

DRY COOLERS

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS



Contact:
Address : Organize Deri Sanayi Bölgesi Kazlıçeşme Street No:18 X-12 Özel Parsel
Tuzla 34957 İSTANBUL, TURKEY
Telephone : (0216) 394 12 82
Fax : (0216) 394 12 87
E-mail : info@friterm.com
Web : www.friterm.com

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1. ABOUT THIS MANUAL/GENERAL

This document specifies the instructions for installation, operating and maintenance of the Dry-Coolers (FDH, FDV and FDW models) manufactured by FRITERM A.Ş., Turkey.

The instructions below must be followed strictly for the health and safety reasons during installation and maintenance of products.

Upon receipt, the equipment should be visually inspected, and in case of any damage or fault, the supplier must be notified within 7 days.

The manufacturer will not accept any responsibility in these situations;

- Damages caused by persons,
- Damages equipment due to the disregarding of the recommendations indicated in this handbook.

1.1 Observing the operating manual

To follow the instructions defined in this document is a prerequisite for safety of the staff and for the equipments to be operated in a fault-free and safe manner.

- The operating manual must always be available.
- All persons who are responsible for the transport, assembly, initial commissioning, operating, maintaining or repair of the component must be acquainted with the operating manual. The operator should accept that they are acquainted with the operating manual in writing.
- All requirements and instructions in this operating manual must be complied with.
- The documentation of purchased products is a constituent part of this operating manual. All safety information in this operating manual and all other information must be observed.
- All relevant regulations concerning accident prevention and environmental protection must be complied as well as the confirmed technical regulations for safe and proper working.
- The director is the responsible person who employs the adequate staff for servicing operating and monitoring the system.

1.2 Warranty

- The seller warrants that the equipment delivered to the buyer shows no defects caused by failure of design, material, manufacturing and/or workmanship within the warranty period.
- The buyer must notify in written form within 7 days from the receipt of the goods, any perceptible default including transport damages. For hidden defaults, he must notify the default in written form within 7 days from observation time.
- Unless otherwise agreed, the warranty period shall be 24 months starting from the date of delivery.
- The warranty does not cover defects in the product's operation stemming from a fault in materials or parts provided by the buyer, nor shall it cover an installation that has not been assembled according to the seller's instructions and according to professional practice.
- The warranty shall not cover equipment and/or its accessories if they have been modified by the buyer without seller's written consent.
- The warranty clause can only be invoked by the buyer if the equipment is used normally and conformity with its purpose and seller's instructions.
- The seller's liability hereunder shall be limited to repair, modify or replace the parts or equipment that shows defect within the limitation of the items under this article.
- The warranty period of the repaired or modified or replaced parts or equipment shall in no way extend the warranty period of the original ones.
- The works resulting from the warranty conditions shall be carried out in the seller's workshop after the buyer has sent the defective equipment or parts for repair or replacement.
- The seller's responsibility is strictly limited to the obligations as stipulated herein and it is expressly agreed that he shall not be found to make any other indemnity. In particular, he shall in no case be liable to compensate loss caused directly or indirectly by a defect in the equipment delivered.

2. SAFETY REGULATIONS

2.1 Symbols and warning signs

The following terms and/or symbols are used in the operating manual for particularly important information.

Safety messages and symbols are quoted at the relevant positions in the operating manual if there is danger such as death, personal injury and environmental damage. These safety warnings must be strictly adhered to.



Indicates a hazardous situation which, if not avoided, may result in death or serious injury



Indicates a hazardous situation which, if not avoided, may result in serious injury.



Indicates a hazardous situation which, if not avoided, may result in moderate or minor injury.



Additional notes, information and tips.

2.2 Personal protection

While working on and standing by the product, protective clothing must be worn.



- Safety shoes
- Safety helmet
- Protective gloves for fitting and repair work
- Chemical-resistant clothing and protective gloves for cleaning work, especially when handling solvents
- Safety goggles for cleaning work, especially while handling solvents or using compressed air for cleaning
- Hearing protection

2.2.1 Personal protection signs



Head Protection



Eye Protection



Foot Protection



High Visibility Clothing



Protective Clothing



Hand Protection

2.2.2 Warning signs



No Smoking



Flammable



High Voltage



Hot Surfaces



Hand Injuries



Poisoning Danger



Fire Risk



Frostbite Hazard

2.3 Warnings

- In an unexpected situation use the emergency stop button which is set up on an easily accessible place.
- Do not exceed maximum operating pressure given on the unit's type plate.
- Unless the advised safety devices available or fully active the unit must not be operated.
- Set up the unit with extreme cleanliness.
- The unit must not be operated if it is damaged. Friterm must be informed about all damages.
- The unit must be installed and maintained by qualified personnel only.

2.4 Improper use

Danger of injuries in improper using;

2.4.1 Hazardous rotating machinery



Danger of cutting hands and fingers.



2.4.2 Hazardous voltage



Electrical Voltage can cause serious injuries or death. Do not contact with voltage direct or indirect. Do not forget to power off the unit before you begin maintenance work.

2.4.3 Hazardous thermal



Some of the components of the unit such as fin and tube have high temperatures.



Danger of burns and frostbites.



The danger of frostbite can occur if there is insufficient frost protection. Also if the unit cannot be drained completely, frostbite hazard occurs after draining.

2.4.4 Hazardous glycol



Ethylene glycol always must be kept out of fire, because of it is flammable.



If the concentration of ethylene glycol increase there will be a risk of asphyxia due to reduced oxygen concentration.



No smoking.

3.2 Type plate



Type		Serial Nr:	
Capacity		Fans	
Thg - Tsg / Tsç		Total Power	
Weight		Power Supply	
Prod.Year.		Max.Opr.Pr.	
		Internal Vol.	



