三花微通道换热器

SANHUA MICRO CHANNEL HEAT EXCHANGER

Sanhua Micro Channel Heat Exchanger Installation & Maintenance Manual

SMH-CP-JW67　A5

Editor：_____

Reviewer：_____

Countersigner：_____

Standarded：_____

Approver：_____

Hangzhou Sanhua Micro channel Heat Exchanger Co., Ltd

Amendment records				
Number	Revision date	Version	Overview of revisions	Revised by
01	2017.08.24	A0	增加安全环保，水箱应用内容	汤大军
02	2018.06.27	A1	增加可燃制冷剂冷媒充注和维修安全内容	刘丹丹
03	2019.7.22	A2	见 12 修改内容	刘丹丹
04	2020.9.22	A3	修订应用环境、安装、冷媒充注、清洗和水箱应用等内容	刘丹丹
05	2021.4.21	A4	修订涂层折弯、热应力、震动、清洗工序及水箱应用等相关内容	刘丹丹

Foreword

This manual is a guide for installation and maintenance of Micro channel Heat Exchangers (MCHEs) supplied by Sanhua. We recommend that you read this manual carefully before starting any work.

The MCHE is specially designed and manufactured for operating conditions that were specified by the customer. Please consult Sanhua if you want to change the operating conditions.

Attention: Sanhua will not be responsible or liable for any damage caused by failure to comply with the instructions in this manual and/or due to incorrect installation, operation and maintenance of the MCHE.

Catalogue

1. Storage and Working Environment

The storage temperature range for Micro Channel Heat Exchanger (MCHE) is -40°C to 121°C (-40°F to 250°F).

MCHE should be stored in a dry and clean indoor ambient. The chemical composition of the air surrounding the MCHE should be harmonious with aluminum. Avoid storing MCHE coils in the extreme PH environments as it might destroy the aluminum oxide layer and, therefore, increase the risk of corrosion.

Improper storage and stacking can cause premature corrosion or deformation and will reduce the MCHE's life. Please pay close attention to this.

If the MCHE charged with Nitrogen will be stored in the warehouse for a long time, we suggest to use the Cu sealing cap and pin valve to instead of rubber plug. To minimize potential damage, we recommend to keep the MCHEs in the package until installation in the unit.

Metal chips, copper and steel cuttings can cause galvanic corrosion, so please ensure the storage and installation areas clean and separated from machining or welding areas. Special tools or keep tools clean is recommended if you need to use it to deal with the MCHE coil.

The MCHE including coating coils should not be stored or installed in the ambient full of sand or dust without protection to avoid the potential corrosion risk because of dust accumulation. Sanhua suggest to add protective shield outside of the MCHE in case that the object, such as tree branch, bigger sand, blew by the wind may destroy the coil. On the other hand, it could prevent the sand, dust, waste blocking the MCHE fins which will impact the heat transfer performance.

.....

2. Application Environment

Corrosion is a natural process, which converts a refined metal to a more stable form such as its oxide, hydroxide, or sulfide. It is the gradual destruction of materials by chemical and/or electrochemical reaction with their environment. Corrosion of materials influences the service life of equipment and structure. Fortunately, when the environmental factors are properly identified, and the materials and protective options are appropriately selected, the process of corrosion can be controlled. This will ensure the safety and reliability of the equipment and structure during their service life.

MCHE coils are always used in atmosphere and their corrosion is mainly caused by the atmosphere and the contaminants in it. Generally, the corrosivity of atmosphere are influenced by the climate and contaminants. The aggressive factors include but are not limited to, temperature, relative humidity, wind, rain, snow, fog, dew, haze, dust, particles, proximity to pollutant source, sulfate compounds, chlorine and chlorides, and nitrogen-containing compounds. The combination of this and other factors may result in the premature failure of the equipment. Therefore, it is important that the corrosion factors, which includes the localized environment surrounding the equipment and the probable changes in the future, shall be correctly identified before installation. And the environment corrosion factors including the potential ones surrounding the MCHE application should also be considered.

2.1.Selection guide of MCHE materials and coating

The application environments of MCHE are often characterized as rural, urban, coastal (marine), industrial, combined coastal & industrial and so on. The atmospheric corrosivity of these environments is divided into six categories: C1, C2, C3, C4, C5 and CX, according to ISO 9223:2012 standard. The guidelines for MCHE coil materials and coating selection for different atmospheric corrosivity category are given in the following table 2-1.

Table 2-1 Options of MCHE coils

Atmospheric corrosivity category (ISO 9223)	**C1, C2**	**C3**		**C4**	**C5**	**CX**
		Inland	**Coastal**			
Corrosivity	**Very low, Low**	**Medium**	**Medium**	**High**	**Very high**	**Extreme**
Typical environments-examples	**Indoor, Rural areas**	**Urban areas**	**Urban areas**	**Polluted Urban, industrial, coastal areas**	**Very high pollution & salt deposition areas**	**Extreme industrial, coastal areas**
MCHE STA*	OK	OK	NR	NR	NR	NR
MCHE LLA**	OK	OK	AP	NR	NR	NR
MCHE 2nd G LLA***	OK	OK	AP	NR	NR	NR
MCHE with TCP coating	OK	OK	OK	AP	NR	NR
MCHE with E-coating	OK	OK	OK	OK	AP	NR

Note: (*) STA: Standard alloy; (**) LLA: Long life alloy; (***) 2nd G LLA: Second-generation Long-life alloy.
OK: Recommended; AP: Acceptable when protection is applied, life may be shortened; NR: Not recommended.
When MCHE coils are used in high ambient temperature and humidity and too much dust without efficient cleaning in time, Life of coils would be shortened.

It is also noted the selection criteria is a gross one. It depends on the local environmental characteristics, and therefore risk might still exist when recommended. Necessary protection on coils can reduce the influence of harsh environment. Such as avoiding oceanic air blowing directly to the coil in the coastline area or keeping the coil far away from the coastline. When there are noticeable corrosion sources exist in the vicinity of the unit with MCHE for the recommended or acceptable option, such as the sewage outlet, exhaust gas outlet, smoke outlet, aquiculture area, sand and dust, mine field, metallic dust (such as debris from metal cutting & polishing plant), chemical reagents, deicing salt and etc. MCHE coils should be installed far away from such location, an additional separating wall and filter screen, periodic cleaning and rinsing would be helpful to reduce the negative influence of such corrosion sources on MCHE. In addition, when there are copper powder and copper containing agents waste in an area, please do not use bare or TCP MCHE coils. Always choose the option for the most severe environmental factors.

Even the MCHE was installed in a mild environment, some dusts and contaminants may also deposit on the surface of MCHE, and these accumulations always absorb some moisture, while would cause the electrochemical corrosion of MCHE. Too much accumulations without effective cleaning will lead to heavy corrosion on MCHE, which is similar as installed the MHCE in a harsh environment. Periodic cleaning can reduce the extent of corrosion and is necessary for the continuous service of MCHE. Based on different environment corrosivity categories, we suggest to clean the coil once a year for C1, C2 areas, once a quarter for C3 area, and once a month for C4, C5, CX areas. Section 8 shows the cleaning procedure for referring to.

2.2.Determination and estimation of atmospheric corrosivity

The ambient environment shall be clearly identified for the intended installation. Generally, the atmospheric corrosivity of rural and urban environment are C1-C3; The atmospheric corrosivity of coastal and industrial environment are C3-C4; The atmospheric corrosivity of heavily polluted industrial areas and high salinity coastal areas can be C5. Some extreme industrial areas, coastal and offshore areas, and occasional contact with salt spray areas are of CX. For the large environmental difference between different installation sites, and the probable changes in the future especially in areas with rapid growth, the corrosivity of the environment needs to be estimated on a case-by-case basis.

The reference methods for estimating the corrosivity of the atmosphere are given here. Method A and B are rooted in the ISO9223 standard, method C relies on experience only.

These methods are all characterized by some uncertainties and limitations.

The reliability of the three methods decreases in the order A B C.

Method A. Determining the corrosivity categories for the atmospheric environments is based on the first-year corrosion rate measured with standard metal specimens. The minimum purity for aluminum specimens required by ISO9226 is 99.5%. The corrosion rate (r_{corr}) is expressed in grams per square meter per year ($g/(m^2 \cdot a)$) for different categories of aaluminum and are listed here: C1, r_{corr}, negligible; C2, $r_{corr} \leq 0.6$; C3, $0.6 < r_{corr} \leq 2$; C4, $2 < r_{corr} \leq 5$; C5, $5 < r_{corr} \leq 10$; CX, $r_{corr} > 10$.

