



*Global Only 1. Company
for Professional Fluid Solution*

With Hydraulic Motor

High Performance Air / Oil Cooler

● FH-Series



- CE Approval
- Optimized for Mobile & Industrial Hydraulic System (Hydraulic Motor)

FLOWFORCE CO., LTD.

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



Maximum cooling capacity 154,000 Kcal/h

(at ETD 40°C)

The Best Optimal Solution for Mobile and Industrial Special 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 FH 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.

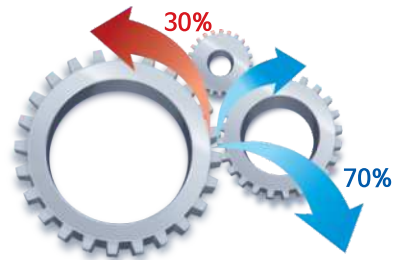
- Increase internal leakage
- High potential risk of cavitation
- Shorten the life-cycle of components



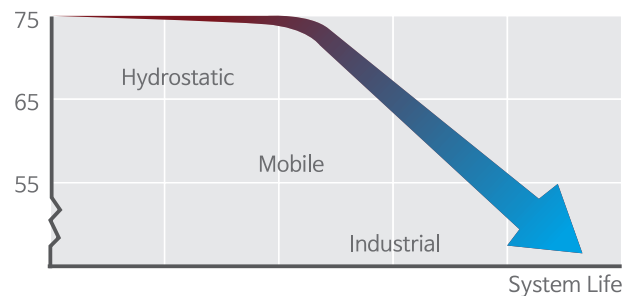
Consideration

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

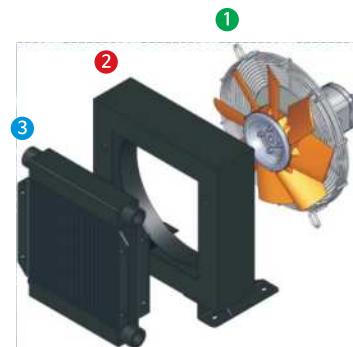
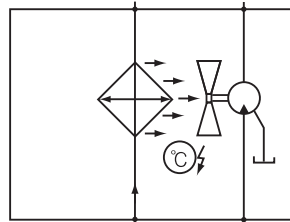
- Compact design with light weight
 - High efficiency hydraulic motor (6.3 cc/r ~ 24.5 cc/r)
 - Cooler matrix: With low pressure drop and high cooling capacity
 - Low noise of fan & fan motor
 - Collar bearing of hydraulic fan motor
- It can be equipped with multifunctional peripheral such as by-pass valve, thermo-switch, etc.

1 Environment friendly & Easy to maintenance



Main Parts

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



Design 특징



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

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

Main Applications

- Mobile hydraulic system
- Closed hydraulic system
- Concrete pump car
- Special purposed vehicle / Heavy equipment vehicle
- Marine Hydraulics
- Special purposed industrial hydraulic system
- Rock drill equipment
- Lubrication system

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

1 FH - 2 060 - 3 11 - 4 00 - 5 0 - 6 0 - 7 0

1 FH = HYD. Motor	2 Cooler size	3 Discharge rate of HYD. Motor
FA =AC Motor	050, 060, 070, 080, 090, 100,110, 120,	00 =Without motor
FD =DC Motor	130, 140, 150, 160, 170	06 =6.3cc
FH =Hydraulic Motor	(※ Refer to page 8)	08 =8cc
FC =Circulation Pump Type (Off-Line)		11 =11.2cc
		14 =14cc
		16 =16cc
		19 =19cc
		25 =24.5cc

4 Thermo contact	5 Cooler matrix	6 Matrix protect guard
00 =Without thermo contact	0 =Without matrix	0 =Without guard
40 =40°C -WIRE TYPE	1 =Standard	S =Stone guard
50 =50°C -WIRE TYPE	2 =Two pass	D =Dust guard
60 =60°C -WIRE TYPE	X =Special	T =Dust and Stone guard
41 =40°C -DIN CONNECTER TYPE		
51 =50°C -DIN CONNECTER TYPE		
61 =60°C -DIN CONNECTER TYPE		
XX =Special		

7 Standard / Special
0 =Standard
Z =Special

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

■ 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

■ HYD. Motor Specification

- Max. Working Pressure : 120 Bar
- Max. Drain Pressure : 2 Bar
- Oil Viscosity : 10 ~ 600mm²/s (optimal 30 ~ 45mm²/s)
- Oil Temperature : Max. +90°C
- Oil Cleanliness : Grade B25>75(ISO/DIS Code 19/16)
- Discharge rate : 6.3 cc/rev ~ 24.5 cc/rev
- Oil type : Mineral oil

