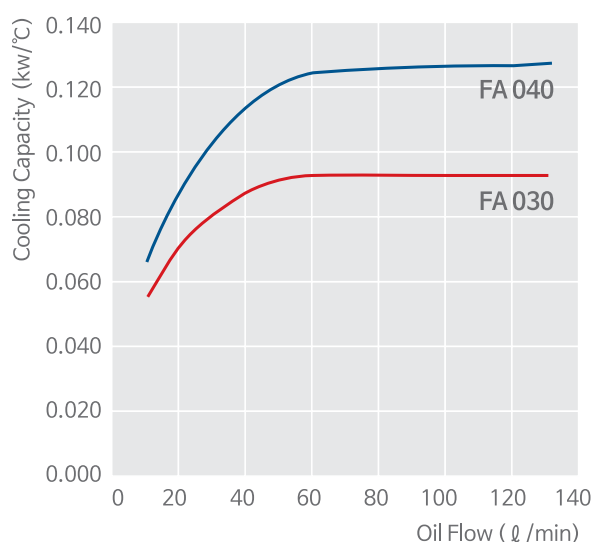
FA 030

- Flow rate : Max. 100/min (P=0.6bar)
- Working pressure : Max. 14bar
- Isulation class : B
- Noise level : 60dB(A)
- **Motor specification**
Single-phase 110V 50/60Hz : 0.65A (85W)
Single-phase 220V 50/60Hz : 0.26/0.28A, 101W
- Weight : 6.5kg

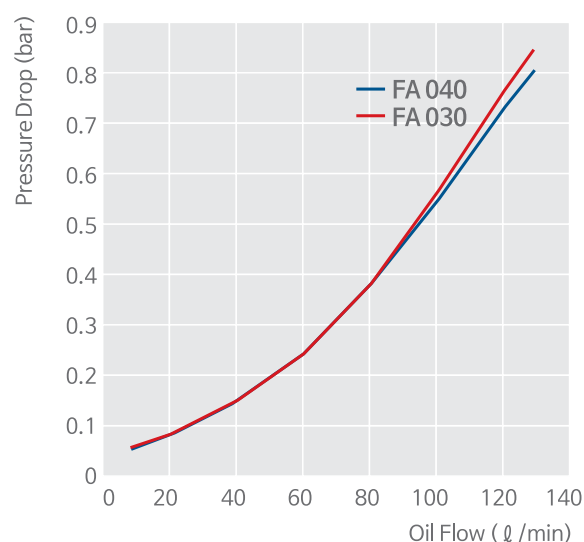
FA 040

- Flow rate : Max. 100 l / min (P=0.6bar)
- Working pressure : Max. 14bar
- Isulation class : B
- Noise level : 60dB(A)
- **Motor specification**
Single-phase 110V 50/60Hz : 0.65A (75W)
Single-phase 220V 50/60Hz : 0.26/0.28A, 55/60W
Three-phase 380V 50/60Hz : 0.15/0.12, 65/65W
Three-phase 440V 60Hz : 0.11A, 70W
- Weight : 7.5kg

2 Cooling Capacity



3 Pressure Drop at 30cSt



- Cooling capacity (kw) / $\Delta T(^{\circ}\text{C})$
- The performance curves are based on ETD at 40°C (Inlet oil temperature=60°C, ambient temperature=20°C)
- Suction is the standard type but in case you need a blow type, please contact FLOWFORCE.

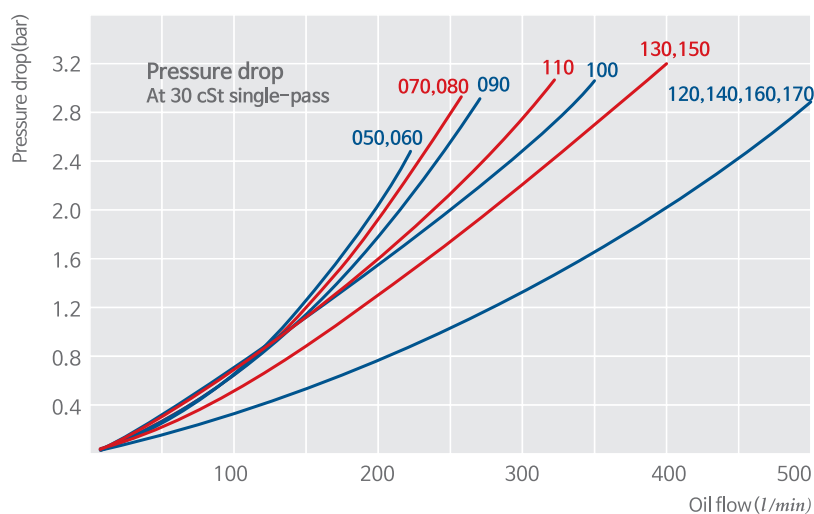
3. FA 050 – 170 Series Air / Oil Cooler



The following performance curves are based on the inlet oil temperature at 60°C and the ambient temperature at 20°C.