Method B. Estimating the corrosivity categories for the atmospheric environments is based on the calculated first-year corrosion rate. Dose-response function calculations describe four environmental parameters, SO2 dry deposition, chloride dry deposition, temperature and relative humidity. Equation for aluminium:

$$r_{corr} = 0.0042 \times P_d^{0.73} \times \exp(0.025 \times RH + f_{Al}) + 0.0018 \times S_d^{0.60} \times \exp(0.020 \times RH + 0.094 \times T)$$

$$f_{Al} = 0.0009 \times (T - 10) \quad \text{当 T≤10℃；}$$

$$f_{Al} = -0.0043 \cdot (T - 10)$$

$$N = 113, R^2 = 0.65$$

Where, [r_{corr}] is first-year corrosion rate of metal, expressed in micrometers per year (μm/a); T is the annual average temperature, expressed in degrees Celsius (℃), interval from -17.1 to 28.7; RH is the annual average relative humidity, expressed as percentage (%), interval from 34 to 93; Pd is the annual average SO2 deposition, expressed in milligrams per square meter per day (mg/(m2·d)), interval from 0.7 to 150.4; Sd is the annual average Cl- deposition, expressed in milligrams per square meter per day (mg/(m2·d)) , interval from 0.4 to 760.5.

Method C. Estimating the probable corrosivity of the atmospheric environments can be accomplished by referring to the corrosion performance of nearby equipment and/or infrastructure. For example, one can check the corrosion performance of the nearby heat exchanger coils in service for years, such as the nearby round tube plate fin, and/or MCHE coils. If the nearby coils are commonly coated, or severe corrosions such as crush, perforation, cracking have taken place on bare aluminum fins, the corrosivity of the environment in the past service period should be at a high level. If the nearby coils are uncoated, and the bare aluminum fins are without obvious corrosion, the corrosivity of the environment in the past service period should be at a medium or low level.

.....

3. Handling - Handle with care!

Compared with tube & fin coils, MCHE is made of soft aluminum, and the weight is lighter which makes it easy to handle. However, if don't handle the coil carefully, the coil is easy to be damaged. Fortunately, the micro channel tubes support and protect the fins resulting in less fin damage compared to traditional tube & fin coils.

Notice: The inlet and outlet tubes are designed only for connection and to support their own weight. Unfortunately, they locate where handles would be and often look like handles. **Never lift a MCHE by the inlet and outlet tubes!**

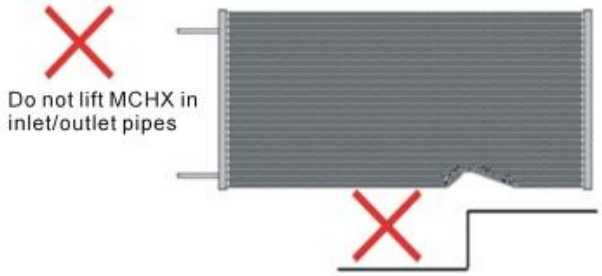

Fig. 3-1Do not hit or drop MCHE on edges.

Fig. 3-2 The right way to lift MCHE.

Because MCHEs are made of soft aluminum, so crashing, forcing, placing heavy objects on top of, or stepping on products will almost certainly deform them. Any sharp objects contacting the product may cause leakage failure of the product. Do not store them on the ground, or lean against the equipment, wall, or workbench. MCHEs must be stored in an appropriate container, and should not contact any sharp objects.

Fig. 3-3 Do not put MCHE on the ground.

Fig. 3-4 Do not lean against the equipment, wall, or workbench.

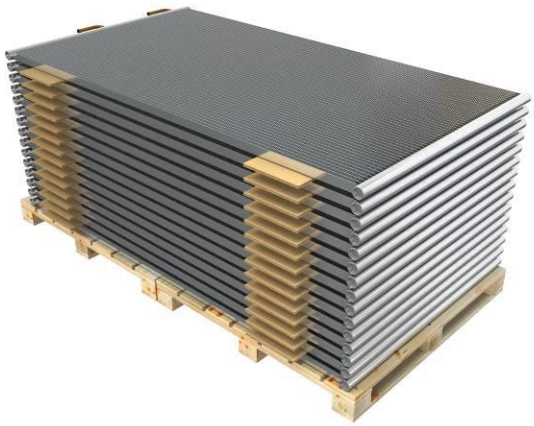

Fig. 3-5 The right way to store MCHEs.

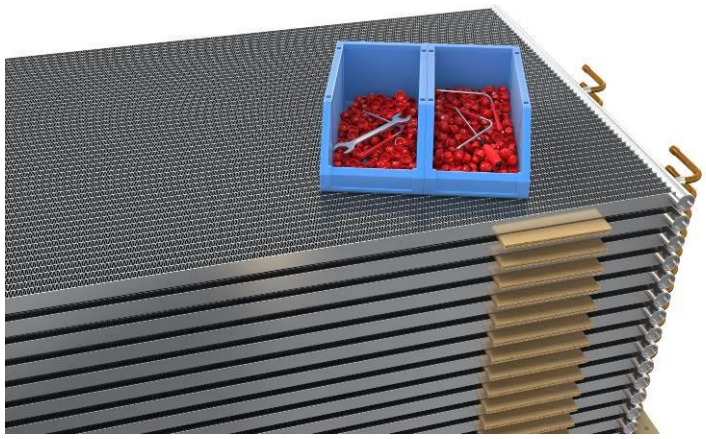

Fig. 3-6 Never put anything on MCHE except cardboard or similar material.

Notice that if the coils have slight bending deformation, it is possible to flatten them back out by laying them concave side down on a flat table and tapping them firmly with a special flat plate.

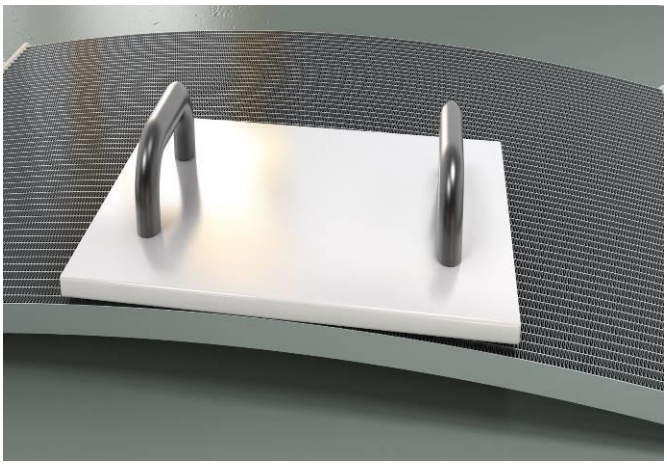

Fig. 3-7 Repair the bending coil with a special flat plate

This procedure only works for bowed coils, not for local fin protrusions.

.....

4. Bending Procedure

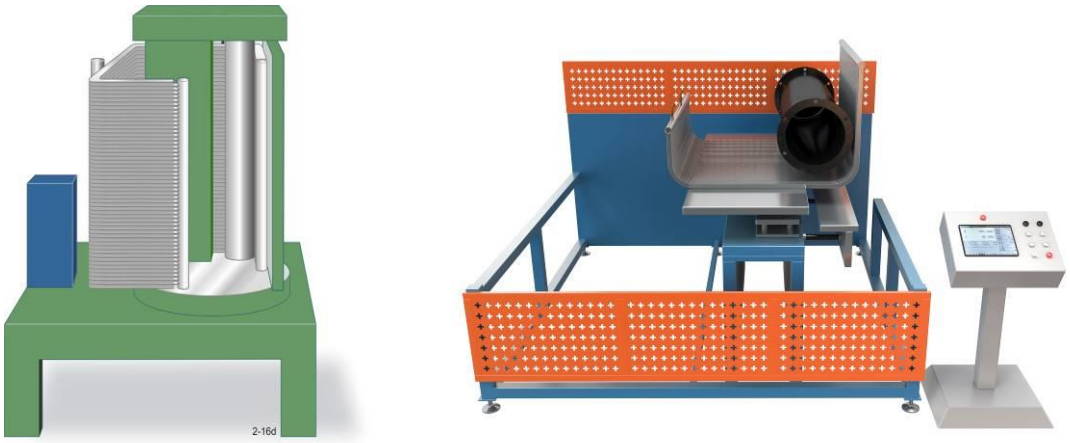

Fig. 4-1 Bending machine

MCHE and tube & fin heat exchangers can use the same bending machines. We recommend shipping flat MCHEs for efficient packing and bending them at customer's plant.