※ Caution

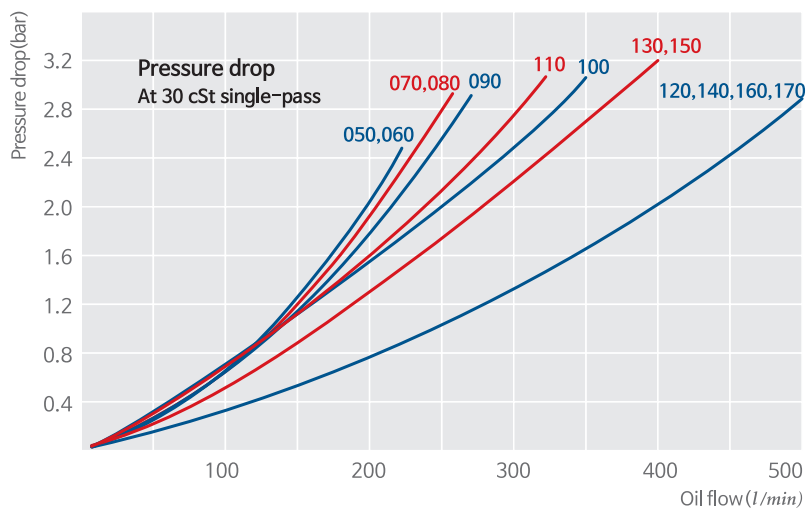
Please contact FLOWFORCE if the temperature difference is more than 50°C between inlet oil temperature and the ambient temperature.