Technical Comments

- Cooling capacity(kw) = Specific cooling performance (kw/°C) X $\Delta t(^{\circ}\text{C})$
- The performance curves are based on ETD at 40°C(Inlet oil temperature=60°C, ambient temperature=20°C)
- 1 kw = 860 Kcal/h
- Suction is the standard type but in case you need to have blow type, please contact FLOWFORCE.



The curves are based on the average viscosity at 30 cSt.

1 Temperature/Viscosity table

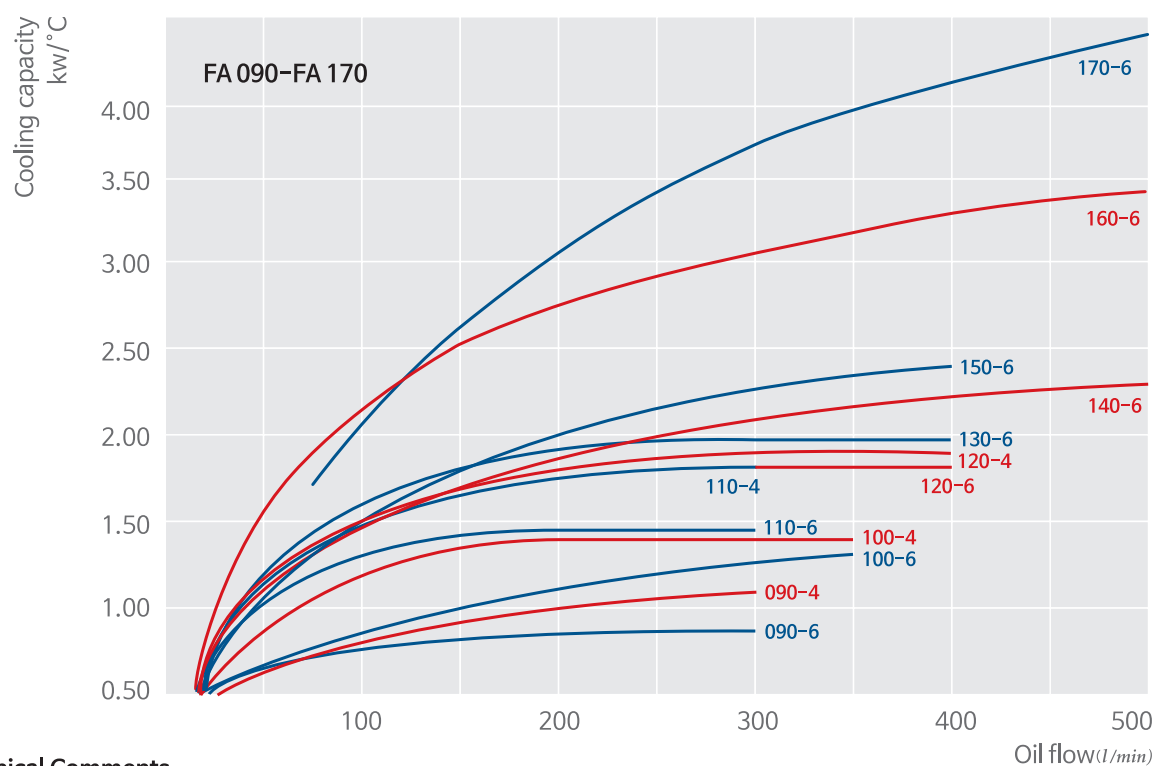
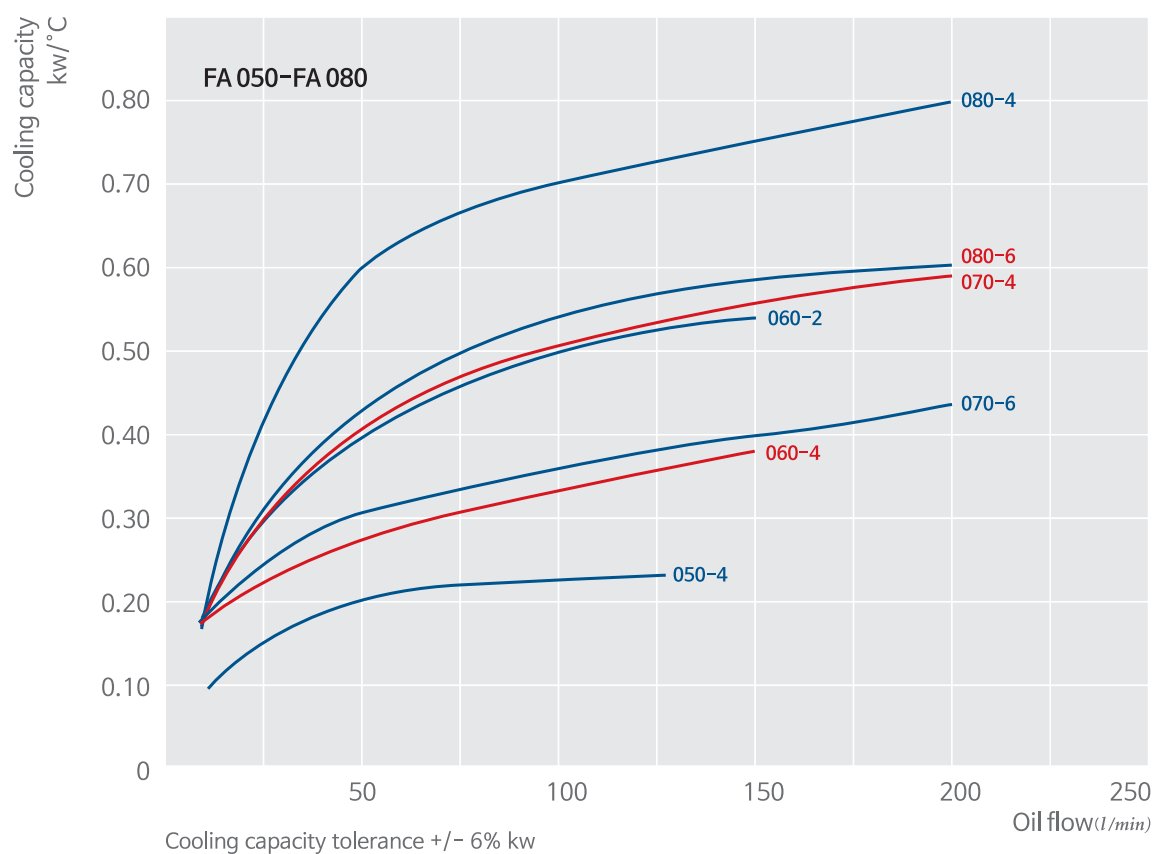
Type of oil	at 50°C (cSt)	at 60°C (cSt)	at 70°C (cSt)
VG 16	9.4	5.6	3.3
VG 22	15	11	8
VG 32	21	15	11
VG 46	29	20	14
VG 68	43	29	20
VG 120	68	44	31
VG 220	126	77	51
VG 320	180	108	69

2 Correction factor

Viscosity (cSt)	K	Viscosity (cSt)	K
10	0.6	60	1.6
20	0.8	80	2.14
30	1.0	100	2.7
40	1.2	150	4.2
50	1.4		

