MANUAL FOR THE INSTALLATION OF REFRIGERATING SYSTEMS FOR COLDROOMS AND DISPLAY CASES

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page	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
rev.	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
page	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Rev.	A	A	A	A	A	A	A	A	A	A	A	A	A	A	-

RECORD OF CHANGES

Rev.	CHANGE ORDER N°	Date	Approval	Description of change
-	N. A.	30/12/97		Formal issue
A	N.A.	06/05/02		Revision of organisation and standards

TABLE OF CONTENTS

Section Page

1. AIM

The present manual specifies some technical standards for assembling the refrigerating systems for coldrooms and display cases on behalf of COSTAN and following COSTAN's instructions.
It is understood that any work performed, however not explicitly provided for, will have to be carried out professionally and according to the best technological knowledge.

2. DOCUMENTS

2.1. APPLICABLE DOCUMENTS

a) QUALITY MANUAL
b) QM00193Q “product installation”

2.2 REFERENCE DOCUMENTS

a) UNI EN ISO 9001
b) UNI 8011
c) installation manuals for Costan products.

3. OVERVIEW

a) assembly must be performed according to UNI standards, with special regard to standard UNI 8011.
b) Work must strictly comply with the instructions appearing in the design supplied by COSTAN.
c) Unless special design instructions are provided, the instructions in COSTAN technical documents will have to be followed and especially:
   - the installation manual
   - the instructions for the installation of the display cases
   - the instructions for the use of the refrigerating unit.

4. SUPPLY OF ASSEMBLING MATERIAL

a) Assembly will have to employ the materials that COSTAN supplied to the client.
b) If the materials supplied to the client are insufficient, upon COSTAN's permission, further material be supplied by the installer, who commits himself to purchasing them from original spare parts dealers; the properties of said materials must at least meet COSTAN's spare parts standards
c) Any surplus material supplied to the client will have to be returned to COSTAN.
d) Consumables will be supplied by the installer and will be included in the assembly estimate.

5. SPECIAL PROVISIONS

a) Solderings must be made in inert gas atmosphere.
c) Copper-on-copper solderings must be hard type (use alloy rods code 813000000).
d) Copper-to-steel and copper-to-brass solderings must be made using alloy code 813110000 and deoxidiser 813800000.
e) Soldering vessels and piping that contain refrigerant is expressly forbidden.
f) Pressure testing of refrigerating circuits must be performed according to the instructions appearing below in the present installation manual.

The evacuation will have to be done following the instructions appearing below in the present installation manual.

6. INTERACTION WITH OTHER INSTALLERS

The refrigerating system installer must co-ordinate his activity with the other firms possibly working on site in order for the best overall result to be achieved in quality terms.
For example:

- display case support walls
- drilling of walls and floors where the piping needs to run through
- piping systems
- water drainage.

7. DECLARATIONS TO BE SUPPLIED

At the end of the work the installer must issue a declaration attesting that pressure tests were carried out as prescribed.

8. COORDINATION

COSTAN can appoint a representative to coordinate operations and especially:

- contacts with the client
- the work progress
- the installation final inspection and testing.

9. FIRST VERIFICATION

Once the unit and the display cases have been brought to their service position, it is the installer's task to ensure that they have not been damaged during transportation and handling.
The refrigerating unit and display cases are delivered with the circuit filled with dry air plus a small amount of refrigerant gas at a pressure of 10-13 bar. Thus using a pressure meter it is possible to check the piping joints and evaporator for leaks that may have been caused during transportation.

10. SUCTION LINE

This is the most critical piping. When installing it the following rules must be observed:

10.1 LINE SLOPE

Suction line horizontal stretches must slope toward the return by 2% (towards the machinery room) in order for correct oil return to be ensured even under minimum charge conditions (low gas velocity) Fig. 1.

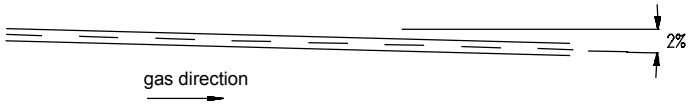


Fig.1

10.2 LINE INLETS

If the evaporator stands at a lower elevation, the relevant suction line pipe must only be inserted in the greater section pipe and from above (Fig. 2).

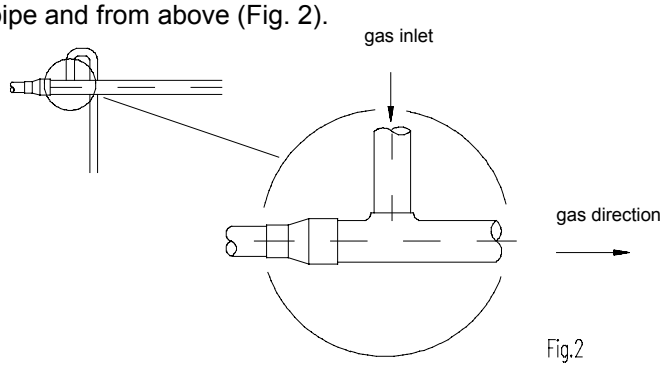


Fig.2

10.3. LINE INSULATION

The suction line must be insulated as far as the machinery room manifold using insulating material Armaflex type “F” for TN systems and type “M” (higher thickness) for BT systems. On double-stage BT systems with economiser, the insulation must be made using insulating material type "F" for the liquid line and type "F" for the suction line. On glycol systems, both refrigerant lines must be insulated by Armaflex type "M" or "T".

Pipe diam. int./ext.	ARMAFLEX “F”	ARMAFLEX “M”	ARMAFLEX “T”
8,5/10	F12	-	-
10,5/12	F12	-	-
12,5/14	F15	-	-
14,5/16	F15	M15	T17
16,5/18	F17	M17	T17
20,5/22	F22	M22	T22
26,5/28	F27	M27	T27
33/35	F34	M34	T34
39/42	F42	M42	T42
51/54	F54	M54	T54
62/66	F70	M70	T70
74/80	-	-	T80

10.4 UPWARD STRETCHES

Vertical suction stretches require that measures be implemented in order to facilitate the return of oil to the refrigerating unit. In particular, if a single appliance is cooled, the connection to be made is

represented in Fig. 3. The diameter of the upward stretch section can be smaller than the line diameter.

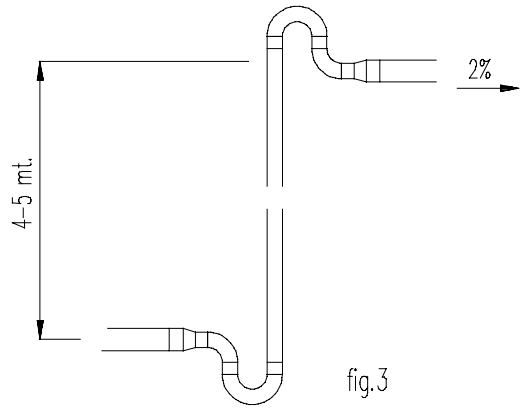


fig.3

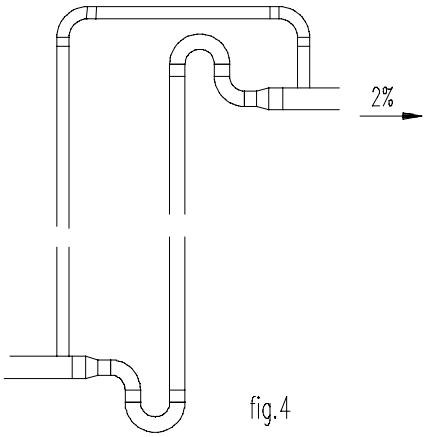


fig.4

Conversely, if the upward stretch is supposed to cool more than one appliance or if evaporators can be cut out individually, the pattern represented in Fig. 4 must be followed, which includes a smaller-section secondary upward stretch (by-pass)

For upward stretches beyond 4-5 mt, intermediate siphons will have to be implemented as shown in fig. 5, both for single and double upward stretches.

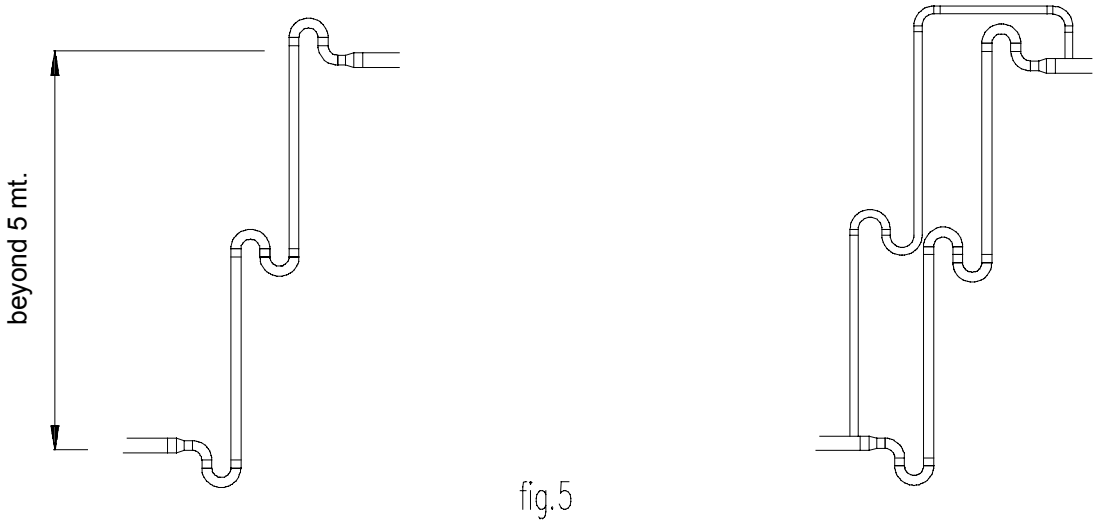


fig.5

11. DISCHARGE LINE

As a rule the discharge/liquid line poses no particular problem. It is however necessary to avoid having too many bottlenecks and bends which would otherwise cause high flow resistance.