1. FH 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.



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

1 Temperature/Viscosity table

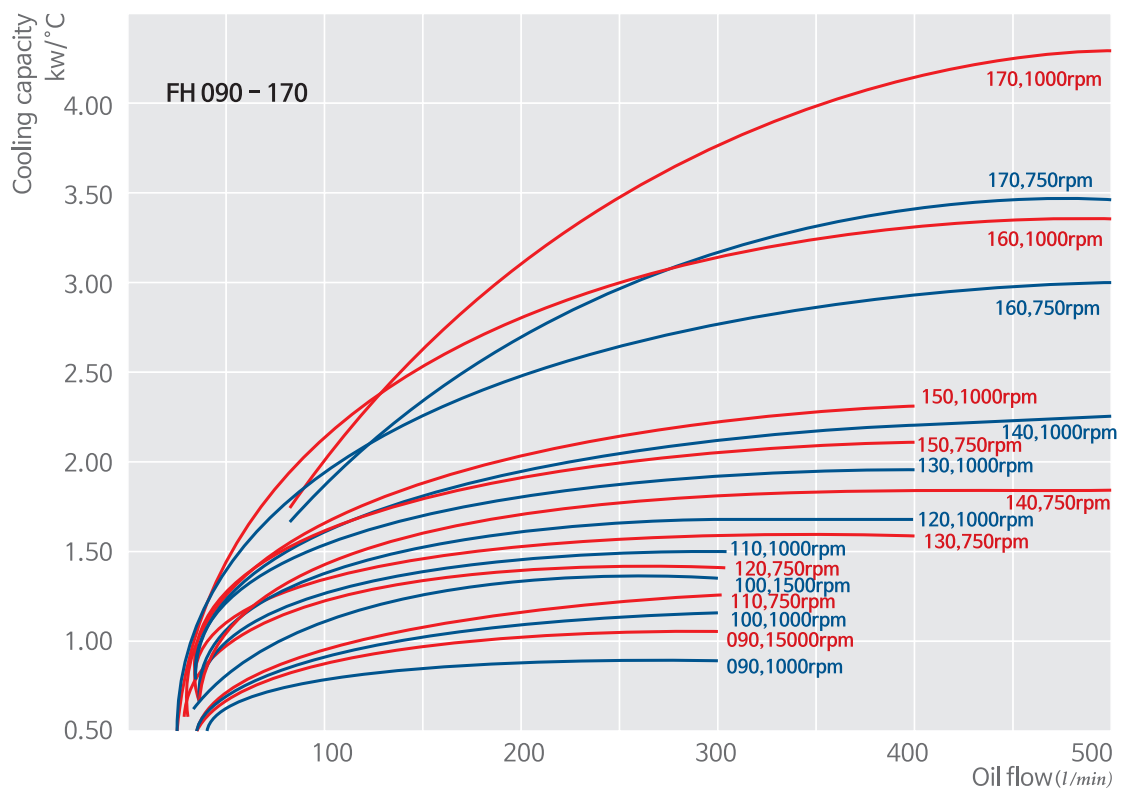
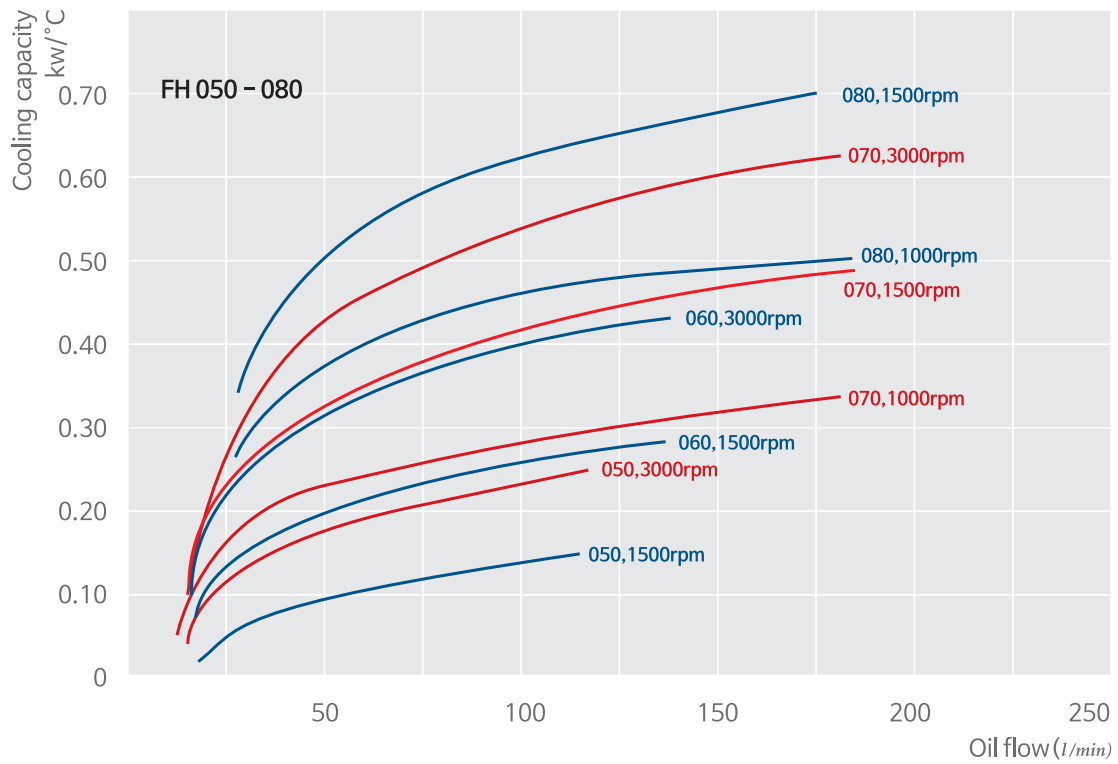
Type of oil	at 50°C (cSt)	at 60°C (cSt)	at 70°C (cSt)
VG 16	9.4	5.6	3.3 cSt
VG 22	15	11	8 cSt
VG 32	21	15	11 cSt
VG 46	29	20	14 cSt
VG 68	43	29	20 cSt
VG 120	68	44	31 cSt
VG 220	126	77	51 cSt
VG 320	180	108	69 cSt