Warning：Clamp force, bending radius, and other relative parameters need to be changed when using the same bending machines as with tube & fin heat exchangers.

Bending radius

The minimal bending radius meeting the acceptable production pass rate is a function of the micro channel tube, fin, and alloy, as well as the bending equipment, fixtures, bending speed and bending length. Therefore, during the development process the customer should test bending the coil on the specific production configuration to verify the design's manufacturability. In general, tighter radius, thicker tubes, and longer bend lines are more difficult to bend.

Recommended minimal bending radius (as determined by factory tests under the most favorable conditions) are shown below for different micro channel tubes and fins. Consult Sanhua for the tubes not listed. **Do not extrapolate or interpolate the values arbitrarily. Use a more generous radius if possible.**

Remember that micro channel coils are made of soft aluminum that is easier to be deformed during handling. Pay attention to the following points during bending:

- Ensure the coils flat and undamaged when they are put into the bending machine.
- Keep the flat tubes perpendicular to the bending axis before bending.
- Fix the coil carefully during bending, and don't crush it.
- Slow bending speeds will yield better results.

Tab. 4-1 Minimum bending radius for different tube types

Model	Structural parameters		Tube Alloy	Minimum Bending Radius	
	Tube (Wmm*Hmm*Port #)	Fin (Hmm*Gage mm)		mm	inch
2G12	12.0*1.0*12	8.1*0.07-FPI21	AA3102	40	1.57
4G12	12.0*1.5*14	8.1*0.07-FPI21	AA3102	50	1.97
4G12	12.0*1.5*14	8.1*0.07-FPI26	AA3102	60	2.36
1G16	16.0*1.8*10	8.1*0.10	AA3102	90	3.54
2G16	16.0*1.3*16	8.1*0.08	AA3102	90	3.54
3G16	16.0*1.3*16	11.4*0.09	AA3102	110	4.33
3G16	16.0*1.3*16	11.4*0.09	AA3103MOD	110	4.33
3G18	18.0*1.3*23	11.4*0.09	AA3103MOD	125	4.92
1G20	20.0*2.0*12	8.1*0.10	AA3102	110	4.33
2G20	20.6*1.3*20	8.1*0.08	AA3102	140	5.51
2G20	20.6*1.3*20	8.1*0.08	AA3103MOD	170	6.69
2G25	25.4*1.3*26	8.1*0.08	AA3102	200	7.87
2G25	25.4*1.3*26	8.1*0.10	AA3102	170	6.69
2G25	25.4*1.3*26	8.1*0.08	AA3103MOD	220	8.66
2G25	25.4*1.3*26	8.1*0.10	AA3103MOD	190	7.48
4G25	25.4*2.0*20	8.1*0.08	AA3102	200	7.87
4G32	32*2.0*25	8.1*0.08	AA3102	300	11.81
2G32	32*1.3*32	8.1*0.08	AA3102	300	11.81
4G32	32*2.0*25	8.1*0.1	AA3102	300	11.81
2G32	32*1.3*32	8.1*0.1	AA3102	300	11.81

Such as vertical bending machines, the micro channel coil slides along the table. The coil weight will fall on the headers or the dead tube at the bottom. The dead tube is designed only to protect and support the fins and not designed to hold the entire weight of a large coil, particularly when combined with a frictional load that may push the fins over. Therefore, be careful to ensure that no end of the coil is cantilevered against the edge of the table which will cause the coil to droop making that the tubes are no longer perpendicular to the bending axis, resulting in corkscrewing or reducing bending quality and consistency.

Per the above with vertical bending machines, it is important to control the quality, parallelism, and height (relative to the header ends) of the bottom dead tube.

Multi-bend bending coils on a horizontal bending machine can also cause cantilevered loads from the dead weight of the unsupported bent legs. For instance, on a three-bend coil, depending on fixture, the load of the first 75% of the coil may be put back into the remaining coil, possibly causing poor bend quality or permanent deformation. This problem is more severe for MCHE than tube & fin heat exchangers.

Bend for coated coil

If coated coil will be bent, please contact with Sanhua engineer to confirm the bend conditions (e.i. bend radius, bend angle).

Low coil temperature will reduce the flexibility of coating which may result in the cracking of coating after bending. For the bend of coated coil, the coil and environment temperature shall be not lower than 15℃ when coil is bent.

Too long storage time will also reduce the flexibility of coating which may result in the cracking issue of coating after bending. For the bend of coated coil, the coil shall be bent within 180 days after coating. However, a shorter storage time will achieve a better bendability of coated coil. It is strongly recommended that coated coil is bent within 90 days after coating.

Coated product prior to bend must be stored in non-corrosive, ventilated, dry and light-avoiding environment.

.....

5. Installation

The MCHE incorporated into a system shall be compatible with the product design pressures and temperatures. Design pressures of different refrigerants are given as follows:

Tab. 5-1 The design absolute pressure for different refrigerants

Refrigerant	Design absolute pressure
R134a	2.0MPa（290Psia）
R22	2.9MPa（421Psia）
R407C	3.0MPa（435Psia）
R404A	3.5MPa（508Psia）
R410A	4.5MPa（653Psia）
R32	4.5MPa（653Psia）
R454B	4.5MPa（653Psia）
R1234ze	2.0MPa（290Psia）
R1234yf	2.0MPa（290Psia）
R513A	2.0MPa（290Psia）
R290	2.34MPa（339.3Psia）

Range of temperature：

- Ambient air temperature in the “run state”: -40℃ to 72℃（-40°F to 161.6°F）
- Range of the refrigerant side operating temperature: -40℃ to 121℃（-40°F to 250°F）

Notice：

- The temperature difference between the refrigerant side and air side is large when the working temperature is very low, thermal stress effect on the production life should be considered. If the temperature difference is larger than 60℃, customer must evaluate the thermal stress effect at the project development stage.
- Range of the refrigerant side operating temperature of some production is -40℃ to 150℃(-40°F to 302°F). Please contact Sanhua technology engineer if necessary.

5.1.Pass arrangement

Carefully identify the locations of the inlet & outlet tubes. A Micro channel condenser is often designed with multiple passes (parallel flow) that have fewer tubes in each successive pass.

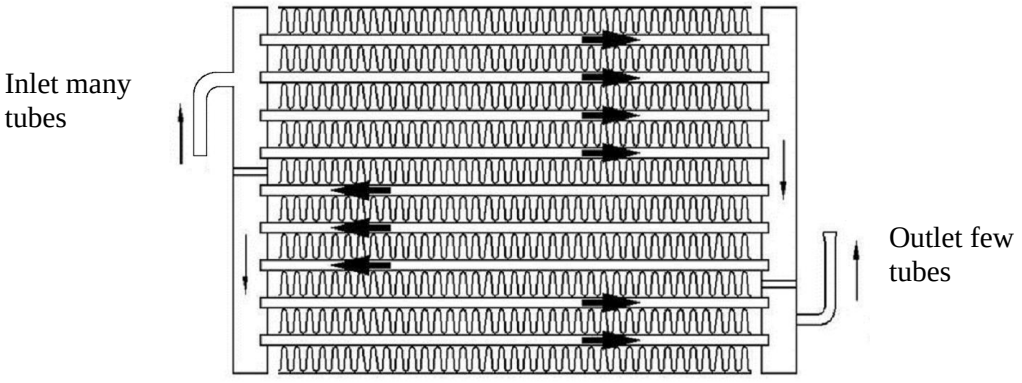

Fig. 5-1 Condenser

The inlet tube diameter of micro channel evaporator is often smaller than that of the outlet tube as showed in Fig. 5-2.

