kemtech

CHILLER UNIT
- OIL CHILLER
- WATER CHILLER
- COOLANT CHILLER

HIGH PRESSURE COOLANT SYSTEM
- SUB TANK TYPE
- VESSEL TYPE
- MCF

MF SERIES

MAGNETIC FILTERING SYSTEM

UTILITY CABINET SYSTEM

AUTOMATIC FILTERING SYSTEM

OIL SEPARATOR

HIGH PRESSURE COOLANT PUMP

profluid

To do our best so our customers can do theirs.

kemtech

We, kemtech, will step toward the customers with products that can realize the value more that expected by the customers.

MANAGERMENT PHILOSOPHY	Based on honesty and trust, we will help our customers realize lasting value so we can help society have the brightest future possible. How With passion, a healthy work ethic, and understanding our customers as our foundation, we - shall create a corporate culture that allows us to adapt to any changing business environment; - shall become a strong company that grows with our customers by meeting their concerns with the latest technology and or after service care.
VISION	To do our best as market leaders so our customers can do theirs.
OUR CORE SPIRIT	To challenge the world with passion so as to create enhanced value for ourselves and our customers.
MISSION STATEMENT	Kemtech is focused on continuously changing so as to create enhanced value for all in a relentlessly predictable way so that our customers through constant cooperation are visibly happy, and completely satisfied.

Contents

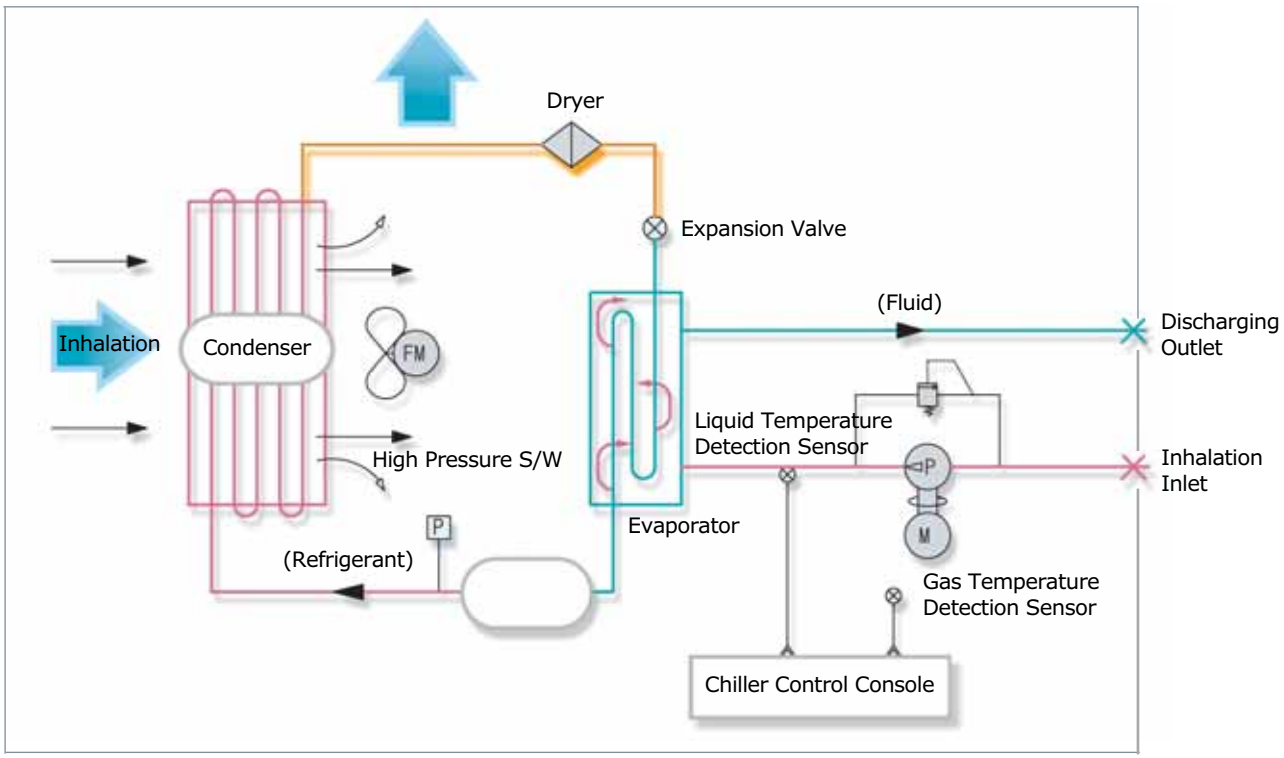
COMPANY HISTORY

1992. 04	Jesung Corporation was established
1995. 02	Oil chiller was developed, sales started
1997. 01	High-pressure cutting fluid device was developed, its sales started
1999. 01	Factory moved (Ulsan Hyomoon apartment type factory)
06	Coolant chiller was developed, sales started
2001. 09	Water chiller was developed, sales started
12	Design rights registration for cutting fluid filter
2002. 03	CE certification for oil chiller
2003. 05	Patent registration for cutting fluid filter device
12	Design rights registration for high-pressure cutting fluid device
2004. 06	Factory expanded (total 2,000㎡)
2006. 01	Amalgamated as on integrated corporation Kemtech Co., Ltd
07	Oil chiller is export to Japan's Okuma started
2007. 01	ISO 9001 certification obtained
07	Oils separator was developed, sales started
2008. 07	Utility cabinets for machining center were developed
09	Opened a research institute in Ulsan Convergence Scientific Technology Center
11	Registered patent for an oil separation device
2009. 05	Developed a magnetic filter
06	Developed an automatic filter
07	Registered utility model for an oil skimmer
2010. 01	HYDAC Filter, Nominated as the agent representing Korea for high pressure pump of SKF

profluid

PROFLUID CHILLER

Description of Cooling Cycle



Refrigeration cycle	It is divided into compression process, condensation process, expansion process and evaporation process. Compressor, condenser, expansion valve and evaporator exist at each process.
Compressor	It increases pressure by compressing refrigerant vapor to allow the refrigerant vapor (low temperature, low pressure, gas) to evaporate from the evaporator for it to easily condense. The refrigerant cycles inside the cooling device, through repeated evaporation and condensation processes, delivers heat from low temperature to high temperature.
Condenser	It is a heat exchanger that cools and liquefies refrigerant vapor (high temperature, high pressure, gas) that obtains cycling power from the compressor. High temperature refrigerant exchanges heat with air through the fan and refrigerant with high temperature, high pressure and gaseous state is condensed to medium temperature and high pressure liquid state by passing through the condenser.
Expansion Valve	It controls refrigerant fluid flow during cooling cycle and lowers pressure and temperature to facilitate heat absorbing process through fluid evaporation by supplying refrigerant fluid to the evaporator. At the same time, it controls and supplies the adequate refrigerant fluid flow by responding to a change in refrigeration load.
Evaporator	As a heat exchanger that performs cooling process at the cooling device, it is a device that makes low temperature and low pressure refrigerant fluid supplied to the evaporator exchange heat with cooling target material (oil, water or cutting fluid). Refrigerant fluid required in cooling is supplied through the expansion valve and evaporated vapor is supplied to the compressor.

Through the repetition of this cycle, the fluid inhaled to the chiller and discharged is maintained and managed at a temperature that a user desires.

Ⅱ Description of Chiller Model Symbols

PF	OC	150	-	L	P	H	T	-	S	C	
	①	②		③	④	⑤	⑥		⑦	⑧	⑨

① Unit Type
- OC : Oil chiller (for cooling the main spindle & lubricant, hydraulic fluid)
- WC : Water chiller (for cooling high frequency main spindle & semiconductor equipment, medical apparatus)
- CC : Coolant chiller (for cooling the cutting fluid used in cutting & grinding)

② Division of capacity
- 030 : 700/900kcal/HR
- 050 : 1,500/1,700kcal/HR
- 075 : 2,500/2700kcal/HR
- 110 : 3,500/3,700kcal/HR
- 150 : 4,800/5,300kcal/HR
- 220 : 7,200/7,500kcal/HR

③ Temperature Control Method
- A : Body temperature synchronized control (analog method)
- D : Fixed (setting) temperature control (digital method)
- L : LCD Digital Temperature Control

④ P : Cycle Pump Attachment Type

⑤ H : Heater Attachment Type

⑥ T : Sub tank Attachment Type

⑦ Heat Exchanger Type
- S : Direct submerging type
- No marking : Evaporator built-in type

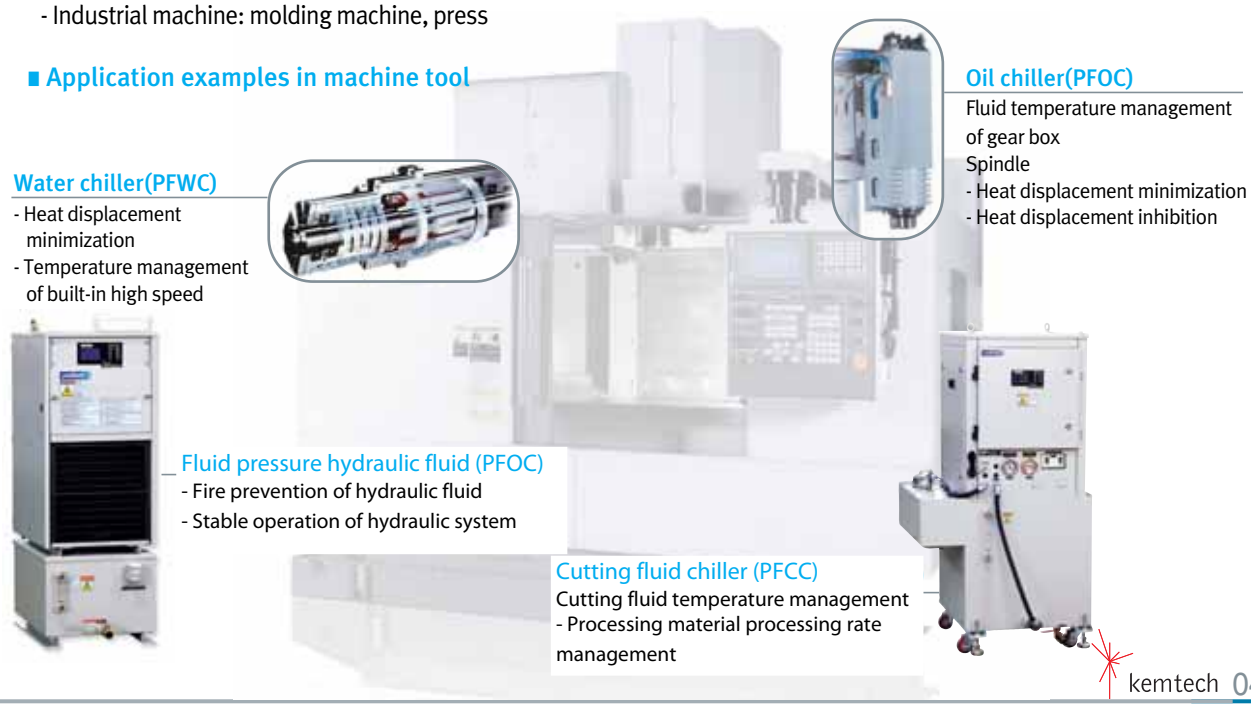
⑧ Attachment Type
- C : Roller attachment type
- Non-specified: BOLT Assembly Type (See Drawing)