11.1 DISCHARGE LINE BRANCHOFFS

The drawing shows the connections to be made for user piping branching off from a main line.

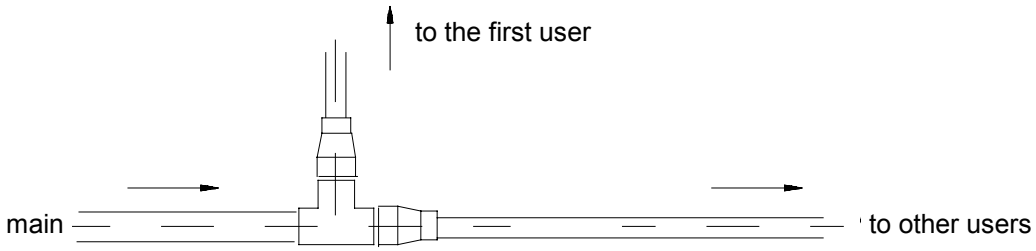


Fig.6

11.2 POSITIONING AND CONNECTING UP THE DISCHARGE MANIFOLD

If the refrigerating unit does not include a built-in liquid manifold (discharge to cooled appliances), the installer will have to choose the most appropriate position for manifold installation (Fig. 7).

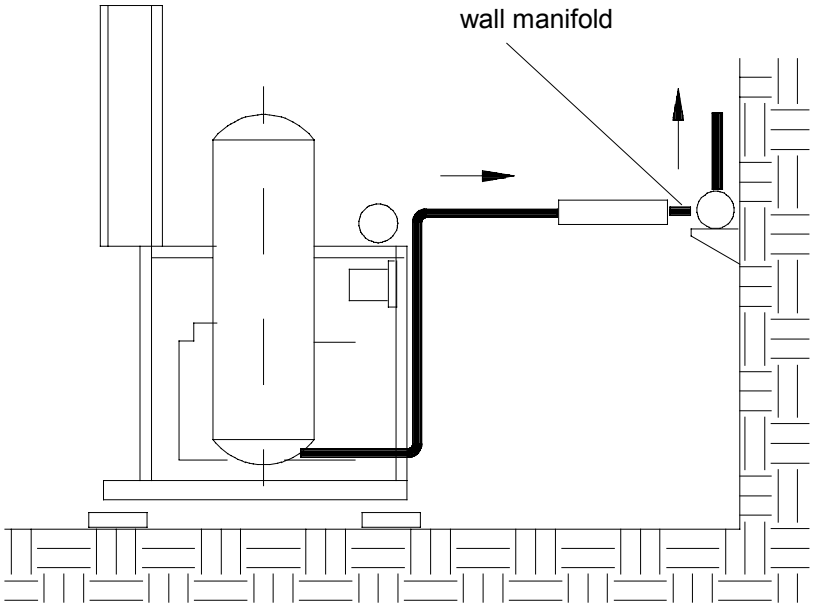


Fig.7

If the discharge line needs to branch off from a common manifold (located near the refrigerating unit), then two cases can be differentiated, depending on the position of the receiver being higher or lower than the evaporator's.
The receiver should always be placed higher than the evaporator. In this case the receiver – manifold – evaporator connection can be carried out as in Fig. 8.

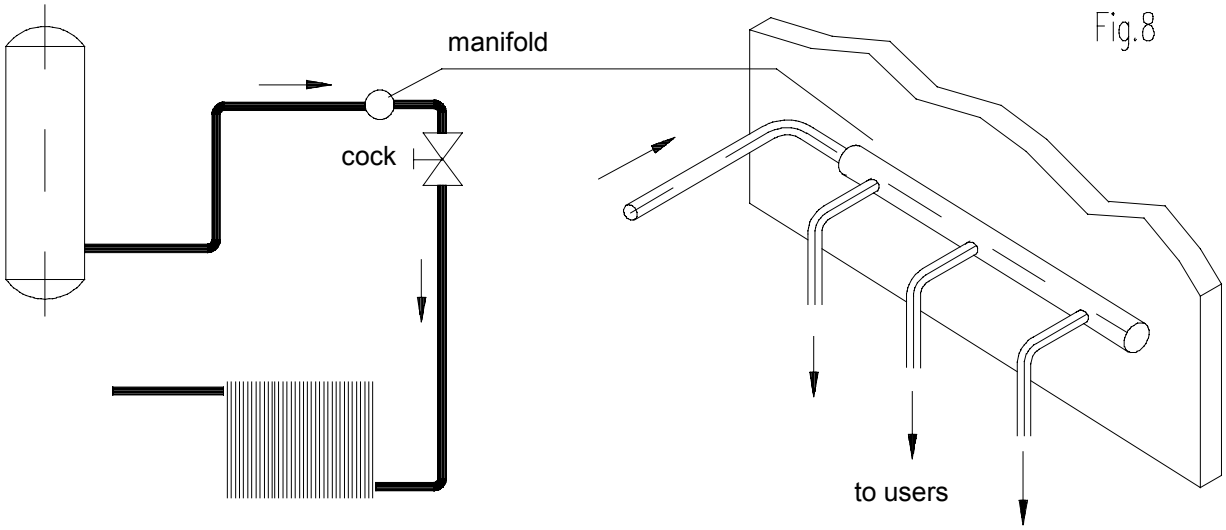


Fig.8

Conversely, if the evaporators elevation is higher than the receiver's, a connection like in Fig. 9 can be performed.

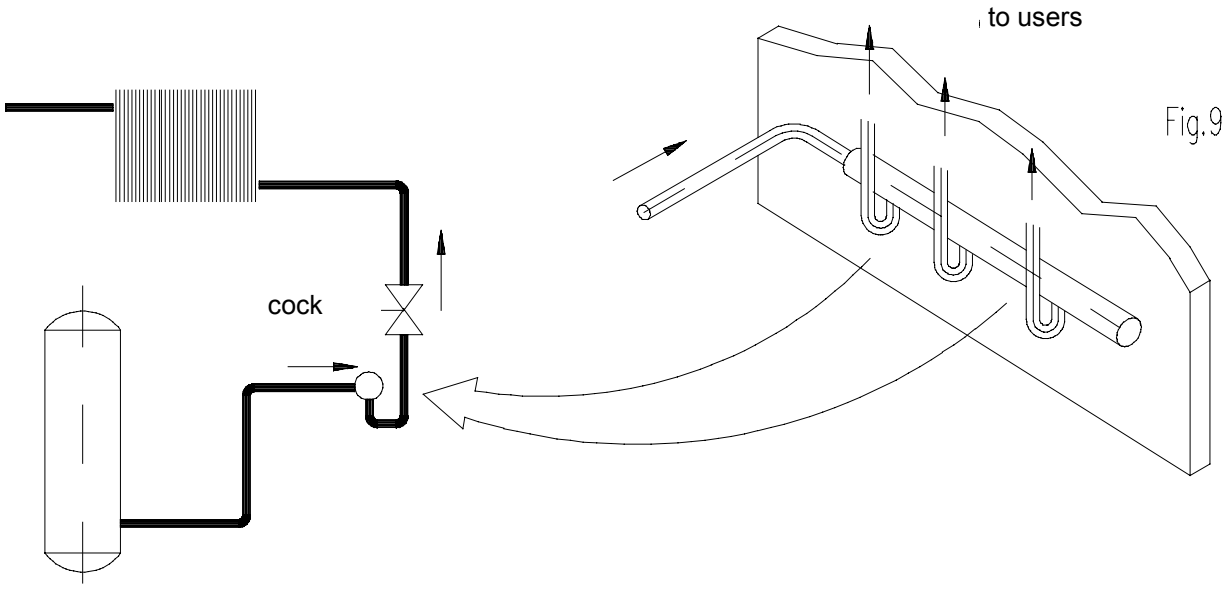


Fig.9

In this case the size of the liquid manifold will have to suit a very low velocity, so as to avoid undersupplying some of the circuits (velocity V < 0.4 m/s).
While installing, ensure that the liquid line does not run through excessively warm rooms: otherwise, the relevant stretch will have to be insulated (contact Costan engineering office).

12. REFRIGERATING UNIT/CONDENSER CONNECTION

As a rule, in refrigerating units with parallel-connected compressors, the hot gas line from the single compressor to the common manifold must slant downwards; the line leading to the condenser is also fitted with a check valve: this prevents any oil or condensed gas flowback during machine layoff periods.
The condenser must always be positioned at an elevation higher than the liquid receiver's. This will ensure the effective drainage of the condenser itself.
The connection between the compressors and the condenser, as well as the connection between the condenser and the liquid receiver must be carried out as in Fig. 10 so long as the difference in level

between the former two does not exceed 5 mt. Otherwise (beyond 5 mt.), the discharge line will have to include an intermediate siphon (to this respect, refer to the upward suction stretches section above).