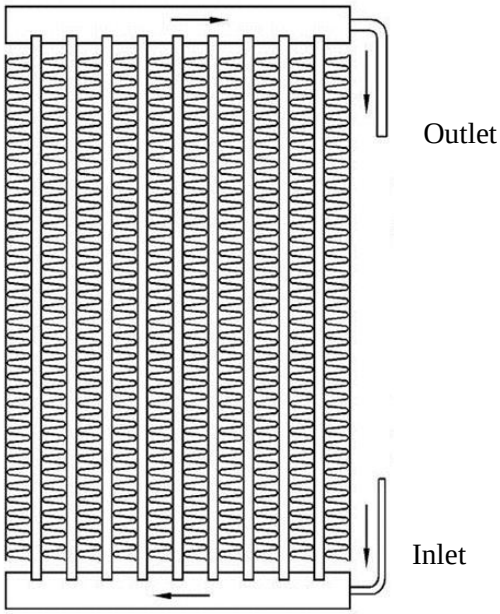

Fig. 5-2 Evaporator

Incorrect connection of the inlet tube and the outlet tube of MCHE will result in excessively high refrigerant side pressure drop, and poor heat exchange performance.

5.2.Inlet/outlet connections

Inlet/outlet connections are designed for connections, not to act as handles to support the coil and other components. When installing the coil, it is necessary for customer to use the suitable elbow tube to connect the inlet and outlet tubes of the coil showed in Fig. 5-3 to avoid destroying the connection tubes or causing leakage by pulling or bending them.

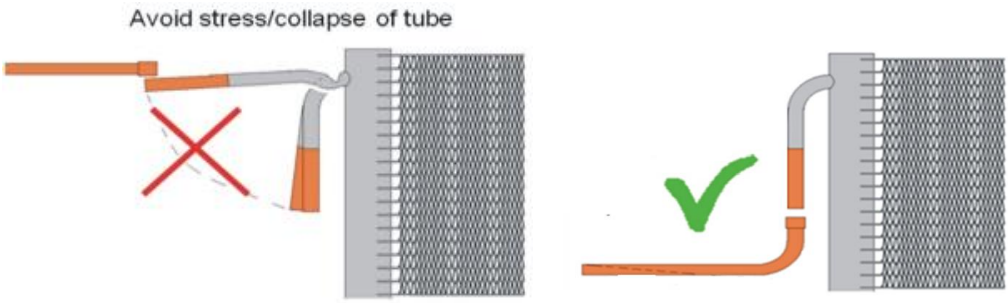

Fig. 5-3 Avoid stress of tube

When copper and aluminum tubes are joined together, galvanic corrosion will happen on the aluminum. Using paint or heat shrink tube on the connections to prevent moisture outside which will decrease the galvanic corrosion.

Fig. 5-4 Using nitrogen to control oxidation when brazing copper pipes

To protect the Cu-Al brazing joint and heat shrink wrap or ZRC paint from the heat of brazing, the tube length after the joint on inlet/outlet pipes should be longer than 70mm as showed in Fig. 5-5. When brazing the coil into your system, the Cu/Al brazing joints and the heat shrink wrap should be additionally protected by dry nitrogen purging, and/or wrapping the copper stub tube with a wet cloth, so the heat shrink wrap and ZRC paint is not overheated. The length of aluminum inlet/outlet tube on the MCHE also needs to be at least 70mm to protect the tube-to-header brazing joint.

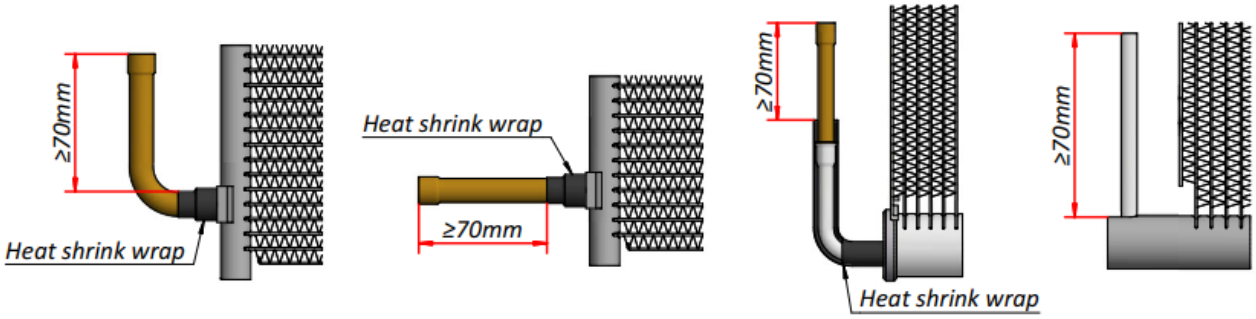

Fig. 5-5 The pipe length after the braze joint should be longer than 70mm.

Check and clean the copper tubes before brazed into the refrigeration system so that there are no copper cuttings (residuals from the previous manufacturing processes) which may flow into the MCHE with the refrigerant during operation.

Warning: When removing the rubber stop which keeps nitrogen inside the MCHE under pressure, we suggest using a special puller to avoid injuring the fingers.

The rigidity of MCHE is higher than that of tube-fin heat exchanger because of the entire NB furnace brazing. When customer connect the inlet and outlet connections of MCHEs to their unit, they should evaluate the system vibration effect on the MCHE and take proper cushioning measures to prevent the inlet & outlet connections from cracking in the long term.

5.3. Coil installation

The MCHE condenser is designed to have the airflow and refrigerant in a cross-flow configuration. To optimize the two flows, install the condenser vertically or at least 15° from horizontal, with the refrigerant inlet tube in the upper position relative to the outlet tube. We suggest to install the outdoor on the roof or some height on the outside wall. If you have to install the outdoor on the ground, please prepare a special platform with height no less than 0.5m to install it.

When installing MCHE, we suggest to keep the MCHE away from the water dropped down from copper components to avoid the corrosion.

MCHE would get shoe mark on the lower side during NB furnace brazing. When Installation, the shoe mark face of MCHE coils should be better on the leeward face of AC unit to avoid the potential negative influence of shoe mark on the appearance and other properties of coils.

Ensure that the air flow is distributed evenly across the entire face area to attain the specified capacity. Seal wide gaps between coil and installing metal sheet, and the gaps on the non-fin areas of flat tubes with proper sealant to make sure there is no by-pass between the fan inlet and outlet showed in Fig.5-6.

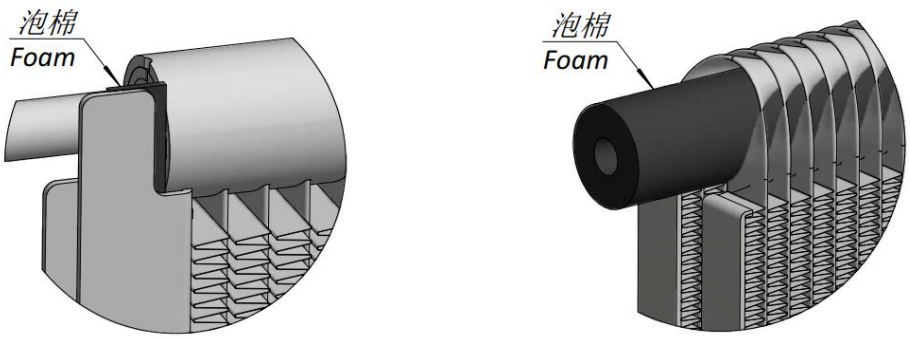

Fig. 5-6 Seal the gaps with foam

Thermal expansion of aluminum is higher than most other materials. To avoid the continuous thermal stress that may decrease a product's life, the MCHE must be mounted with at least some flexible brackets to keep the coil can expand freely along the flat tube length direction, and unnecessary stress or tension is not applied to the heat exchanger or its connections.