2 Correction factor K

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

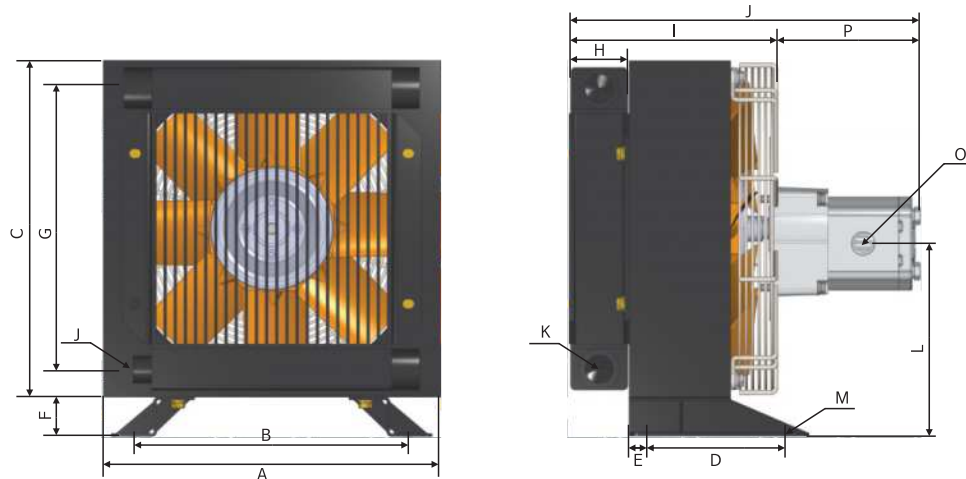
3 Cooling capacity by models



Technical Comments

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

2. FH 050 – 170 Series Air Oil Cooler



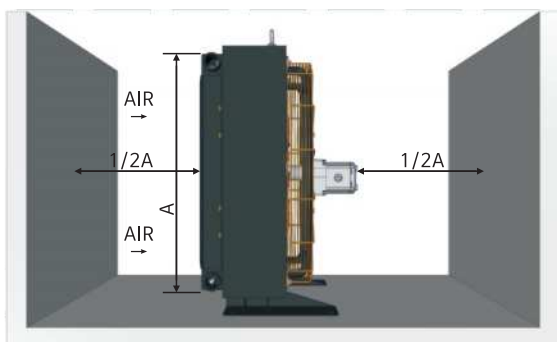
4 Dimension

TYPE	A	B	C	D	E	F	G	H	I	J	K	L	M	N
FH 050	365	297	408	145	27	73	305	65	222	G1/2	G1	209	SLOT10X15	I+P
FH 060	440	390	480	170	27	73	375	65	249	G1/2	G1	244	SLOT10X15	I+P
FH 070	496	436	536	195	27	69	439	65	266	G1/2	G1	272	SLOT10X15	I+P
FH 080	579	520	629	220	27	77	525	65	279	G1/2	G1	323	SLOT10X15	I+P
FH 090	692	620	742	270	27	89	615	65	309	G1/2	G1 1/4	380	SLOT 12X18	I+P
FH 100	692	620	742	270	27	84	625	85	329	G1/2	G1 1/2	380	SLOT 12X18	I+P
FH 110	868	796	938	320	27	108	782	65	353	G1/2	G1 1/4	483	SLOT 12X18	I+P
FH 120	868	796	938	320	27	98	802	85	373	G1/2	G2	483	SLOT 12X18	I+P
FH 130	1022	940	1092	325	37	116	930	65	377	G1/2	G1 1/2	565	SLOT 14X21	I+P
FH 140	1022	940	1092	325	37	111	940	85	397	G1/2	G2	565	SLOT 14X21	I+P
FH 150	1185	1103	1285	395	37	118	1130	65	404	G1/2	G2	666	SLOT 14X21	I+P
FH 160	1185	1103	1285	395	37	118	1130	85	424	G1/2	G2	666	SLOT 14X21	I+P
FH 170	1185	1103	1285	395	37	118	1130	113	452	G1/2	G2	666	SLOT 14X21	I+P

HYD. Motor	Discharge rate (cm3/r)	In	O	Out	P	Max. Working Pressure (bar)
06	6.3	G1/2"		G1/2"	137	250
08	8	G1/2"		G1/2"	140	250
11	11.2	G1/2"		G1/2"	144	250
14	14	G1/2"		G1/2"	149	250
16	16	G1/2"		G1/2"	153	250
19	19	G1/2"		G3/4"	157	200
25	24.5	G3/4"		G3/4"	167	170

TYPE	Fan Speed (rpm)	Fan Power (kw)	Weight (Kg)	Max. Speed (rpm)	Acoustic pressure Level dB(A) 1m
FH 050	1500 / 3000	0.10 / 0.65	10	3500	62 / 79
FH 060	1500 / 3000	0.20 / 1.50	15	3500	67 / 82
FH 070	1000 / 1500 / 3000	0.10 / 0.35 / 2.50	18	3500	60 / 70 / 86
FH 080	1000 / 1500	0.15 / 0.50	30	2840	64 / 76
FH 090	1000 / 1500	0.65 / 2.00	40	2350	75 / 85
FH 100	1000 / 1500	0.70 / 2.00	56	2350	77 / 86
FH 110	750 / 1000	0.75 / 1.80	70	1850	74 / 82
FH 120	750 / 1000	0.75 / 1.80	77	1850	75 / 83
FH 130	750 / 1000	0.70 / 1.60	105	1690	80 / 87
FH 140	750 / 1000	0.70 / 1.60	111	1690	81 / 88
FH 150	750 / 1000	1.70 / 4.00	117	1440	85 / 91
FH 160	750 / 1000	1.70 / 4.00	125	1440	86 / 92
FH 170	750 / 1000	1.70 / 4.00	184	1440	87 / 93

3. Service Instruction



■ **Installation**

FH 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.

