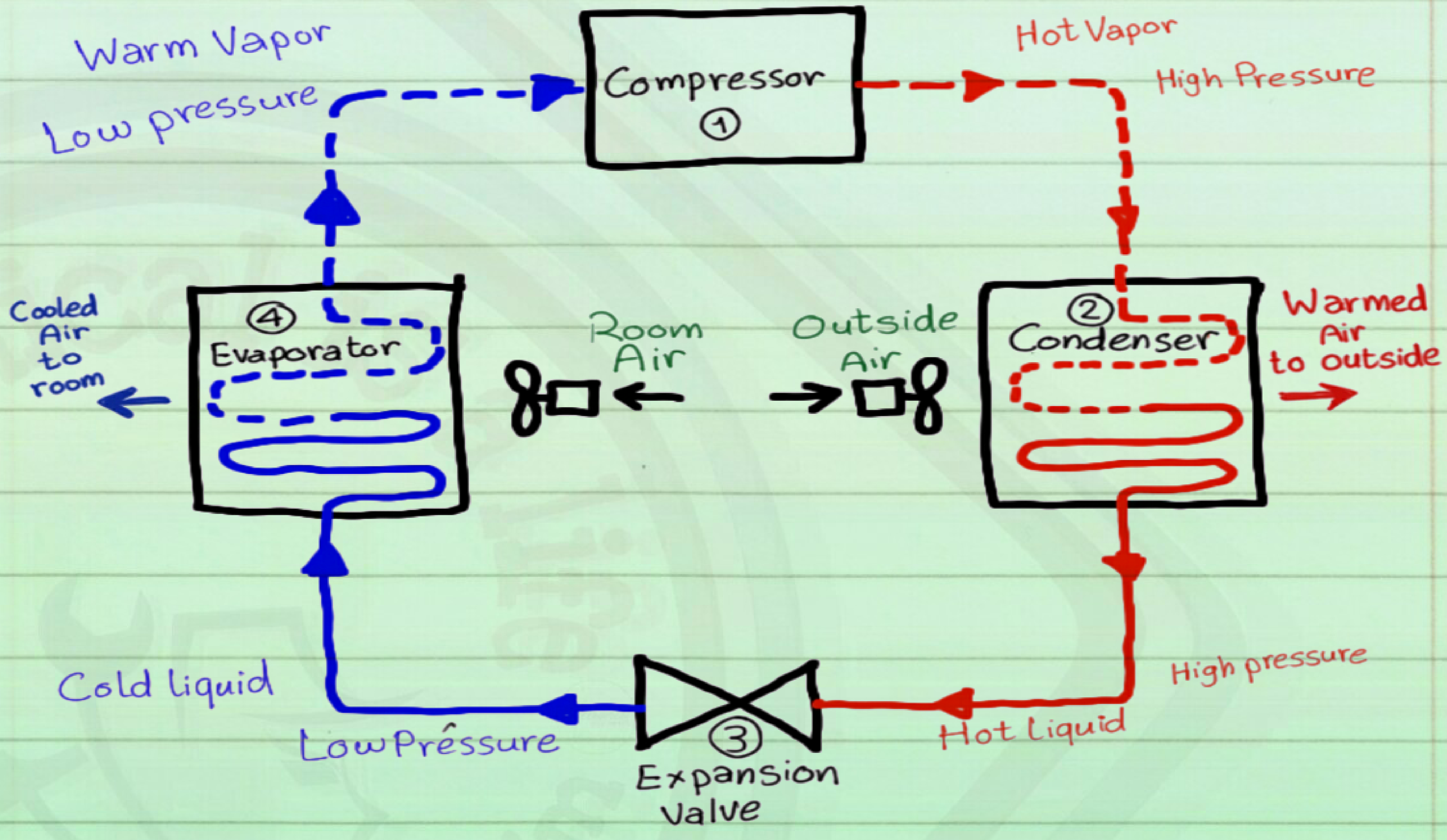
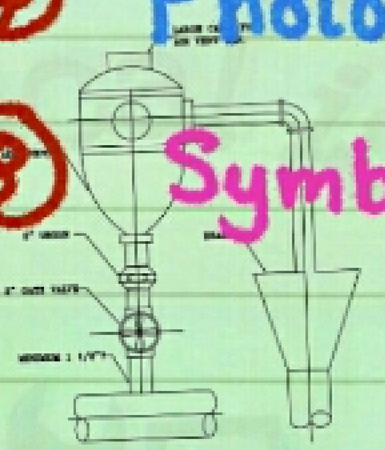
Heat Ventilation Air Condition



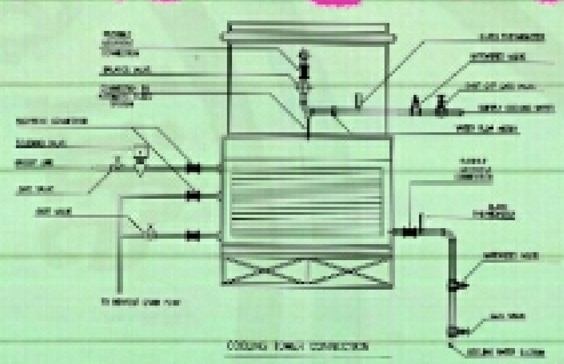
By Eng. : Ramy Ghoraba

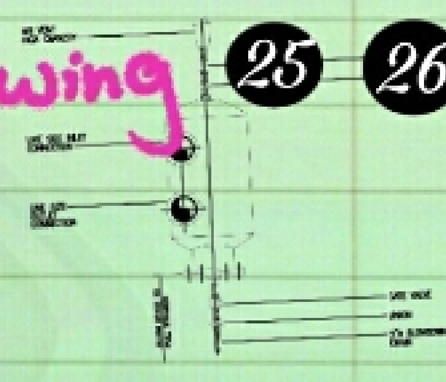
PART 01

PART ① Contents



AUTOMATIC AIR VENT
ON MAIN HEADERS

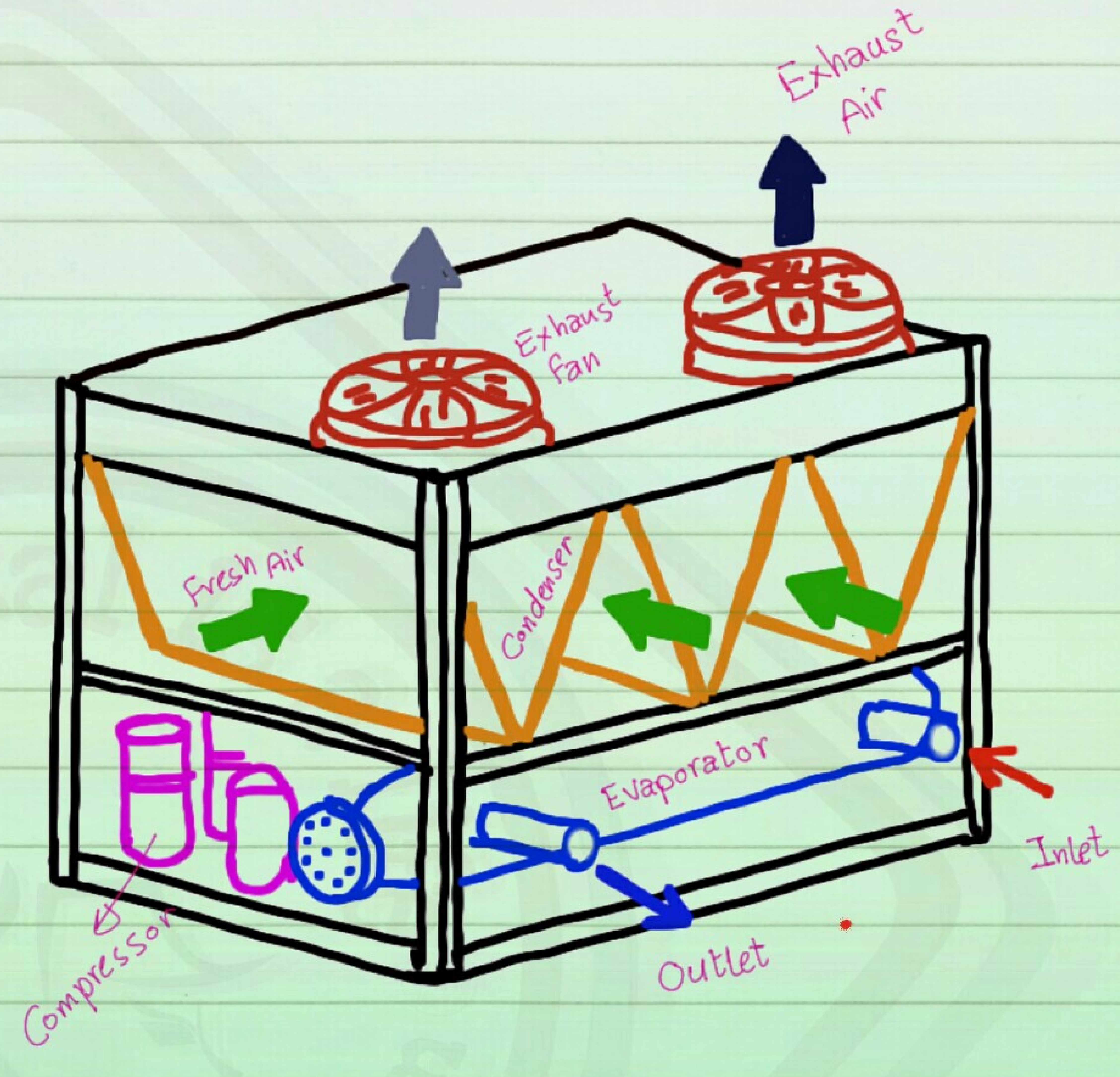




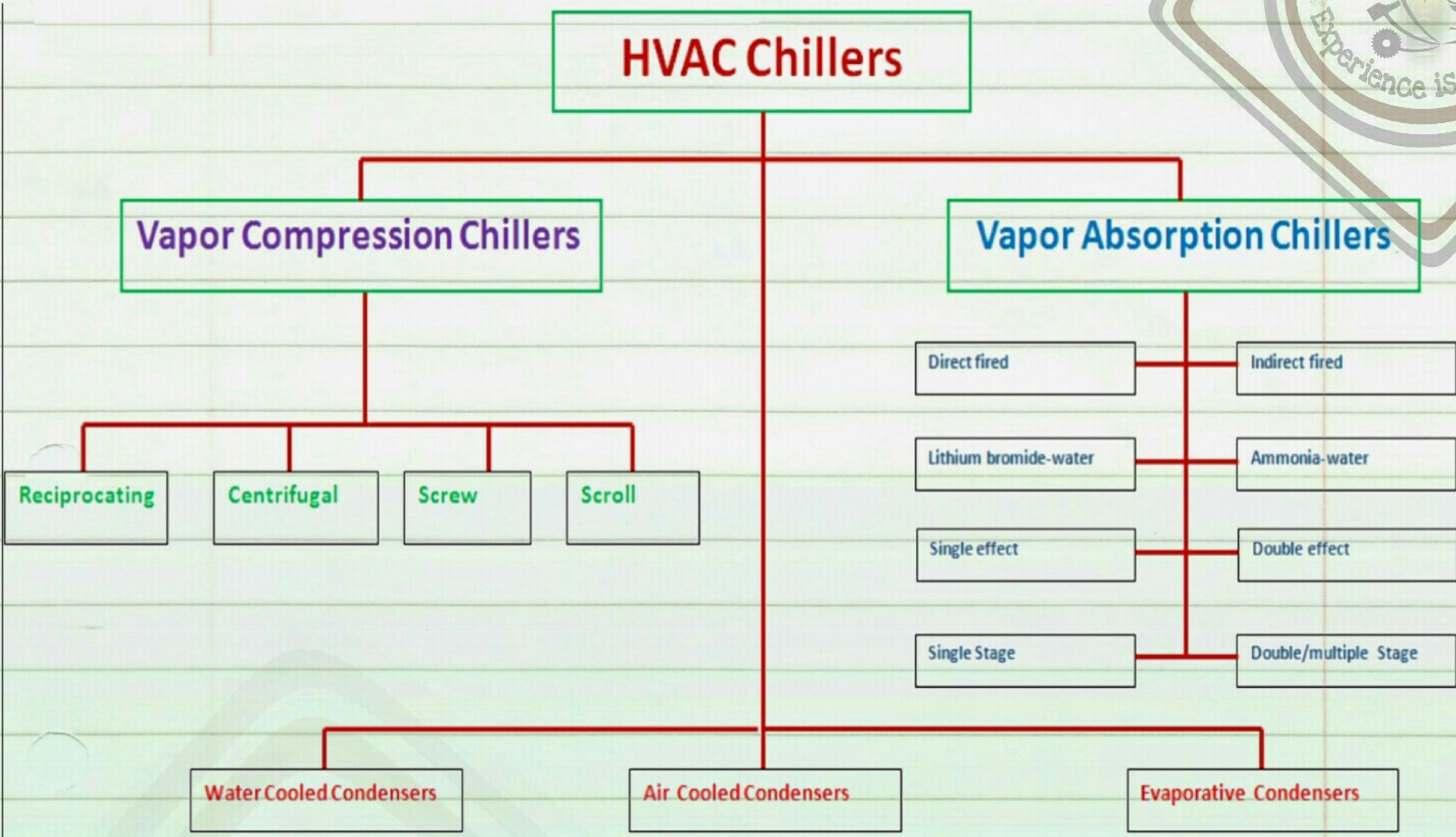
CHILLED WATER AIR SEPARATOR

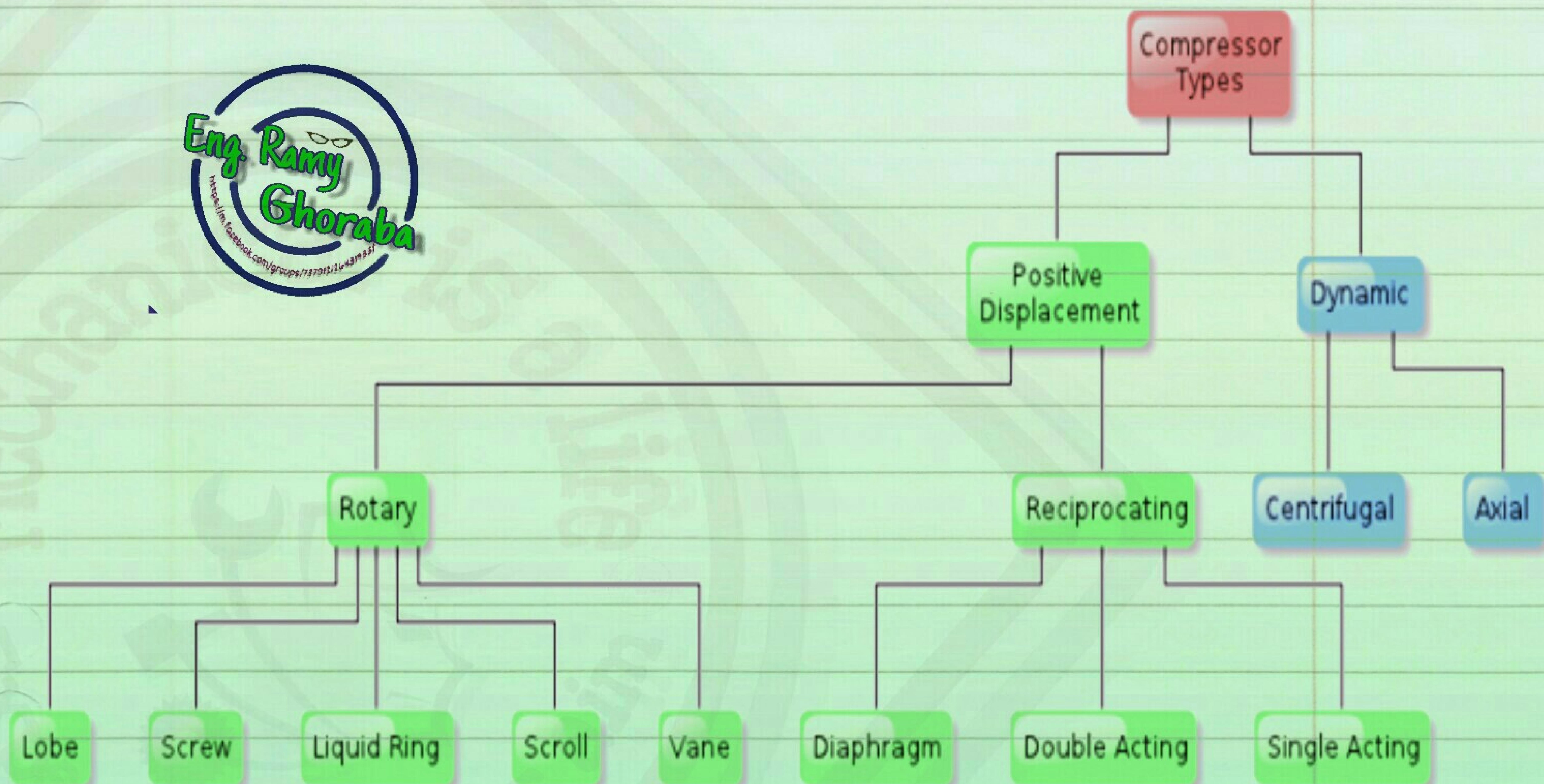
Eng. Ramy Ghoraba

① Chiller



Exhaust Air
Exhaust fan
Fresh Air
Condenser
Evaporator
Inlet
Outlet
Compressor


HVAC Chillers
Vapor Compression Chillers
Vapor Absorption Chillers
Reciprocating
Centrifugal
Screw
Scroll
Direct fired
Indirect fired
Lithium bromide-water
Ammonia-water
Single effect
Double effect
Single Stage
Double/multiple Stage
Water Cooled Condensers
Air Cooled Condensers
Evaporative Condensers


Compressor Types
Positive Displacement
Dynamic
Rotary
Reciprocating
Centrifugal
Axial
Lobe
Screw
Liquid Ring
Scroll
Vane
Diaphragm
Double Acting
Single Acting

Air cooled scroll chiller

Water cooled scroll chiller

Air coold screw chiller

Food water chiller

Single compressor Water cooled

Double compressor water cooled

Scroll type plastic injection water

Brewery/beverage glycol chiller

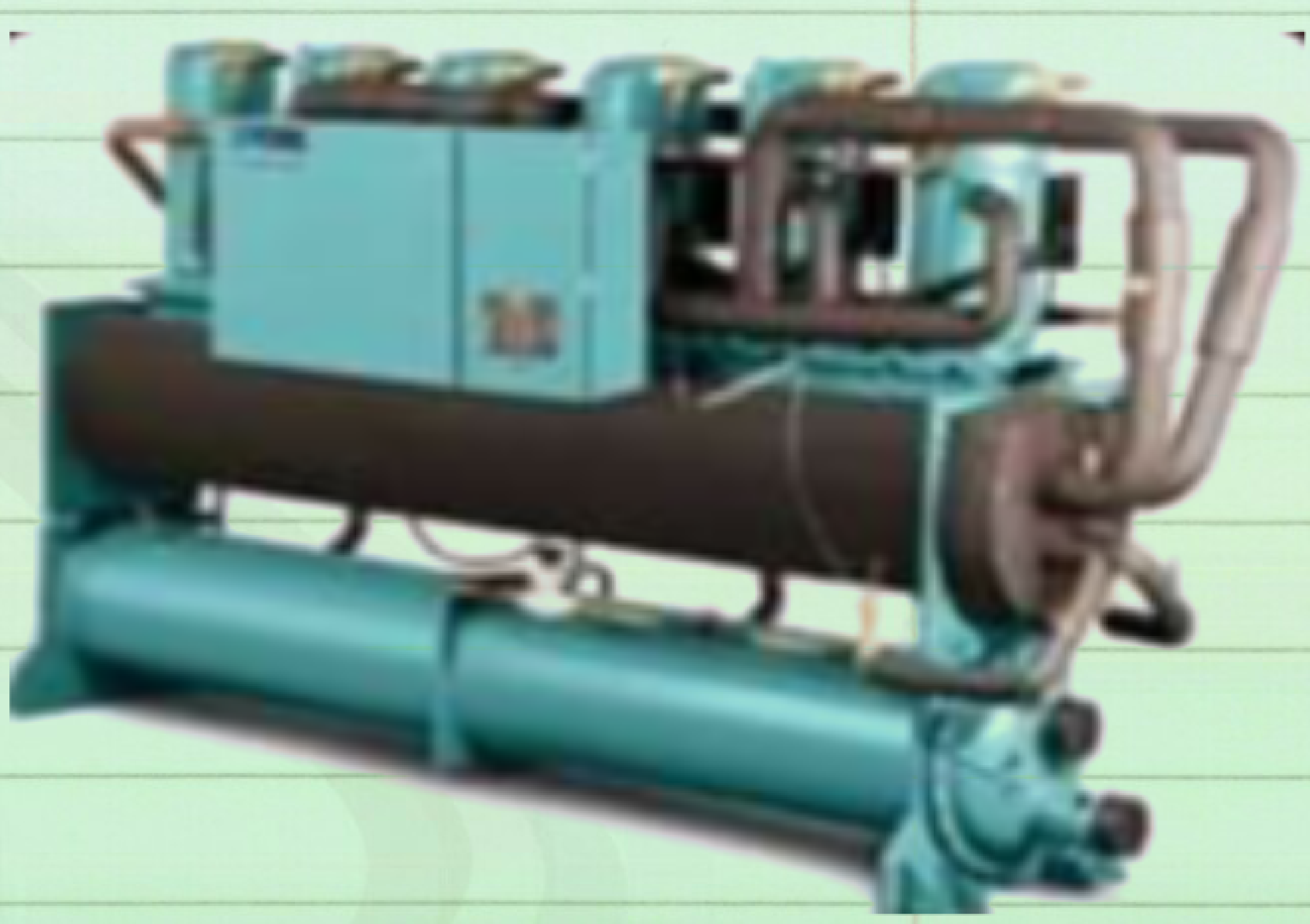
-5 °C Chemical water chiller

Types of CHILLERS

Reciprocating chiller

Centrifugal chiller

Screw chiller

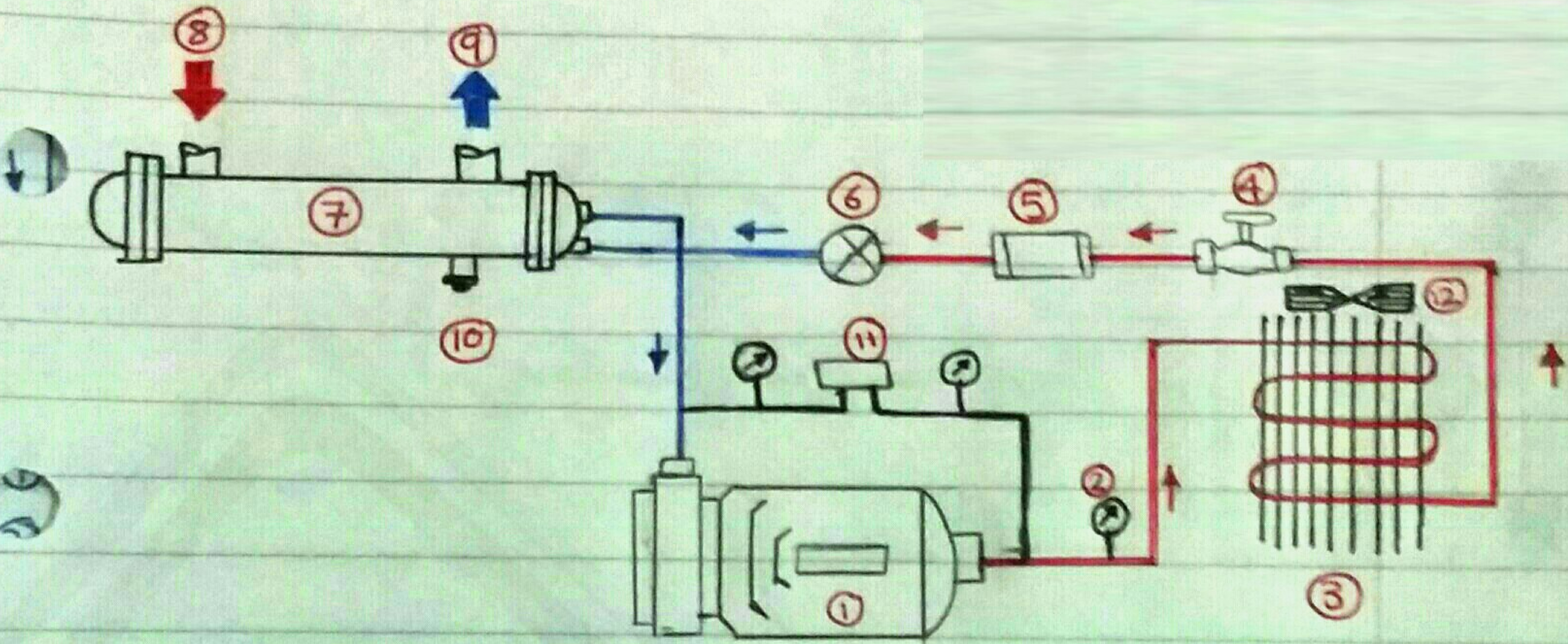


Scroll chiller

⊛ Chilled Water System

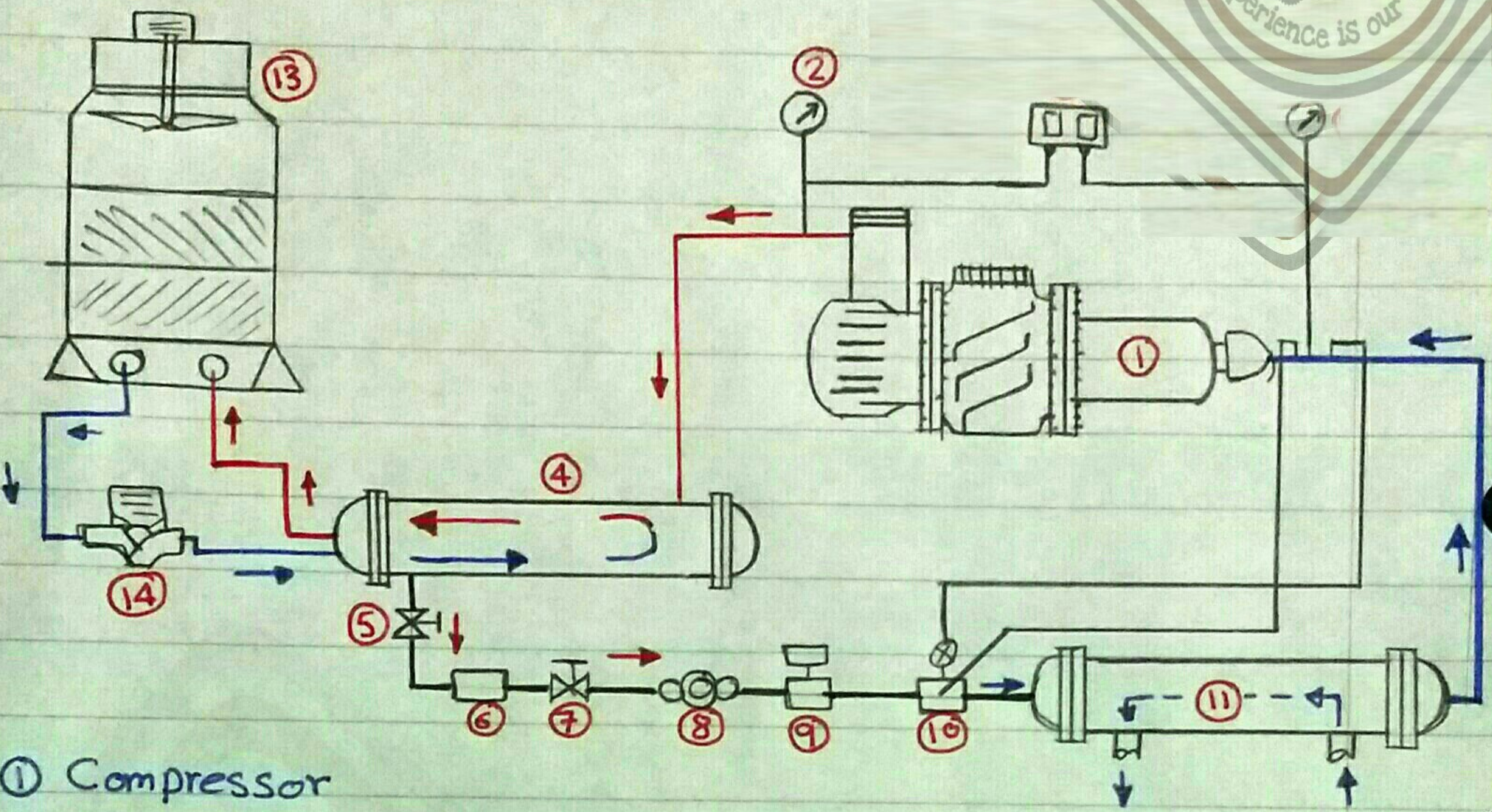
Ⓐ Chiller

——————— Air Cooled

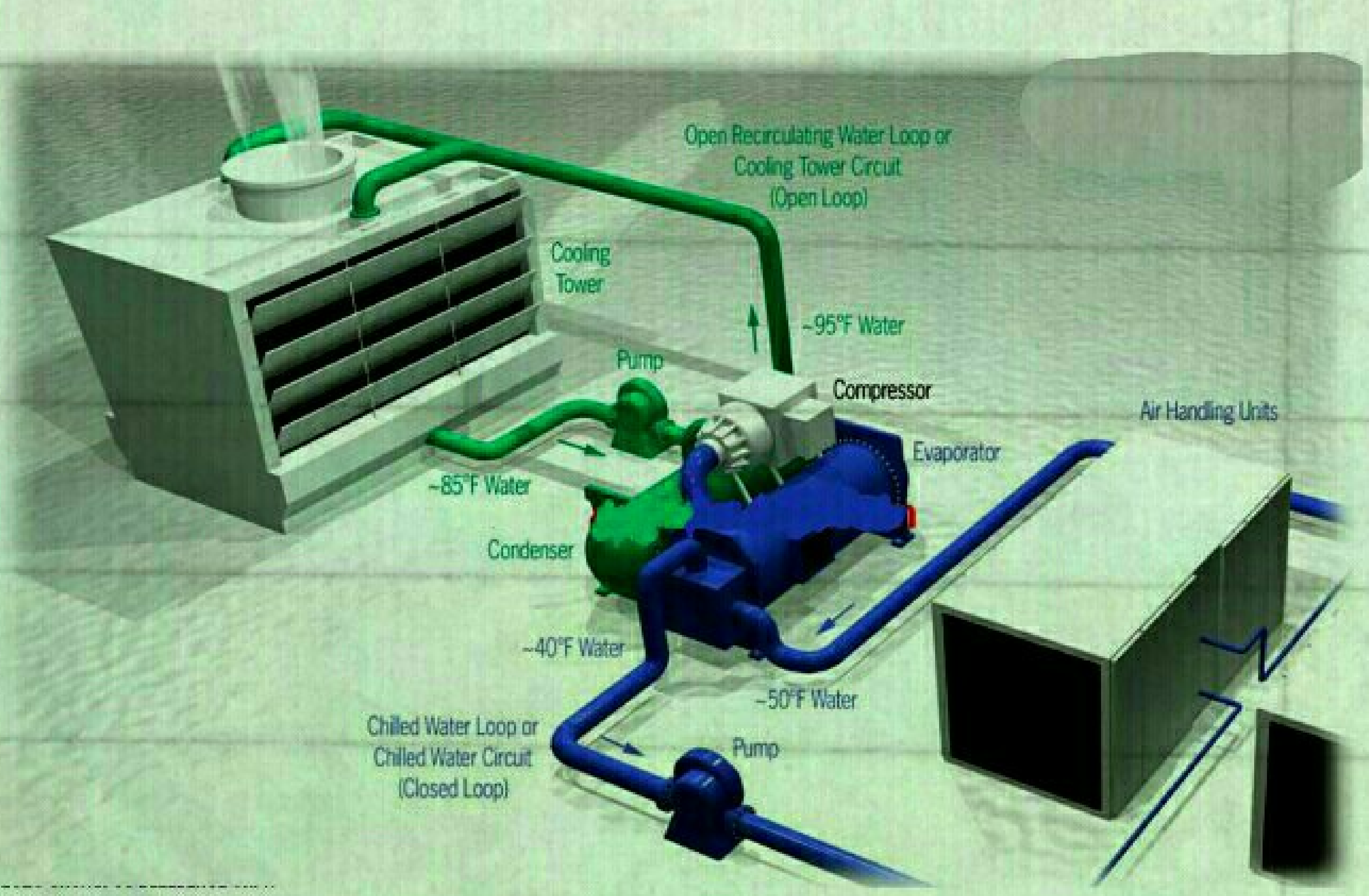


1. Compressor
2. Pressure gauge
3. Condenser
4. Shut off valve
5. Filter dryer
6. Expansion valve
7. Evaporator
8. water IN
9. water OUT
10. Drain
11. High/low pressure protector
12. Condenser Fan.

(B) Water Cooled Chiller

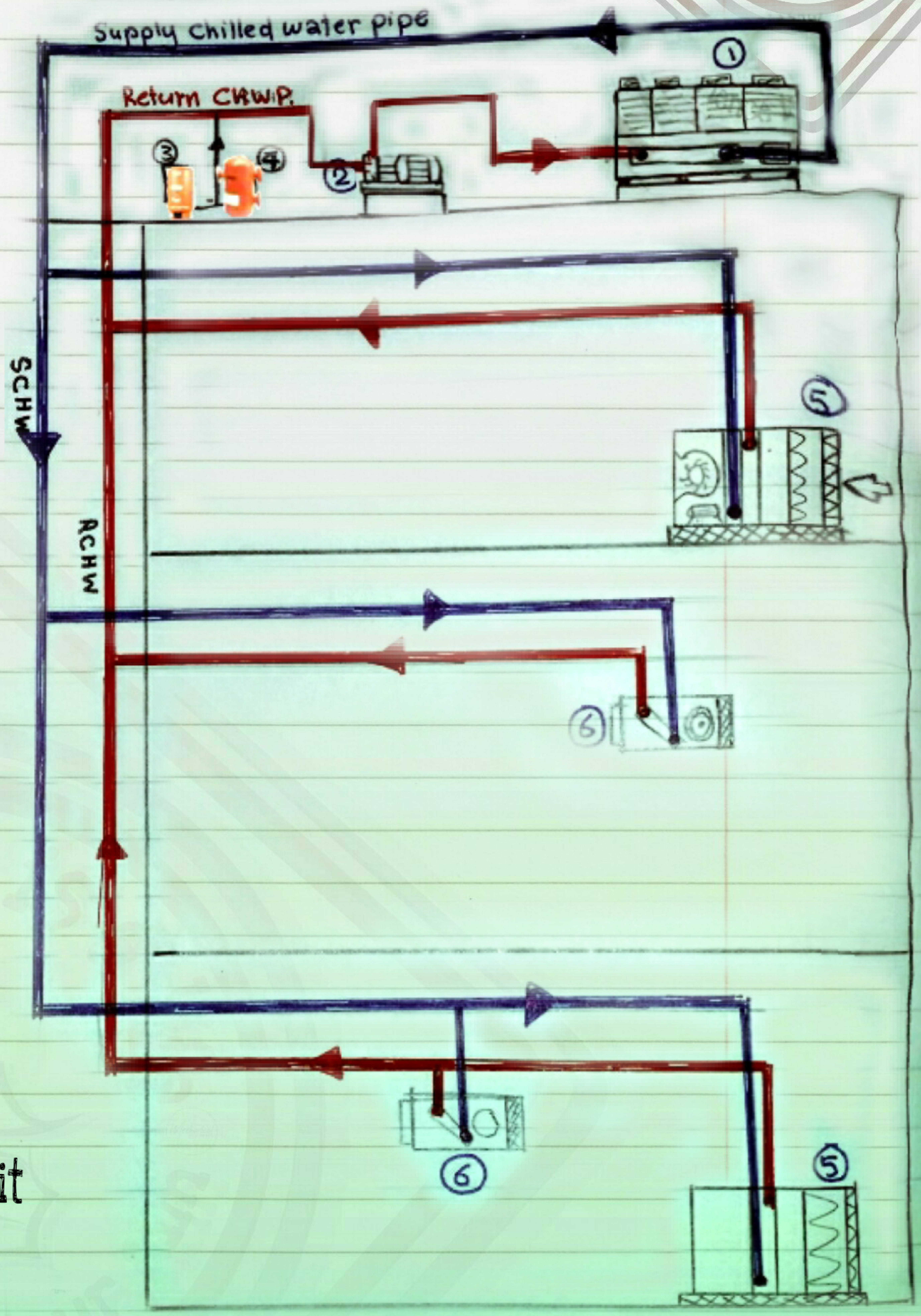


① Compressor
② High pressure gauge
③ high/low pressure protector
④ Condenser
⑤ Shutoff valve
⑥ Filter dryer
⑦ Shutoff Valve
⑧ Liquid mirror
⑨ Solenoid valve
⑩ Expansion valve
⑪ Evaporator
⑫ Low pressure gauge
⑬ Cooling tower
⑭ pump.



Chilled water system sample

Air Cooled



1- Chiller

2- Pumps

3- Make up unit

4- Air Separator

5- Air handling unit

6- Fan coil unit

Water cooled chiller System Sample

1- Evaporator

2- Condenser

3- Compressor

4- Chilled water pump

5- Condensation pump

6- Cooling tower

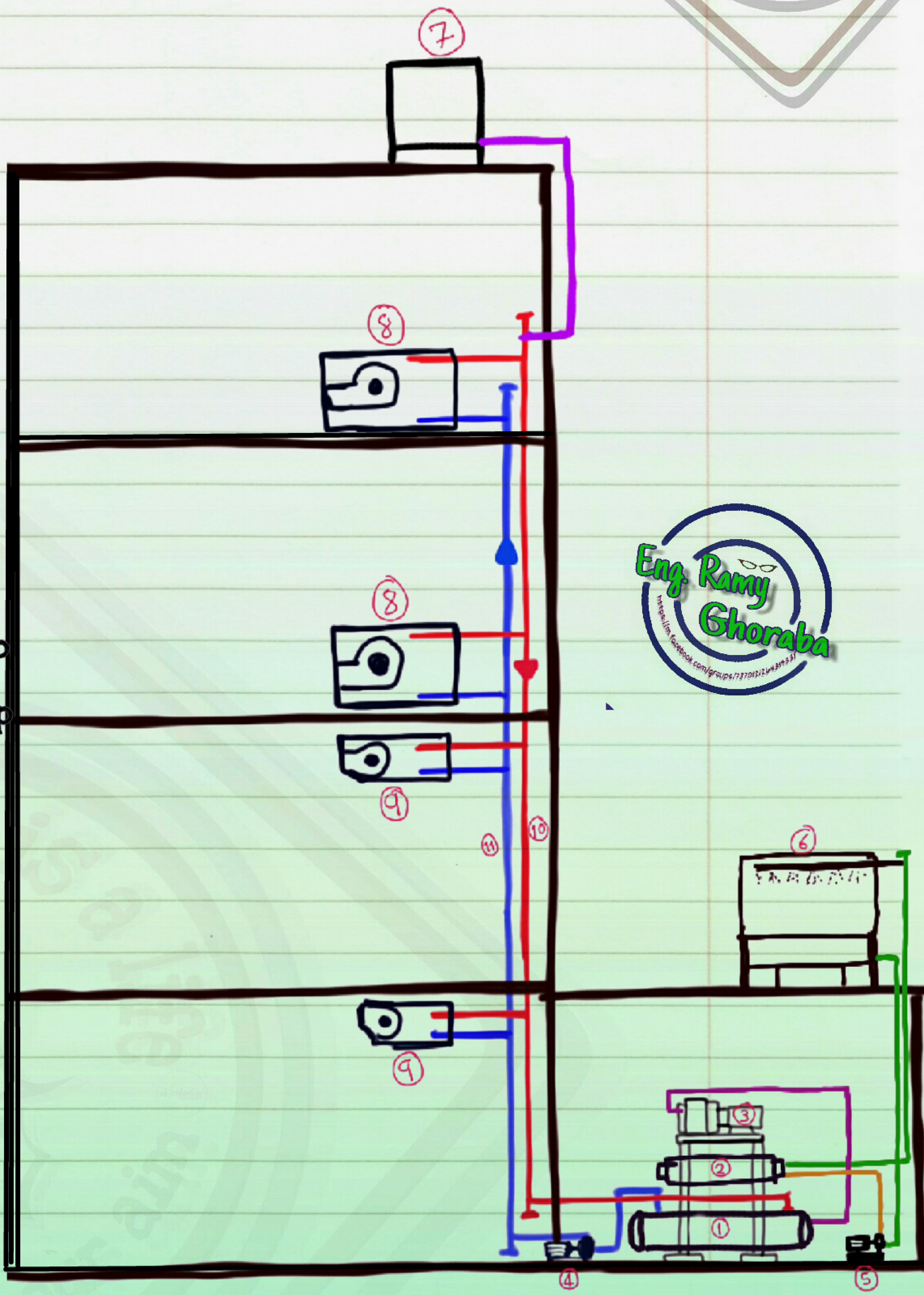
7- Expansion tank (Makeup unit)

8- AHU

9- FCU

10- Chilled water Return pipe

11- Chilled water Supply pipe



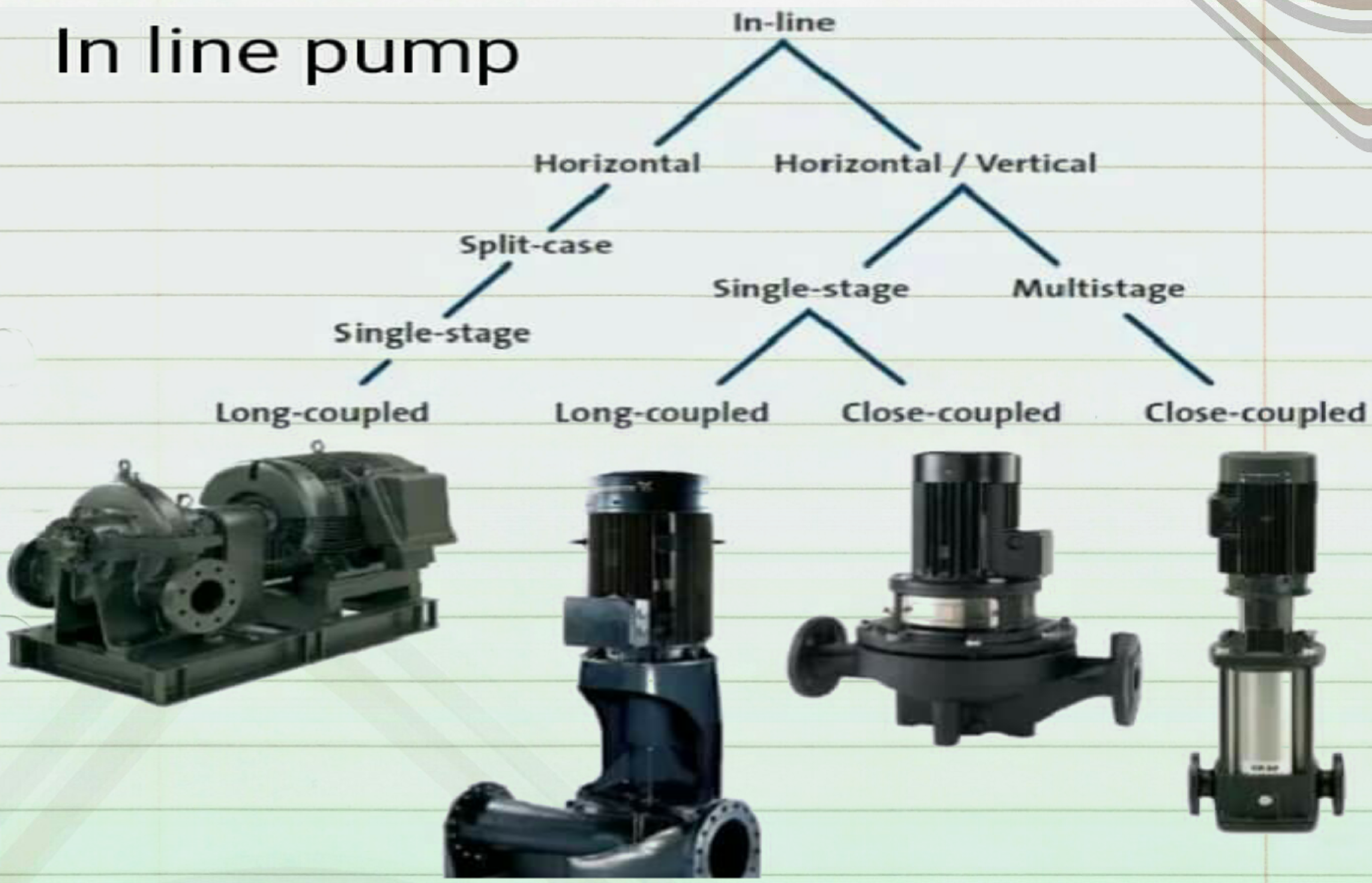
② PUMP

PUMPS

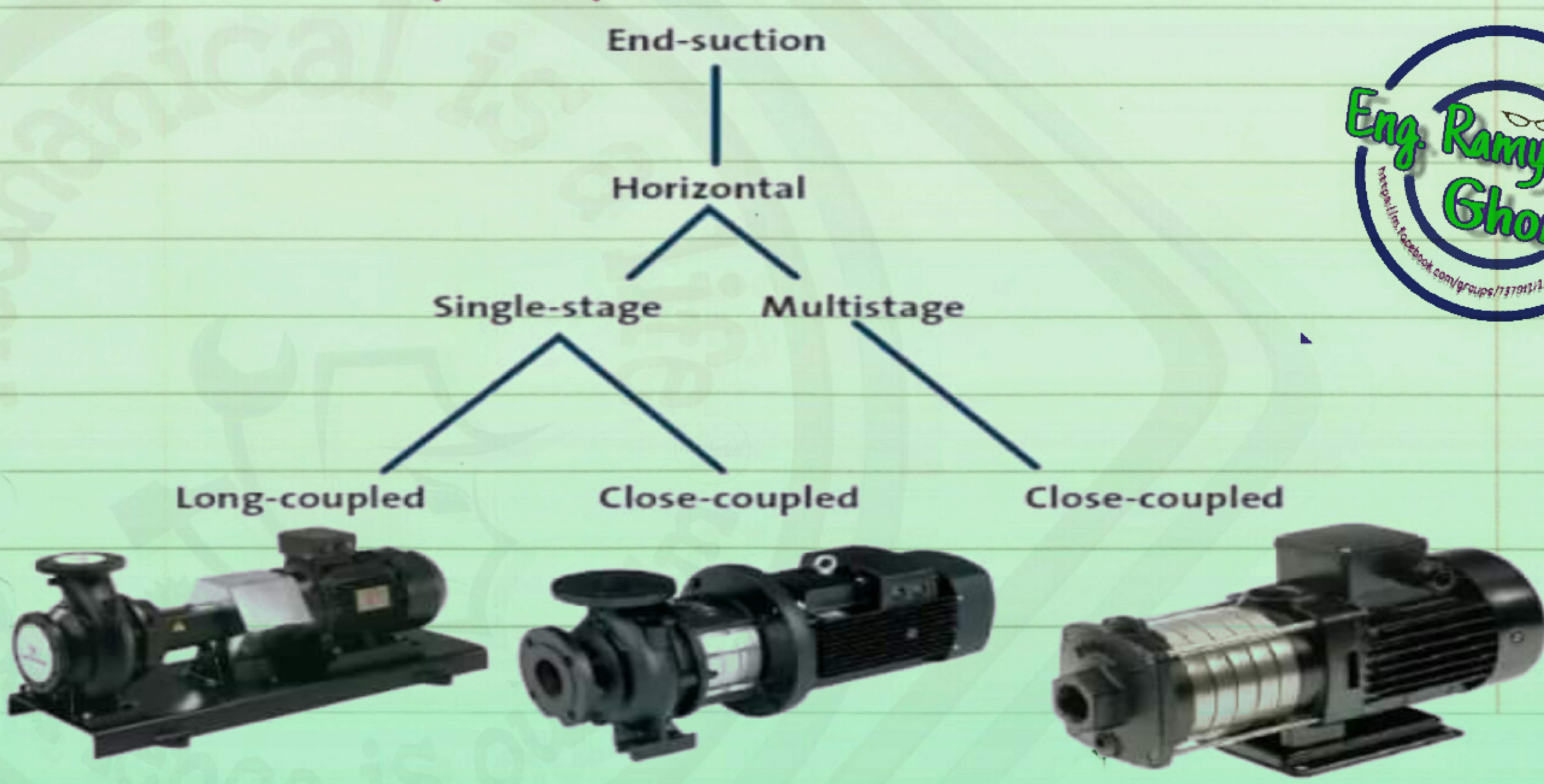
- ذات الإزاحة الموجبة — POSITIVE DISPALCEMENT
  - ترددية — RECIPROCATING
    - مكبس — PISTON
    - كباس — PLUNGER
    - غشاء مرن — DIAPHRAGM
    - (PISTON, PLUNGER):
      - فردية التأثير — SINGLE ACTING
      - مزدوجة التأثير — DOUBLE ACTING
  - دوارة — ROTARY
    - ترسية — GEAR
    - حلزونية — SCREW
    - فصوص — LOBE
    - لقم منزلقة — SLIDE VANE
    - مكبس — PISTON
- ديناميكية — DYNAMIC
  - طاردة مركزية — CENTRIFUGAL
    - تدفق محورى — AXIL FLOW
    - تدفق قطرى — RADIAL FLOW
  - ذات تأثير خاص — SPECIAL EFFECT
    - السحب بتيار الغاز — JET GAS LIFT

Pump Types

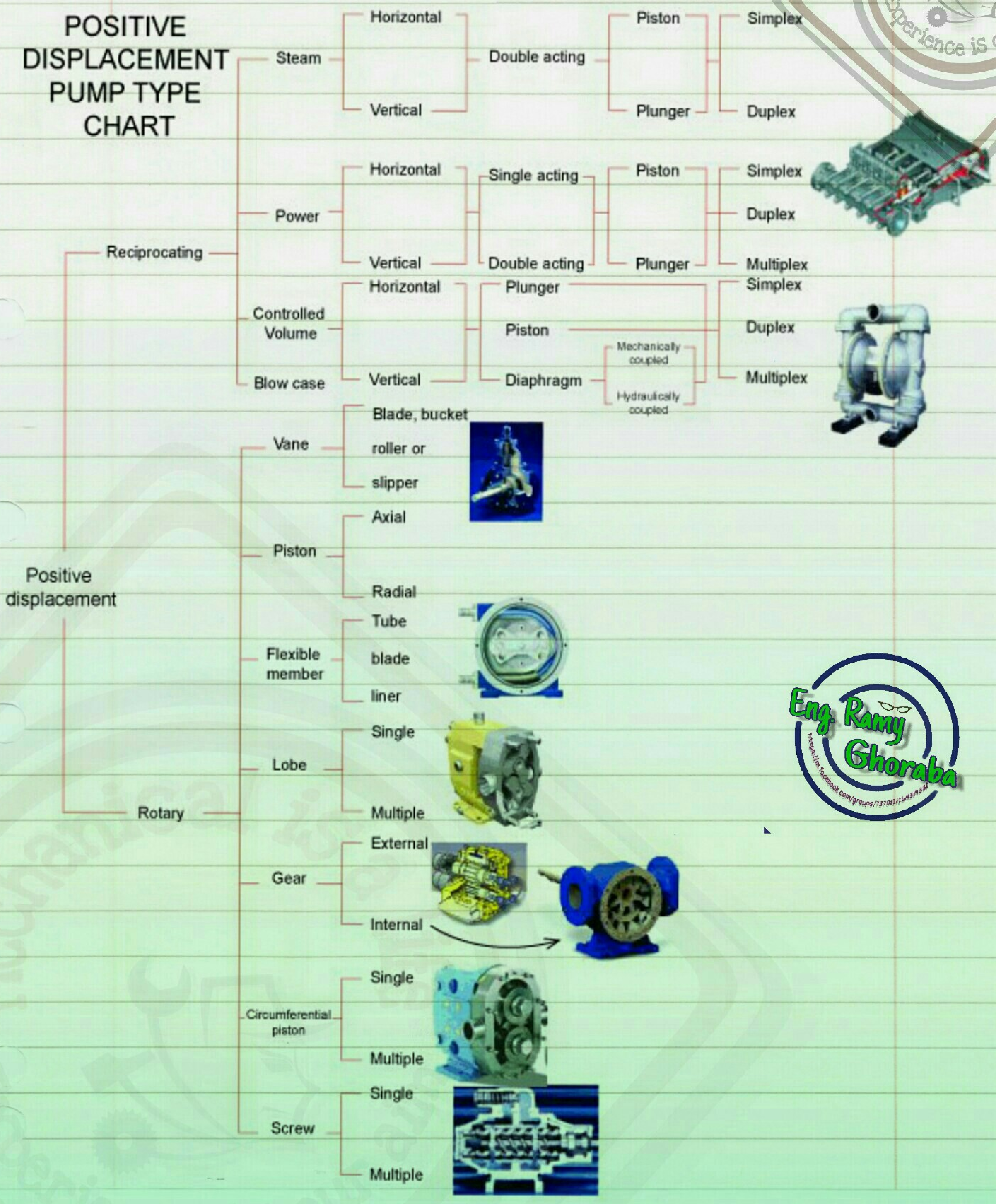
In line pump



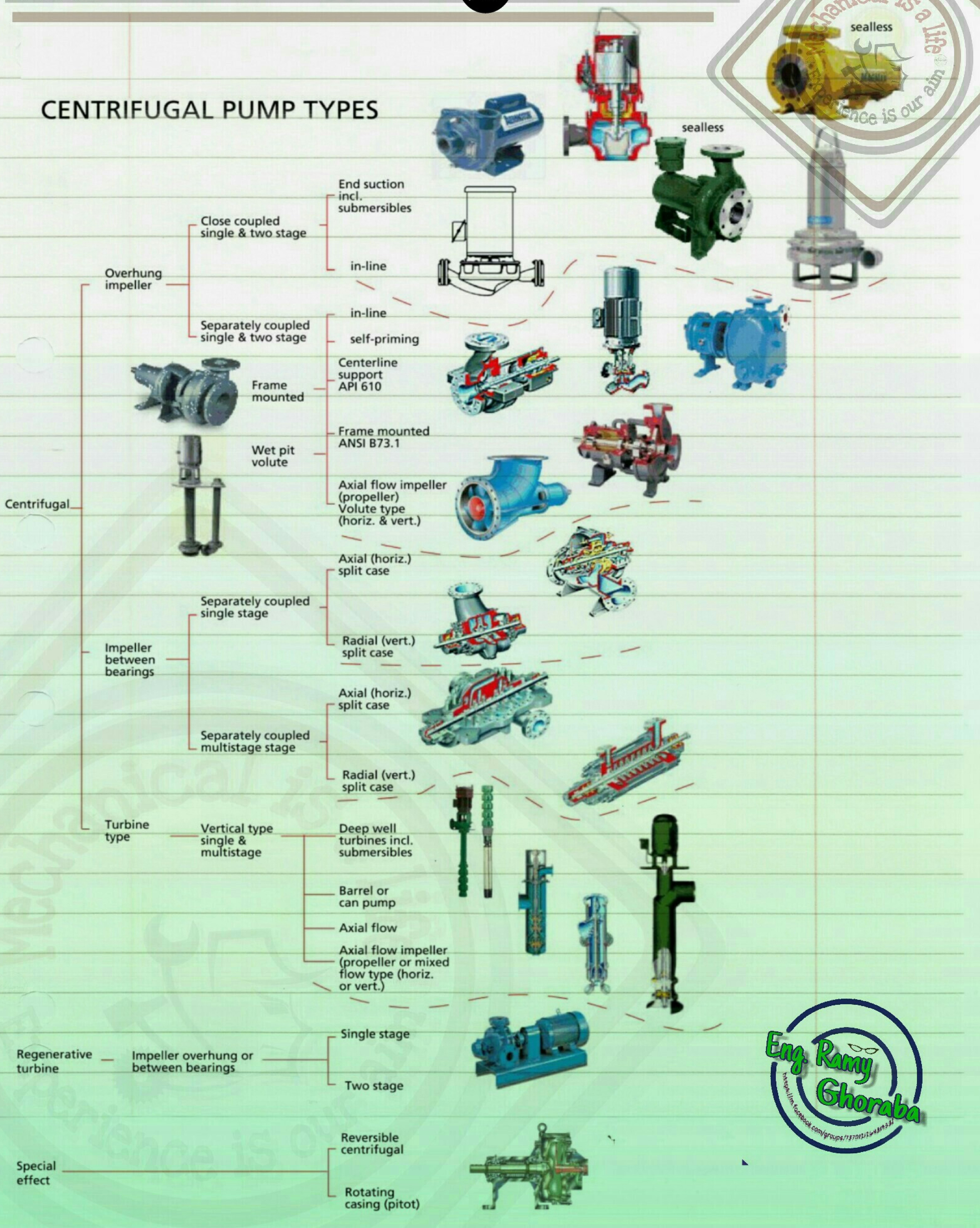
End suction pump



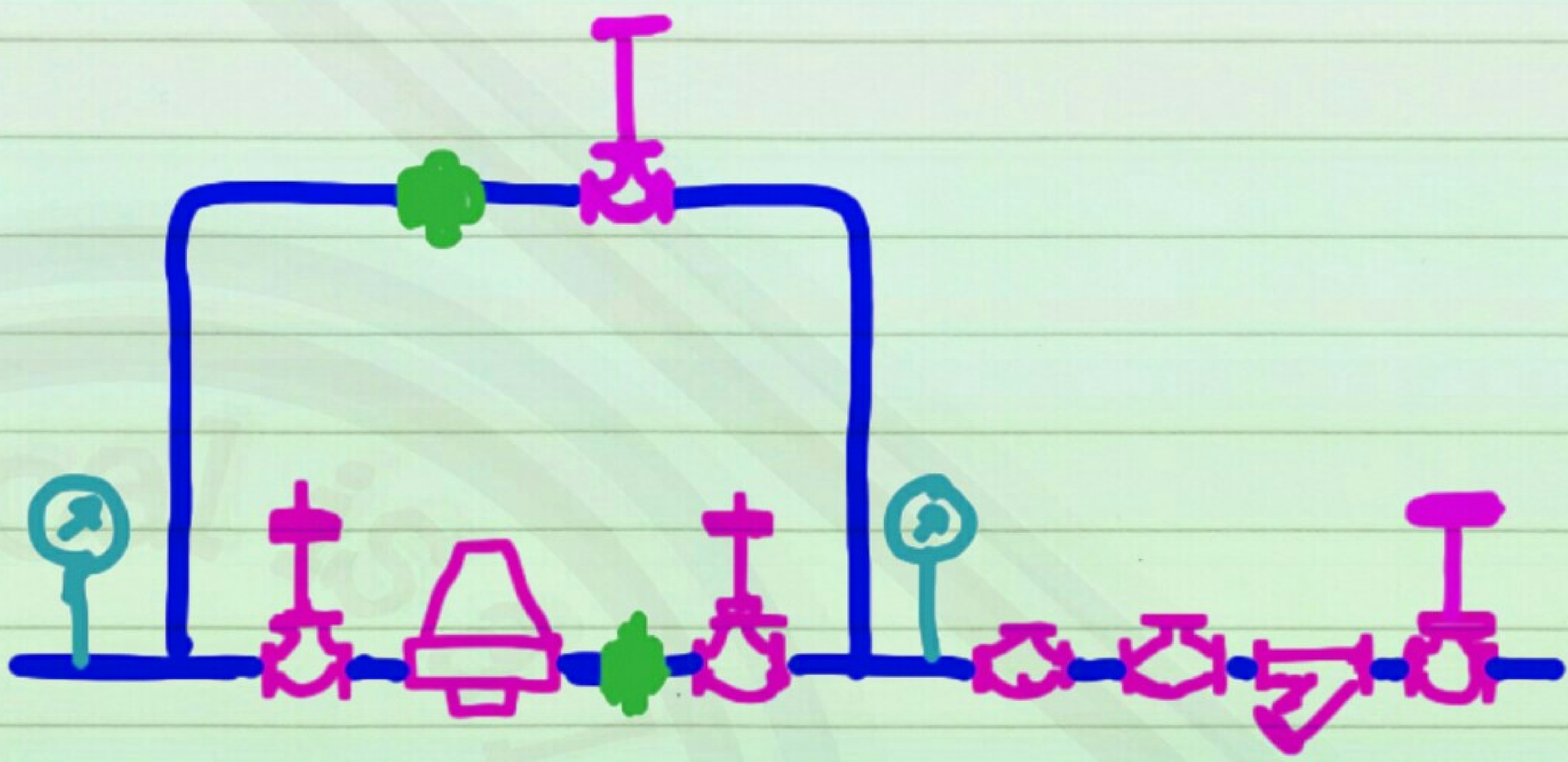
POSITIVE DISPLACEMENT PUMP TYPE CHART



CENTRIFUGAL PUMP TYPES



③ MAKE UP UNIT

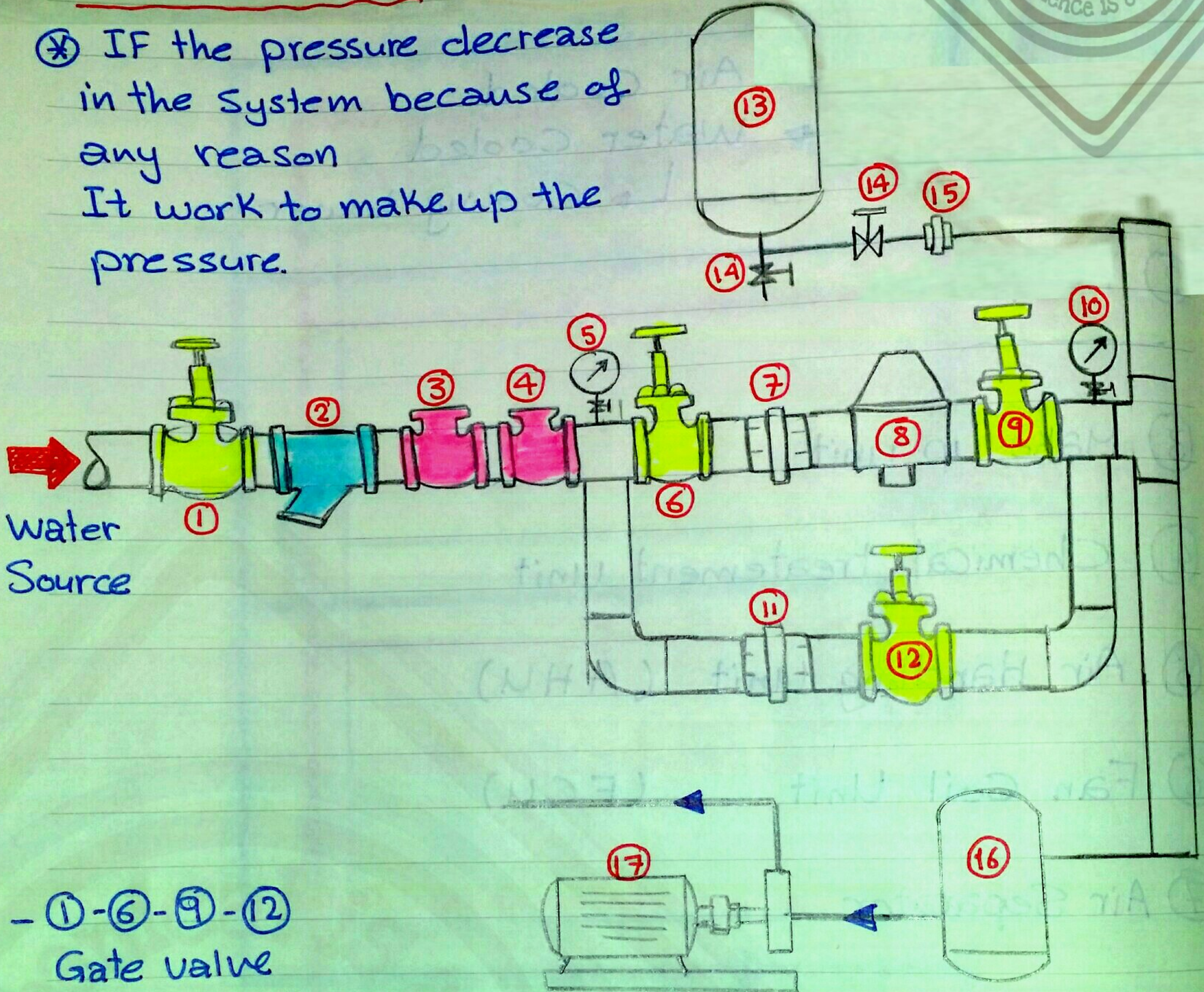


Eng. Ramy Ghoraba

NOTES

(*) Make Up Unit

(*) IF the pressure decrease in the system because of any reason
It work to make up the pressure.