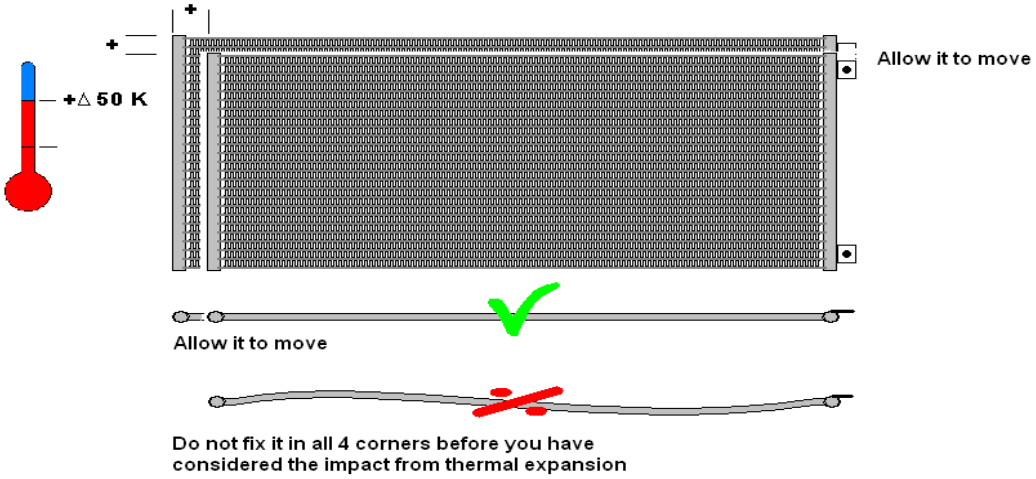

Fig. 5-7 Coil with flexible brackets

Using rubber or plastic grommets, bumpers, etc. between the brackets and MCHE can not only decrease the thermal stress, but also can avoid galvanic corrosion resulted by direct contact between the coil and other different metal. If it can't be avoided that MCHE will contact with metal fasteners and/or frames, we suggest to insert plastic/rubber/foam between the aluminum coil and dissimilar metals, or choose suitable alloy, paint or coatings to avoid the contact.

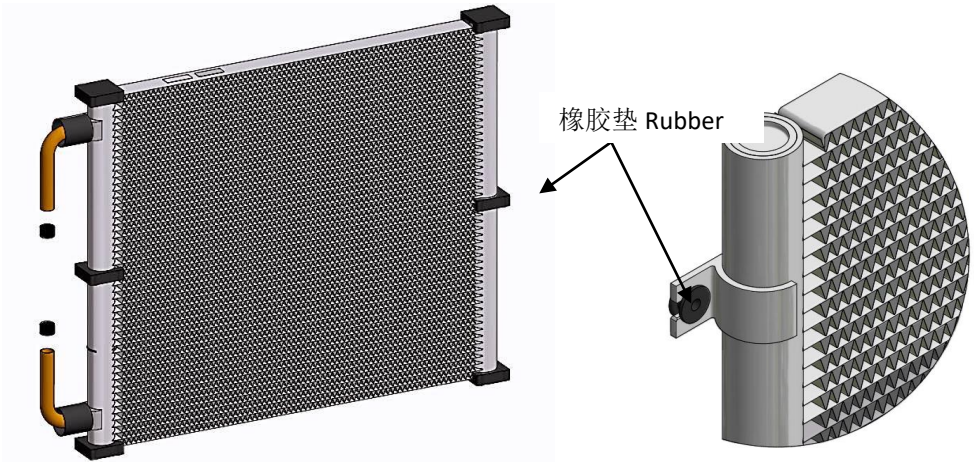

Fig. 5-8 Installation with rubber

In order to meet customer's specific requirements, a variety of different mounting brackets are available, as shown below:

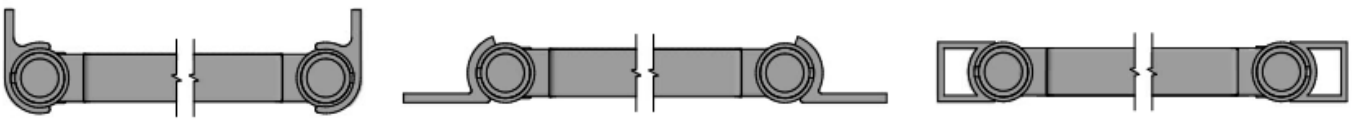

Fig. 5-9 Different brackets

For more bracket options and installation methods, please contact Sanhua engineers for more information.

If using end plate to install the coil, customer must take measures to evaluate the thermal stress and vibration effect on the coil.

.....

6. Refrigerant charge

Sanhua MCHEs require a significantly smaller refrigerant charge than tube & fin heat exchangers. Too little or too much charging will both decrease the system capacity. Sanhua suggest to follow strictly with the rate refrigerant charge and operation process introduction that the air conditioner manufacturer require.

Refrigerants used to charge the MCHE should be from reputable manufacturers and must meet international, federal, state, and regulations and standards. Do not mix different brand refrigerants to charge the system. When charging flammable refrigerants like R32, R1234yf etc., the refrigerant should be away from fire and high temperature heat sources which may cause fire, including brazing and smoking. After charging the refrigerant, a leak test should be made before running the system.

Sanhua MCHEs are designed for evaporators and condensers of refrigerants group I and II. The refrigerant type used shall be in accordance with the refrigerant type indicated on the product label; Or the used refrigerant type shall be in accordance with the technical requirement of the approved drawing. Do not use any kind of refrigerant not authorized by Sanhua.

.....

7. Leak and E-coating Repairing Procedures

7.1.Leak repairing procedure

The procedure that repairing Micro channel tube leakage by torch brazing is only to be used for flat tube repair. Prepare the following materials and tools：

Tab. 7-1

Materials	Tools
• Non-corrosive flux • Pre-fluxed zinc-aluminium repair wire • Non-corrosive flux-cored Zn-Al based brazing filler wire • Stainless steel heat shield or high temperature resistant fibre • Nitrogen or compressed dry air	• Refrigerant detecting instrument • Extinguisher • Needle nose pliers (long nose) • Brush • Knife • Oxy-Acetylene torch

For a unit using nonflammable refrigerants, after finding the refrigerant leak, and before starting the repair, use the appropriate equipment to evacuate the unit to ensure no refrigerant is left, then repair the MCHE according to the below steps.

For unit using flammable refrigerants like R32, R1234yf etc., there should be no fire, equipment that may produce spark and high temperature heat source which may cause fire in the surrounding environment. When finding the refrigerant leak, firstly disperse the crowd, then take actions to recycle the refrigerant urgently to ensure no refrigerant left in the unit. Then use nitrogen to blow away remain refrigerant around the environment. At last, use detecting instrument to check the refrigerant purity. Carry out the following MCHE repair work after the refrigerant purity is zero.

The below instructions assume that you are familiar with general air conditioning repair procedures.

1) Leakage check

Leak check per the units manufacturer’s instructions or as follows. Use nitrogen or compressed dry air to pressurize the heat exchanger, and then detect the leak point by spraying the coil with a soap solution and looking for bubbles and/or foam.

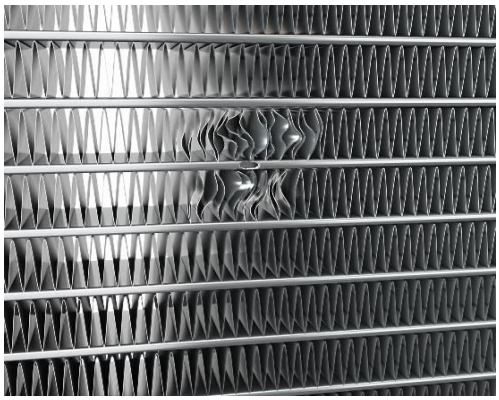

Fig.7-1 Leak point

2) Clean the leak point

Clean the dirt from the surface around the leak point with a brush and water.

Eliminate the oil and contaminants around the leak point using alcohol.

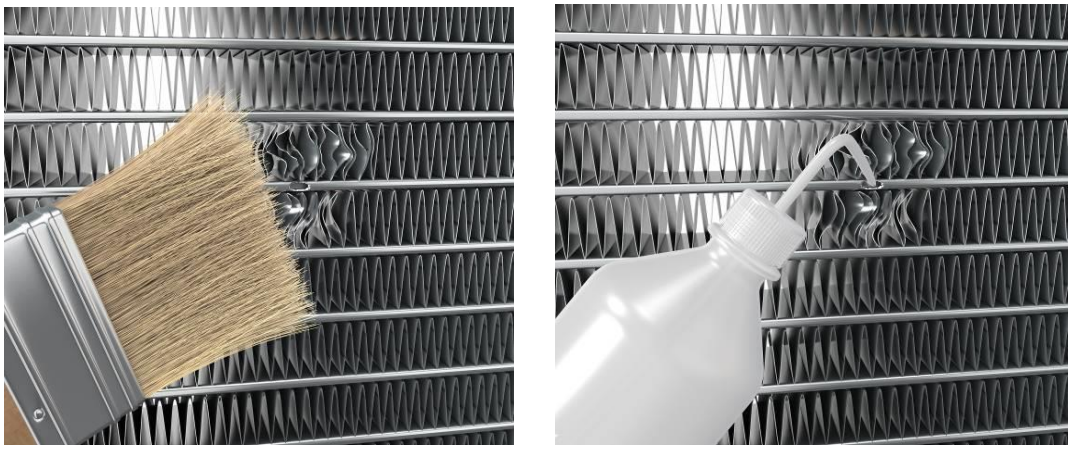

Fig. 7-2 Clean the leak point

3) Open the leak point by using a knife

Open the leak point diameter to at least 1 mm by using the tip of knife carefully. Remove all aluminum fragments;

Shape the cut to make it easy for the brazing material to enter the leak area.