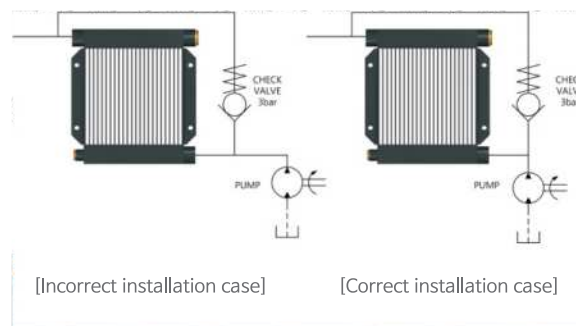
■ **Noise Level**

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

4. Model selection & Calculation

1 How to select the appropriate cooler

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

Definition

■ Tio [°C]	Inlet oil temperature	■ P1 [kw]	Total amount of heat exchange
■ Tia [°C]	Inlet air temperature	■ Q [l /min]	Oil flowrate
■ Δt [°C]	Entrance Temperature Difference, Δt = Tio - Tia	■ Cp	Specific heat capacity (2.08 kJ / kg °C)
■ Pa [kw/°C]	Corrected amount of heat exchange	■ Sg	Oil density (0.89 kg/dm ³)
■ P2 [kw/°C]	Cooling capacity, P2 = P1 / Δt		

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	(Tio)	55°C
Inlet air temperature	(Tia)	25°C
Oil flow rate	(Q)	90 l /min

Calculation

1. Calculation of P1

$$P1 = \frac{300 \times 0.89 \times 2.08 \times (45 - 15)}{25 \times 60} = 11.11 \text{ kw}$$
2. Δt = Tio - Tia = 55°C - 25°C = 30°C
3. Required specific performance :

$$P2 = P1 / \Delta t = 11.11 \text{ kw} / 30^\circ\text{C} = 0.37 \text{ kw}/^\circ\text{C}$$
4. Corrected amount of heat exchange

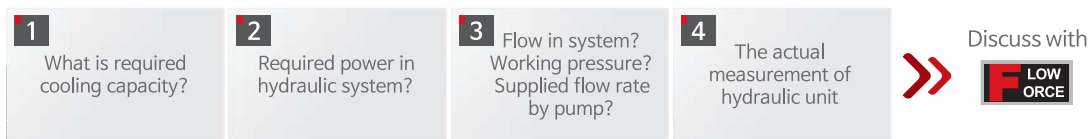
$$Pa = P2 \times 1.1 = 0.4 \text{ kw}/^\circ\text{C}$$
5. Using the performance curve, select the appropriate cooler at 90 l /min
6. Suggested model to cover the required cooling capacity is one of FH 060 (3000rpm) or FH 070 (1500rpm)
7. HYD. Motor - Inlet flow rate

$$Q = \frac{q \times n}{10^3 \times \eta_{vol}} \quad \begin{array}{l} \cdot q (\text{cc/rev}) = \text{Discharge rate of HYD. Motor} \\ \cdot n = \text{Fan Speed} \\ \cdot \eta = \eta_{vol} (\text{Volumetric efficiency}) \\ \quad : 90\% \text{ Working pressure of HYD. Motor at 150Bar} \end{array}$$



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

The process for the calculation of cooling capacity



Selection of the most appropriate oil cooler

5. 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	<input type="checkbox"/> Indoor	<input type="checkbox"/> Outdoor	<input type="checkbox"/> Etc. ()
Application				
Type of motor	<input type="checkbox"/> AC FAN Motor <input type="checkbox"/> DC FAN Motor <input type="checkbox"/> HYD Motor <input type="checkbox"/> Off-line <input type="checkbox"/> 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	<input type="checkbox"/> Steel(STD.) <input type="checkbox"/> SUS <input type="checkbox"/> other()
		Matrix		<input type="checkbox"/> Aluminum(STD.) <input type="checkbox"/> other()	
		Motor		<input type="checkbox"/> Standard <input type="checkbox"/> other()	