- ① - ⑥ - ⑨ - ⑫ Gate valve
- ② strainer
- ③ ④ Check valve
- ⑤ ⑩ Pressure gauge
- ⑦ ⑪ ⑮ Union
- ⑧ Pressure reducing valve
- ⑬ Expansion tank
- ⑭ Ball valve

⑯ Air Separator
⑰ Pump

Backflow preventer

What is backflow?

Backflow is the undesirable reversal of the flow of water from its intended direction in any pipeline or plumbing system. Backflow is dangerous because it can allow drinking water in plumbing systems to become contaminated and unusable.

What is a backflow preventer?

Backflow preventers are mechanical plumbing devices installed in a plumbing system to prevent water from flowing backward in the system. A properly installed, tested and maintained backflow preventer at the service entrance to a building or property can reliably prevent the backflow of water of an unknown quality from flowing back into the community water system.

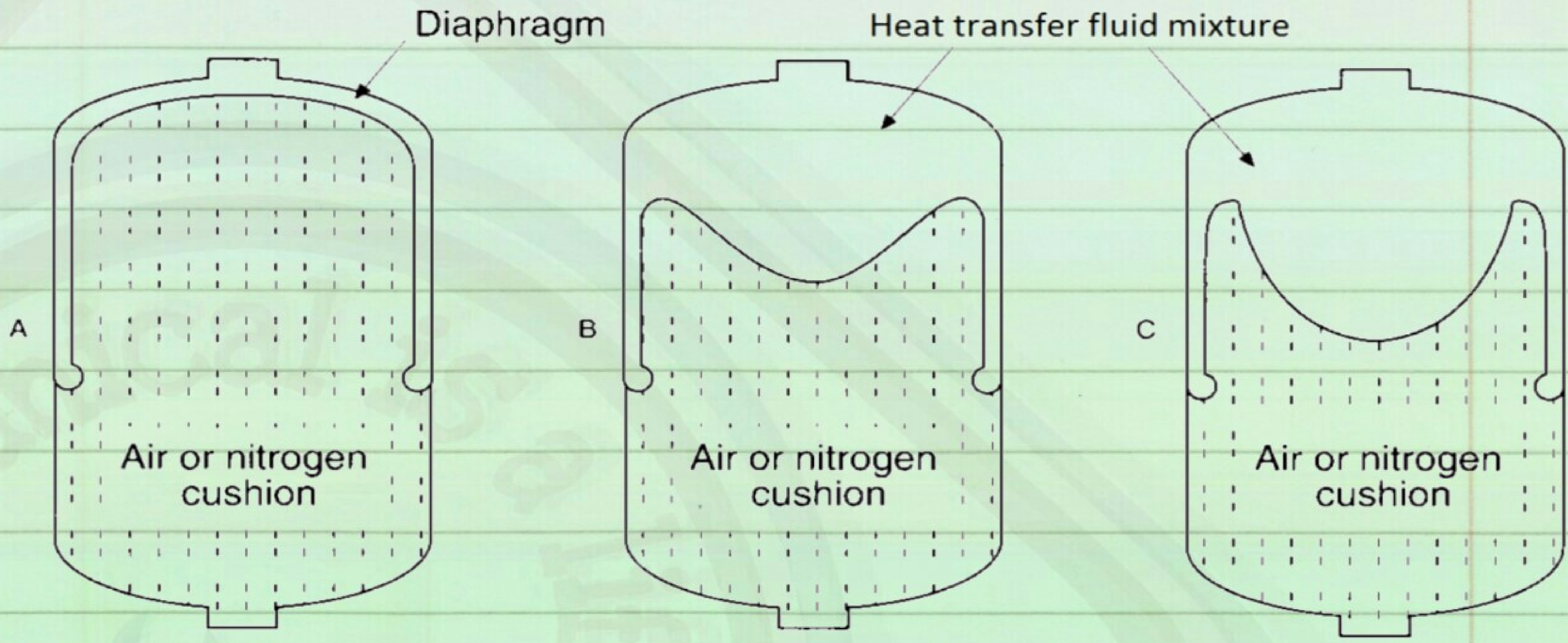
THE PRESSURE REDUCING VALVE : DEFINITION

This valve reduces the pressure of the water that goes through it, and is used to obtain a regulated and constant value at its outlet.

It is installed at the water mains (for a bungalow as for a flat). It protects the whole installation from problems due to excess pressure : noises in the pipes, water hammer, splashes, premature wear of household electrical appliances and taps.

The pressure reducing valves are completely automatic.

Expansion tank



A. When system is filled, no fluid enters tank when cushion and water pressure are in equilibrium

B. As temperature increases, diaphragm moves to accept heat transfer fluid mixture

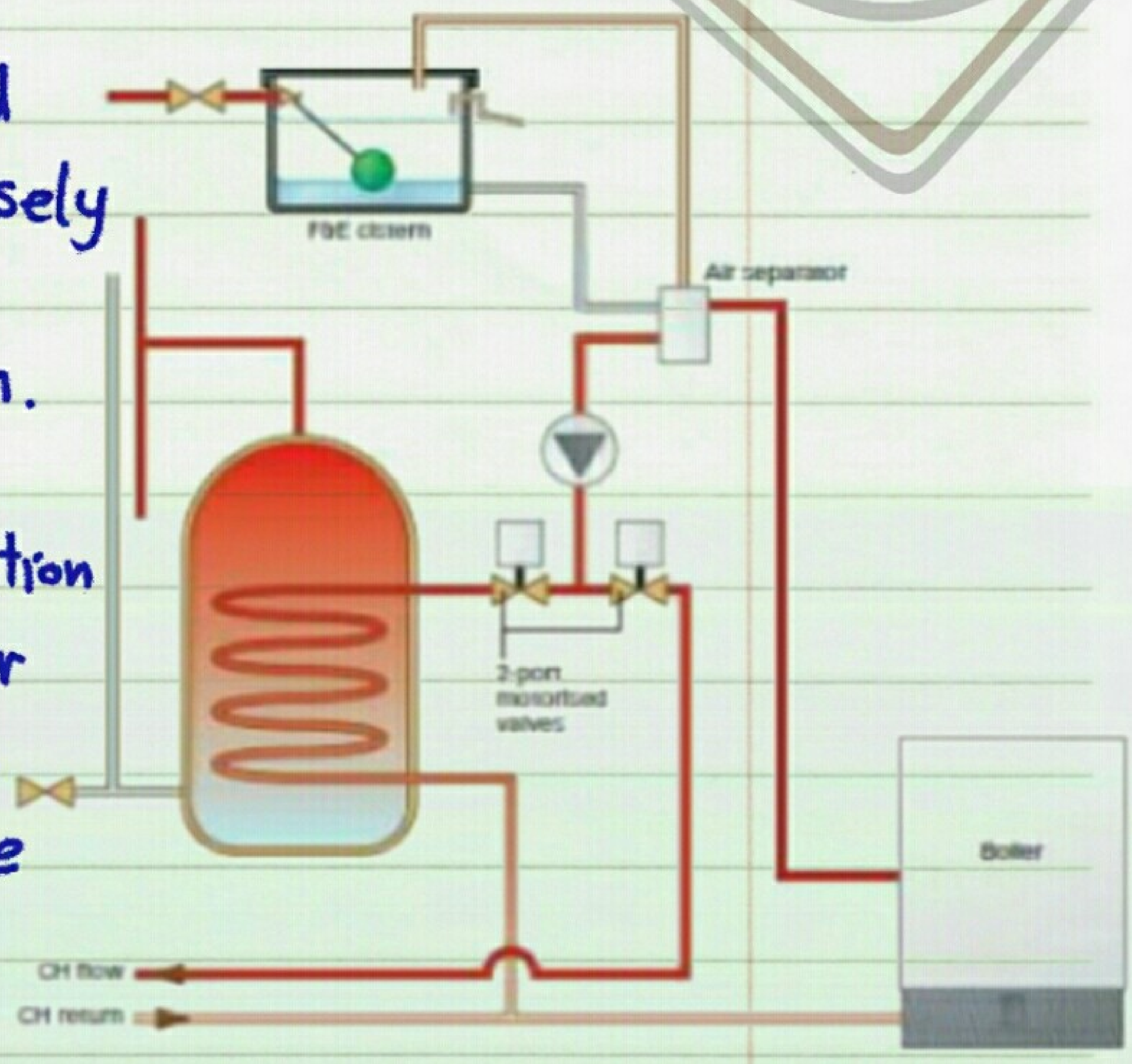
C. When fluid rises to maximum, full acceptance of expansion is achieved

④ AIR SEPARETOR

Air Separator

Function

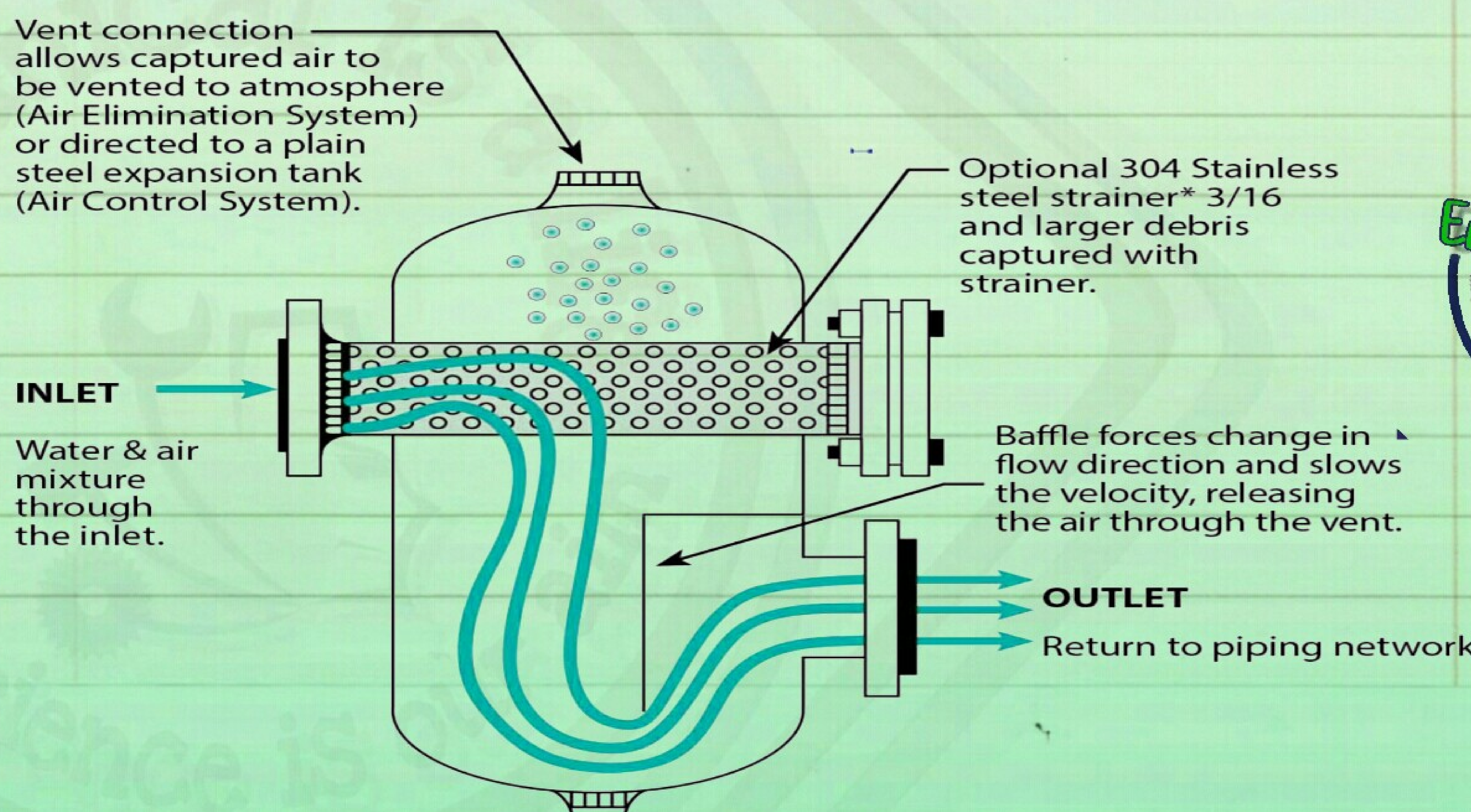
- To enable the cold feed and vent pipe to be joined closely together into a correct layout to serve the system.

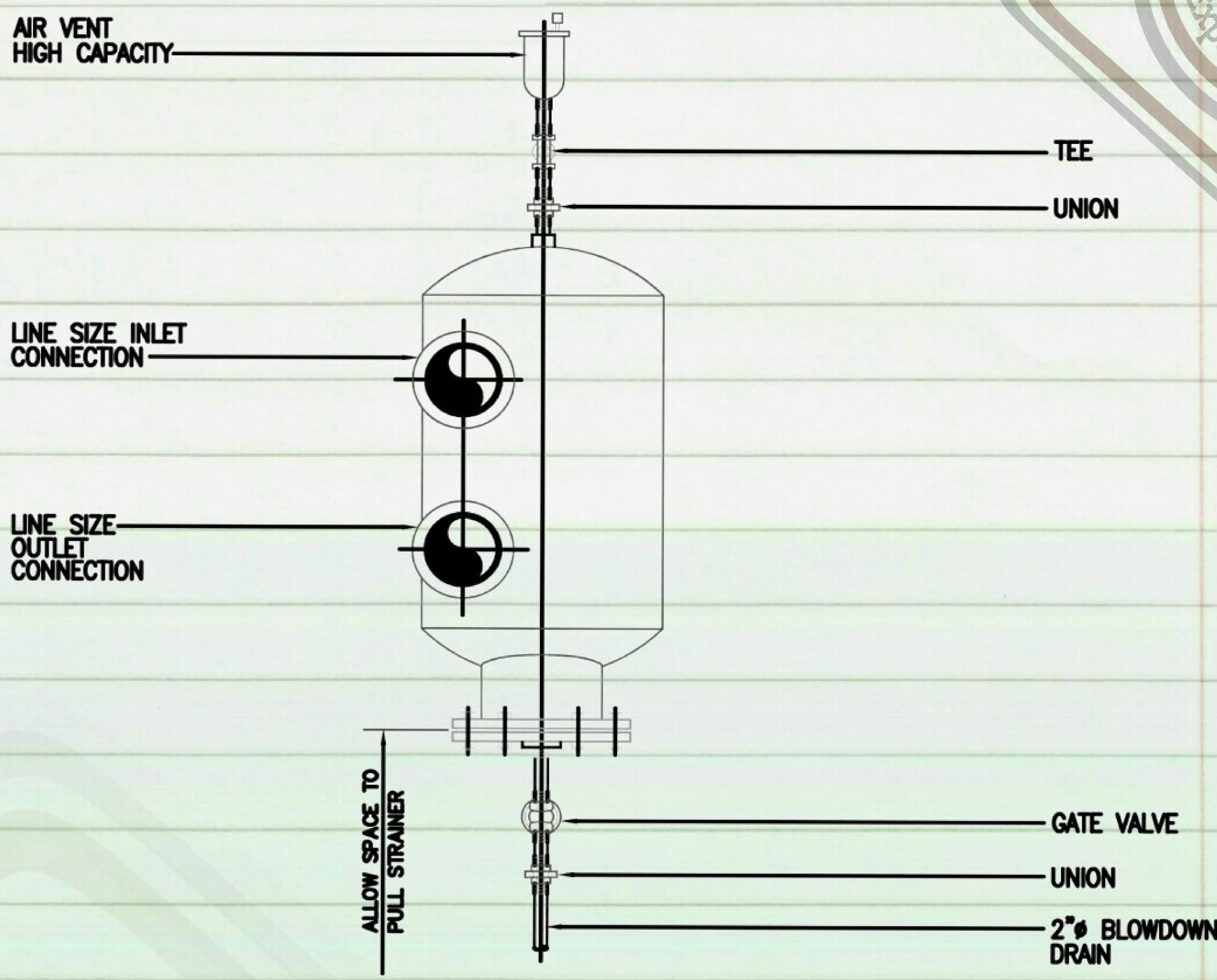


- The grouping of the connection causes turbulence of water flow in the separator which in turn removes air from the system

- This reduces noise in the system and lowers the risk of corrosion.

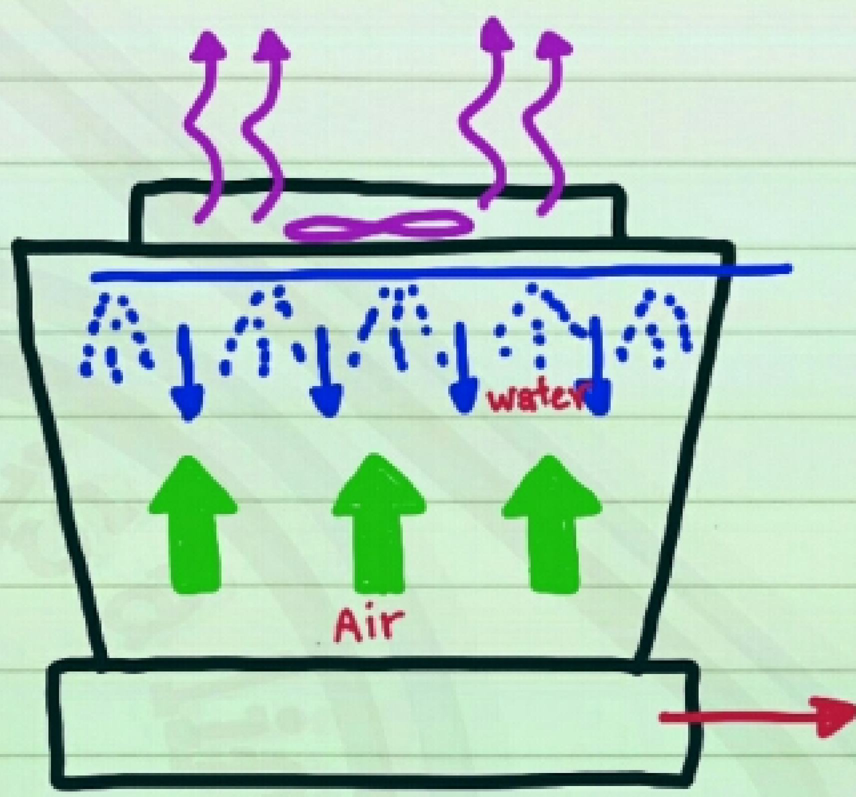
Air Separator Flow Pattern





Air Separator installed in a plant room.

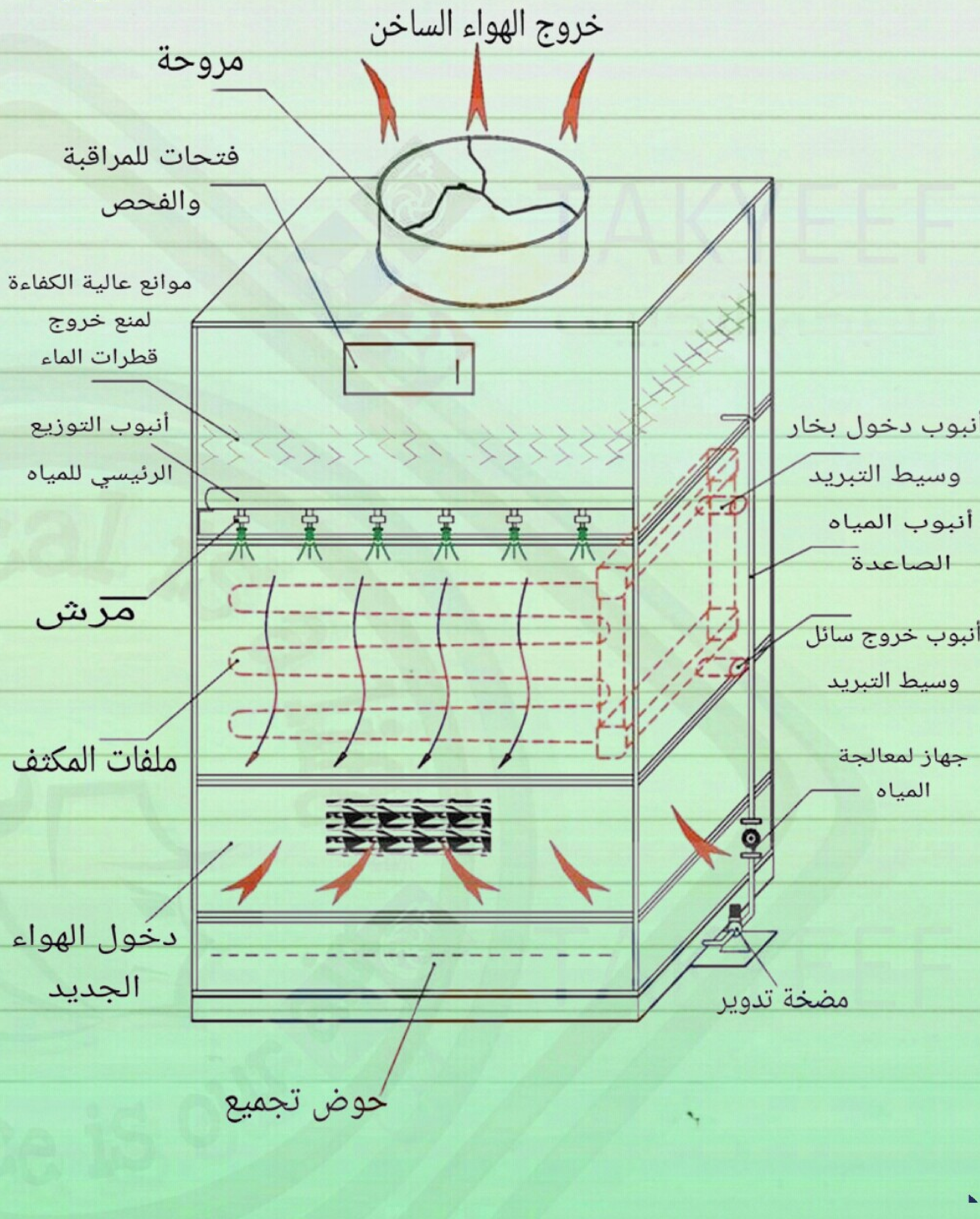
⑤ COOLING TOWER



Cooling Tower

Function

- Decrease the temprature of Water for the Condenser by water Spray on a large area to achive maximum touching with air then the water evaporates with the heat.



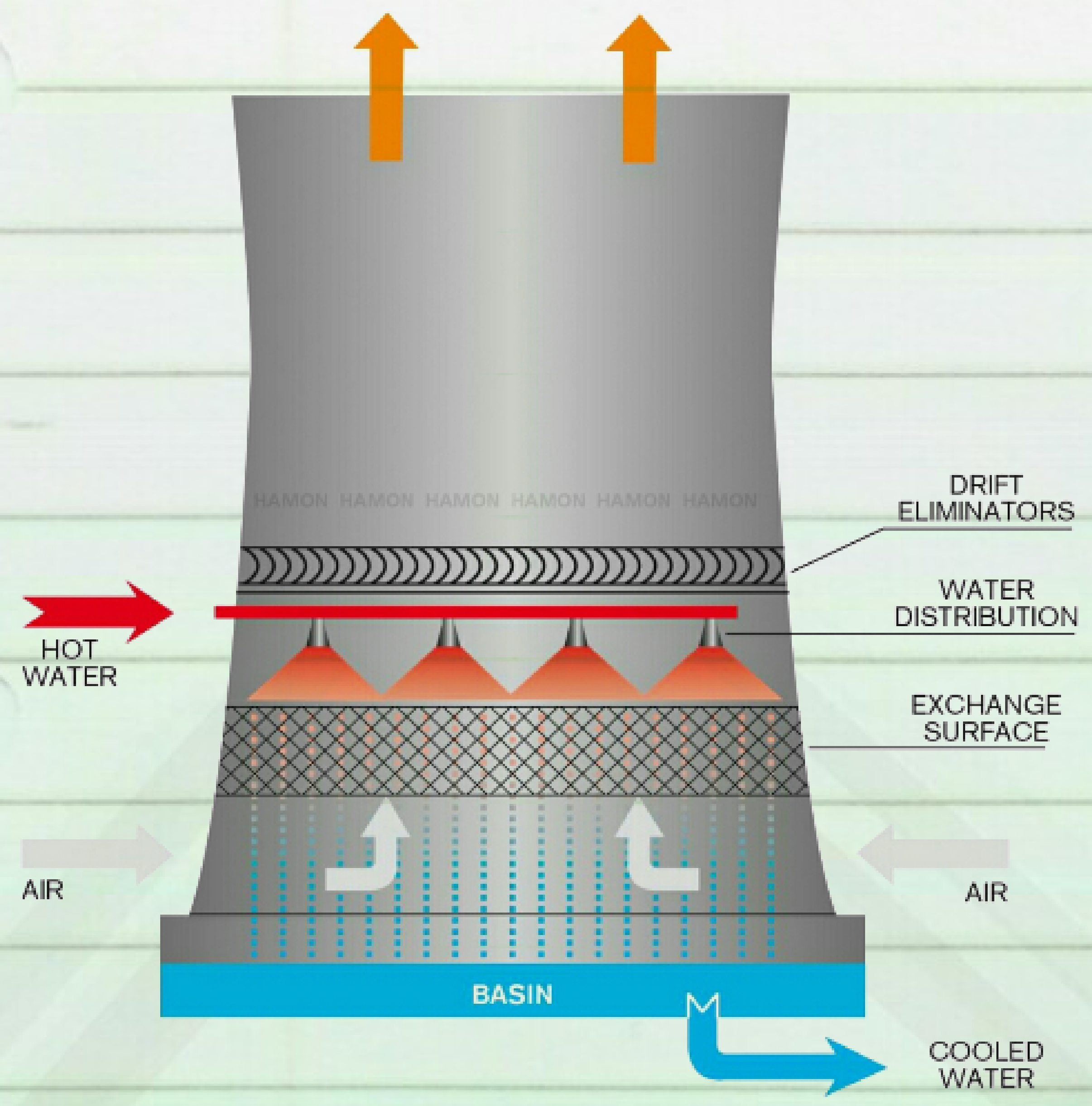
Cooling tower types

A- AS per Air entering

1- Natural draft

Natural circulization

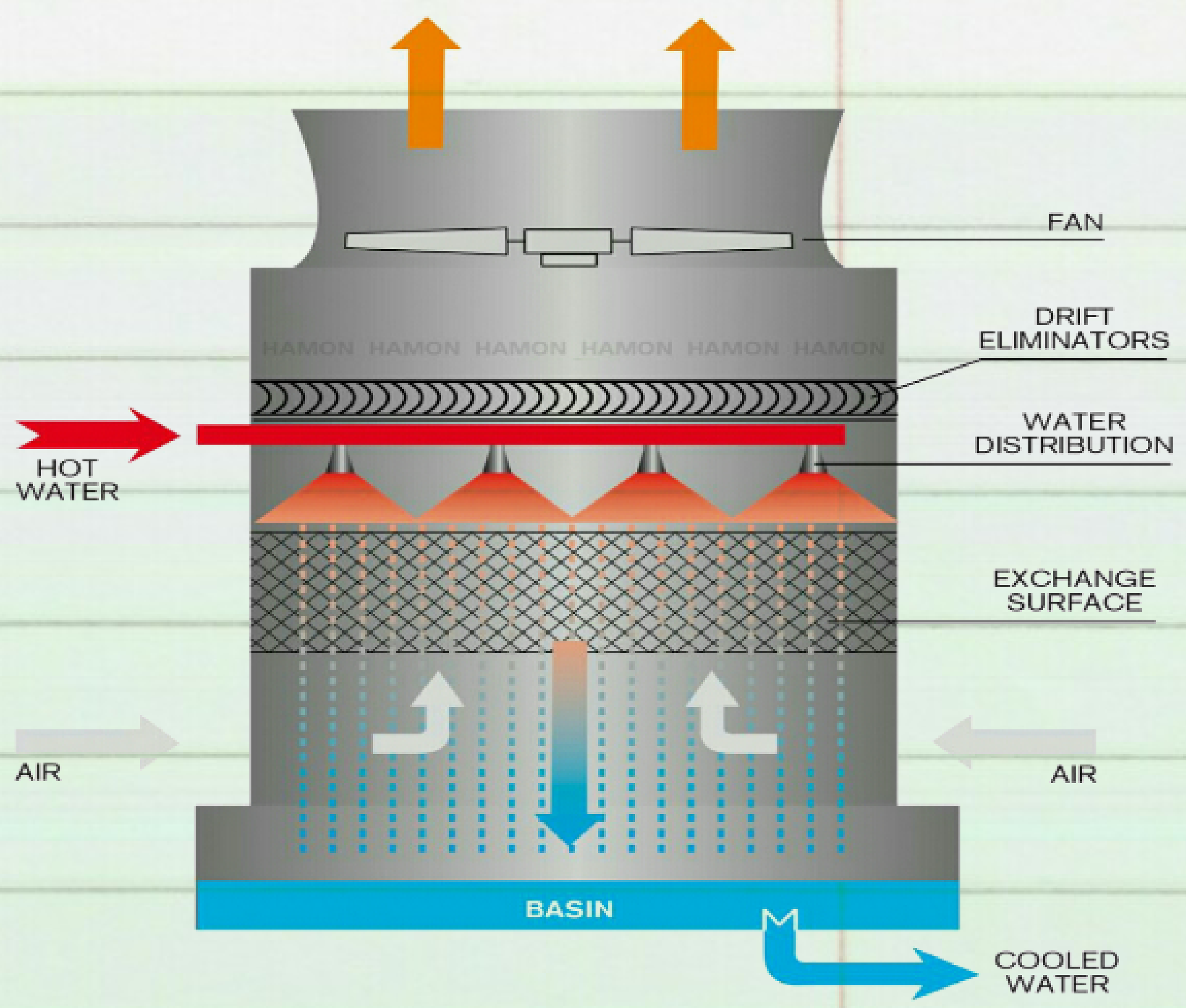
for the air



2- Mechanical draft

Used fans

for air moving



B- AS per heat removing

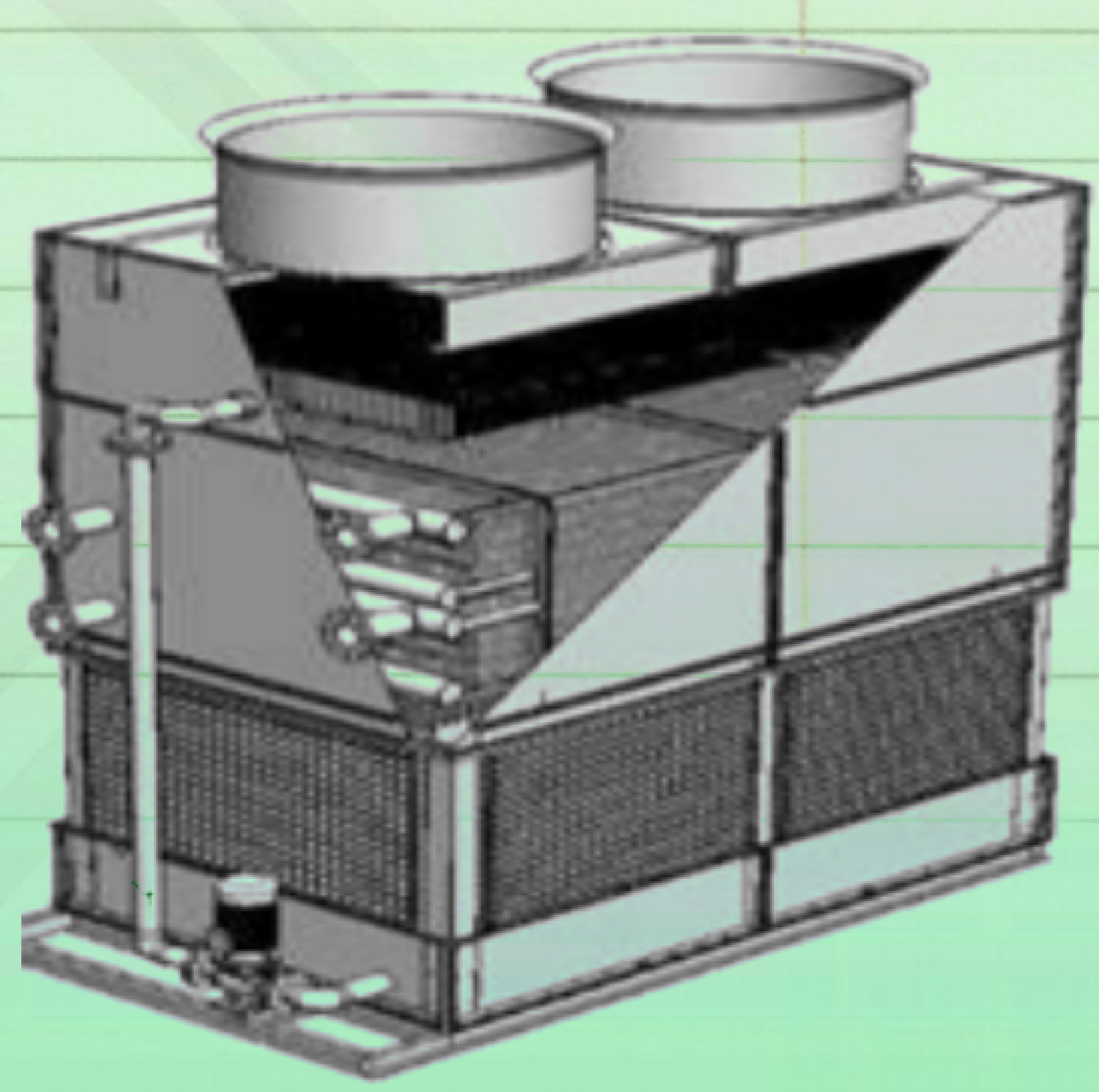
1- Open cooling tower

water Spray from up

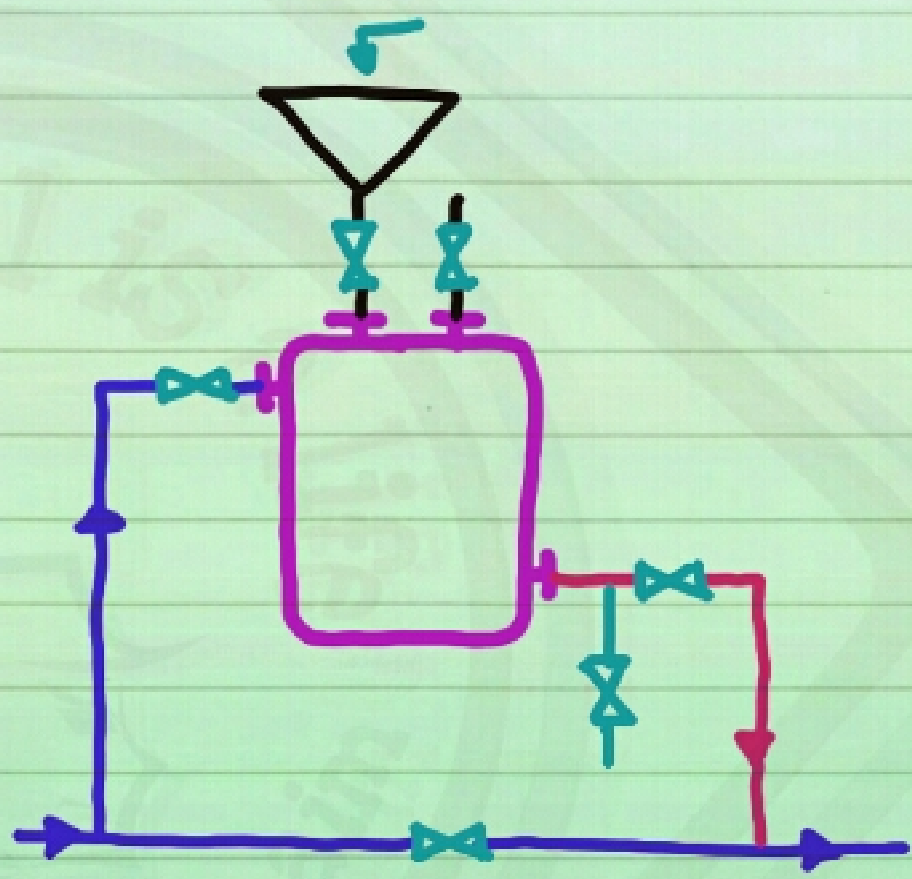
and take the heat from air

2- Closed cooling tower

Used Heat exchanger



⑥ CHEMICAL TREATMENT UNIT



Chemical treatment Unit

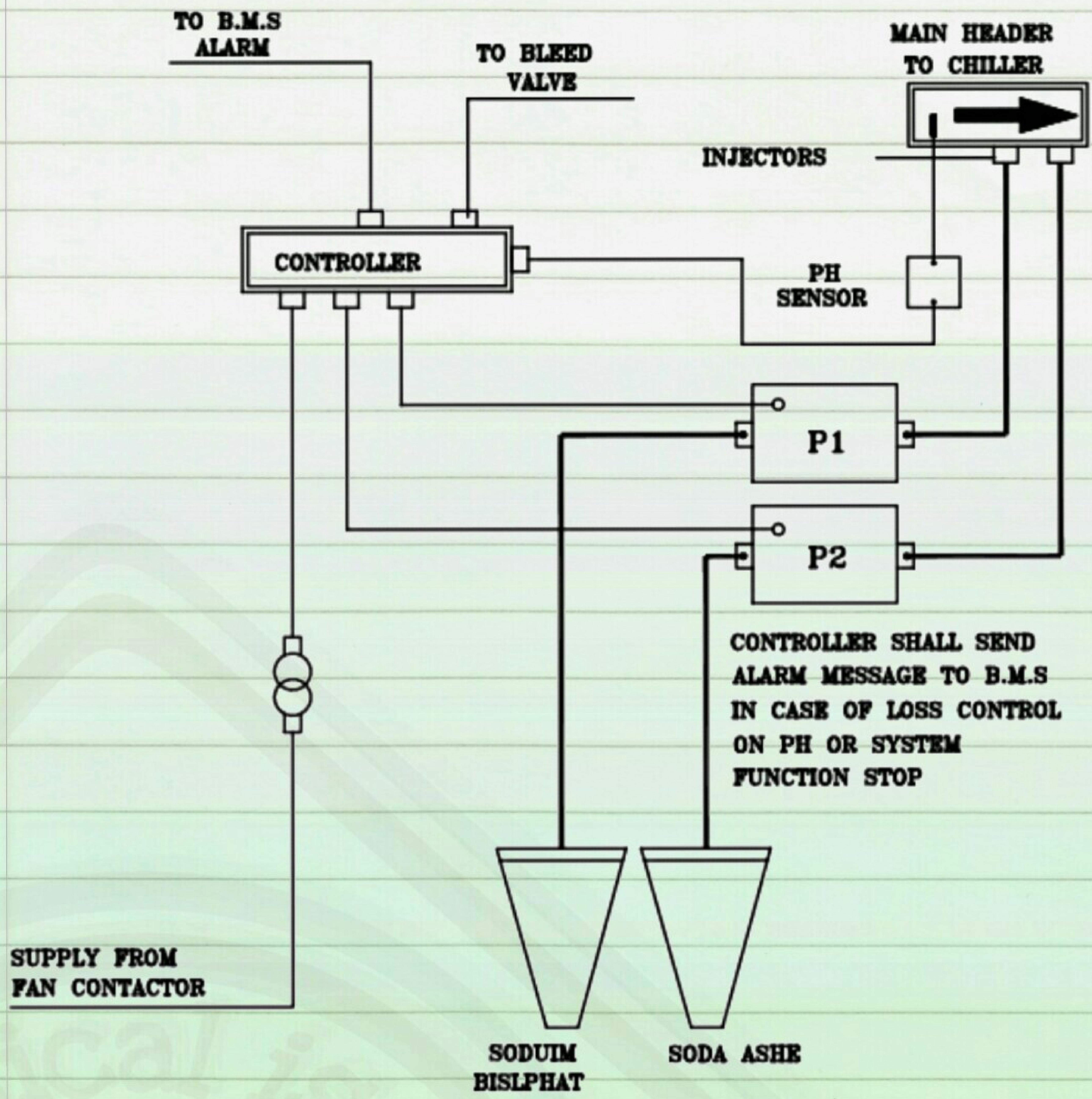
- Very important for the life of the System because it is a closed System.
- Chemical react with the pipes to form aprotective thin inside layers.
- Chemical help in maintaining of PH level.
- Chemical remove Corrosive dissolved oxgyen in the water.

Dosing pump used to applying the predetermind quantities of chemical at regular intervals.

* Mechanical treatment:
  Before Commissioning, System should be cleaned & flused using treated water.

* Filtration:
  Used for removing (or reducing) the Solid particles (like →
  - welding flush
  - Concrete.

Chemical treatment Station



7

PHOTO FROM REAL SITE

① Chiller


Air Cooled


Water Cooled

② Pumps

③ Make Up Unit

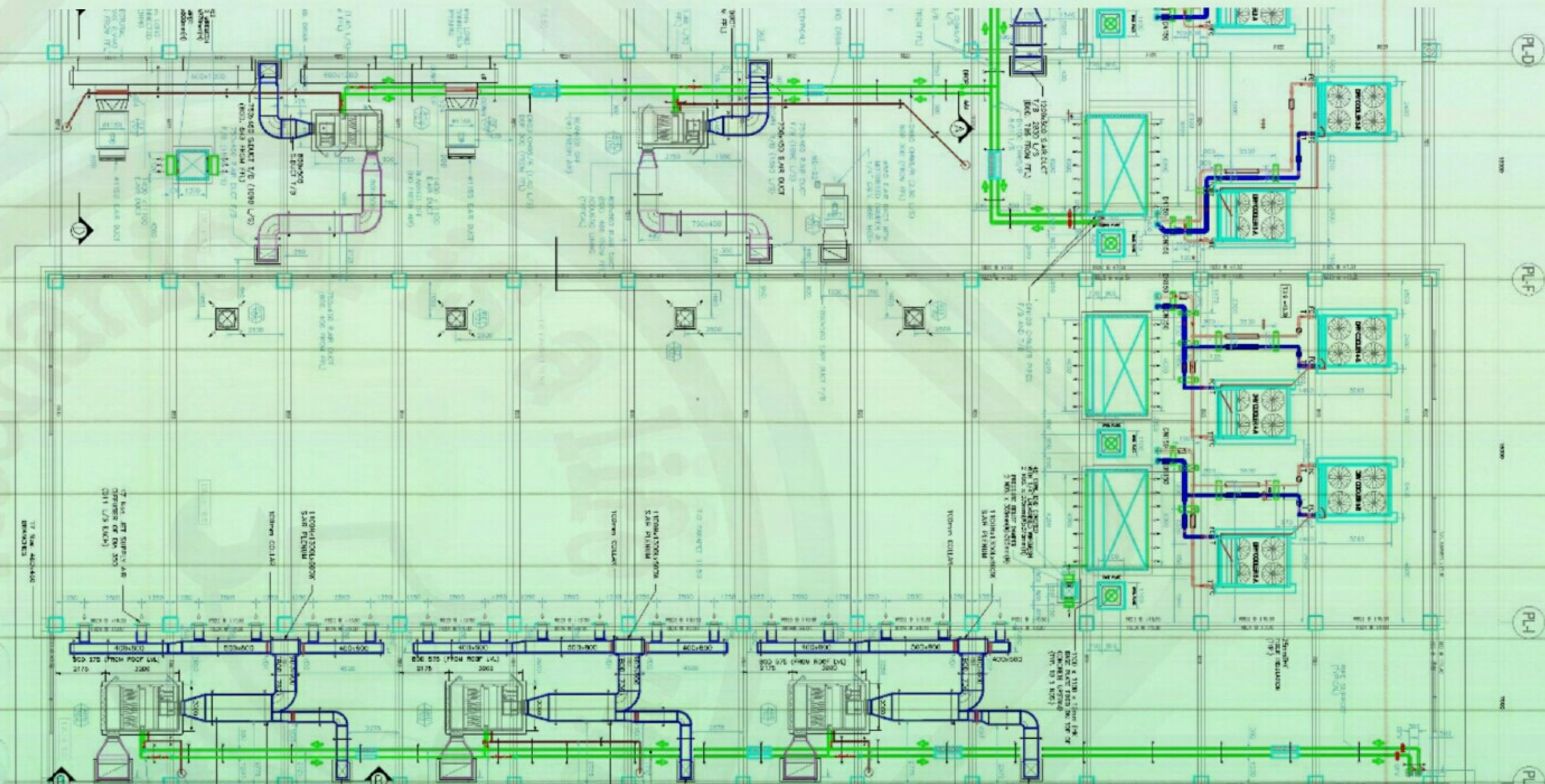
④ Air Separator

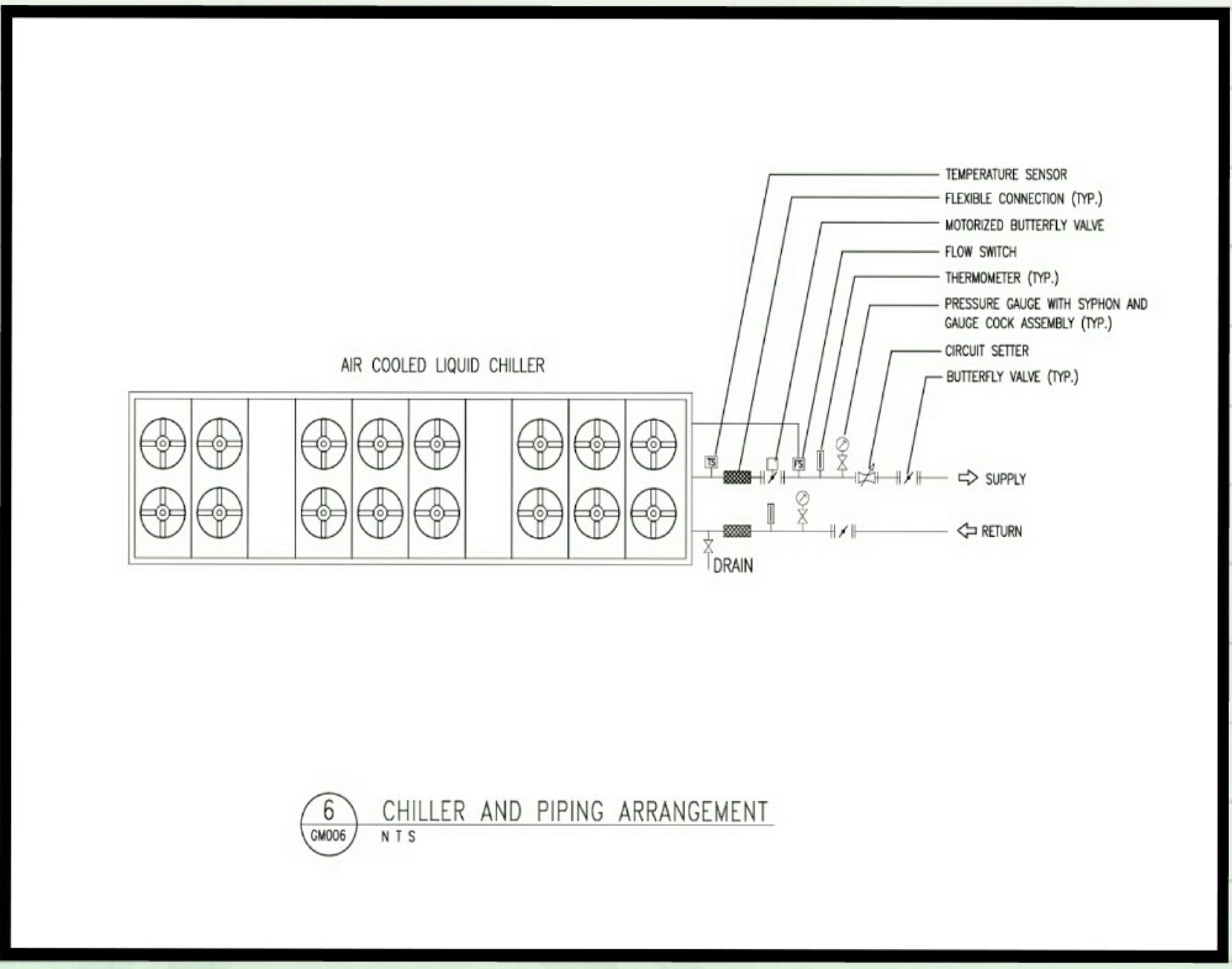
⑤ Cooling Tower

⑥ Chemical treatment Unit.