⑨ Option
- 1 : Sub tank level check function
- 2 : Chiller cycle pump pressure detection function
- 3 : Discharged fluid flow rate control function
- 4 : Special voltage specification (380/440[Vac])
- 5 : Customer requested exterior dimension
- 6 : Length of temperature detection sensor

Ⅲ Key Application Examples

■ Application field
- Factory machine: machining center, CNC lathe, grinder, dedicated machine tool and NC electrical discharge machine
- Industrial machine: molding machine, press

■ Application examples in machine tool



Water chiller(PFWC)
- Heat displacement minimization
- Temperature management of built-in high speed

Oil chiller(PFOC)
Fluid temperature management of gear box
Spindle
- Heat displacement minimization
- Heat displacement inhibition

Fluid pressure hydraulic fluid (PFOC)
- Fire prevention of hydraulic fluid
- Stable operation of hydraulic system

Cutting fluid chiller (PFCC)
Cutting fluid temperature management
- Processing material processing rate management

PROFLUID
OIL CHILLER UNIT

Ⅰ Special Features

High accuracy temperature control oil chiller

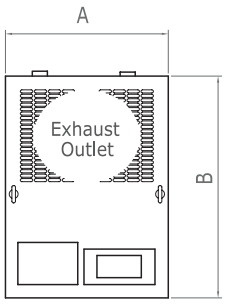
- Environmentally-friendly refrigerant R407C used in all units
- Durability & stability achieved
  Applying 3 Phase Rotary Compressor to overall models
- High accuracy control achieved (±0.5℃), on/off control
- LCD Digital Controller Mounted (Korean/English Supported)
- All units CE (European Conformity) mark certified
- Compact size allowing the installation of integrated machine tool type
- Embodying low-noise system by applying low-noise pump exclusive for oil cooler
- Supporting the function to be indicated in Korean and English-Easy maintenance and control
- Responding to user requested items through a large model lineup, various product development and design capability

Ⅱ Technical Data - Oil Chiller

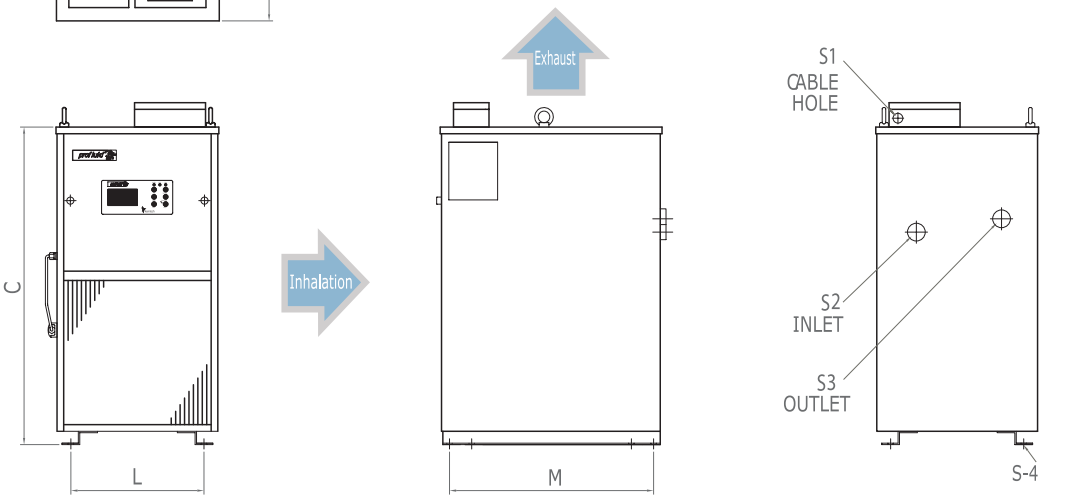
Classification		Unit	PFOC030	PFOC050	PFOC075	PFOC110	PFOC150	PFOC220
Nominal cooling capacity 50/60 [Hz]		kcal/Hr	800/900	1500/1700	2500/2700	3500/3700	4900/5300	7200/7500
Compressor		kW	0.3	0.5	0.75	1.1	1.5	2.2
Motor	Pump	kW	0.2	0.2	0.4	0.75	0.75	0.75
	Fan	kW	0.1	0.1	0.2	0.2	0.2	0.2
Pump discharged fluid flow rate		ℓ /min	11/14	11/14	23/27	28/34	28/34	40/46
Temperature control method	Synchronized	℃	-9.9 ~ +9.9					
	Fixed		5 ~ 50					
Temperature range used (inlet fluid temperature)		℃	5 ~ 50					
Voltage specification		Vac	3 Phase 200/220[VAC] 50/60[Hz] Contact our company for special voltage specifications.					
Circuit breaker installation capacity		A	15	15	15	25	25	25
Refrigerant			R407 / R-22 / ~~R134a~~					
Viscosity of oil used		cSt	2 ~ 200(below ISO VG 32)					
Pipe standard	Inlet/Outlet	inch	Rc ¾" / Rc ¾"			Rc 1" / Rc 1"		
Exterior dimension	W×H×D	mm	Refer to the exterior diagram.					
*Oil tank capacity		ℓ	35	35	40	85	85	85
Weight		kg	65(95)	65(95)	80(120)	90(175)	100(185)	100(245)
Safety protection mechanism			High · Low pressure detector, excess current detector for motor protection, circuit breaker, reverse phase detector, thermal for compressor protection *Level S/W *Flow S/W					

Notes) 1. ( )denotes the weight including liquid weight inside the tank.
2. The above specification is subject to change according to circumstances within the company.
3. Rc is the ISO standard name for PT female screw.
4. *indicates option.

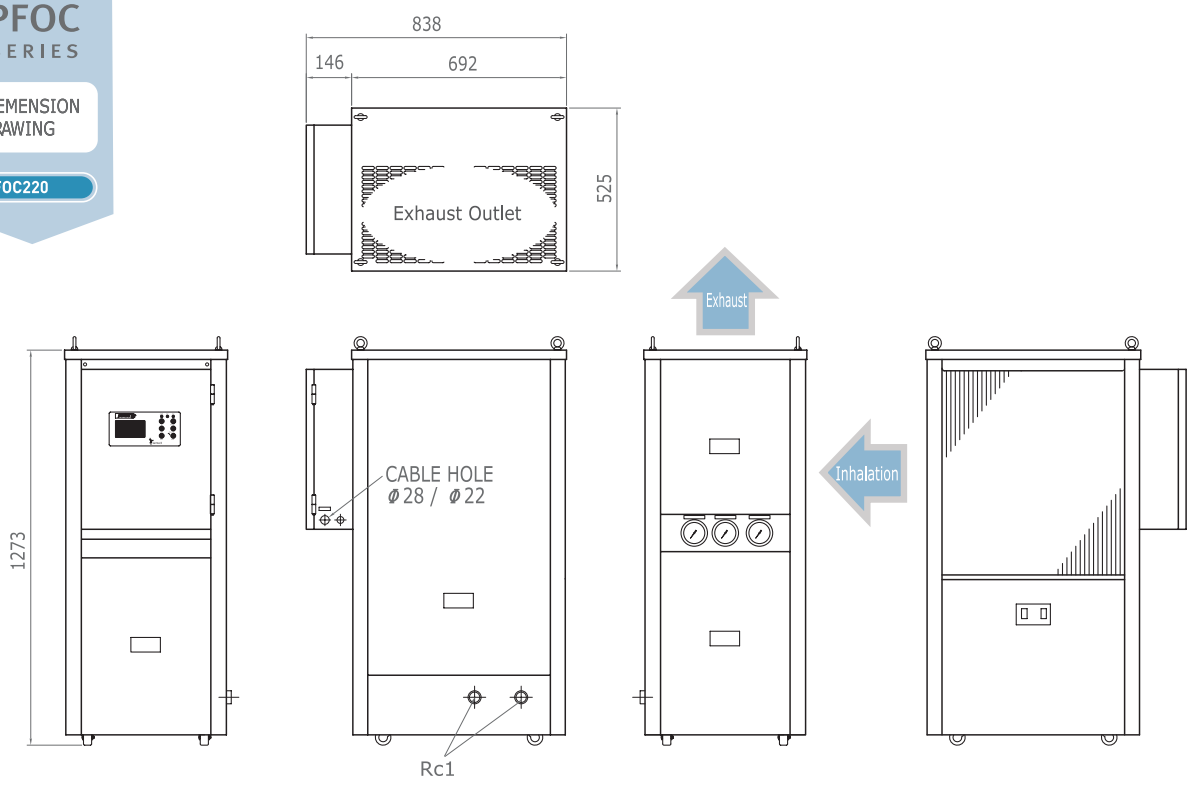
PFOC
SERIES
DEMENSION DRAWING
PFOC030/050
PFOC075
PFOC110/150



MODEL No.	A	B	C	L	M	S1	S2	S3	S4
PFOC030/050	367	500	716	300	460	ø22	Rc3/4	Rc3/4	4-ø12
PFOC075	367	448	836	300	410	ø22	Rc3/4	Rc3/4	4-ø12
PFOC110/150	500	564	1070	425	520	ø22	Rc1	Rc1	4-ø12



PFOC
SERIES
DEMENSION DRAWING
PFOC220



PROFLUID
WATER CHILLER UNIT

Ⅰ Special Features

As a sub tank built-in type, installation and use is possible regardless of machine tool manufacture

- Environmentally-friendly refrigerant R407C applied in all units
- Durability & stability achieved
  Applying 3 Phase Rotary Compressor to overall models
- Realizing improvement in cooling water temperature control (±0.5℃)
- LCD Digital Controller Mounted (Supporting Korean and English)
- All units CE (European Conformity) mark certified
- Various specification options available such as heater, cycle pump, coolant, level check, fluid flow rate check and operation hour setting
- Supporting the function to be indicated in Korean and English-Easy maintenance and control
- Responding to user requested items with a large model lineup, various product development and design capability