※ Note : Optimal management viscosity – 30 cSt

3 Cooling capacity by models

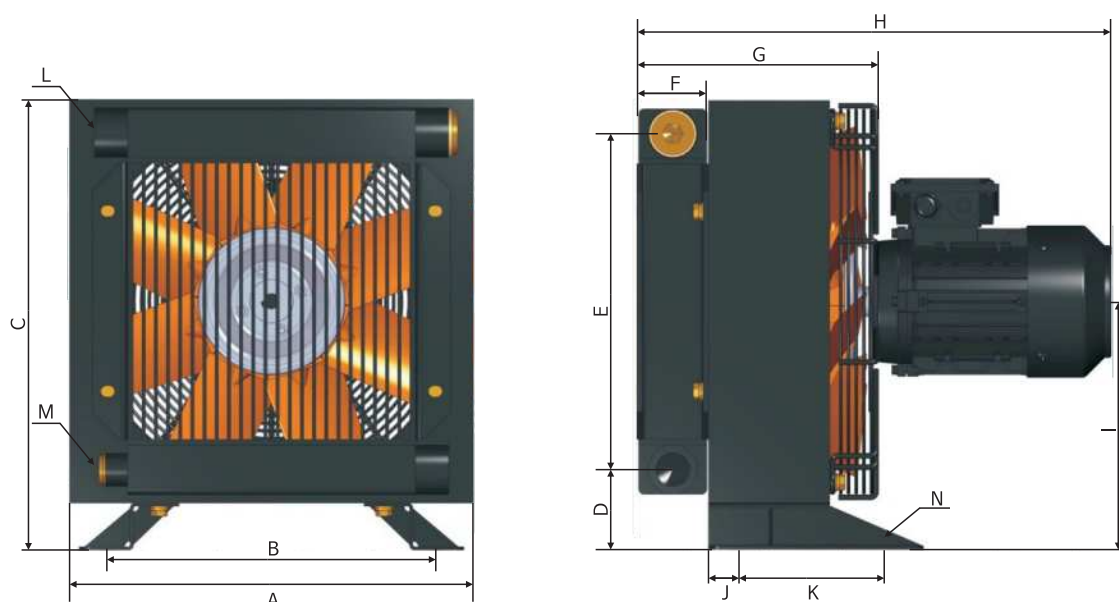


Technical Comments

- Cooling capacity (kw) / $\Delta T(^{\circ}\text{C})$
- The performance curves are based on ETD at 40°C (Inlet oil temperature= 60°C , ambient temperature= 20°C)
- $1\text{kw} = 860\text{ Kcal}/\text{h}$
- Suction is the standard type but in case you need a blow type, please contact FLOWFORCE.