0

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4. TECHNICAL DATA

4.1 Standards

- 97/23/EC PED (Pressure Equipment Directive)
- EN 378 “Refrigeration systems and heat pumps, technical safety and environmental requirements”
- Capacity standards for dry coolers are defined for 34% ethylene glycol mixture by volume, according to the TS EN 1048 standard (Heat Exchangers-Air Cooled Liquid Coolers "Dry Coolers"-Test Methods For Establishing the Performance).
- The system installer is responsible for that the inherent installation and security information are harmonized with the valid standards and guidelines (DIN EN 292 / 294).
- The EMC guideline is to be observed in connection with the control units. The manufacturer or operator of the entire plant is responsible for keeping to the EMC guideline 2004/108/EC

4.2 Product

The basic principle is to transfer the return water load in the system to air by the aid of a heat exchanger including fans. Its working principle is that the air sucked by fans cools the fluid within the tube while it passing through the fins. Thanks to closed fluid circuit, quantity of water does not diminish hence it is not needed to add extra water to the system.

The unit is delivered for operation with a specific operating point:

- Brine inlet temperature and volumetric flow
- Air inlet temperature and airflow volume

4.3 Fans

- Highly efficient axial Ziehl Abegg, EBM or equivalent fans are used in 800-910 mm diameters.
- Fans are arranged for standard draw through air configuration.
- 800/910 mm fans 400V 3~50Hz,
- Triphase fans can work at two different speeds. Furthermore, providing speed control are optional for EC fans.
- Variable fan speed regulation can be achieved using triphase fans with frequency inverter and sine filter.
- All motors are suitable for speed control applications up to 100 %.
- All motors have feature internal protection.
- Standard wiring of all motors are for one speed.
- Ambient temperature for exterior mounting is between -40 °C and +50 °C - +70 °C.
- Fans are designed with assuming fans working Fans run in a housing designed to maximize air flow.
- Recommended maximum starting for motors is 6 starts per hour.
- In case of prolonged stoppage of system, run the fan motors at least 2 hours per week.
- Motor protection IP44 and IP54; insulation class F.
- Friterm reserves the right to use fans of different manufacturers. Depending on the type, the fan data may slightly vary.

4.4 Sound pressure level

Noise pressure levels (LpA) are determined from the sound power levels (LwA) by using following formula according to EN 13487 Surrounding Surface Method.

$$LpA = LwA - 10 \log\left(\frac{Sp}{Sr}\right)$$

Sp = parallelepiped surface at 10 m

Sr = surface reference(1m²)

Sound pressure levels given show the average values on a parallelepiped surface at 10 m distance from the unit in open air over a reflecting plain.

4.5 Sound power level

SES GÜCÜ SEVİYESİ - SOUND POWER LEVEL																				
Fan Çapı Fan Diameter	Fan Hızı (d/dk) Fan Speed (rpm)		Ses Gücü Seviyesi - Lwa - fan başına Sound Power Level - Lwa- per fan dB(A)																Toplam Total Lwa dB(A)	
			63 Hz		125 Hz		250 Hz		500 Hz		1000 Hz		2000 Hz		4000 Hz		8000 Hz			
	Δ	Y	Δ	Y	Δ	Y	Δ	Y	Δ	Y	Δ	Y	Δ	Y	Δ	Y	Δ	Y	Δ	Y
800	890	690	54	49	67	62	69	64	71	66	75	69	73	67	68	60	62	54	79	74
800	670	510	46	44	59	51	61	57	63	58	68	61	66	58	60	52	54	46	72	65
800	440	350	42	43	47	47	53	50	53	51	56	52	56	47	46	40	41	35	61	57
910	900	700	-	-	77	74	80	76	86	80	86	80	82	75	74	67	67	60	94	88
910	885	685	-	-	60	60	67	59	71	55	70	54	66	52	66	51	59	47	80	73
910	650	475	-	-	66	-	63	-	61	-	59	-	57	-	54	-	50	-	70	63
910	420	305	-	-	43	50	41	44	40	44	44	46	43	42	36	35	25	28	59	54

4.6 Noise level data

SES BASINÇ SEVİYESİ SOUND PRESSURE LEVEL

10 m'de Ses Seviyesi Sound Pressure Level at 10m dB(A)			Fan Sayısı Number of Fans														
Fan Tipi	Fan Type	(rpm)	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20
SD	800 mm / Δ	(890 rpm)	47	50	52	53	54	55	55	56	56	57	58	59	59	60	60
SY	800 mm / Y	(690 rpm)	42	45	47	48	49	50	50	51	51	52	53	54	54	55	55
LD	800 mm / Δ	(670 rpm)	41	44	46	47	48	49	49	50	50	51	52	53	53	54	54
LY	800 mm / Y	(510 rpm)	33	36	38	39	40	41	41	42	42	43	44	45	45	46	46
QD	800 mm / Δ	(440 rpm)	29	32	34	35	36	37	37	38	38	39	40	41	41	42	42
QY	800 mm / Y	(350 rpm)	25	28	30	31	32	33	33	34	34	35	36	37	37	38	38
SD	910 mm / Δ	(900 rpm)	57	60	62	63	64	65	65	66	66	67	68	69	69	70	70
SY	910 mm / Y	(700 rpm)	51	54	56	57	58	59	59	60	60	61	62	63	63	64	64
LD	910 mm / Δ	(885 rpm)	45	48	50	51	52	53	53	54	54	55	56	57	57	58	58
LY	910 mm / Y	(685 rpm)	39	42	44	45	46	47	47	48	48	49	50	51	51	52	52
QD	910 mm / Δ	(650 rpm)	38	41	43	44	45	46	46	47	47	48	49	50	50	51	51
QY	910 mm / Y	(475 rpm)	31	34	36	37	38	39	39	40	40	41	42	43	43	44	44
ED	910 mm / Δ	(420 rpm)	27	30	32	33	34	35	35	36	36	37	38	39	39	40	40
EY	910 mm / Y	(305 rpm)	19	22	24	25	26	27	27	28	28	29	30	31	31	32	32