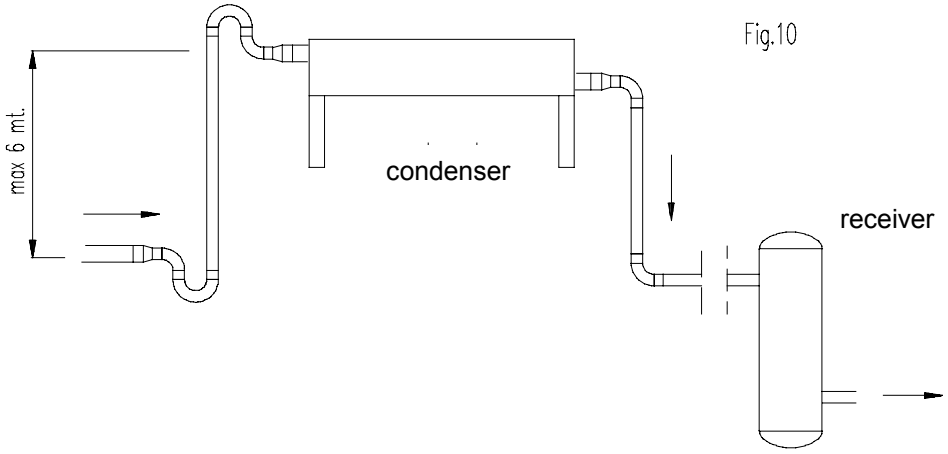
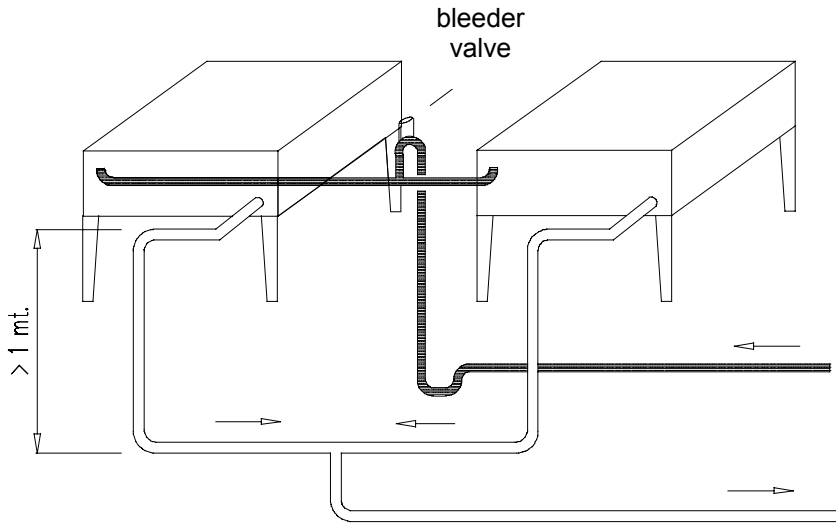


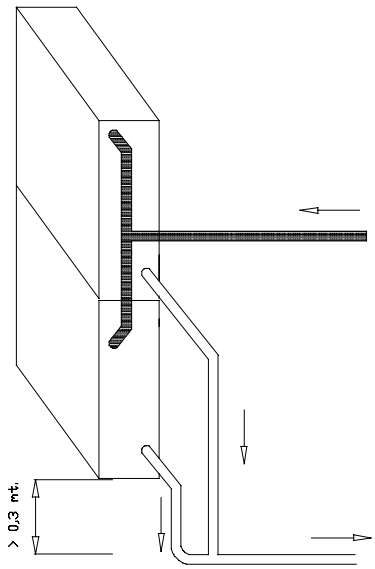
Fig.10

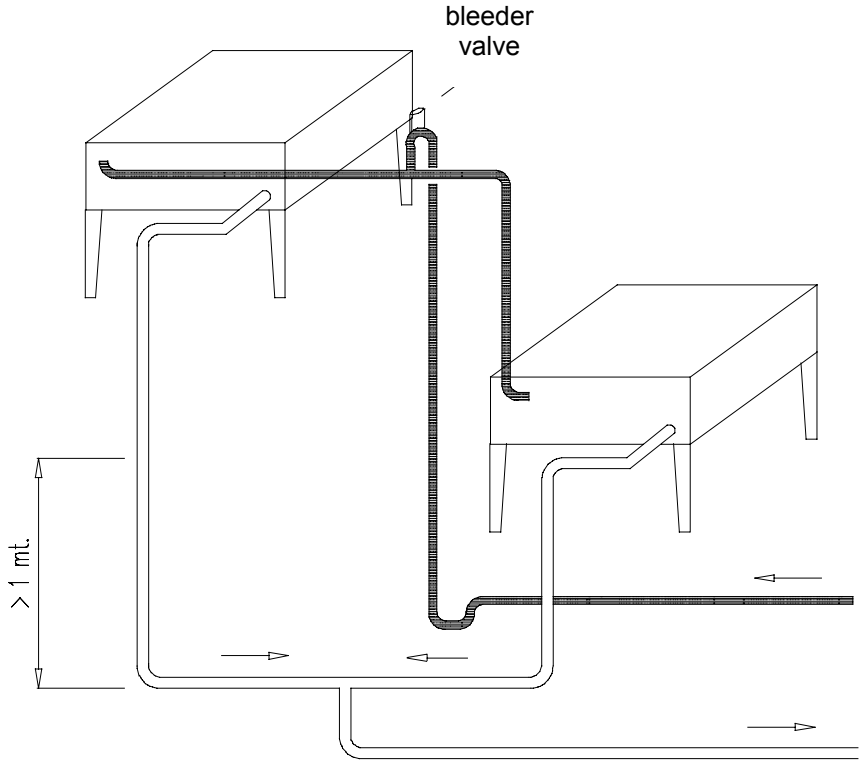
Line diameters must comply with the values appearing in the connection diagrams. As for positioning and fastening vibration dampers, refer to the next section.



The connection between two parallel condensers will have to be carried out as represented in the drawing above. Place an exhaust valve at the highest point of the installation (Fig. 11).

Two particular cases are dealt with below:
a) double-battery condenser placed vertical;
b) parallel connection of two condensers placed on different levels.





13. CONNECTION OF DISPLAY CASE PIPING

Before installing, study the best position for valves and cocks, considering that they might need maintenance (example: replacement of filter).

Mark out overall dimensions, the position of feet and incoming piping; position the pipes leading to and from the evaporator as represented in Fig. 12.

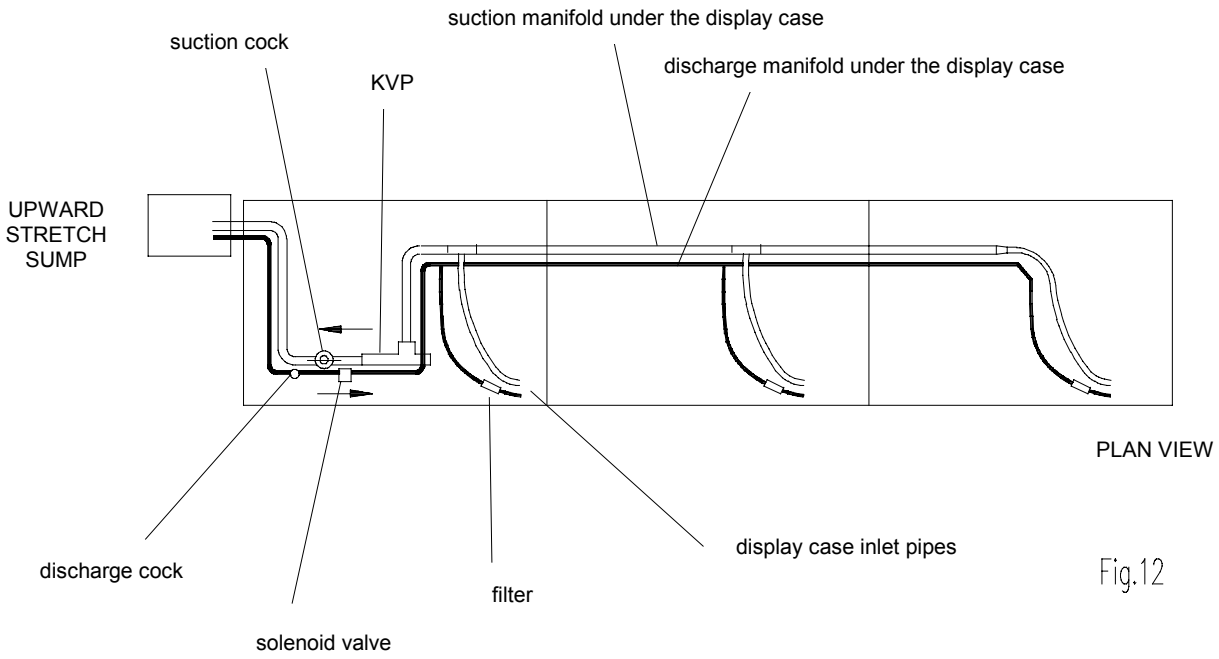
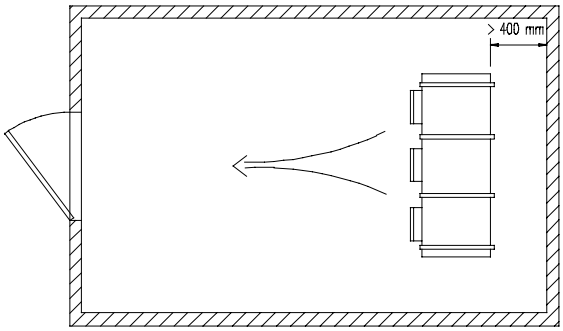


Fig.12

When provided for, the layout of valves, filters and cocks for standard display cases is as represented in the drawing above.
Display cases with independent electrical control board fitted with evaporation control system Danfoss AK10 do not require a solenoid valve, as the relevant functions are performed by the electrical valve AKV in the Danfoss system.