3. FA 050 - 170 Series Air / Oil Cooler

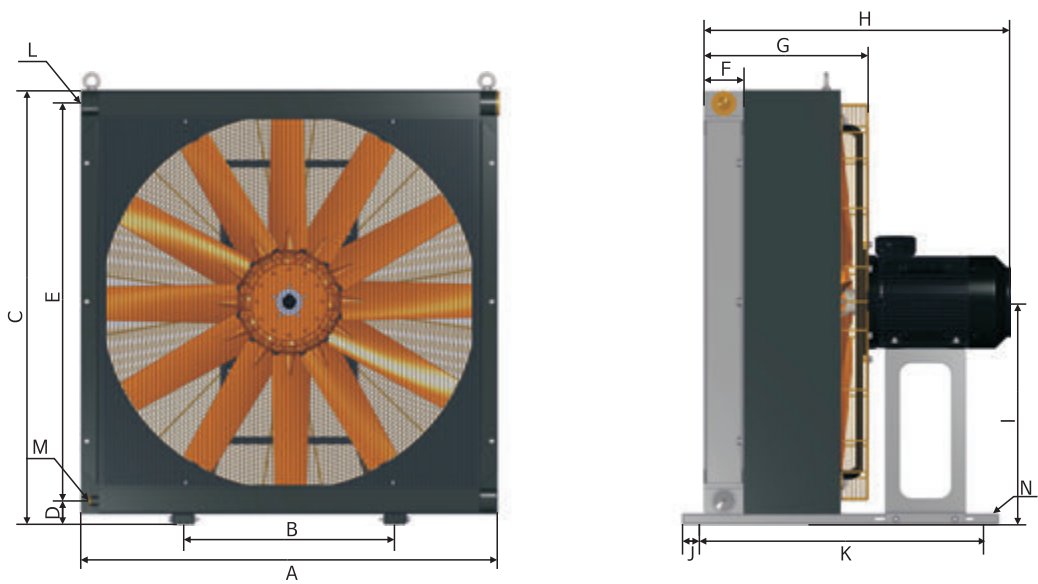
4 Dimension



FA 050~120

Type	Acoustic pressure level LpA dB(A) 1m	No. of Poles/Kw	Weight/Kg (Approx...)
FA 050-4 Three-phase motor	62	4-0.25	19
FA 060-2 Three-phase motor	82	2-1.1	31
FA 060-4 Three-phase motor	67	4-0.25	25
FA 070-4 Three-phase motor	70	4-0.37	30
FA 070-6 Three-phase motor	60	6-0.18	30
FA 080-4 Three-phase motor	76	4-0.75	40
FA 080-6 Three-phase motor	64	6-0.18	35
FA 090-4 Three-phase motor	84	4-2.2	65
FA 090-6 Three-phase motor	74	6-0.55	50
FA 100-4 Three-phase motor	85	4-2.2	71
FA 100-6 Three-phase motor	75	6-0.55	56
FA 110-4 Three-phase motor	84	4-2.2	95
FA 110-6 Three-phase motor	81	6-1.5	95
FA 120-4 Three-phase motor	85	4-2.2	104
FA 120-6 Three-phase motor	82	6-1.5	105
FA 130-6 Three-phase motor	86	6-2.2	143
FA 140-6 Three-phase motor	87	6-2.2	154
FA 150-6 Three-phase motor	90	6-5.5	203
FA 160-6 Three-phase motor	91	6-5.5	213
FA 170-6 Three-phase motor	92	6-5.5	231

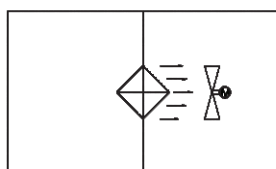
※ Acoustic pressure level is based on 50Hz.
In case of 60Hz, approximately 4dB will be increased.



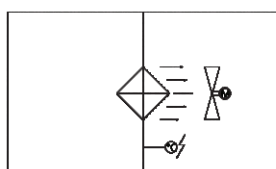
FA 130~170

Model	A	B	C	D	E	F	G	H	I	J	K	L	M	N
FA 050-4	365	297	408	73	305	65	220	430	225	27	145	G1	G1/2	10X15 SLOT
FA 060-2	440	203	408	73	375	65	247	247	225	27	510	G1	G1/2	10X15 SLOT
FA 060-4	440	390	480	73	375	65	247	465	260	27	170	G1	G1/2	10X15 SLOT
FA 070-4	496	436	536	68	439	65	263	474	288	27	195	G1	G1/2	10X15 SLOT
FA 070-6	496	436	536	68	439	65	263	474	288	27	195	G1	G1/2	10X15 SLOT
FA 080-4	579	520	629	77	525	63	277	508	340	27	220	G1	G1/2	10X15 SLOT
FA 080-6	579	520	629	77	525	63	277	487	340	27	220	G1	G1/2	10X15 SLOT
FA 090-4	692	620	742	88	615	65	320	626	396	21	278	G1 1/4	G1/2	12x30 SLOT
FA 090-6	692	620	742	88	615	65	320	545	396	21	278	G1 1/4	G1/2	12x30 SLOT
FA 100-4	692	620	742	88	615	85	340	646	396	21	278	G1 1/2	G1/2	12x30 SLOT
FA 100-6	692	620	742	88	615	85	340	565	396	21	278	G1 1/2	G1/2	12x30 SLOT
FA 110-4	868	796	938	108	782	65	370	668	499	27	320	G1 1/4	G1/2	12x18 SLOT
FA 110-6	868	796	938	108	782	65	370	668	499	27	320	G1 1/4	G1/2	12x18 SLOT
FA 120-4	868	796	938	108	782	85	390	688	499	27	320	G2	G1/2	12x18 SLOT
FA 120-6	868	796	938	108	782	85	390	688	499	27	320	G2	G1/2	12x18 SLOT
FA 130-6	1022	518	1052	76	930	65	395	713	541	25	750	G1 1/2	G1/2	14
FA 140-6	1022	518	1052	76	930	85	415	733	541	25	750	G2	G1/2	14
FA 150-6	1185	600	1235	68	1130	65	425	826	633	25	850	G2	G1/2	14
FA 160-6	1185	600	1235	68	1130	85	440	841	633	25	850	G2	G1/2	14
FA 170-6	1185	600	1235	68	1130	113	468	869	633	25	850	G2	G1/2	14