Fan Sayısı Değişiminin Ses Gücü Seviyesine Etkisi

Deviation on Sound Power Level in case of Several Fans

Fan sayısı Number of Fans	(ad.) (pcs.)	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20
Ses Gücü Seviyesindeki Artış Change in Sound Power Level	(dBA)	0	3	5	6	7	8	8	9	9	10	11	12	12	13	13

Uzaklık Distance m	Ses Seviyesindeki Değişim Change in Sound Pressure Level dBA
1	20
5	6
10	0
50	-14
100	-20

5. TRANSPORT AND STORAGE

5.1 Check for completeness and transport damage

- Check if there is any damage on product or package. Immediately after receipt, the delivery must be inspected for possible transport damage. Any damage must be reported immediately to the shipping company. If it is to be expected that the transport damage may affect proper operation, then the device must not be commissioned.
- Upon receipt, the equipment should be visually inspected, and in case of any damage or shortage, the supplier should be notified within 7 days.

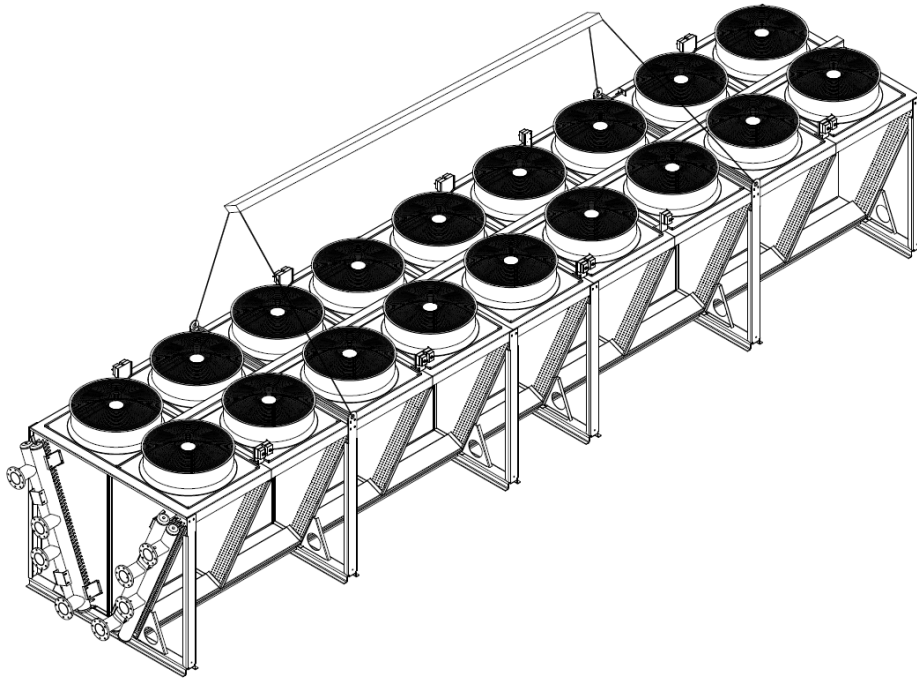
5.2 Transport

The product may only be lifted and moved by persons who:

1. are authorised to operate crane systems,
2. are authorised to drive motorised handling equipment
3. also know the transport and lifting instructions according to the operating manual and the assembly drawing.

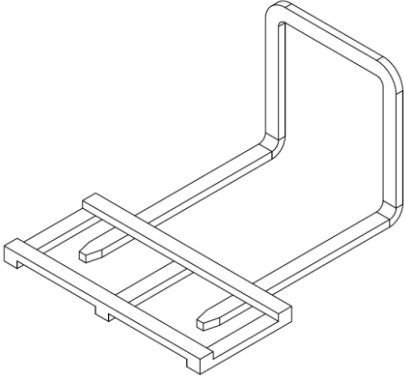


Suitable transport equipment must be used.

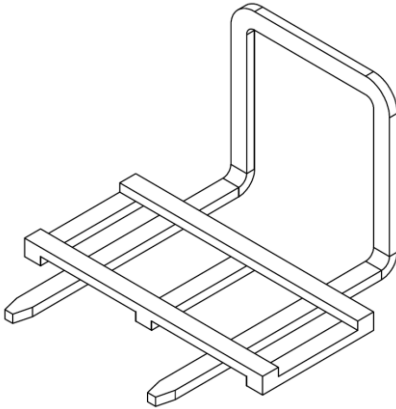




Only lift the packed unit with a forklift with full work length.