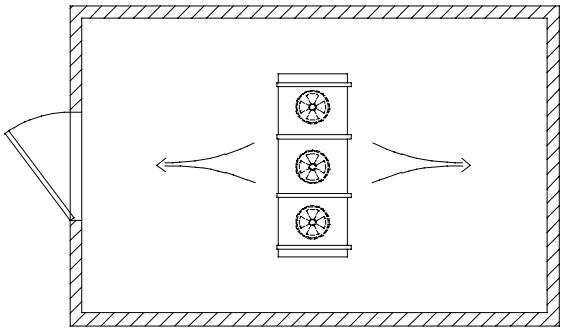
14. POSITIONING OF COLDROOM EVAPORATORS

Evaporators can be of two types:
a) wall-mounted;
b) double flow ceiling-mounted.
In case a) the evaporator is placed no closer than 40 cm from the wall opposite the door (depending on evaporator model), with the air flow arrow as in Fig. 13 a. In case b) the evaporator must be placed at mid-ceiling, with the longer side perpendicular to the coldroom greatest side, as shown in fig. 13 b.



Coldroom with wall evaporator

Fig.13-a



Coldroom with ceiling evaporator

Fig.13-b

15. CONNECTION OF COLDROOM PIPING

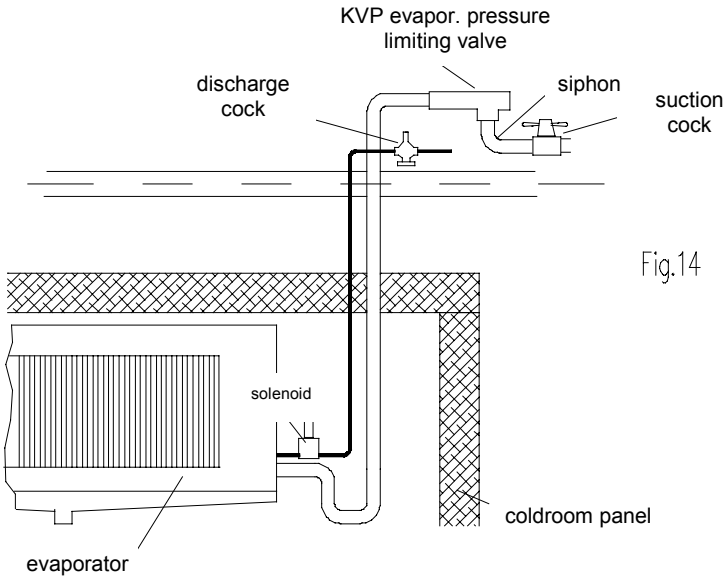


Fig.14

Solder valves and cocks respecting gas direction and the adequate brazing temperature (the pages below contain some general rules for soldering some of the components). The drawing does not show the filter and thermostatic valve, as these are factory-installed on the evaporator.

16. INDIRECT COOLING SYSTEMS

16.1 PIPING INSULATION AND CLAMPING

The discharge and return lines must be insulated using Armaflex type “M” or “T”. As for clamping, follow the instructions in the "Line fastening" section.

16.2 BLEEDER VALVES

To remove any air bubbles in the system while starting up, provide for 3/8" bleeder valves at the highest point in the glycol-affected piping stretch. To facilitate valve replacement, it is advisable to install a shut-off cock upstream of the valve.

16.3 CONNECTION OF DISPLAY CASES/COLDROOMS

The connection of display cases and coldrooms must comply with the diagrams in figs. 15 a-b.
Cocks must be installed using three-piece joints fitted with screw-connection o-ring on the valve side and by soldering on the pipe side.
The exhaust must be placed at the lowest point in the manifold under the display case, just outside the evaporators.
When it comes to evaporators for coldrooms, ensure that these have an exhaust connection. Otherwise, provide for an external cock.
Set the STAD balancing valves to guarantee that the appliances will get the required cooled liquid flow, according to the values appearing in the final design.

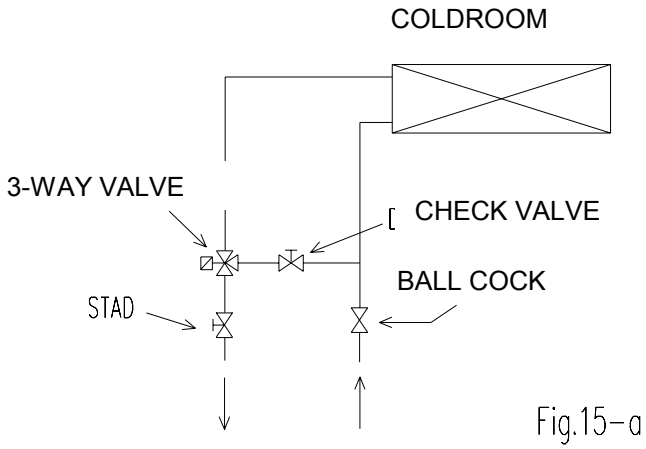


Fig.15-a

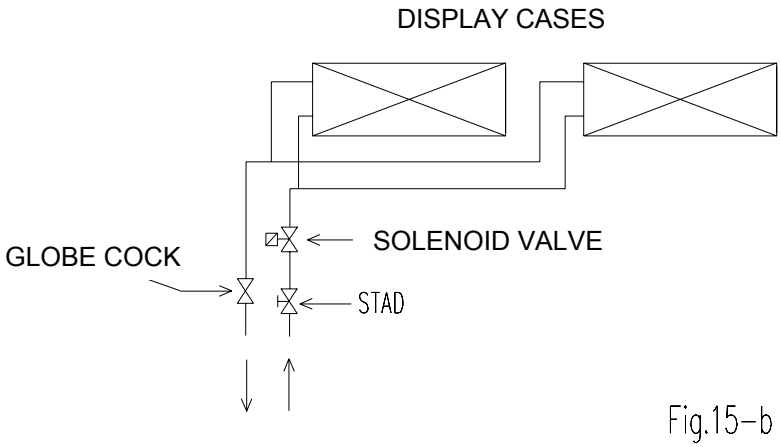


Fig.15-b

16.4 EXPANSION JOINTS

The connection of the refrigerating unit to the lines cooling the appliances and returning from these must include expansion joints suitably clamped so as to allow movement only along the axis of the joint.

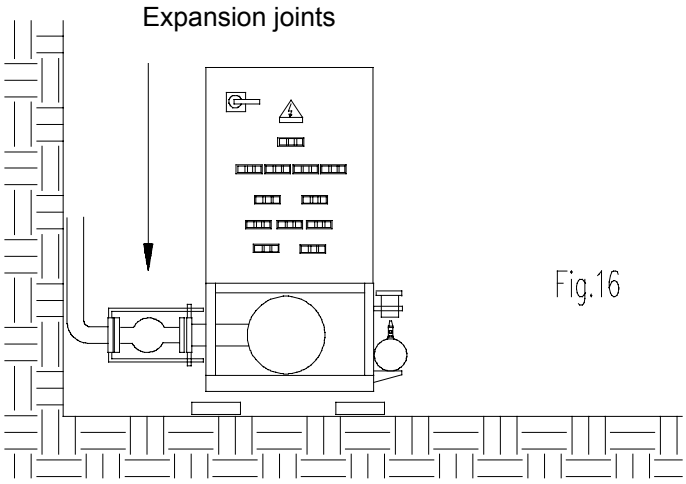
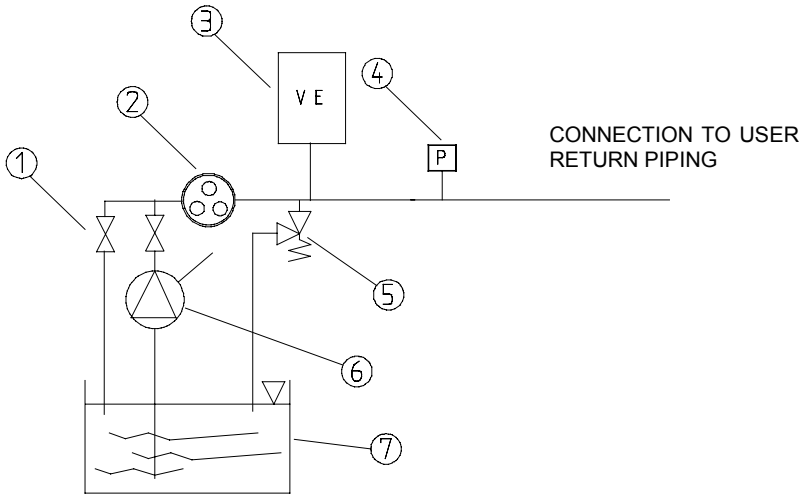


Fig.16

16.5 SERVICE EQUIPMENT

Each cooled appliance circuit must be provided with a service equipment as represented in the figure. This allows charging and topping up by the use of a manual pump, emptying and brine expansion as temperature changes by means of an expansion vessel of suitable size. The service equipment also includes a safety valve and a pressure switch that remote-transmits alarms in the event of a circuit pressure loss (i.e. when there is a leak in the system). A flow meter is standard-supplied to help in the charging and solution diluting operations.