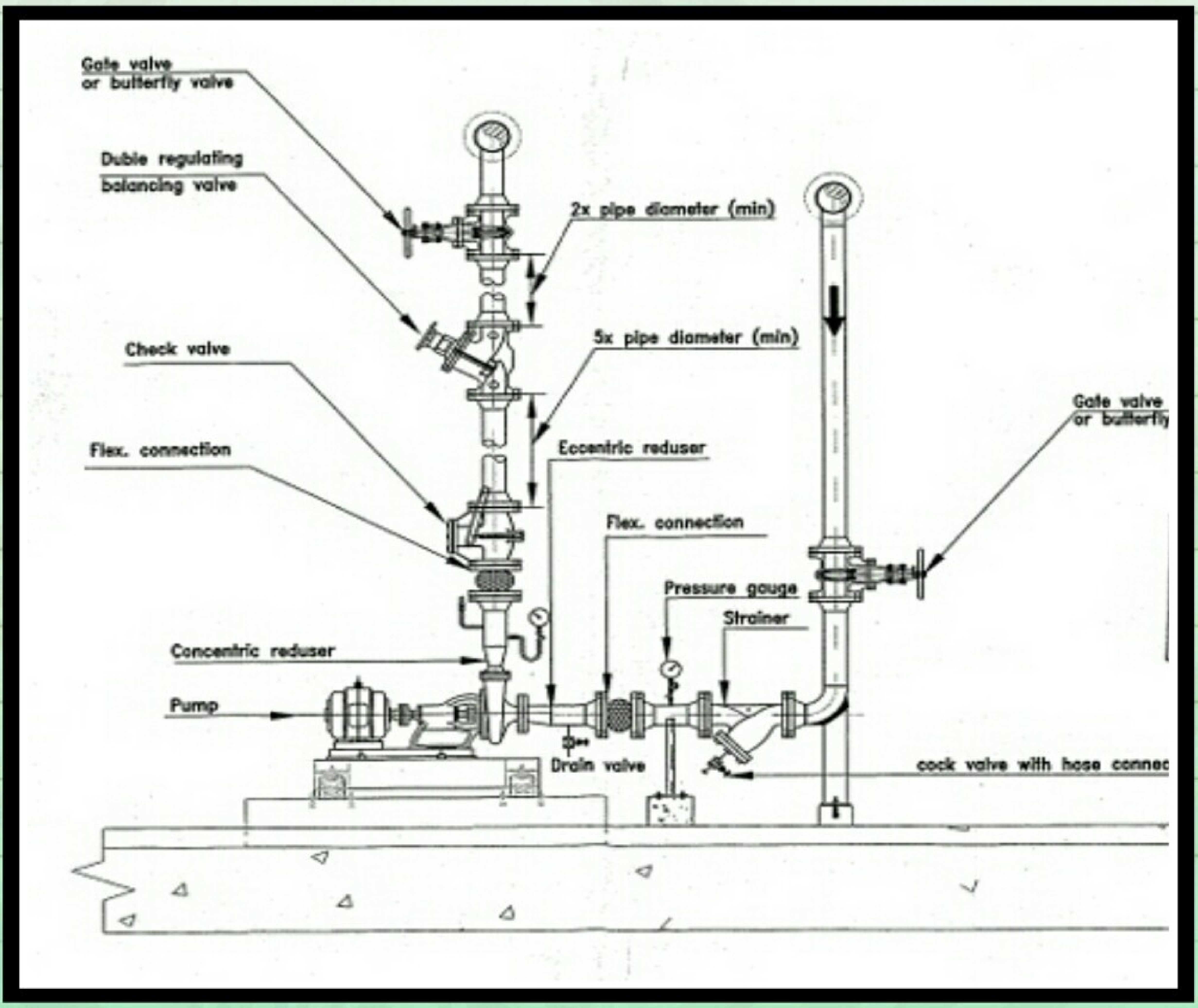
8

SYMBOL FROM IFC DRAWING

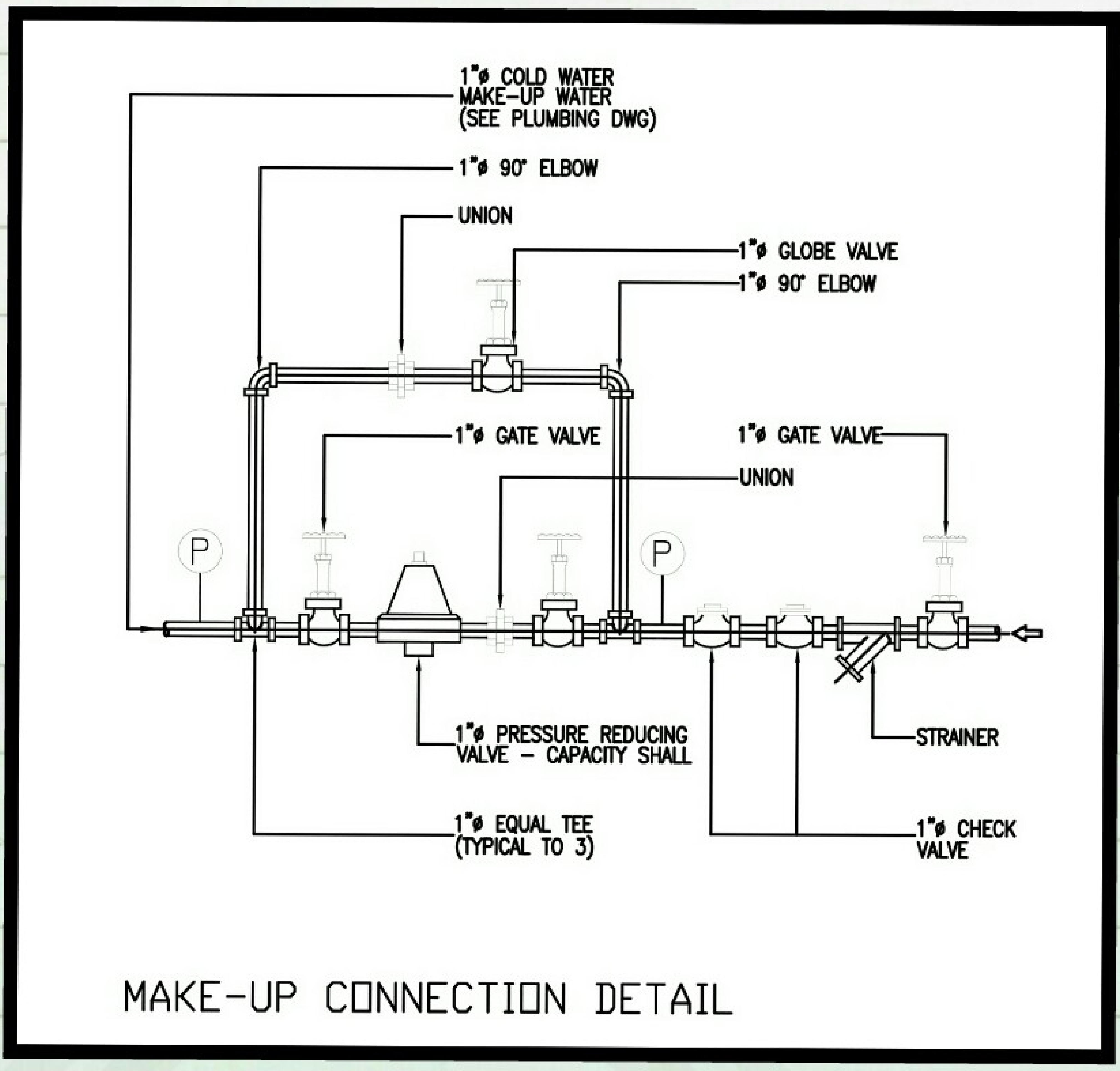




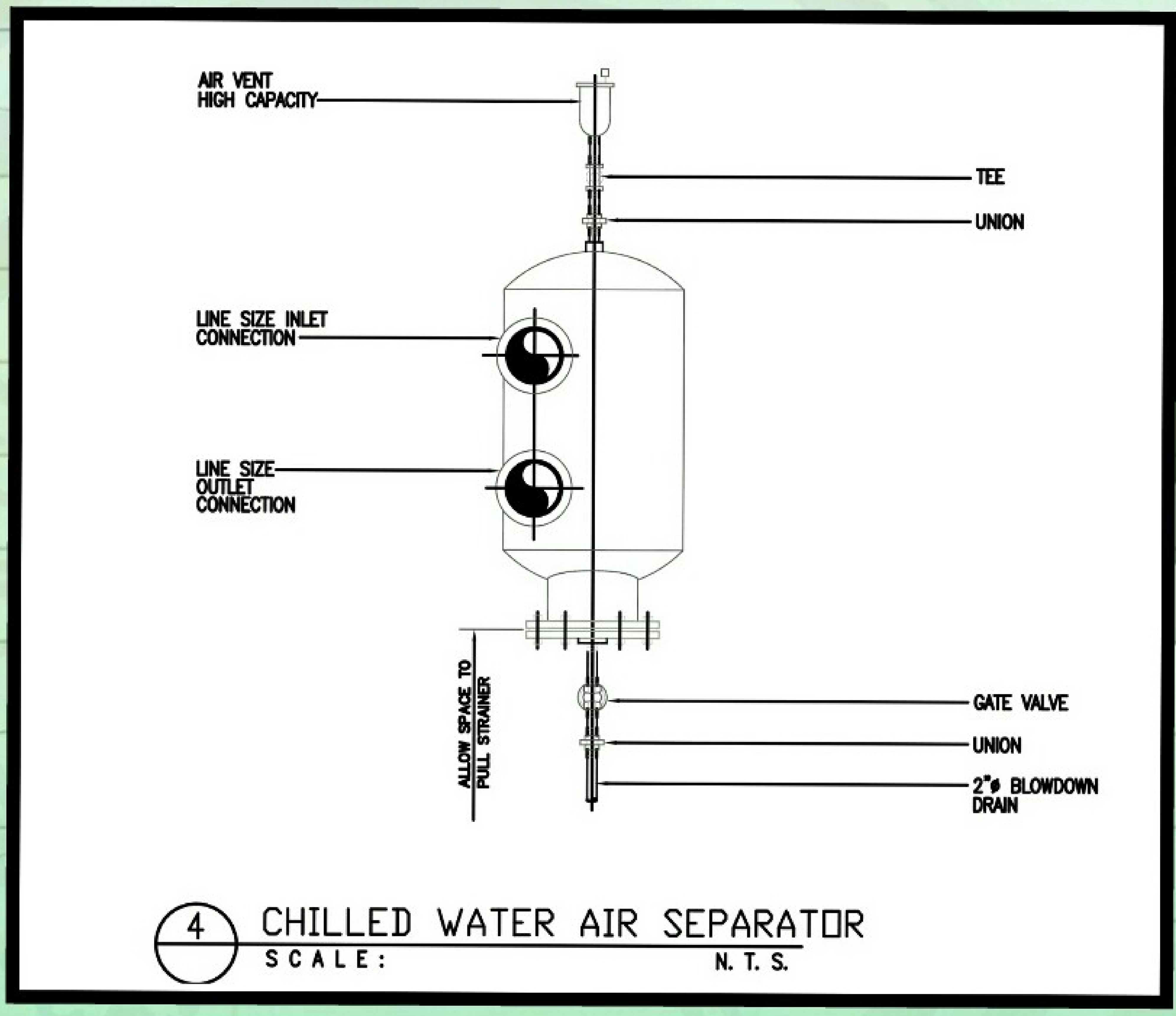
Chiller



Pump



Make Up Connection



Air Separator

PART 2

By Eng. /

Eng. Ramy Ghoraba

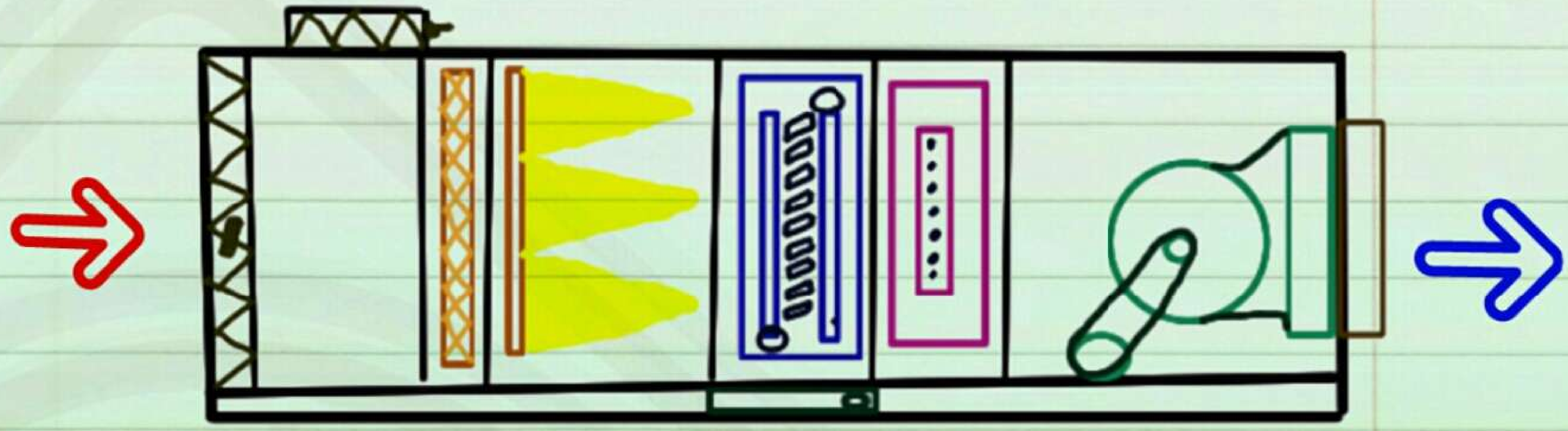
PART 2 Contents

PART 2 Contents

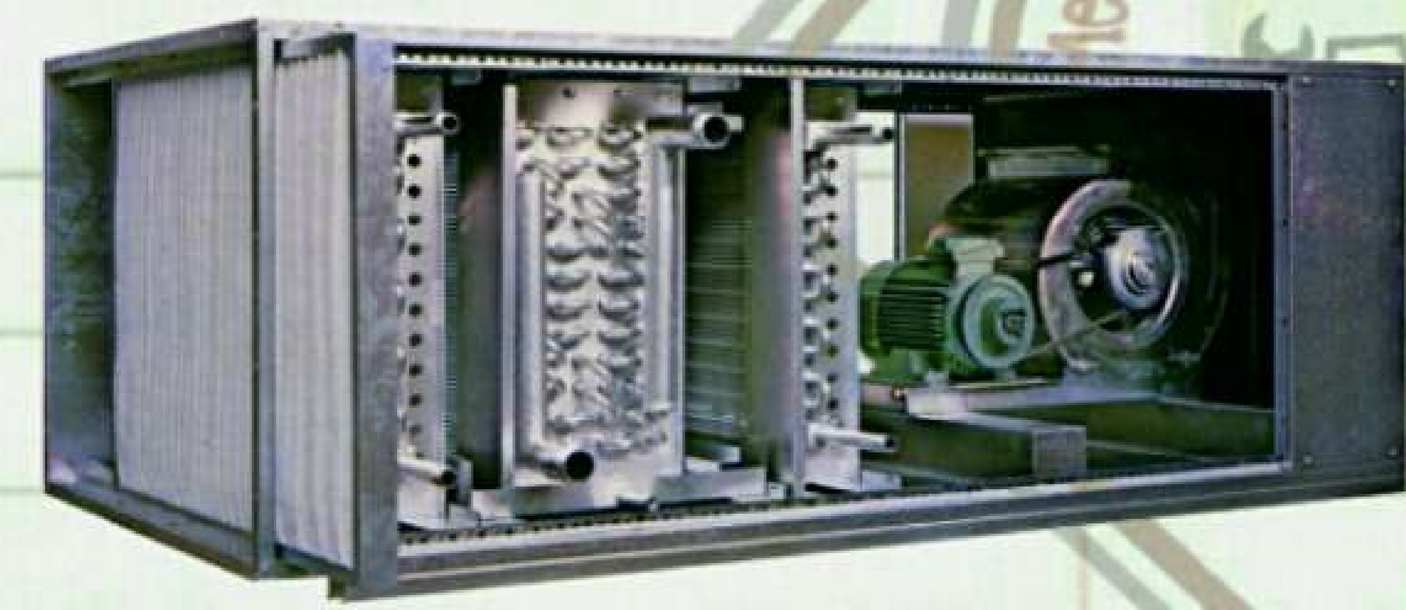
①

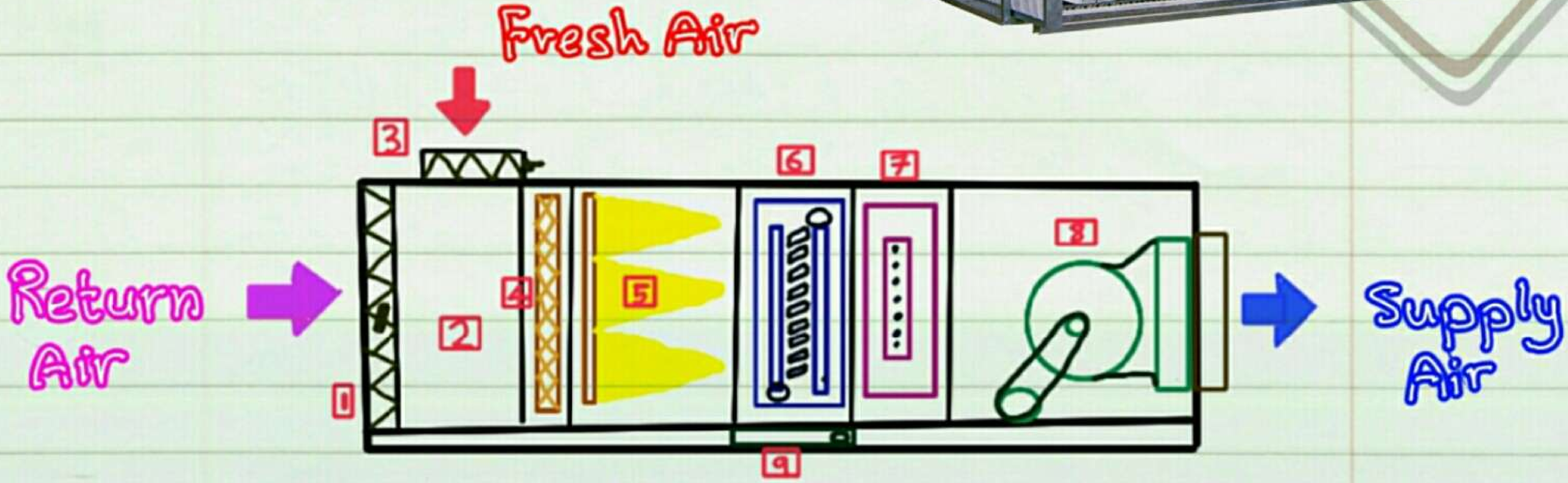
Air Handling Unit

AHU

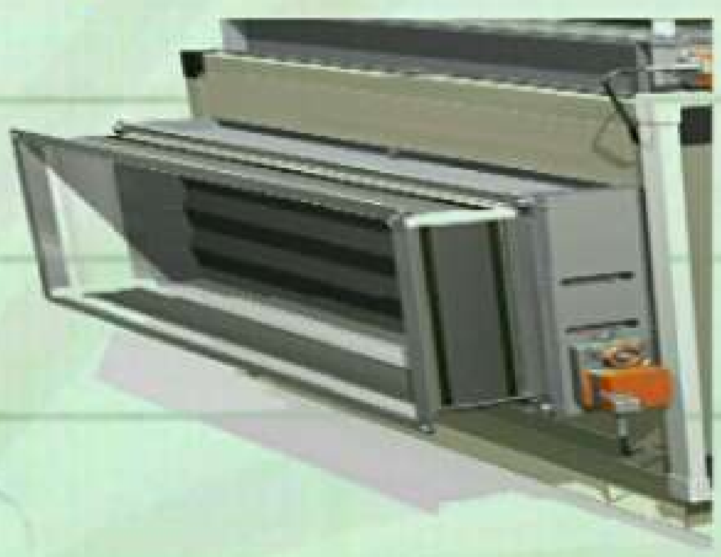


Air Handling Unit AHU





① Return Air open with V.D



② Mixing Box

③ Fresh Air Open

④ Pre Filter

⑤ Bag Filter

⑥ Cooling Coil

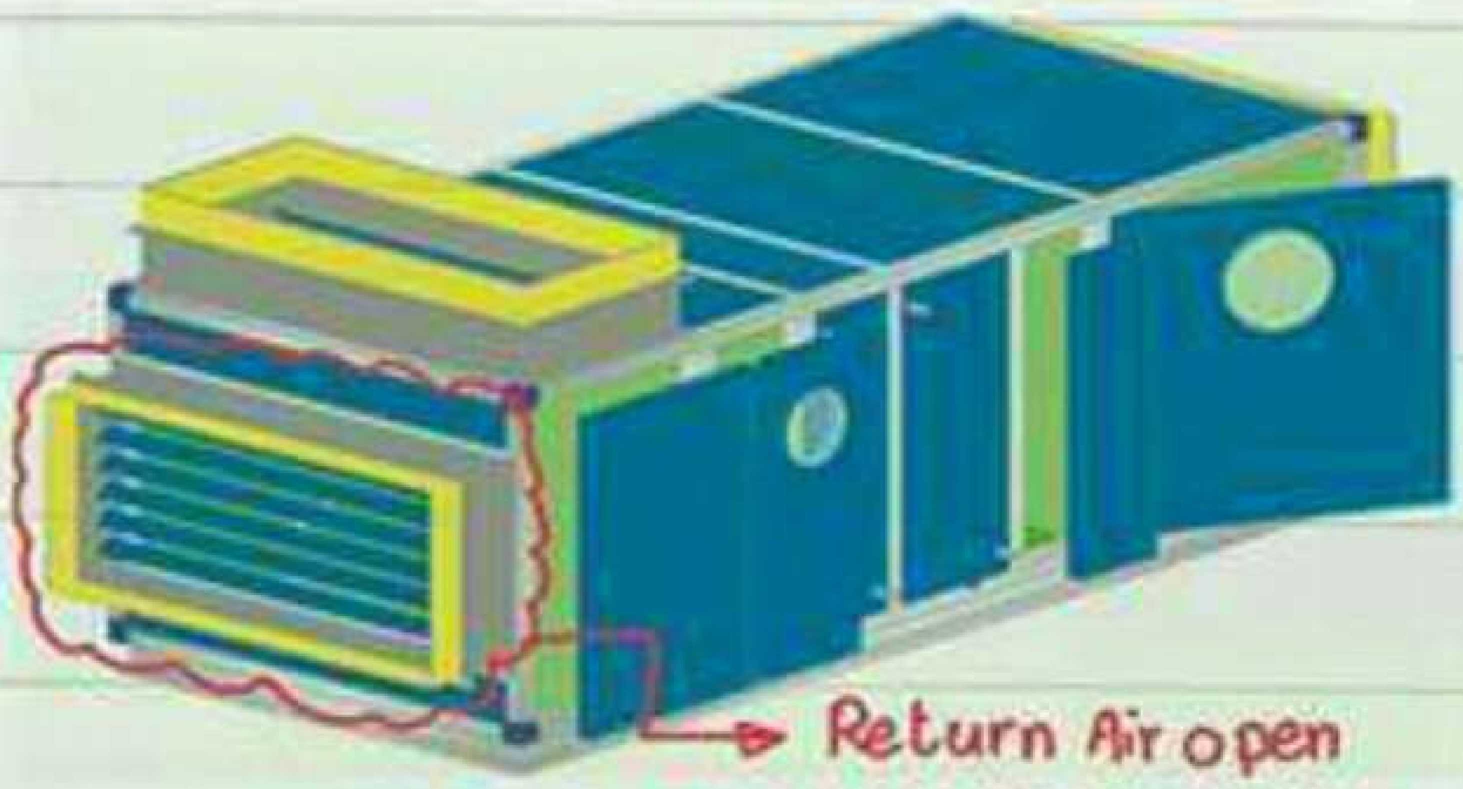
⑦ Electric heater

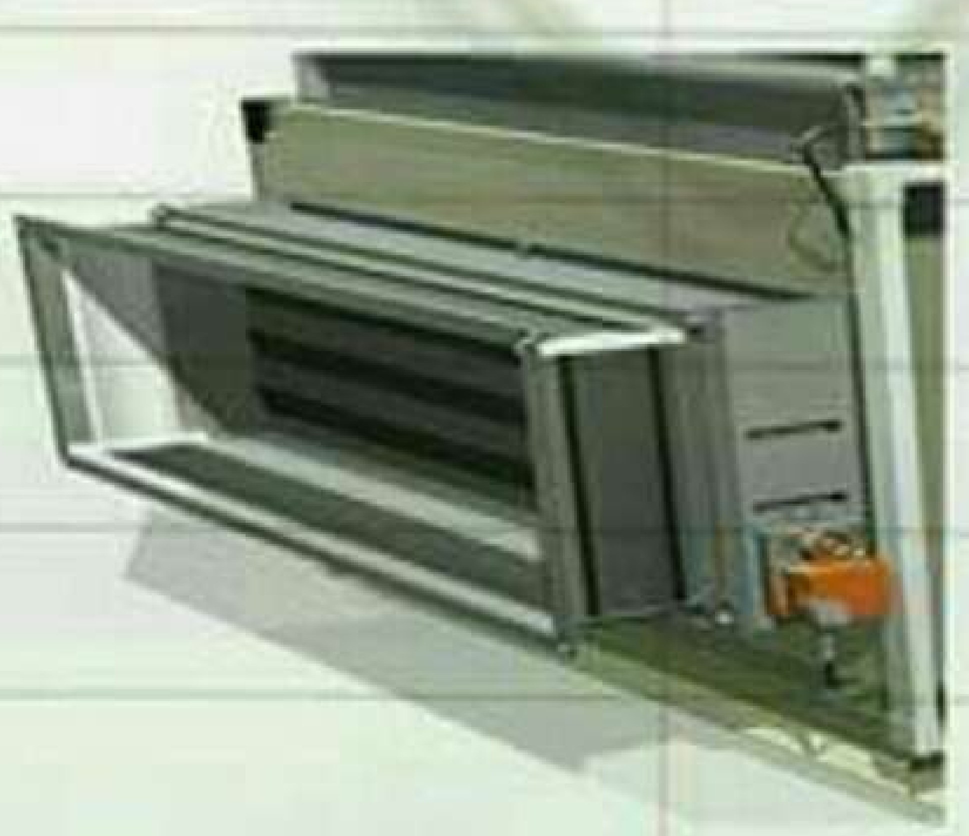
⑧ Supply Fan

⑨ Drain pain

① Return Air opening with Volume damper

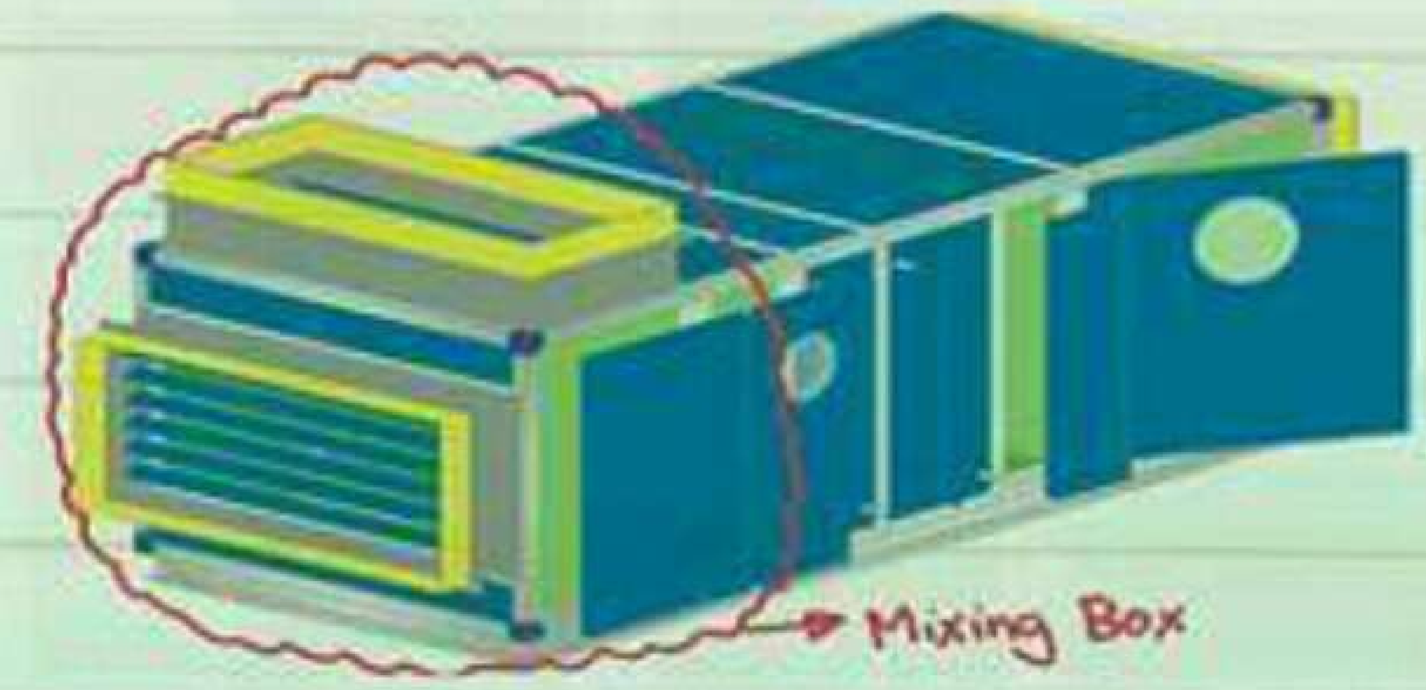
→ The opening which receive the return air from the building, and the volume damper exist to control of the quantity of flow rate.

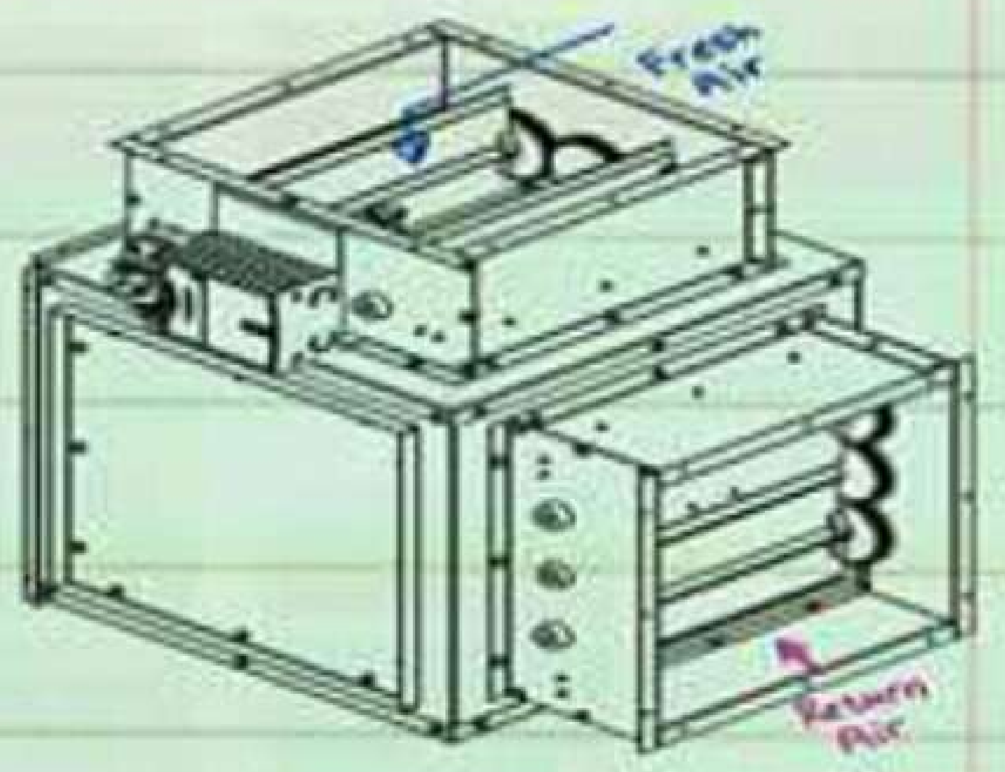




② Mixing Box

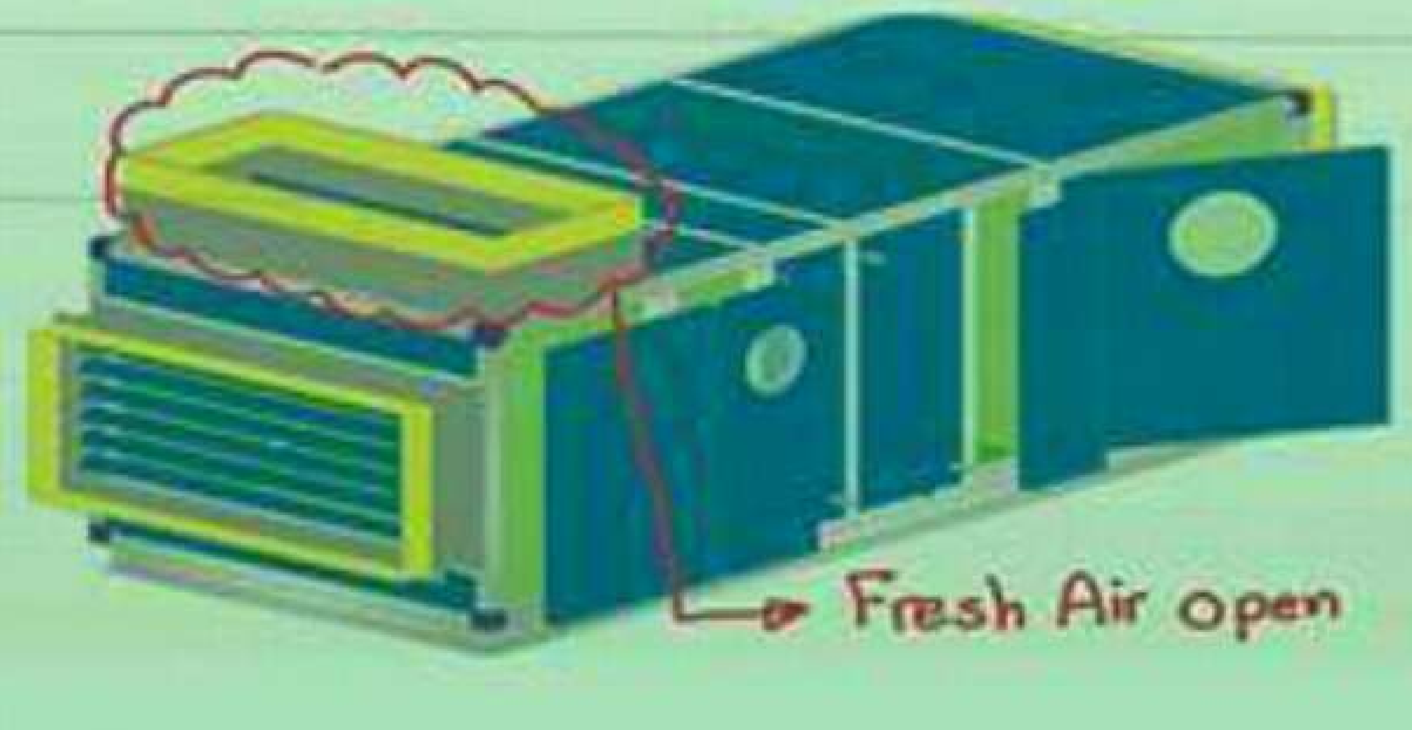
→ The return Air and fresh air are mix inside it with the required percentage





③ Fresh Air Opening

→ The opening for fresh air and should have sand trap louver with volume damper and filter



④ Pre Filter

→ It is the first filter that return air pass on it,

Function → Air purification from impurities.

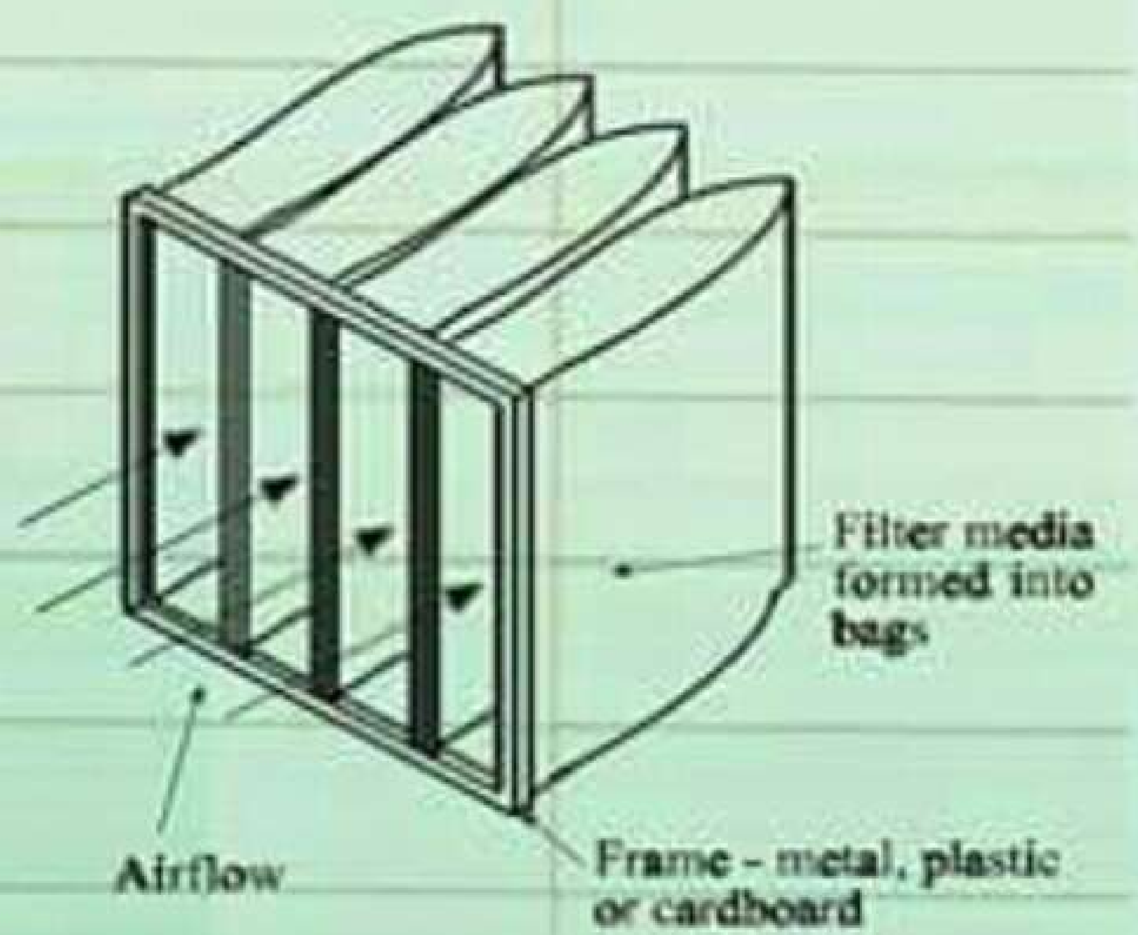
→ It is consist of a sponge and aluminum.

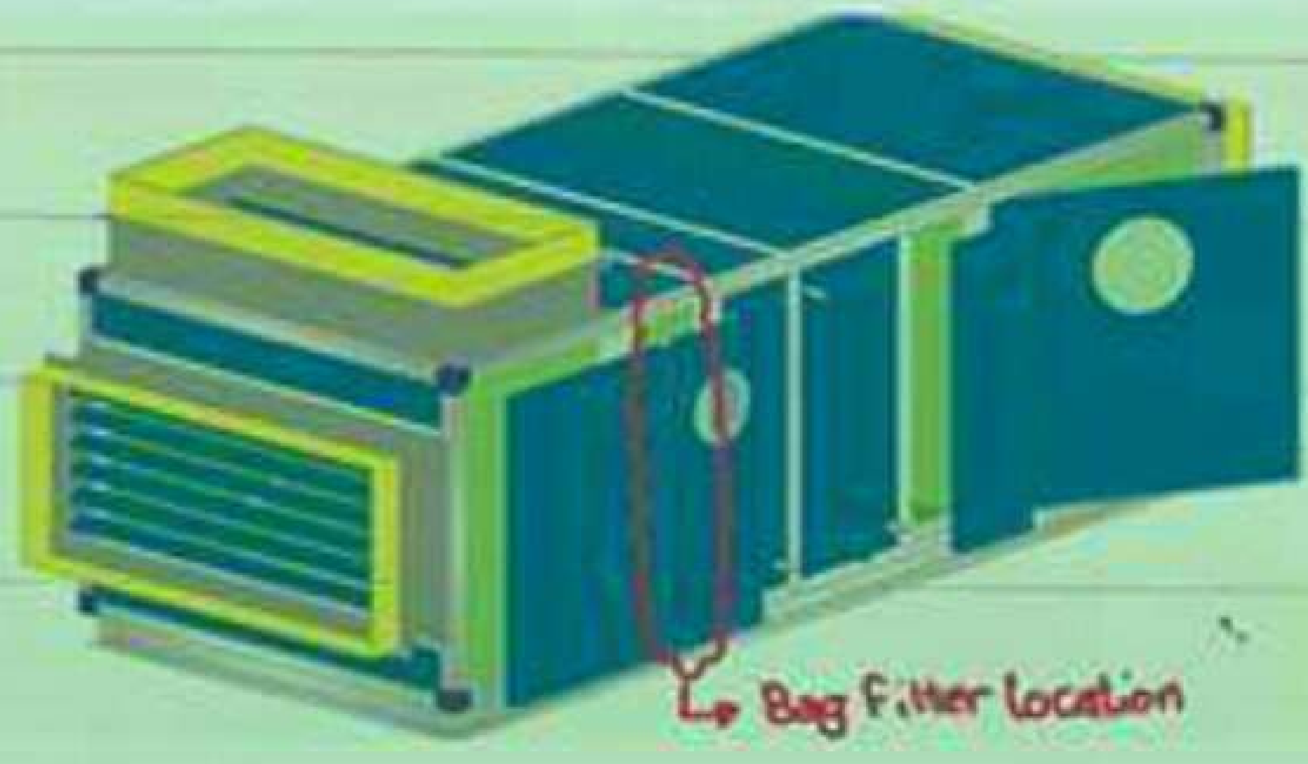
→ Easily to removed and cleaned.

⑤ Bag Filter

→ It is the second stage for air cleaning.

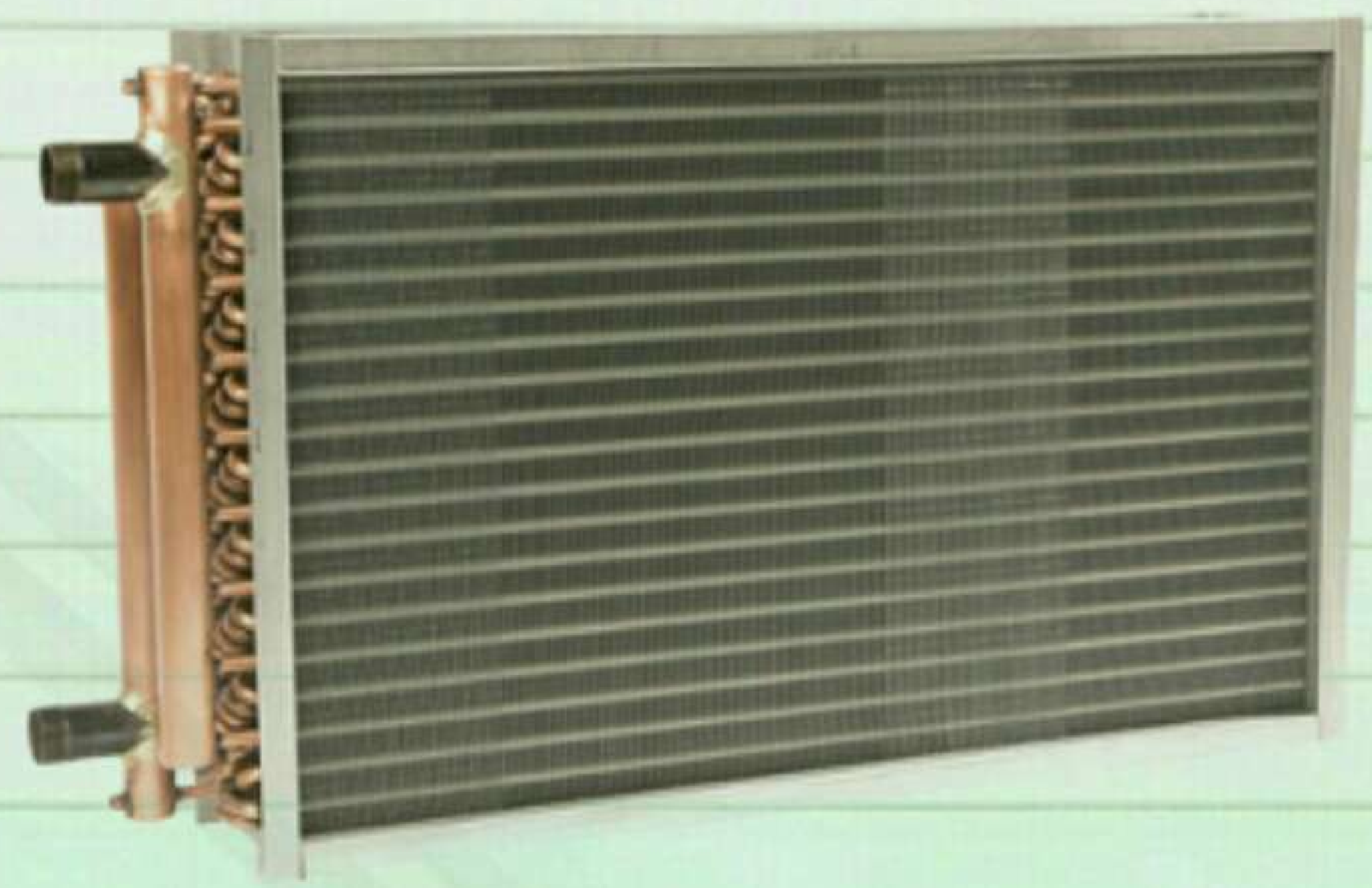
→ After mixing box, the air pass on a bag filter





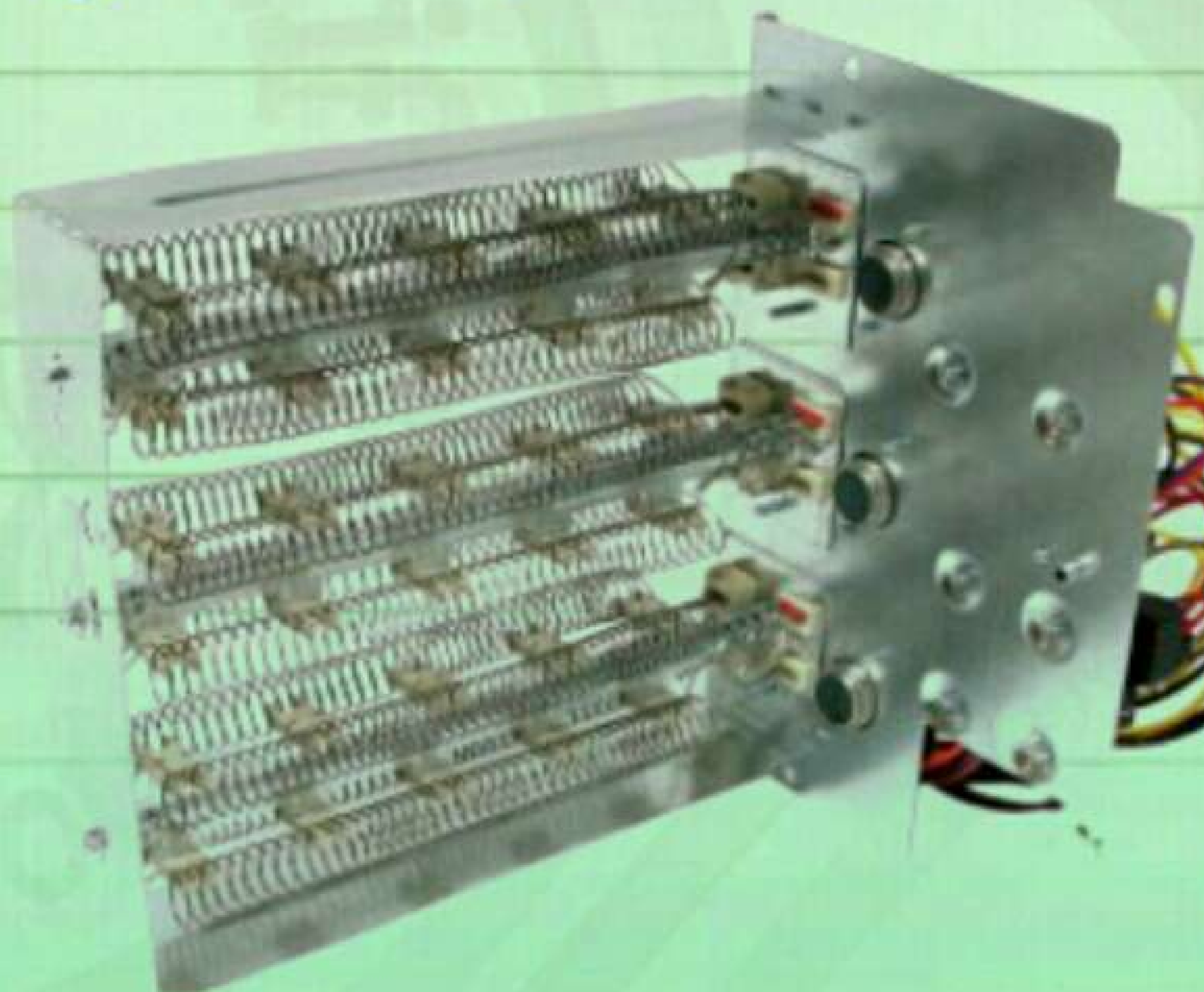
Cooling Coil

- Cold water passes through the Cooling Coil
- Hot return air passes on the Cooling Coil
- Heat exchange occurs between Cold water from chiller & hot return air
- The air getting cold then send to the rooms.



Electric heater

- Optional if we need AHU work for Cooling / Heating
- Have a stages as per require load.



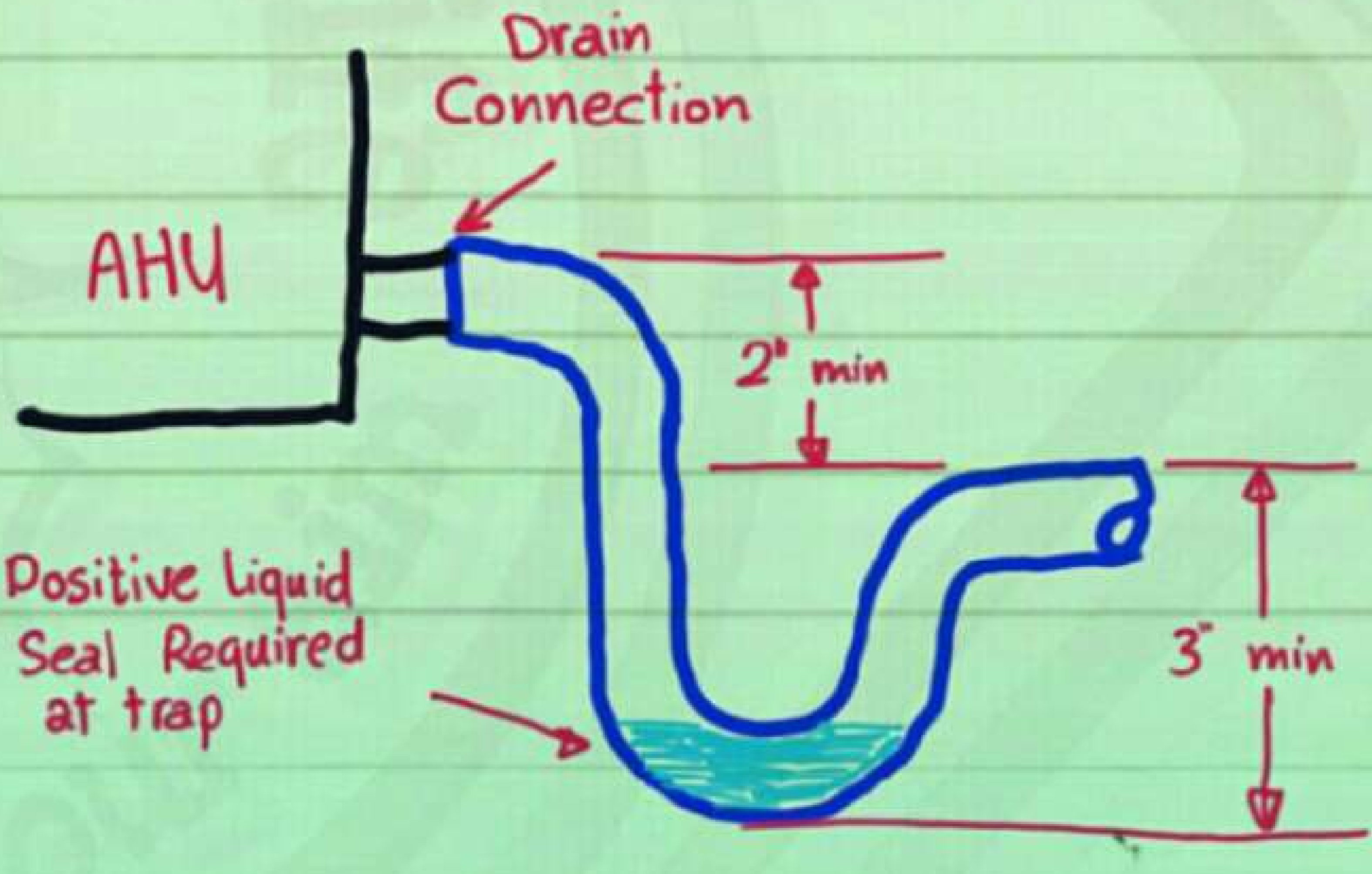
Fan Section

- Fan with electric motor
- Take the air from the room and send it again to the room after Cooling the air by Cooling Coil.

Drain pain

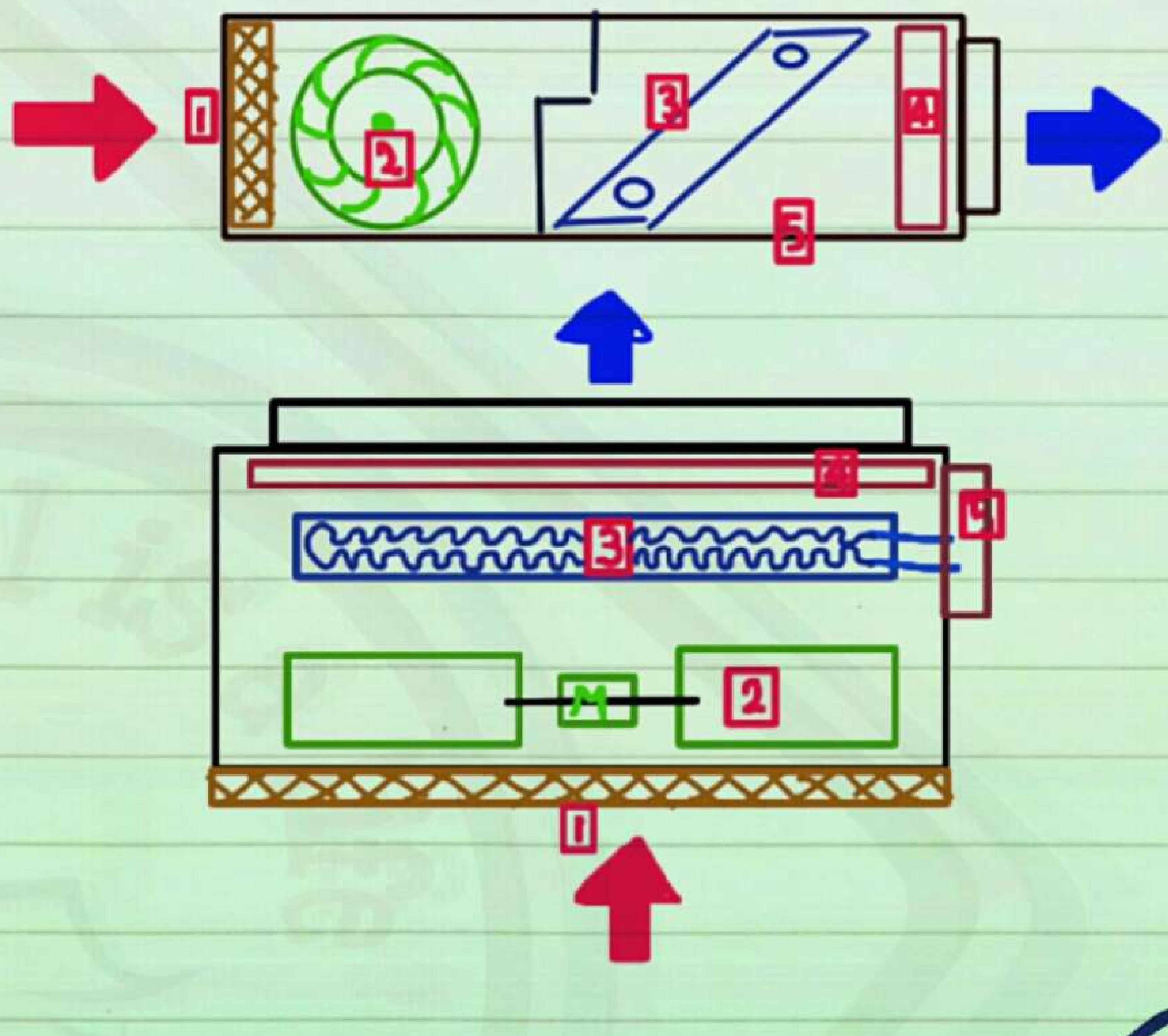
- To Collect the Condensating water from the Cooling Coil.

P- Trap for Drain pain

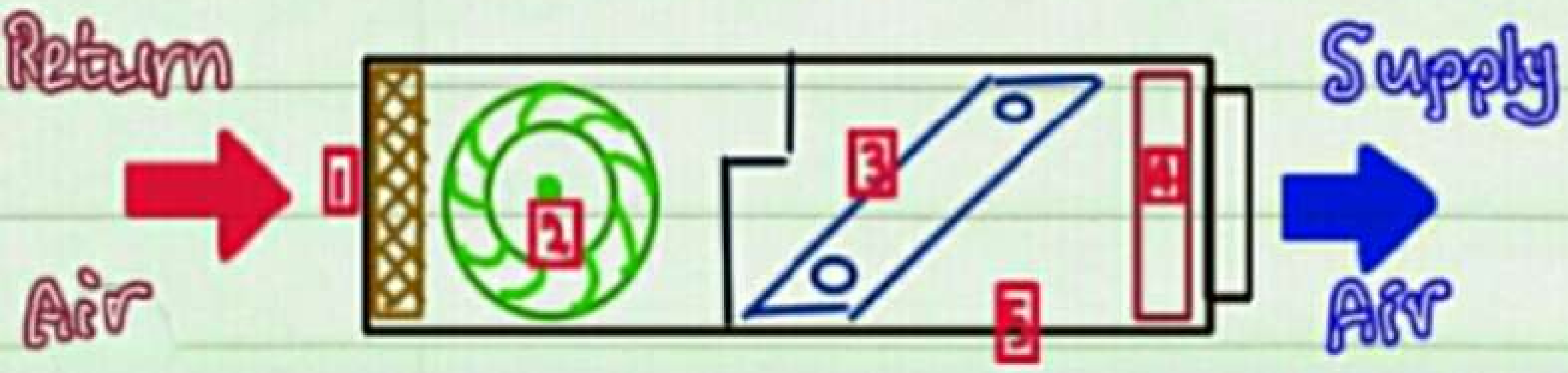


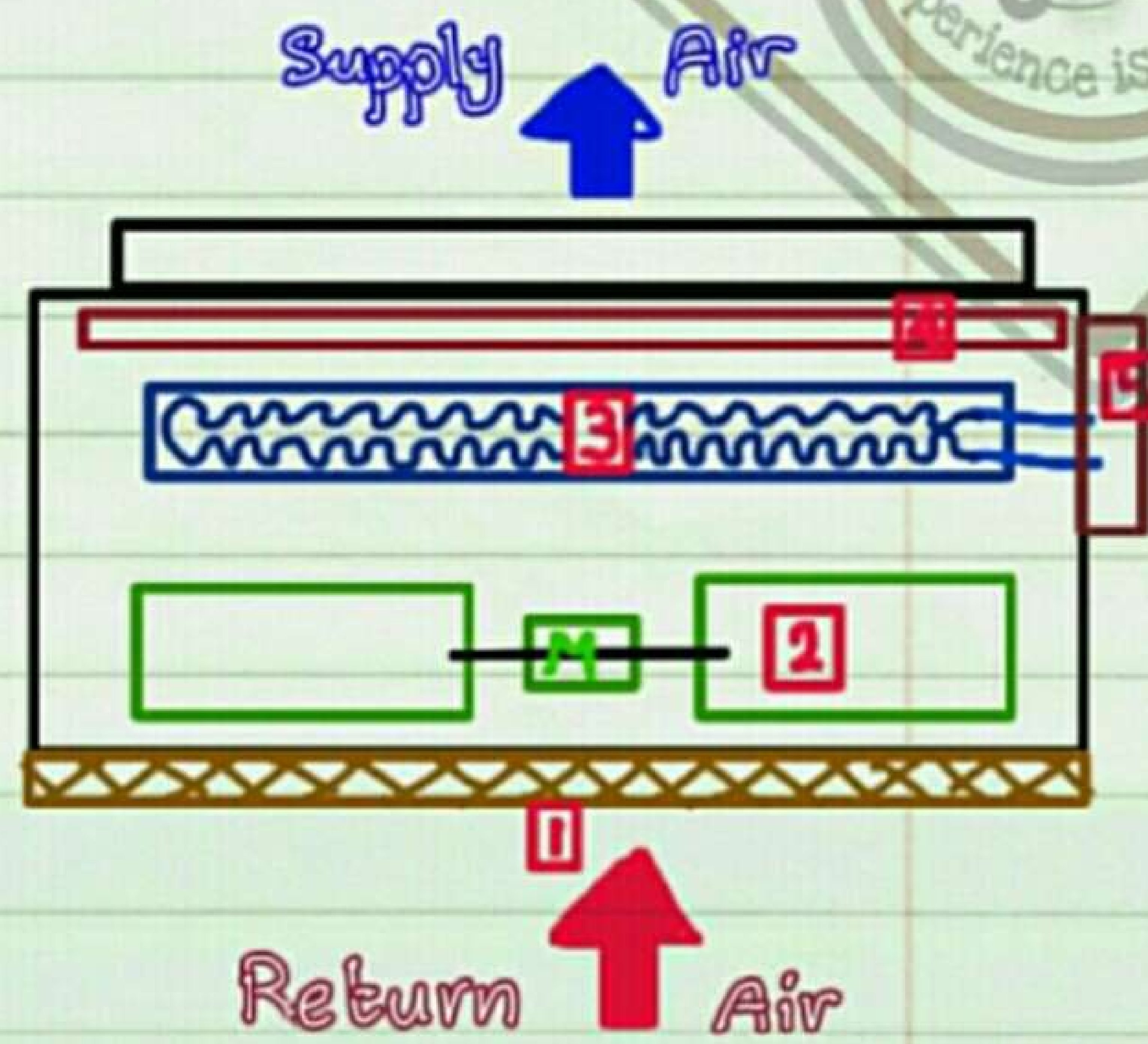
②

Fan Coil Unit
F C U

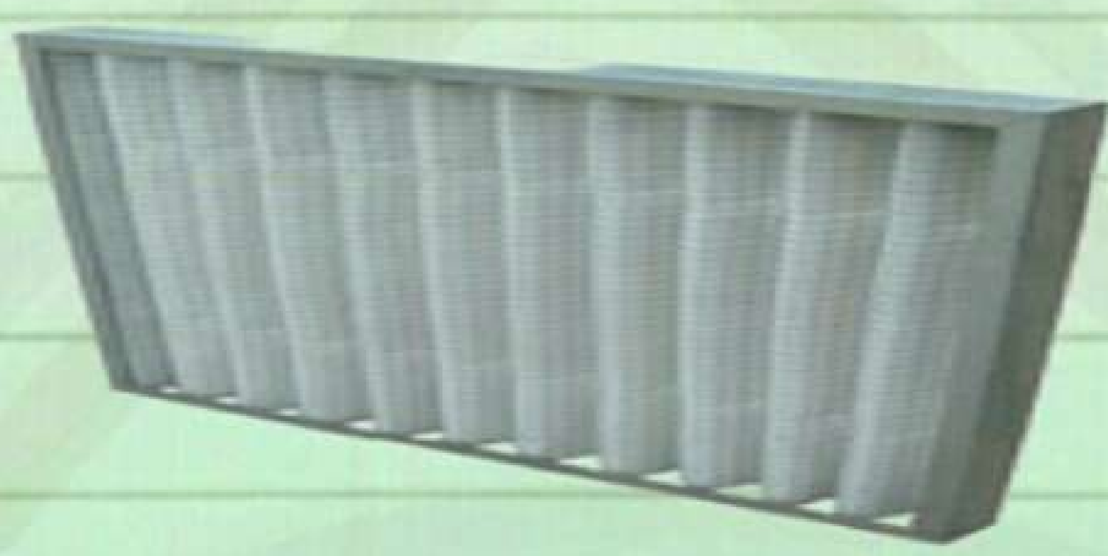


Fan Coil Unit FCU

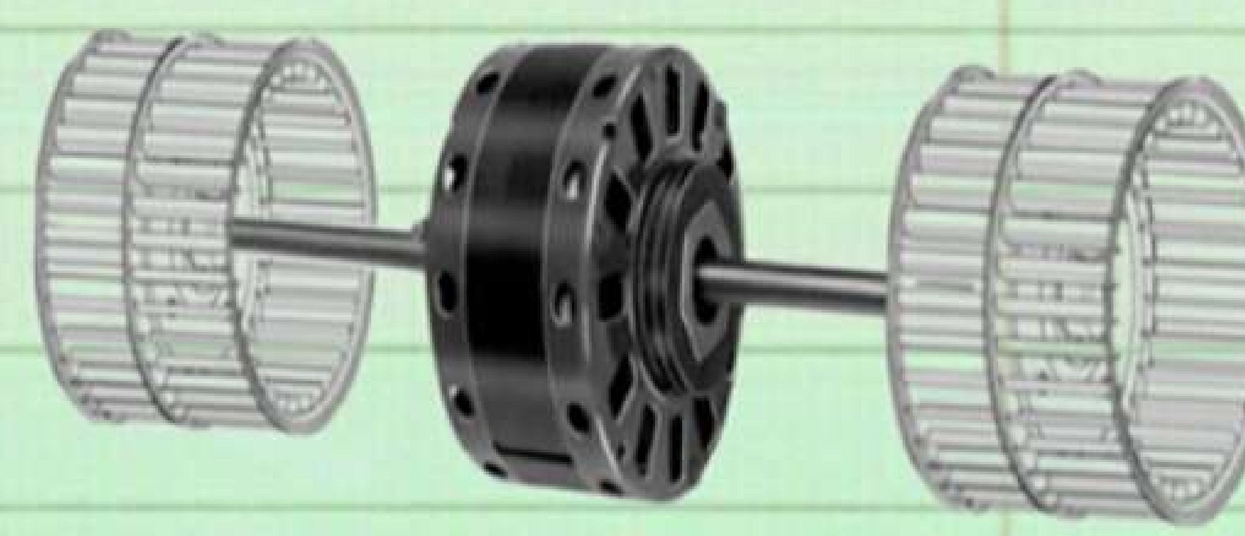




① Pre filter

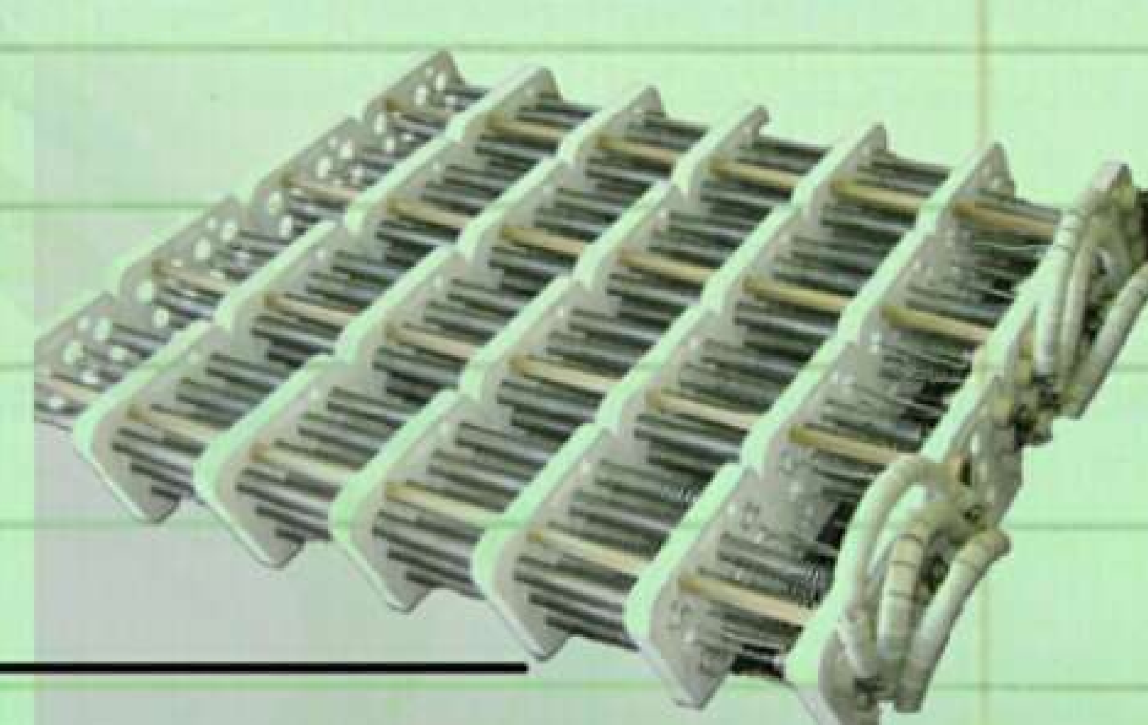


② Fan section

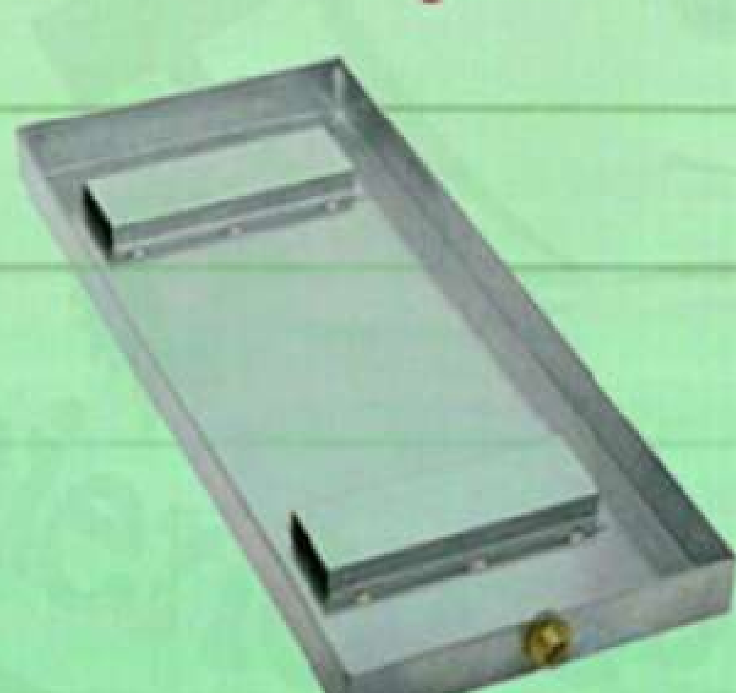


③ Cooling Coil

④ Electric heater



⑤ Drain pain

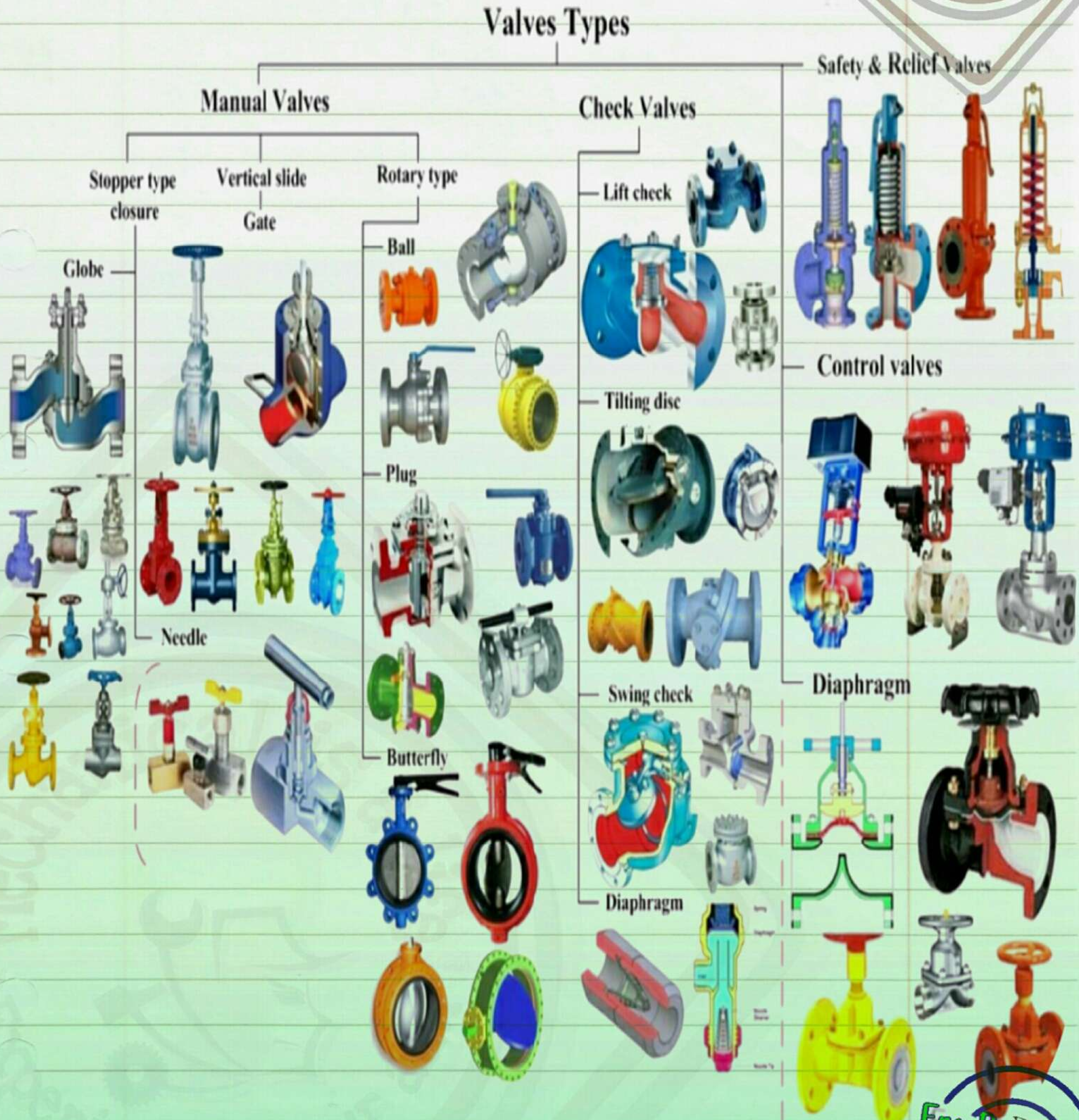


3 Valves

Valves

- Ball Valves
- Gate Valves
- Globe Valves
- Check Valves
- ButterflyValves
- Safety Valves
- Plug Valves