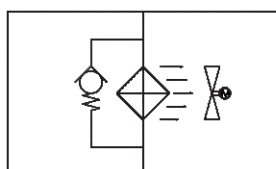
4. Cooler installation / Piping Diagram



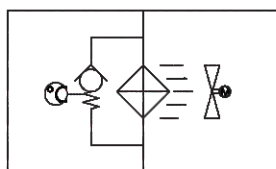
Standard Suction type
Model A,B



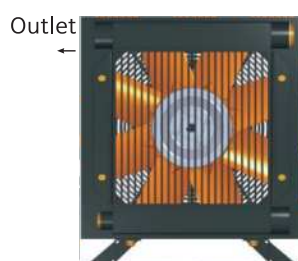
With thermo-switch Model C, D



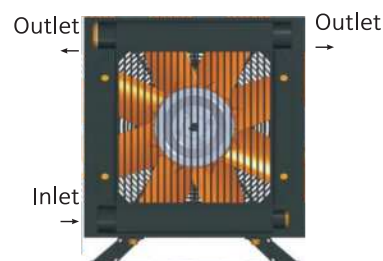
With by-pass valve Model E, F



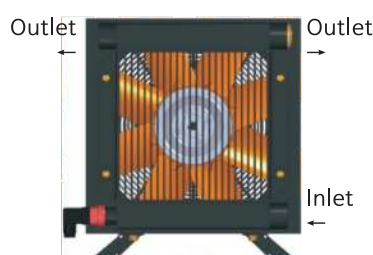
With temperature operated
by-pass valve Model E, F



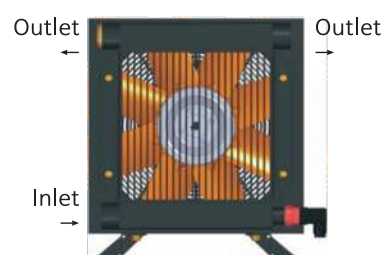
Model A



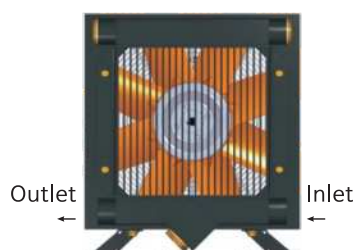
Model B



Model C



Model D



Model E

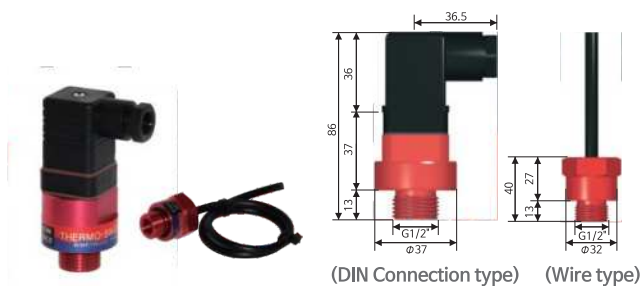


Model F

1 Thermo contact

Responsive to the temperature to operate the oil cooler in the desired temperature by sensing the motor signal.

Type	: Bi-metal control system
Switching capacity	: 24VDC 5A (In the case of inductive loads, the relay controller should be used)
Max working Temp	: 120°C
Set temperature	: Refer to the specification
Proctction	: IP65



※Caution※ Please be sure to use within the allowable voltage and current ranges. When using the motor directly in inductive loads will cause damage to the contacts.

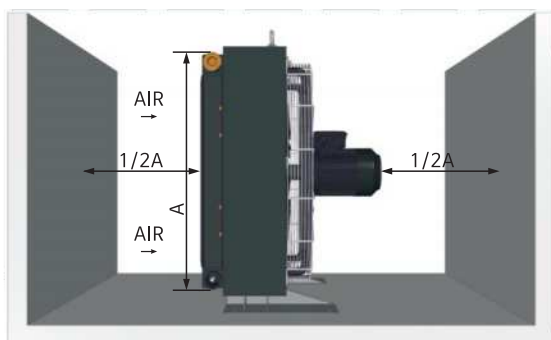
1-1 Types of thermo contacts

Model	Temperature	Connectrion
T40-W	40	Wire
T40-C	40	Connector
T50-W	50	Wire
T50-C	50	Connector
T60-W	60	Wire
T60-C	60	Connector

ex:T40-W : 45°C ± 5°C (ON), 35°C ± 5°C (OFF)

(Operating range will be varied based on the temperature change of oil)

5. Service Instruction



■ Installation

FA Series Air / Oil Coolers can be installed and mounted in any position but an upright installation is recommended. Prior to the installation, please consider the enough space for the air-flow of the coolers. In order to keep the best performance of the coolers, please do not disturb air-flow.