Ⅱ Technical Data - Water Chiller

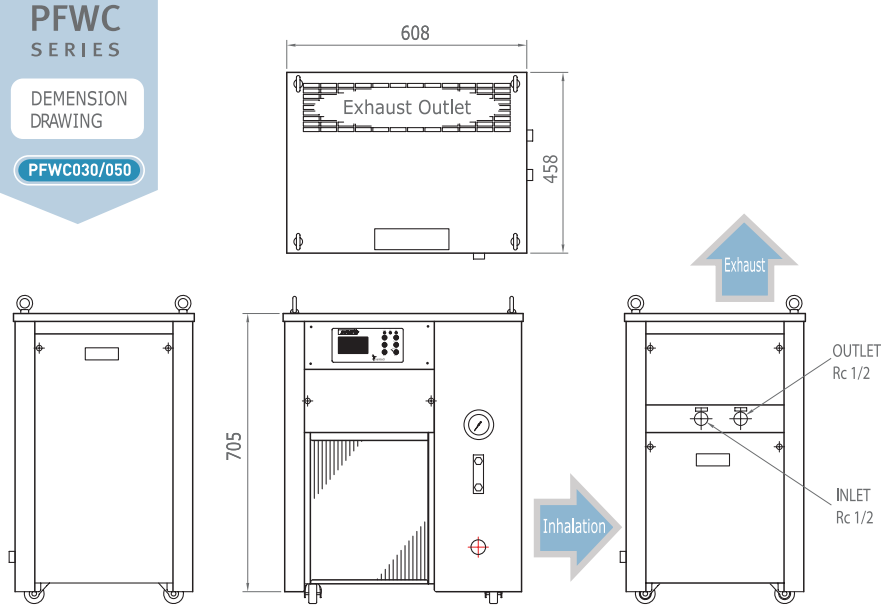
Classification		Unit	PFWC030	PFWC050	PFWC075	PFWC110	PFWC150	PFWC220
Nominal cooling capacity 50/60 [Hz]		kcal/Hr	800/900	1500/1700	2500/2700	3500/3700	7200/7500	7200/7500
Compressor		kW	0.3	0.5	0.75	1.1	2.2	2.2
Motor	Pump	kW	0.33	0.33	0.33	0.33	0.25	0.75
	Fan	kW	0.1	0.1	0.2	0.2	0.2	0.2
Pump discharged fluid flow rate		ℓ /min	10	10	42	42	80	40/46
Temperature control method	Synchronized	℃	-9.9 ~ +9.9					
	Fixed	℃	5 ~ 50					
Temperature range used (inlet fluid temperature)		℃	5 ~ 50					
Voltage specification		Vac	3 Phase 200/220[VAC] 50/60[Hz] Contact our company for special voltage specifications.					
Circuit breaker installation capacity		A	15	15	15	25	25	25
Refrigerant			R407 / R-22					
Viscosity of oil used		cSt	Distilled water + antifreezing liquid (50%:50%), industrial water (Note 2)					
Pipe standard	Inlet/Outlet	inch	Rc ¾" / Rc ¾"			Rc 1" / Rc 1"		
Exterior dimension	W×H×D	mm	Refer to the exterior diagram.					
Oil tank capacity		ℓ	10	10	40	40	40	45
Weight		kg	60(70)	65(75)	80(120)	120(160)	(160)	150(195)
Safety protection mechanism			High · Low pressure detector, excess current detector for motor protection, circuit breaker, reverse phase detector, thermal for compressor protection *Level S/W *Flow S/W					

Notes) 1. ( )denotes the weight including liquid weight inside the tank.
2. Be sure to consult with us in advance when you use industrial water
3. The above specification is subject to change according to circumstances within the company.
4. Rc is the ISO standard name for PT female screw.
5. * indicates option.

PFWC SERIES

DEMENSION DRAWING

PFWC030/050

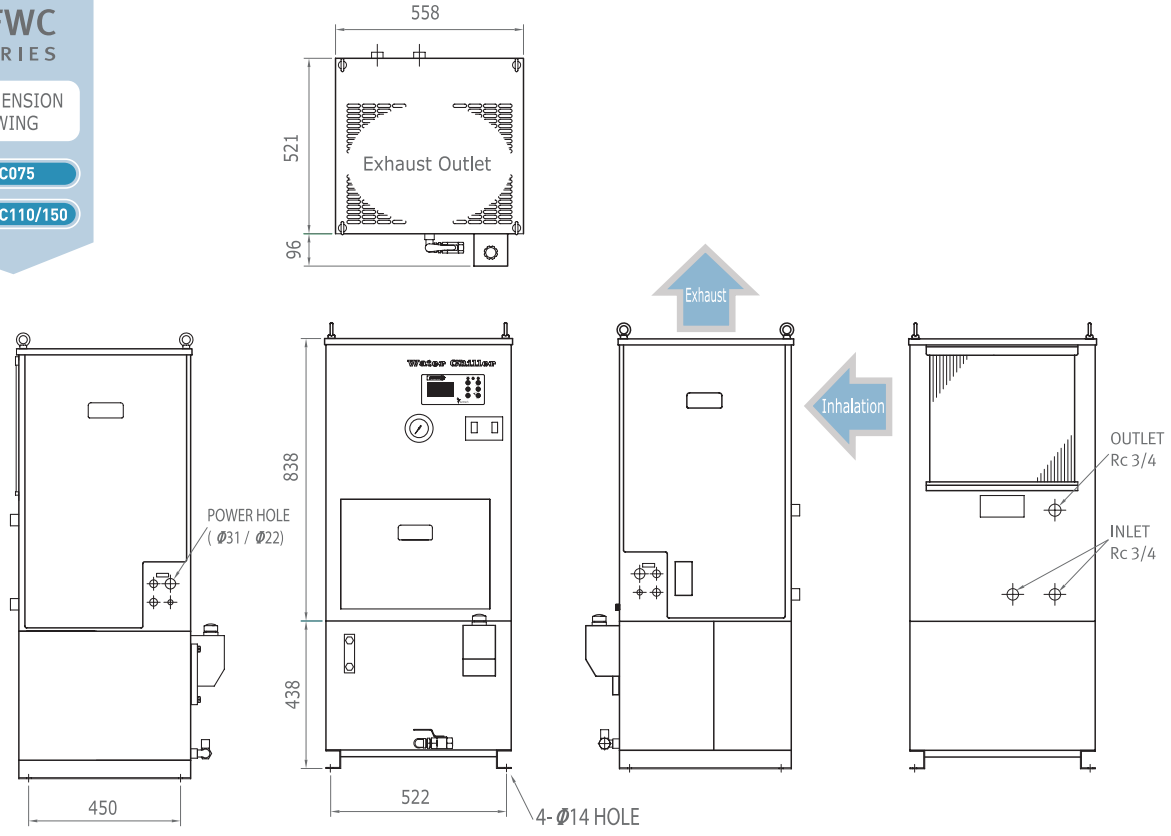


PFWC SERIES

DEMENSION DRAWING

PFWC075

PFWC110/150



PROFLUID
COOLANT CHILLER UNIT

Ⅰ Special Features

As a sub tank integrated type, installation and use is possible regardless of machine tool manufacturer

- Environmentally-friendly refrigerant R407C applied in all units
- Durability & stability achieved
  Applying 3 Phase Rotary Compressor to overall models
- High accuracy achieved (±0.5℃) for coolant temperature control
- LCD Digital Controller Mounted (Supporting Korean and English)
- All units CE (European Conformity) mark certified
- Various specification options available such as heater, cycle pump, coolant, level check, fluid flow rate check and operation hour setting
- Supporting the function to be indicated in Korean and English-Easy maintenance and control
- Responding to user requested items with rich model lineup, various product development and design capability

Ⅱ Technical Data - Coolant Chiller

Classification		Unit	PFCC075	PFCC110	PFCC150	PFCC220
Nominal cooling capacity 50/60 [Hz]		kcal/Hr	2500/2700	3500/3700	4900/5300	7200/7500
Compressor		kW	0.75	1.1	1.5	2.3
Motor	Pump	kW	0.18	0.18	0.18	0.18
	Fan	kW	0.2	0.2	0.2	0.2
*Pump discharged fluid flow rate		ℓ /min	70	70	70	70
Temperature control method	Synchronized	℃	-9.9 ~ +9.9			
	Fixed		5 ~ 50			
Temperature range used (inlet fluid temperature)		℃	5 ~ 50			
Voltage specification		Vac	3 Phase 200/220[VAC] 50/60[Hz] Contact our company for special voltage specifications.			
*Heater capacity (optional)		kW	1	2	3	3
Circuit breaker installation capacity		A	15	25	25	25
Refrigerant			R407 / R-22			
Application liquid to be cooled			Water-soluble & water-insoluble, cutting fluid, grinding oil(NOTE 3)			
Pipe standard	Inlet/Outlet	inch	Rc 3/4"		Rc 1"	
			2" HOSE NIPPLE		3" HOSE NIPPLE	
Exterior dimension	W×H×D	mm	Refer to the exterior diagram.			
Oil tank capacity		ℓ	85	120	120	180
Weight		kg	100(185)	130(250)	130(250)	150(330)
Safety protection mechanism			High · Low pressure detector, excess current detector for motor protection, circuit breaker, reverse phase detector, thermal for compressor protection *Level S/W *Flow S/W			

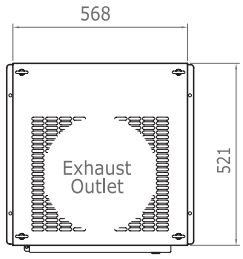
Note) 1. ( )denotes the weight including liquid weight inside the tank.
2. The above specification is subject to change according to circumstances within the company.
3. Be sure to consult with us in advance when you use industrial polishing oil.
4. For water-insoluble cutting fluid, viscosity should be less than 30 cSt.
5. Rc is the ISO standard name for PT female screw.
6. *indicates option.

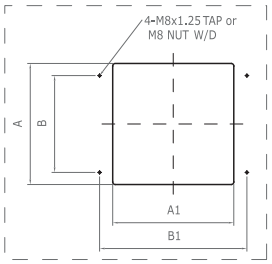
PFCC SERIES

Direct Submerging Type

DEMENSION DRAWING

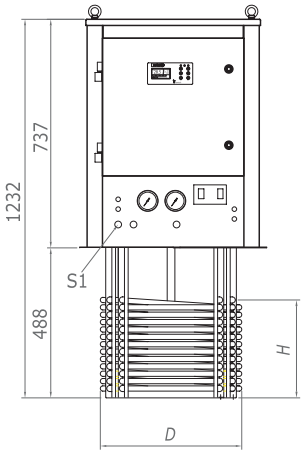
- PFCC075
- PFCC110/150
- PFCC220

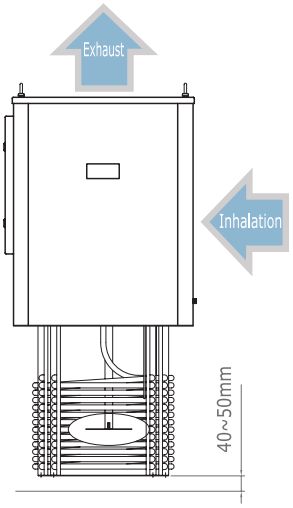


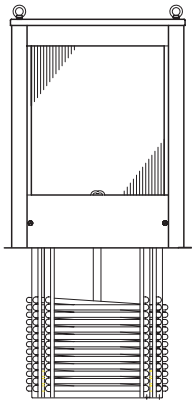


Processing Dimensional Map for Mounting Main Body

MODEL NO.	D	H	S1	A	A1	B	B1
PFCC075	382	273	ø28	500	440	384	486
PFCC110/150	440	319	ø22	480	480	440	319
PFCC220	448	288	ø34	480	480	440	319