⊛ Classification of Valves types

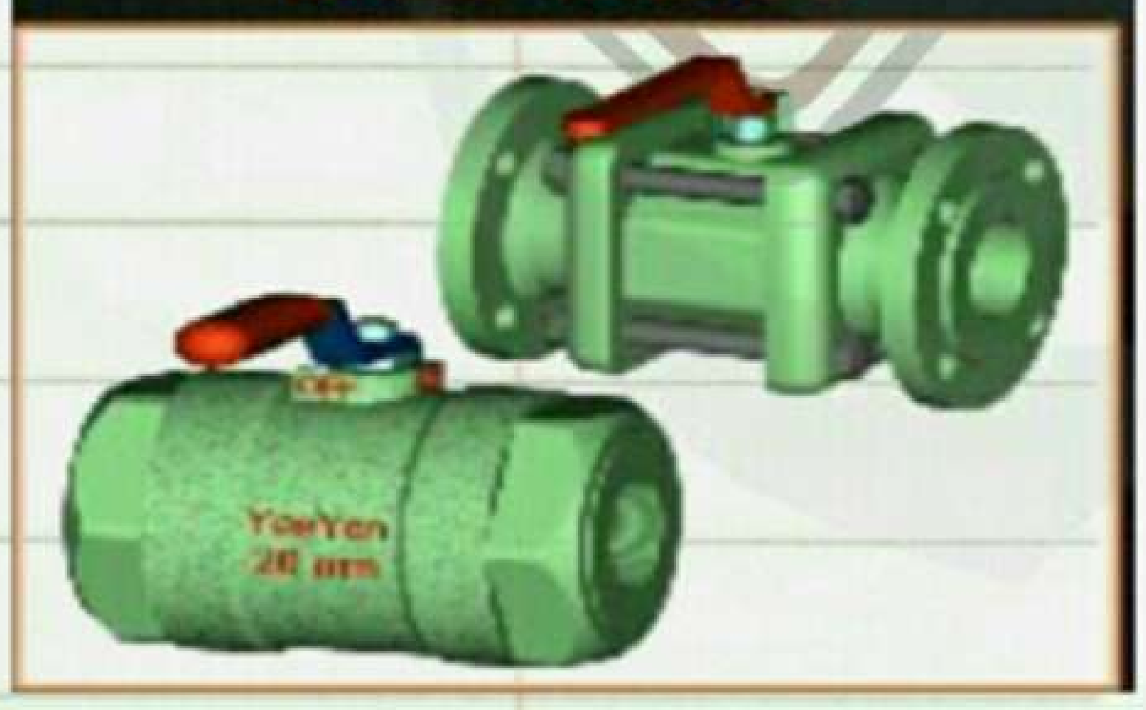


⊛ Types of Valves

BUTTERFLY VALVES

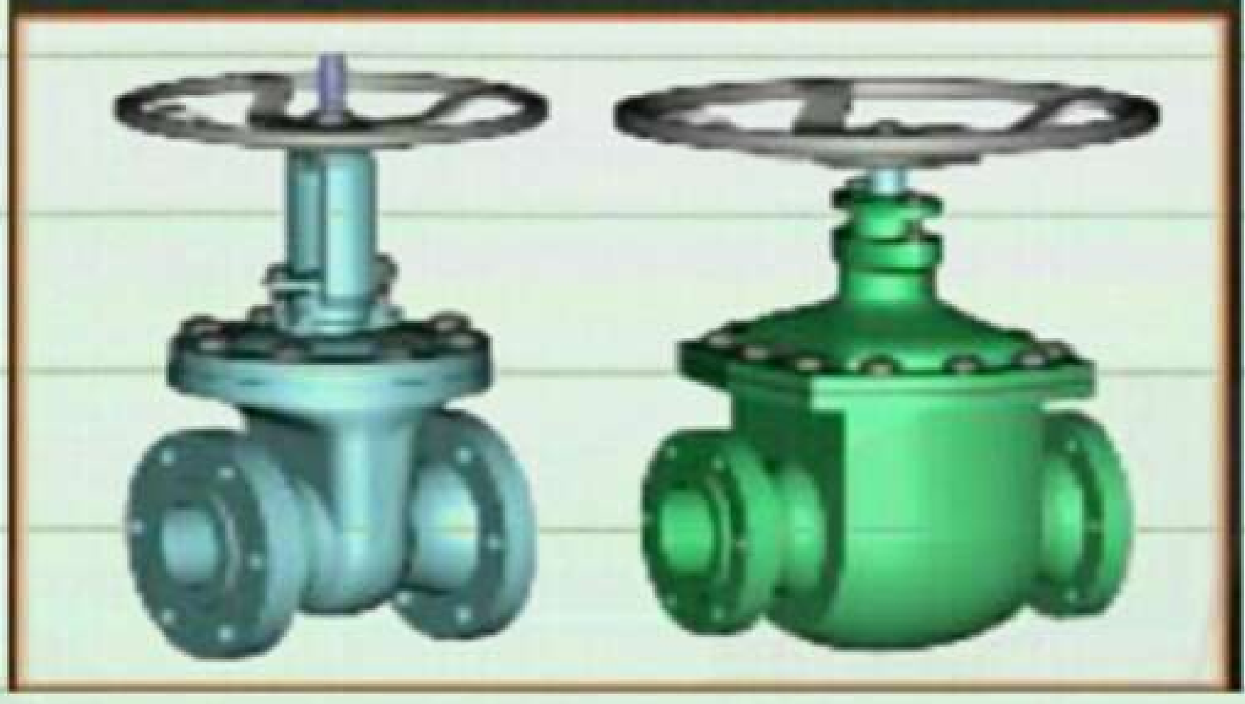
GLOBE VALVES

BALL VALVES



CHECK VALVES

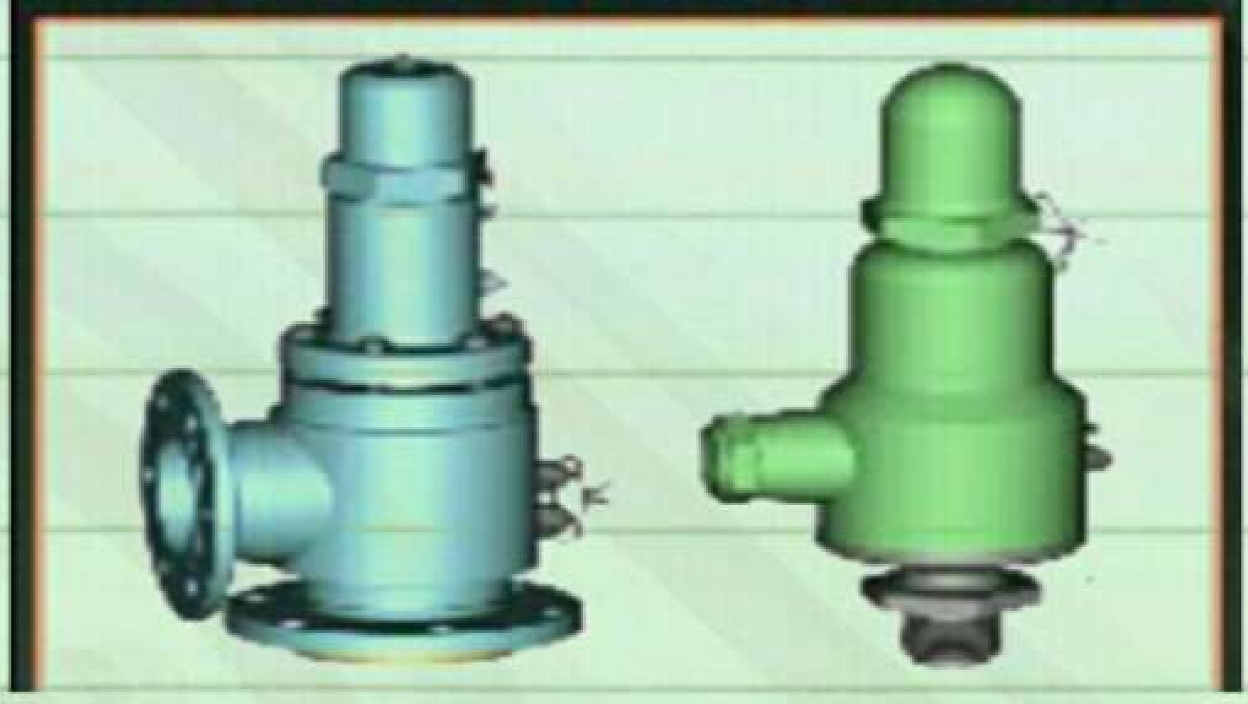
GATE VALVES



NEEDLE VALVES

PLUG VALVES

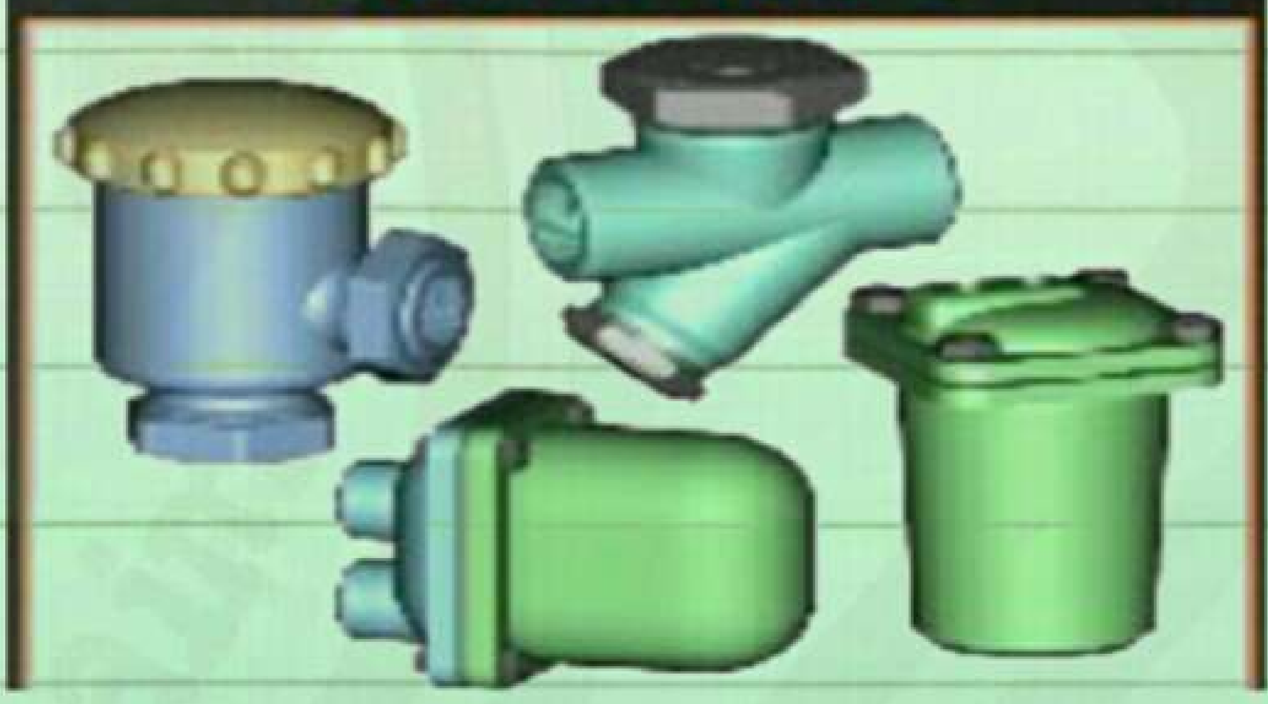
PRESSURE RELIEF VALVES



DIAPHRAGM VALVES

CONTROL VALVES

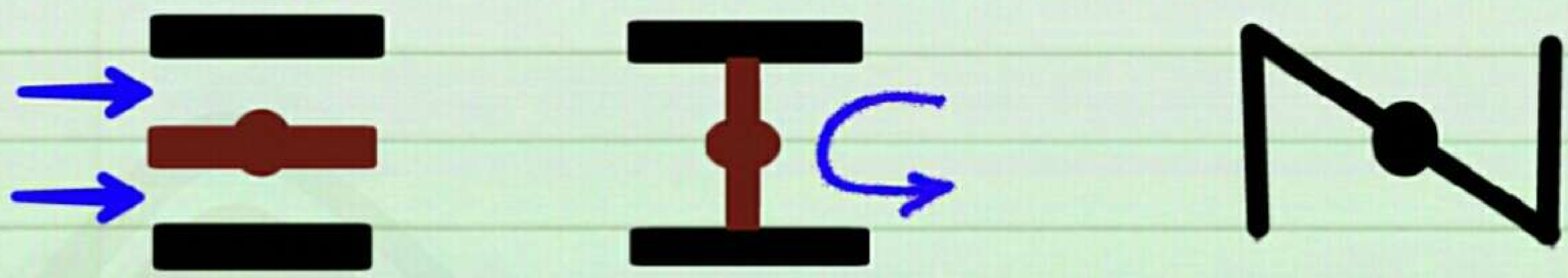
STEAM TRAPS



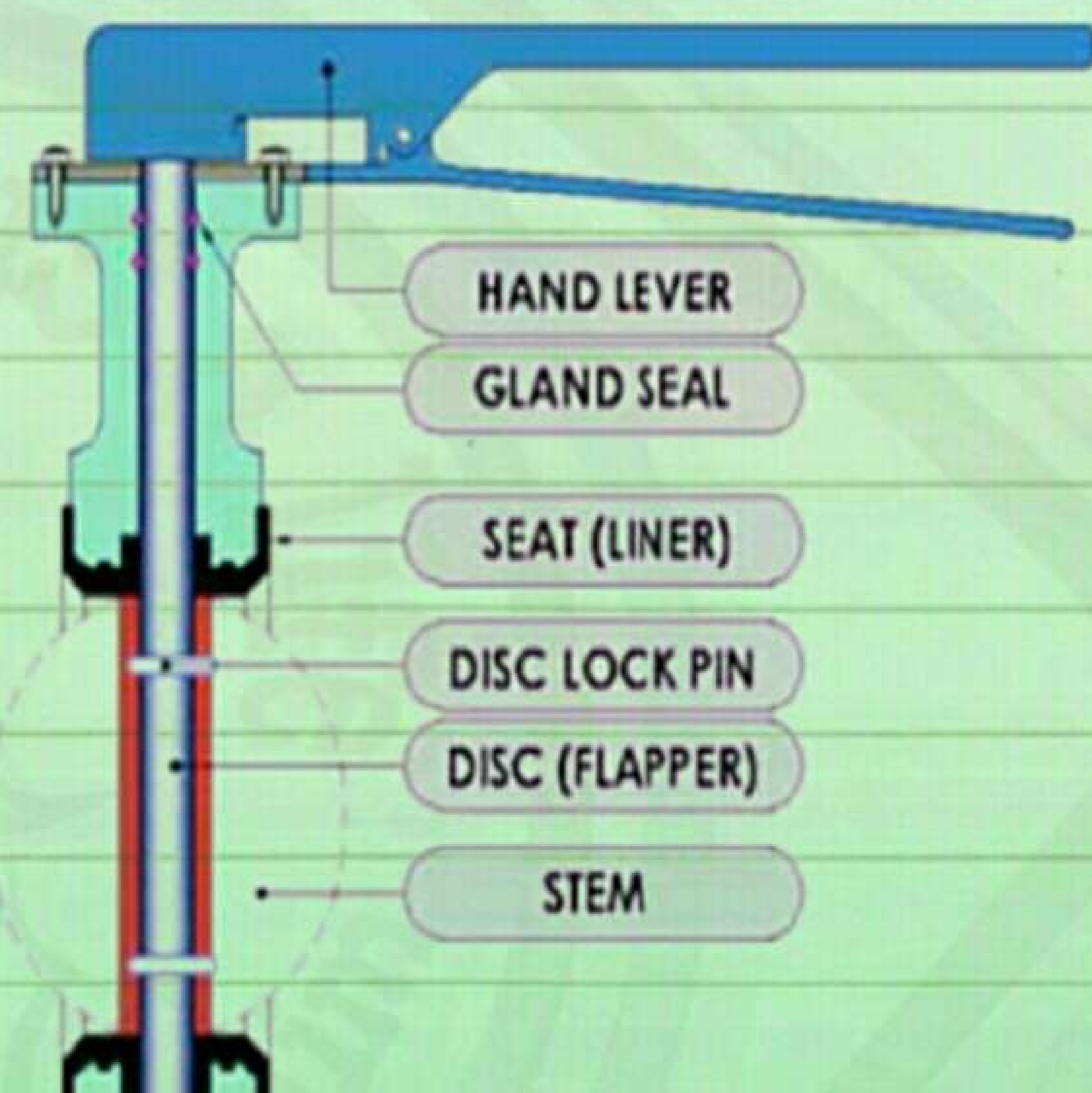
STRAINERS

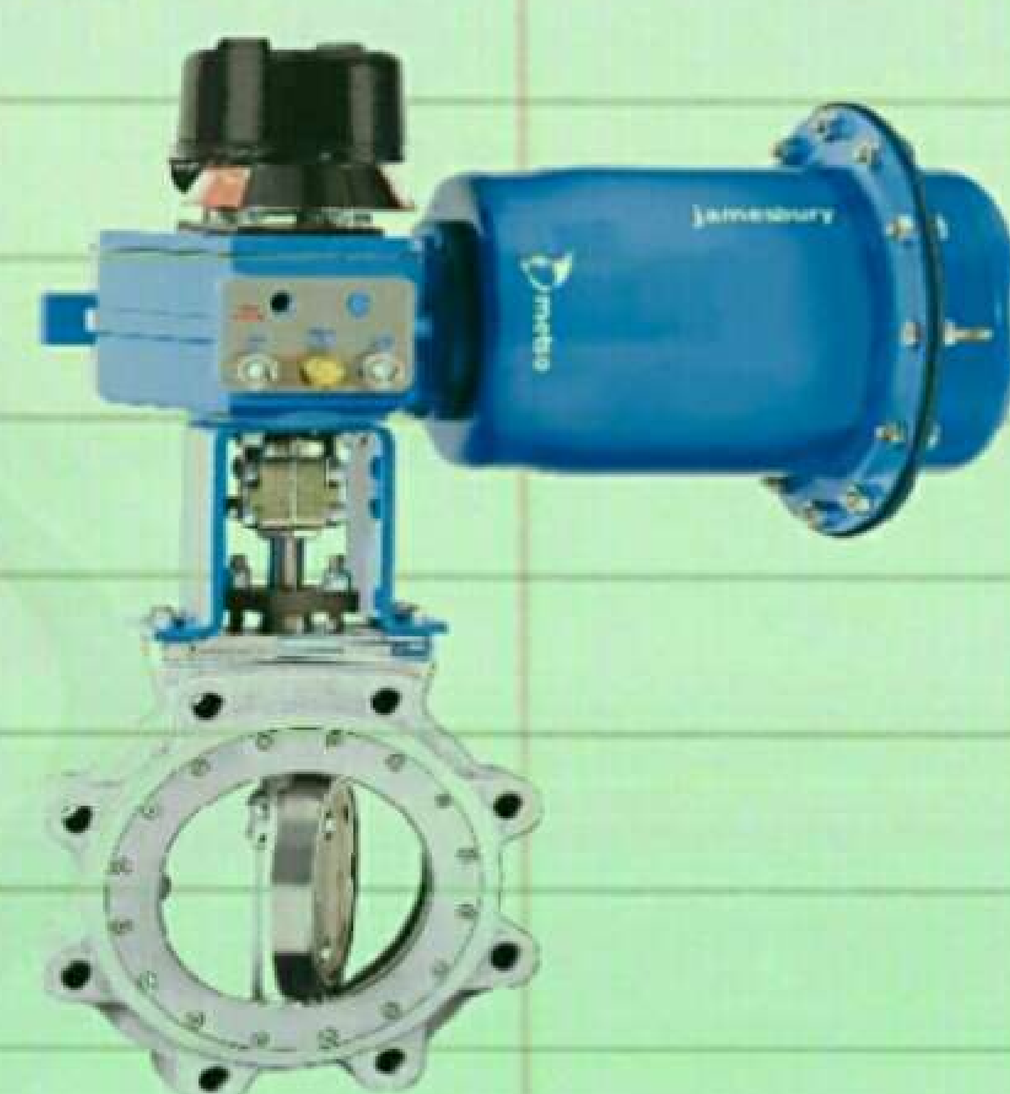
① Butter fly valve

- Tight shutoff.
- Can be used as a Control valve.
- Little resistance of flow.
- Optimal for automoted operation with a low operation torque and 90 degree operating angle.
- Light weight and Compact.



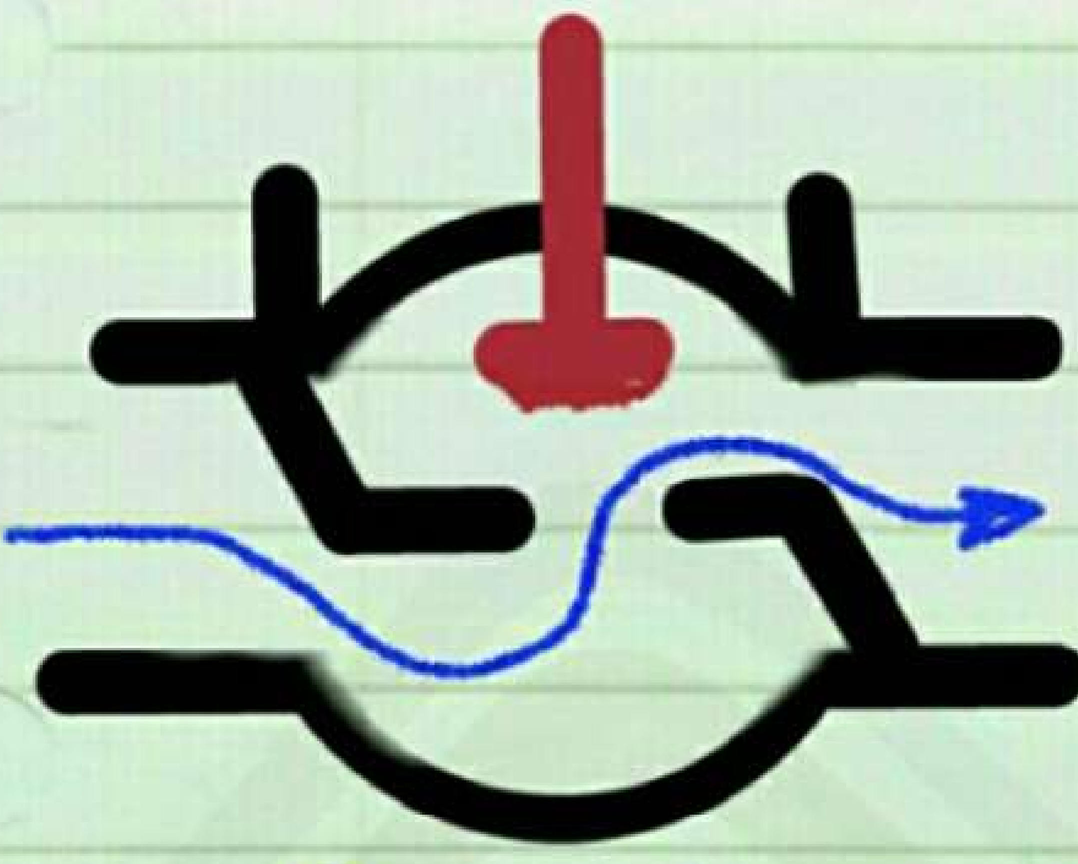
Open　　Close　　Symbole



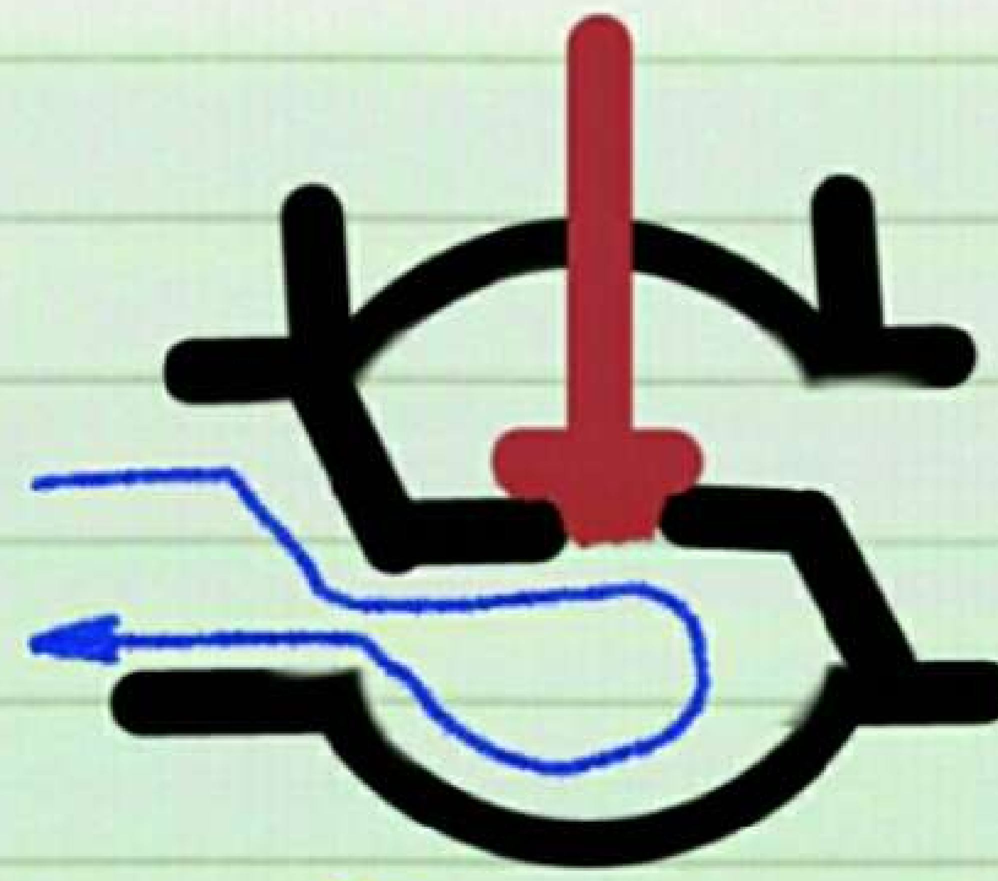


⊛ Globe Valve

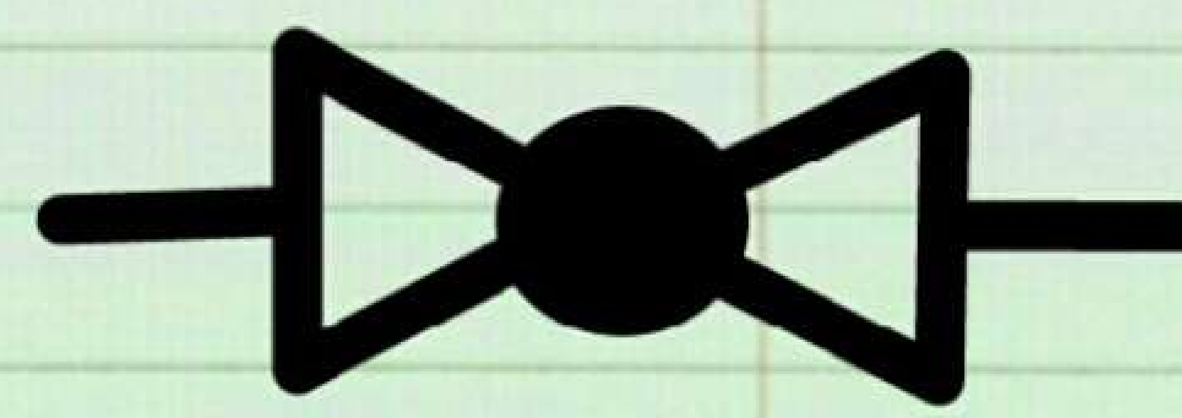
- The globe shaped body Control the Fluid into a S shaped flow
- Tight shut off and Can be used as a Control Valve.
- Large risistance to flow
- Much power is required to open and close.



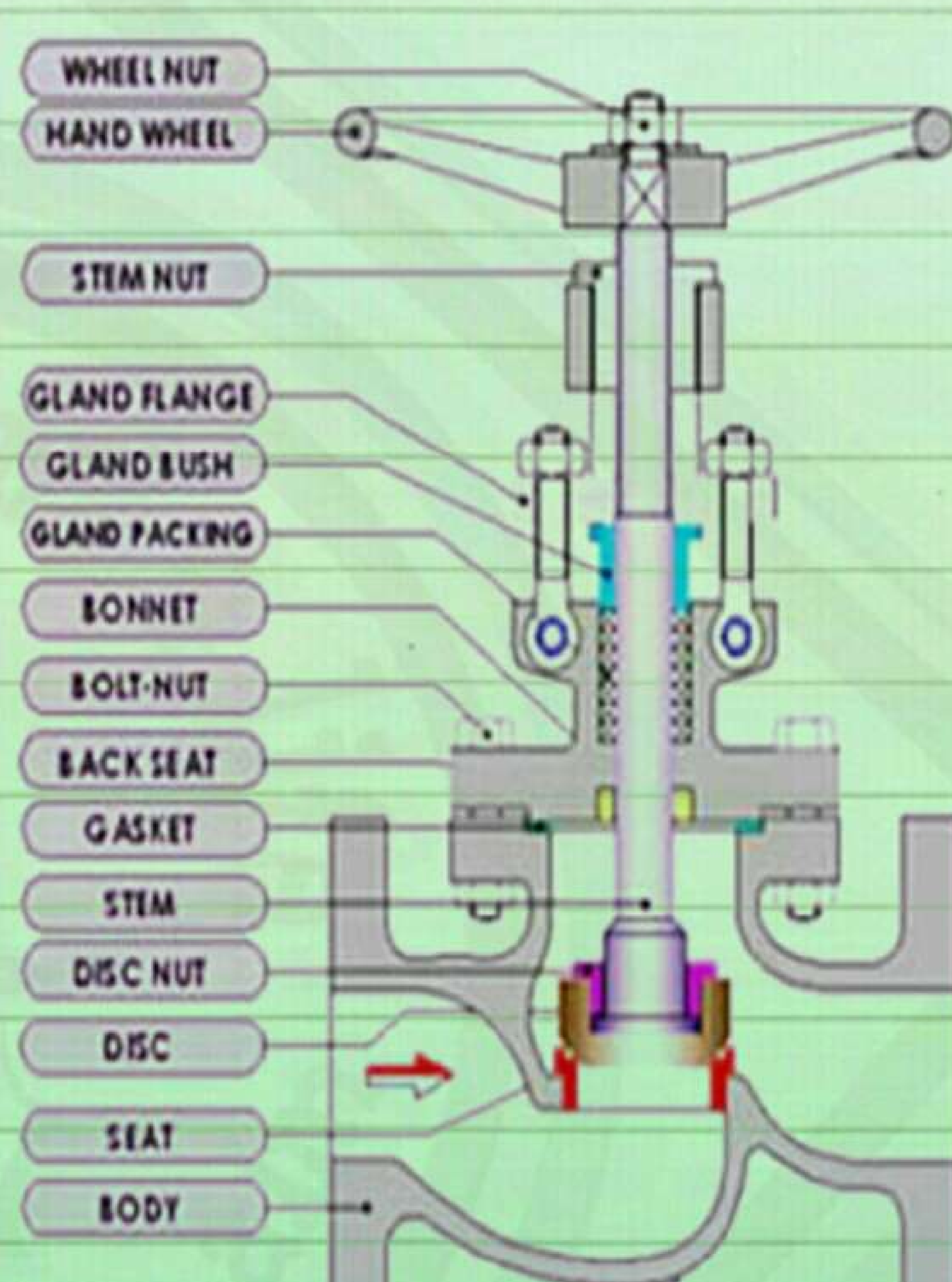
Open

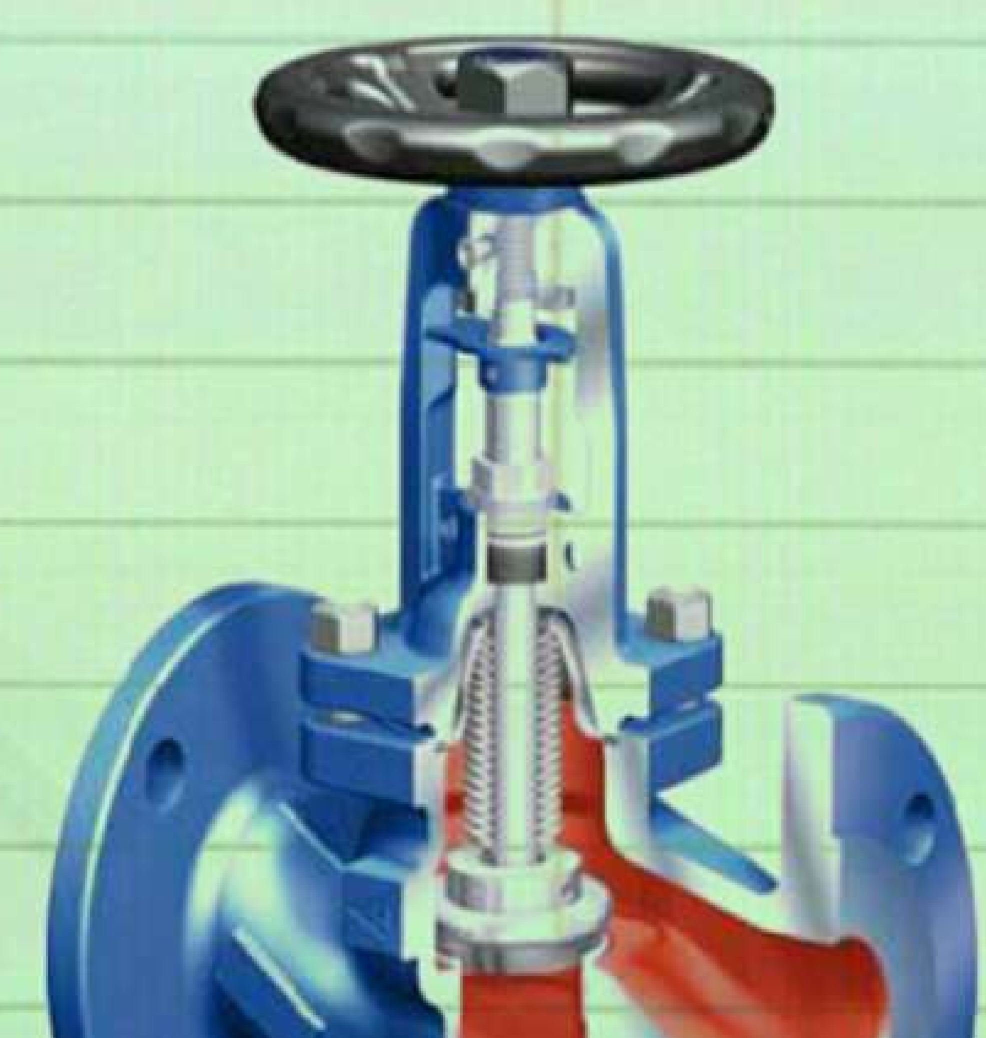


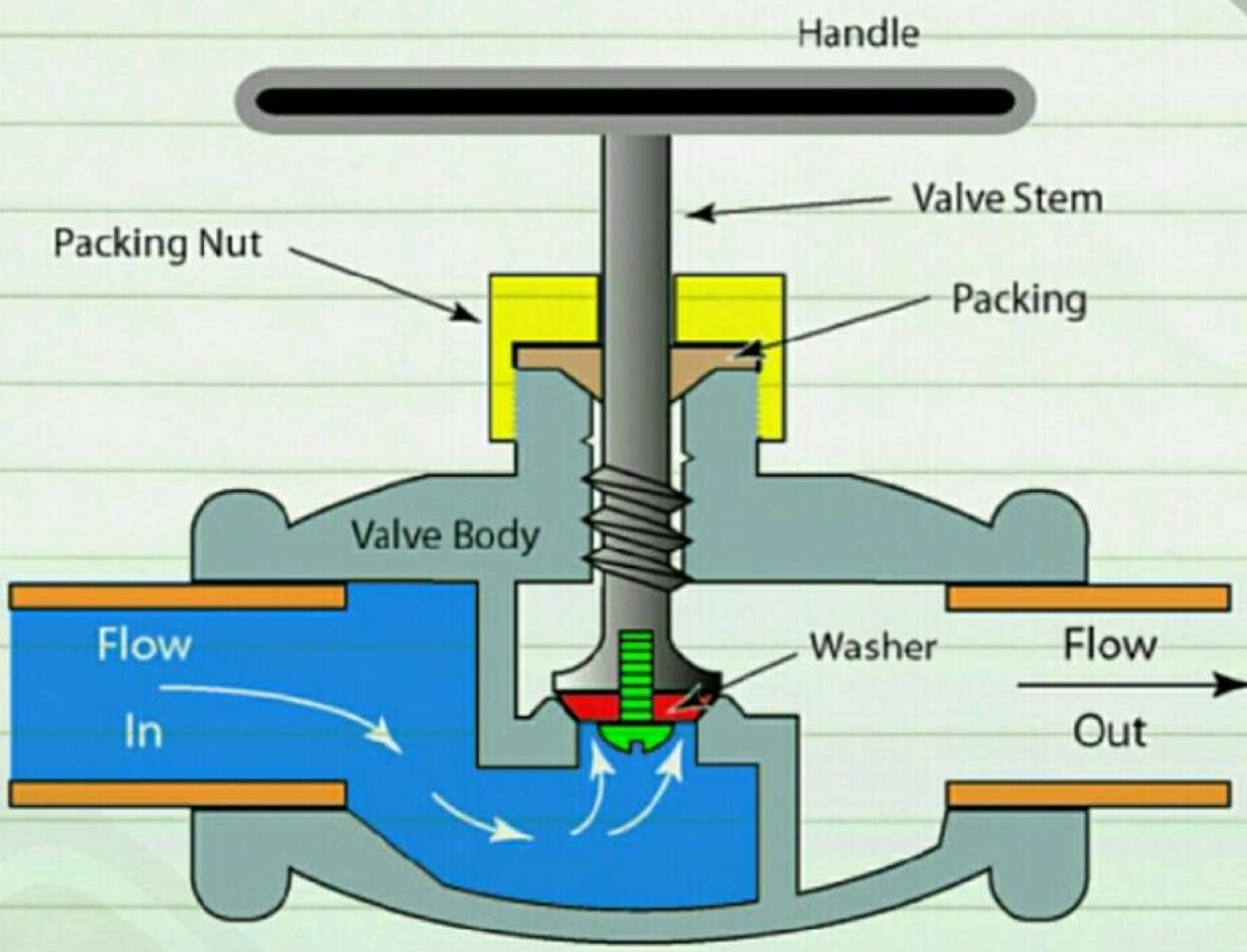
Close



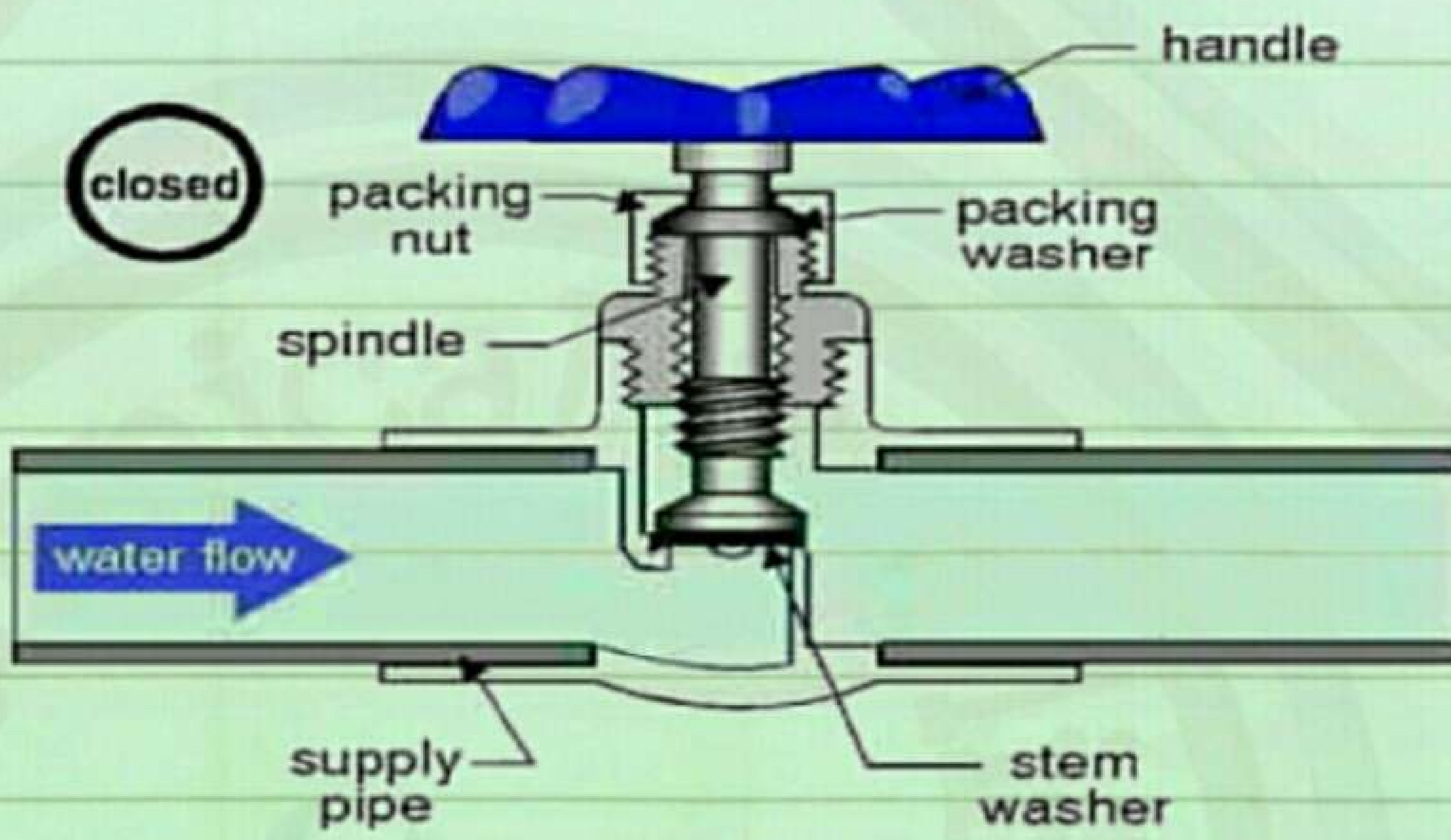
Symbol



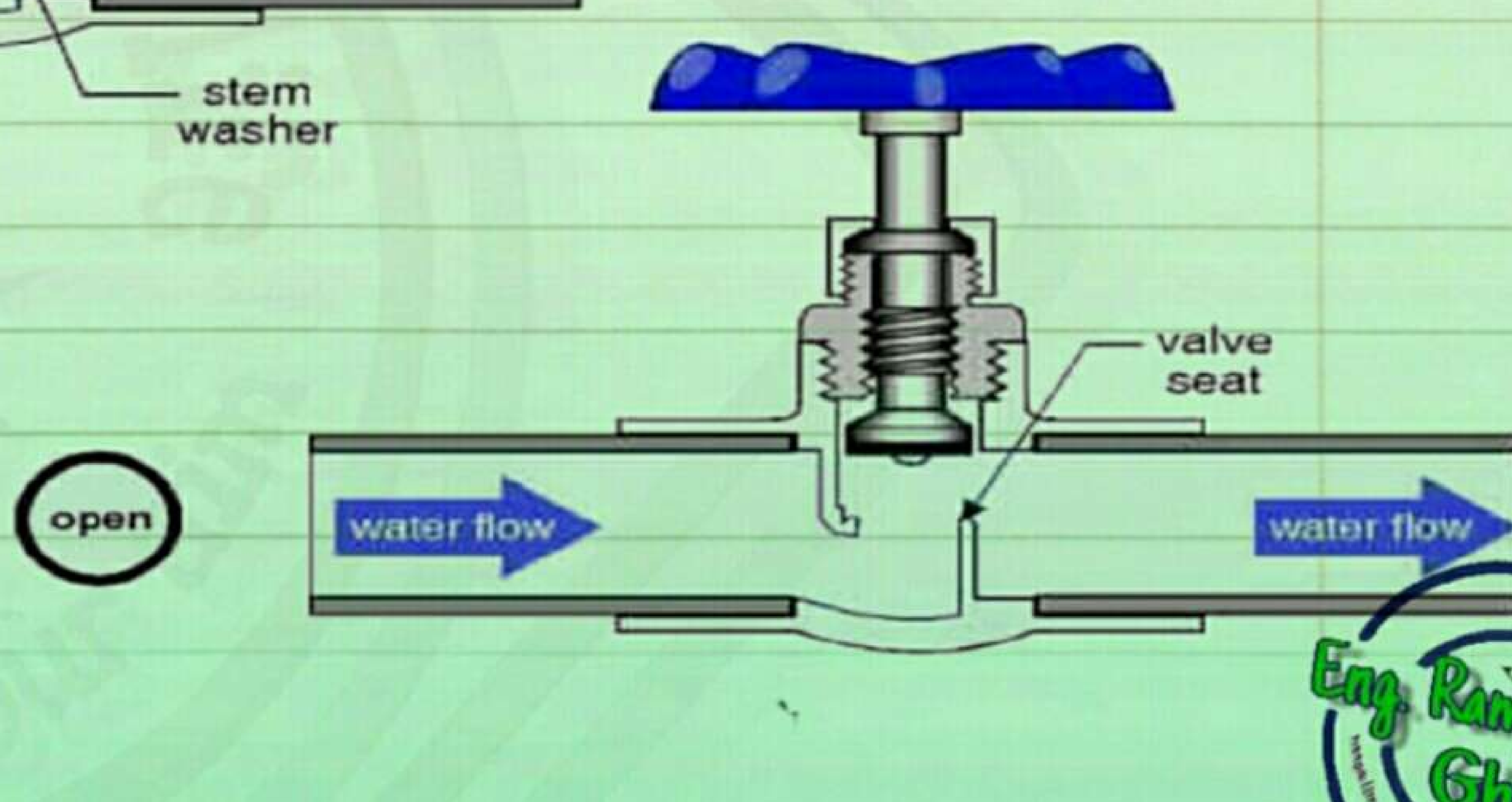




Globe valve

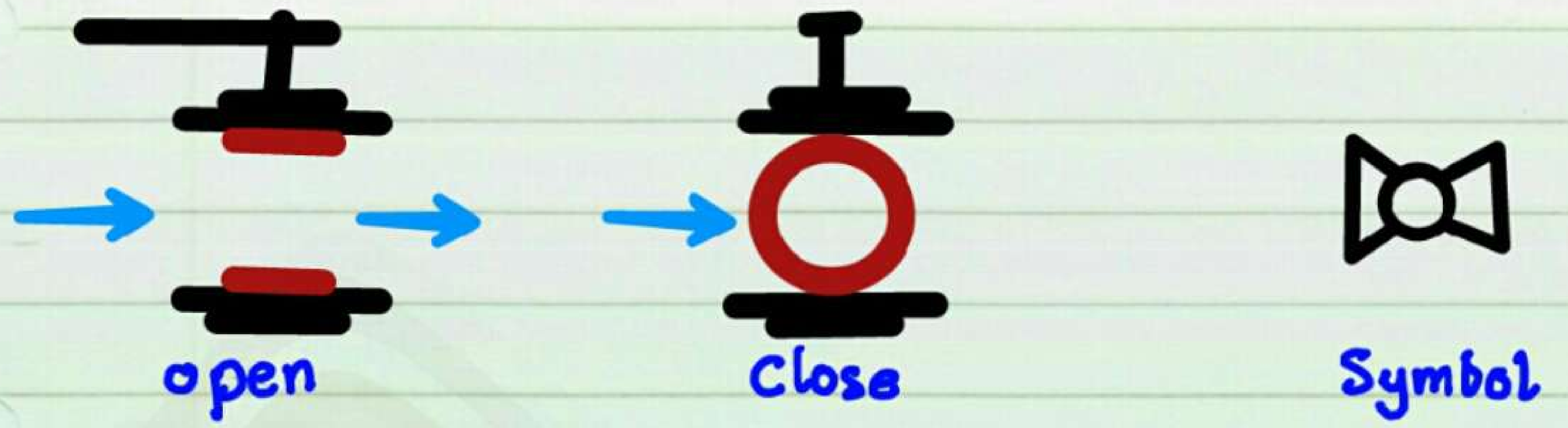


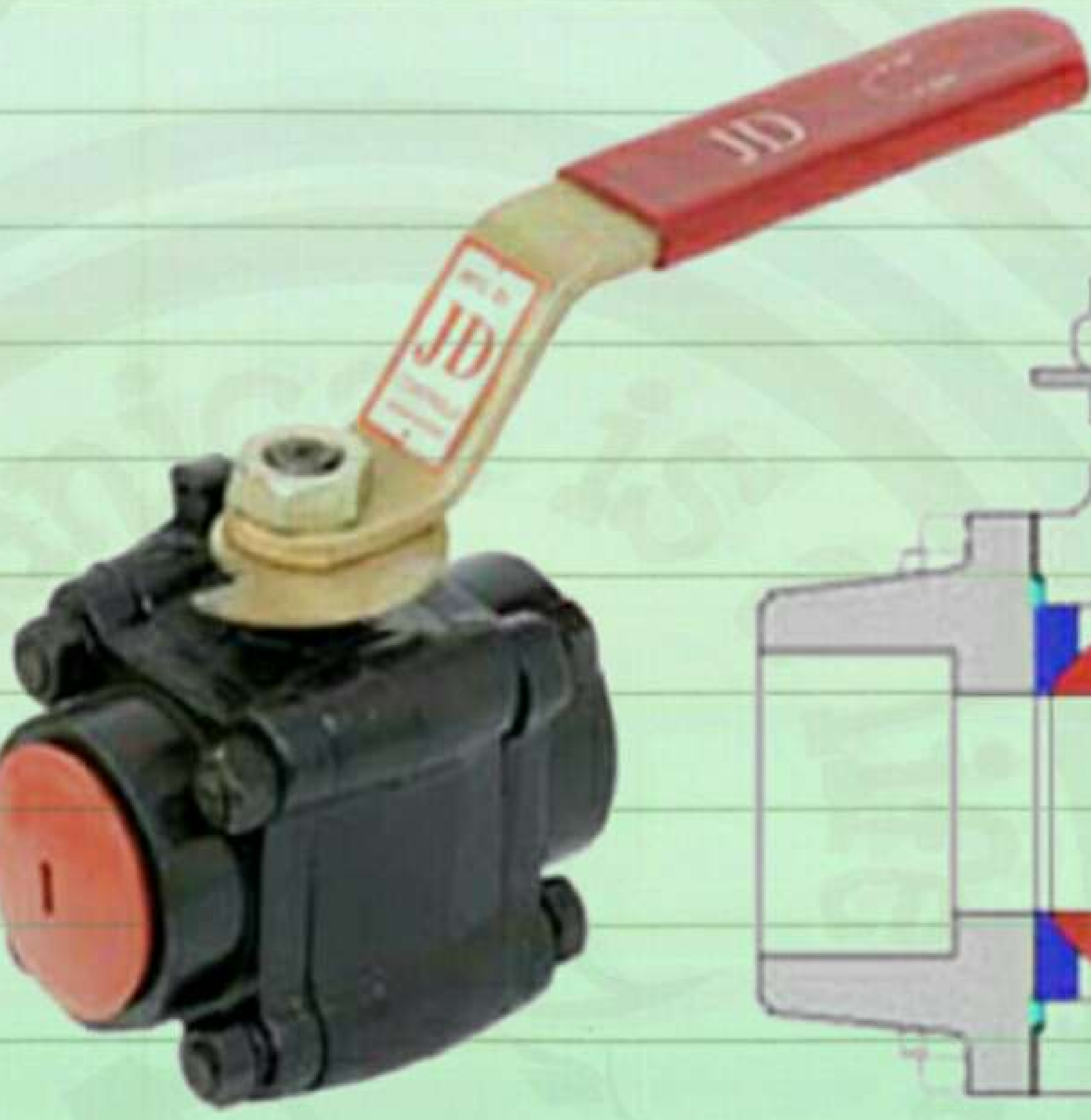
glove valves tend to be restrictive but,
can be used to throttle water flow