Pos.	Description
1	Drain cock
2	Meter
3	Expansion vessel
4	Alarm pressure switch
5	Safety valve
6	Hand-driven pump
7	Recovery tank

17. SAFETY VALVE CONNECTION

The safety valve exhaust pipe must be made of a 33/35 copper pipe.
Costan System safety valves feature a soldering connection for a 35mm pipe (35 ODS). Minysystem and Integral System feature a pipe exiting the unit where the user and condenser discharge and return pipes are supposed to be. It will be sufficient to extend it till outside the machinery room.

Gas exhaust must occur safely, with no damage to people or property. Exhaust gas must always be led outdoors as set out by Costan. (Ref. Italian decree May 21, 1974 -Book E- Applicative technical specs)

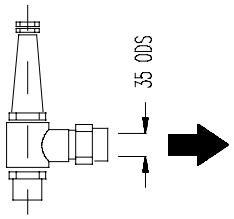


Fig.17

18. FASTENING OF VIBRATION DAMPERS

BOA vibration dampers are effective only if correctly installed on the suction and discharge lines.
The flexible tube must be positioned in order for the movement allowed to be on a plane perpendicular to the axis of the device.

> The vibration damper must not be placed in a position that may allow forces to be directed parallel to its axis.

It is advisable to install and place dampers as in the figure. The axis of the vibration damper must be parallel to the compressor's the damper must be as close to the compressor as possible.

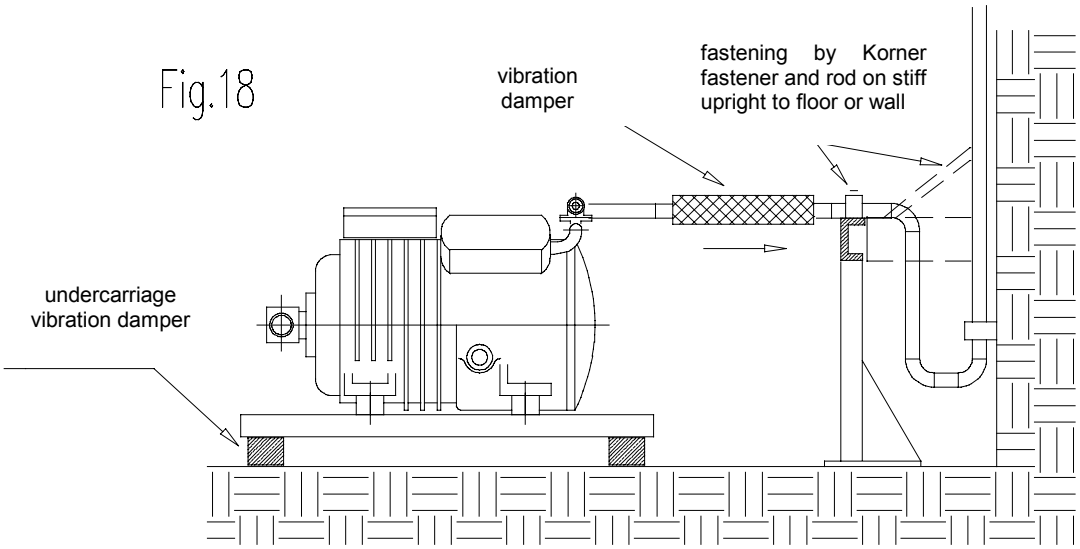


Fig.18

It is absolutely necessary to fasten the line stiffly (stiff wall-fastening on stiff structure as in Fig. 18) just downstream (or upstream in the case of suction lines) of the vibration damper.
The distance from the vibration damper must not exceed 20-30 centimeters (Fig. 19).

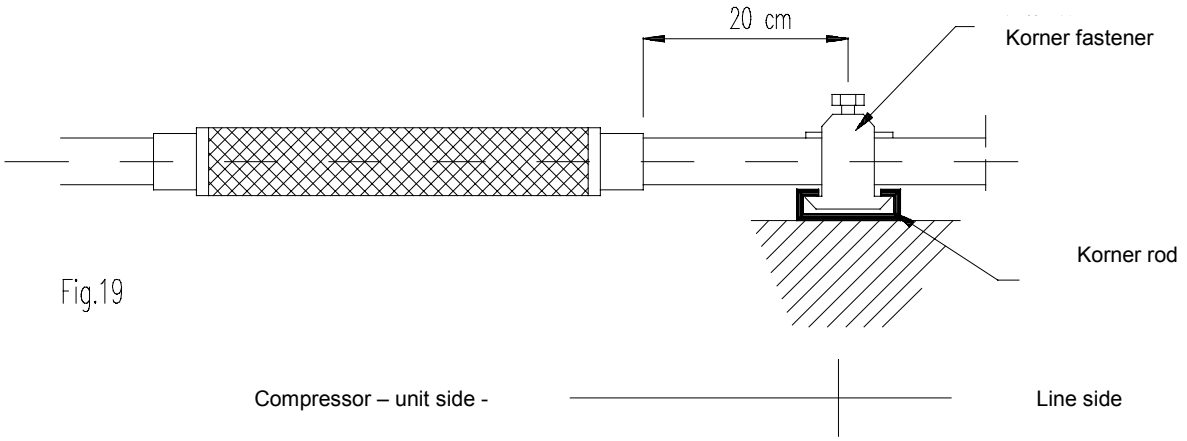


Fig.19

If very wide relative movement between fixed parts and the machinery is expected (because particular vibration dampers were installed on the undercarriage – e.g. SASCO spring dampers) it is appropriate to use two BOA dampers per line, as shown in Fig. 20.

This will counteract movement in the three directions, and will avoid BOA dampers severer work conditions.

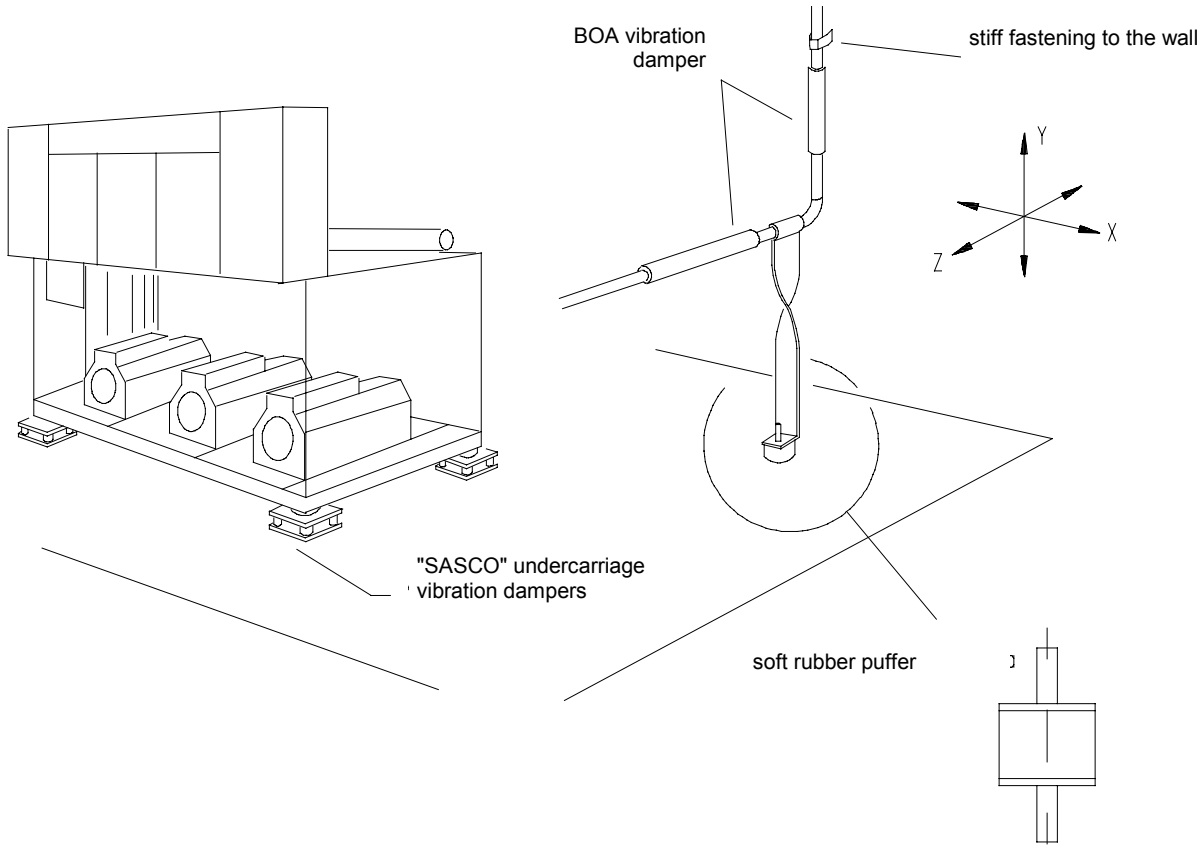


Fig.20

The drawing above represents a connection including 2 vibration dampers with a stabilising rod in between.