FALSE



TRUE



Risk of accident due to falling load

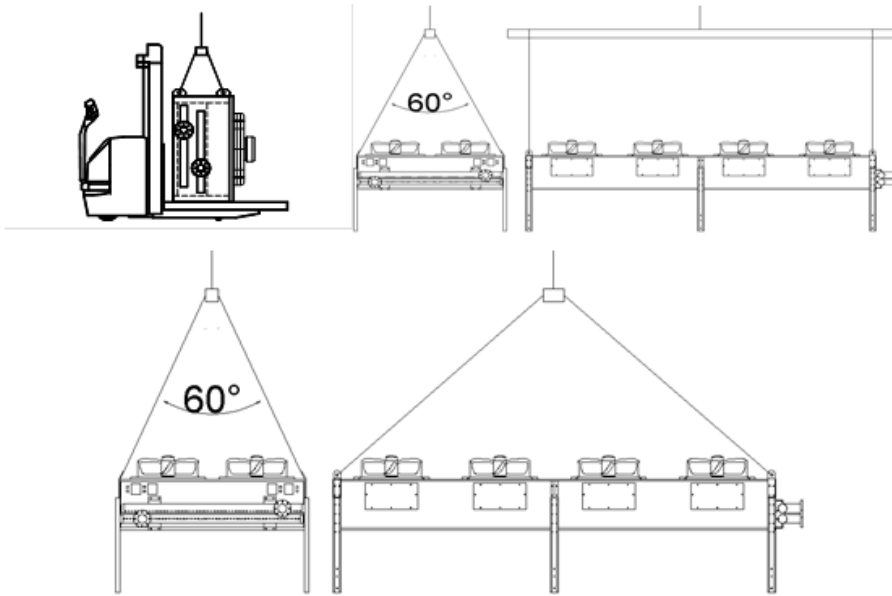
The size and weight of the product may cause accidents while transporting.

- Be extremely careful during transport to avoid damage or deformation on the product.
- Only use suitable transport equipment and lifting gear with sufficient load-bearing capacity.
- Never stand or work under suspended loads.

- Wear appropriate protective clothing (helmet, safety gloves, safety shoes).



- During lifting, a suitable lifting tool like a forklift or a crane is to be operated as in the drawings below. When lifting the equipment with hauling hooks, it is necessary to use a lifting beam connected to the hooks.
- Product is mounted with wooden beams at the bottom. It can be placed on the ground on these wooden beams. These wooden beams provide enough height for forklifts. During landing the equipment onto the ground, be careful for the notches on the ground and prevent defects of the aluminium fins below the equipment.



Handling scheme during carriage

If lightweight product is to be handled without a lifting vehicle, excessive care should be taken and suitable gloves should be used.

NOTICE

Be careful not to damage the product by the forks of the forklift. In order not to scratch the equipment, place a separator material. (cardboard, plywood, isolation material etc.)

5.3 Storage

- Store the equipment in the original packaging in order to protect from improper weather conditions, dirt, moisture and environmental effects and the equipment.
- Avoid excessive storage periods (one year of storage at maximum is recommended).
- If the equipment is stationary for long periods in a humid atmosphere, the fans should be switched ON for minimum two hours per a month to remove moisture that may have condensed within the motors
- Pay attention to the instructions on visual signs and labels for safety transport and handling of packaged product.
- Avoid exposure to extreme heat and cold.

CAUTION

Damage caused by improper storage

Incorrect or improper storage may cause damage to the radiator or radiator components.

6. INSTALLATION

The system installer is responsible for the proper installation according to standards and guidelines (DIN EN 292 / 294) which contains installation and security guidelines

The EMC guideline is to be observed in connection with the control units. The manufacturer or operator of the entire plant is responsible for following the EMC guideline 89/336/ EEC.

Before installing, it must be ensured that the technical specifications of the equipment are in accordance with the desired working conditions.

6.1 Location

The equipment is designed only for permanent installation. It should be fixed to a stable base.

The working fluid, the maximum working pressure and the voltage declared by the producer should be proper for the working environment.

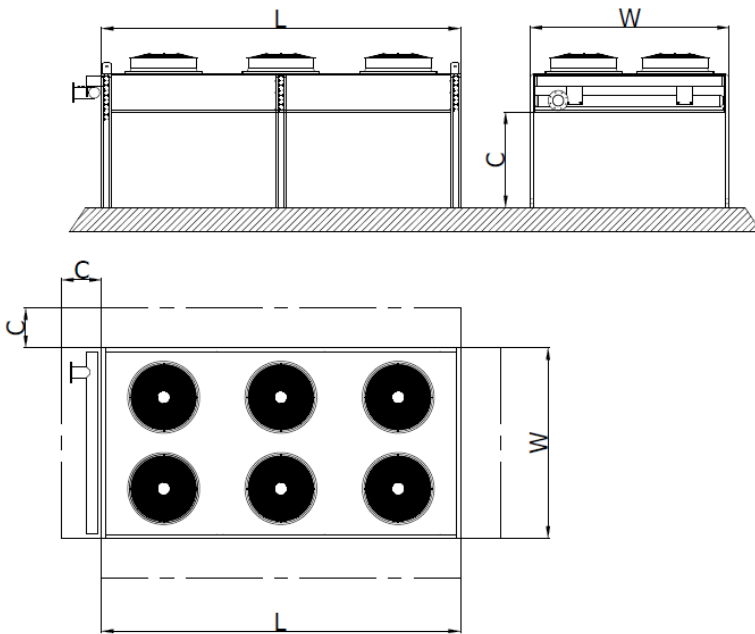


The working area should be well ventilated and should not be contained any hazardous substances or explosives.

Air motion should not be adversely affected by obstructions and inlet air should not be undesirably heated or cooled by some other equipment.