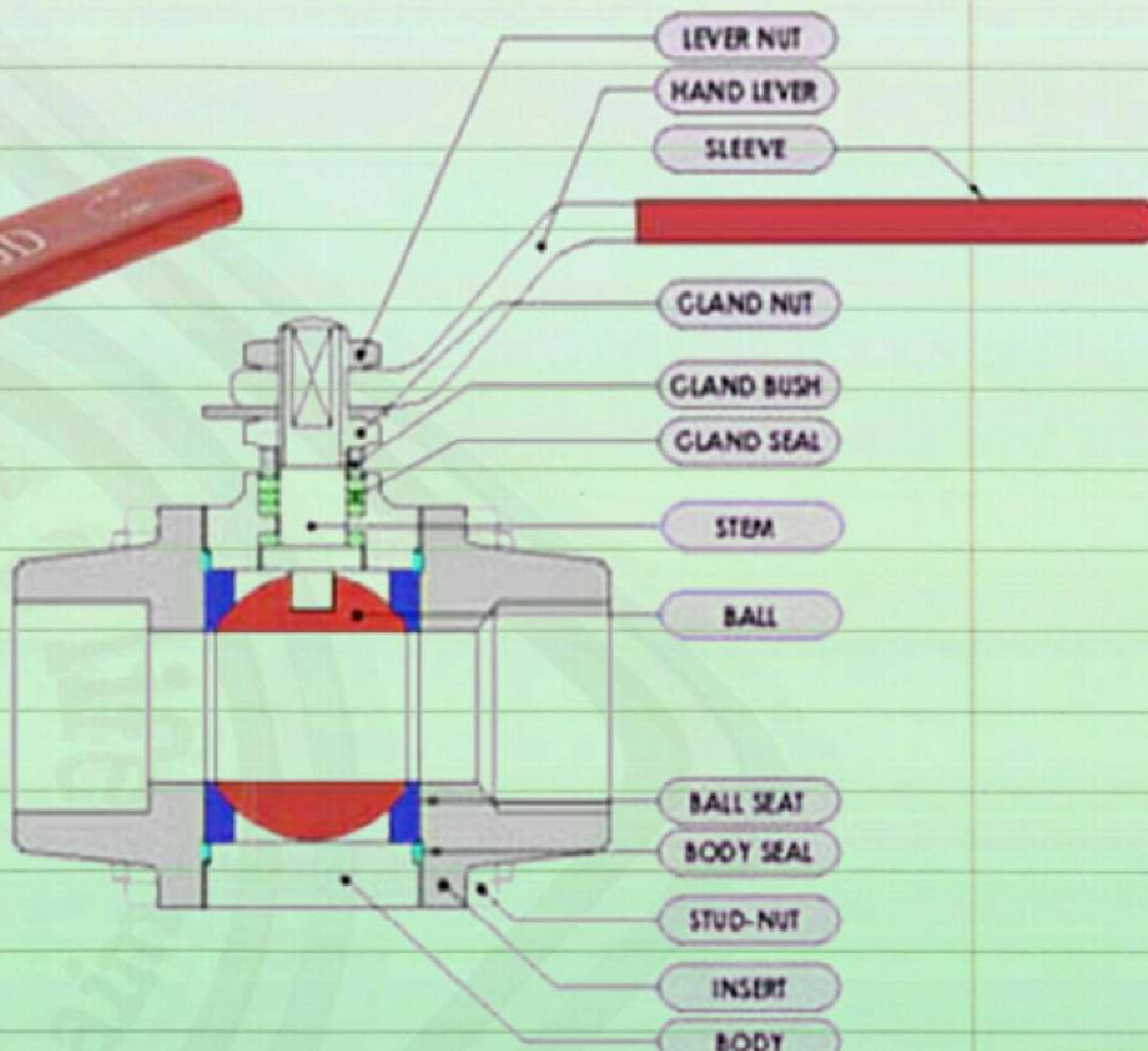


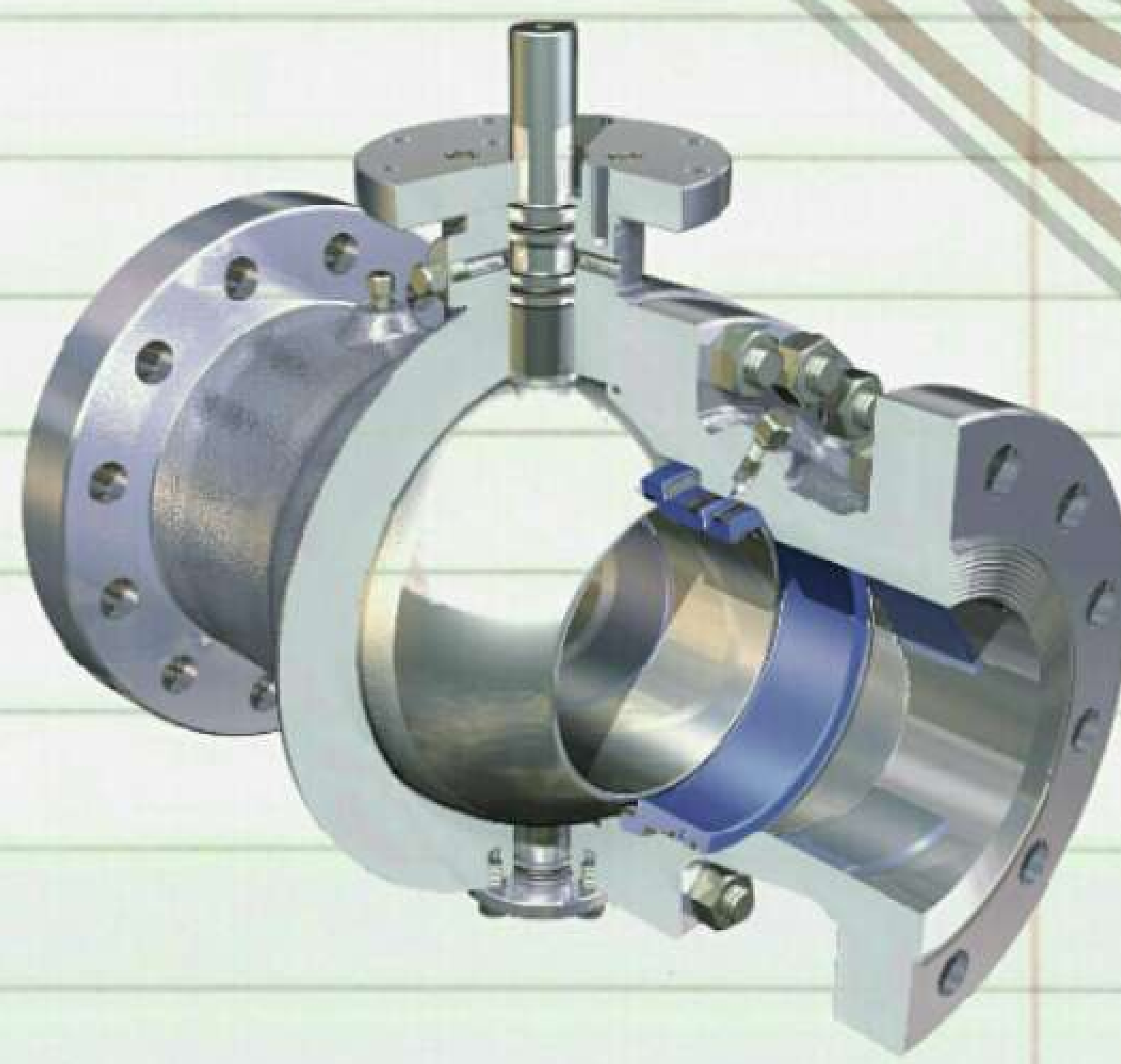
⊛ Ball Valve

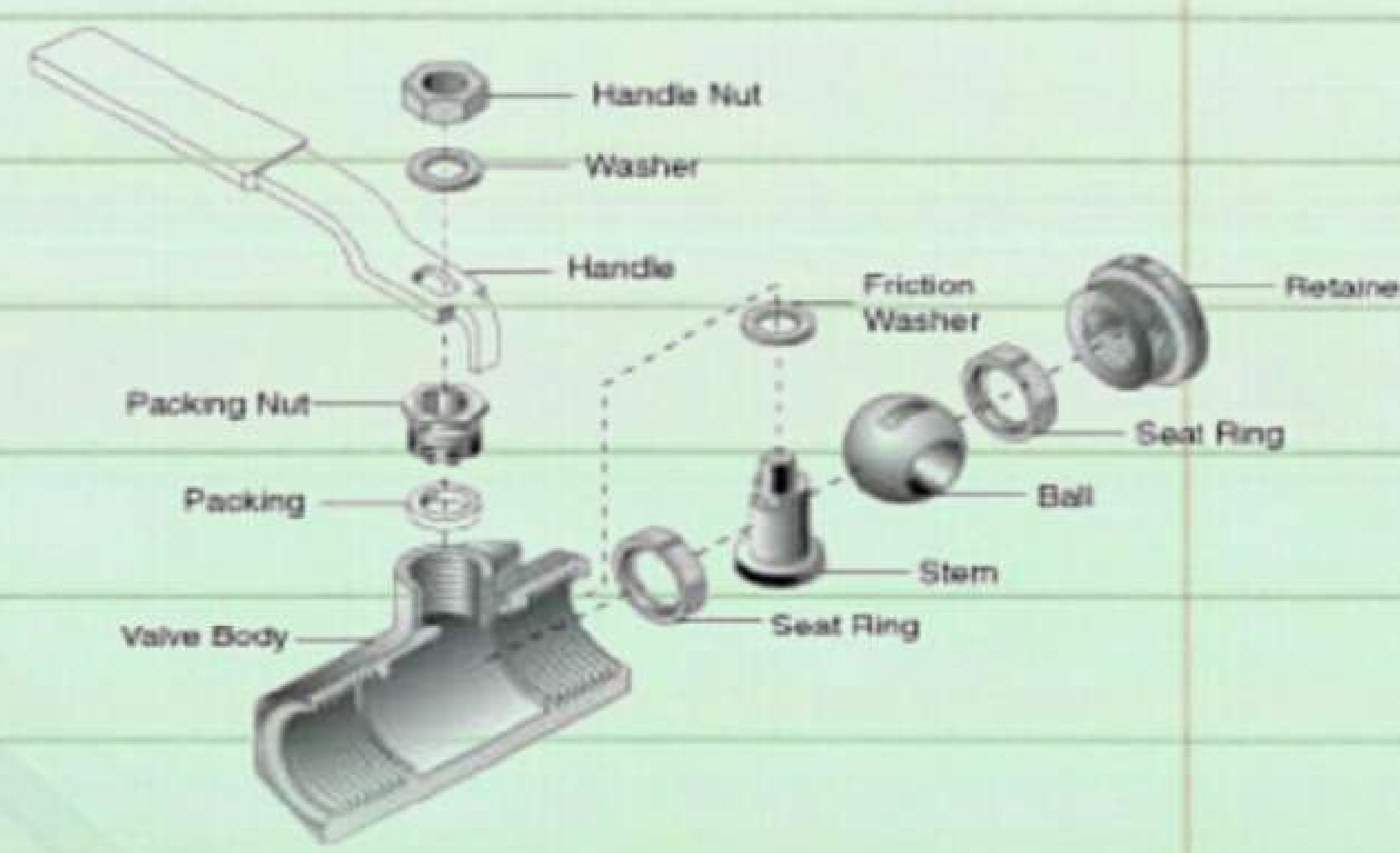
- Valve stopper is ball saped.
- Used as ON - OFF.
- Little resistance to flow when fully open.
- Optimal for automoted operation with 90 degree operating angle

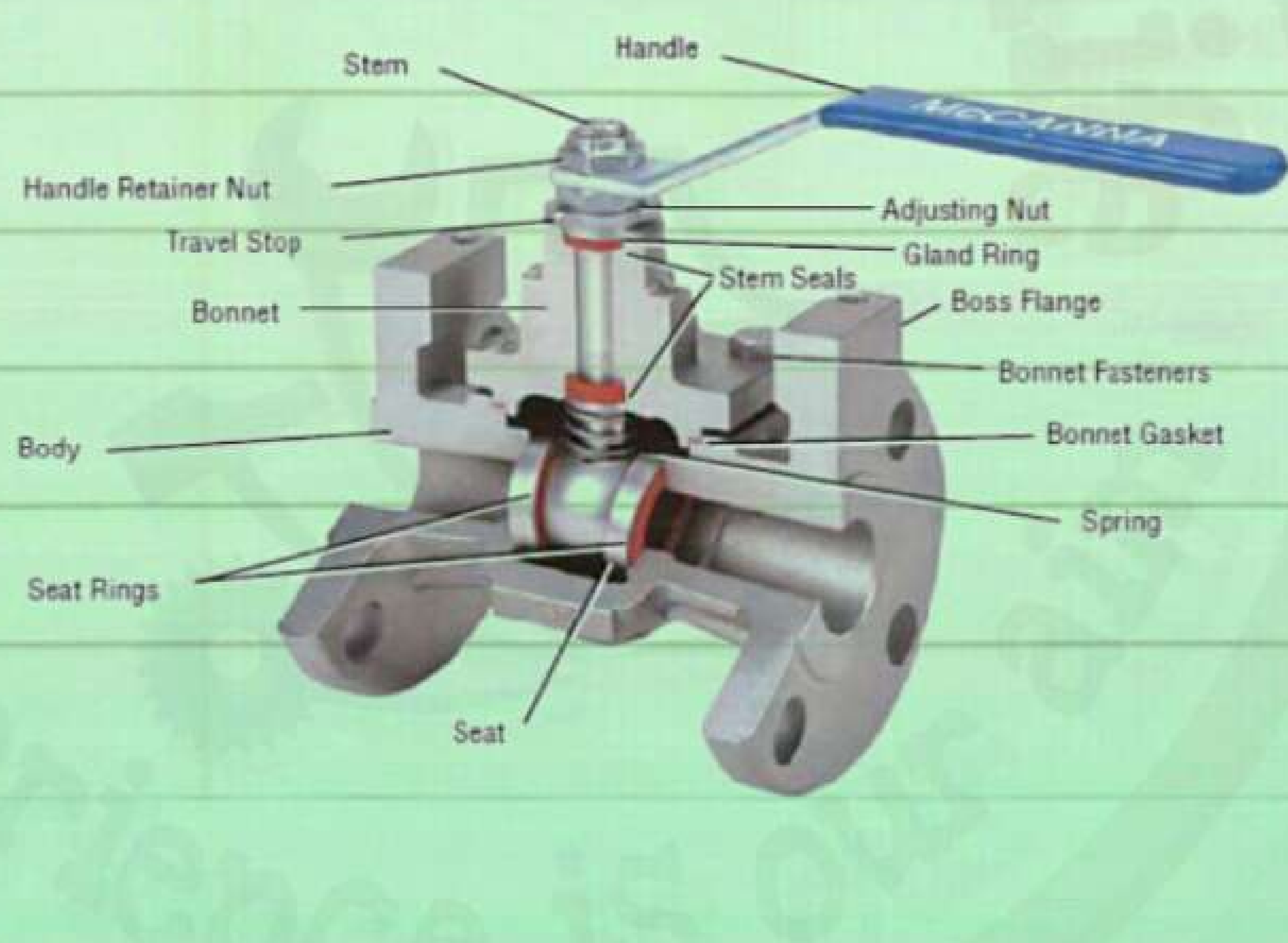








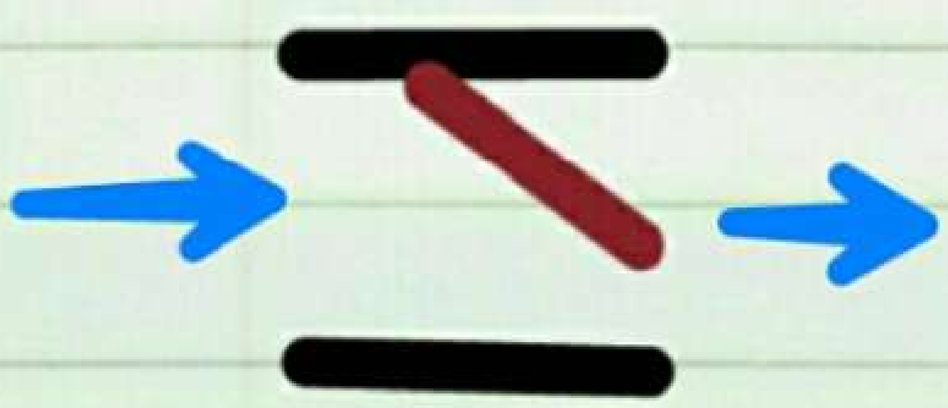

Handle Nut
Washer
Handle
Friction Washer
Retainer
Packing Nut
Seat Ring
Ball
Packing
Stem
Valve Body
Seat Ring


Stem
Handle
Handle Retainer Nut
Adjusting Nut
Travel Stop
Gland Ring
Stem Seals
Bonnet
Boss Flange
Bonnet Fasteners
Body
Bonnet Gasket
Spring
Seat Rings
Seat

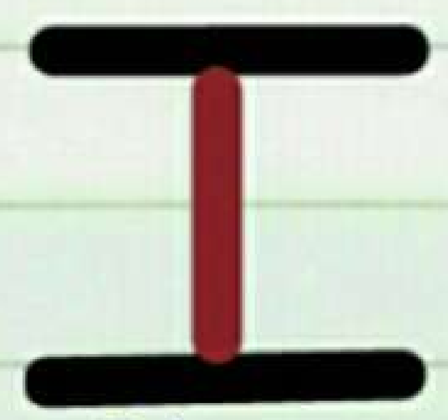

4
300
WCB

Check Valve.

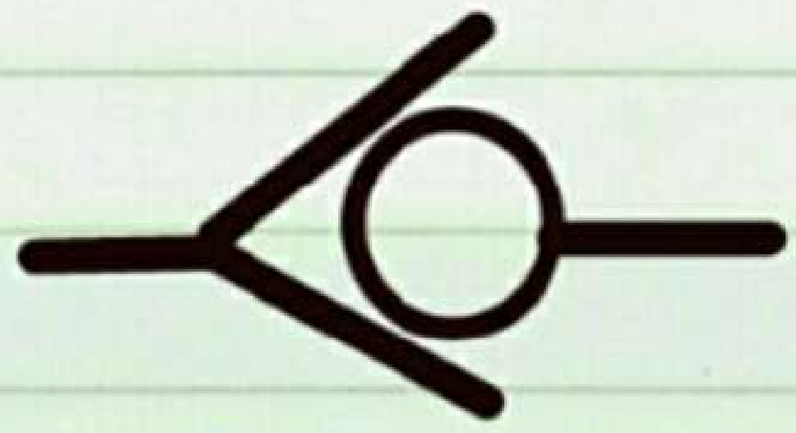
- Used only when the flow in one direction.
- Light weight disk allows vertical installation.
- High operating speed prevent water hammer.



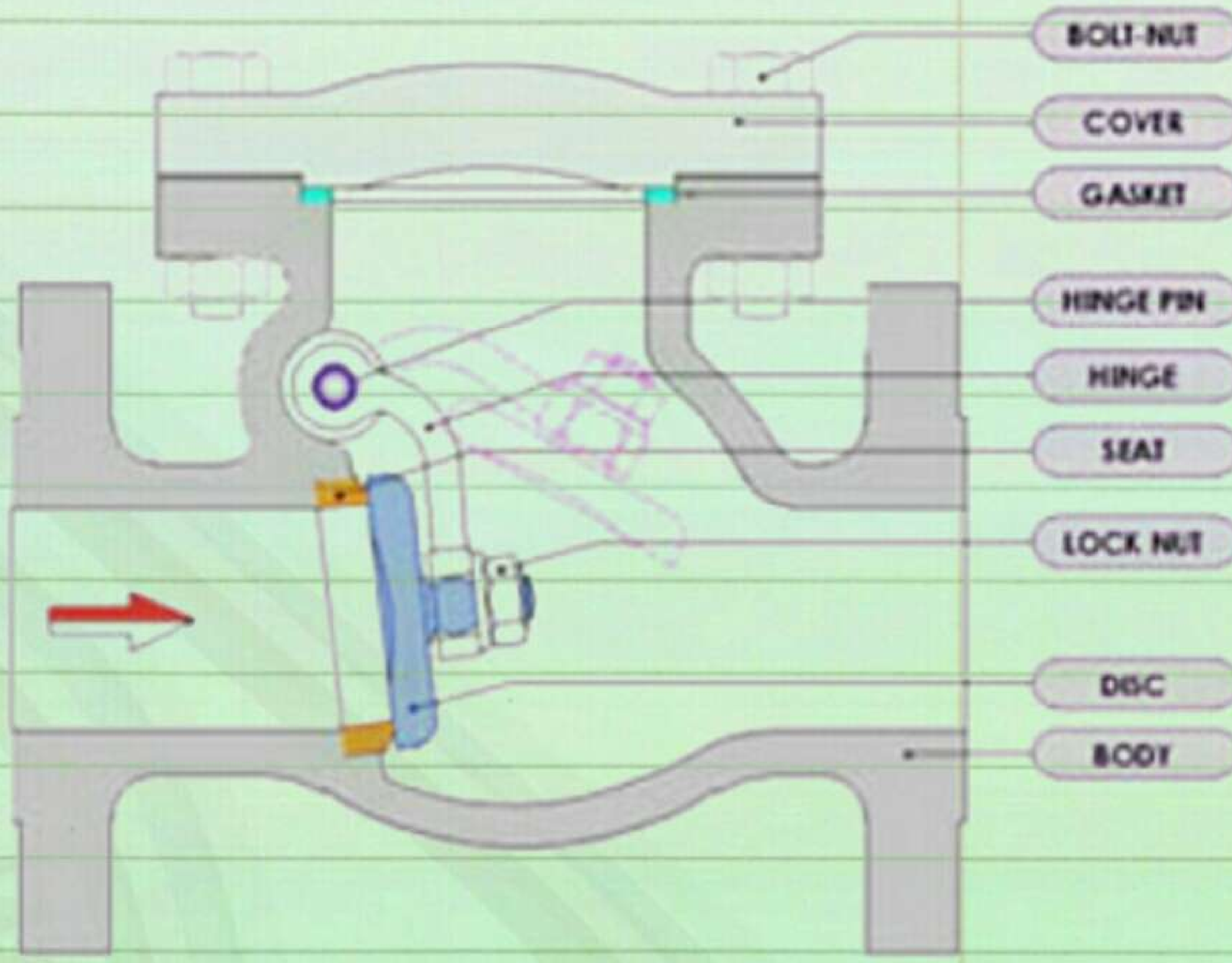
Open

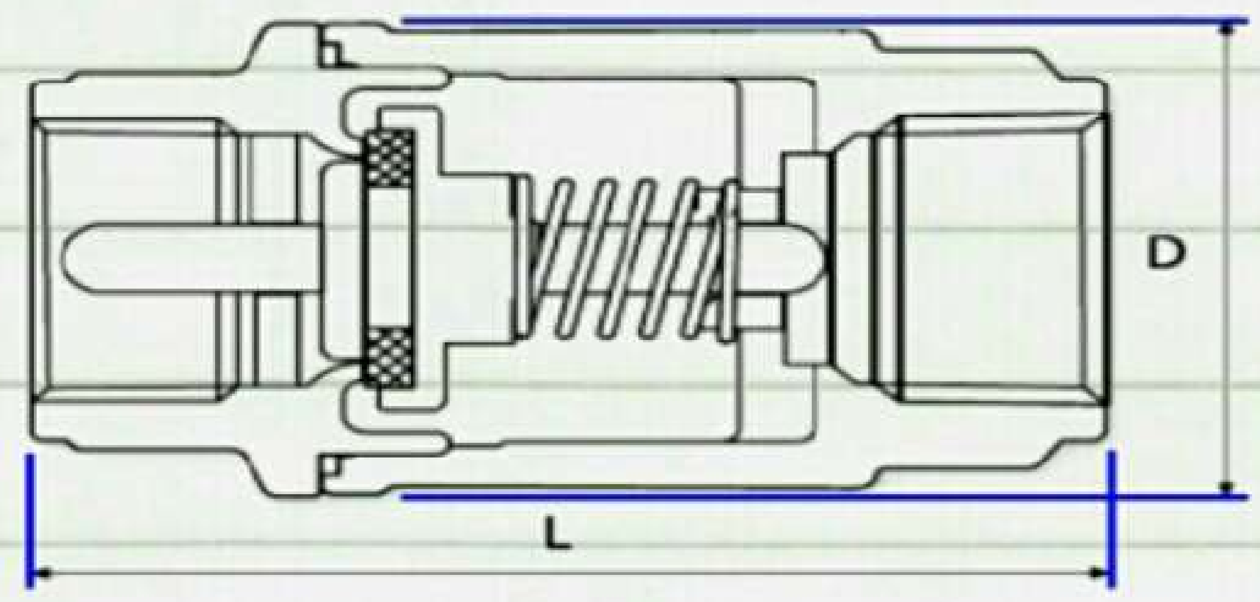


Close

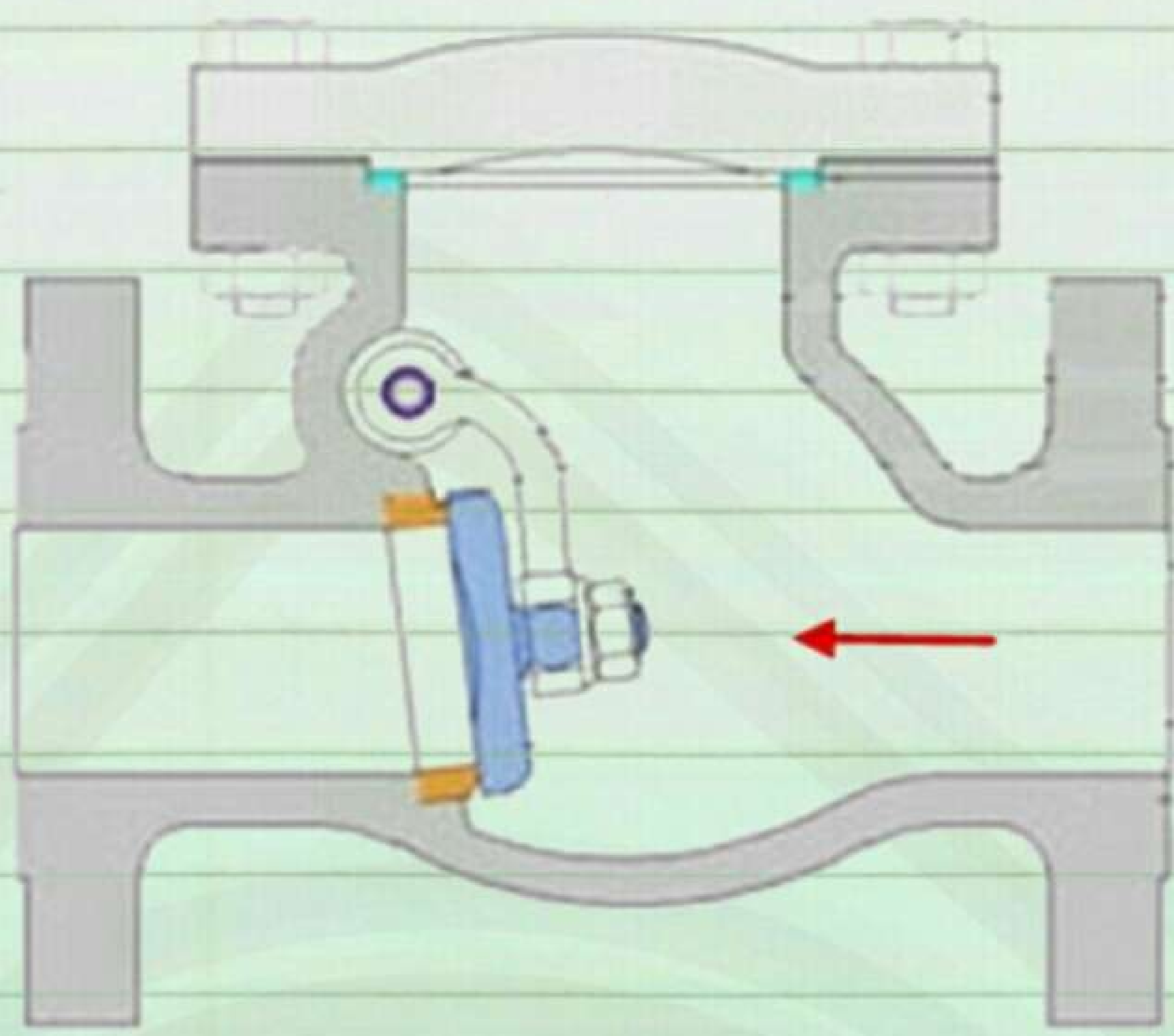


Symbol

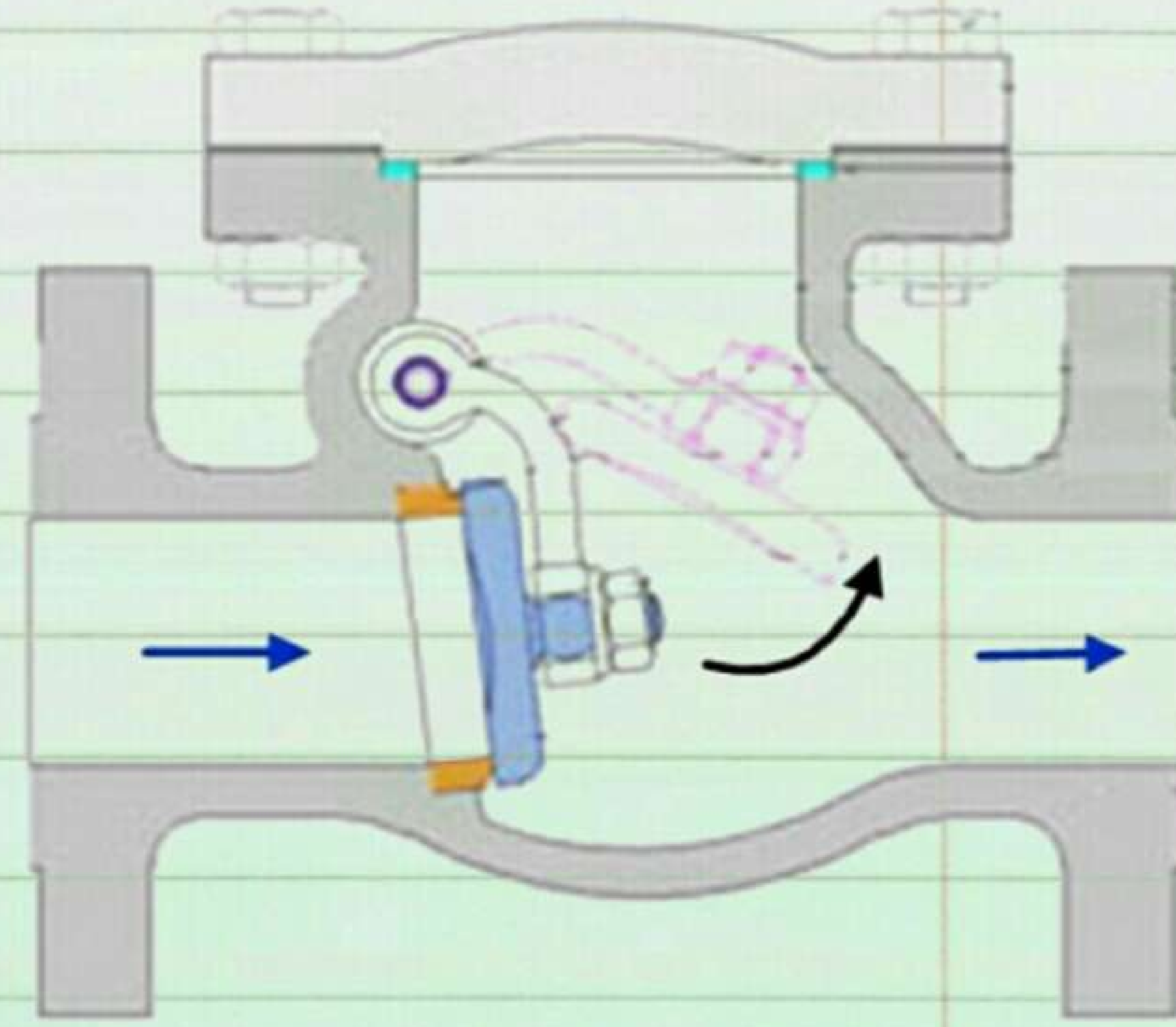


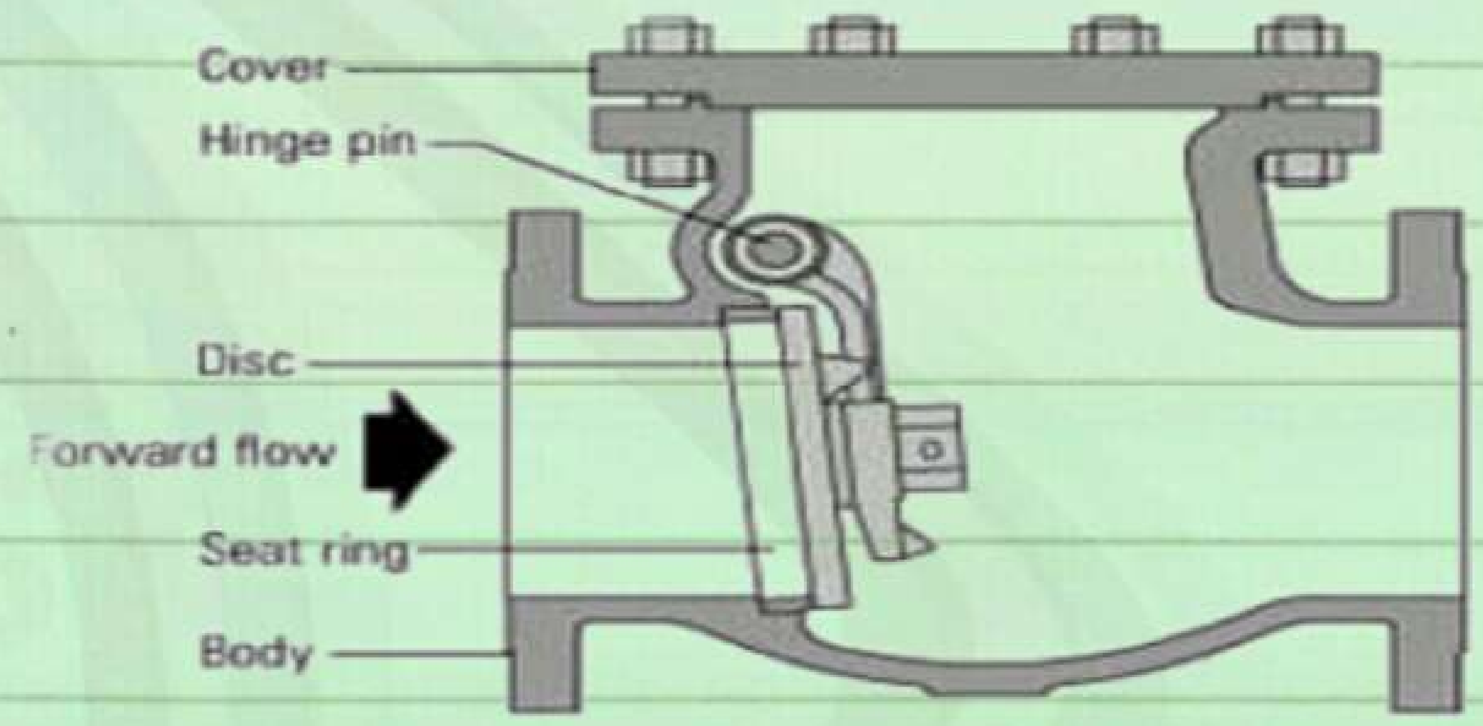


Flow back prevented



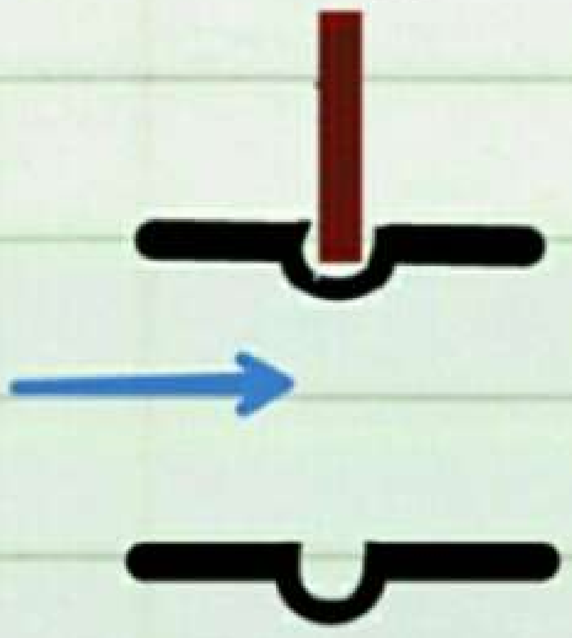
Inflow allowed



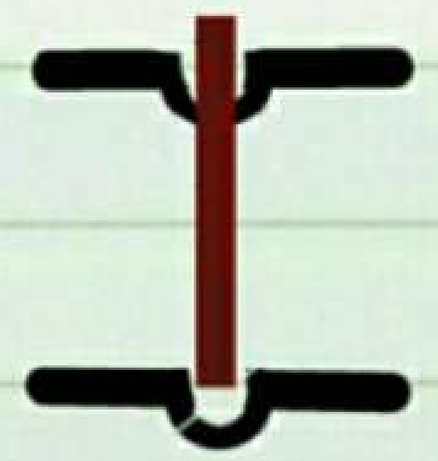


⊛ Gate Valve

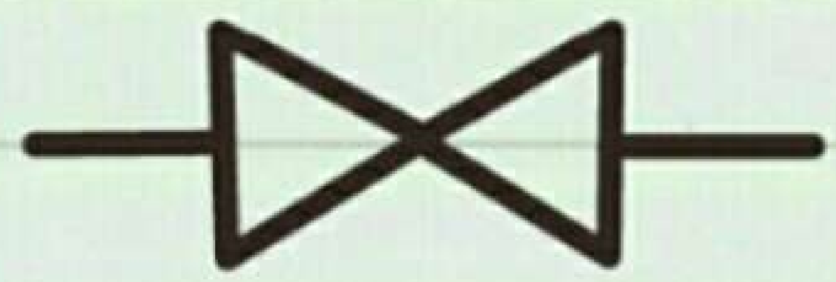
- The gate is lowered to cutoff the path of flow.
- Use only as ON - OFF.
- Little resistance to flow when fully open.
- Long stroke requires time to open and close.



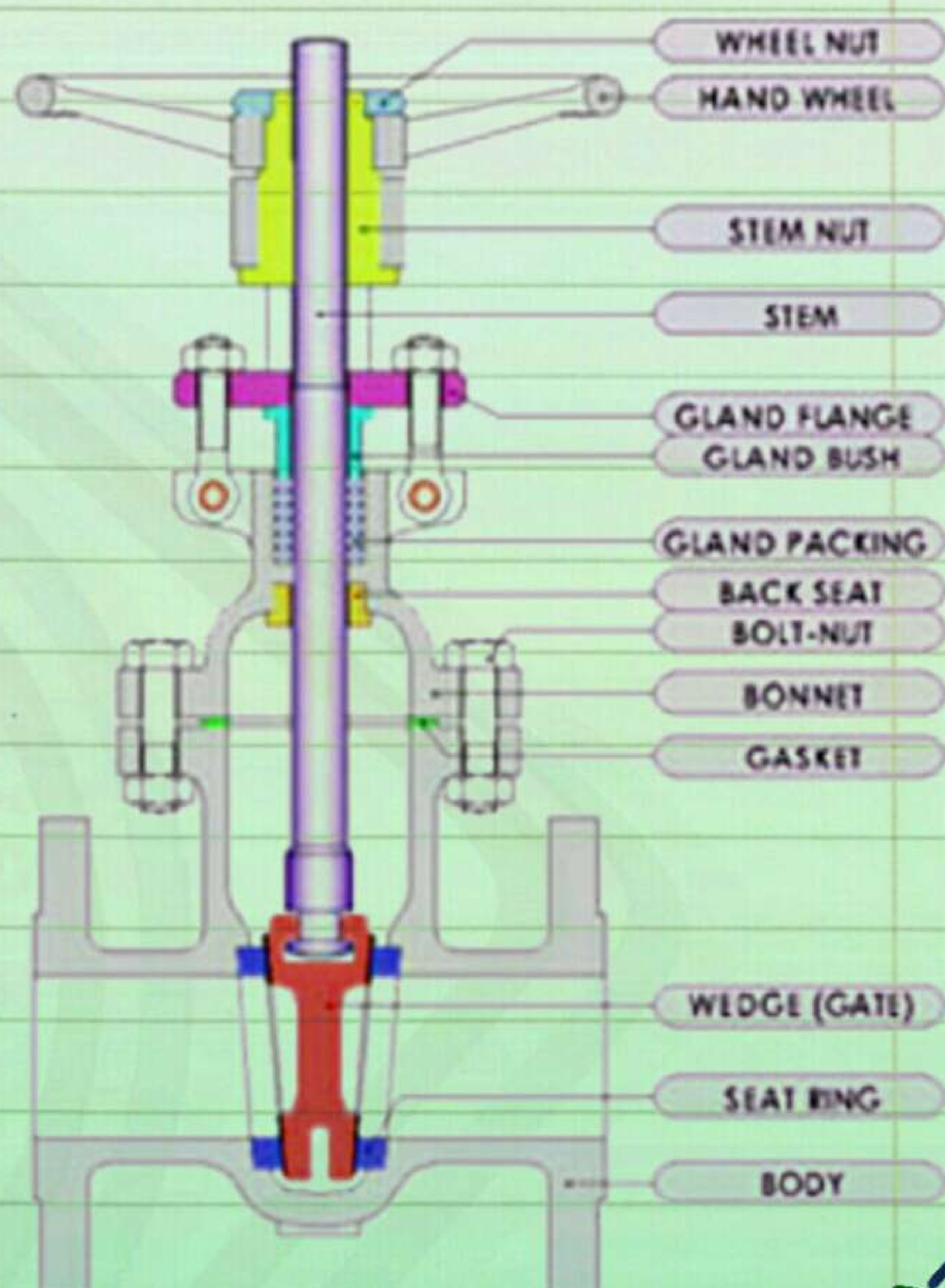
Open

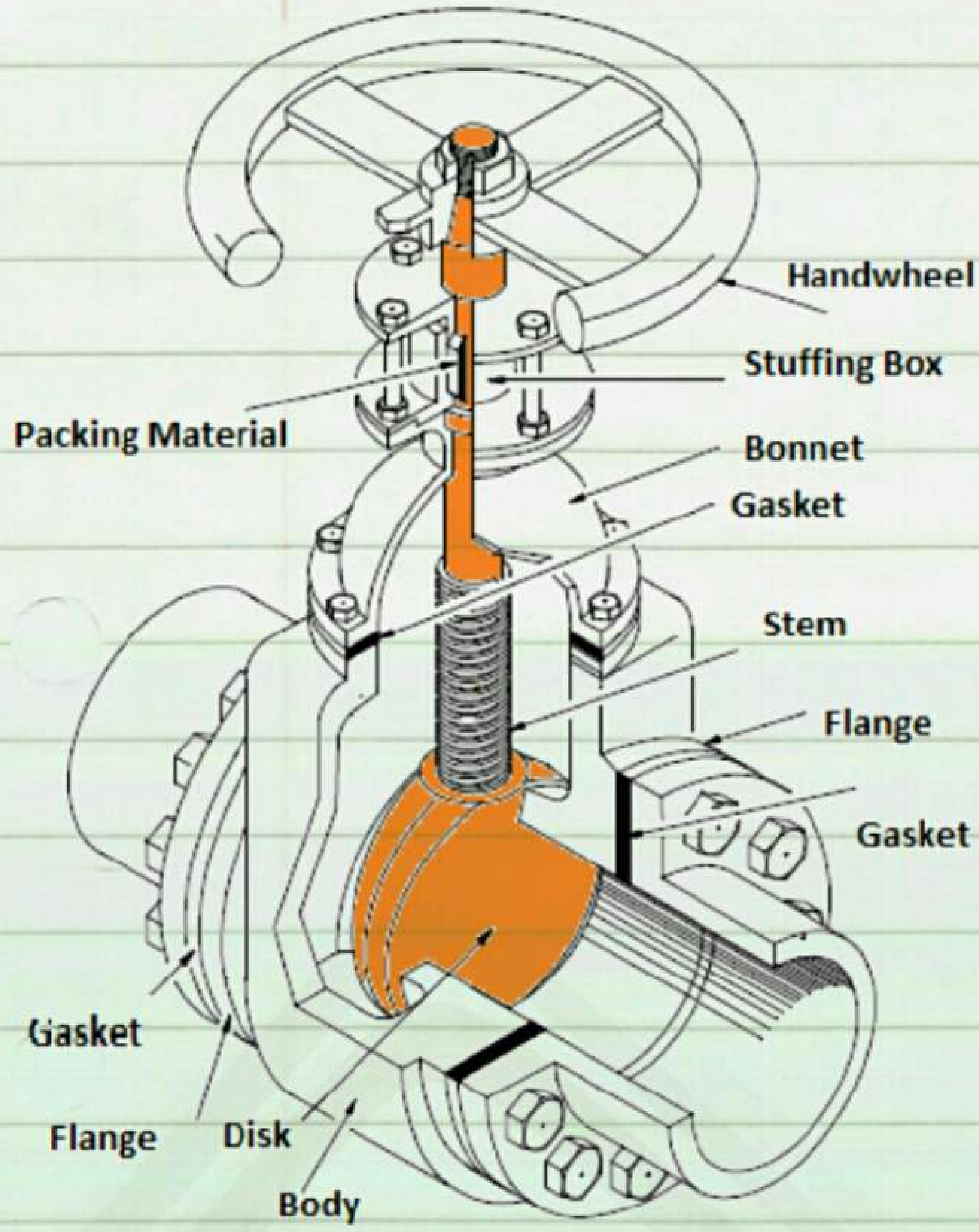


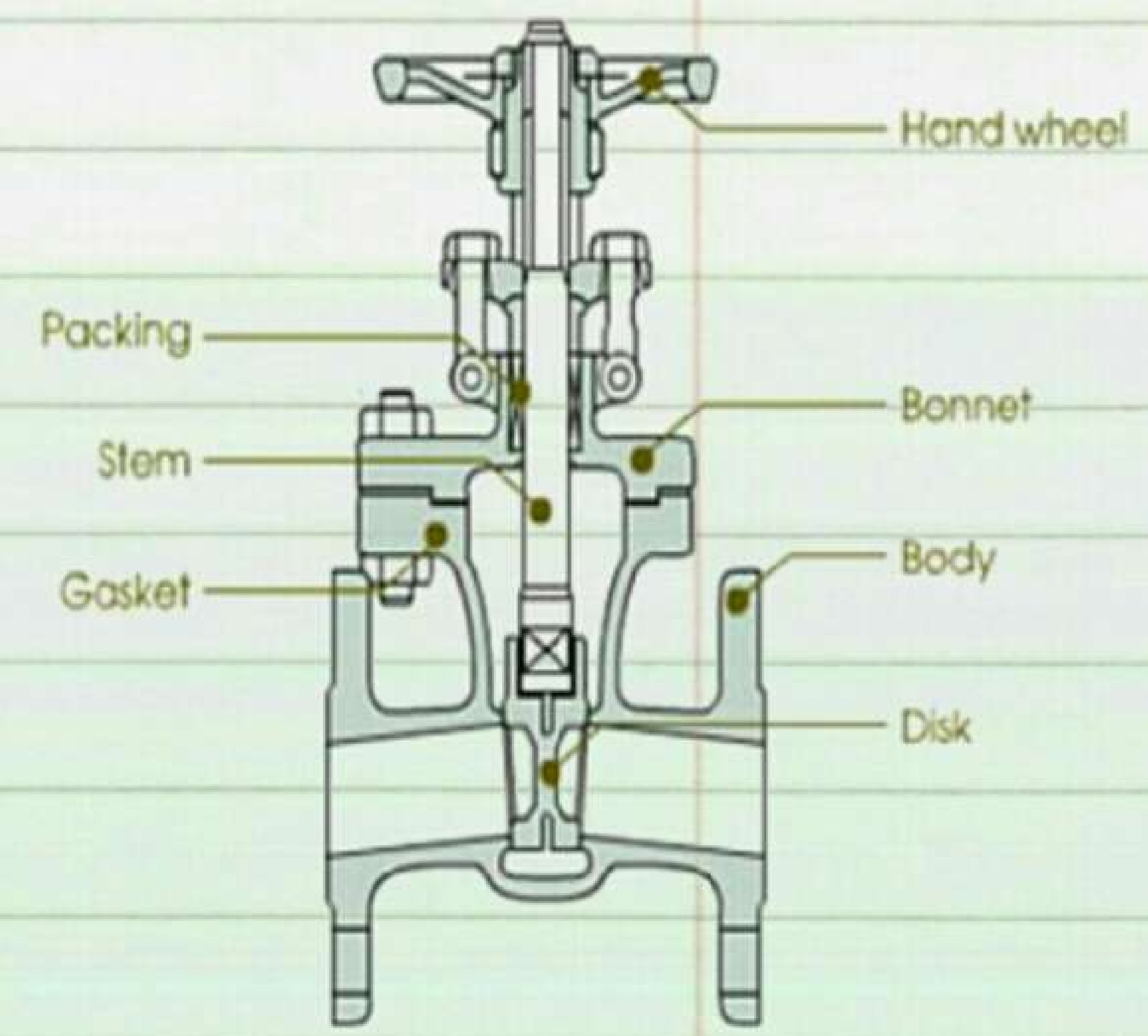
Close

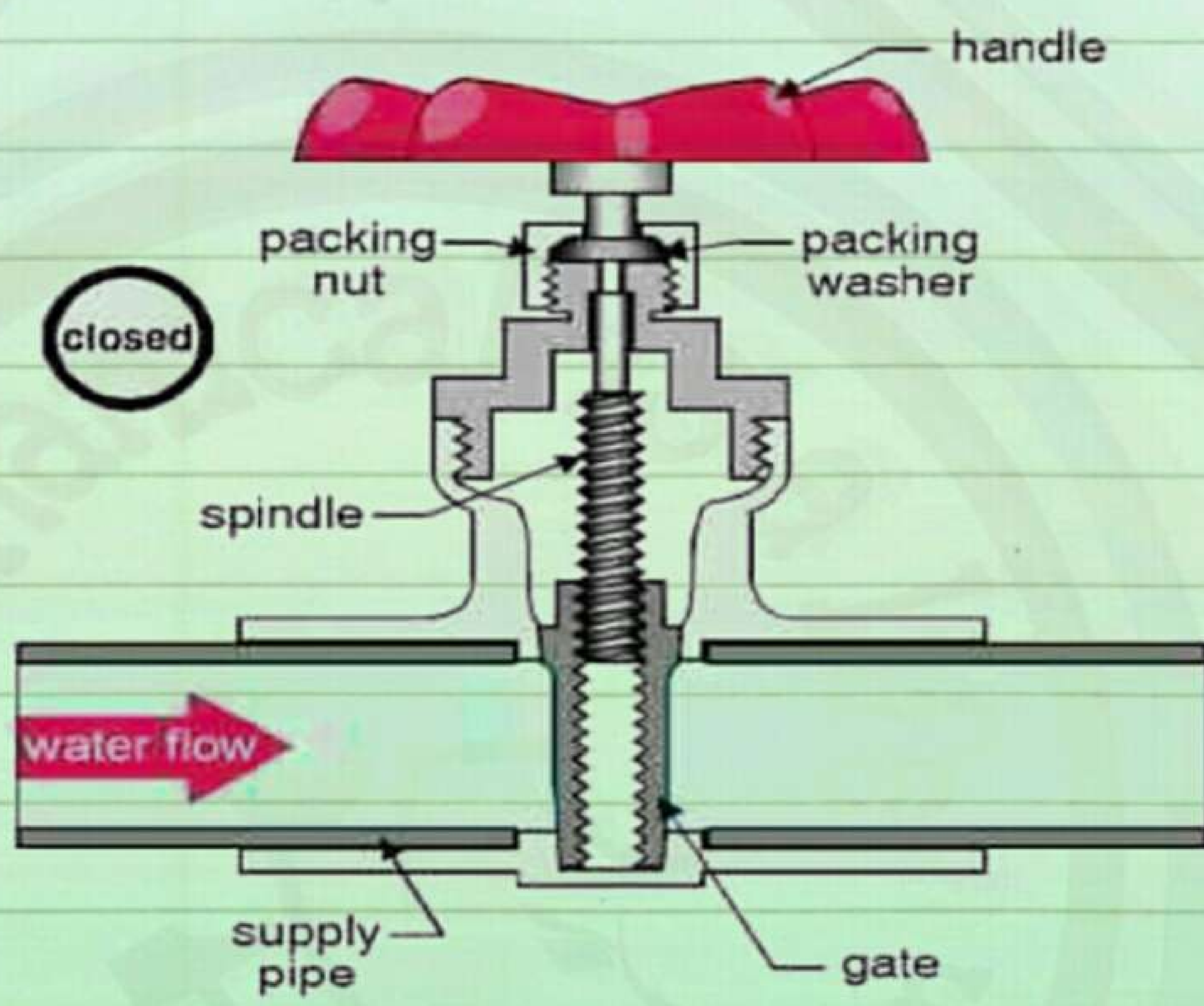


Symbol



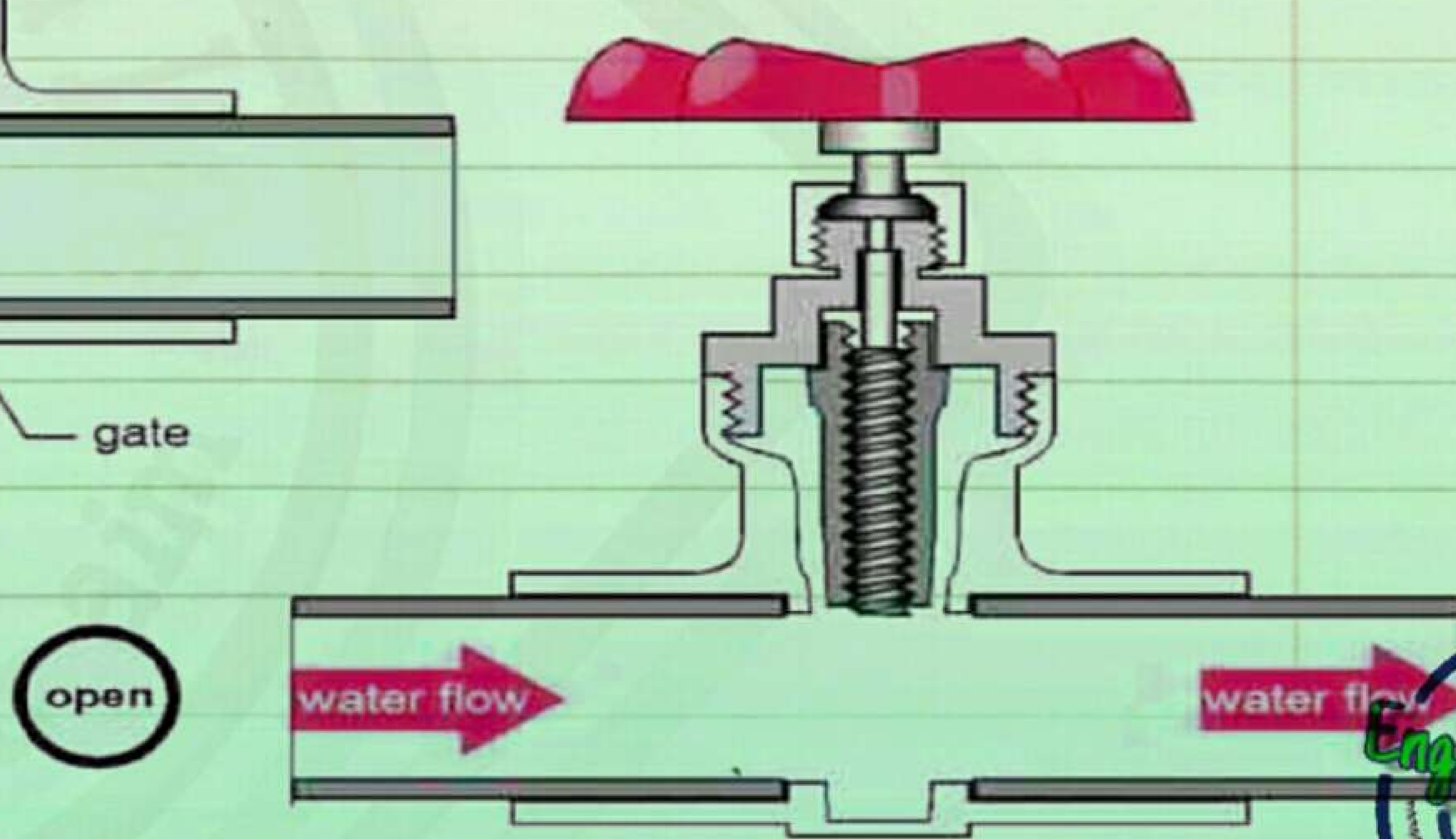






gate valves are meant to be fully open or fully closed

since the seal is metal-to-metal, corrosion can cause these valves to fail



(*) 2 way Control Valve (*)

→ To Control the quantity of water which enter AHU _ FCU.

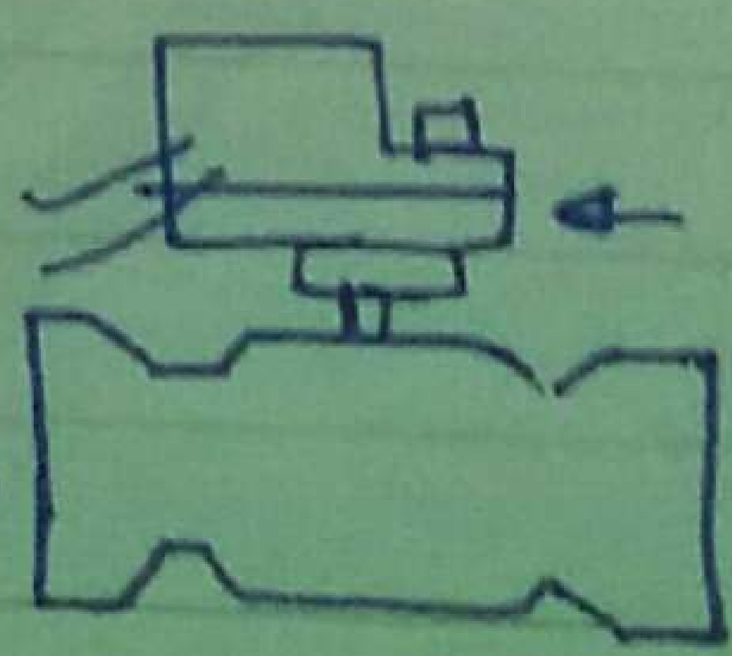
→ Used only in Case of Variable Speed Pump (VSP)

→ There is 2 kinds

1. ON/OFF
   - When you have the setpoint → OFF 100%
   - When you need to Cool → ON 100%
   - No power saver
   - Cheep.

2. Modulating
   - Close & open with scale according to the required temp.
   - power saver

(*) It Controlled by install differential pressure switch (DPS) on the main chilled water pipe to send a signal to the VSP to increase or dicrease the pump speed.



2way.

Actuator

2 Way valve

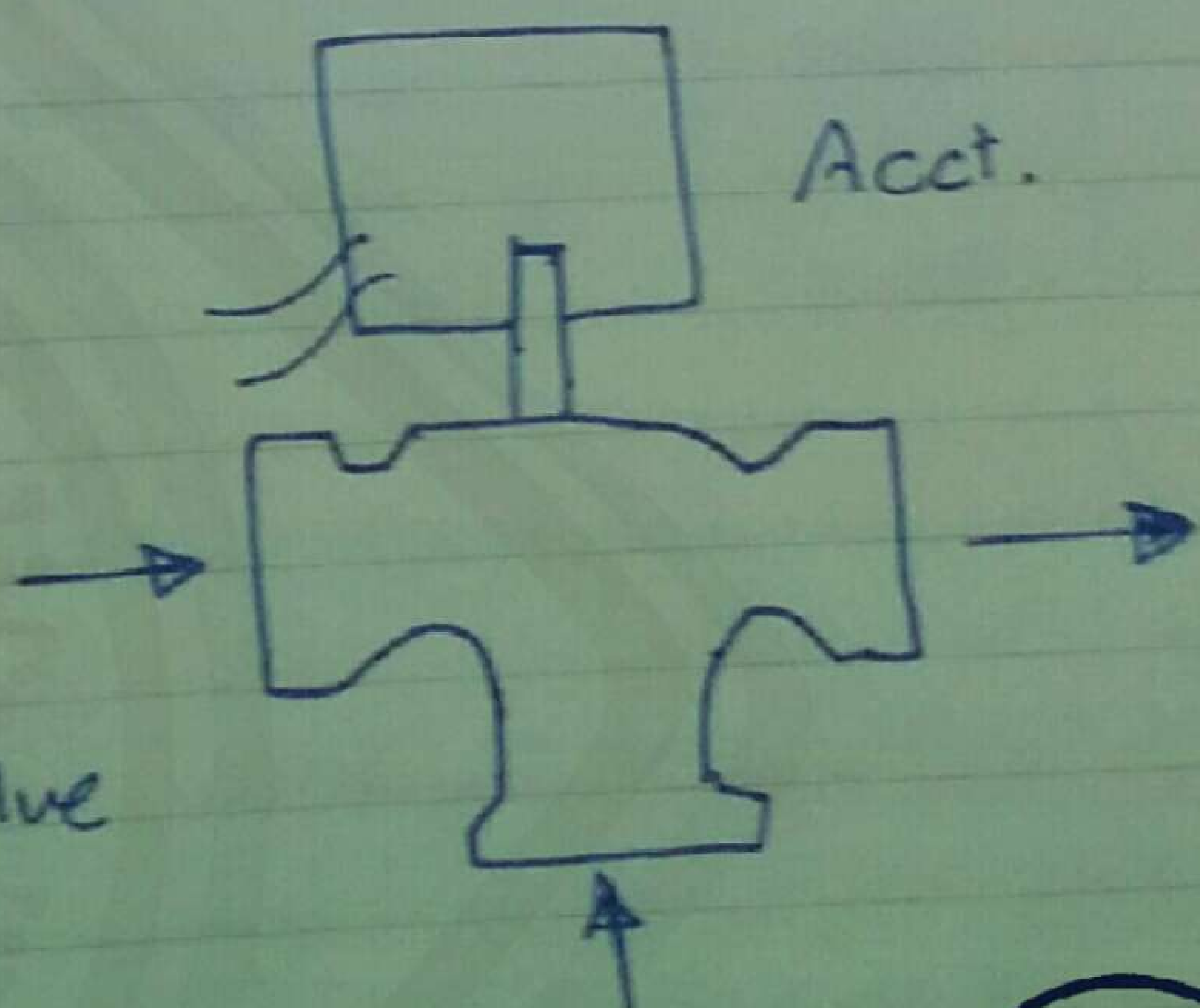
3 way Control valve

→ Used only with a Constant speed pump (CSP)

→ There is 2 Kinds

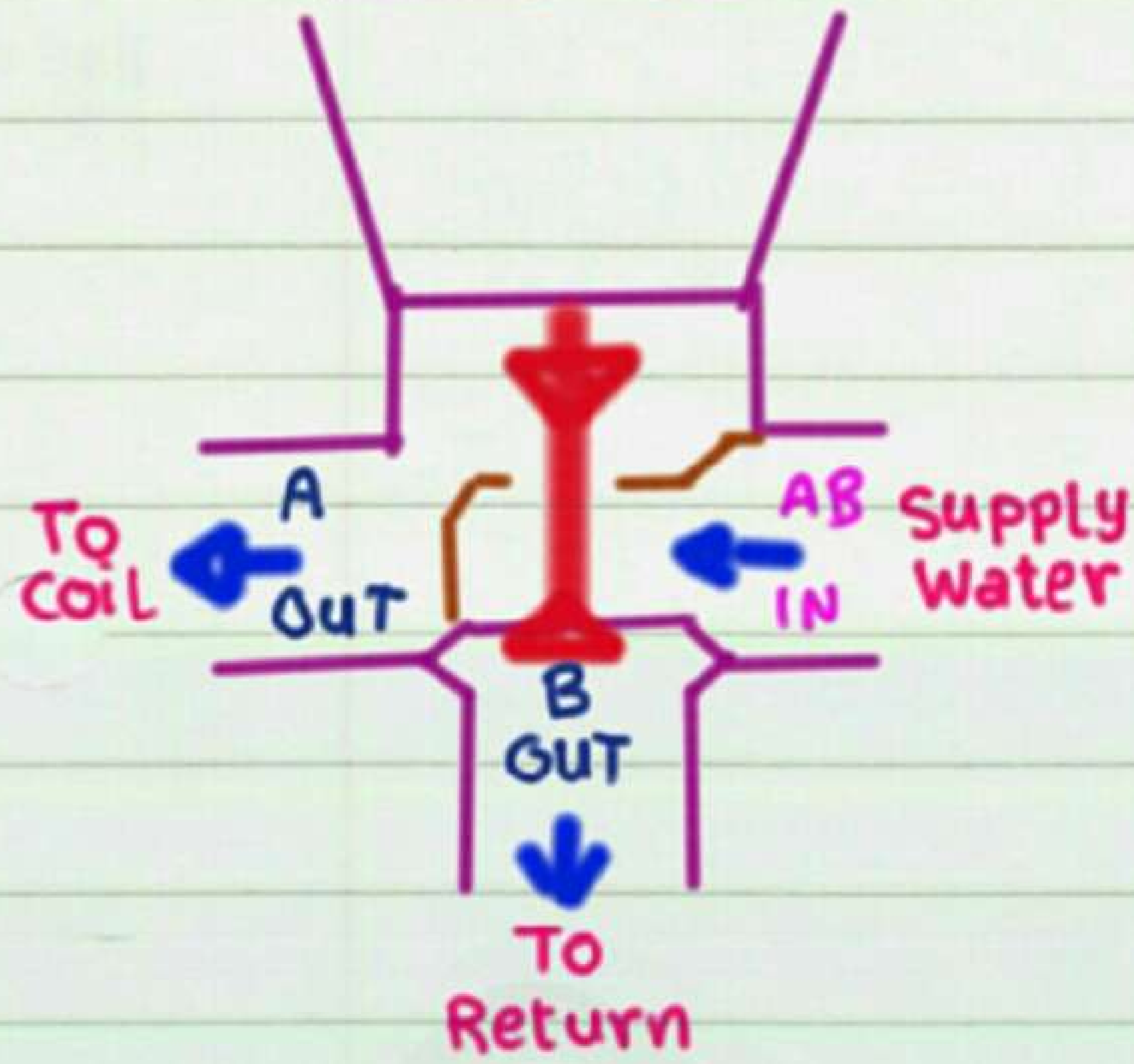
① Mixing 3-way valve
- Installed in ~~entrance~~ Exit of the unit.
- Have 2 entrance & 1 exit

② Diverting 3-way valve
- Installed in exit of the unit
- Have 1 entrance & 2 exit.