This rod (which is not fastened stiffly – see drawing), is required to limit system movements and control the action of vibration dampers. In actual fact, when positioned as shown in the drawing, the rod enables all movement occurring perpendicular to the axis of the vibration dampers, so that these are not subject to compression or tensile stress.

19. FASTENING OF PIPING

Both discharge and suction piping (which is mostly insulated) will be fastened using Korner fasteners and rods.
Fasteners must be placed on the line every 2-3 mt. However, liquid line pipes of diameter below 16 will have to be fastened to the suction line by way of Legrand clamps (fig. 22-a).

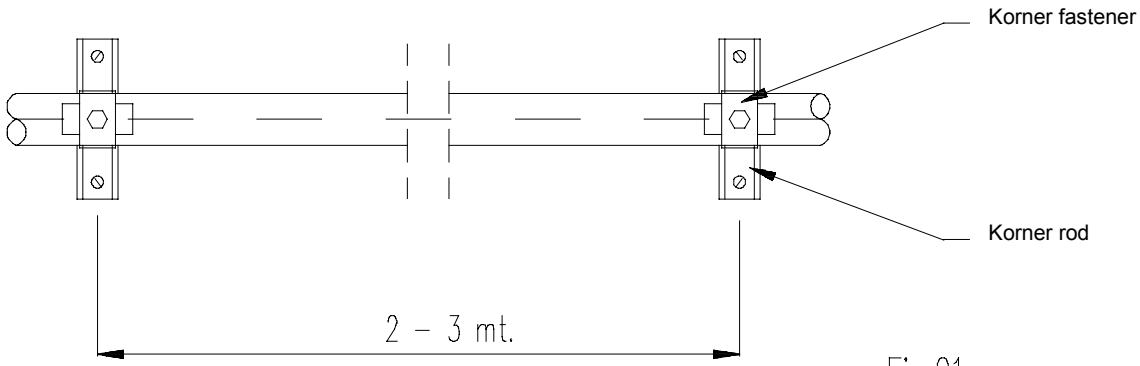


Fig.21

19.1 SUSPENDED STRETCHES

Suspended stretches can be fastened to the structure of the building as follows:

- stiffly clamped, when piping movement needs to be restricted (e.g. at the beginning of long straight stretches) – Fig. 22-a.
- linked to the ceiling by tie-rods – Fig.22-b.

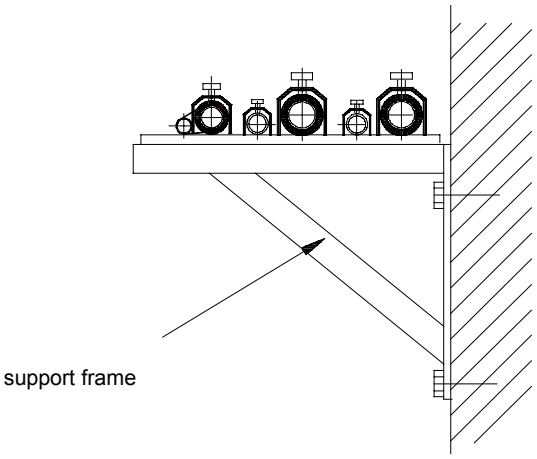


Fig.22-a

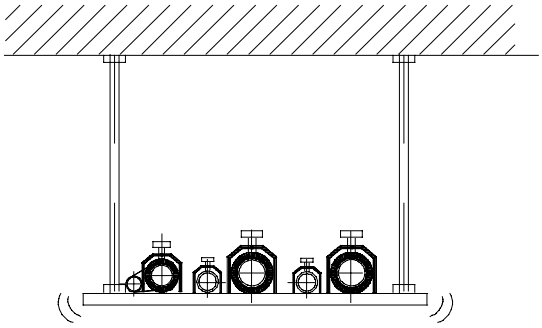
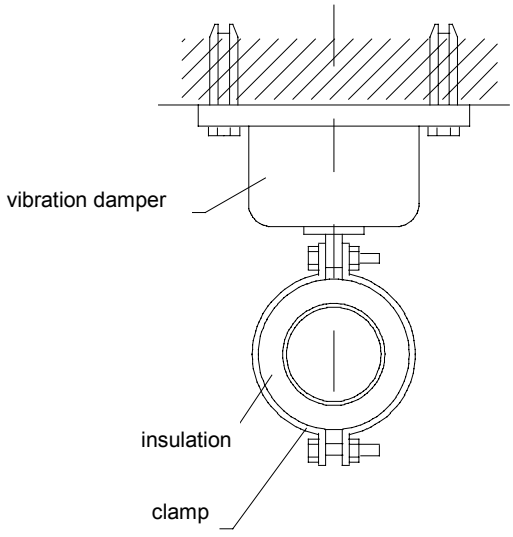


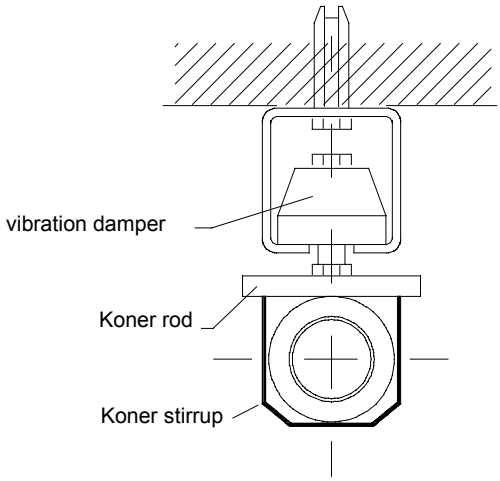
Fig.22-

In special cases in which vibration transmission is deemed likely, the piping can be fastened directly onto the wall, provided that rubber vibration dampers or special support stirrups are placed between the piping and the wall (see Fig. 23).

These drawings picture two piping vibration dampers manufactured by Vibrostop Italiana and known on the market as AAT series and SILENTFIX series. As concerns their use, contact Costan Engineering Office.



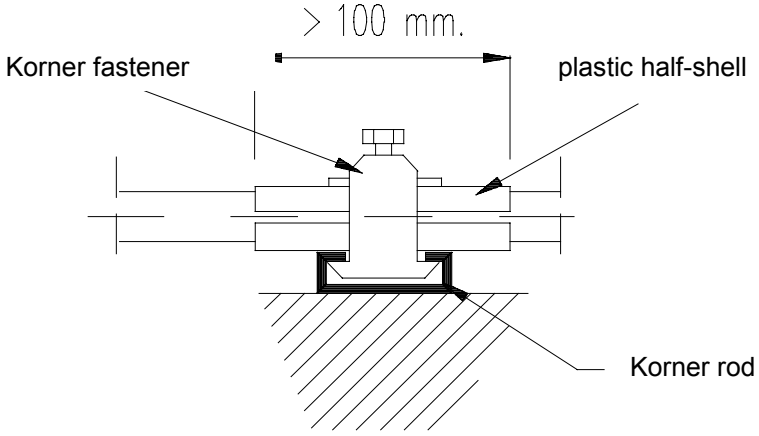
Serie AAT



SILENTFIX SERIES

Fig.23

Whenever Armaflex series T insulating tube is used (32mm thick), in order to avoid crushing it, it will be necessary to distribute strain on two plastic half shells as shown in fig. 24.



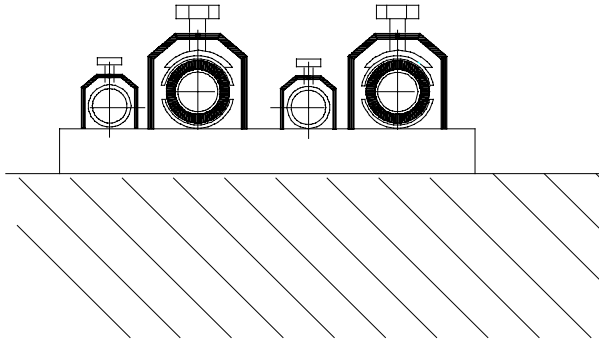
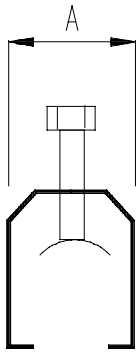


Fig.24

19.2 PIPING RUNNING IN RACEWAYS

The size of the raceway must allow easy piping installation by way of the relevant fasteners. To this respect, the table below shows overall piping width based on diameters. The approximate overall width results from adding up the numbers shown in the table plus 100 mm. The minimum raceway dimension may not be smaller than 200 mm. (in width).

Pipe diameter	A/mm			
	No insulation	Armaflex F	Armaflex M	Armaflex T
Ø 18	30	35	45	75
Ø 22	30	35	55	75
Ø 28	35	40	55	90
Ø 35	40	45	65	90
Ø 42	45	55	70	110
Ø 54	65	70	90	125
Ø 66	70	90	90	140



20. BRAZING COPPER PIPING

20.1 REFRIGERATION PIPING

Raw copper pipes are supplied closed with plugs at the ends to stop moisture from entering them. Plugs must not be removed until the pipe is soldered to the system. Pipes devoid of plugs must not undergo strong temperature changes. Otherwise the moisture contained in the air filling the pipes would condense.