■ Cleaning

- Cooler body: When cleaning exterior of the coolers by water, ensure to disconnect the power supply.
- Cooler matrix: Using the compressed air to clean the cooler matrix but no damages on the cooler matrix.
- Fan housing: Remove the cooler matrix, when cleaning the inside of the fan housing. Use compressed air to clean the fan housing and blow the compressed air from the electric motor to fan guard.

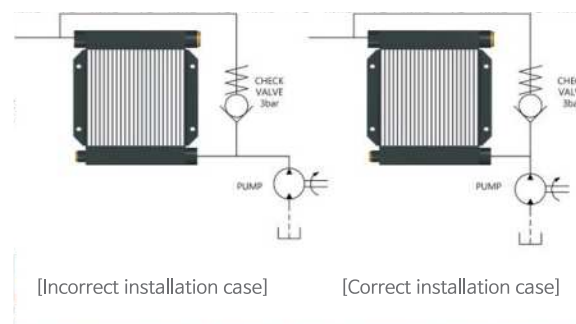
■ Noise Level

The noise level of the oil cooler might vary with depending on reflection from surrounding objects, natural frequency and interference sources.

■ Connection of cooler matrix

Using flexible hydraulic hoses to connect the cooler matrix. Make sure that all the hydraulic hoses and connections should be considered for the required pressure, flow and temperature of application. If there is a risk of pressure peaks or flow peaks the coolers should be mounted together with a filters in a separate cooling circuit.

■ How to install an external by-pass



Take the next step

Use the right accessories(options)



Pressure-controlled by-pass valve

Integrated type that allows the oil to bypass the cooler matrix if the pressure is too high and it reduces the risk of the cooler burst.



Temperature controlled by-pass valve

Integrated type and same function with pressure controlled by-pass valve but working by the temperature.



Thermo contact

Work by the sensor with fixed set point. Automatic switching on and off the fan motor.



Stone guard / Dust guard

Protect components and cooling system. Good to use under tough working condition



Temperature-controlled an external 3-way valve

Same function as the temperature-controlled by-pass valve but installed externally.

6. Model selection & Calculation

1 How to select the appropriate cooler

- Determination of cooler size and model
- Determination of expected pressure drop

Definition

■ T_{io} [°C]	Inlet oil temperature	■ P_1 [kw]	Total amount of heat exchange
■ T_{ia} [°C]	Inlet air temperature	■ Q [l/min]	Oil flowrate
■ Δt [°C]	Entrance Temperature Difference, $\Delta t = T_{io} - T_{ia}$	■ C_p	Specific heat capacity (2.08 kJ / kg °C)
■ P_a [kw/°C]	Corrected amount of heat exchange	■ S_g	Oil density (0.89 kg/dm ³)
■ P_2 [kw/°C]	Cooling capacity, $P_2 = P_1 / \Delta t$		

Example of Calculation

- Tank oil volume (V) 300Liter
- Oil temperature at start-up (T^1) 15°C
- The oil is heated up approx.
 Oil temperature after 25 min (T^2) 45°C
 Inlet oil temperature (T_{io}) 55°C
 Inlet air temperature (T_{ia}) 25°C
 Oil flow rate (Q) 90 l/min

Calculation

1. Calculation of P_1

$$P_1 = \frac{300 \times 0.89 \times 2.08 \times (45 - 15)}{25 \times 60} = 11.11 \text{ kw}$$
2. $\Delta t = T_{io} - T_{ia} = 55^\circ\text{C} - 25^\circ\text{C} = 30^\circ\text{C}$
3. Required specific performance :

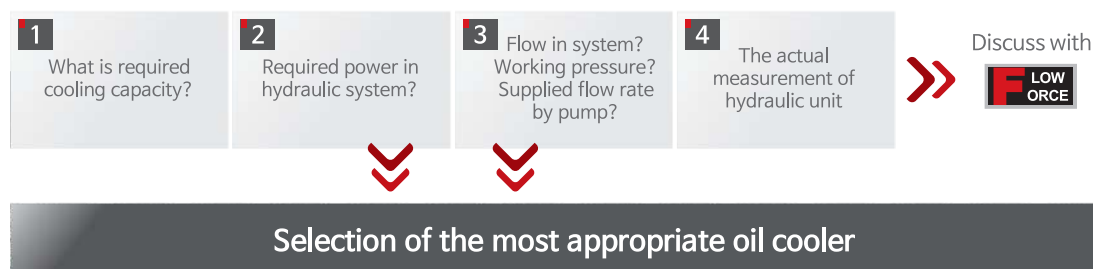
$$P_2 = P_1 / \Delta t = 11.11 \text{ kw} / 30^\circ\text{C} = 0.37 \text{ kw}/^\circ\text{C}$$
4. Corrected amount of heat exchange