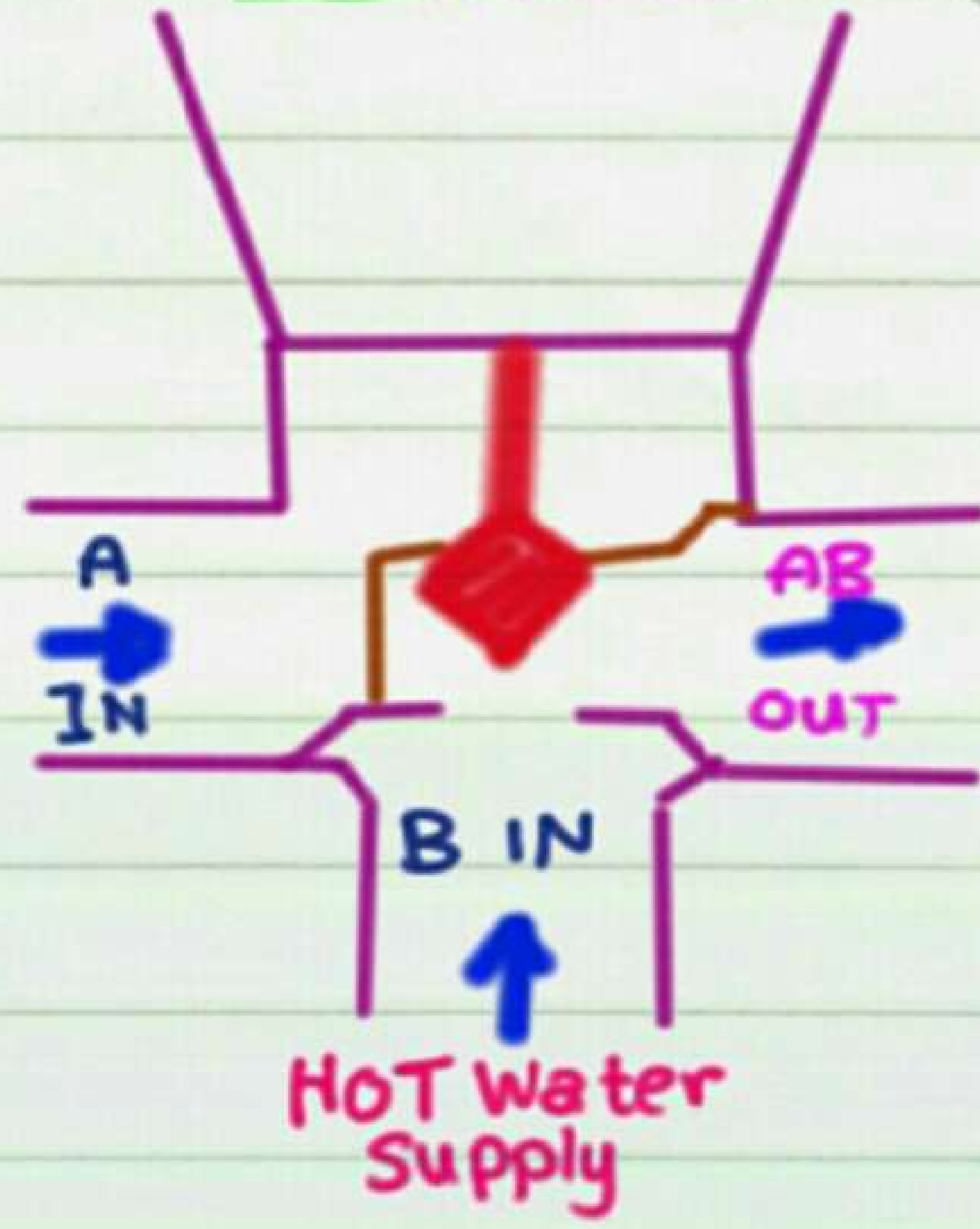


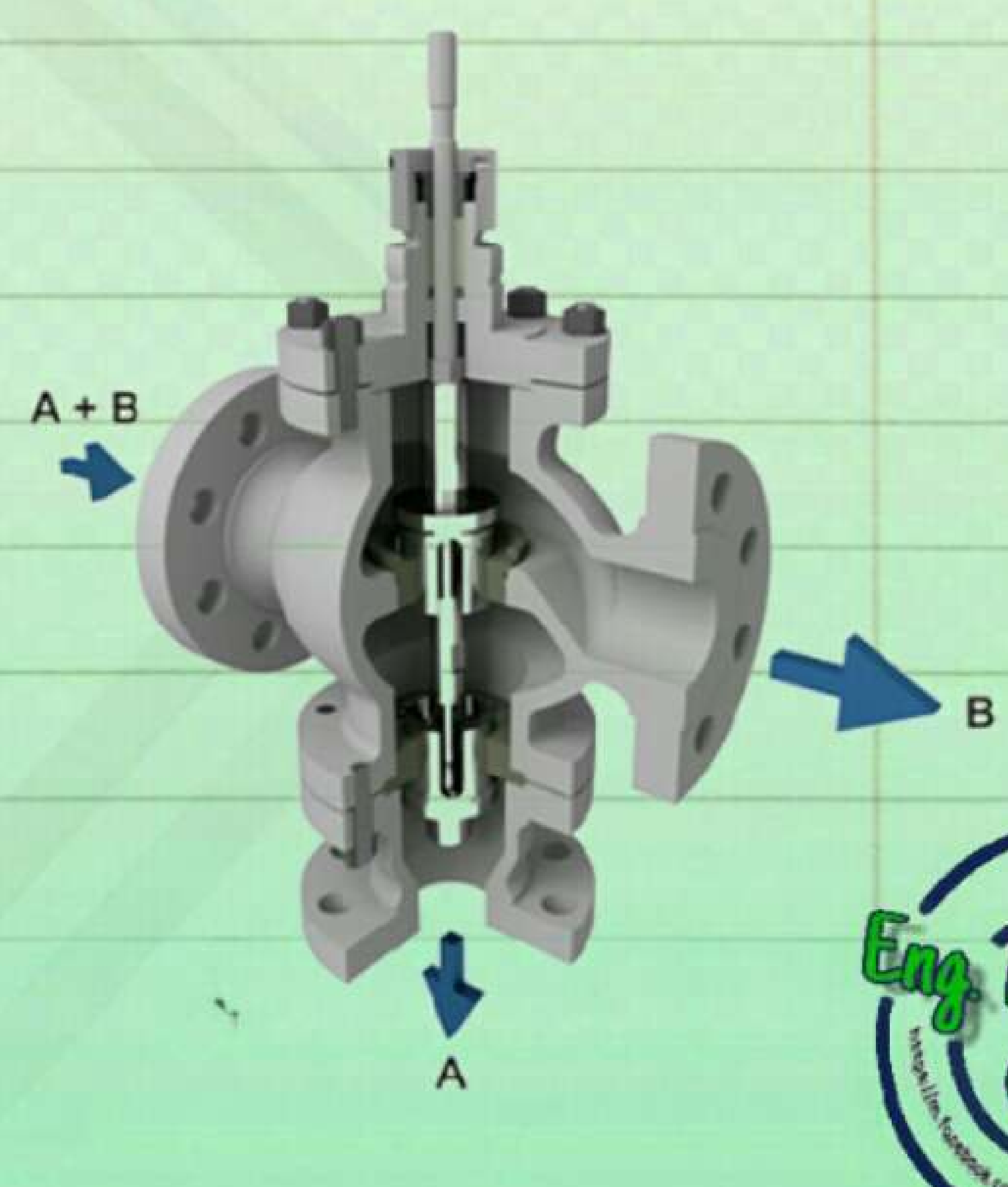
3 way valve

Diverting Valve



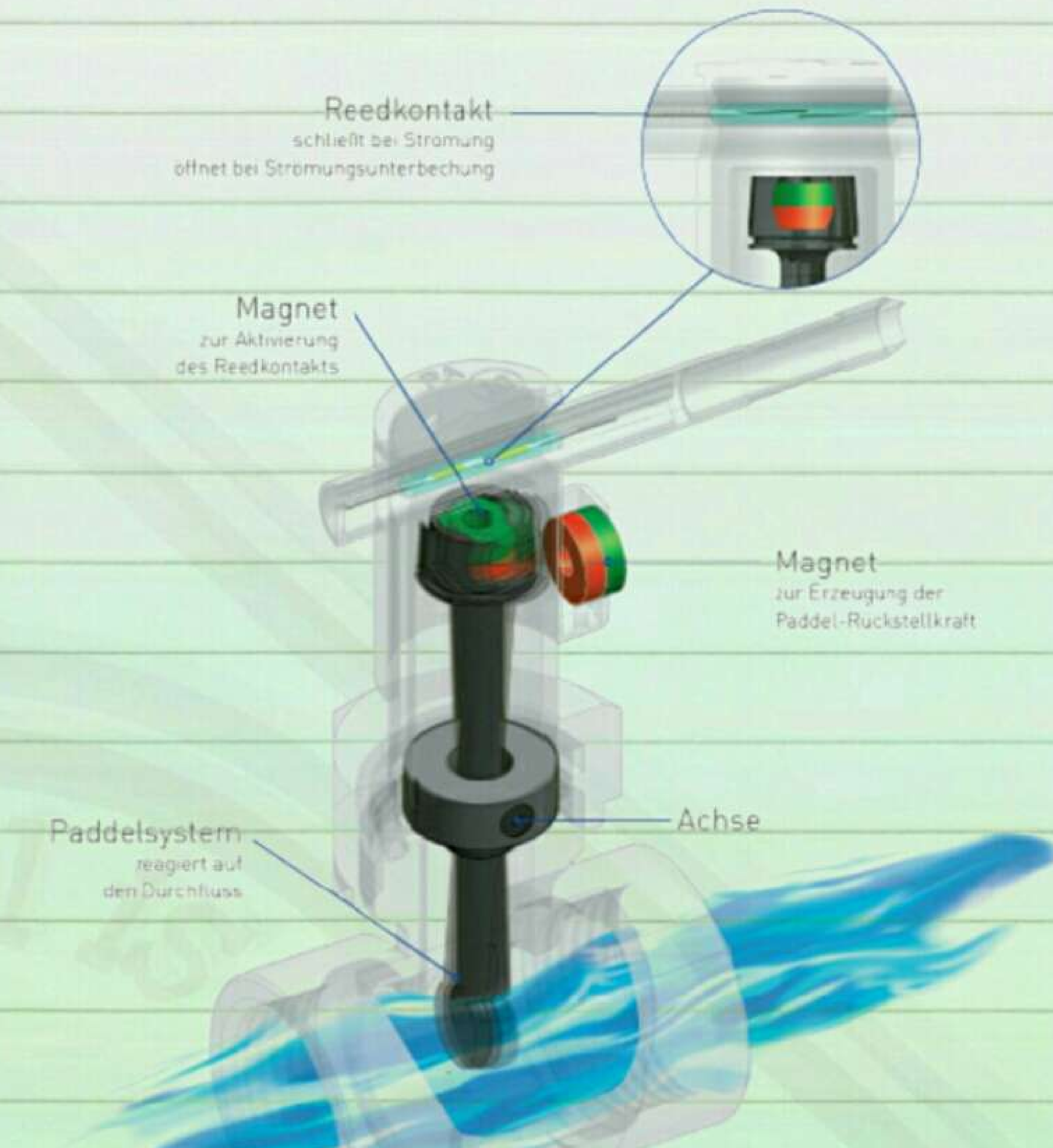
Mixing Valve





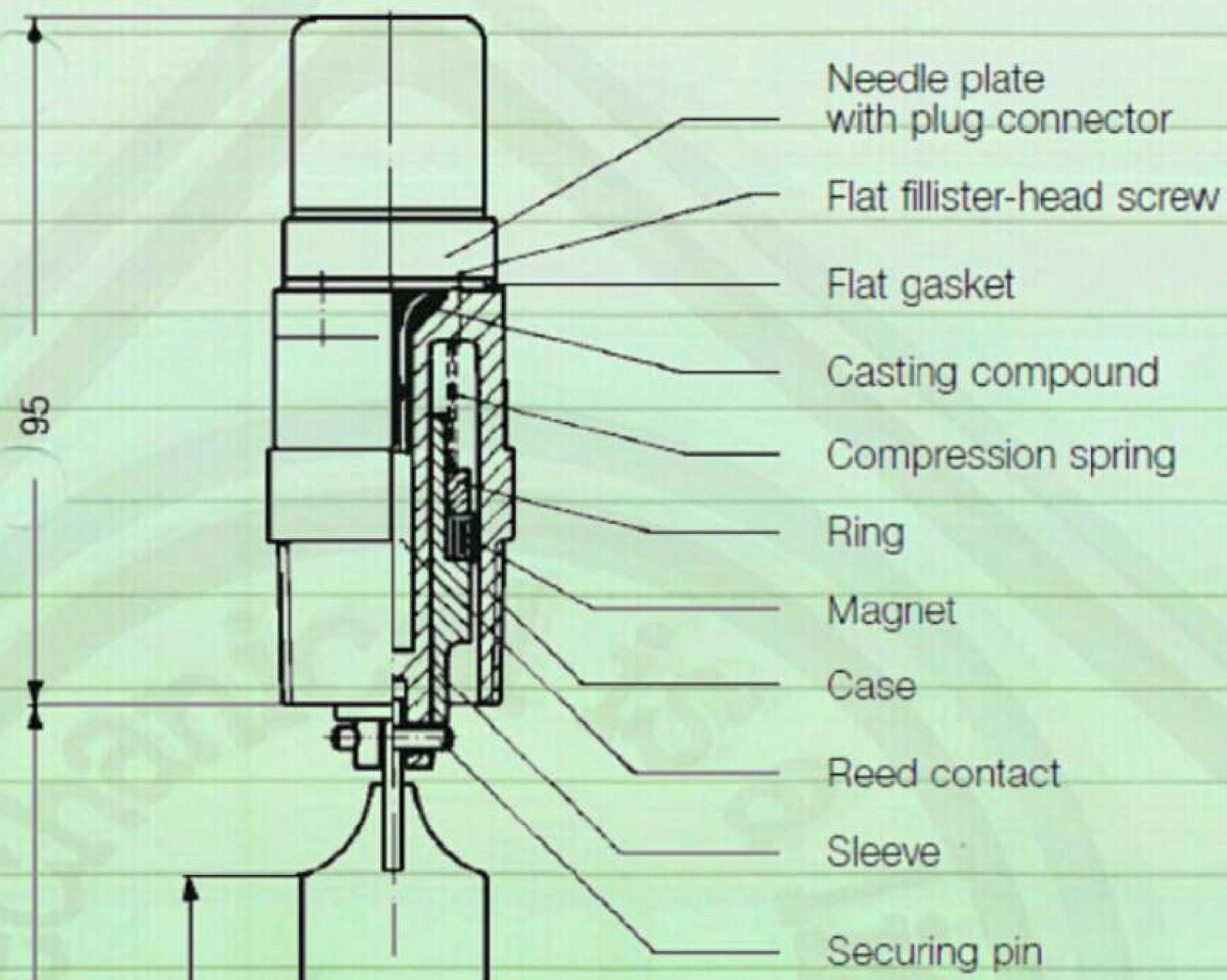
4

Flow Switch



⊛ Flow Switch

- It detects the presence or absence of flow in piping.
- Working by sending a trip signal to the control panel in the chiller to protect it from damage and for cooling circuit protection
- It is normally used to shut OFF the chiller whenever there is no circulation of water.

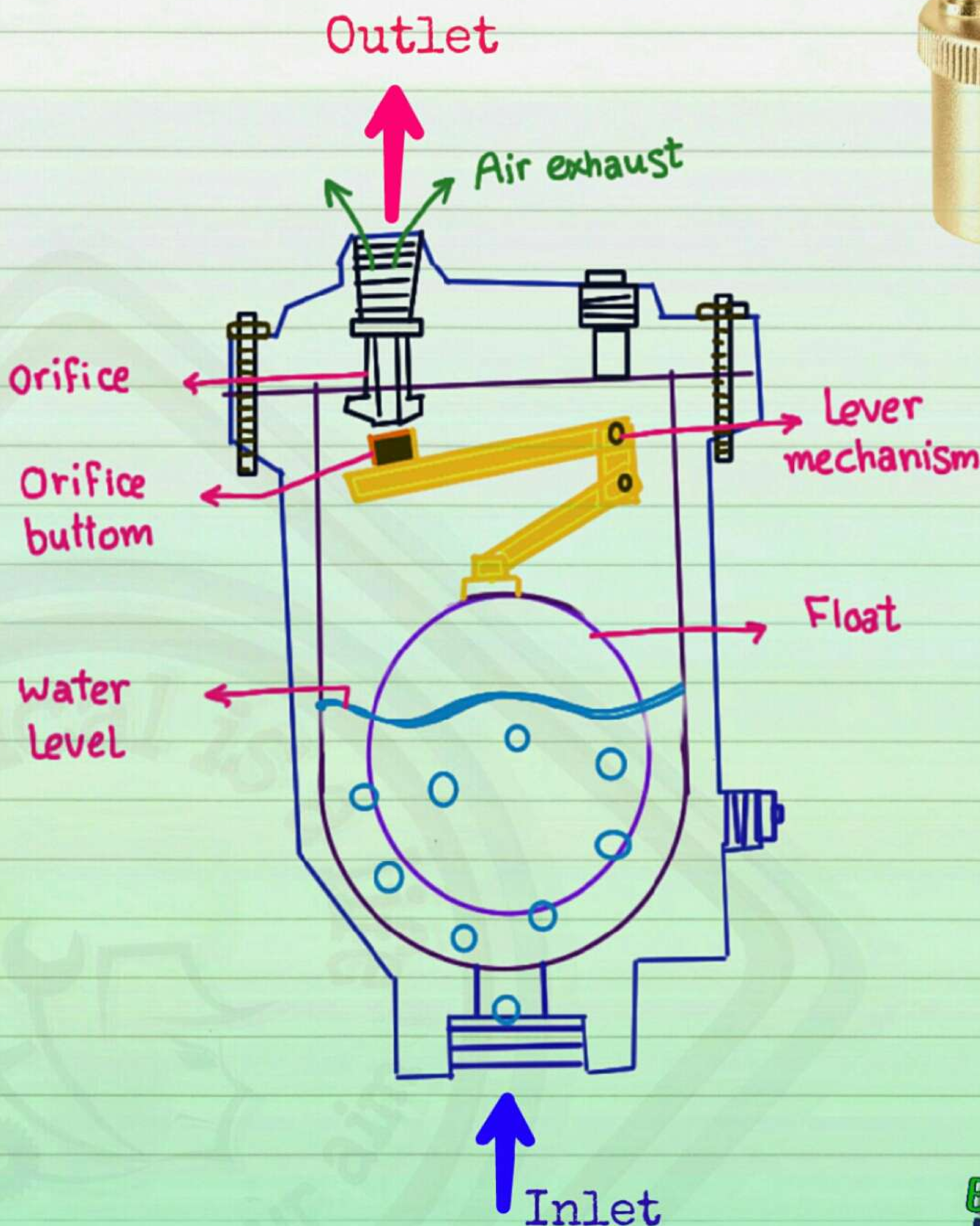


⑤

Automatic Air Vent

Automatic Air Vent.

- Used for exhaust the air from water pipe.
- Install in the pipe header.



How it works

At start-up the air vent is open allowing air to pass through the main valve. As soon as water reaches the vent the float is raised and the lever mechanism closes the valve.

When more air reaches the vent chamber, the float falls and opens the valve. After the air is discharged, the valve closes, due to a rising water level.

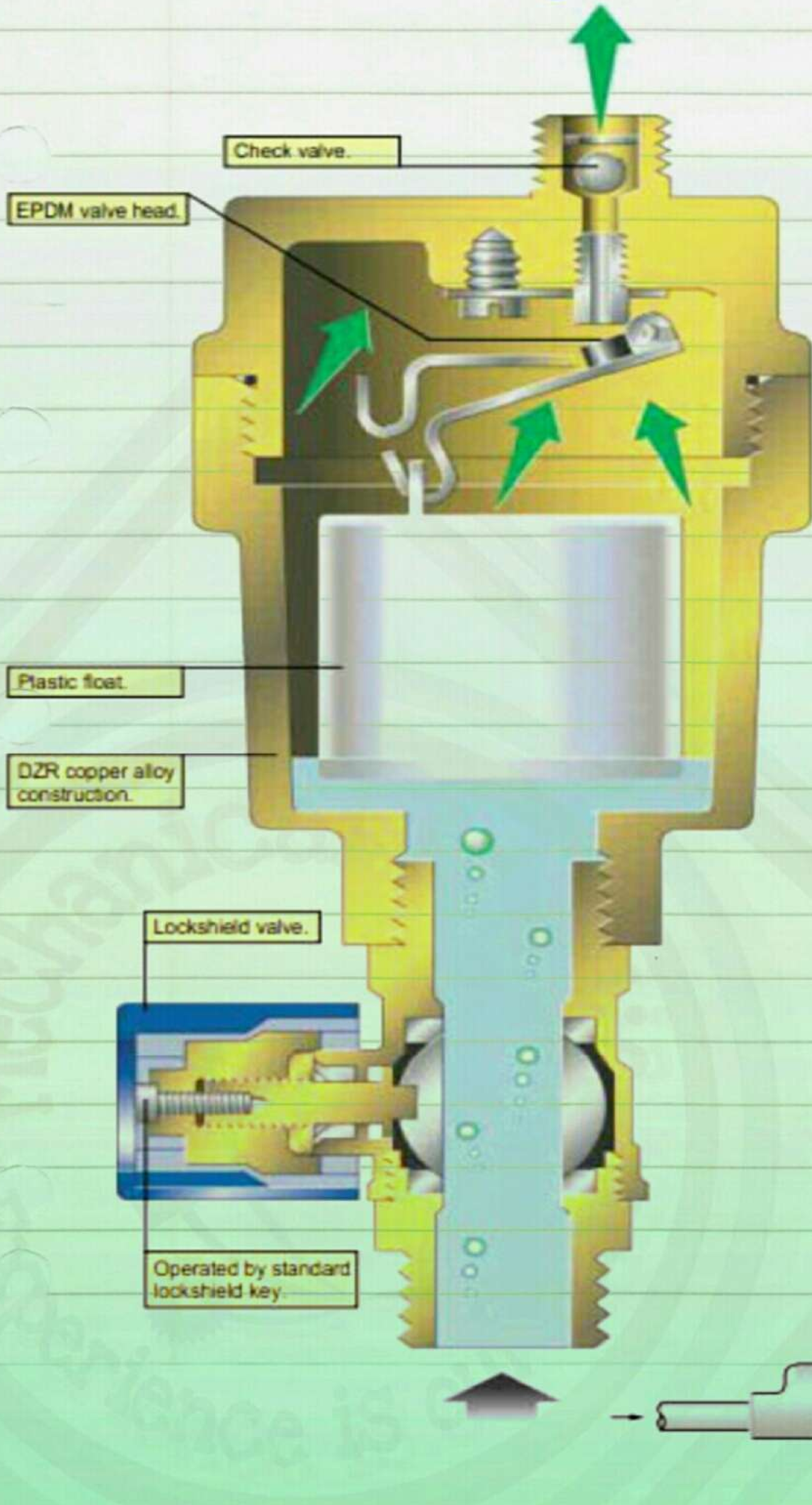
The check valve is essential where there is a possibility of the system operating in vacuum by preventing air being drawn into the system.

The lockshield ball valve has a unique feature that offers 3 modes of operation:

- **Normal operation.**
- **Locked in open position.**
- **Locked in closed position.**

In normal operation the ball valve can be adjusted using a lockshield key.

In the open or closed position the valve can be locked. If the plastic cover and screw are removed the valve stem can be rotated to lock the ball valve in the open or closed position.



Typical application

- The automatic air vent should be installed vertically with the inlet at the bottom.

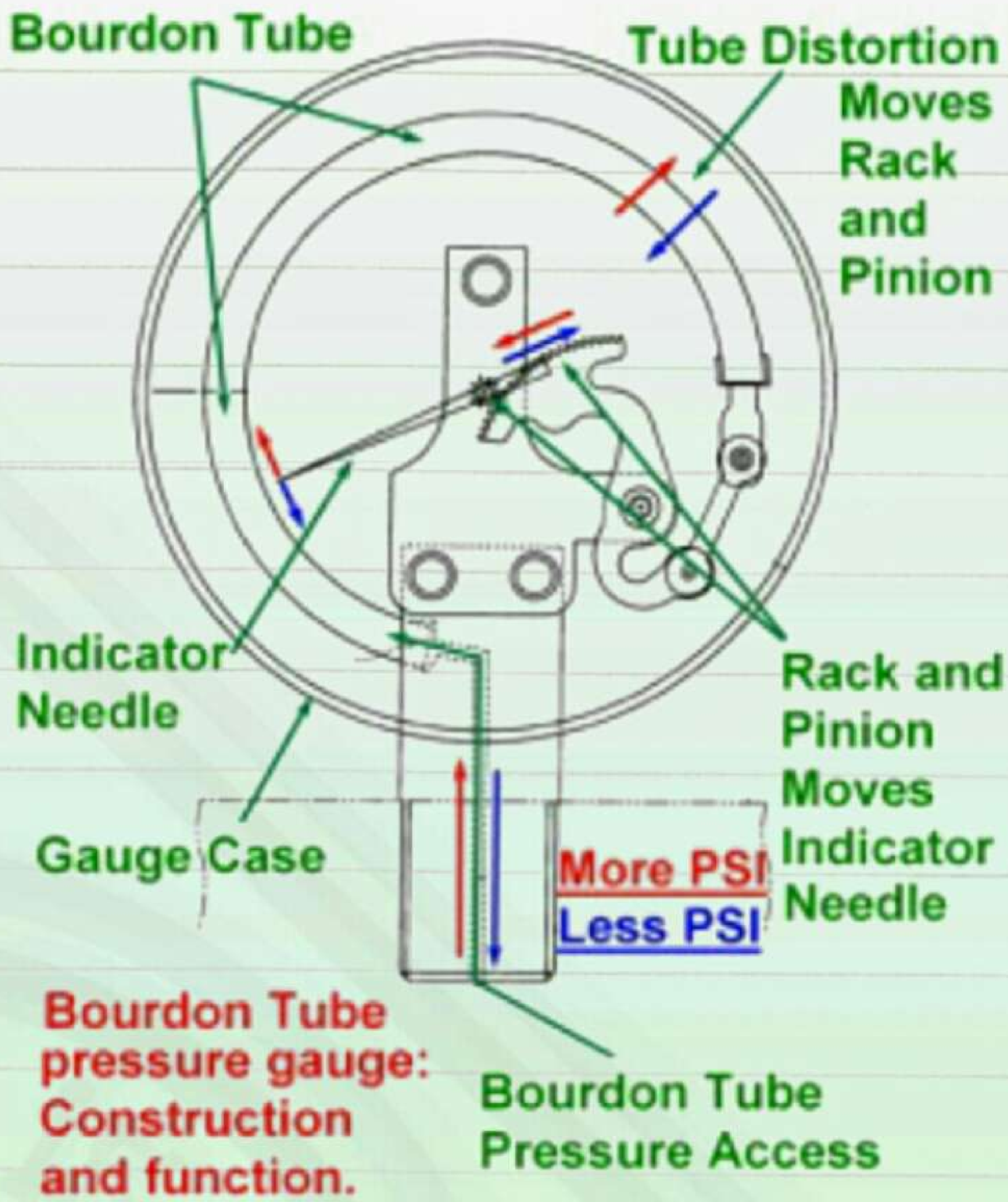
We recommend piping the discharge from the air eliminator/air vent to a suitable safe point.

6

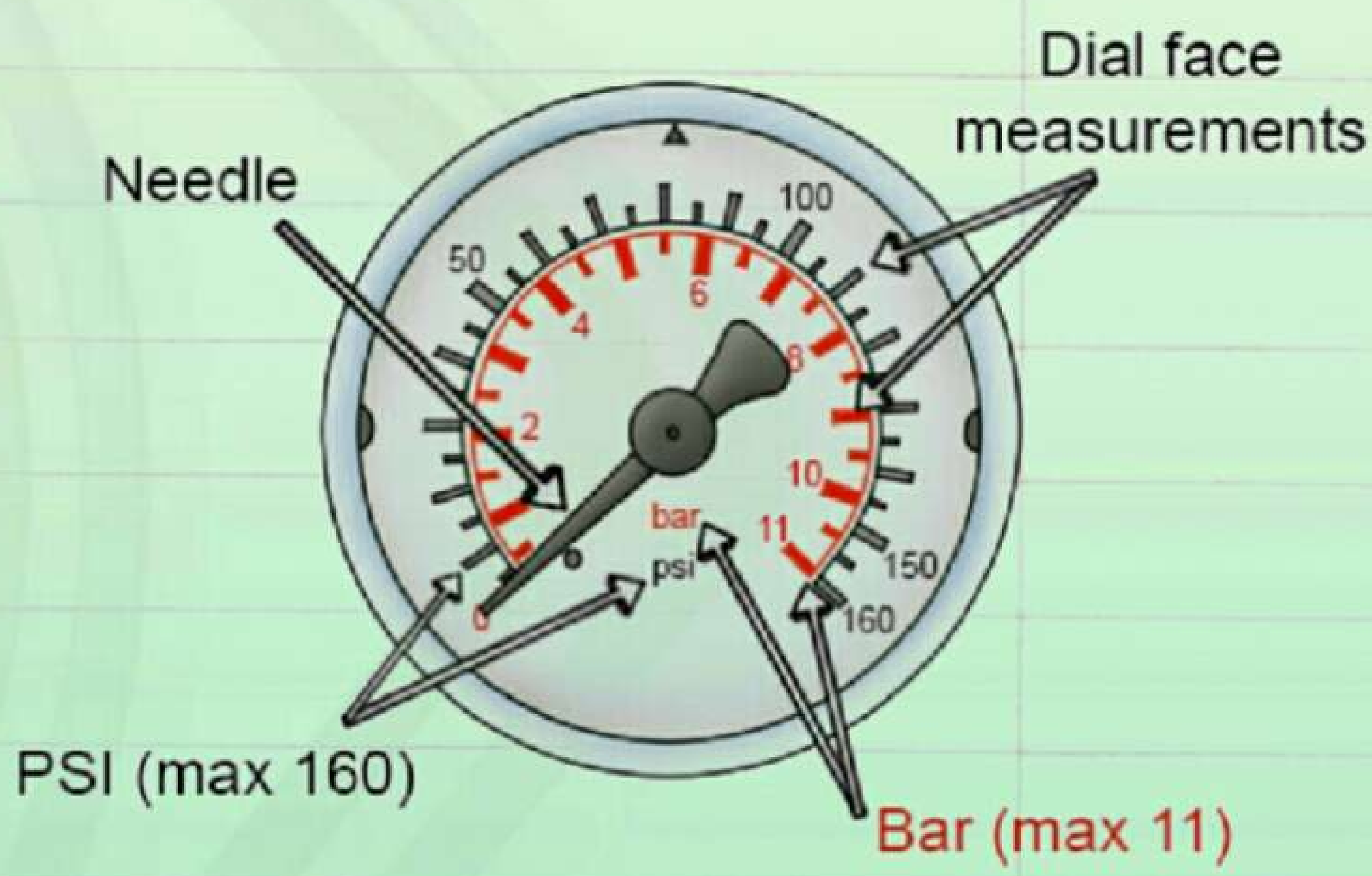
Pressure Gauge

Pressure gauge

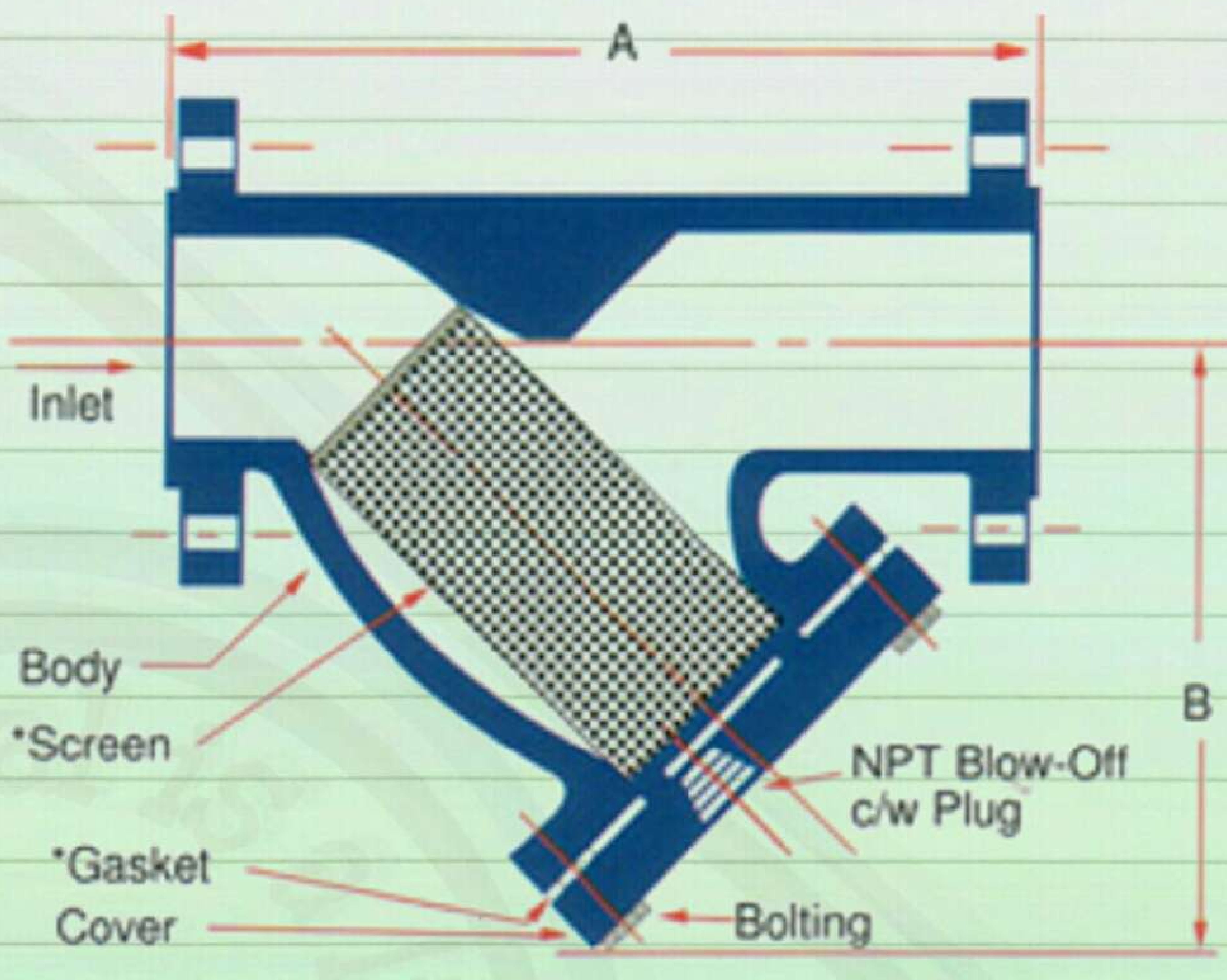
- Used to measure the pressure of the water at the Current floor
- Used for the purpose of inspection to check the water pressure in pipes.



Bourdon Tube pressure gauge: Construction and function.

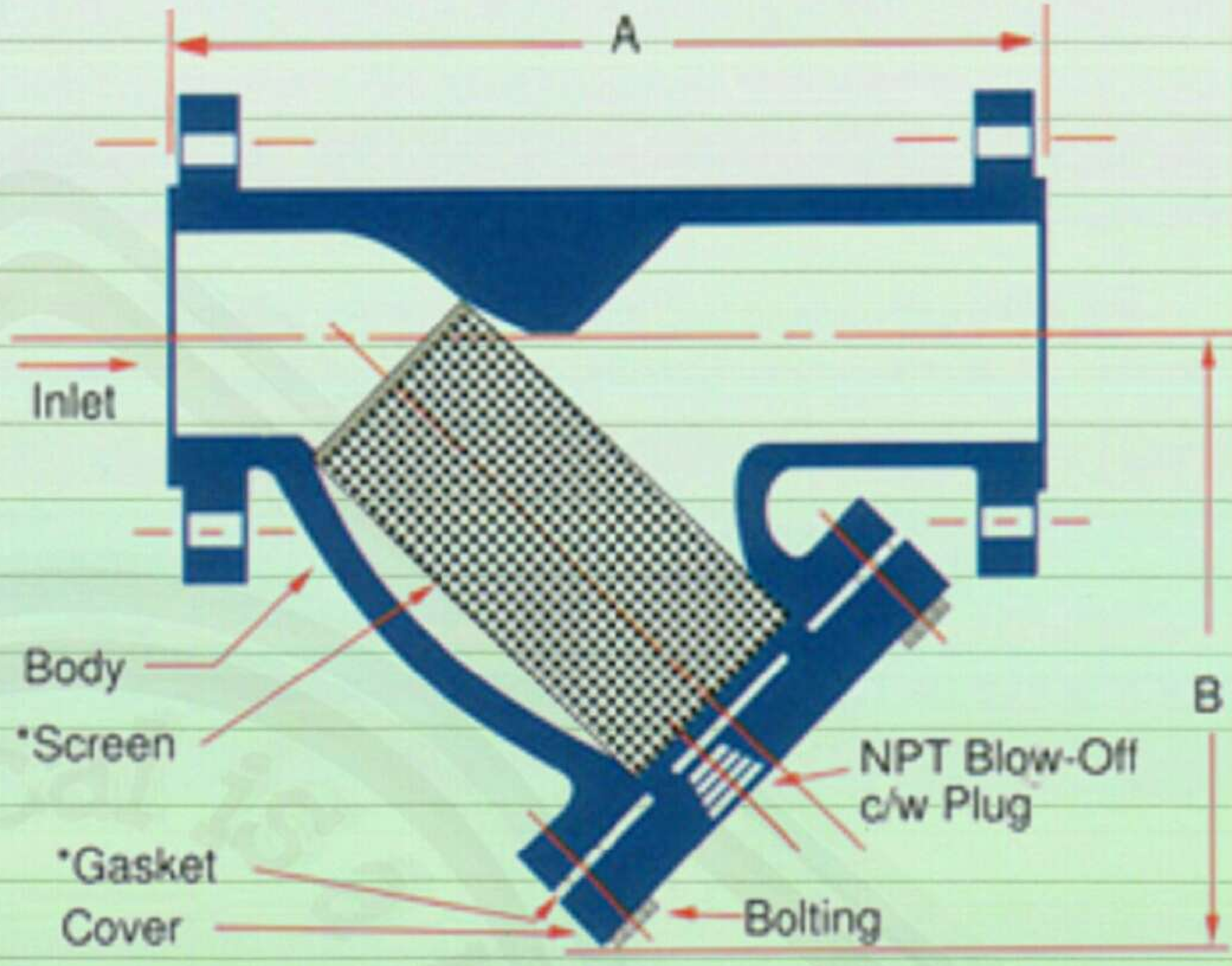


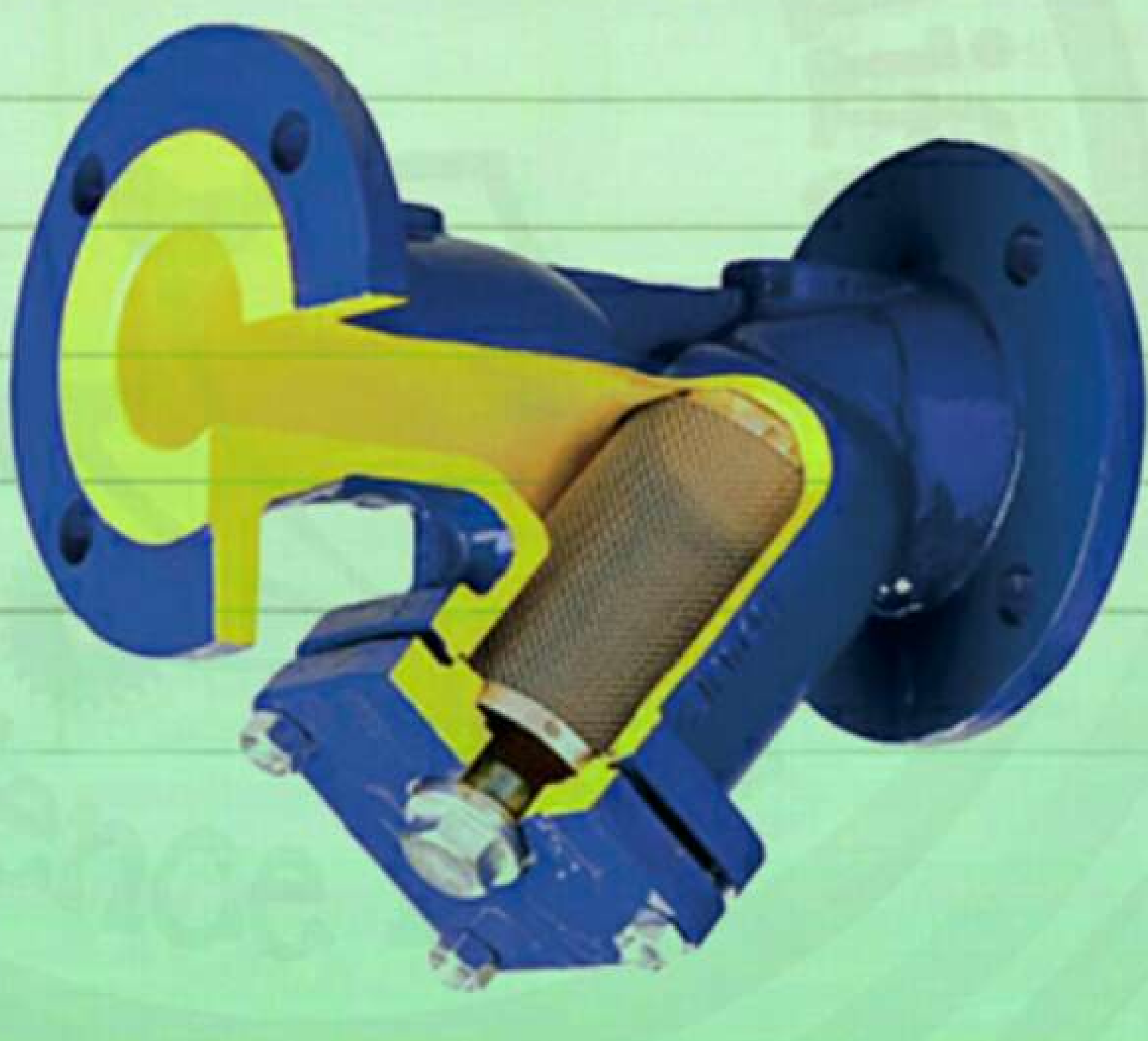
Y - Strainer


A
Inlet
Body
*Screen
*Gasket
Cover
Bolting
NPT Blow-Off
c/w Plug
B

⊛ Y- Strainer

- Take their name from their Configuration.
- Install in the entrance line.
- Used in either horizontall or vertical pipe.
- Mechanically it remove solids from the water pipe before entering the Coil pipes to prevent any damage in it.





8

Flexible Joint

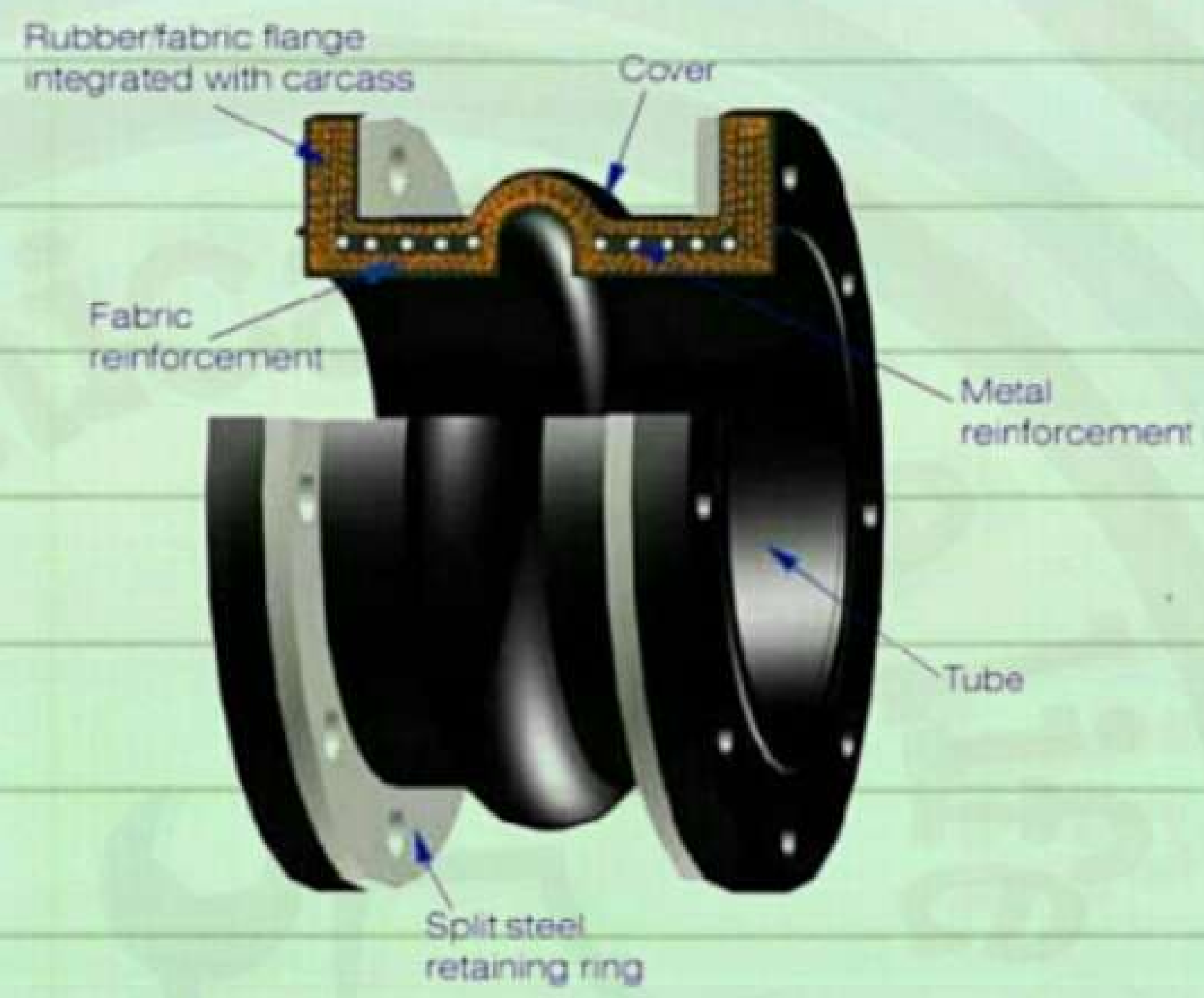
Flexible connection

Function

- Absorb and damp the vibration and noises.
- Compensate expansion caused by differances in the temprature.
- Tension reduction.
- Easily to remove when revising the pipe line

Types:

1- Rubber expansion joint



2- Stainless steel expansion joint

9

HooK Up

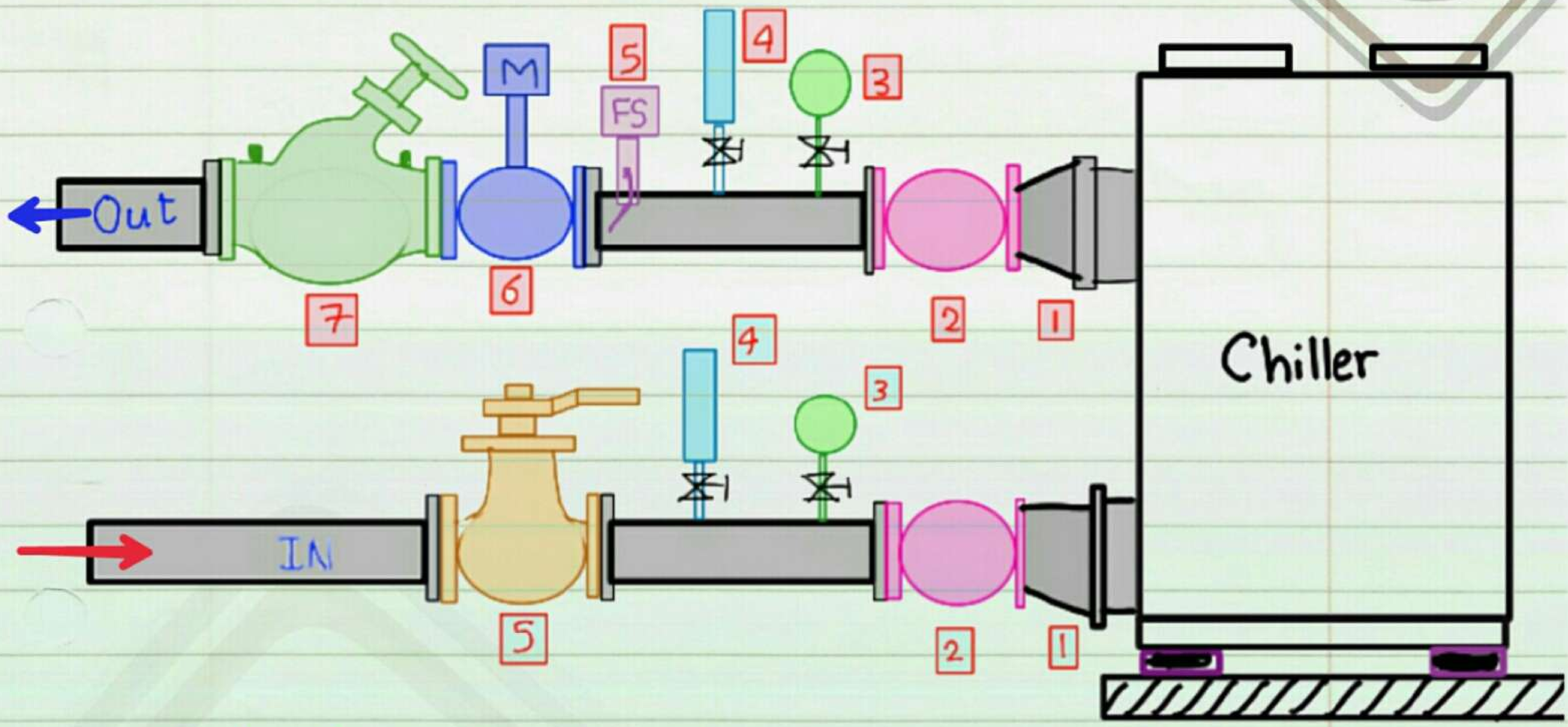
Chiller

pump

AHU

FCU

- Chiller hook up



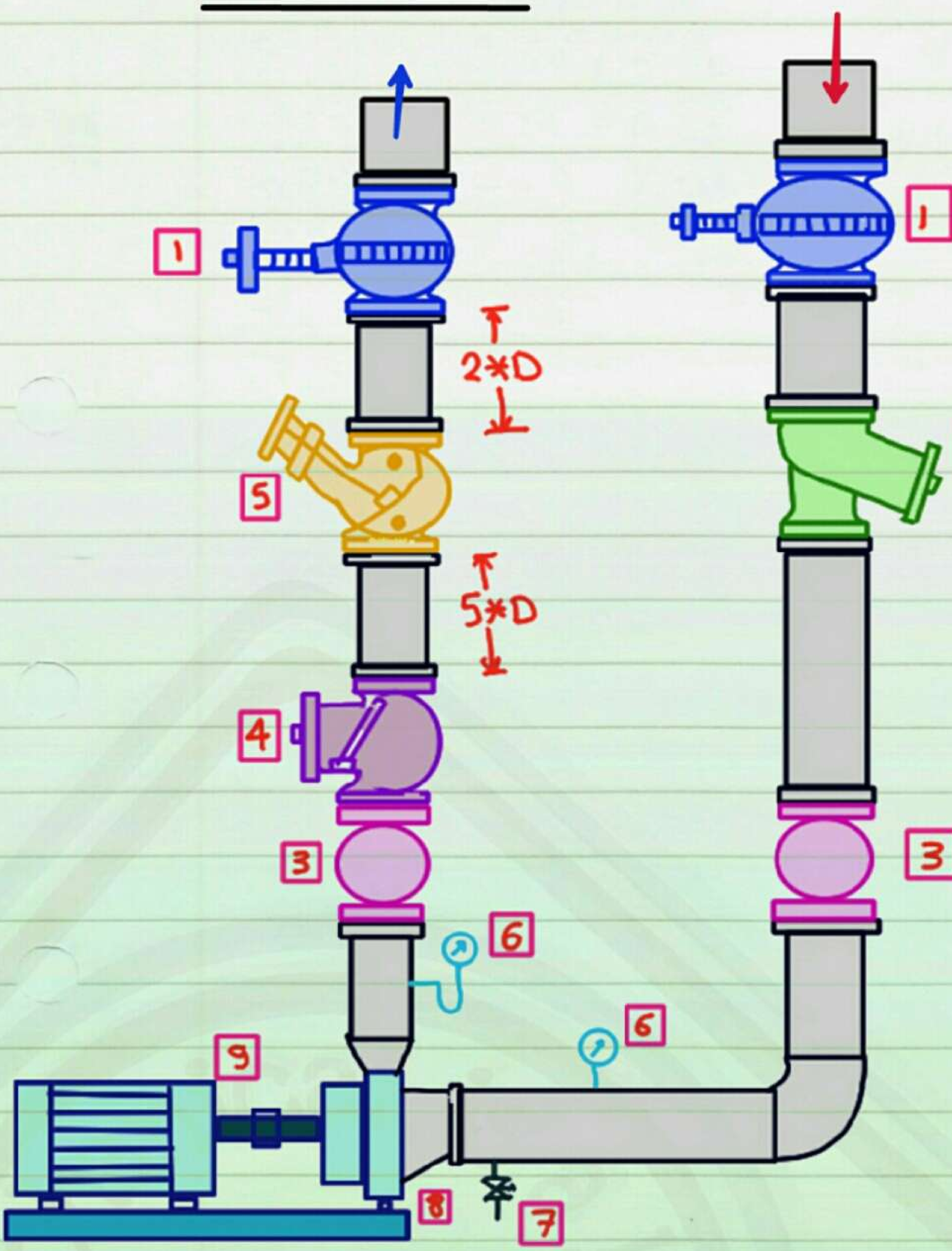
Inlet line

1- Ec centric reducer
2- Flexible joint
3- Pressure gauge
4- Thermostat
5- Isolation valve (Gate - Butterfly)

Outlet line

1- Reducer
2- Flexible joint
3- Pressure gauge
4- Thermostat
5- Flow switch
6- Isolation valve (Optional - Motorized)
7- Double regulating valve (Optional)

Pump hook up



Inlet line

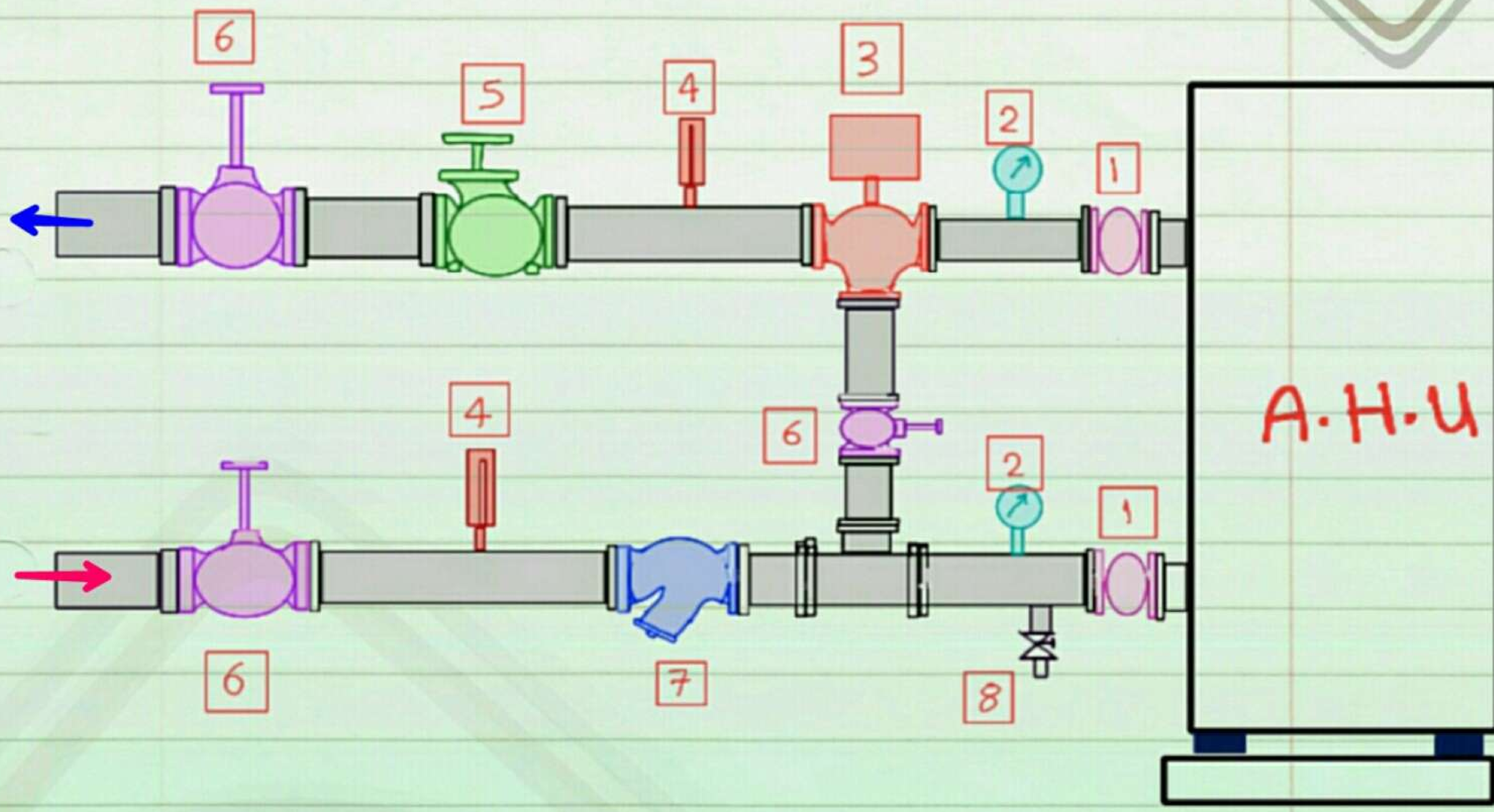
1- Gate valve
2- Strainer
3- Flexible joint
6- Pressure gauge
7- Drain valve
8- Ec centric reducer

Outlet line

1- Gate valve
3- Flexible joint
4- Check valve
5- Balance valve (Optional)
6- Pressure gauge

Air Handling Unit (AHU)