6.2 Requirements at the set up point

6.2.1 Outdoor set up of FDV unit

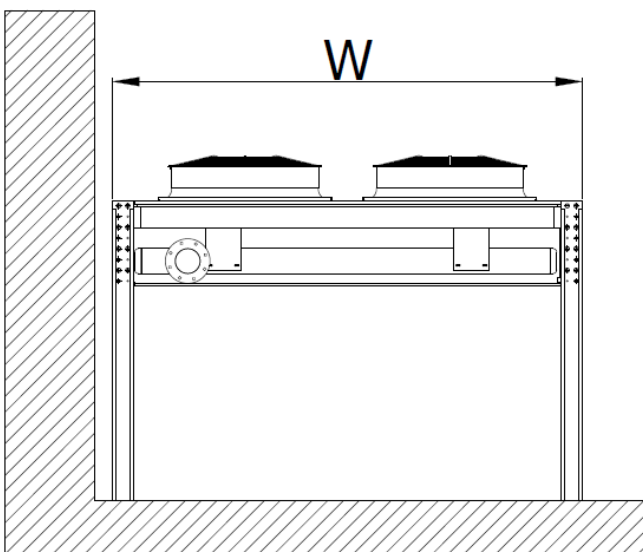


$$A_1 = L * W \text{ (m}^2\text{)}$$

$$A_2 = 2 * (L + W) * C$$

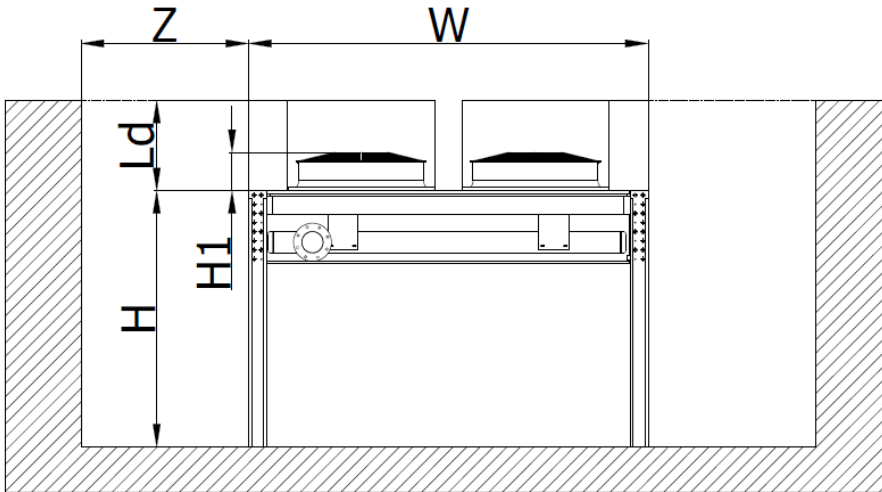
Condition: $A_2 \leq A_1 * 0,65$

6.2.2 Set up next to wall

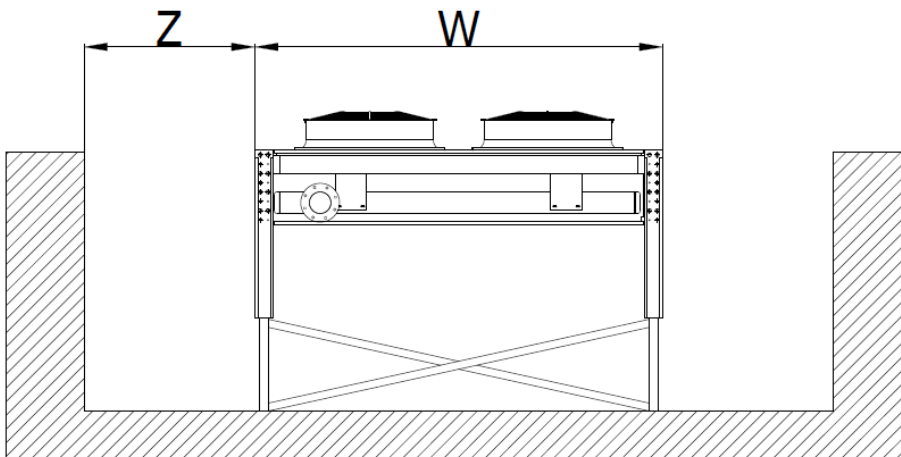


Extended legs must be used. (795 mm to 1200 mm)

6.2.3 Set up in pit-hallow

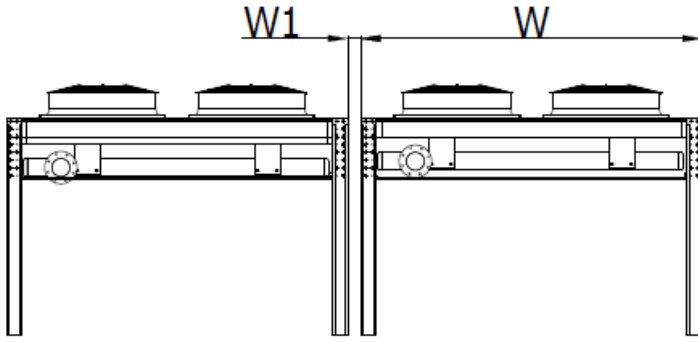


Condition;
 Fans with ventilation
 channel:
 $Z \geq 0,5 * W$
 $L_d = 450 - 600 \text{ mm}$

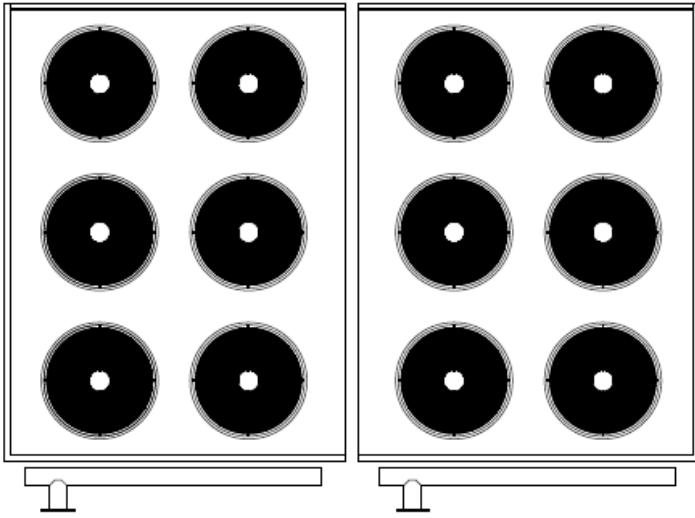


Condition;
 Fans with Friterm
 Streamer:
 $Z \geq 0,5 * W$
 Fans without Friterm
 Streamer:
 $Z \geq 0,65 * W$