2 Operation Condition

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

3 Options

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

4 Additional Specification

Nameplate	<input type="checkbox"/> Standard	Manufacturer's standard
	<input type="checkbox"/> Other	English/Other :
Paint	<input type="checkbox"/> Manufacturer's standard (RAL 9005)	
	Request	
Internal cleanliness	<input type="checkbox"/> Manufacturer's standard	
	<input type="checkbox"/> ISO4406	
Motor approval	<input type="checkbox"/> CE <input type="checkbox"/> UL <input type="checkbox"/> ATEX <input type="checkbox"/> Other()	
Certificaiton	<input type="checkbox"/> CE <input type="checkbox"/> ASME <input type="checkbox"/> CLASS() <input type="checkbox"/> Other()	
Other specification		

※ Please feel free to write below blanks.

Type / Series		Product model	
Q'ty		Requested delivery date	

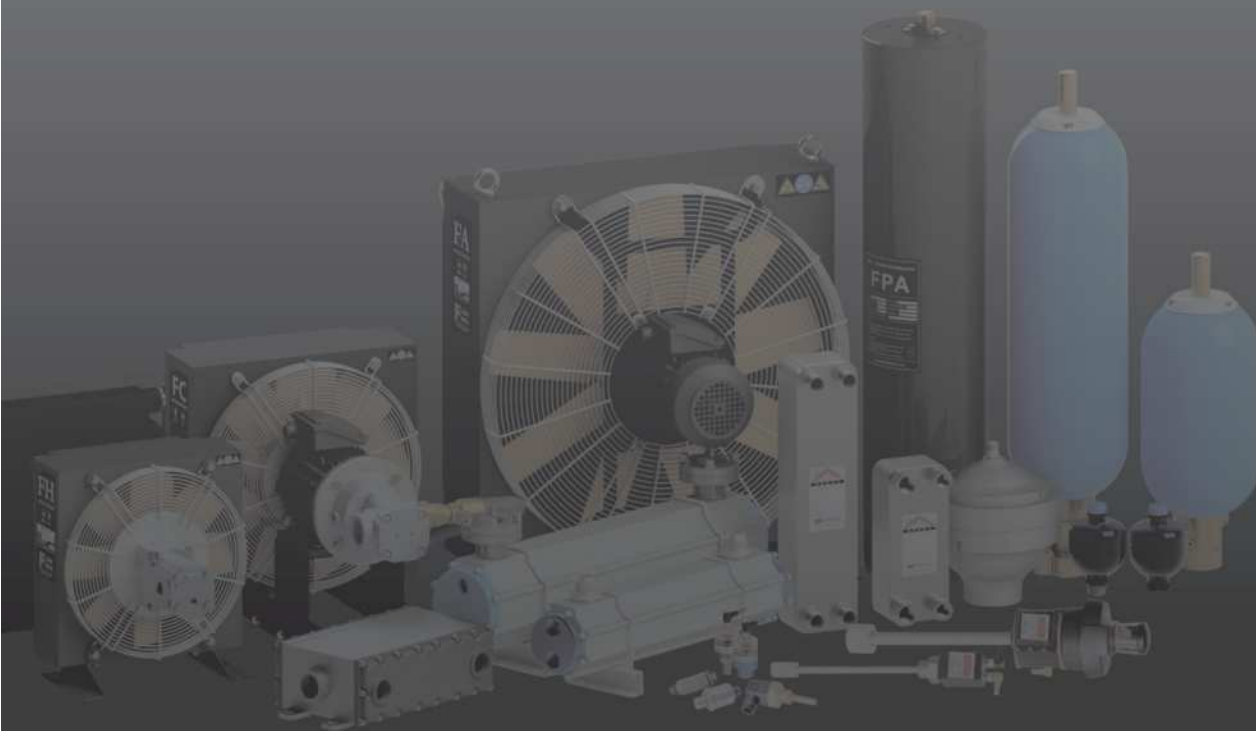
The faith and belief in technology with new CI, FLOWFORCE is a hydraulic system accessory manufacturer with

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.



FLOW **ORCE** (주)플로우포스
Flowforce. Co., Ltd.

경기도 화성시 서신면 공평항로 1686-7
Tel. 031-499-9885 | Fax. 031-355-4175

1686-7, Gungpyeonghang-ro, Seosin-myeon,
Hwaseong-si, Gyeonggi-do, Korea
www.flowforce.co.kr

master@flowforce.co.kr