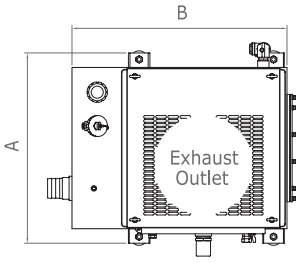


PFCC SERIES

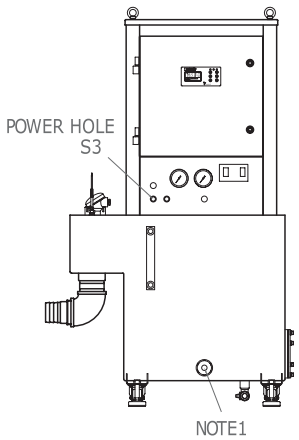
Sub Tank Type

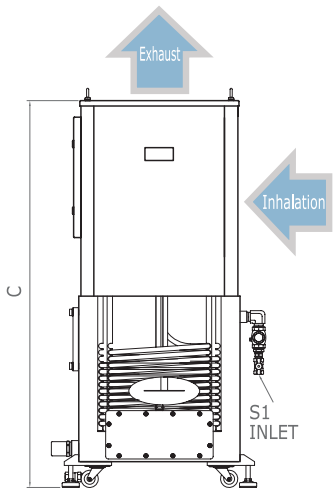
DEMENSION DRAWING

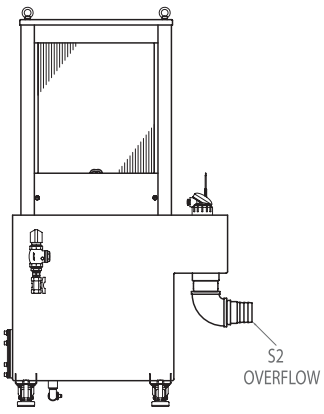
- PFCC075
- PFCC110/150
- PFCC220



MODEL NO.	A	B	C	S1	S2	S3
PFCC075	736	709	1440	Rc3/4″	Rc2″	ø28
PFCC110/150	708	800	1440	Rc3/4″	Rc3″	ø22
PFCC220	708	800	1636	Rc3/4″	Rc3″	ø34







HIGH PRESSURE COOLANT SYSTEM

Ⅰ Necessity of High Pressure Coolant

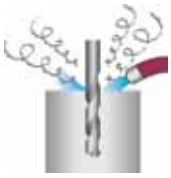
Recent interest on high pressure fluid grew as machine tools tend to become high speed and high precision.
Low pressure (below 14kgf/㎠) cutting fluid is blocked by the vapor barriers created by machine tool's cutting speed. It loses cutting fluid function before it enters the cutting zone because of evaporation.
On the other hand, high pressure (over 20kgf/㎠) cutting fluid can reach the cutting zone to achieve the following :

1. Smooth lubrication and cooling effect
2. Improvement in cutting capability
3. Improvement in tool lifetime by removing the phenomenon of chip re-cutting
4. Improvement in cutting surface roughness
5. Smooth chip removal effect
6. Deburring effect
7. Smooth cutting and cutting capability improvement in special processes such as deep hole processing and difficult-to-cut material processing

In case 70kgf/㎠ high pressure cutting fluid is used in the cutting of difficult-to-cut materials, the tool manufacturer test shows the following results compared with the use of common cutting fluid.
1. 20% reduction in cycle time because of an improvement in cutting speed and feed
2. 50% improvement in tool lifetime

Ⅱ Hole Processing (Drilling, Boring and etc.)

Low Pressure Cutting Fluid / Flood Coolant



- Cutting fluid cannot reach a processing point and almost not cutting fluid is supplied to the tool.
- Peck cycle is used because chip discharge is difficult.
- Re-cutting often occurs because thread like chip surrounds the tool and tool holder.

High Pressure Cutting Fluid / Through Tool Coolant

- Cutting fluid is supplied to a processing point at the highest pressure.
- Chip is discharged effectively from a deep hole by reflected pressure and cutting fluid.
- The drill can perform more difficult processing therefore reducing work hour. The tool's lifetime is significantly increased compared with the use of low pressure cutting fluid.

Ⅲ Turning

High Pressure Coolant

- Highly reduced heat zone is created through the direct spray of cutting fluid to a processing point.
- Cutting hydraulic wedge effect can be produced depending on the usage. Wearing of the tool is reduced by cooling the contact zone between chip and tool.
- Cutting chip into small pieces increases chip discharging capability. This prevents re-cutting by chip and increases tool lifetime.

Ⅳ Application

Machining Center

Application - Tool

Main spindle · Tool penetration

- Vertical machining center
- Horizontal machining center
- Tapping center
- Gun drilling M/C
- Boring M/C, special purpose machines

CNC Lathe / Automatic lathe

Application - Tool

- Difficult-to-cut material processing
- Low carbon steel processing
- Steel material processing on a vertical lathe

HIGH PRESSURE COOLANT SYSTEM

Ⅰ Sub Tank Type (PFF70-15 / PFF70-25 / PFF70-25S)

As a product that has a cutting fluid tank, automatic operation is possible using the machine body and interface and independent operation is also made possible.

Specifications	Unit	PFF70-25	PFF70-15	PFF70-25S
Fluid flow rate (Discharge + Bypass)	ℓ /min	25	13	25
Motor	kW	5.5	3.7	5.5
Voltage specification / 3 phases	VAC	220/440	220/440	
Current value	A	19/9.3	12.9 / 6.5	19 / 9.3
Frequency	Hz	50 / 60	50 / 60	
Inlet pipe standard	inch	Rc 1	Rc 1	
Outlet pipe standard	inch	R 1/2	R 1/2	
Maximum pressure used	Bar	70	70	
Standard orifice diameter	ø (mm)	2.5	1.5	2.5
The number of filters	EA	4	4	
Filter accuracy	㎛	10, 25, 50	10, 25, 50	
Tank capacity	Liter	140	180	
Exterior size	W×L×H	550×1150×1600	600×1200×1280	
Weight	kg	327	272	
Standard color		Light Gray	Light Gray	

- Consult with our company for special voltage specifications.
- The above specifications are subject to change according to circumstances of the company.
- The maximum pressure is based on the standard orifice.
- R is the ISO standard name for male screw, and Rc for female screw.
- Flow means the outlet flow at the maximum pressure.

Ⅱ Dual Vessel Type (PF70-20DF / PF70-30DF)

When the differential pressure sensor notifies the replacement period of the bag element in the dual vessel type, conversion to a different vessel is made using the level and then the bag element can be replaced without stopping the machine.

Specifications	Unit	PF70-20DF	PF70-30DF
Fluid flow rate (Discharge + Bypass)	ℓ /min	17	25
Motor	kW	3.7	5.5
Voltage specification / 3 phases	VAC	~~3PH~~ 220VAC	
Current value(50/60Hz)	A	15.5/14.1	23/21.1
Frequency	Hz	50 / 60	
Inlet pipe standard	inch	Rc 3/4	
Outlet pipe standard	inch	R 1/2	
Maximum pressure used	Bar	70	
Standard orifice diameter	ø (mm)	2.0	2.46
The number of filters	EA	2	
Filter accuracy	㎛	5, 10, 25, 50, 100	
Exterior size	W×L×H	700×940×1340	
Weight	kg	285	300
Standard color		Light Gray	

- Please consult our company for special voltage specifications.
- The above specifications are subject to change according to customer's circumstances.
- The maximum pressure is based on the standard orifice.
- R is the ISO standard name for male screw, and Rc for female screw.
- Flow means the outlet flow at the maximum pressure.

Ⅲ Single Vessel Type (PF70-15SF / PF30-20SF / PF20-20SF / PF15-30SF)

It includes one vessel and the big element replacement period can be figured out using the differential pressure sensor.

Specifications	Unit	PF70-15SF	PF30-20SF	PF20-20SF	PF15-30SF
Fluid flow rate (Discharge + Bypass)	ℓ /min	14	13	13	25
Motor	kW	3.7	1.5	1.5	1.5
Voltage specification / 3 phases	VAC	220-380-440			
Current value(50/60Hz)	A	11/10	7.7/7	7.7/7	7.7/7
Frequency	Hz	50 / 60			
Inlet pipe standard	inch	Rc 3/4			
Outlet pipe standard	inch	R 3/8″		R 1/2″	
Maximum pressure used	Bar	70	30	20	15
Standard orifice diameter	ø(mm)	1.5	1.5	2.0	2.46
The number of filters	EA	1			
Filter accuracy	㎛	5, 10, 25, 50, 100			
Exterior size	W×L×H	360×800×1355			
Weight	kg	110	105	105	105
Standard color		Light Gray			

- Consult with our company for special voltage specifications.
- The above specifications are subject to change according to customer's circumstances.
- The maximum pressure is based on the standard orifice.
- R is the ISO standard name for male screw, and Rc for female screw.
- Flow means the outlet flow at the maximum pressure.

Ⅳ Vessel Filter (MCF)

Since the differential pressure sensor is attached, the replacement period of the bag element can be automatically detected. (Interface with the machine body is possible)

Specifications	Unit	MCF
Fluid flow rate	ℓ /min	100
Inlet pipe standard	inch	Rc 3/4
Outlet pipe standard	inch	Rc 3/4
Maximum pressure used	Bar	0~20
The number of filters	EA	Single/Dual
Filter accuracy	㎛	5, 10, 25, 50
Weight	kg	38
Standard color		Light Gray / Dark Gray

- R is the ISO standard name for male screw, and Rc for female screw.

PROFLUID
MF SERIES

Ⅰ High Pressure Coolant System

For processing problem, chip blocking in automation process, etc. you can solve them by using high-pressure cutting oil now!

Low-pressure cutting oil (14㎏f/㎠) is not able to pass through cutting heat curtain that take place from high-speed rotation processing being evaporated before reaching cutting area, which may not serve its proper function as a cutting oil.

Especially for CNC lathe and automatic lathe requiring high-precision, processing of the materials difficult to cut, complex processing, high-speed processing for muilti-product, it is necessary to use high-pressure cutting oil now!

Improvement in chip-treatment capacity

High pressure cutting oil system enables smooth chip treatment in complex processing of the materials difficult to cut and automation process. Especially high-pressure cutting oil exceeding 70㎏f/㎠ is effective in cutting the chips and discharging them.

Improvement in cutting speed

- Improved in general steel material and the materials difficult to cut by 20%

Improvement in tool life

- Improved in the process from rough grinding to finish grinding by 50%

Ⅱ Advantage of MF Series High Pressure Coolant System

Hole Processing / Through Tool Coolant

- Supplying cutting oil to the point for processing at maximum pressure
- Discharging chips effectively through the hole in the processing of the material difficult to cut
- Extending tool life and improving cutting condition in the processing of deeper hole with diameter to be grinded

Turning / High Pressure Coolant

- Directly spraying cutting oil at the processing area so as to reduce the occurrence of thermal zone in large scale
- It enables to generate wedge effect by the pressure of cutting oil, and reduce wear of tool by cooling the contact area between chip and tool
- Improving the discharge of chip by cutting chips into small pieces so as to prevent re-cutting by chip, and subsequently improving roughness and enhancing the life of tool

Ⅲ Characteristic of MF Series High Pressure Coolant System

Safety and Convenience

- Adopting Sub Tank (Clean Tank) and Level Switch for continuous use in smooth manner
- Applying low-noise high-pressure pump with high durability
- Attaching Solenoid Valve for reasonable use of cutting oil
- Ergonomically designed construction

Continuous Use

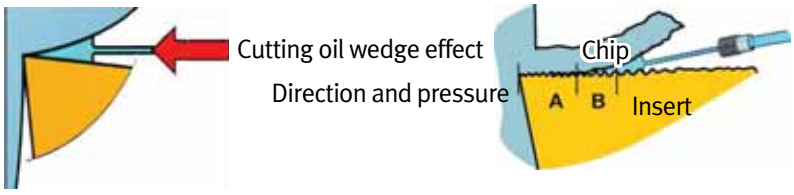
- Dual type filter attached enables its conversion into stand by filter through conversion lever manipulation when replacing filter; Filter replacement without the suspension of machinery/system enables continuous use of machinery and automation.
- Sensor is attached, which automatically marks the time for filter replacement.
- Function of filter automatic-conversion; Option of Discharge Port Sol. Valve (Max. 8 Ports) can be selected

Ⅳ Application of MF Series High Pressure Coolant System

CNC Lathe/Automatic Lathe

- Improving processing speed in precise and complex processing of the material difficult to cut
- Discharging chips smoothly in the processing of gun drill for small diameter
- Separating and discharging chips easily from material, chuck or automated device in narrow space so as to enable automation process such as Bar Feeder.
- Adopting the specification proper for CNC lathe and automatic lathe for convenient use

Wedge effect by cutting oil pressure



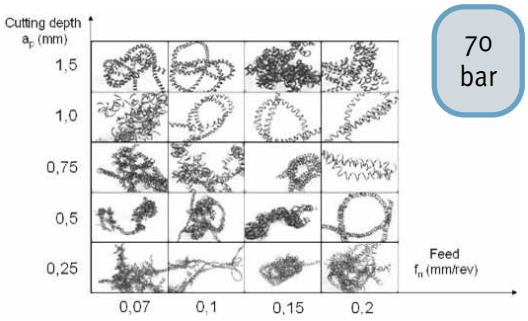
Small-type Machining Center, Tapping Center

- Filtering & high pressure coolant system at economic price that is suitable for small type machining center, tapping center
- In the case of using the machinery in cell form in continuous processing or automated line, it enables continuous operation without the stoppage of machinery or line
- Suitable for the general process for Steel, Al, etc. (Drilling, Milling, Tapping, etc.)
- In the case there are many fine chips in magnetic property such as casting process, etc. it would be efficient with magnetic filter used for pre-filter.
- In the process having many fine chips, the effect may be reduced.