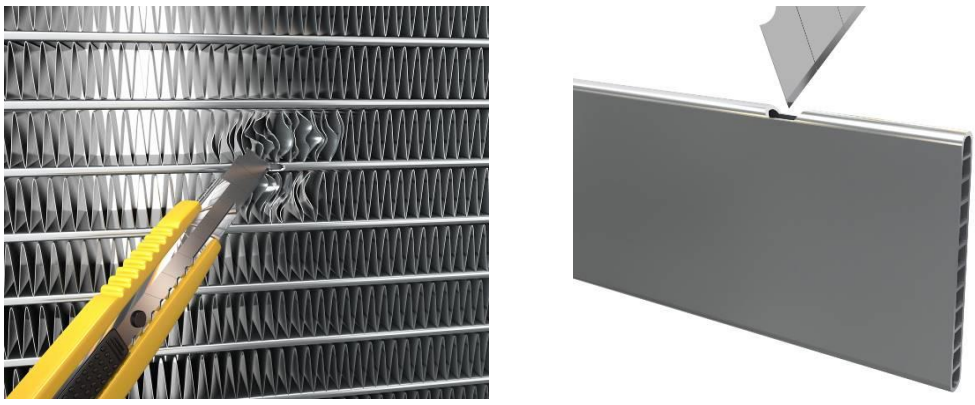

Fig. 7-3 Open the leak point

4) Clean the surface around the leak point with alcohol.

5) Place a thermal baffle around the damaged area to protect adjacent tubes and air centers.

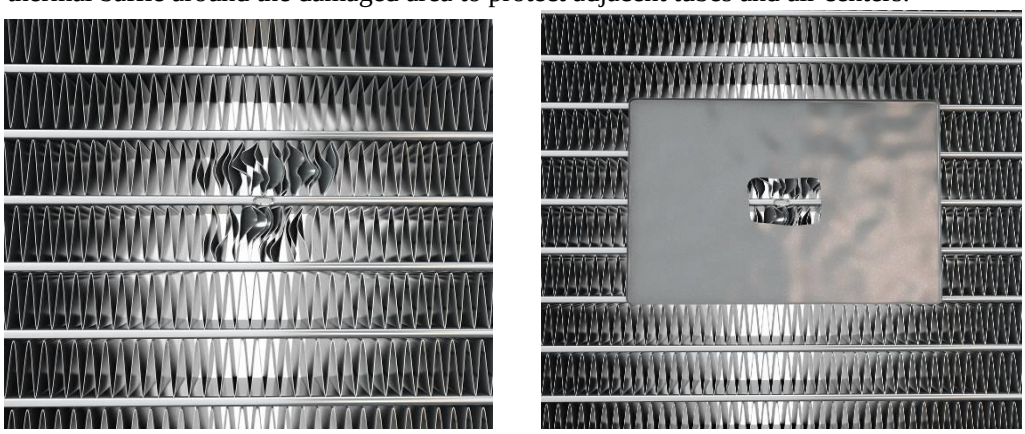

Fig. 7-4 Protect the tube near the leak point

6) Adjust the torch tip to a neutral or rich carburizing (low oxygen) flame (450℃-500℃), and evenly heat the damaged area. Then move the solder wire to the damage area and gradually make the solder fill the coil tube ports. At last, cool and remove the thermal baffle.

Warning: The coil tube walls are very thin, and it is possible to burn through the tube wall if excessive heat is applied. Sanhua suggest that the operator need to wear the protective glasses and take other effective actions to protect eyes and skin from being burnt.

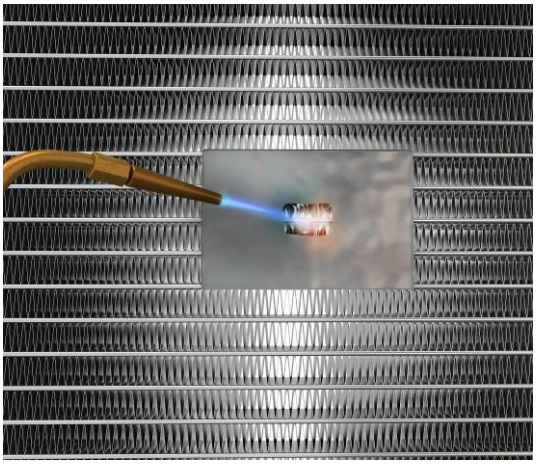

Fig. 7-5 Brazing the leak point

Fig. 7-6 Check leakage

7) Remove the welding torch and all the high temperature heat source. According to the air condition system operating instruction, repeat original leakage check to ensure that the leak point has been plugged.

8) After the MCHE is repaired and checked that there is no leakage, reinstall the coil in the unit and charge with refrigerant. Test the performance of the unit.

.....

7.2.E-coating repairing procedure

Please prepare the materials and tools below before repairing the e-coating.

Tab. 7-2

Materials	Protection materials	Chemical
• Sandpaper • Nylon bristle brush • Scott Brite pads • lint free cloth • Textured tape	• Protection glasses • Face mask • Plastic gloves	• Alcohol or Acetone

Don't use in rainy days or cold climates. Please carefully read the content regarding Safety, Storage and Product Characteristics, which may present on can body or packaging or technical documents provided by manufacturer and/or reseller. Please follow up the repairing procedure below.

1) Ensure to shut down the power of the unit prior to the repair work.

2) Use sandpaper, nylon bristle brush and Scott Brite pads to clean the defect area. No dirt, chip, lint and any other contaminants is permissible on the surface of coil.

Caution: Only the end plate and the header are allowed to use sandpaper to clean. The flat tube area should not use sandpaper to avoid damaging the flat tube.

3) Use lint free cloth to wipe off and clean the affected repair area by using Alcohol or Acetone. Please note refer to the Material Safety Data Sheet (MSDS) for proper handling procedures when use any chemicals.

Caution: The protection glasses, face mask, plastic gloves shall be used when applying chemical.

4) Allow the surface dry thoroughly. Then use tape (such as textured tape) to mask the area you do not want to be coated. Normally the end line of touch up paint is recommended to exceed at least 15-20 mm form repair area boundary line.

5) The recommended paints from Sanhua are represented in the following table, Tab. 7-3. Prior to application, shake the paint in order to mix the paint solution completely.

6) Spray uniformly with 5-15 cm away from the defect area.

7) Spray 2-3 times and wait 5-10 minutes for each interval. Note that spray too much once would lead to coating runs.

8) After spraying, wait until coating is dry and then remove the tape materials.

9) Continue to wait until coating has cured before restarting the unit.

Caution: Inquire the proper drying condition and time from paint spray can supplier.

Tab. 7-3

Recommended Spray Can paint			
Product Name	Aerosol Spray Can Paint 39# Black (aerosol cans)	ElectroFin E-coat Black Touch Up (aerosol cans)	Aqua Aero Coil Coat Black Touch-up Spray Cans (aerosol cans)
Manufacturer	Shenzhen Sunrise New Energy Co., Ltd. or Shenzhen Rainbow Fine Chemical Industry Co., Ltd.	Modine Manufacturing Company	Aqua Aero Coatings BV
Reference picture			

.....

8. Cleaning Procedure for MCHE

Outdoor Air Heat Exchangers in general, Micro Channel Heat Exchangers more specifically, are susceptible to fouling because its nature depending on the particulates present in the atmosphere during the operating conditions.