$$P_a = P_2 \times 1.1 = 0.4 \text{ kw}/^\circ\text{C}$$
5. Using the performance curve, select the appropriate cooler at 90 l/min
6. Suggested model to cover the required cooling capacity is one of FA 070-4 or FA 080-6



Discuss with FLOWFORCE for better cooling solution that we, **FLOWFORCE** always stay with customers.

The process for the calculation of cooling capacity



7. Technical Questionnaire – Air Oil Cooler

Please contact FLOWFORCE by email(master@flowforce.co.kr) or fax(031-499-9886) after filling the blanks below.

Date :

Company / Dept.	/		Doc. No.	
Contact information	Person		Tel.	
	E-mail		Fax.	
System information	Name of system			
	Location	☐ Indoor	☐ Outdoor	☐ Etc. ()
Application				
Type of motor	☐ AC FAN Motor ☐ DC FAN Motor ☐ HYD Motor ☐ Off-line ☐ Other()			

1 Working Condition

Working fluid		Temperature	Inlet temperature	°C
Max. Allowable pressure drop	bar		Ambient temperature	°C
Flow rate	ℓ /min		Outlet temperature	°C
Required cooling	KW		Max. Working temperature	°C
Capacity Viscosity	ISO VG	Material	House ☐ Steel(STD.) ☐ SUS ☐ other()	
			Matrix ☐ Aluminum(STD.) ☐ other()	
			Motor ☐ Standard ☐ other()	

2 Operation Condition

☐ AC FAN Motor		☐ DC FAN Motor		☐ HYD' Motor		☐ Off-line	
Motor	☐ 110V ☐ 220V	Motor	☐ 12v ☐ 24v	Flow	cc/rev() rpm()	Flow	☐ 20.7cc/rev ☐ 27.6cc/rev ☐ 29.0cc/rev ☐ 42.0cc/rev ☐ 53.1cc/rev ☐ 40.8cc/rev ☐ 61.2cc/rev
	☐ 220/380V						
	☐ 440V						
Hz	☐ 50Hz ☐ 60Hz						
IP	☐ Standard ☐ Other()						

3 Option

Themo contact	☐ T40 ☐ T50 ☐ T60
	☐ DIN-TYPE ☐ WIRE-TYPE
By-pass valve integrated type	☐ SINGLE PASS ☐ TWO PASS
	☐ By temperature ☐ By pressure Temperature()°C, Pressure()bar
Temperature sensor	☐ PT100 ☐ Temperature Transmitter(4~20mA)
Temperature controler	☐ Simple ON/OFF ☐ Inverter PID
Filter unit	☐ 5μm ☐ 10μm
Protective guard	☐ STONE GUARD ☐ DUST GUARD
Adapter(PF→PT)	☐ 1" ☐ 1"1/4 ☐ 1"1/2 ☐ 2"

4 Additional Specification

Nameplate	☐ Standard	Manufacturer's standard
	☐ Other	English/Other :
Paint	☐ Manufacturer's standard(RAL 9005)	
	Request	
Internal cleanliness	☐ Manufacturer's standard	
	☐ ISO4406	
Motor approval	☐ CE ☐ UL ☐ ATEX ☐ Other()	
Certificaiton	☐ CE ☐ ASME ☐ CLASS() ☐ Other()	
Other specification		

※ Please feel free to write below blanks.

Type / Series		Product model	
Q'ty		Requested delivery date	

The faith and belief in technology with new CI, FLOWFORCE is a hydraulic system accessory manufacturer with

28 years of business background and experience aiming to be the Global Only 1. Company in the hydraulic accessories and cooling solution technology.

FLOWFORCE also implements energy-saving on its site and lead the market with new technology by supplying the most efficient eco-friendly and next-generation products as its guaranteed, created and shared value for the customers.

By the experience together with next-generation technologies that we, FLOWFORCE will exert efforts to improve customer problems with differentiated engineering solutions and leading the market.

Thank you.



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