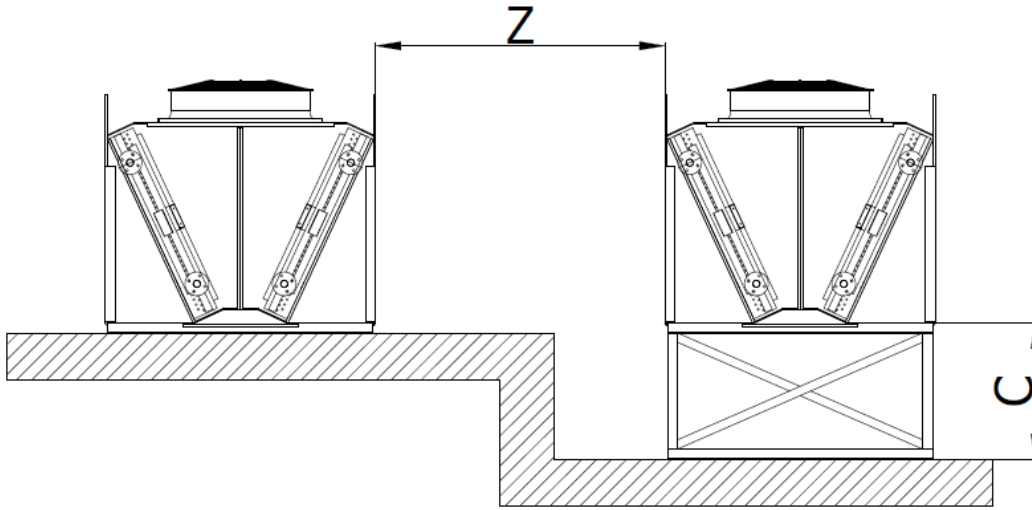
6.2.4 Several FDV units



Condition: $W_1 \cong 100 \text{ mm}$

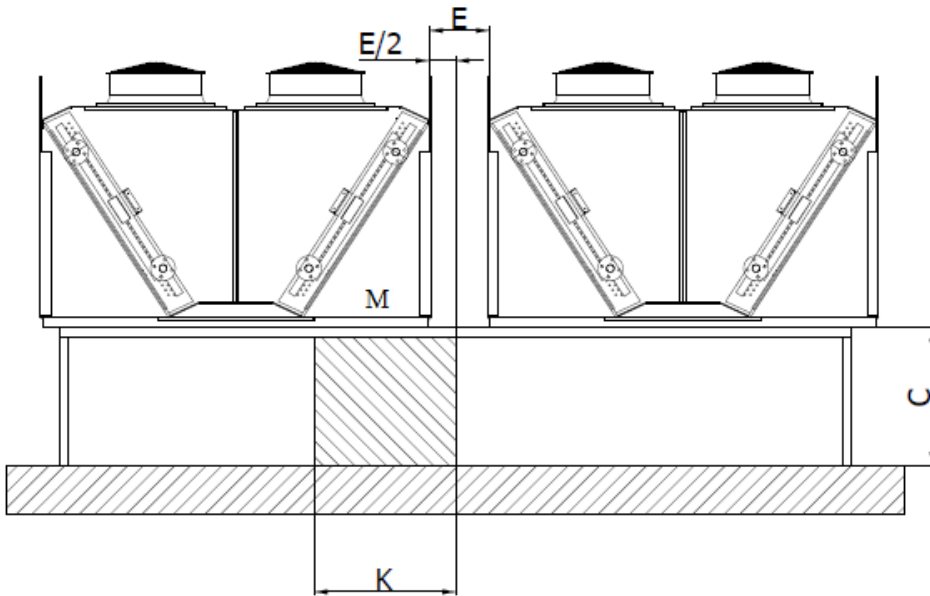


6.2.5 Requirements at the set up point (FDW units)



C value must be set by taking into account the top level of units.

6.2.6 Several FDW units

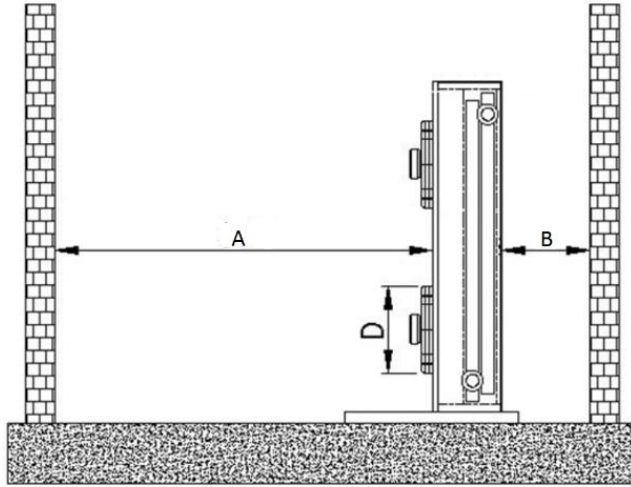


Flow Area = Finned Length x Finned Height

$$K = M + \frac{E}{2}$$

$$C = \frac{\text{Flow Area}}{K \times 2}$$

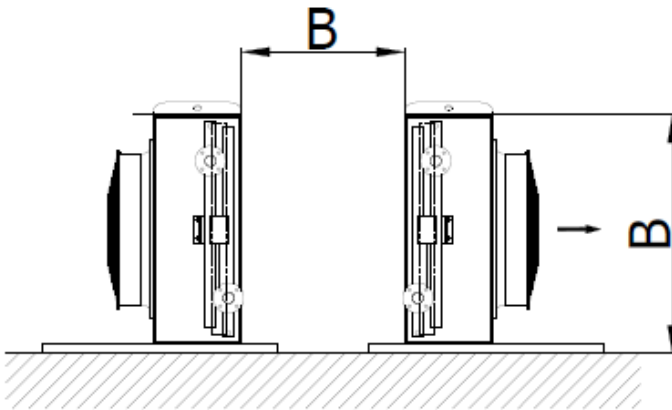
6.2.7 Requirements at the set up point (FDH units)