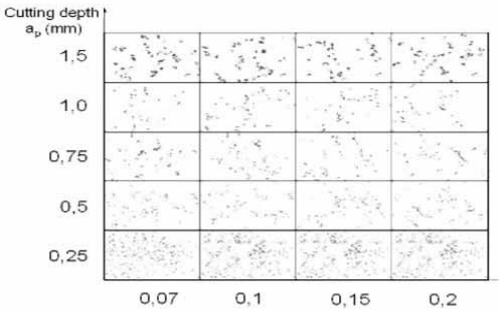
PROFLUID
MF SERIES

Result of Chip Control Test when High-Pressure Cutting Oil is used in CNC Lathe(Titanium-Ti6A14V, HRC30)

Pressure of general cutting oil



70 bar



(CNGP 120408 H13A-V_c=60m/min)

Technical Data - MF Series

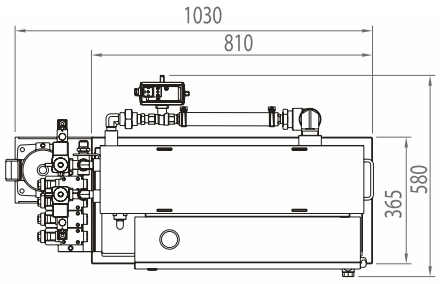
Specifications	Unit	PFMF 30-20	PFMF 70-15	PFMF 120-10	PFMF 200-10
Max. Outlet Pressure	kgf/㎠	30	70	120	200
Flow (Discharge + Bypass)	LPM	13	14	9	9
Motor	KW	1.5	4.0	4.0	7.5
Voltage Specification/3 Phase	VAC	220 / 380			
Current Value	A	7.0 / 4.0	14.6 / 8.4	14.6 / 8.4	28 / 15.5
Frequency	Hz	50 / 60			
Inlet Side Piping Specification	inch	Rc 1/2			
Outlet Side Piping Specification	inch	Rc 3/8 JIS			
Overflow Piping Specification	inch	Rc 1-1/2			
Max. Operating Pressure	Bar	30	70	120	200
Standard Orifice Diameter	ø(mm)	1.5	1.5	1.0	1.0
Max. SOL Quantity Attached	EA	4/8	4/8	4/8	3
Quantity of Filter	EA	2			
Grade of Filter	㎛	10, 25, 50			
Tank Capacity	Liter	80			90
External Size	W × D × H	1030×580×1340			1070×580×1420
Weight	kg	160	173	173	190
Standard Color		Light Gray			

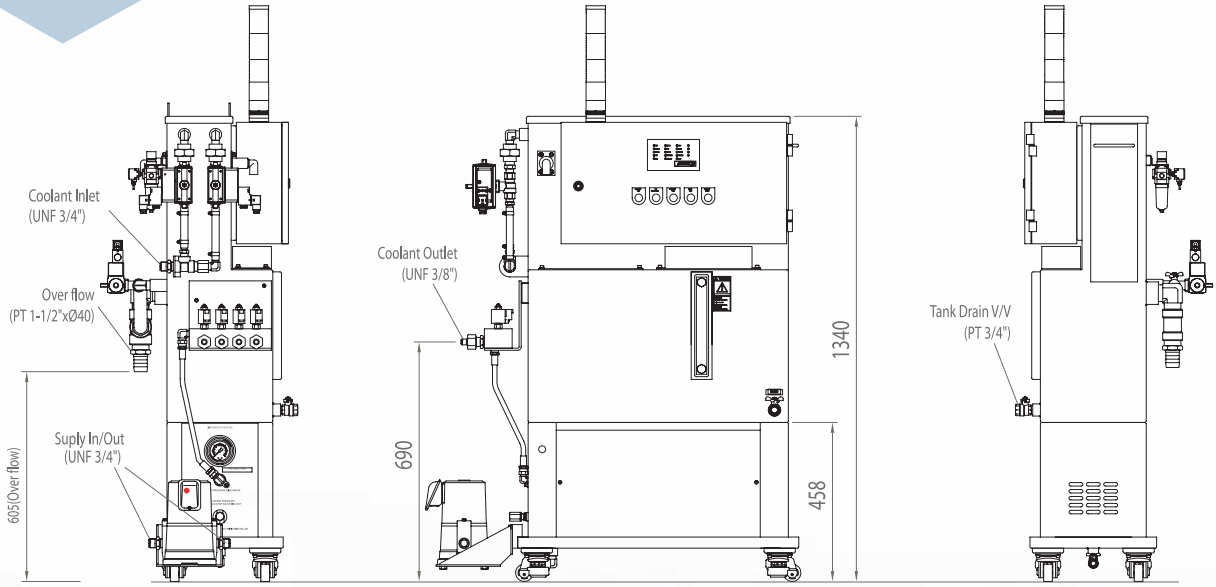
- Flow means the flow at maximum pressure.
- Max. pressure is based on Standard Orifice.
- Be sure to consult with us for special voltage specification.
- The afore-mentioned specification is subject to change depending on the company's circumstance.
- R and Rc mean the codes of ISO standard for PT male screw and PT female screw respectively.

PFMF SERIES

DEMENSION DRAWING

- PFMF30-20
- PFMF70-15
- PFMF120-10
- PFMF200-10





PROFLUID
MAGNETIC FILTERING SYSTEM

Ⅰ Magnetic Filtering System

It adopts rare earth magnet (Nd-Fe-B Magnet) that is high magnetic permanent magnet having extremely high coercive force and residual induction compared with the material of permanent magnet developed so far.
For the processing of the part material having magnetic property or its washing process;

- It addresses filtering of chip up to 98%
- It even filters and separate fine chip or sludge in 5㎛.

This system incorporates;

1. Magnet filter that separates fine chips with 12,000 gauss
2. Sludge conveyor that separately collects sludge for sedimentation and separation
3. Bag filter that separates non-magnetic material that pass through magnetic filter
4. High-pressure cutting oil device that stores clean fluid and then let it out in proper pressure through high pressure pump.
   In addition, each unit built in modular type can be used independently.

Ⅱ Effect of Magnet Filtering System

Magnetic Filtering System

1. When it is used for pre-filtering, it reduces the number of bag, paper and cartridge filter being used and minimizes the time of machinery and device being suspended, and finally improves the operation ratio.
2. It is used for the next process of Paper Filter, Bag, or Cartridge Filter, which is suitable for fine chip filtering, and improves durability and reliability for the function of machinery.
3. It requires almost no consumable parts. It reduces the use of consumable filter resulting in cost saving and the increase of cutting oil life and cleaning cycle of tank as well.
4. It requires small area for installation, and can be maintained in easy and simple manner.
5. It provides a variety of options, and enables separate discharge of the chips used, and connection with high-pressure cutting oil system.

Ⅲ Characteristic, Advantage and Application of Magnet Filtering System

Characteristic/Advantage

1. It requires rare consumable parts and is almost maintenance-free. It improves operation ratio by reducing the stoppage of machinery due to frequent filter replacement.
2. Its compact size enables to be installed even in a small space.
3. It enables automatic backwashing of filter.
4. It doesn't require any separate tank or pump when installed at the line.
5. It remarkably reduces maintenance of pump, valve, slid, cover, spindle used in the machine or device improving the reliability for the system.
6. Quality of filtering is excellent. - Max. 5㎛
7. Magnetic filter is solely adopted, it may not provide perfect filtering function.
   -This system ensures to provide its filtering up to 98%.

Application

Magnetic filter can be used in the process that adopts chips with magnetic property.

1. With filter being is use, it doesn't cause change in the property of cutting oil.
2. When it is used for pre-filtering, chip can be filtered up to 98%, resulting in epoch-making increase in the life of paper, bag or cartridge filter.
3. It may filter fine chips when used in the next process of paper, bag, or cartridge filter preventing the phenomenon that chips are accumulated on inside of machinery or part, etc., finally reducing the requirement of maintenance.
4. It extends life of cutting oil and cleaning cycle of tank as well, while saving the cost
5. Backwashed sludge can be discharged through sludge conveyor (option) in the form of chip separated from moisture.
6. Clean fluid filtered can be stored in a separate tank and used in connection with high pressure cutting oil system through high pressure pump. High pressure cutting oil system with 20 bar up enhances productivity up to approx. 30% and increases life of tool by twice depending on its usage.