20.2 CUTTING THE PIPES

Pipes must be cut using a pipe-cutter or a handsaw. Never use any kind of lubricant. Remove all possible shavings or flaws using the appropriate tool. Avoid the formation of copper chips in the pipe. Use callipers to perfect the exact diameter and rounding.

20.3 PHOSPHOROUS BRAZING

Phosphorous brazing is made of a copper alloy with 7% phosphorous, which melts at approximately between 700°C and 750°C. When phosphorous-brazing no deoxidising agent must be used. This type of brazing can only be applied in copper-to-copper solderings.

20.4 INSTRUCTIONS FOR BRAZING

If the pipe is in contact with atmospheric air when being brazed at high temperature, oxidation by-products will form. When brazing it is necessary to blow a light jet of dry compressed air or dry nitrogen into the pipe (the gust must be just perceived by the palm). Never use ordinary compressed air, as this contains a high amount of moisture. Never blow the pipe by mouth. Only start brazing when there is no air left in the component to be brazed. Begin to braze by supplying a massive amount of protective gas. Once brazing, bring gas velocity to the minimum and keep the protective gas flow like this all through the brazing procedure. Brazing is made by oxygen and gas, in a light oxygen shortfall and using a relatively large nozzle. The weld material must be applied only when brazing temperature has been reached.
Use protection goggles while brazing.
Once made ready to be used later, the pipes need to be closed at both ends.

21. BRAZING COMPONENTS

21.1 SILVER BRAZING

Silver brazing is made of a 30% silver alloy including copper, zinc and tin. Melting temperature is approximately between 655°C and 755°C.
Silver brazing sticks only on clean, oxidation-free metal surfaces. This is why it is necessary to clean the ends of the pipes using special brushes and apply the deoxidising agent before brazing. The deoxidiser must be spread in a thin layer around the brazing point after the parts have been joined . Silver brazing can be used to braze various materials, e.g. iron/copper.

Follow the brazing instructions in the previous section.
Special care should be exercised to avoid using more weld material than necessary, as the pipe could otherwise be blocked (either totally or partially). Braze quickly (in approximately 15 seconds) to help the deoxidiser absorb the oxygen effectively.
Brazing temperature must not exceed the maximum level. Therefore, move the flame away slowly once the melting temperature has been reached. Deoxidiser remains on the outside of the pipe must be removed using a brush and hot water.

Find below some instructions for brazing valves, cocks, etc, which must be strictly followed to avoid damage to the drive, seal or electrical parts of the components.

21.2 COCKS

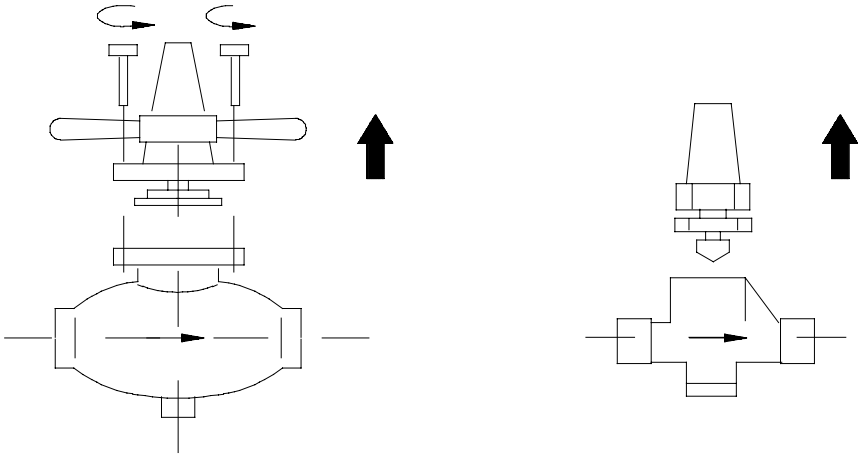


Fig.25

Disassembly globe and cap valve (see fig. 25).
Braze using silver-copper-zinc alloy (hard brazing): mind the gas flow direction and assembly accordingly.
Wait for the cock to cool down.
Lubricate the seal using freeze-proof oil.
Reassemble the cock.

21.3 SOLENOID VALVE

Slip the coil off the body.
Wrap the valve in a wet cloth.
Braze using copper-phosphorous alloy. Avoid directing the flame to the valve body.
Cool off with water at once.

21.4 KPV, KVR, KVL VALVES

Ensure that the pressure gauge tap needle is not in.

Wrap the valve in a wet cloth.
Braze using silver-copper-zinc alloy; avoid directing the flame to the valve body.
Cool off with water at once.

22. STEPS TO BE CARRIED OUT PRIOR TO START UP

The following steps must be carried out before starting up the refrigerating unit. Compliance with these rules is essential for correct system performance. These rules apply to direct-cooling systems. For indirect-cooling systems it will be necessary to follow the instructions below (applicable to the part in which the refrigerant part is) plus the steps in section 17 concerning the system part containing the non-freeze solution.

22.1 SYSTEM PREPARATION

a) Open all system cocks.
b) Switch on all the appliances to be cooled (display cases and coldrooms) in order for solenoid valves to open.

22.2 FIRST SYSTEM EVACUATION

DO NOT START COMPRESSORS DURING THIS PHASE: SEVERE DAMAGE MAY ENSUE.

a) Connect up the vacuum pump.
b) Evacuate the system until the vacuum gauge reads a residual pressure of 0,05 mbar max.
c) Disconnect the pump from the rest of the system.
d) Stop the pump.
e) Read and record the vacuum gauge.
f) If leaks are noticed, spot them by dividing the system into cut-out sections.

g) Repeat steps from b) to f) until a vacuum can be kept for approximately 12 hours. Then proceed to the next step.

22.3 WASHING AND PRESSURE TESTING

DO NOT START COMPRESSORS DURING THIS PHASE: SEVERE DAMAGE MAY ENSUE.

a) Pressurize the system with nitrogen and refrigerant (first let in refrigerant, then nitrogen up to a pressure of 10 bar).
b) Check for any system leaks using a leak detector (of course it will be necessary to dwell longer on the joints). Each time a leak is found, it will be necessary to cut the relevant stretch out, repair the leak, proceed to evacuation and restore pressure.
c) Leave the system in this pressure condition for 12 hours. If at the end of this term the pressure value has not changed, it will be possible to proceed to the next step.

22.4 SECOND EVACUATION OF THE SYSTEM

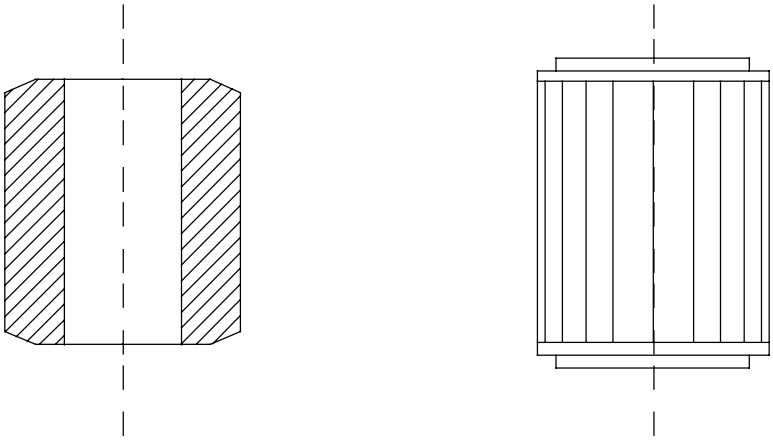
DO NOT START COMPRESSORS DURING THIS PHASE: SEVERE DAMAGE MAY ENSUE.

a) Connect up the vacuum pump.
b) Evacuate the system until a residual pressure of 0,05 mbar max.
c) Disconnect the pump from the rest of the system.
d) Stop the pump.
e) Read and record the vacuum gauge.
g) Leave the system in this condition for 12 hours. If at the end of this term the test pressure value has not changed, it will be possible to proceed to the next step (system start-up).

23. SYSTEM START-UP

a) Blow refrigerant into the system.
b) Start the refrigerating unit. To carry out this procedure, strictly comply with the technical documents attached with the unit.
c) Set high pressure (the low pressure unit is factory-set).
d) After 12 hours of operation (or else when a considerable increase in charge loss through the suction filters is noticed), stop the system.
e) Cut out the filters (using the cocks placed upstream and downstream of the filters) and replace their cartridges. Put a similar dryer cartridge Castel 4490/A in the liquid line filter and a microfiltering cartridge Castel 4495/C in the suction line filter. Cartridges are supplied with the system.
g) Evacuate the affected line stretches and then restart the system.

NOTE: AFTER EVERY WORK REQUIRING THE REFRIGERATING CIRCUIT TO BE OPENED, EVACUATE THE SYSTEM STRETCH INVOLVED USING THE PUMP UNTIL A PRESSURE OF 500 MICRONS IS REACHED.