$$A \geq 3 m$$

$$B \geq D$$

6.2.8 Side-by-side setup (FDH units)



6.3 Mounting

Stability of units must be provided by users in their plants during mounting against to any vibration.

Air flow should not be faced with any obstacle because of any restriction.

Additional pressure should not be created by fans or motors which are located next to the product.

Installation and electrical connection must be performed by only qualified personnel.

Be careful while unpacking and installing products in order not to cause any damage to the tubes and piping connections.

NOTICE

It must be ensured that no electrical supply connection exists during installation.

The mounting position of the equipment should be in accordance with its design.

The connections used for mounting should be adequate to support the total operational forces.

The product must be mounted in such a way that no vibration would be carried to the product (vibration dampers can be used if required).

Carrier legs and lifting lugs are delivered as mounted on equipment.

DANGER

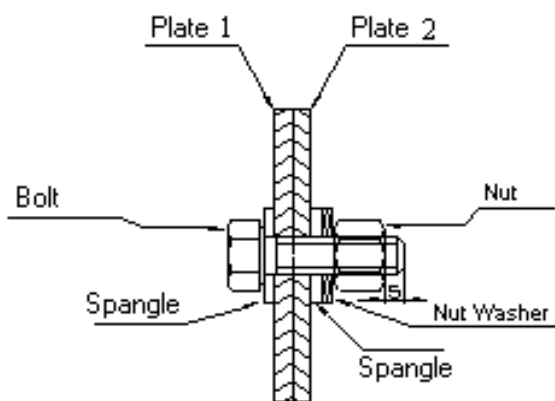
Electrical connections must not be done before mounting the product to the ground with the legs.

CAUTION

Product must not be operated and electrically connected before the mounting legs fixed.

NOTICE

6.3.1 Ideal mounting scheme



6.3.2 Leg mounting

Legs have been delivered demounted with the equipment.

For every leg; 6 piece M10x25 nut, M10 bolt and 12 piece spangles are given. The product is delivered with lifting eyes on. The equipment is delivered with lifting eyes mounted on it.

6.4 Connection

The electrical connection must comply with the relevant instructions and ground wires must be installed correctly.



Risk of injury by electric shock

When connecting the electronic control to the power supply, injuries by electric shock are possible because of the voltage supply.

- All electrical connections on the product must be made by a qualified electrician in accordance with the electrical engineering rules.



The electrical connection must not be done unless the legs are mounted.

Given nuts, bolts and spangles, must be completely used for mounting.

For the horizontal (H) type mounting:

- The product must be fixed with 4 lifting eyes, afterwards must be lifted approximately 1m so as to begin leg mounting.
- Use two spangles and a nut for each bolt while leg mounting.
- Be sure that all legs are equally far away from the surface
- Lower down the equipment slowly.
- The position control must be maintained with a water gauge on the product. The dry cooler must be positioned parallel to the surface.
- Fix the equipment to the surface.

For the vertical (V) type mounting:

- Fix the equipment with 2 lifting eyes and afterwards begin foot mounting.
- Use 2 spangles and a nut for each bolt must be used.
- Lower down the equipment slowly.

- The position control must be maintained with a water gauge placed on the equipment.
The product must be positioned parallel to the surface.
- Fix the equipment to the surface.

7. OPERATION

7.1 Initial commissioning

Before running the unit for the first time, be sure that all guards, motor mountings and electrical covers are secure, installation and electrical connection are done properly, internal wiring is kept away from the fans and the fans can rotate freely.

7.2 Regular commissioning

If the equipment is stationary for long periods in a humid atmosphere, the fans must be switched ON for **minimum of two hours in every month** to remove any moisture that may have condensed within the motors.

While the fans are running, anything that could pass through the finger guards, like a piece of cloth or long hair, must be kept away from the fans.

7.3 Shutting down

Fan connection must be disconnected and working fluid circulation must be stopped to shut the product down.



After shutting the unit down, the operating pressure must be observed whether the operating pressure exceed maximum operating pressure or not.



Stay away from the air direction of the fans while the fans are running.



Before touching, it is recommended to ensure that the headers and the connection pipes are neither too hot nor too cold due to working conditions of the fluid inside.

The operation must be stopped and the supplier must be informed in case of any unusual working condition, such as abnormal operating noise. Intensive vibrations due to out-of-balance running of the fans may lead to outage.

Maintenance must not be performed while the equipment is in use (*See part 8 for details*).