The fouling of heat exchangers not only has a negative impact on heat transfer efficiency but also is directly correlated to the lifetime of the equipment because a dirty coil will accelerate the corrosion progress and, ultimately, it may potentially cause system failures.

Dirt on the coil surface will increase the air side pressure drop and decrease the energy efficiency of a system. What's more, much dust on the coil surface will accelerate the corrosion progress and may potentially cause system failures. So, the system and the coil should be periodically inspected and cleaned according to the cleaning procedures based on the application environment to decrease the corrosion caused by dust accumulation.

Types of fouling encountered on the external surfaces of a Micro-Channel Heat Exchanger may include, but not limited, to the following:

- Dirt, dust and debris
- Pollen and leaves
- Insects and bird carcasses
- Trash (plastic bags, paper)

Fouling on the MCHE surface tends to grow over time, it will increase the air side pressure drop, reduce the heat transfer, and decrease the energy efficiency of the whole system.

For the above reasons, Cleaning is a critical part of the healthy maintenance of Outdoor Air Heat Exchangers, but the microchannel cleaning procedures can differ from those for cleaning traditional fin-and-tube coils.

Luckily, compared to fin-and-tube heat exchangers, microchannel coils tend to accumulate more fouling on the surface, and less inside the coil which can make it easier to clean.

The personnel in charge with the operation, supervision, and maintenance of the MCHE Cleaning process must be adequately instructed, according to the reference Standard EN 378-4:2008, "Refrigerating Systems and Heat Pump – Safety and Environmental Requirement. Part. 4: Operation, maintenance, repair and recovery".

Also, according to the same Standards, it is recommended that the personnel in charge shall keep an updated logbook of the Process.

The Cleaning logbook, that can be a part of the maintenance documents for the whole system, may include, but not limited, for example the following items:

- Date of the performed duty
- Details of all maintenance work
- Record of the operations executed during the activity
- Picture of the coil surface before and after the cleaning

In conclusion, MCHE should be periodically inspected and cleaned according to the following cleaning procedures based on the application environment identified by the 5 Atmospheric Corrosivity Category classes (ISO 9223).

We identify three different levels of cleaning procedures:

1. Visual Inspection
2. Water Rinse Cleaning
3. Cleaner Cleaning, specifically for E-coated coil only

The frequency of this servicing is much depending to the installation area and spot conditions, but it is suggested to be no less the one indicated on the table below.

Table 8-1 Frequency indication for Cleaning Procedures based on different areas

Atmospheric corrosivity category (ISO 9223)		**C1, C2**	**C3**		**C4**	**C5**	**CX**
			Inland	**Coastal**			
Corrosivity		**Very low, Low**	**Medium**	**Medium**	**High**	**Very high**	**Extreme**
Type of MCHE	**Type of Inspection / Cleaning**	**Typical environments-examples**					
		Indoor, Rural areas	**Urban areas**	**Urban areas**	**Polluted Urban, industrial, coastal areas**	**Very high pollution & salt deposition areas**	**Extreme industrial, coastal areas**
All (*)	Visual Inspection	Monthly	Monthly	Monthly	Monthly	Monthly	-
All (*)	Water Rinse Cleaning	Annually	Once a quarter	Once a quarter	Monthly	Monthly	-
All (*)	Cleaner Cleaning	Bi-annually	Bi-annually	Bi-annually	Bi-annually	Bi-annually	-

(*): Note that within this group we include Bare coil, MCHE with TCP treatment and with E-coating.

8.1. Visual Inspection

Note: This inspection is applicable for all the type of MCHE!

Regular visual inspections are essential to increase the reliability and lifetime of microchannel heat exchangers. During every scheduled maintenance procedure, check the heat exchanger for mechanical damages, leakage, or corrosion signs. If any of the above revealed, provide additional diagnostic to determine and overcome the reason for the problem.

An example of the activities to be performed may include, but not limited, the following:

- Check for trash (plastic bags, paper)
- Visual examination of the coil surface
- Presence of external damages due to hit or other
- Overview of the quality surface and missing corrosion inception

8.2. Water Rinse Cleaning

Note: This procedure is applicable for all the type of MCHE!

The build-up of fouling on the aluminum surface, which is exposed to moisture, can reduce the durability of the heat exchanger. The maintenance and cleaning procedures below are part of the regular maintenance and will prolong the life of the coils.

CAUTION: Before cleaning the coil, ensure the power of unit is tuned off. This should be done before any service work on any electrical equipment. In addition, appropriate personal protective equipment (safety glasses, gloves, etc.) should be worn.

The clean procedures are as following steps:

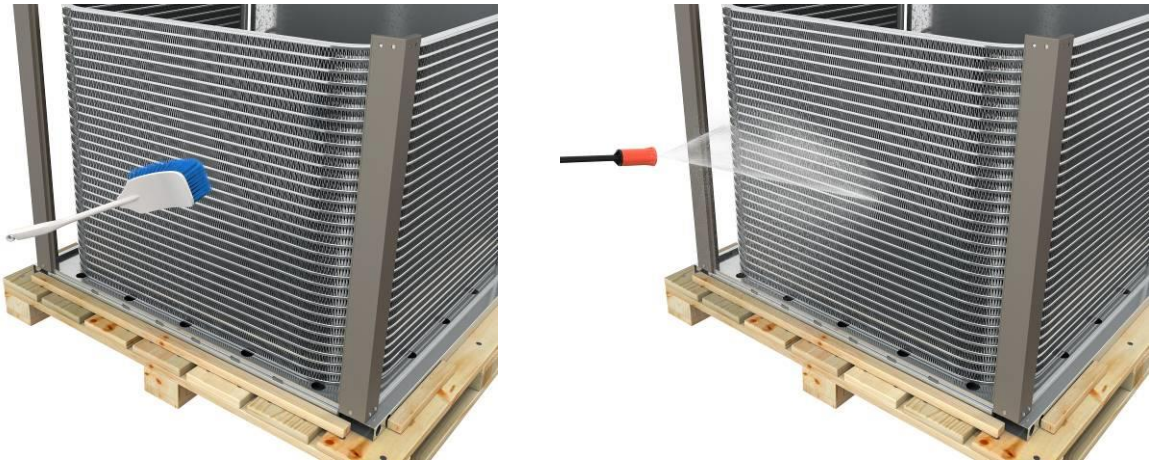

Fig. 8-1 Clean the MCHE

Step 1: Remove surface debris

Remove surface dirt, leaves, fibers, etc. with a vacuum cleaner (preferably with a brush or other soft attachment) or a soft brush, compressed air blown from the inside out, or a soft bristle (not wire!) brush. In either case, the tool should be applied in the same direction of the fins height to avoid deforming the fins.

Do not impact or scrape the coil with the vacuum tube, air nozzle, etc.

NOTE: If the dirt and contaminants are not removed, water rinse will drive them into the coil which will make cleaning efforts more difficult. Surface dirt and contaminants must be completely removed before using water rinse.

Step 2: Water rinse

Do not use any chemicals (including those advertised as coil cleaners) to wash MCHEs. It can cause corrosion. **Rinse with water only**.

Hose the MCHE off gently, preferably from the inside to outside and top to bottom, running the water thru every fin passage until it comes out clean. Micro channels fins are stronger than traditional tube and fin coil fins, but they still need to be handled with care. Do not bang the water onto the coil surface.

Step 3: Blow dry (*optional*)

Because of MCHE's fin geometry, it tends to retain more water than traditional tube and fin coils. Depending on the specific design and installation of the coil, it should be beneficial to blow or vacuum out the water from your unit to speed up the drying.

WARNING!

It is feasible to carefully clean a coil with a pressure washer, **but we do not suggest because it may totally damage a coil if the pressure is too high.**

If using high-pressure washer, the distance between it and the coil surface should not be too close. At the same time, we recommend putting your thumb over the end of the hose to make the water flow out gently and decrease the possibility for impact damage and keep nozzle centerline and coil surface as vertical angle as much as possible.

Warranty claims related to cleaning damage, especially from pressure washers or chemical attack, will not be honored.

8.3. Cleaner Cleaning

Note: This inspection is applicable for all the type of MCHE!