Solid dryer and antiacid cartridge
Code 761300028

Mechanical microfiltering cartridge
Code 761300034

Fig.26

24. SYSTEMS WORKING ON FREON R404A

a) It is important to braze components following the instructions in section 12 to avoid the formation of oxidation inside the line while welding.

b) The R404a refrigerant must be charged while LIQUID by the use of tanks fitted with liquid-gas cocks or by simply overturning the tank. This procedure is necessary to prevent any change in the concentration of the various refrigerant components.

24.1 POLYESTER OIL (POE)

HFC refrigerants require the use of polyester oil. Such oil is strongly hygroscopic and this makes it necessary to follow certain rules strictly when using it.
The oil container must only be opened the moment it needs to be used and it must be shut tight as soon as possible. If the container stays open for a long time (approximately 5 minutes), the oil therein will become useless and will have to be disposed of according to the waste disposal standards in force in the respective country. It is understood that the system in which the oil is being introduced must have been evacuated beforehand.

25. PREPARATION PROCEDURE FOR INDIRECT-COOLED SYSTEMS

The instructions below concern the indirect-cooling line section affected by the non-freeze solution.
a) Open all balancing valves and cocks; excite the solenoid valves.
b) Charge the system with pressurized air at 2 bar: This is performed by connecting the system cock, which is fitted with a meter, to the water supply mains.
c) Write down the volume of water introduced into the system.
d) Sight-check the joints for leaks. If a leak is detected, cut out the stretch and repair. Repeat steps a) – d) until system pressure can be kept for approximately 12 hours.
e) Start circulation pumps and leave them on for at least 6 hours.
f) Empty the system and repeat steps a)-e) until the water appears clear and devoid of welding oxidation remains.
g) After having emptied the system for the last time, proceed quickly to introducing the non-freeze solution up to a pressure of 2 bar using the appropriate charging pump.
h) Start the circulation pumps.
i) Remove any air bubbles using the bleeder valves located on the evaporators of display cases and coldrooms.
l) As air is bled from the system, restore pressure by manually pumping the non-freeze solution.
m) Measure the concentration using a densimeter and, if necessary, correct by adding pure non-freeze solution until the design pressure is reached. To calculate the quantity of refrigerant to be added, use the measured volume values (first wash total volume and pumped-in solution).
n) After the system has worked for a week, check concentration using a densimeter.

26. PROBLEMS

26.1 BURNT SEMIHERMETIC COMPRESSOR

Before carrying out any work on the system, follow the instructions below:

a) Cut out power by turning the circuit-breaker handle on the electrical board door, which is marked yellow-red, until the reference arrow meets the position marked "O".
b) Open the electrical board lock by the appropriate key (which is attached). The latter step can only be carried out after step a) has been performed: the main switch has a door-lock security.
c) Turn off the cutout switch on the burnt out compressor and place a padlock in the appropriate hole in order to avoid accidental powering.
d) Close the electrical board and power up the machine sections uninvolved in the failure by repeating steps b) and a) in this order.

Then it will be possible to work on the burnt out compressor.
First it is necessary to open the motor electrical box and disconnect the power cables. Then verify the electrical insulation using an ohmmeter between the phases and between each phase and the earth lead to ensure that the electrical motor is actually burnt out. If so, the compressor will have to be replaced.
To determine the procedure to be followed it is necessary to establish how severe the burning is (check wheather the oil is acid and whether it has lost its lubricating properties).
To this respect, proceed as follows:
a) wear safety gloves (the oil-refrigerant misture can be harmful for the skin)
b) in case of mineral oil, check oil acidity using the ad-hoc kit.

Two cases can be discriminated:
a) the oil is not acid (acidity index below 0,05)
1- Cut out the refrigerating unit from the system by shutting the cocks upstream of the suction manifold and the cocks on the compressors.
2- Replace the burnt out compressor.
3- Cut out the filter on the liquid discharge line.
4- Place antiacid dryer filters on the suction filters and replace the cartridges on the liquid filter.
5 – If provided, replace the oil filters between the oil manifold and the float regulators.
6- Evacuate the line stretches involved in these operations using the vacuum pump.
7- Open the cocks previously closed and start the unit up.
8- Leave the machine on for 12 hours.
9- Stop the refrigerating unit, replace the dryer cartridges on the suction line with ordinary mesh filters and the liquid line filter cartridges with similar catridges. This must only be done after having closed the necessary cocks and after having evacuated the affected system sections using the vacuum pump.

b) the oil is acid
1- Cut out the compressors by the appropriate cocks.
2 – Empty the compressor (freon, compressor crankcase oil) and dispose of the resulting material following the waste disposal laws in force. In Italy law n°549 dated 28/Dec/93 art 6 forbids their release outdoors.
3- Replace the burnt out compressor.
4 – Check compressor outlets: it is normal to find carbonium on the suction outlet side, as this is directly connected to the electric motor. If the motor was burnt out when it went off, the discharge outlet would generally be clean. If it was burnt out progressively, i.e. while the compressor was running, both circuit sides would be contaminated with an acid sludge formed by oil and carbonium. The repairer will then be able to establish how much the system has been contaminated.
5 – Replace oil filters.
6 – Top up the oil.
7 – Depending on how contaminated the system is, install one or two dryer cartridges. Connect two manovacuum meters at the ends of the regenerating filter on the suction line.
8 – Evacuate the part of the system that is not under pressure following the procedure in the paragraph "Steps to be carried out prior to start up" (it is not necessary to leave the system in vacuum and then under pressure for 12 hours because it is not a first start-up).
9 – Open the cocks that were closed.
10 – Start the compressor and top up the refrigerant. Let the unit work and check the charge loss through the regenerating filter. An increase in charge loss is the evidence that the filter is collecting the contaminants.
11- After 12 hours, stop the refrigerating unit, replace the dryer cartridges on the suction line with ordinary mesh filters and the liquid line filter cartridges with similar catridges. This must only be

done after having closed the necessary cocks and after having evacuated the affected system sections using the vacuum pump.

27. OIL-CHARGING PROCEDURE

a) Systems with an oil regulation system.
These systems feature an oil separator, an oil reserve and an oil level regulator.

Oil separator AC&R

In case of a fault requesting total system evacuation, it will be necessary to provide for the following amounts of oil to be introduced into the separator when recharging.

Oil separator model	Oil charge (kg)
S 5500	0.42
S 5800	0.42
S 5600	0.57
S 1900	0.57

After a few hours of operation, check oil level in compressor crankcases and check again after a few days.

Oil level regulator

The oil level in the float regulators must be approximately at ¼ of the viewer for compressors Copeland D4 and at ½ of the viewer for compressors Copeland D3 and Bock.

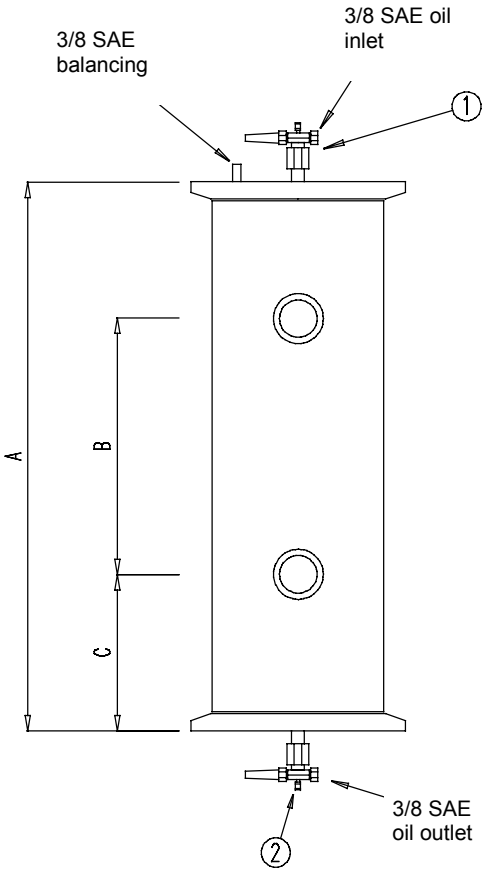
Oil reserve

The oil reserve AC&R features two viewers showing minimum and maximum oil level. During normal operation the oil level must be halfway between the two viewers. At any rate it will be necessary to top up only when the oil level reaches the lower viewer, since the oil circulating in the system could be enough to fill the reserve.
At each system inspection, check the oil level in the reserve. Caution:
THE OIL LEVEL MUST NEVER REACH BELOW THE BOTTOM VIEWER.

To add oil:
a) manually close valves 1 and 2 and drain pressure through connection ¼" SAE (valve 1);
b) connect the oil tank up to valve 2 (down), by a 6mm copper pipe with a filling pipe union;

Find below the oil capacities corresponding to the various receiver levels of the different models.

OIL RESERVE MODEL	A (l.)	B (l.)	C (l.)
S–9108	15	11	2,8
S–9109	7,5	2,8	2,8



To add the proper amount of oil it is advisable to:
a) bring the oil level in the reserve to the bottom viewer and then top up with B/2 liters in regard to the table above;
b) connect the vacuum pump to the valve of cock 1 and start it;
c) open cock 2 while keeping the pump on;
d) remove the vacuum pump and open cock 1.

To remove oil:
a) join a hose with a pressure-meter air pump to the connection on cock 2;
b) slightly close cock 2 and let oil out.
CAUTION: the pressure inside the oil receiver can be high.