- Independent use of magnetic filter may result in incomplete filtering.
- Connection of cartridge filter at front and rear parts may improve filtering effect or reduce the use of consumables, resulting in improvement of operation ratio and saving of the cost

PROFLUID
MAGNETIC FILTERING SYSTEM

Ⅳ Technical Data - Magnetic Filtering System

Specifications		Unit	PROMAG-45	PROMAG-100
Flow Rate (Max.)		ℓ /min	45	100
Magnetic power		Gauss	12,000	12,000
Filtering Level (Max.)		%	98	98
Filtering Degree (Max.)		㎛	5	5
Solenoid Valve Power Source		V	DC24	DC24
Max. Operating Pressure		MPa(kg.f/㎠)	0.7 (7)	0.7 (7)
Static Test Pressure		MPa(kg.f/㎠)	1.0 (10)	1.0 (10)
Max. Operating Temperature		℃	75	75
Air Pressure	Min. Pressure	MPa(kg.f/㎠)	5	5
	Max. Pressure	MPa(kg.f/㎠)	8	8

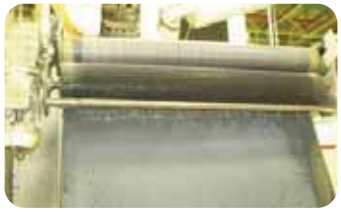
Ⅴ Modular of Magnetic Filtering System

Magnetic Filter
(Pre filter)

Magnetic Filter+Sludge conveyor
(Pre filtering system)

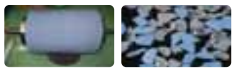
Magnetic Filtering System
(Filtering+Hign pressure coolant)

VI Examples of Magnet Filtering System Application



Clean tank of the cutting oil filtered through paper filter (20㎛)

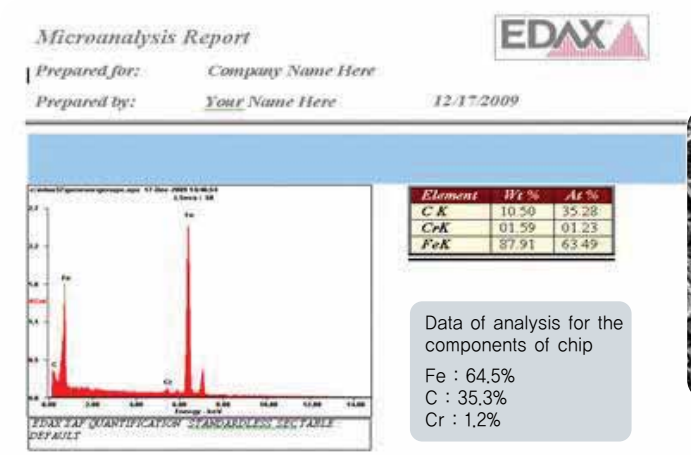
Gear Grinding M/C & Tool Specification

Specification	Ceramic(A120JV6501)
Shape	
Main Components	– Aluminlumoxide + Ceramic 30% – Manufacturer : 3M, Norton
Heat Treatment	– Sintering treatment at the temperature of fusing point or less
Characteristic	– Heat-resistant, Wear-resistant, High-strength – Weak brittleness, High metal-affinity – Weak in impact and vibration – Excessive heat generation during processing time (Multi-particles, less processing) –› Excessive falls of particles

Chip filtered through paper filter

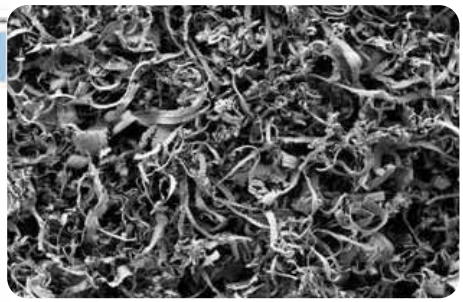
Evaluation of magnetic force of magnet

Pumping in Clean Tank
⬇
Separate Discharge of Chip



Data of analysis for the components of chip

Fe : 64.5%
C : 35.3%
Cr : 1.2%

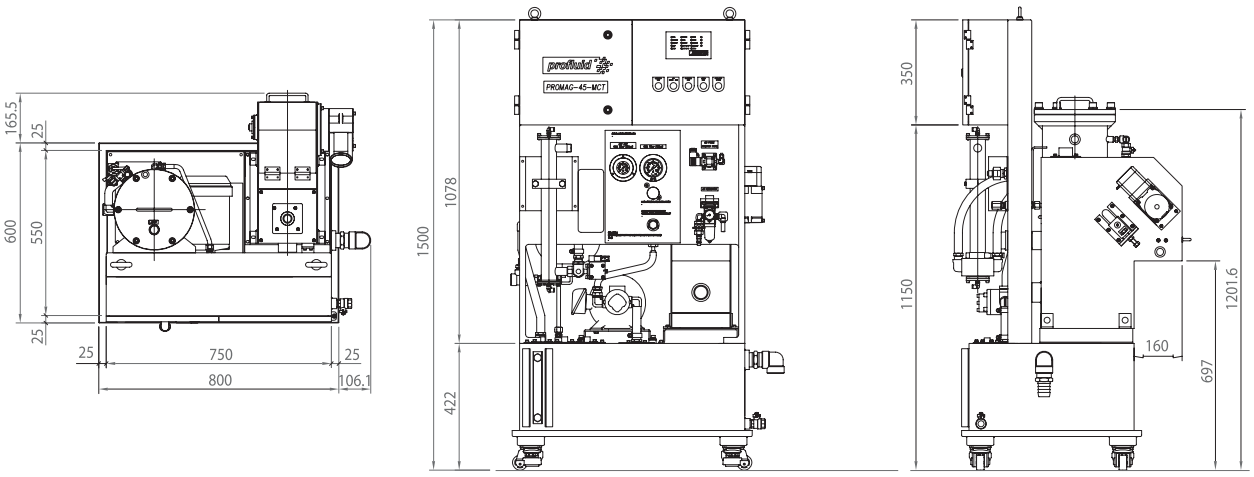


Data of analysis for the components of chip discharged through magnetic filter and the feature of chip expanded

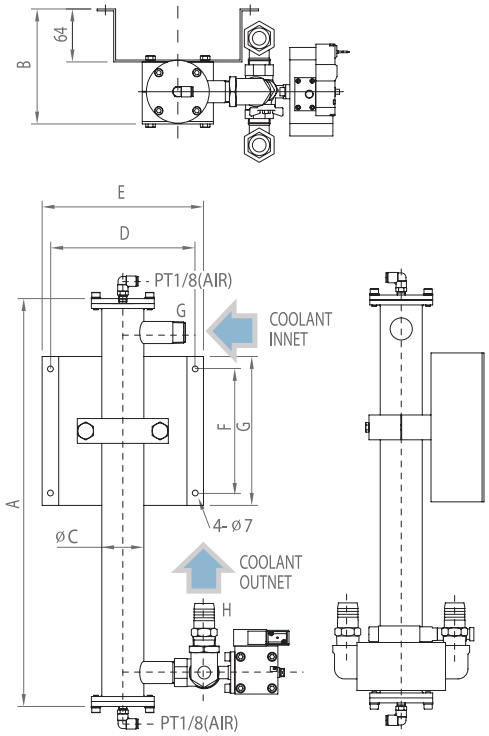
PROFLUID
MAGNETIC FILTERING SYSTEM

VII Drawing

External Figure of PROMAG-45MCT

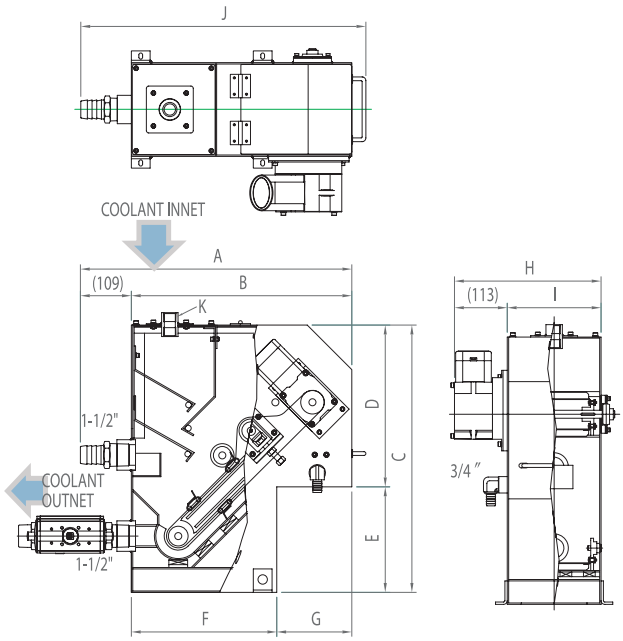


External Figure of Magnetic Filter



MODEL No.	A	B	C	D	E	F	G	H
PROMAG-45	493	139	ø50.8	155	195	150	180	3/4″
PROMAG-100	579	210	ø89.1	170	220	150	210	1-1/4″

External Figure of Sludge Conveyor



MODEL No.	A	B	C	D	E	F	G	H	I	J	K
PROMAG-45	579	470	570	345	225	310	160	313	200	608	3/4″
PROMAG-100	759	650	650	375	275	480	170	513	400	680	1-1/4″

PROFLUID
UTILITY CABINET SYSTEM

I Utility Cabinet

Utility Cabinet is the system incorporated in one cabinet that supplies the entire utilities used for the machinery to meet the requirement of milling machinery manufacturer.

- Joint design enables to reduce the design period of machinery,
- It ensures reduction of the time for production and reliability of components by modular system and specialization.

Units that can be constructed

- Hydraulic Unit (Tank & Manifold assembly)
- Pneumatic System (with Air purge & Measuring system)
- Lubrication (Guide way & Spindle bearing)
- Coolant System (Centralized or Independent, Sub Tank System)
- Coolant Filtering (Automatic Filtering System & Cartridge filter)
- High-pressure cutting oil system (20, 30, 60 bar or more)
- Chiller system (Spindle, Index table Cooling & Hyd' tank, Electric box cooling)

Abundant and various experiences in the manufacture of milling machine

- A variety of machining center
- CNC Lathe
- Diverse exclusive machines and automated design
- Mechanical and electronic design

DESIGN is kemtech

Specialized production in a variety of units and agency activity

- Pioneer in the production of high-pressure cutting oil system
- Specialized production in chiller
- Automatic Filter: Hydac / Mahle
- High-pressure Pump : SKF / Sumitomo

PROFLUID
UTILITY CABINET SYSTEM

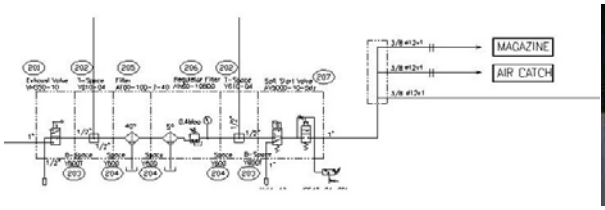
Ⅱ Major Design Points in the Utility of Machinery

Design of the system for supplying and filtering high-pressure cutting oil

- Cutting oil can be supplied through independent, centralized and sub tank, etc. It requires clear information on pre-filtering, pressure and flow-rate in each process.
- Sudden On/Off and change in direction of high pressure cutting oil may result in water hammer causing vibration to piping or machinery.
  - Piping design in consideration of water hammer
  - Design that avoids the blockade of flow path caused by sudden operation from jig / fixture (Locating pad, etc.)
- High pressure cutting oil pump in operation
  - It requires meeting the filtering degree required by the pump and the standard of chip contents
  - When the inlet pressure and back pressure exceeds the required level, it may result in reduction of pump life, especially the damage to seal.
- Degree of filtering of cutting oil should be selected depending on the operation condition of the machinery, which must considers;
  - Degree required by mechanical seal of spindle and rotary joint
  - Degree required by the devices in operation such as blockade in flow path inside the machinery, solenoid V/V, etc.
  - Degree required in consideration of processing work
  - Waching of reference surface and seat of the work where coolant is used to be checked.
- Selection of Filter
  - To be selected properly for its usage (Degree/flow required, Processing work, whether it has magnetic property or not, Contents of material)
  - Maintenance that enables automation or continuous use, Cartridge replacement, Reduction in throw away parts)
  - Size of pressure required to be let in,
  - Method of drain or back flushing, and method of separating chip from sludge

Design of Air Pressure Circuit (Safety)

- **Safety for compression should be ensured.**
  - Preventing safety accident in supply system due to careless construction of the removal of residual pressure (OHSA Regulation)
  - Constructing the soft start-up circuit that interrupts low-speed supply or interrupts supply and then supply metal materials
- **Degree of filtering of each element, Countermeasure of contamination prevention**
  - In the case of compressed air that is supplied to Air Purge, Lubrication (Oil-mist, Oil-air), Linear Scale, etc., it requires a countermeasure against contamination and the degree suitable of filtering.
  - It requires pressure setting suitable for component element and such can be checked so as to interrupt trouble in advance
- **Air Purge**
  - It requires checking if proper pressure exists in each component element, and reviewing piping length, drainage method, etc.