As it is not possible to evacuate fluid fully, antifreeze must be added to product for safety. (*See part 8 for details*)

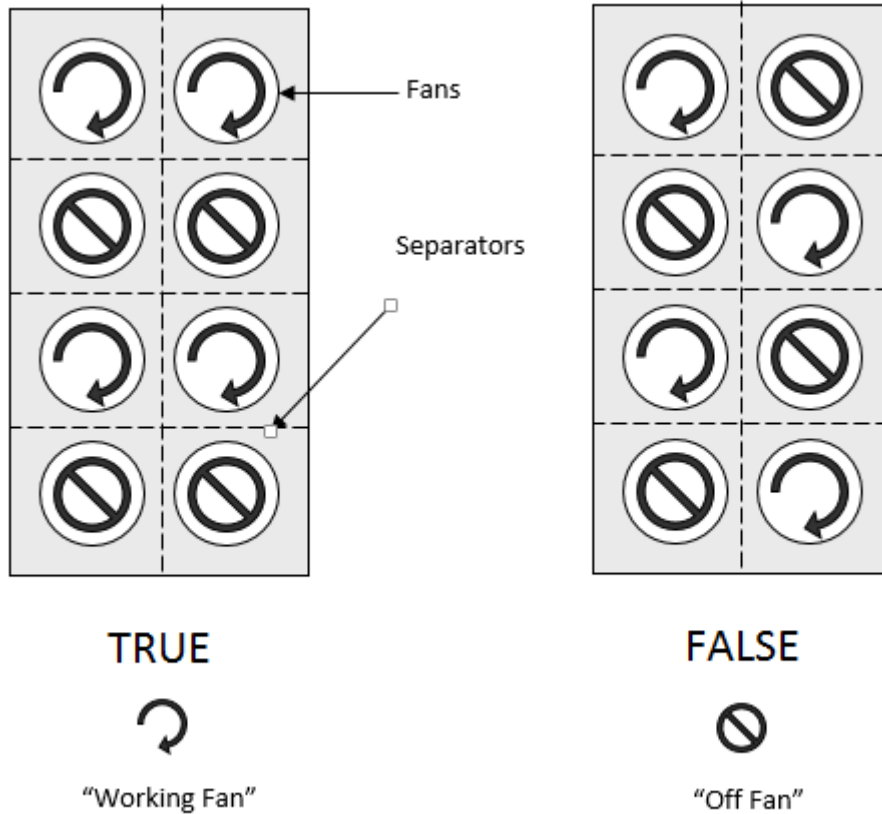


Recommended starting value for fans is 6 per hour while maximum is 10.

7.4 Step control application (If Applicable)

In step controlled applications; the fan groups that will be working and not working must be arranged according to scheme given below which is defined as “TRUE”. Otherwise the problems given below will be observed:

1. The air will not be fully absorbed from by the fans. Hence the efficiency will decrease.
2. When a fan is taken into the circuit which rotates in contrary directions, the fan will be damaged because of constriction.



8. MAINTENANCE

8.1 Maintenance intervals

Maintenance operation is to be performed by qualified personnel only. Please be sure that safety regulations and the worker's protection rules are obeyed during the maintenance and service (DIN EN 50110).

The fluid circulation must be stopped and it must be ensured that no electrical supply connection exists during maintenance. It is advisable to wait till the equipment comes to thermal balance with its surroundings if possible.

Freezing Protection; Since it is not possible to drain all of liquid from the system, dry coolers have freezing threaten. Therefore fluid must be protected against freezing by adding adequately amount of antifreeze to the fluid. On the other hand, quantity of added antifreeze must be checked whether it decreases or not.

ATTENTION !!! It must be chosen 7-10 °C lower temperature in order to provide safely antifreeze (glycol) ratio.

Mixture Freezing Points For Different Antifreeze Ratios	
Volumetric Mixing Ratio	Freezing Temperature
% 100 Water	0 °C
% 80 Water + % 20 Glycol	-7 °C
% 70 Water + % 30 Glycol	-14 °C
% 60 Water + % 40 Glycol	-22 °C
% 50 Water + % 50 Glycol	-33 °C
% 40 Water + % 60 Glycol	-48 °C

Reference: ASHRAE

NOTICE

If the tubes within the equipment or the connection pipes are to be repaired, the fluid in the line must be drained beforehand.

8.2 Fan motor maintenance

- Regarding the bearings, the fans are maintenance-free for 30000-40000 hours under normal operating conditions. Lifetime lubrication is not necessary within this period, and when this period expires or the bearings are damaged, it is necessary to replace the bearings with original parts.
- If the fans are to be maintained, the instruction manual prepared by the fan manufacturer must be followed. Please contact manufacturer when needed.
- After maintenance is performed, ensure that no tools or other foreign materials are left in or near the equipment.

NOTICE

Follow to Initial Commissioning before operating the equipment after maintenance.

8.3 Periodical controls (Once a year)

- Corrosion on the fins and tubes should be inspected. If the tubes are worn-out, leakage may occur.
- The pipeline must be controlled for damage and leakage.
- Mechanical and electrical connections of the fans must be checked. Fans must be able to rotate freely and finger guard must be stable.
- All the fixings, especially fan motor mountings and product installation fixings must be ensured to be secure.

When necessary;

The surface of the heat exchanger must be inspected for dirt and dust, and if needed, should be cleaned by a soft brush, with the help of pressurized air, pressurized hot water or by a similar way. If the fins are cleaned with high pressurized water or air, flow direction should be parallel to the fins. Care should be taken not to damage the fins and the fans. Chemicals that may react with the materials used in the equipment must not be used. Electrical connections and the fan motors must not be wet while cleaning.

9. TROUBLESHOOTING

<i>Faults</i>	<i>Causes</i>	<i>Treatment</i>
Insufficient Capacity	Fans are not running properly	Repair or change fans
	Polluted coils	Clean
	Different brine working pressure	Adjust brine pressurising values to reference values
Fan motor is not working	Fan blade stuck	Enable fan to rotate freely
	Power supply cut off	Fix power supply
Vibration	Fan blades defect	Modify or change fan blades
Fluid Leakage	Parts of carrying brine tools are leaking	Turn off the fans and brine feed, prevent leakage