Routine cleaning is essential to extend the life of a MCHE. **The biannual (2/year) cleaner cleaning and chloride removal should be used for Sanhua MCHE coils besides routine water rinse clean**. Failure to clean a MCHE coil will cause invalidation of the warranty and even result in reduced efficiency and durability in the environment. The following cleaning procedures are suggested to be a part of the routine maintenance activities.

Documented routine cleaning of Sanhua MCHE coils is required to maintain warranty coverage under the Sanhua's terms and conditions of sale.

8.3.1. The biannual (2/year) cleaner cleaning

Besides routine water rinse clean, the biannual (2/year) cleaner cleaning and chloride removal should be used for Sanhua MCHE coils. For routine biannual cleaning, first clean the coil with the approved coil cleaner below (see approved products list under Recommended Coil Cleaners section).

After cleaning the coils with the approved cleaning agent, for the E-coated coil use the approved chloride remover (under the Recommended Chloride Remover section) to remove soluble salts.

CAUTION: Before cleaning the coil, ensure the power of unit is tuned off. This should be done before any service work on any electrical equipment. In addition, appropriate personal protective equipment (safety glasses, gloves, etc.) should be worn. It is recommended to wear clothing that covers the whole body.

The clean procedures are as following steps:

Step 1: Removing Surface dirt and contaminants

A soft non-metallic bristle brush, vacuum cleaner or other cleaning tools can be used to clean the fibers and contaminants on the coil surface prior to applying cleaner.

Mix the correct amount of approved cleaner and water in accordance with the manufacturer's directions on the container. Using pump up sprayer to apply the mixed cleaner on coil surface to remove mold, mildew, dust, soot, greasy residue, lint and other particulates. Keep the cleaning solution to stand 5-10 mins and use water rinse to clean the coil surface thoroughly and carefully.

Recommended Coil Cleaners		
Product	**Type of MCHE**	**Agent**
Nu-Calgon Evap Pow'r-c	Bare coil / TCP coil	www.nu-calgon.com Amazon.com
GulfClean™ Coil Cleaner	E-coated coil	www.ModineCoatings.com/shop Amazon.com Home Depot Supply

Step 2: Water rinse

Hose the MCHE off gently, preferably from the inside to outside and top to bottom, running the water thru every fin passage until it comes out clean. Micro channels fins are stronger than traditional tube and fin coil fins, but they still need to be handled with care. Do not bang the water onto the coil surface.

Step 3: Removing the soluble salts on the surface (**for E-coating coil only**)

GulfClean™ Salt Reducer can be used to remove soluble salts from the e-coating coil, but the instructions must be followed closely.

Soluble salts may be beneath any soils, grease or dirt and adhere themselves to the substrate of the coil surface. For the effective use of the recommended chloride remover, these barriers must be removed on step 1 prior to application of this product.

Recommended Coil Chloride Remover		
Product	**Type of MCHE**	**Agent**
GulfClean™ Salt Reducer	E-coated coil	www.ModineCoatings.com/shop Amazon.com Home Depot Supply

After cleaning the surface dirt and contaminants, apply chloride remover directly onto the substrate. Sufficient product must be applied uniformly across the substrate to thoroughly wet out surface, with no areas missed. This may be accomplished by use of a pump-up sprayer or conventional spray gun. We can also use other methods to wet the entire surface. After the substrate has been thoroughly wetted, the salts will be soluble. Allow the chloride remover mixture stand for 5-10 mins.

It is highly recommended that a hose should be used, as a pressure washer will damage the fins. The water to be used for the rinse is recommended to be of potable quality.

Step 4: Water rinse

Use water rinse to clean the coil surface thoroughly and carefully.

Hose the MCHE off gently, preferably from the inside to outside and top to bottom, running the water thru every fin passage until it comes out clean.

Step 4: Blow dry (*optional*)

It is beneficial to blow or vacuum out the water from your unit to speed up the drying.

WARNING： Except for recommended cleaner, harsh chemicals, household bleach or acid cleaners should not be used to clean MCHE coils. It is very difficult for these cleaners to be rinsed out of the coil and it can accelerate the coil corrosion.

WARNING： High velocity water from a pressure washer or compressed air may cause coil damage or fin deformation increasing airside pressure drop. What's more, it may reduce unit performance or lead to unit stopped. Therefore, it is important to use low pressure water or air to clean the coil surface.

.....

9. Safety and environmental protection

Please refer to the instruction book before installing the product. Handle the product gently to avoid damaging the product when installing. If you have any question, please contact the technology engineers at Sanhua MCHE.

When installing the products in the units or during maintenance work, workers shall have the related professional qualifications, and shall take proper labor protection measures to ensure their safety during the work.

If using high temperature flame brazing when repairing the product, do not touch the repaired area and protect yourself from getting a burned by the high temperature.

The coil is composed of different aluminum alloys, when scraping the coils, please recycle the material, don't discard carelessly; meanwhile keep in mind that there is oil residuals in the coil after being used in the refrigerant system, it should be recycled in order to meet the environment protection requirements of local laws and regulations.

In order to reduce the greenhouse effect and protect the earth's ozone layer, it is recommended that customers use environmentally friendly refrigerants.

For using flammable refrigerants like R32, R1234yf, R290 etc., the products should be installed in the place with better ventilation. And the surround environment should not have fire, equipment that may produce spark and high temperature heat source which may cause fire.

.....

10. Water applications

When aluminum microchannel heat exchanger is used in water system, there are risks of heat exchanger leakage due to medium acidification, dissimilar metal galvanic corrosion, impact corrosion, cavitation corrosion and so on.
In order to delay the internal corrosion and achieve the expected life of the product, Sanhua has the following 6 requirements for the application of aluminum microchannel water radiator:

1. Working pressure

The working pressure in system shall be strictly in accordance with the requirements of Sanhua drawings.

2. Fluid medium

Factors such as pH value of fluid medium, destruction of passivated film ions, corrosion inhibitors all have a significant impact on corrosion, while containing solid impurities may produce erosion and corrosion, etc. so the fluid medium should meet the requirements below.
The refrigerating liquid shall be a mixture of water, ethylene glycol, and corrosion inhibitor and shall be deionized water as per ASTM1193 Types Ⅰ-Ⅳ
The pH must be controlled between 7 and 8.2. Corrosion inhibitors are recommended as follows:

- Organic acids（carboxylate）
  Very effective and long-lived inhibitor, but degrades organic materials such as nylon.
- Mixing organic acids with phosphates
  Efficient long acting inhibitor, used by Asian automobile manufacturers
- Mixing of low silicates with organic acids
  A very effective long-life inhibitor used by North American and European automotive manufacturers
- Other inhibitor systems, such as nitrate-aluminum pitting, anti-foaming agents (ASTM D1881), Anti-cavitation agent (ASTM D2809), bitter agent, etc.
- Sanhua recommend that the concentration of the mixture (glycol + inhibitor) in water should stay between 25% and 60%. In the market there are different commercial brands of this blend (glycol + inhibitor) ready to use for which you should also refer to their working guidelines.
- Refrigeration liquid should be selected suitable for system pipeline material and working temperature.

3. System maintenance

Regular maintenance of refrigerating liquid will greatly improve the corrosion resistance life of products.
The water system loop must be closed, the entry of oxygen should be prevented as far as possible, and effective measures should be taken to clear the air inside the system.
Ensure proper exhaust design, in particular timely discharge of H2
A 100-mesh filter should be used when the system is started to filter impurities, and an 80-mesh filter should be used during normal operation.
Regularly monitor the proportion of refrigerating liquid and corrosion inhibitor, and replace and add them in time.

4. The velocity

In general, the higher the flow rate, the stronger the shear and impact effect on the metal surface, especially when solid particles begin to appear in the fluid, easy to cause erosion and corrosion.

The maximum allowable flow rate is 1.4m/s.

5. Material of system parts

The use of brass/copper and other components in the water system should be avoided as far as possible to reduce the risk of product corrosion. Other metals should be minimized and the distance from aluminum components should be controlled at least 5mm as far as possible.

The non-metallic parts in the system should be compatible with the refrigerating fluid without any reaction. The non-metallic materials in the pipeline system should be selected to ensure high temperature resistance to reduce the system permeability.

6. Fluid temperature

Generally speaking, the higher the temperature, the faster the corrosion rate, but there may be biological corrosion at low temperature. So, the appropriate refrigerating liquid is important. At present, the working temperature of Sanhua micro channel water radiator is below 121℃.

.....