Design of Lubrication System

- It requires using small volume of oil so as to reduce contamination by cutting oil and create clean environment that has rare mist.
  - Requiring compressed air at least exceeding 4 bar with dry and clean condition of 5ß≠ or less
  - System suitable for the rpm of spindle to be selected (Grease, Oil mist, Oil-air)
- **Selection of lubrication oil**
  - Oil with viscosity suitable for the load required by the machinery.
  - When any lubrication oil that generates sediments is used for the purpose of solving other problems, it may reduce the life of the elements such as bearing, etc. due to its disturbance of flow or the particles.
- **Operation of lubrication oil to be checked**
  - It requires applying proper sensor to check the flow of lubrication oil for the safe use of spindle and guide that are the core parts of machinery.
  - Sensor can serve its proper function when the size of pipe diameter and separation distance is met.

Design and Construction of Chiller System

Chiller plays the role of minimizing thermal displacement that takes place in the parts comprising the machinery and then improving preciseness of machinery and durability of its components by matching the temperature of machinery generated during the operation of the machinery with the external air environment of the machinery if possible.

- Exact data of each component element is very important for the design of Chiller.
  - Magnitude of heat generated by the unit such as spindle, index table, etc.,
  - Pressure, flow, etc. of the pump motor used in hydraulic tank, and coolant system become important functions in the design of chiller. It is important to select proper specification that doesnºØt exceed the application if possible.
- Most of the causes of unusual noise from chiller unit take place in the pump, especially from the reason that the piping diameter connected with spindle is too small. Proper sized pipe improves energy efficiency and chiller efficiency as well.
- Fluid adopted in the chiller is used for closed circuit, but it may show the reduction in its function because of filtering problem caused by the phenomenon that fine chips discharged from the machinery or various lubrication oils are mixed resulting in cohesion.
  Therefore, it requires the filtering at the level of approx. 100㎛.
- Chiller is not the product the cause of disorder for which can be easily found and immediate action can be taken.
  - It requires design and production that can minimize the cause of disorder
  - It should be designed so to easily separate and disassemble the unit from the main body of machinery when it is out of order, which may reduce the time for maintenance and improve the operation ratio of machinery.
- Depending on its method of construction, residual thermal source used through the chiller unit can be used for the purpose of reducing the heat of hydraulic unit or electric panel.

PROFLUID
AUTOMATIC FILTERING SYSTEM

Automatic Filtering System is
the product that conducts high-precision filtering granting high operation ratio and continuity with its characteristic that enables to replace filter or maintenance without stopping the operation of equipment of machinery

Ⅰ Effect of Automatic Filtering System

1. Reducing the time for stoppage of machinery or equipment due to the replacement of filter
2. Reduction of maintenance cost
3. Extending the life of fluid
4. Improving the reliability against the function of machinery and equipment
5. Saving the management cost by using the filter in semi-permanent manner
6. Protecting the operator from environmental pollution caused by the operation of machinery and equipment
7. Improving productivity and surface roughness of the processed goods

Ⅱ Main Application of Automatic Filtering System

Industrial field that requires continuity or resource recycling;

1. Device of filtering cutting oil and lubrication oil in metal processing machinery (milling machine)
   - Especially for automobile industry
2. Purification of consumables in the marine transportation fields such as engine oil, fuel, etc.
3. Purification of washing oils of automobile and parts
4. Manufacture of lubrication agent, oil, glue, adhesive, etc.
5. Purification and manufacturing of mixed material, chocolate, bakery batter, fruit juice pulp, etc. or any other fluids
6. Leports, farming, environmental fields

HYDAC INTERNATIONAL

MAHLE

Ⅲ Check Sheet to Select Automatic Filter

Followings are to be checked to select proper filtering system.

- Filtering subject material :
- Operation Pressure (Inlet) : bar
- Degree of Required Filtering : ㎛
- Use of compressed air : bar
- Temperature used for filter : ℃ (Temperature for fluid to be controlled at boiling point or less)
- Filter System Operation : Single Filter □, Dual Filter □, Automatic Filter □, etc( )
- Filter element : To be disposed of after its usage □, Recycling available □, Semi-permanent use □
  Bag □, Wire(Triangular) mesh □, Top mesh □, Fleece-Reinforced SUS □
- Type of cutting (washing) oil : Coolant Emulsion(>8㎟/sec) □, Cutting(>30㎟/sec) □, Oil(>100㎟/sec) □
- Whether filter replacement is available during the operation of machinery :
  Impossible (Line, Continuous Operation) □, Cycle Application □, Stoppage during operation
- Whether cutting (washing) oil is hazardous or not: hazardous □, non-hazardous □, Silicone-family anti-foamer is used □,
  Highly-polluted □, Floating oil □, Reproduction of Bacteria □, etc( ).
- Whether supply pump is in need or not : No need, User's supply, Kemtech's supply, etc.
- Contents of Process to be applied :
- Flow-rate : ℓ/min, ㎥/h
- Degree of Filtering Immediately Before : ㎛, ㎜
- Power source (Power/Control) : V/Hz, V(DC □, AC □)

Ⅳ Factors for calculating the flow to pass automatic filter

Type of material

	steel*	aluminum / magnesium*	grey / nodular-cast iron*
f1	1.0	0.75	

specific filter surface load

* suitability overleaf

Level of separation of chip over the whole process

	central filter unit/pre-filter	chip conveyor/slot sieve/magnet	chip conveyor/perforated plate
	<120㎛	<2mm	
f2	1.3	1.0	0.5

specific filter surface load

Processing process

	Cutting turning, milling, drilling	grinding* SiC, CBN	honing, superfinishing*
f3	1.0	0.6	0.2

specific filter surface load

* suitability overleaf

Material of filter

	wound wire triangular, notched > 80㎛	wire mesh Topmesh > 20㎛	wire mesh Topmesh > 20㎛
f4	1.2	1.0	0.8

specific filter surface load

Type of cutting oil, washing oil

	coolant emulsion > 8 mm²/s	cutting oil > 30 mm²/s	cooling oil > 100 mm²/s
f5	1.0	0.7	0.4

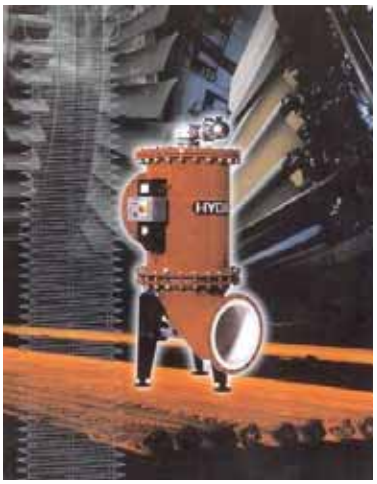
specific filter surface load

NOTE) 1. Floating oil and grease that are let in may badly affect the filtering effect.
2. It requires proper-sized piping and efficient piping to improve filtering effect.
3. Max. passage flow-rate by pipes: 400ℓ /min: 2", 250ℓ /min:1 1/2", 100ℓ /min:1".

PROFLUID
AUTOMATIC FILTERING SYSTEM

HYDAC INTERNATIONAL Auto Back-flushing Filter

AutoFilt® RF3
Automatic Backflushing Filter



Backflushing Filter
AutoFilt® RF4

Overview

The particles of contaminants contained in the system influence on the product quality, and even cause damage by wearing the component of the system (bearing, pump, valve, etc.).

Auto Filt RF3/RF4 is self-cleaning system that separates contaminant particles from the fluid.
It may greatly increase the reliability of the system and reduce maintenance cost. Slitted tube element in conical shape enables high-efficiency filtering and back flushing. Back flushing takes place from differential pressure that is conducted without any stoppage of filtration process in sequence.

- Principle of Back Flushing : Pressure & Flow Velocity (4om/sec) & Vibration (Pulse)
- Main Field of Application
  1. Washing system
  2. Cutting fluid treatment (coolant)
     - coolant main line
     - Protection of High Pressure Pump
  3. Lubricating / fuel oil system
  4. Water treatment system

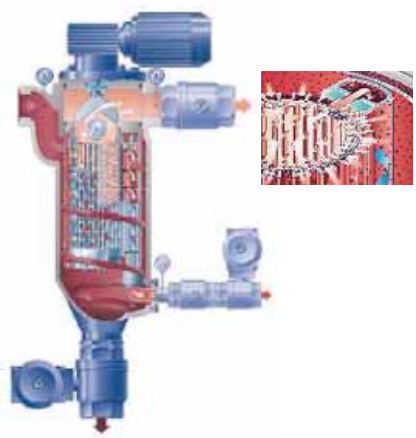
MAHLE

MAHLE Industrial Filters Filtration processes for the metal working industry

AF 133G

- For systems with buffer tank
- Backflush with compressed air or clean fluid
- 5µm.....200µm

AF 113G

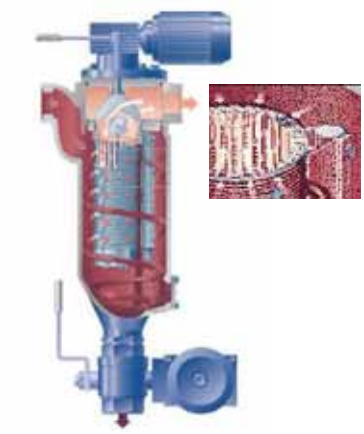


- For systems >3-4bar inlet pressure
- Backflush with clean fluid
- 5µm.....200µm

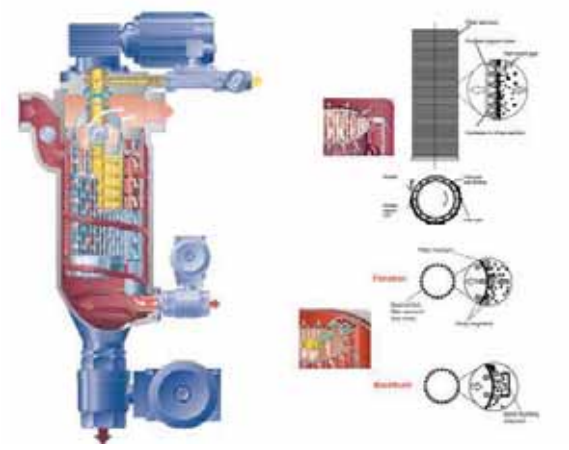
AF 173G

- Continuous outlet flow
- Backflush with compressed air or clean fluid
- 5µm.....200µm

AF 72G



- Continuous outlet flow
- Scraper cleaning
- 30µm.....2000µm



For further details for right selection and use of automatic filter, please refer to the relevant catalog or enquire us to the head office

PROFLUID
OIL SEPARATOR

The oil separator provided by Profluid
can solve all problems caused by tramp oil/tramp solid.

Ⅰ The Effect of Tramp Oil

1. Degradation of machine and tool functions and shortening of tool life (clogging of various filters & nozzles)
2. Foul odor and skin disease to workers caused by the formation of various kinds of bacteria
3. Product failure caused by decomposition and rust occurrence
4. The acceleration of industrial waste production increases environmental costs.

Ⅱ Principle of Removing Tramp Oil

The existing method to separate tramp oil by smearing it on the belt or hose has a problem with efficiency and waste oil handling because a large amount of cutting fluid is mixed and separated. Using the fact that specific gravity varies for different liquids to be separated such as water and oil, Profluid°Øs oil separator uses a principle of the fast speed separation between water and oil through physical dislocation when mixed liquid passes through the filter (media with a large number of pores).

1. The tramp oil along with the cutting fluid is inhaled into the tank using the built-in pump.
2. The cutting fluid inhaled along with the tramp oil passes through the porous filter layer. While the tramp oil passes through the filter that has a large effective specific surface area as line structure without forming inclined surface, particles of the tramp oil are enlarged by speed difference caused by viscous flow and the oil rises to the surface.
3. The floated tramp oil is separated and discharged using specific gravity difference between water and oil.

Special Features of Oil Separator

Superior Separation Capability

The capability of separating only tramp oil without mixing cutting fluid is superior.

Separation by Physical Dislocation and Specific Gravity Difference

Water and oil are separated by the principle of physical dislocation and specific gravity difference using the porous filter.

Compact Oil Skimmer

Since the oil skimmer that inhales oil is compact, it can be used in a standard cutting fluid tank used by a machine company or an existing machine in use without the need for extra modification.

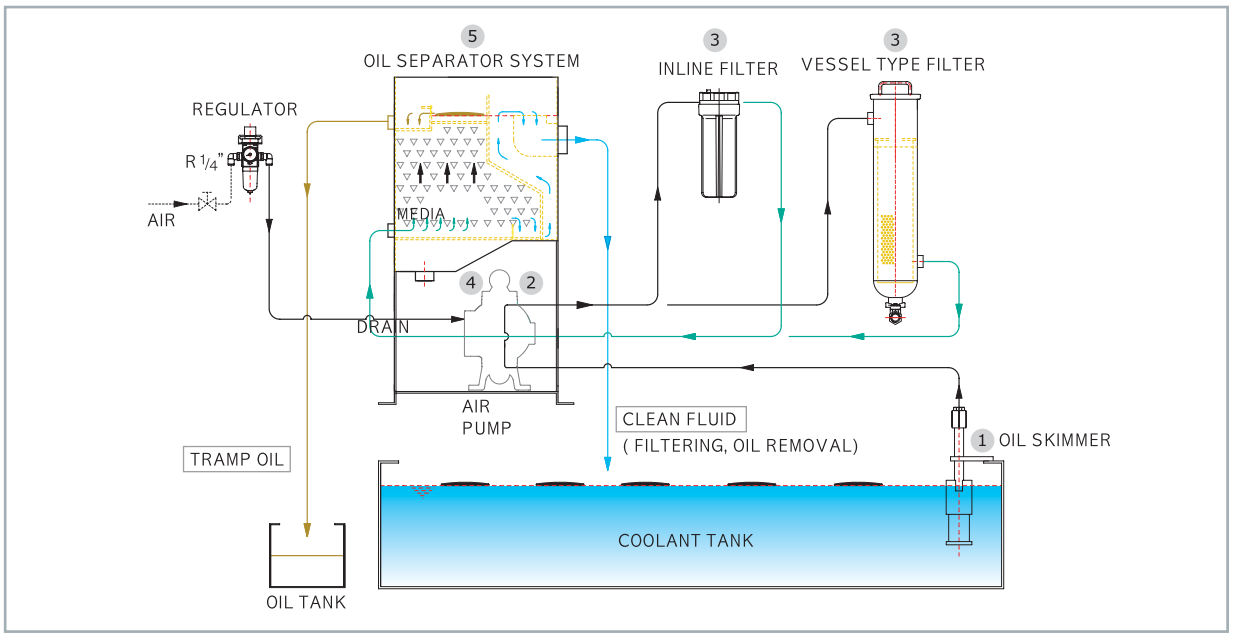
Structure without Electrical Device

It operates by supplying air using the air diaphragm pump without an extra electrical device.

Filtering Function of Tramp Sludge

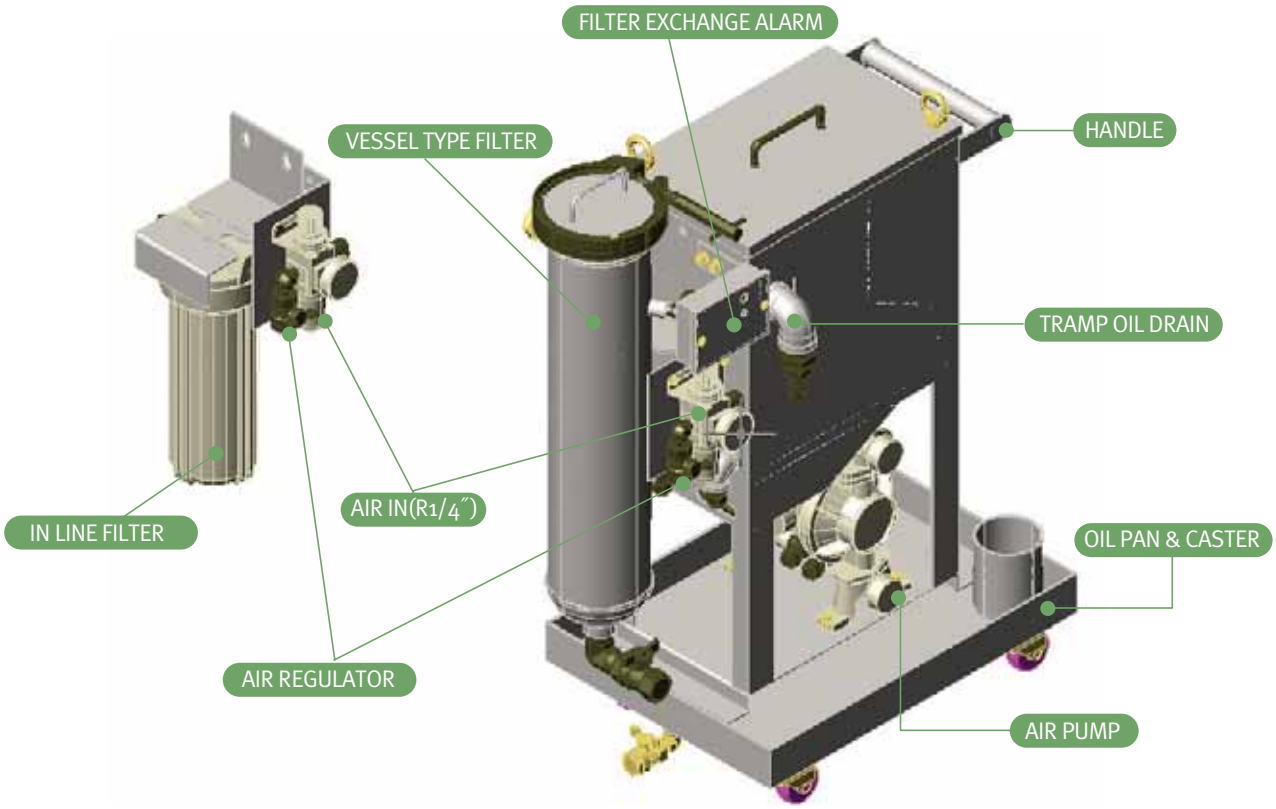
Using the pump in dual mode, it is constructed to filter tramp sludge as well as tramp oil. The filter is washable and reusable. Also, an alarm function that notifies the cleaning period of the filter by the differential pressure sensor is available.

FLOW DIAGRAM



PROFLUID
OIL SEPARATOR

Ⅳ Oil Separator Component Name



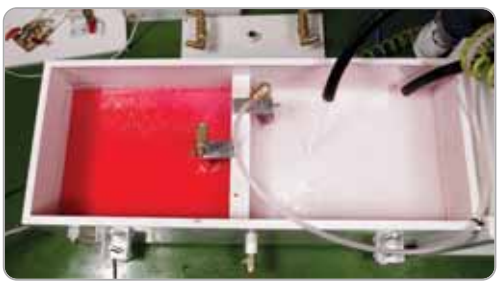

Media


Oil Skimmer


Picture of Separating at the Oil Separator


In Line Filter (Standard)

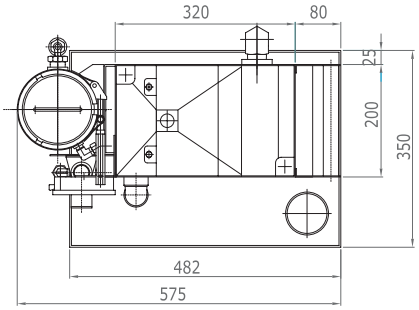

Vessel Filter

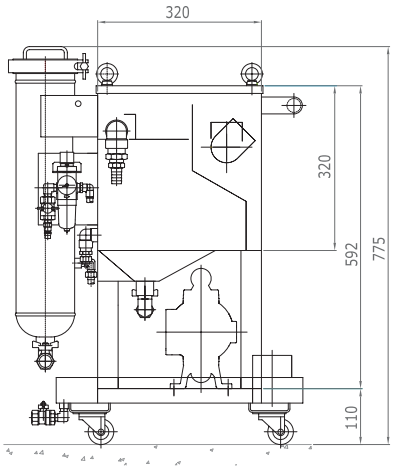

Tank

SPECIFICATION

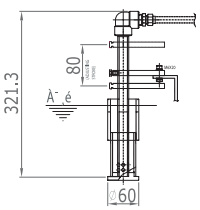
Item		PFOS-40	PFOS-40C	PFOS-40F	PFOS-40CF	Remarks
Application specification	Vessel Filter			○	○	
	Oil pan & Caster		○		○	
Use classification	Fluid state	Tramp Oil		Tramp Oil + Tramp Sludge		
	Portability	–	Portable type	–	Portable type	
Recommended processing capacity		400ℓ / Hour				
Allowed temperature for use		5℃ ~ 65℃				
Pressure	Design pressure	5㎏.f / ㎠				
	Recommended operation pressure	2㎏.f / ㎠				
Inlet Filter	Inline Filter	100 mesh, SUS				Washable & Reusable
	Vessel Filter			100 mesh Bag Filter, SUS		
Floating Skimmer	Size	ø60mm				Patent application certification
	Allowed fluid height difference	50mm (standard specification), handled separately if fluid height difference is big				
	Fixed area adjustment height	100mm (standard specification), handled separately if height is big				
Filter		Porous media				Principle of viscous flow
Pump		Air Diaphragm, standard 3/8" / Dual pumping system				Patent application certification
Weight		25㎏	35㎏	35㎏	45㎏	

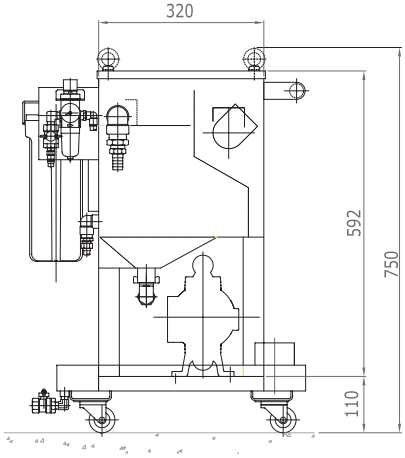
Vessel Filter Type

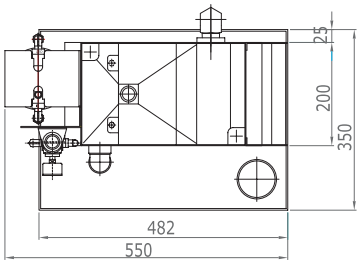




Inline Filter Type







kemtech

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