With 3 Way valve



Outlet line

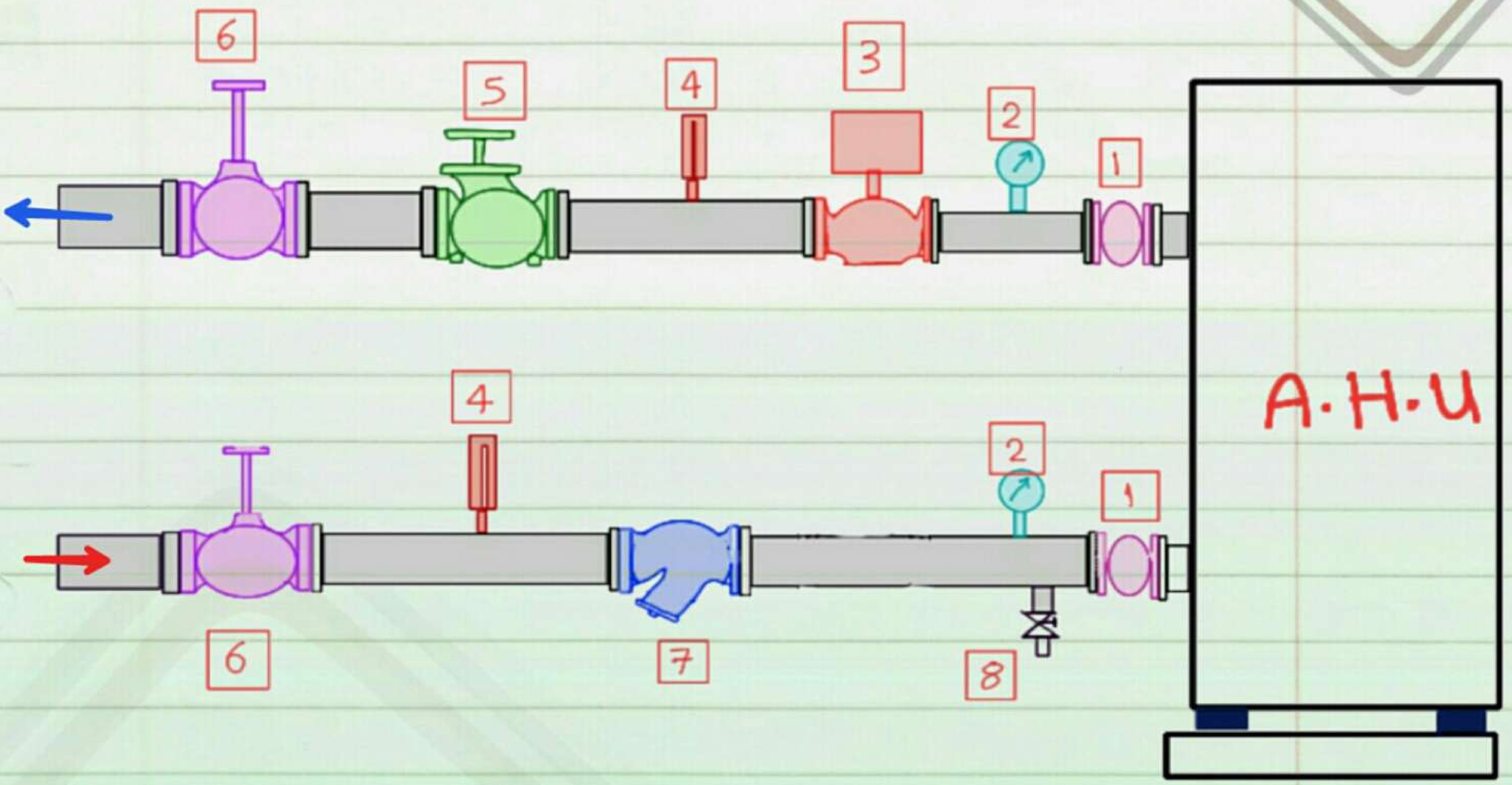
1- Flexible joint
2- Pressure gauge
3- 3 Way valve
4- Thermostat
5- Balance valve
6- Gate valve

Inlet line

1- Flexible joint
2- Pressure gauge
4- Thermostat
6- Gate valve
7- Y Strainer
8- Drain valve

Air Handling Unit (AHU)

With 2 way valve



Outlet line

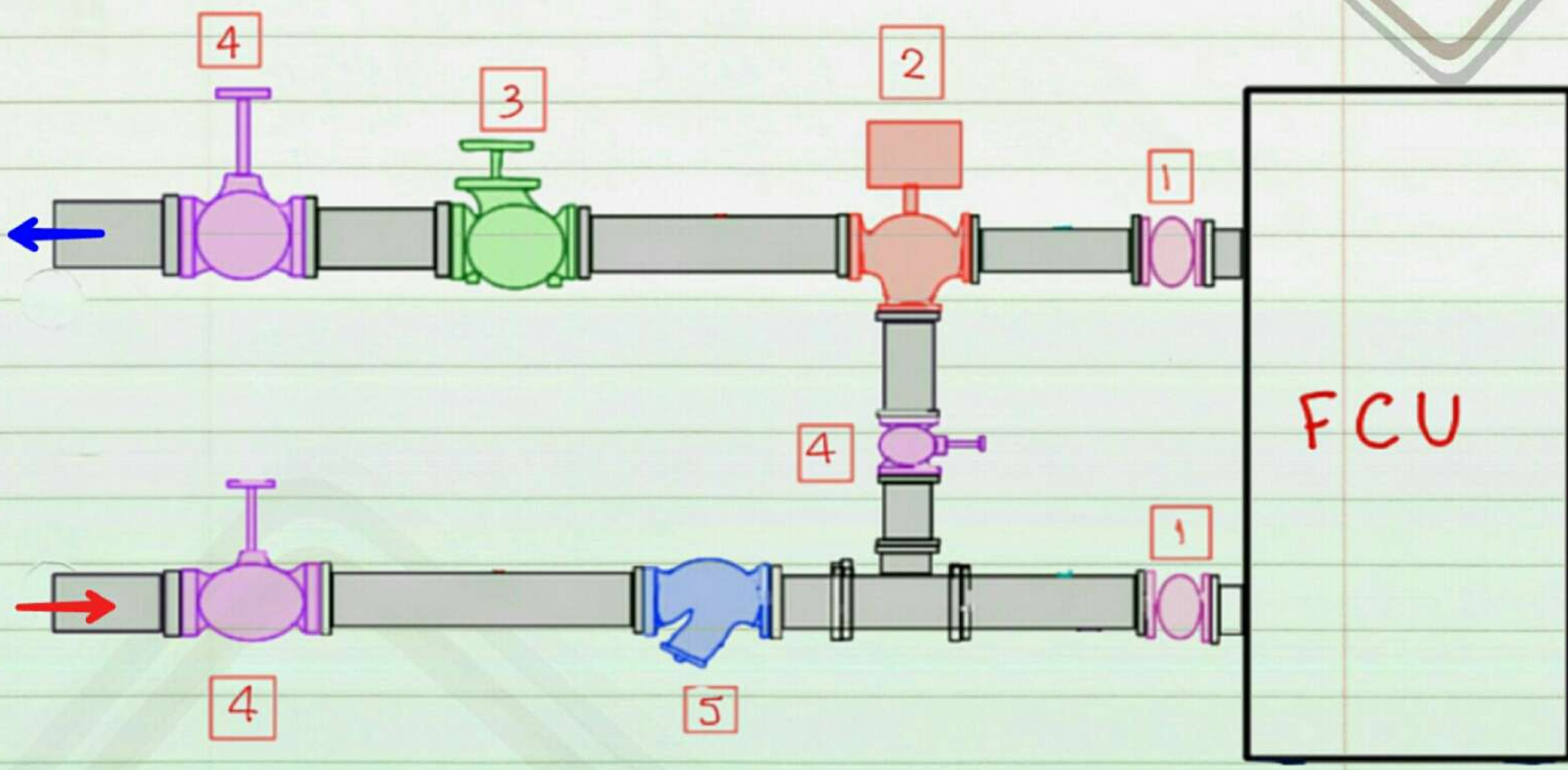
1- Flexible joint
2- Pressure gauge
3- 2 Way valve
4- Thermostat
5- Balance valve
6- Gate valve

Inlet line

1- Flexible joint
2- Pressure gauge
4- Thermostat
6- Gate valve
7- Y Strainer
8- Drain valve

Fan Coil Unit (FCU)

With 3 way valve



Outlet line

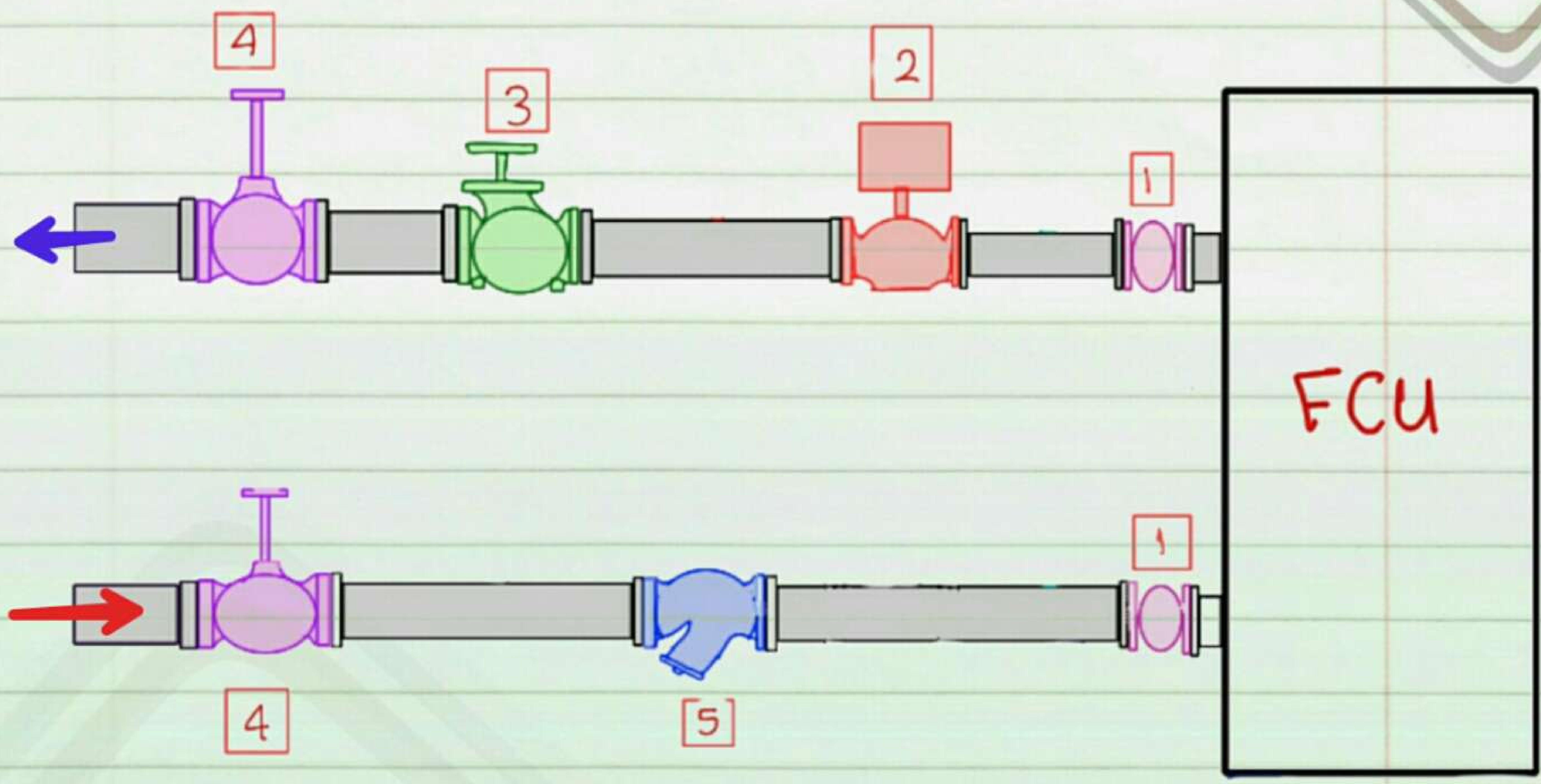
1- Flexible joint
2- 3 Way valve
3- Balance valve
4- Gate valve

Inlet line

1- Flexible joint
4- Gate valve
5- Y Strainer

Fan Coil Unit (FCU)

With 2 Way valve



Outlet line

1- Flexible joint
2- 2 Way valve
3- Balance valve
4- Gate valve

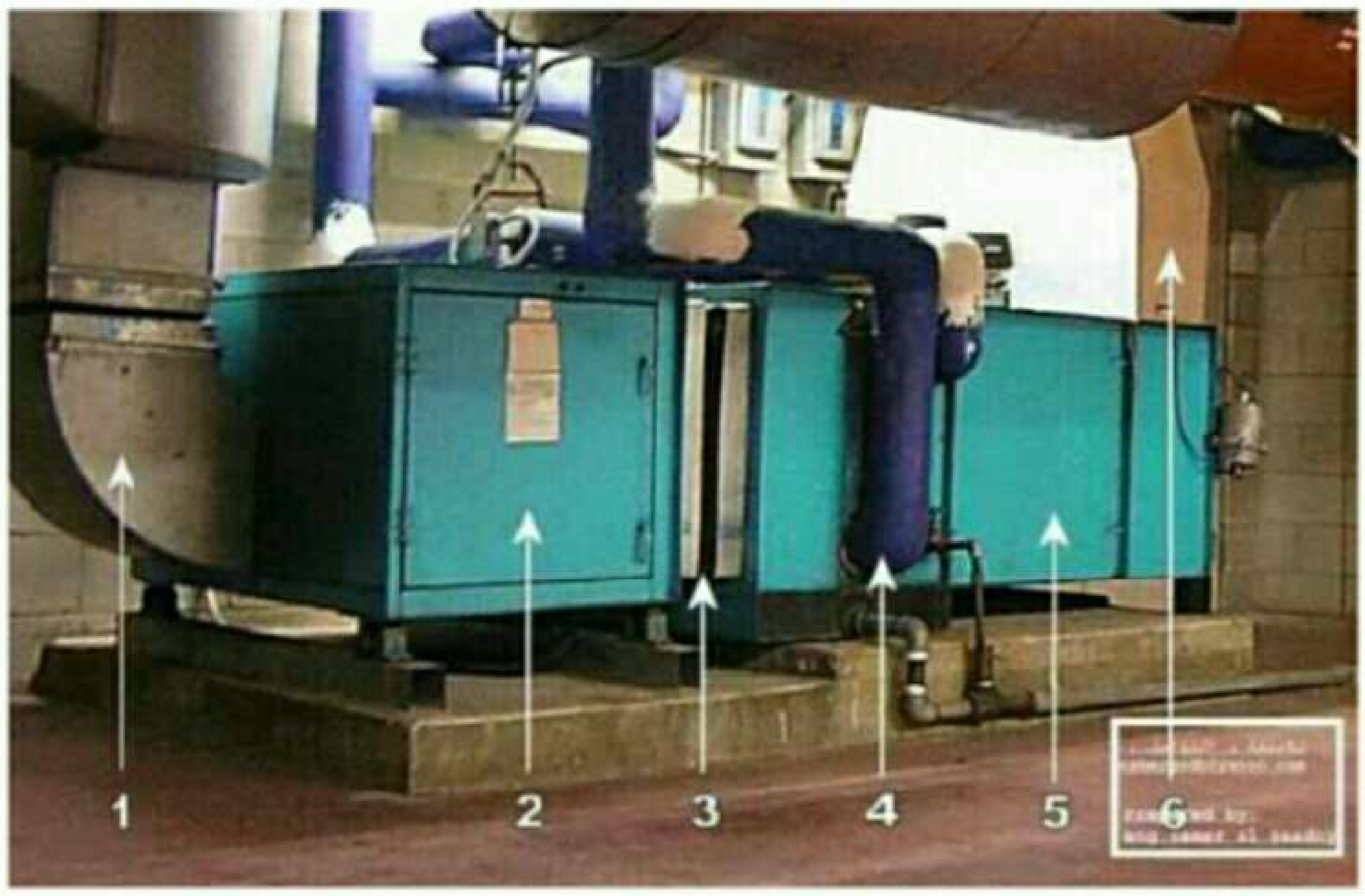
Inlet line

1- Flexible joint
4- Gate valve
5- Y Strainer

10

Photo From Real Site

AHU



FCU

Flexible joint

Pressure gauge

Gate valve

Flow switch

Y Strainer

Globe - Balance valve

Check valve

Ball valve

3 way valve for AHU

2 way valve, Pressure gauge & Thermometer in AHU

3 way valve in FCU

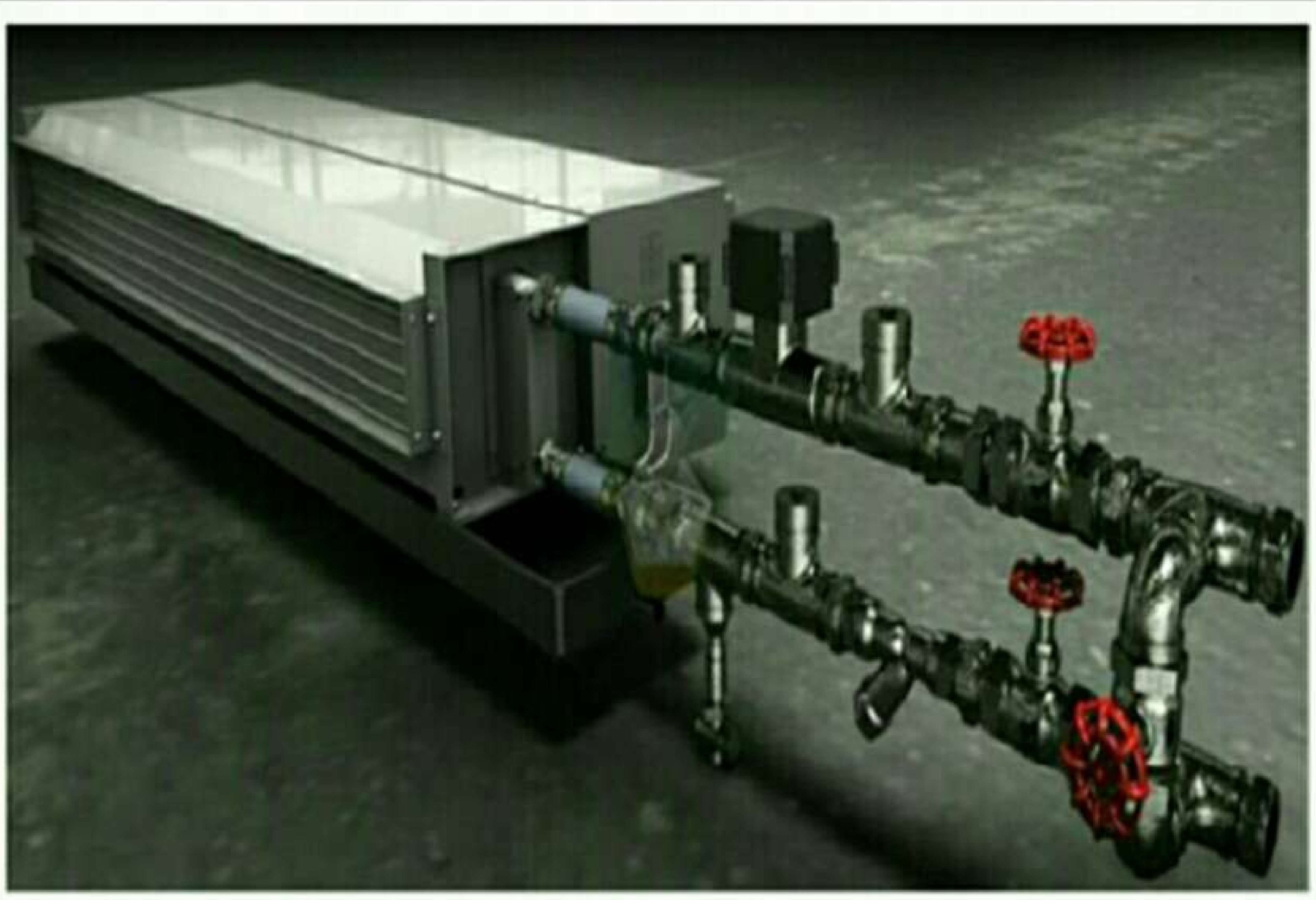
Butter fly valve

Chiller hook up

Pump hook up

AHU HOOK UP

AHU HOOK UP



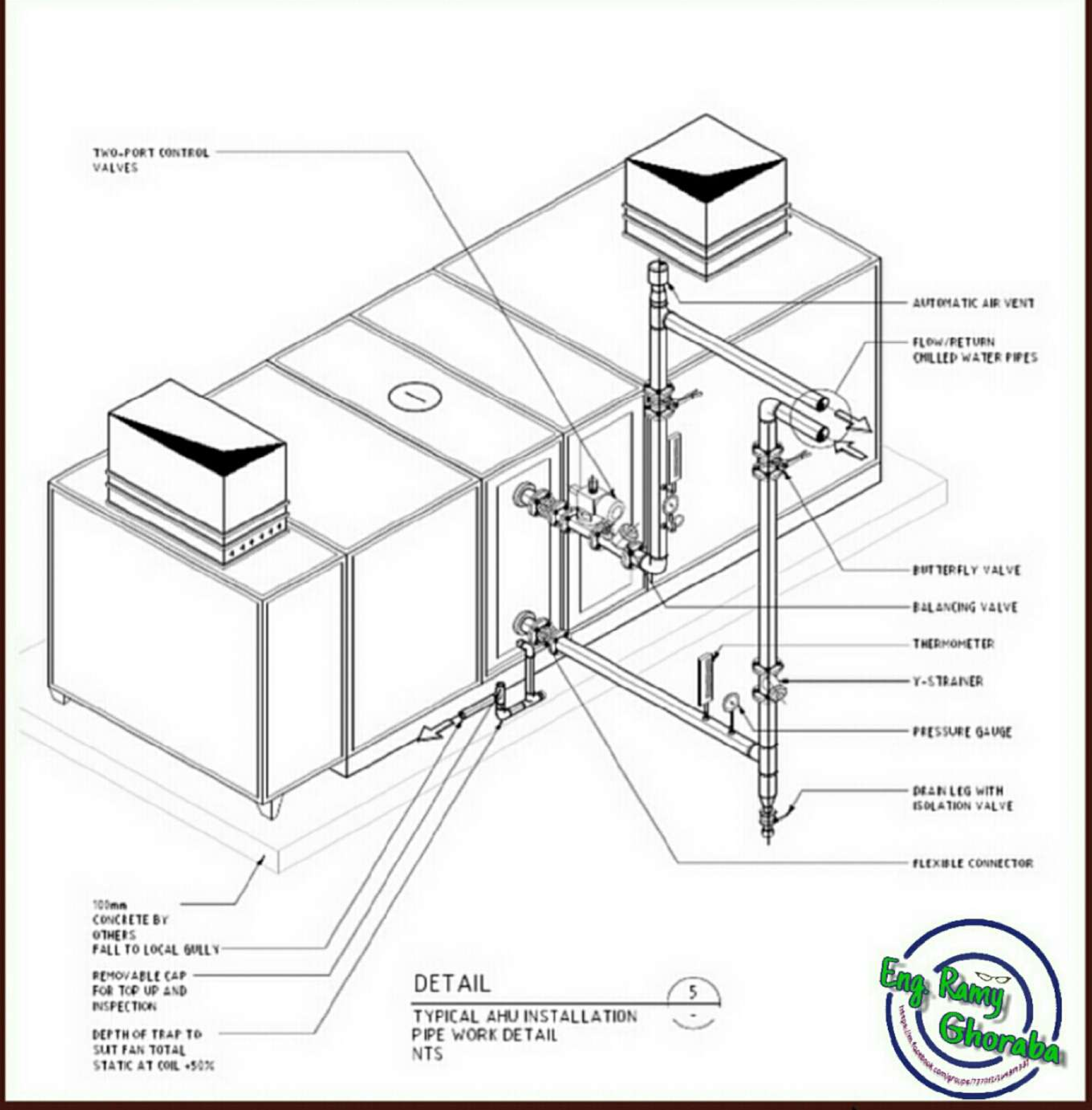
FCU HOOK UP

11

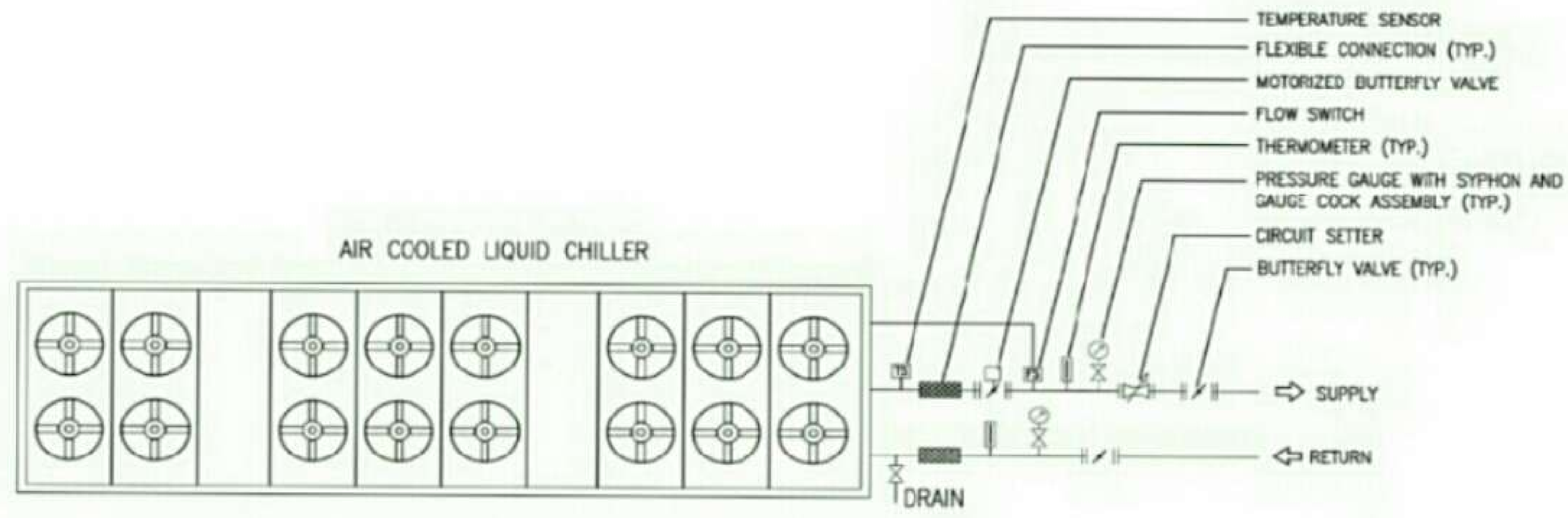
Symbol From IFC Drawing

Eng. Ramy Ghoraba

Isometric for AHU hook up

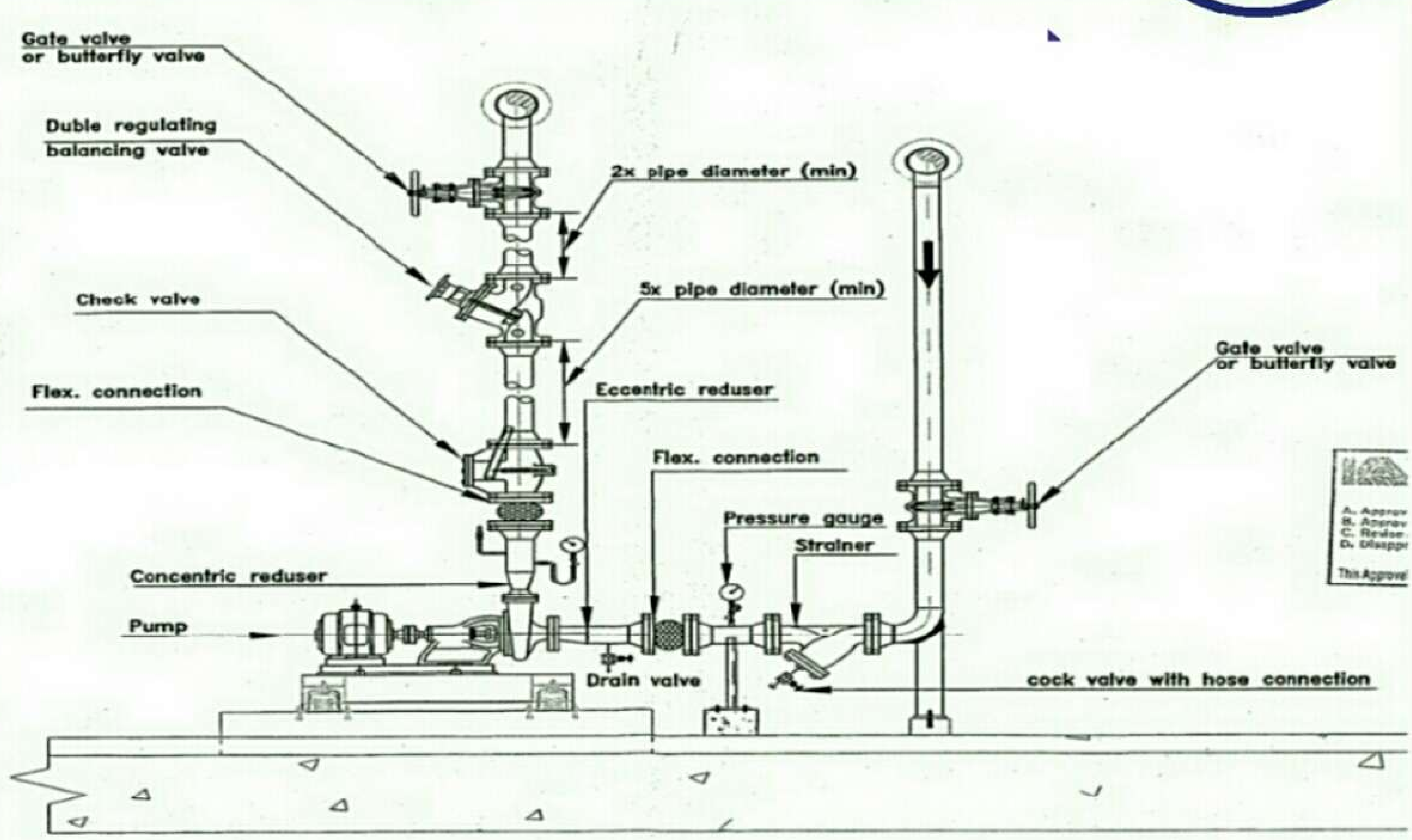


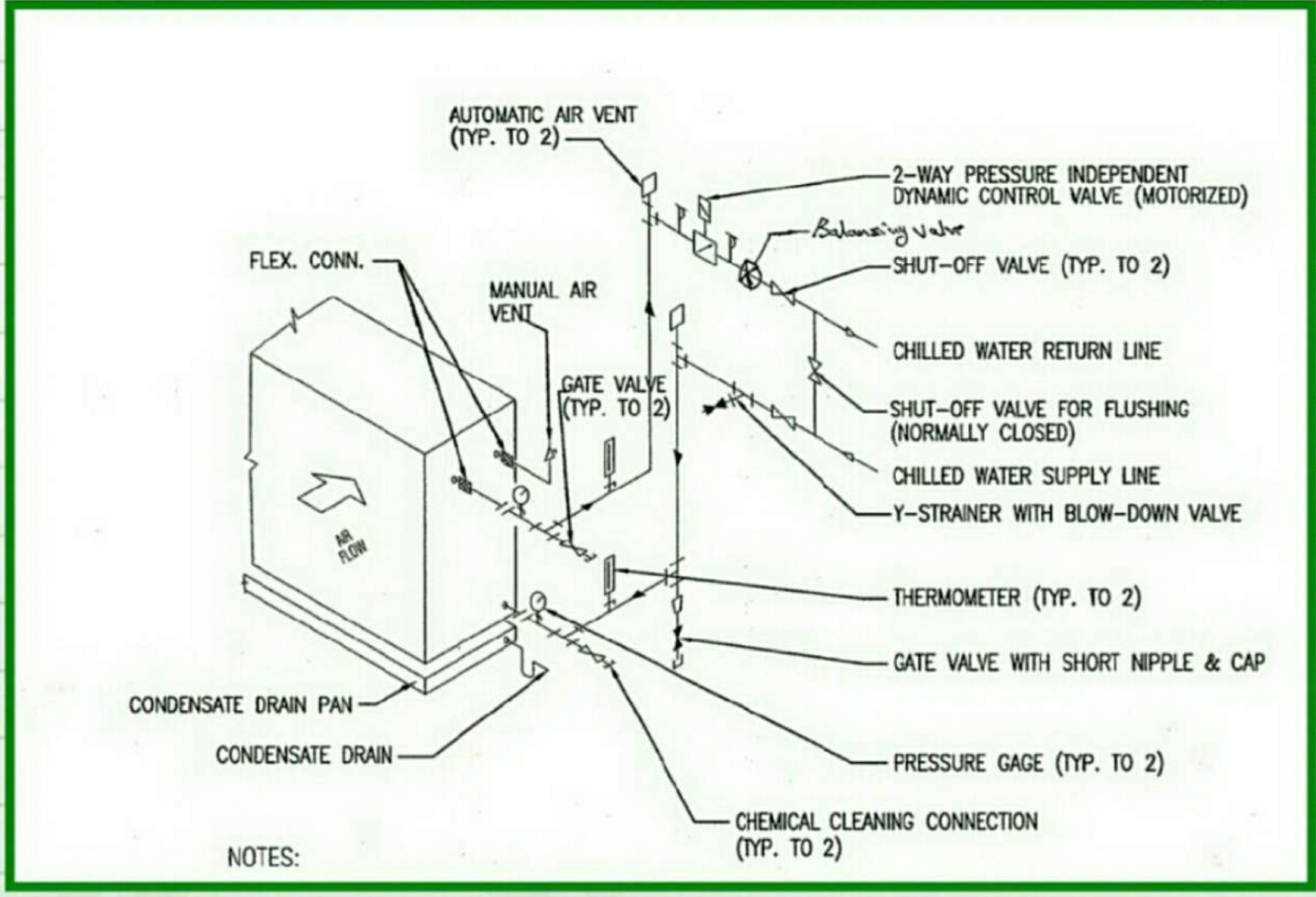
Chiller hook up



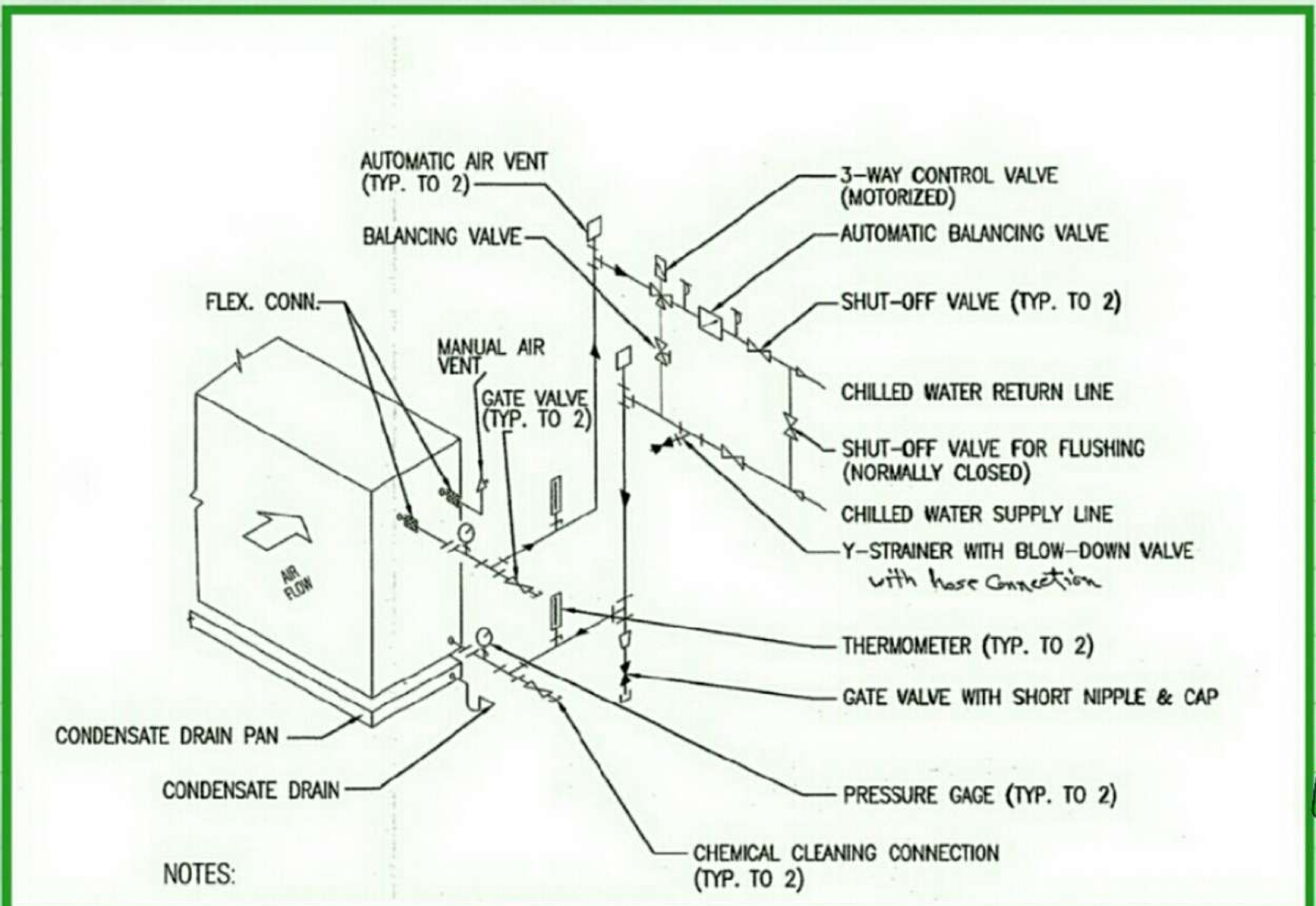
6 GM006 CHILLER AND PIPING ARRANGEMENT
NTS

Pump hook up





2 way valve connection for AHU & FCU



3 way valve connection for AHU & FCU

PART 03

Duct Construction

By:

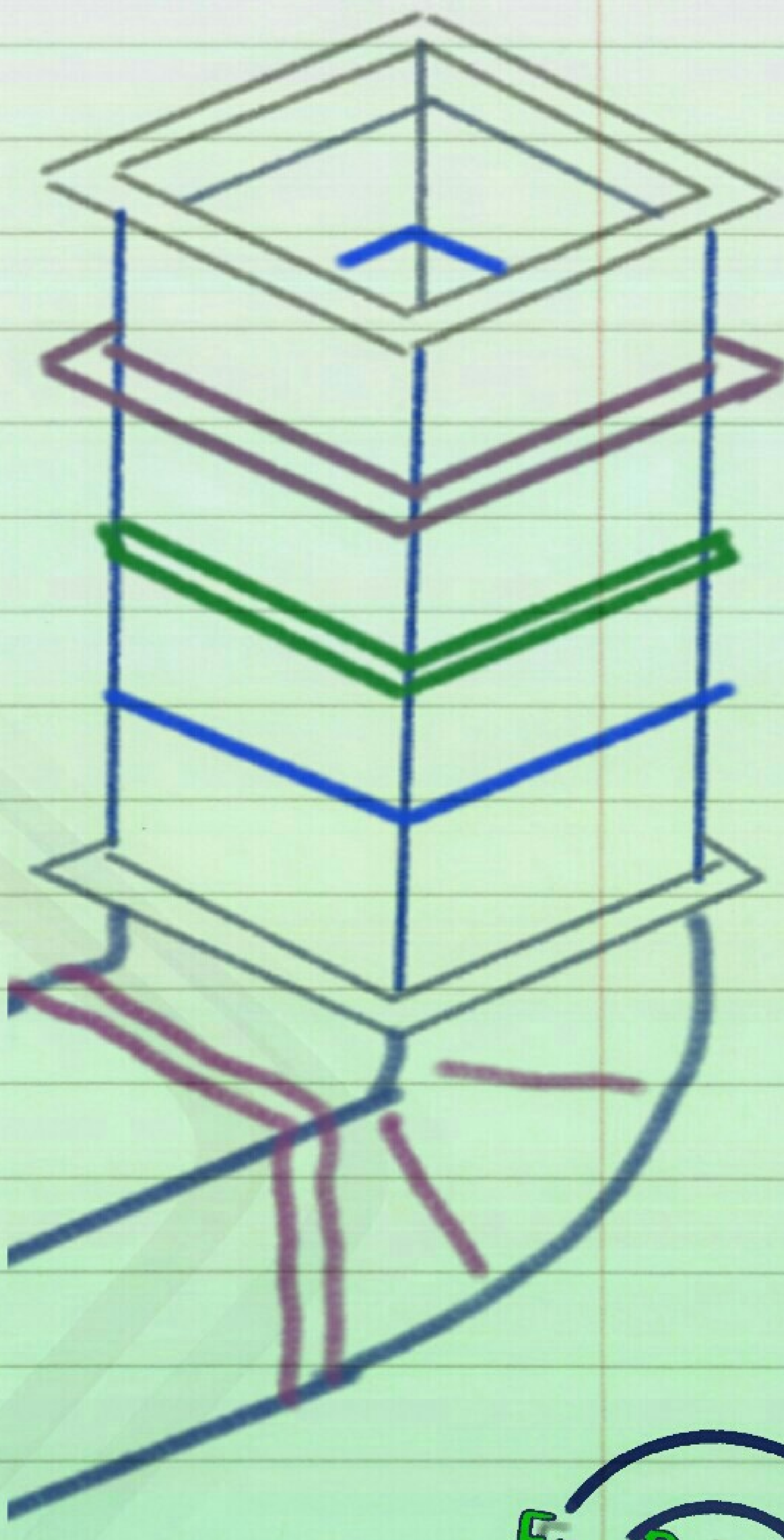
Eng. Ramy Ghoraba

Content

9. Dampers

① Duct

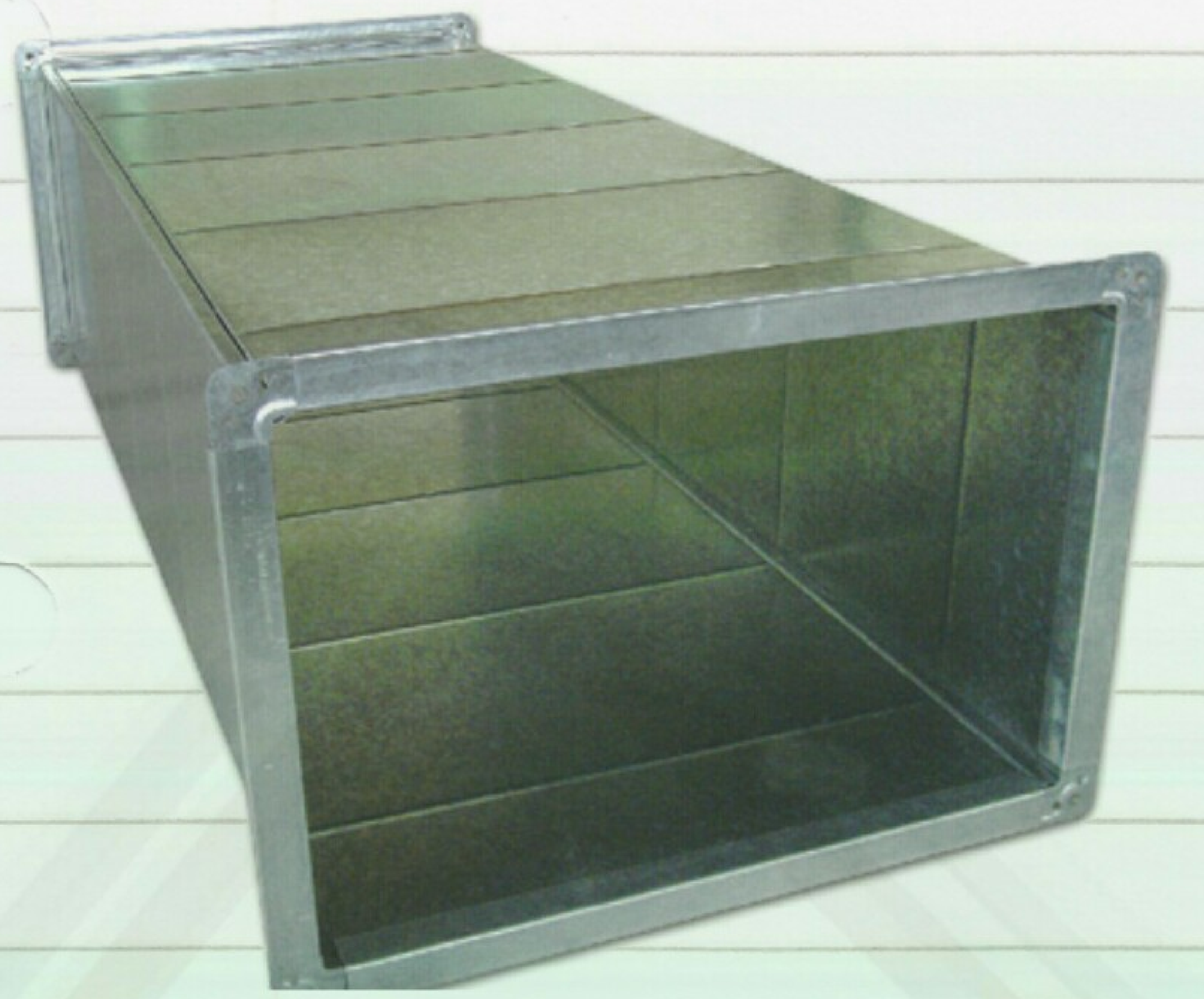
- Types
- Joints
- Gauges

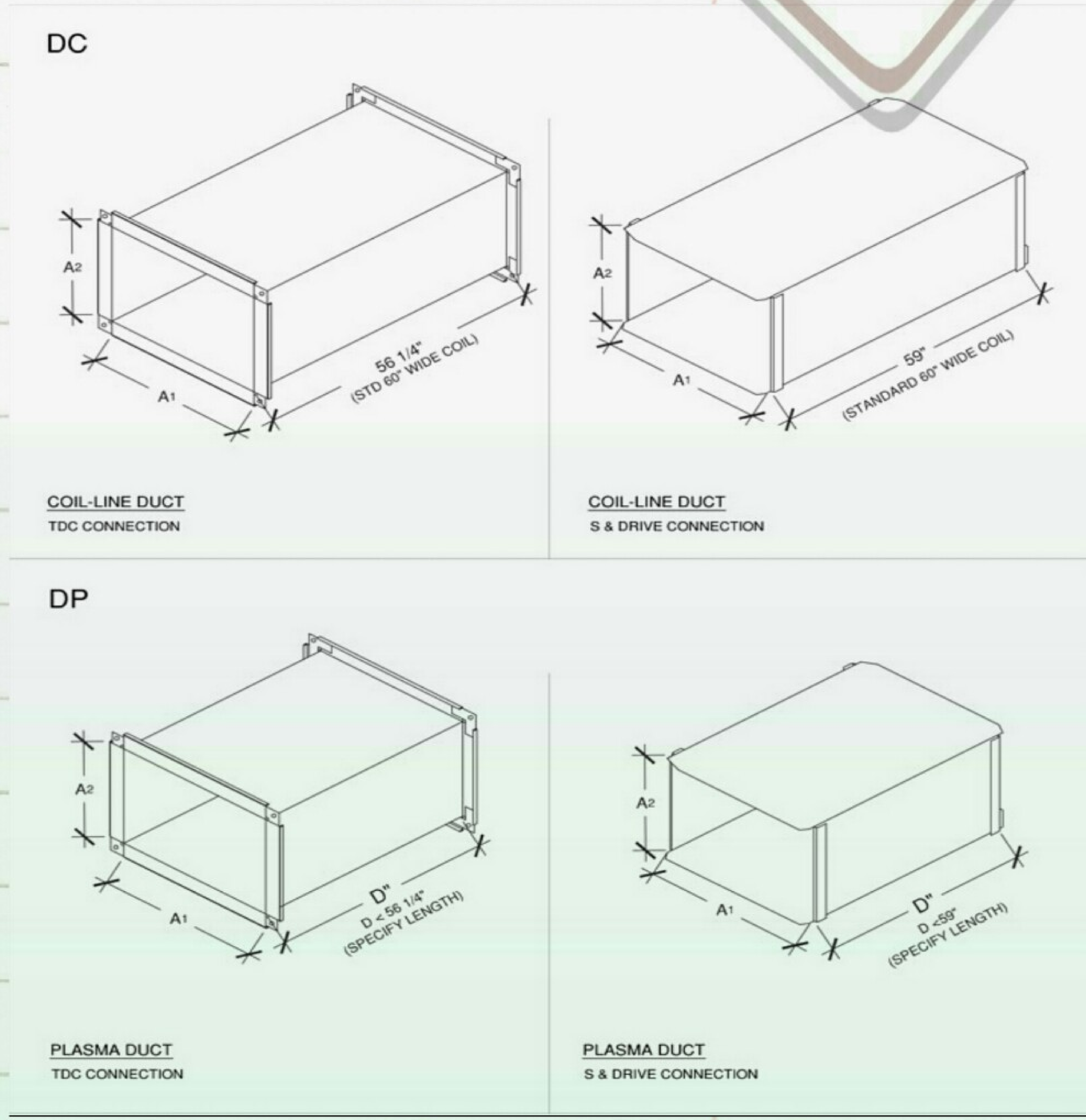


3 Duct Construction

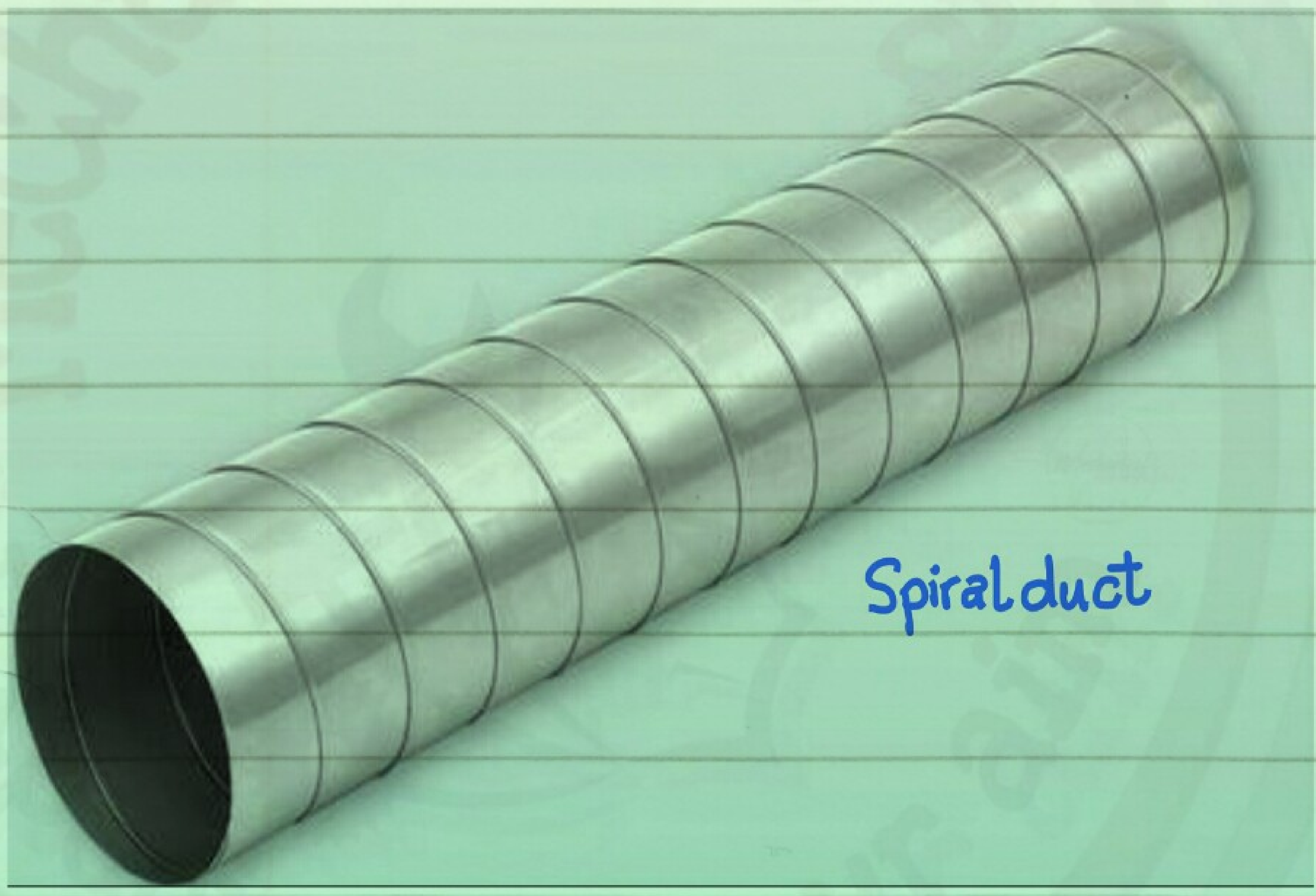
A Duct

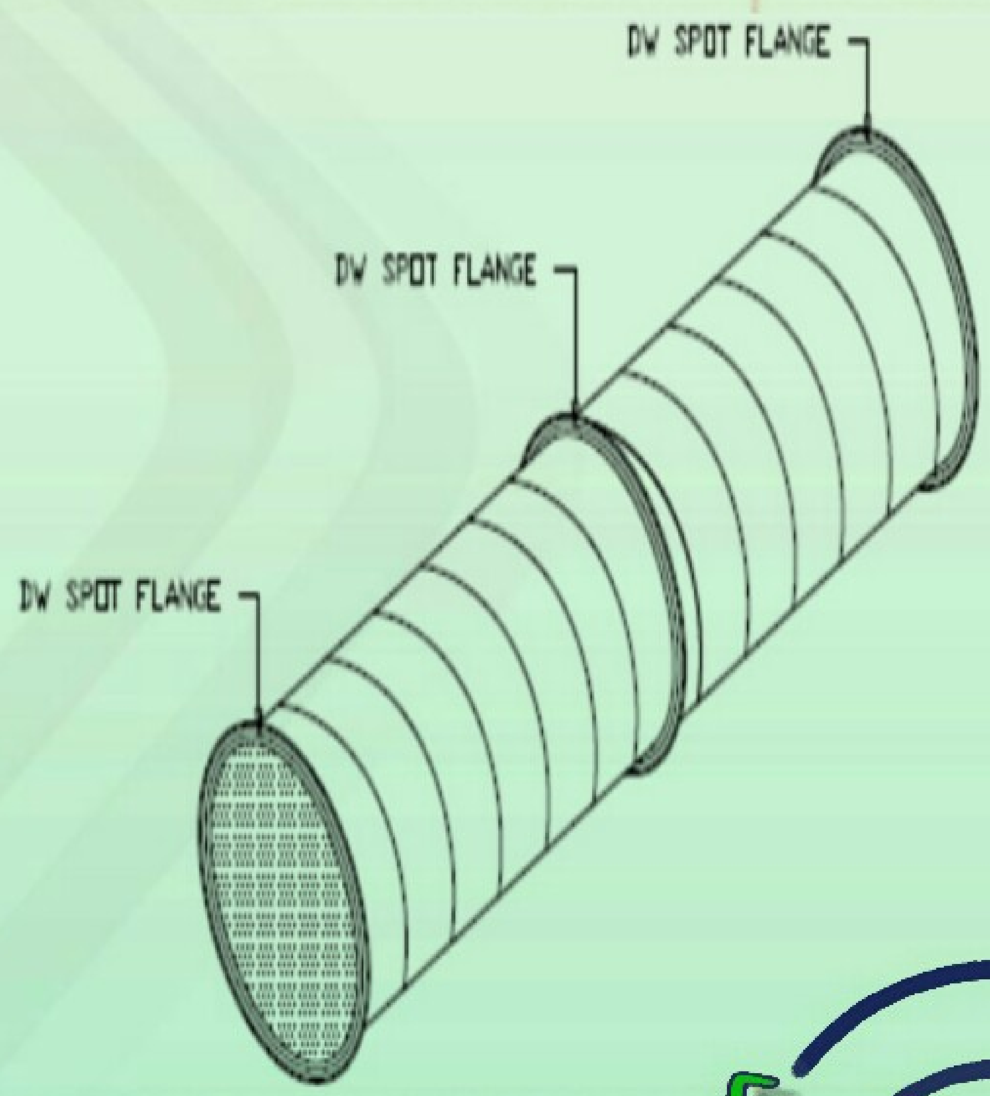
1- Rectangular Duct



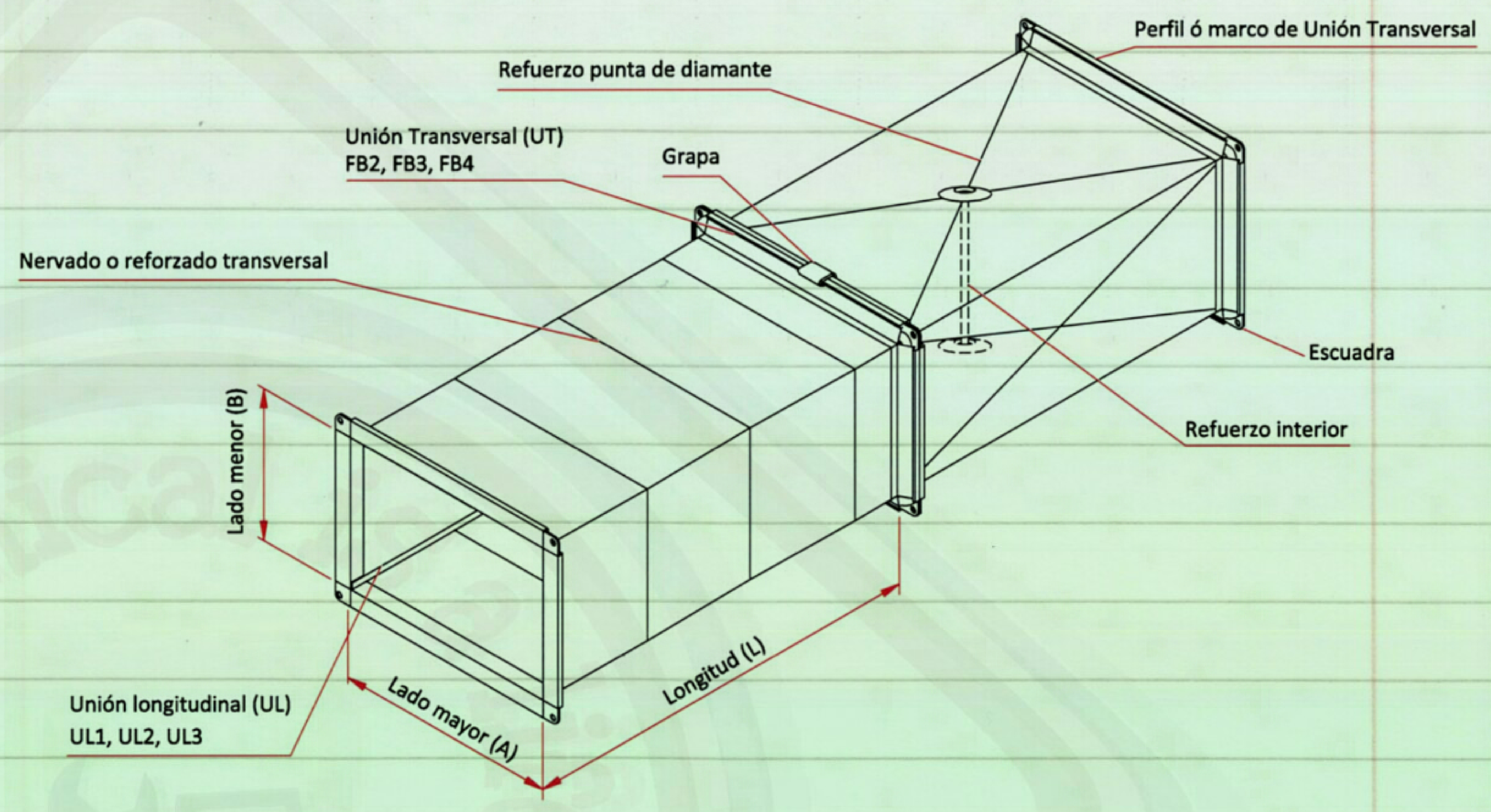


2- Spiral duct

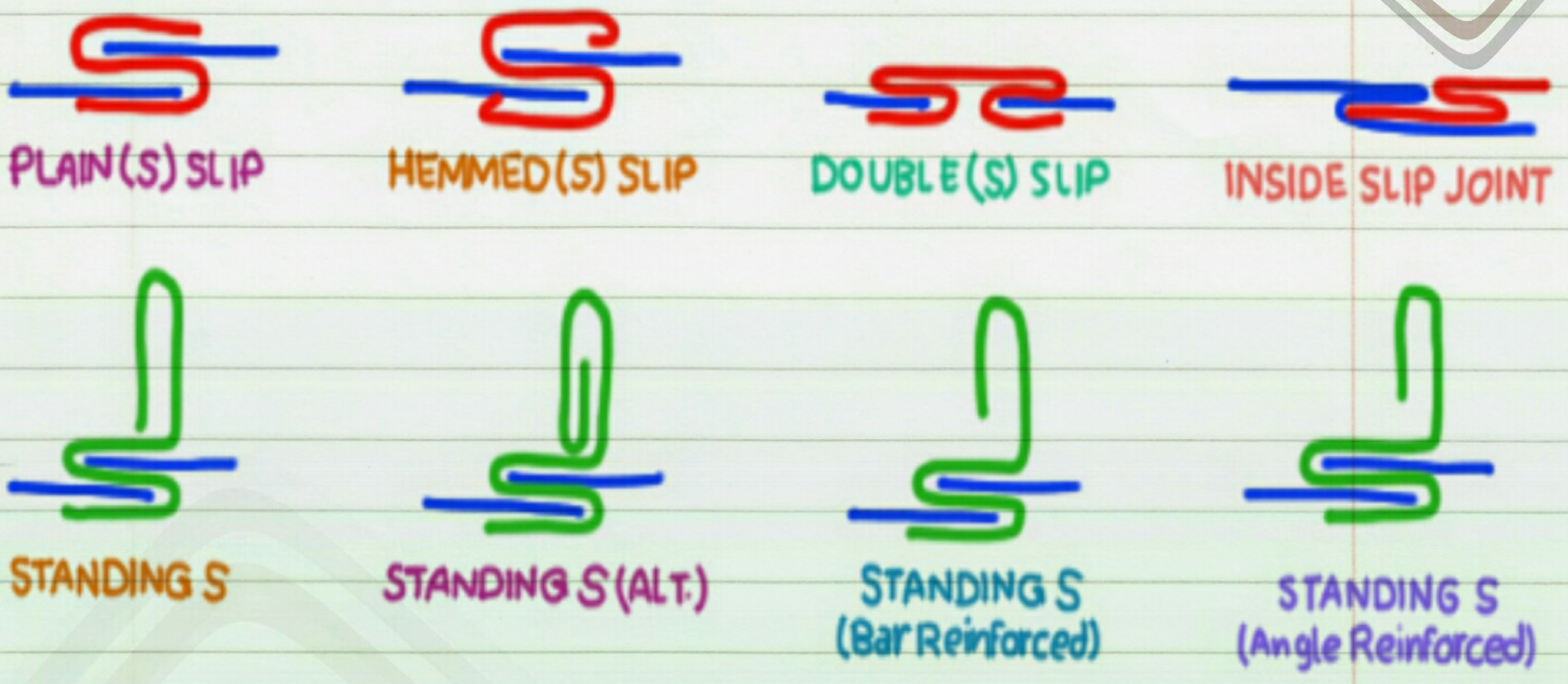




Duct joints types



Rectangular duct joints



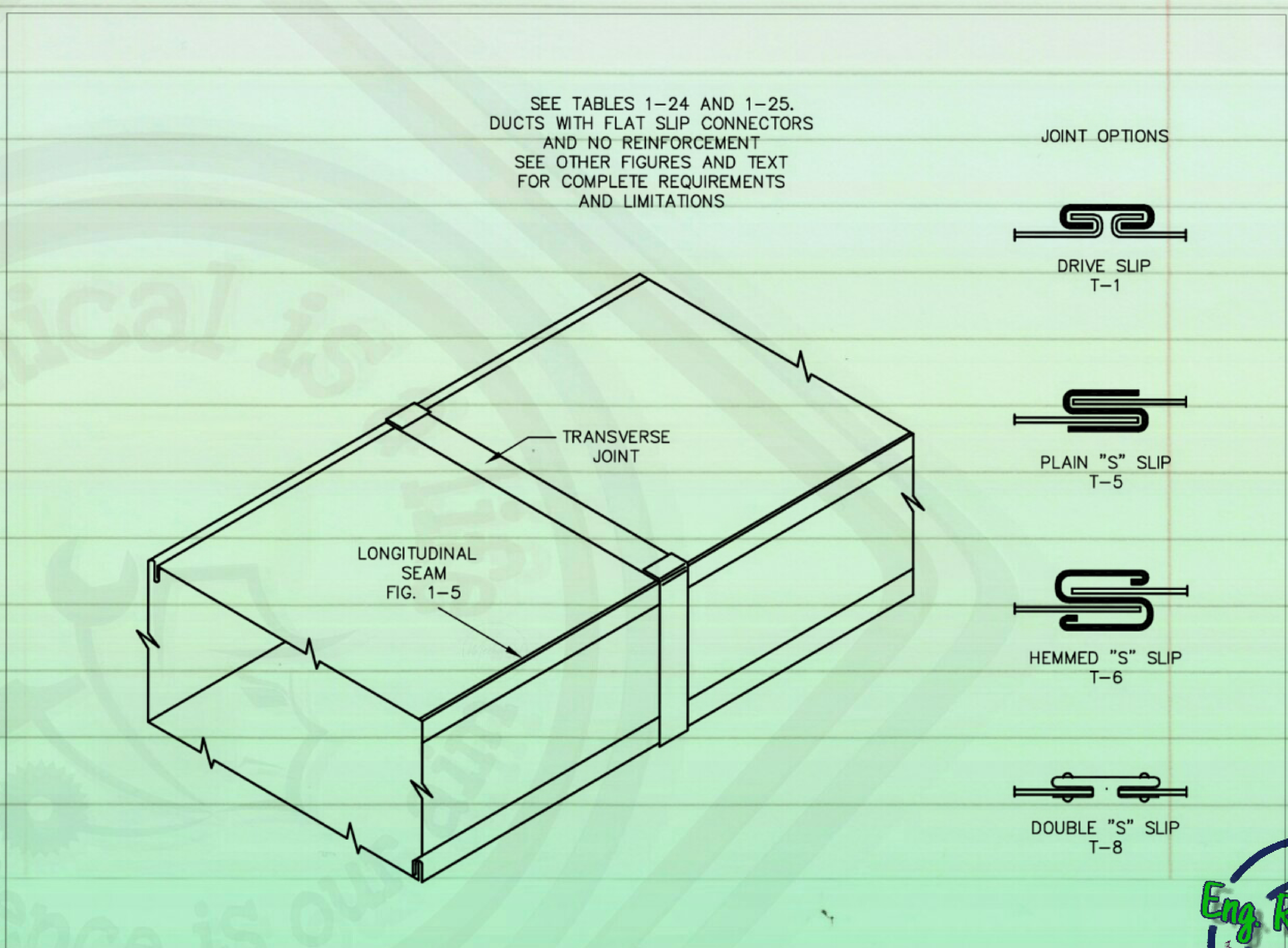


FIGURE 1-7 UNREINFORCED DUCT

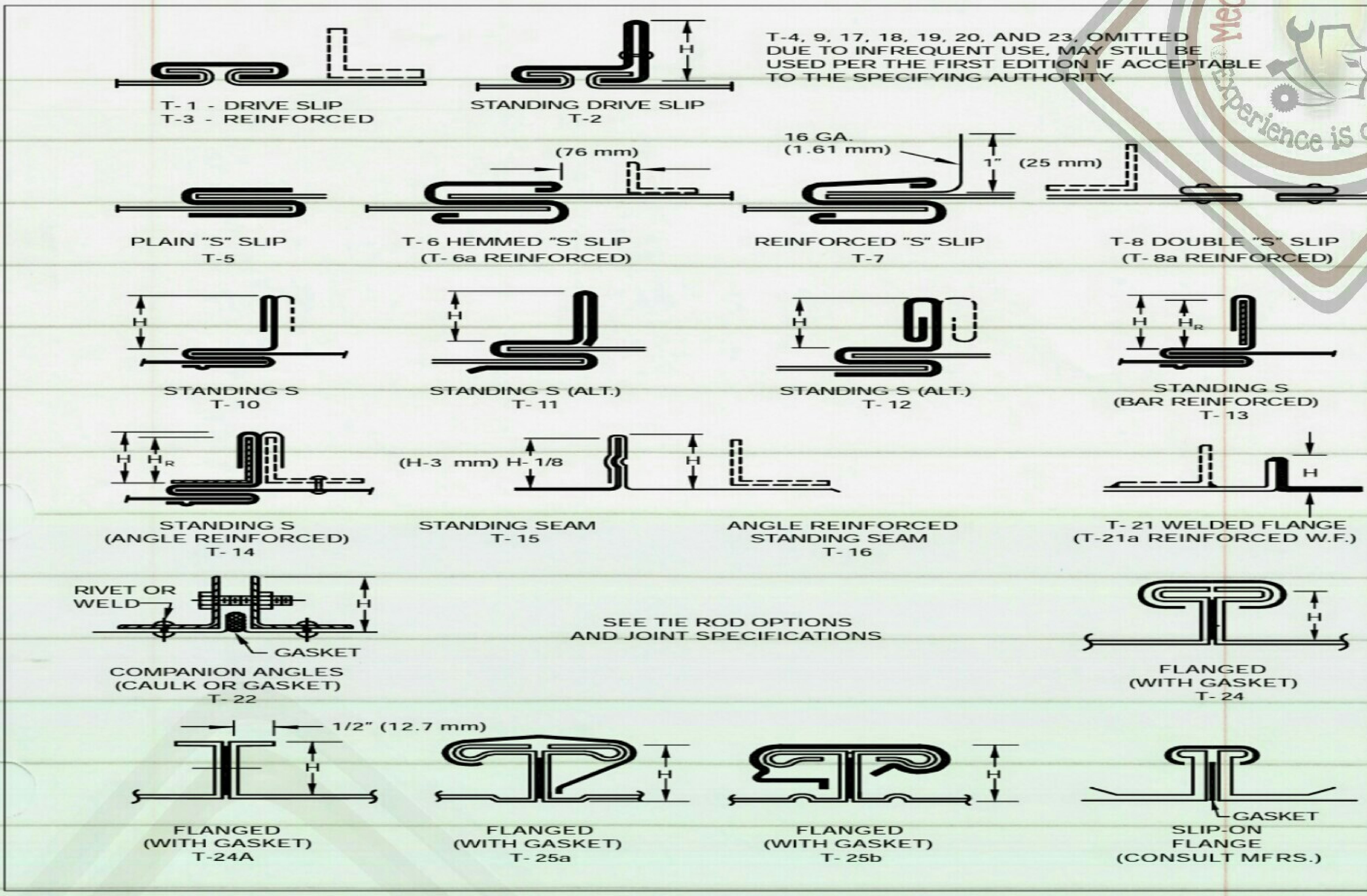


FIGURE 1-4 TRANSVERSE (GIRTH) JOINTS

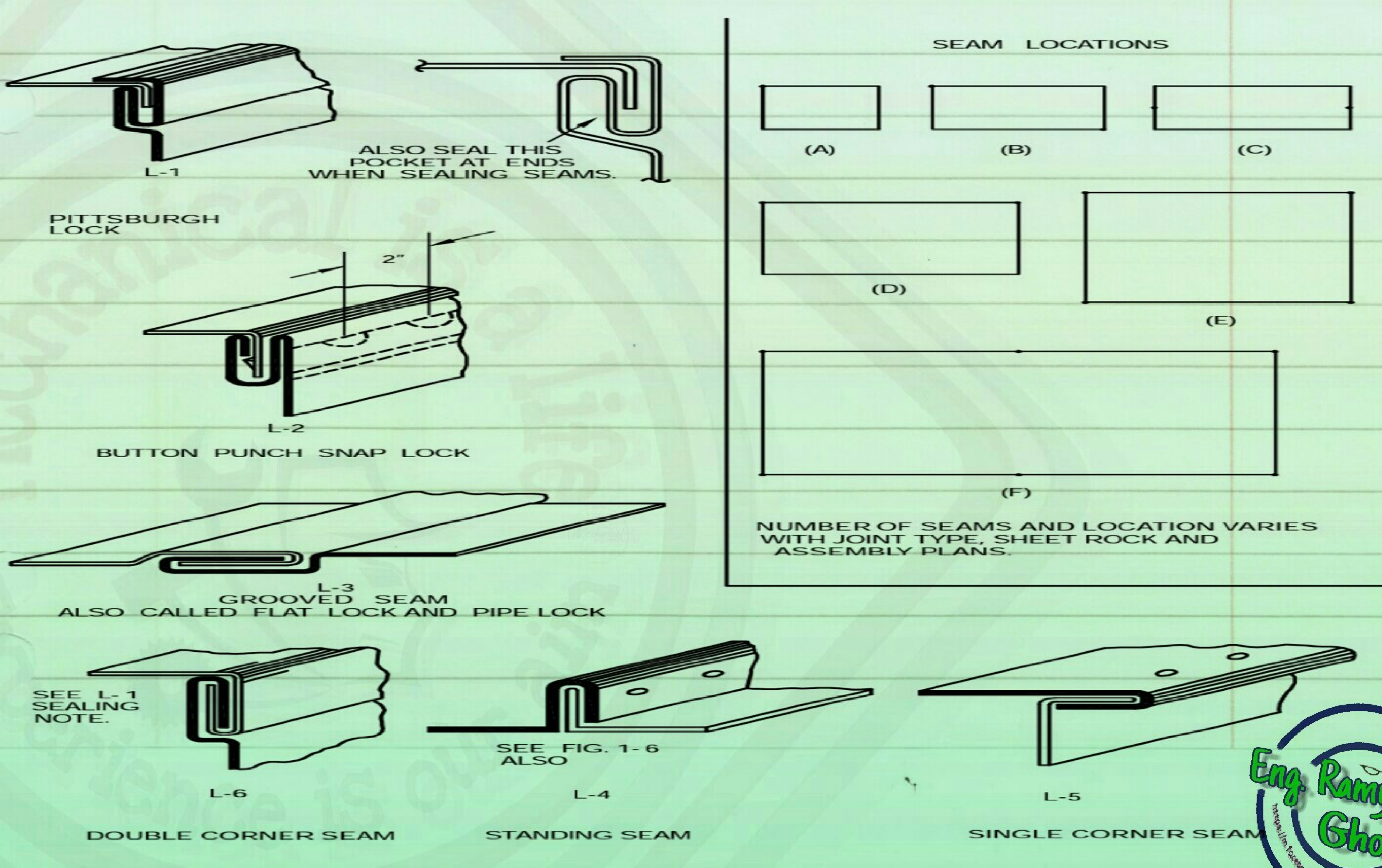


FIGURE 1-5 LONGITUDINAL SEAMS - RECTANGULAL DUCT

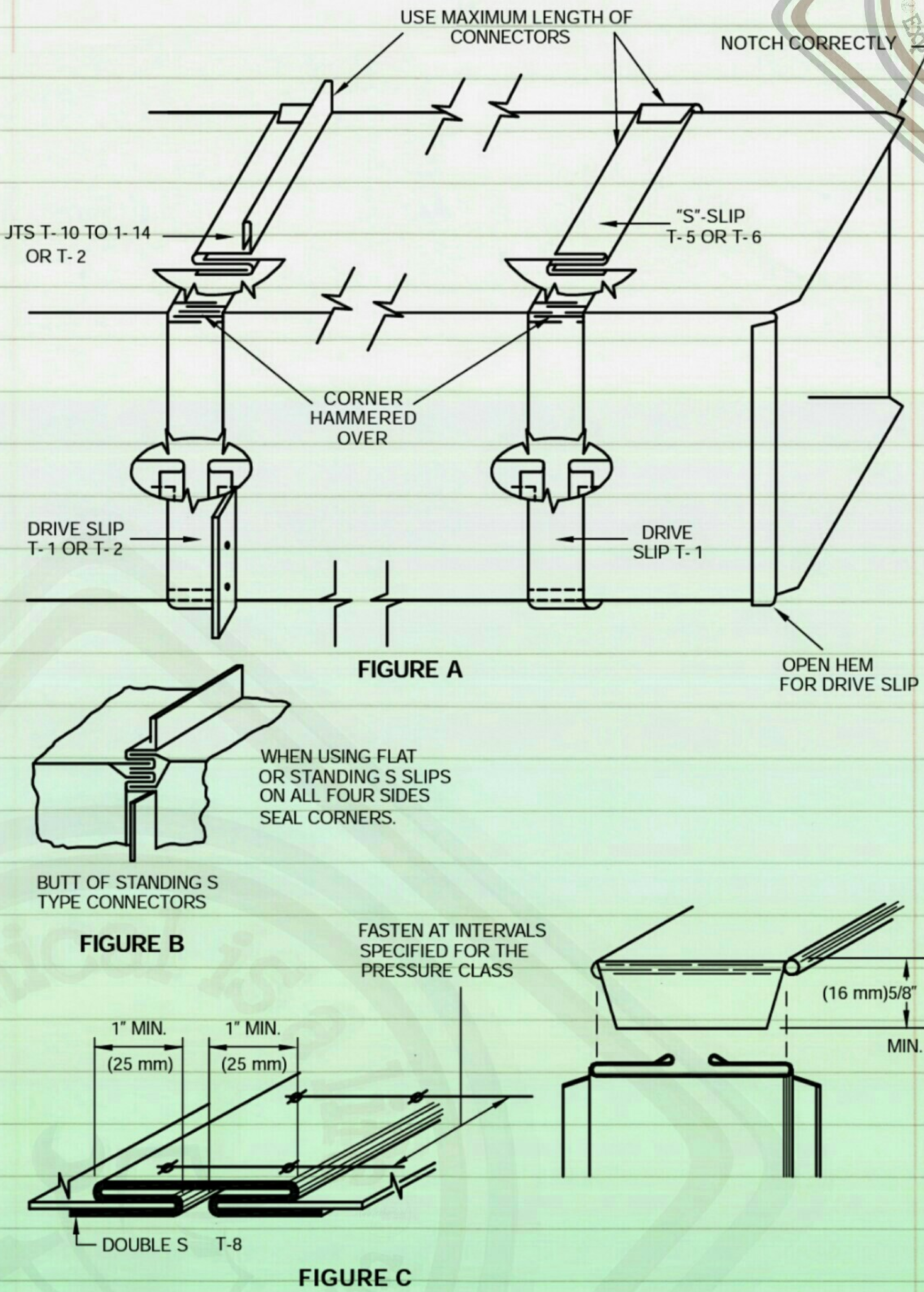


FIGURE 1-13 CORNER CLOSURES - SLIPS AND DRIVES

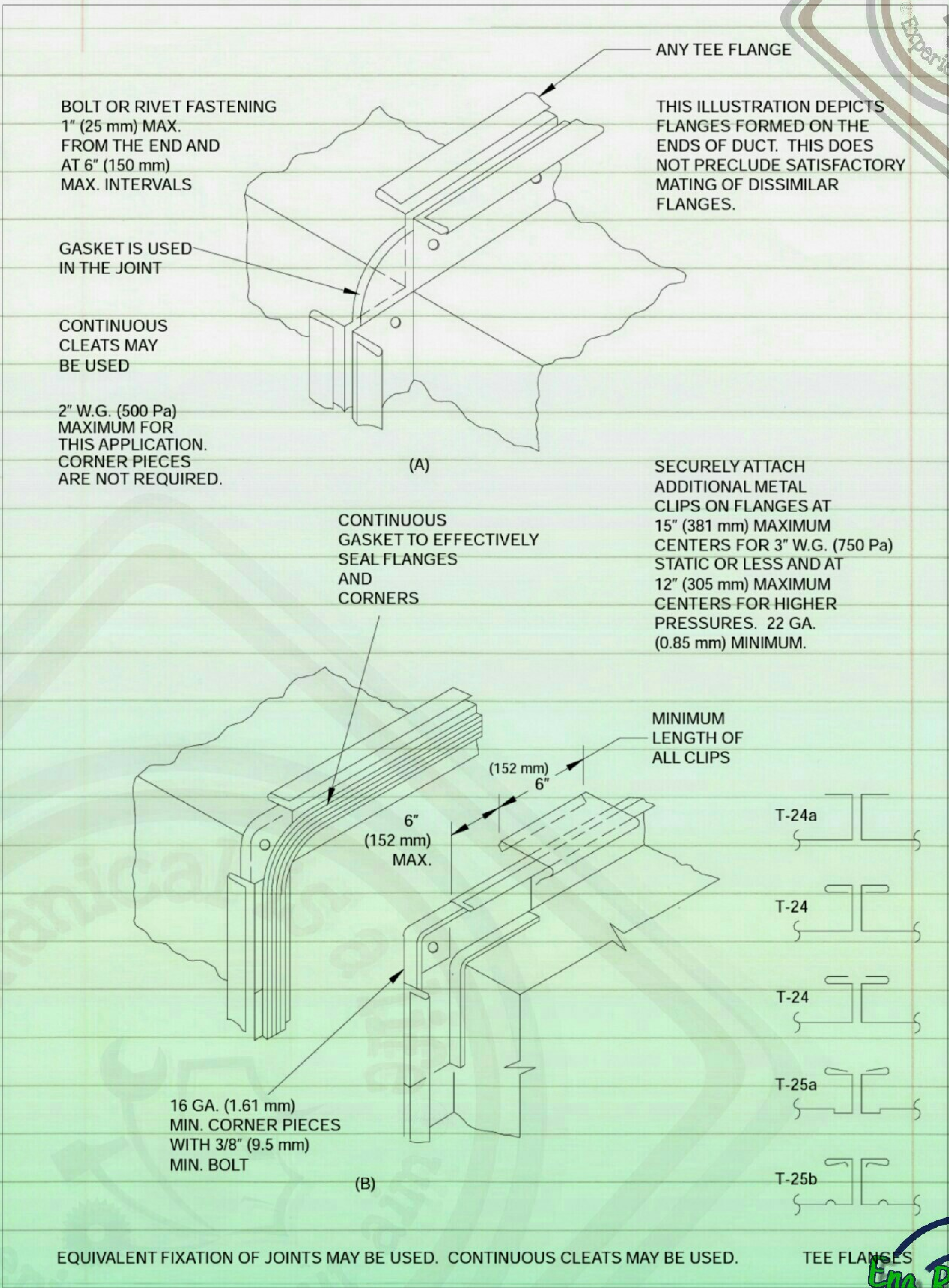
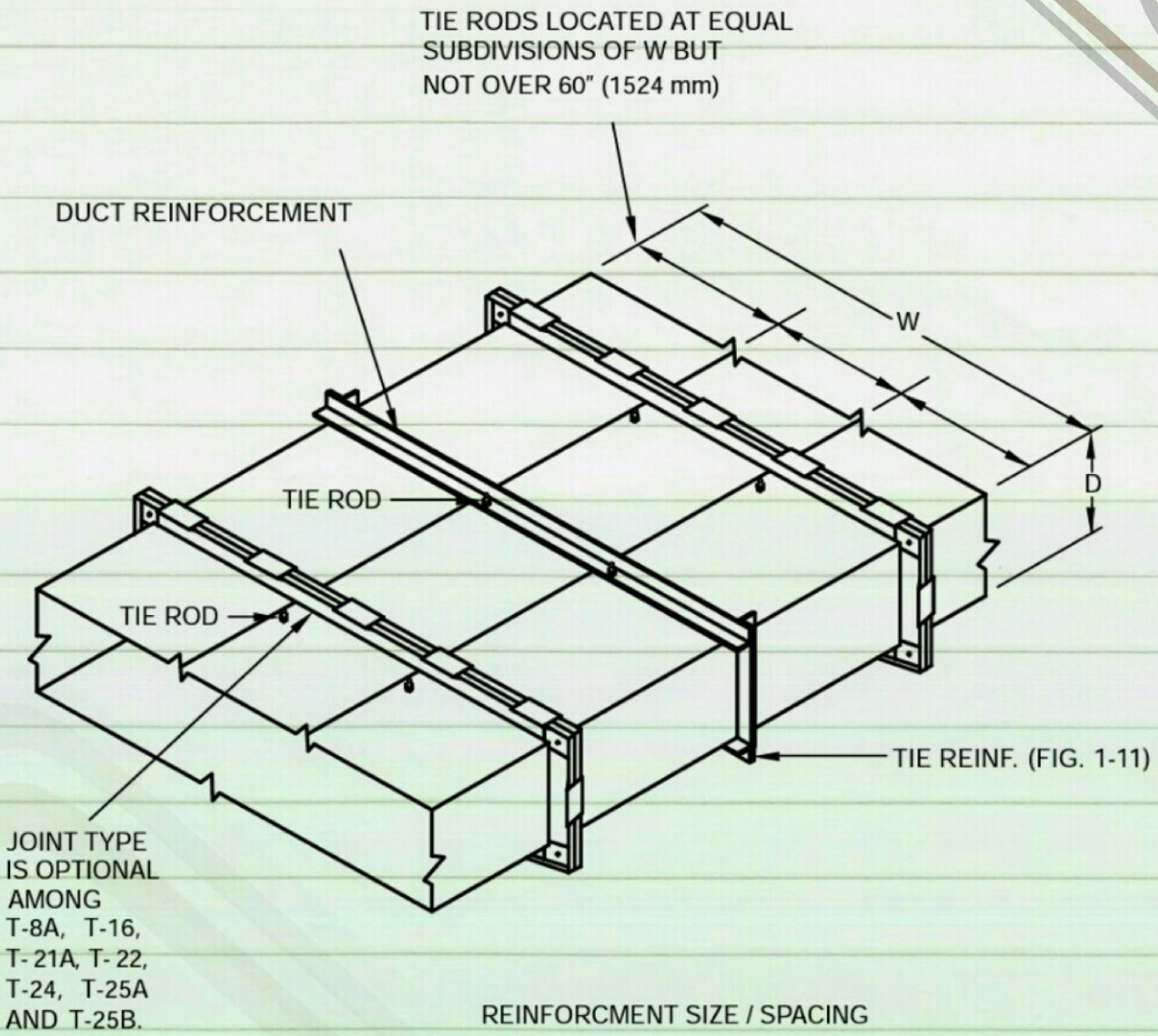


FIGURE 1-15 CORNER CLOSURES - FLANGES



REINFORCMENT SIZE / SPACING

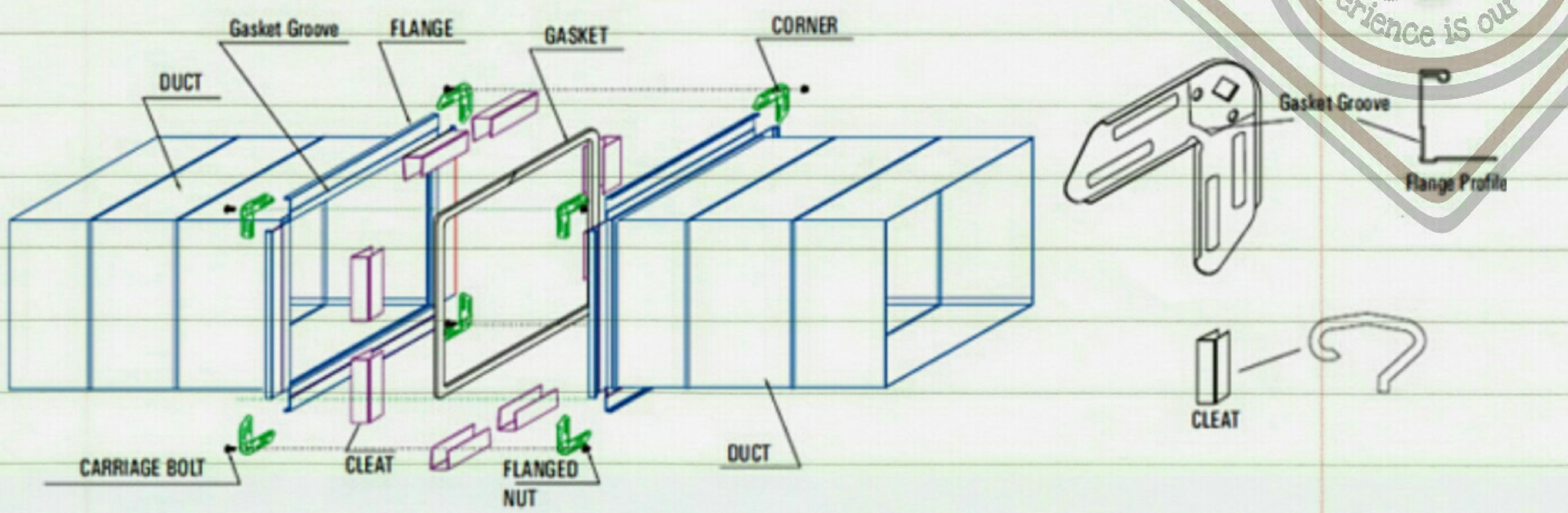
1/2 TO 3" W.G. (125 TO 750 Pa)	I_t @ 2 1/2' (0.75 M)
4" W.G. (1000 Pa)	J_t @ 2 1/2' (0.75 M)
6" W.G. (1500 Pa)	K_t @ 2' (0.60 M)
10" W.G. (2500 Pa)	L_t @ 2' (0.60 M)

NOTES:

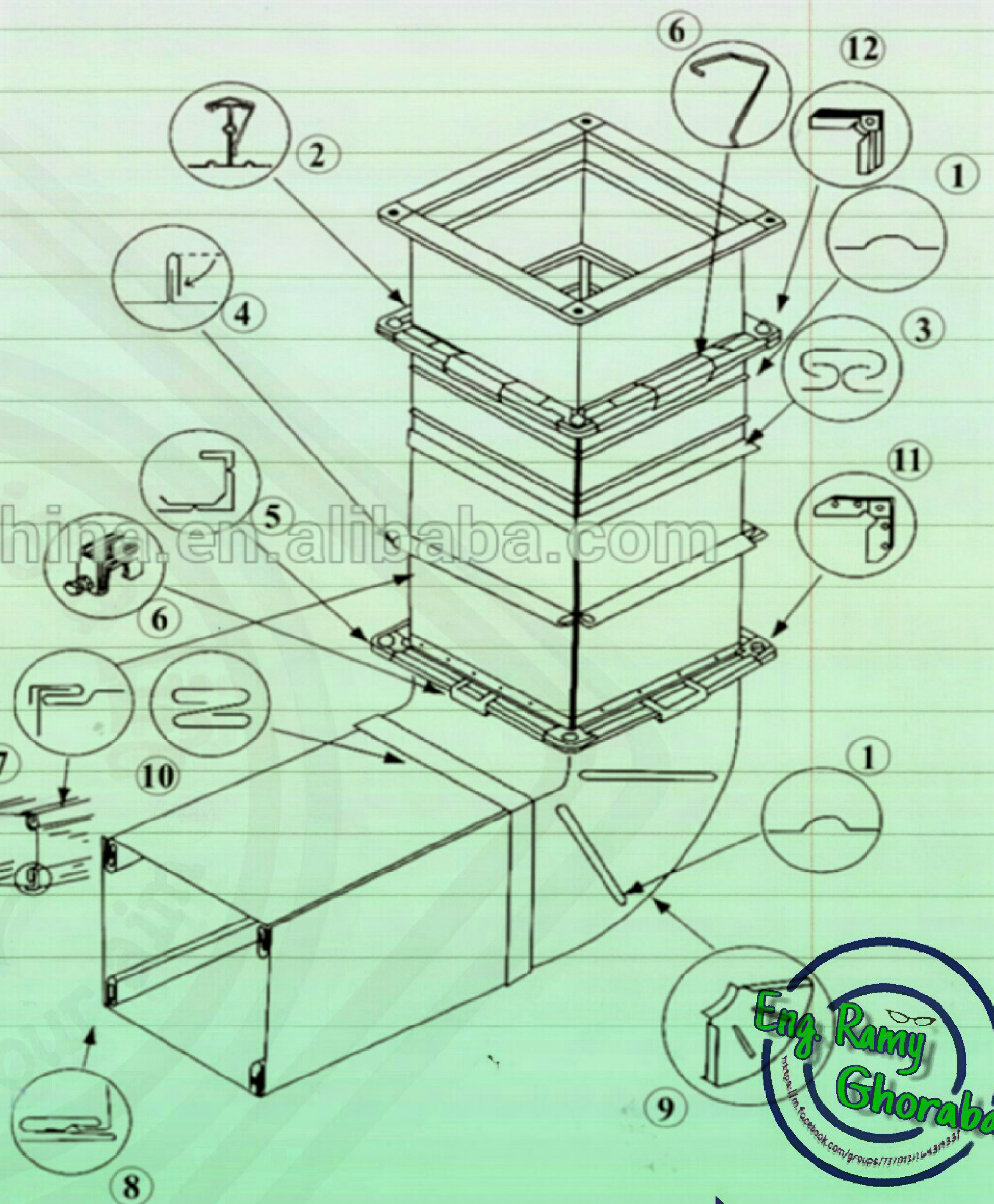
1. SEE TIE ROD TEXT.
2. USE 18 GAGE (1.31 mm) DUCT FOR 6" W.G. (1500 Pa) STATIC OR LESS AND 16 GAGE FOR 10" W.G. (2500 Pa).
3. ON 10" W.G. (2500 Pa) THE MAXIMUM TIE ROD INTERVAL ACROSS THE WIDTH IS 48" (1.2 M).
4. SEE REINFORCEMENT ATTACHMENT IN FIGURE 1-11.
5. SEE SUPPORT OF LARGE DUCTS IN FIGURE 4-6. DUCTS MUCH OVER 100" (2540 mm) WIDTH MAY REQUIRE OTHER INTERNAL SUPPORTS FOR SHAPE RETENTION UNLESS THEY ARE SUPPORTED AS SHOWN IN FIGURE 4-6.

FIGURE 1-12 DUCT OVER 120" (3048 MM) WIDE

Duct installation with joints



1.Glooving
2.TDF Flang
3."C"Locking Seam
4.Single and Double Hem Locknection
5.TDC Flang
6.Clip
7.Pittsburgh Lock Single Lock
8.Snap Lock
9.Elbow Lock
10."S"Locking Seam
11.TPC Corner
12.Corner connecting



① Galvanized steel sheet G(90) (Japan / KSA)
size (2.4*1.2) or (2*1)m

			factor
gauge	(18) →	1.3 mm thickness	* 10.52
	(20) →	= 1mm thickness	* 8.08
	(22) →	0.8 mm	* 6.86
	(24) →	0.6 mm	* 5.64
	(26) →	0.5 mm	* 4.42 Kg/m^2

USG	NOM. T(mm)	Ib/ft2	Kg/m2	SHEET AREA(m2)			SHEET WEIGHT			NO. OF SHHETS PER TON		
				(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
26	0.55	0.91	4.42	1.00	1.20	2.00	4.42	5.30	8.84	226.24	188.54	113.12
24	0.7	1.156	5.64	1.00	1.20	2.00	5.64	6.77	11.28	177.30	147.75	88.65
22	0.85	1.4	6.86	1.00	1.20	2.00	6.86	8.23	13.72	145.77	121.48	72.89
20	1	1.66	8.1	1.00	1.20	2.00	8.10	9.72	16.20	123.46	102.88	61.73
18	1.3	2.156	10.52	1.00	1.20	2.00	10.52	12.62	21.04	95.06	79.21	47.53
16	1.61	2.66	12.96	1.00	1.20	2.00	12.96	15.55	25.92	77.16	64.30	38.58
14	1.994	3.28	16.01	1.00	1.20	2.00	16.01	19.21	32.02	62.46	52.05	31.23

Urgent

As Per SMACNA

D.C.A.2-95
SEC. ED

The National Association Sheet Metal Contractors 1929

RECTANGULAR SIZES	GAGES OF SHEETS FOR	ROUND DIAMETER
Up to 12 in.	26	Up to 12 in.
13 to 30 in.	24	13 to 30 in.
31 to 42 in.	22	31 to 40 in.
43 to 60 in.	20	41 to 60 in.
61 in. and over	18	61 in and over

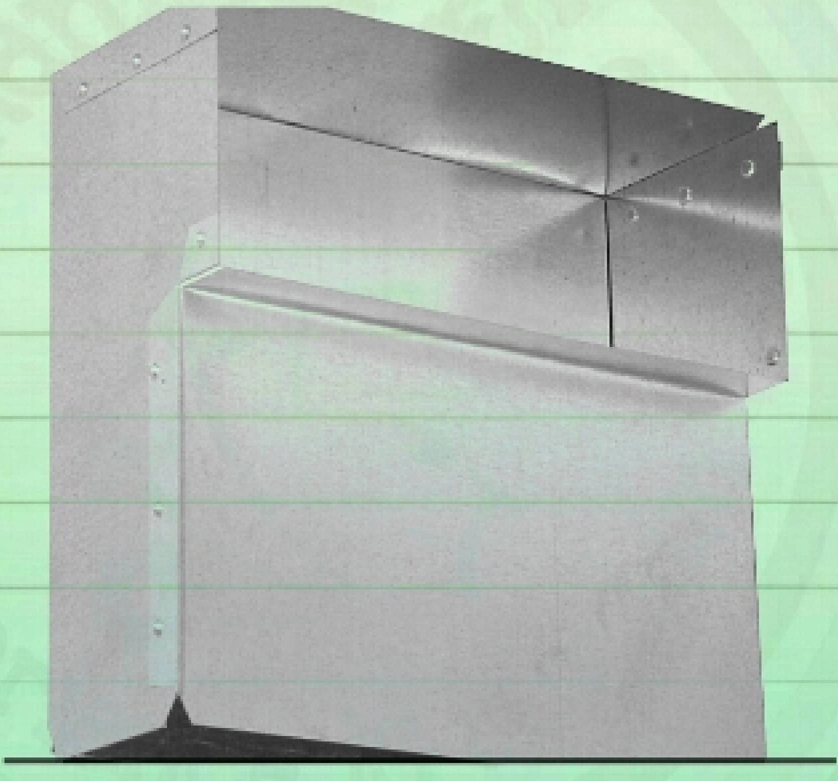
Duct fitting

Elbow

Elbow 90 degree

·5°
Elbow

Elbow 45 degree



Rectangular elbow
90 degree

Elbow types

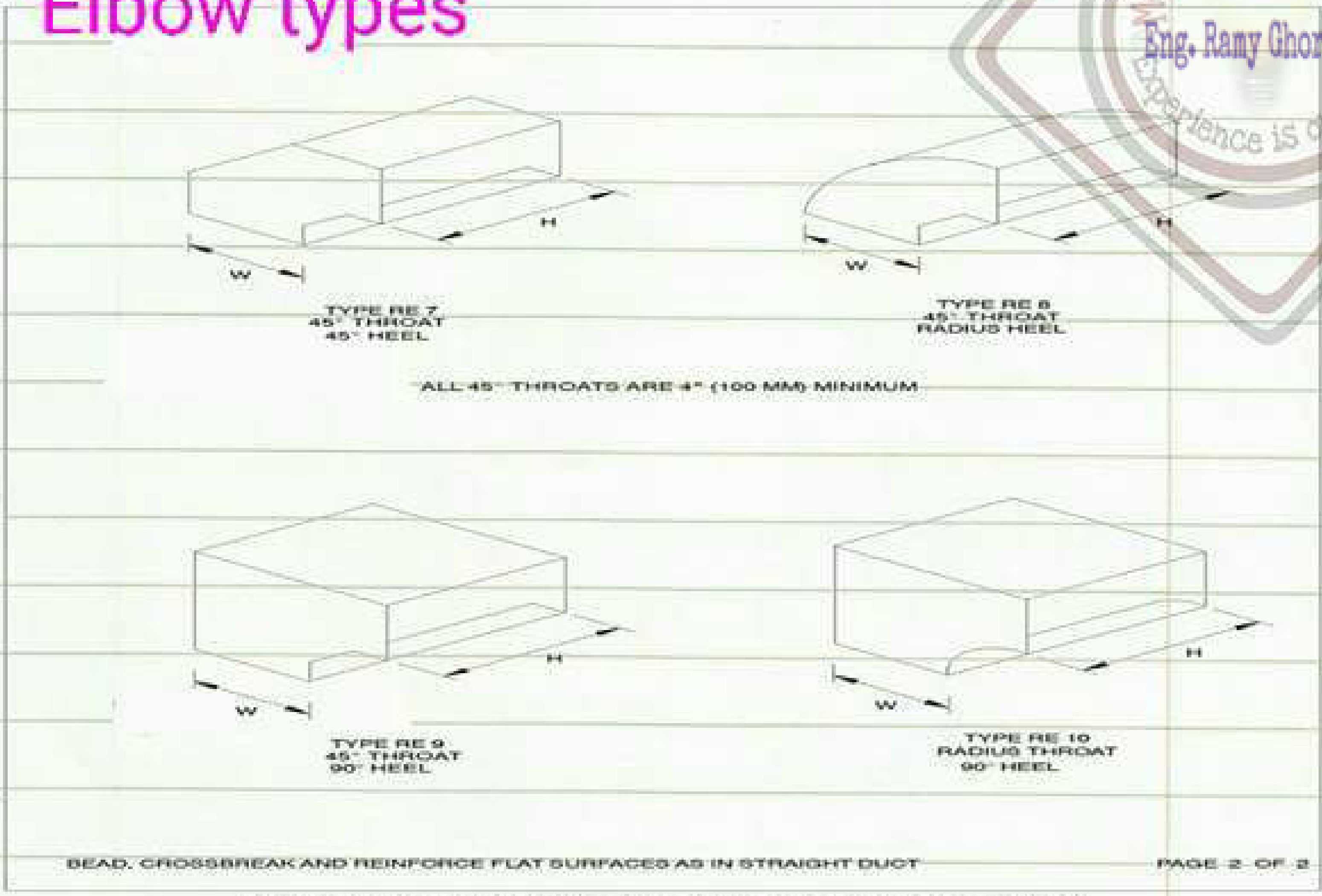


FIGURE 4–2 RECTANGULAR ELBOWS (CONTINUED)

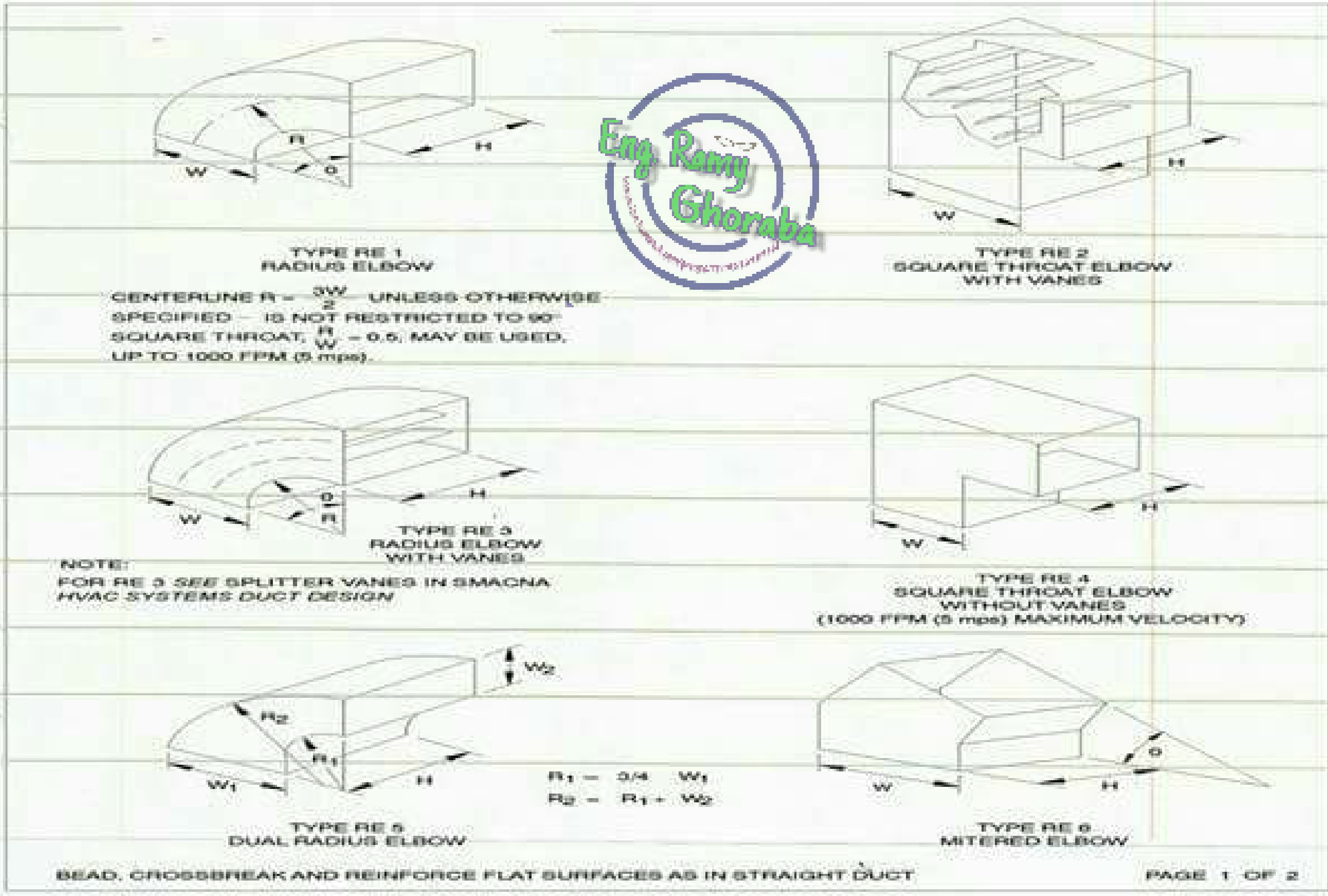
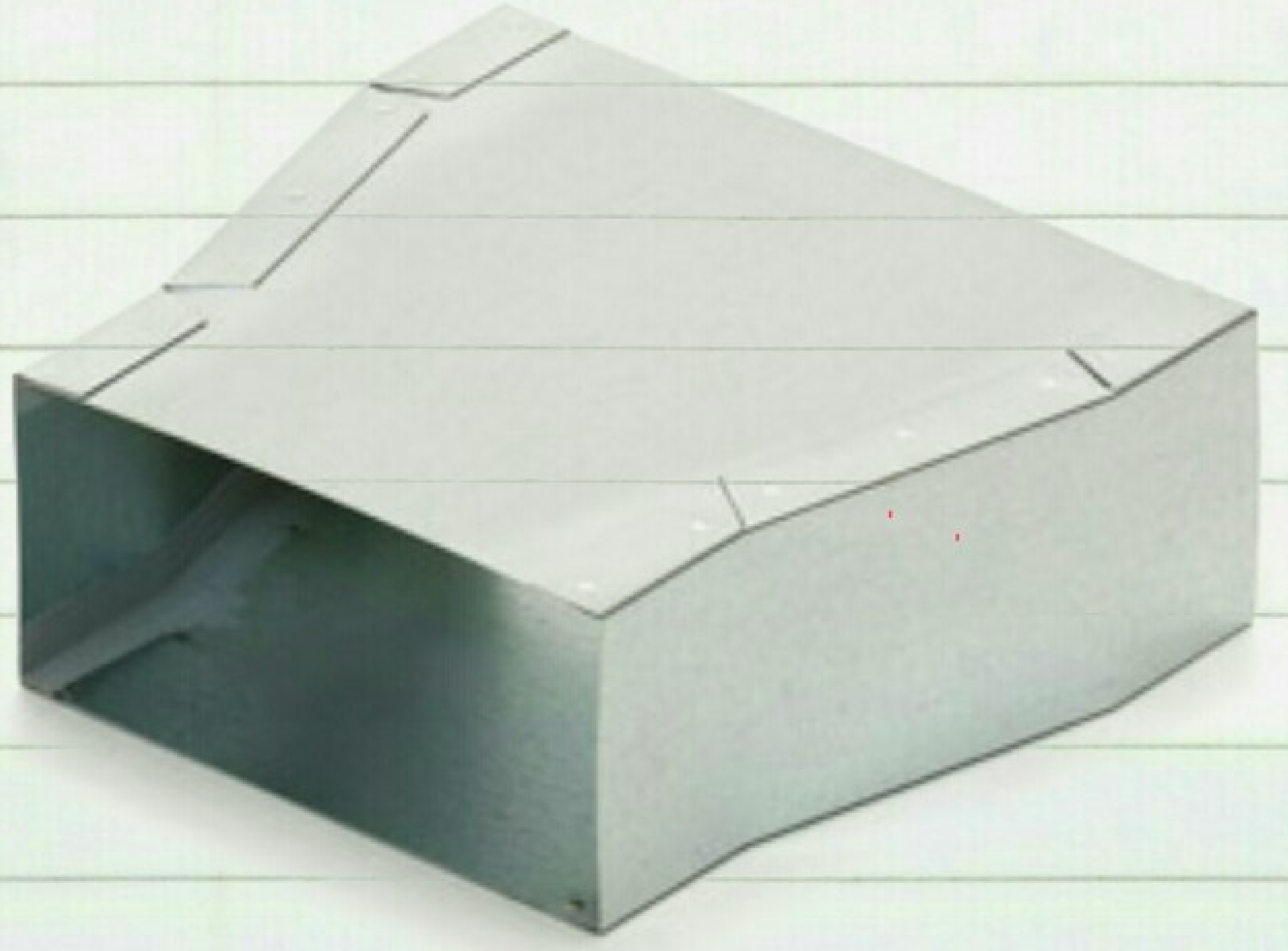
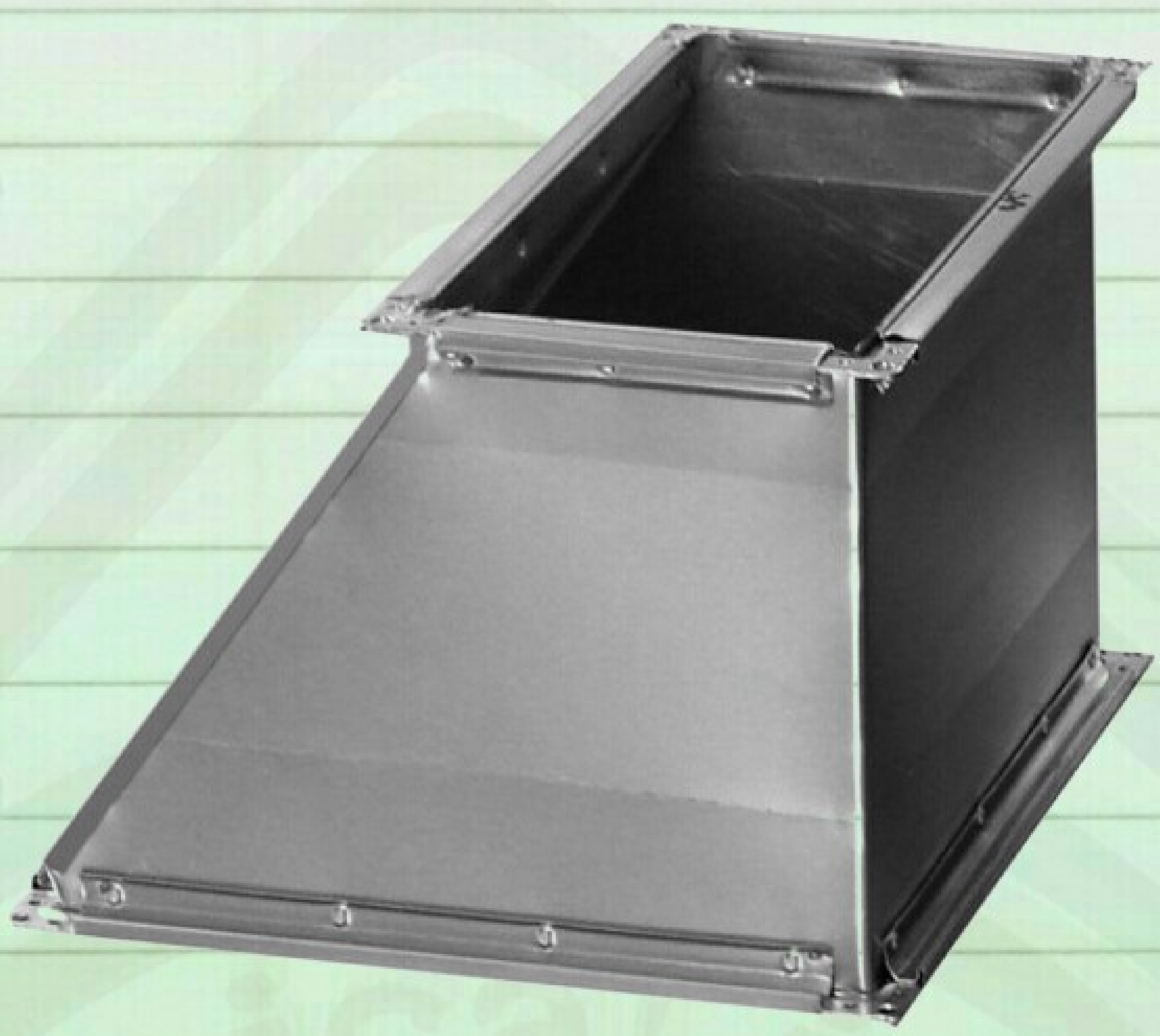


FIGURE 4–2 RECTANGULAR ELBOWS

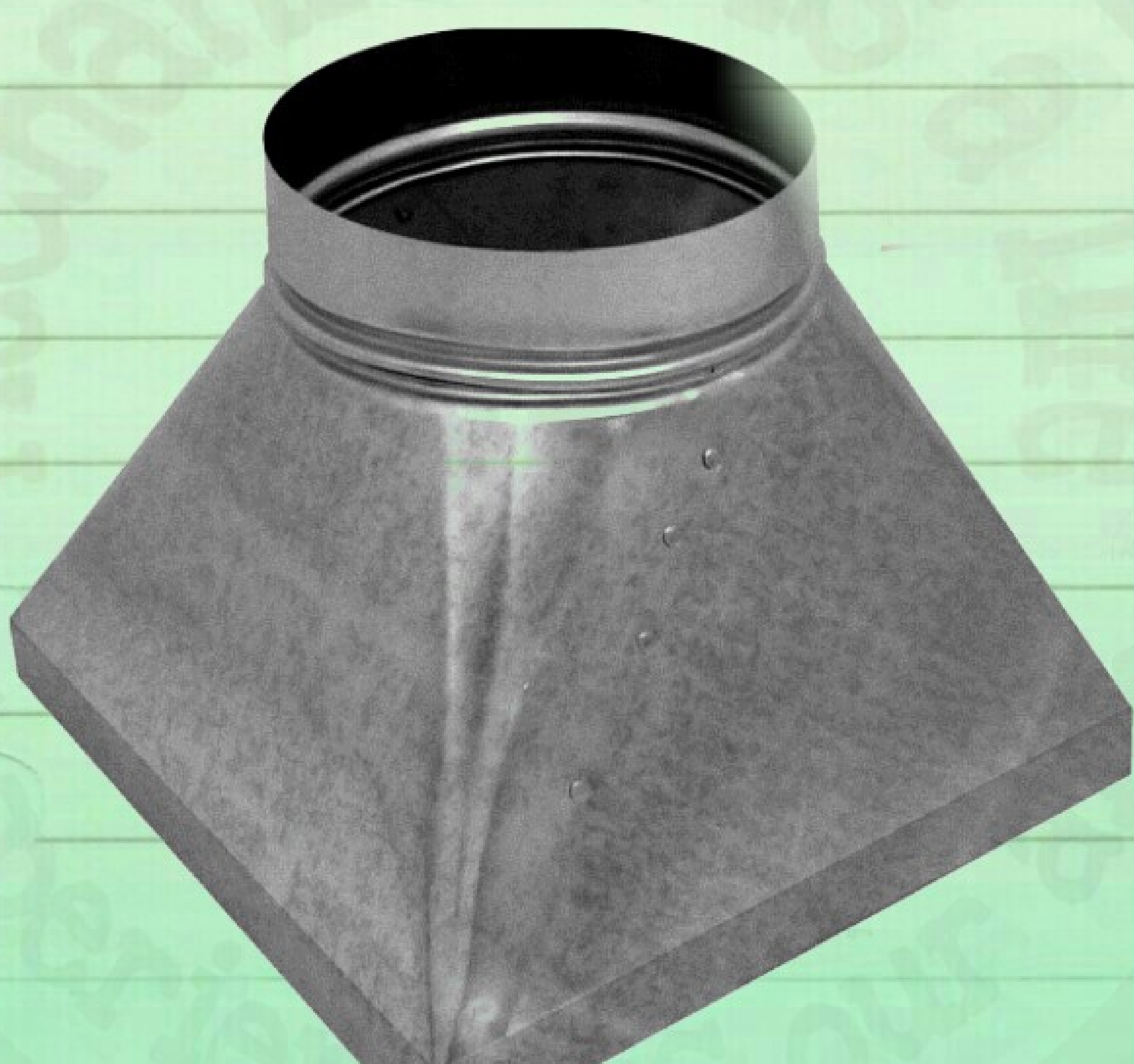
Reducer



Centric Reducer



Ec- Centric Reducer



Square to Round Reducer

Reducer & Offset types

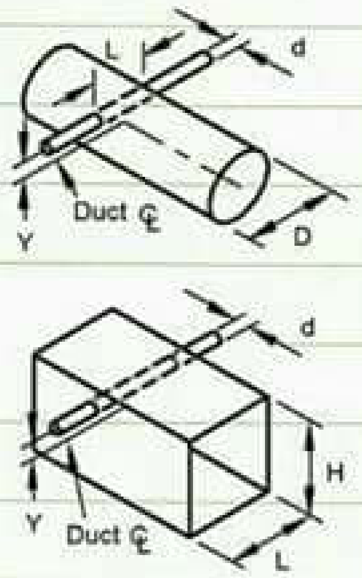


FIG. A IS APPLICABLE FOR UP TO 20% AREA OBSTRUCTION WITH ROUND SHAPED MEMBER AND 10% WITH FLAT PROFILE. Y IS THE DISTANCE FROM DUCT CENTER.

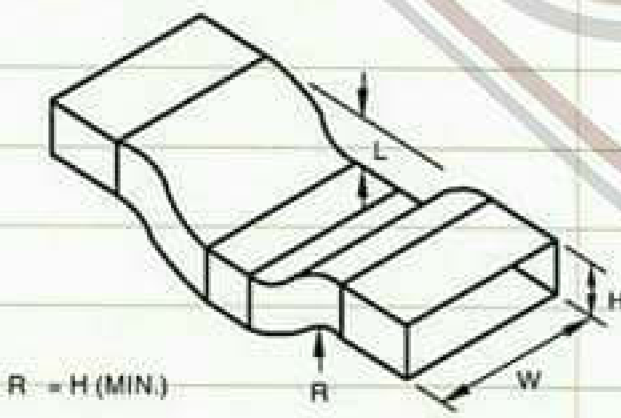


FIG. A

FIG. B

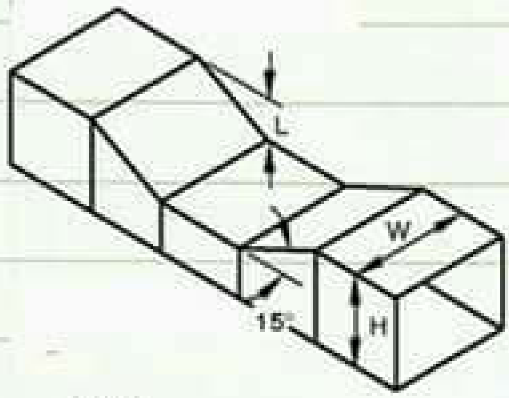


FIG. C

20% MAXIMUM AREA REDUCTION

L/H = 0.5 TO 2
B = 12" (300 mm) MIN.

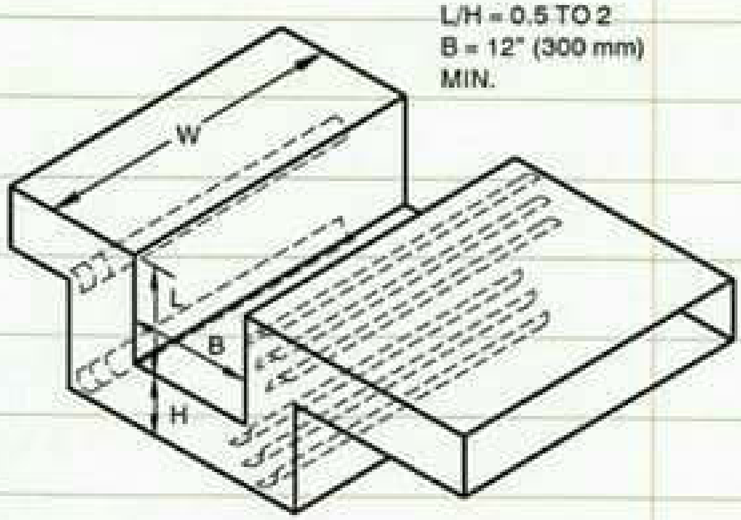
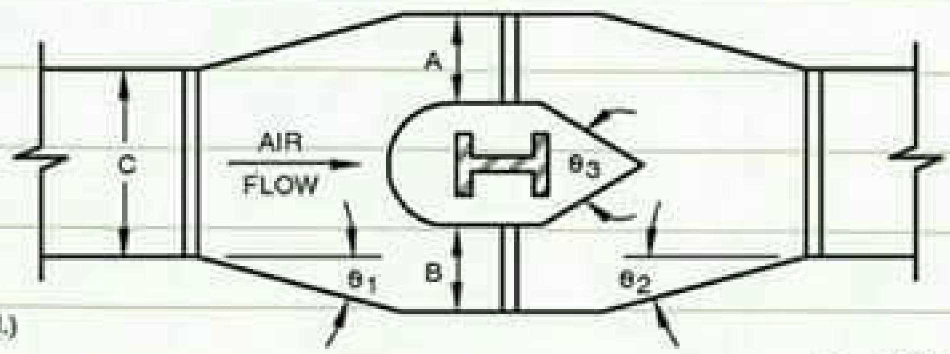


FIG. D

VANES MUST DIRECT FLOW PARALLEL TO DUCT WALL
CAUTION: HIGH LOSS COEFFICIENTS



A+B = 1.25C (MIN.) AT CONSTANT DEPTH.

FIG. E

θ_1 = 20° MAX.
θ_2 = 30° MAX.
θ_3 = 60° MAX.

(USED WHEN OBSTRUCTION EXCEEDS 20% OF SECTION AREA AND OFFSETS AROUND ARE NOT POSSIBLE).

FIGURE 4-8 OBSTRUCTIONS

OFFSETS 2 AND 3 AND TRANSITIONS MAY HAVE EQUAL OR UNEQUAL INLET AND OUTLET AREAS. TRANSITIONS MAY CONVERT DUCT PROFILES TO ANY COMBINATION FOR RECTANGULAR, ROUND OR FLAT OVAL SHAPES.

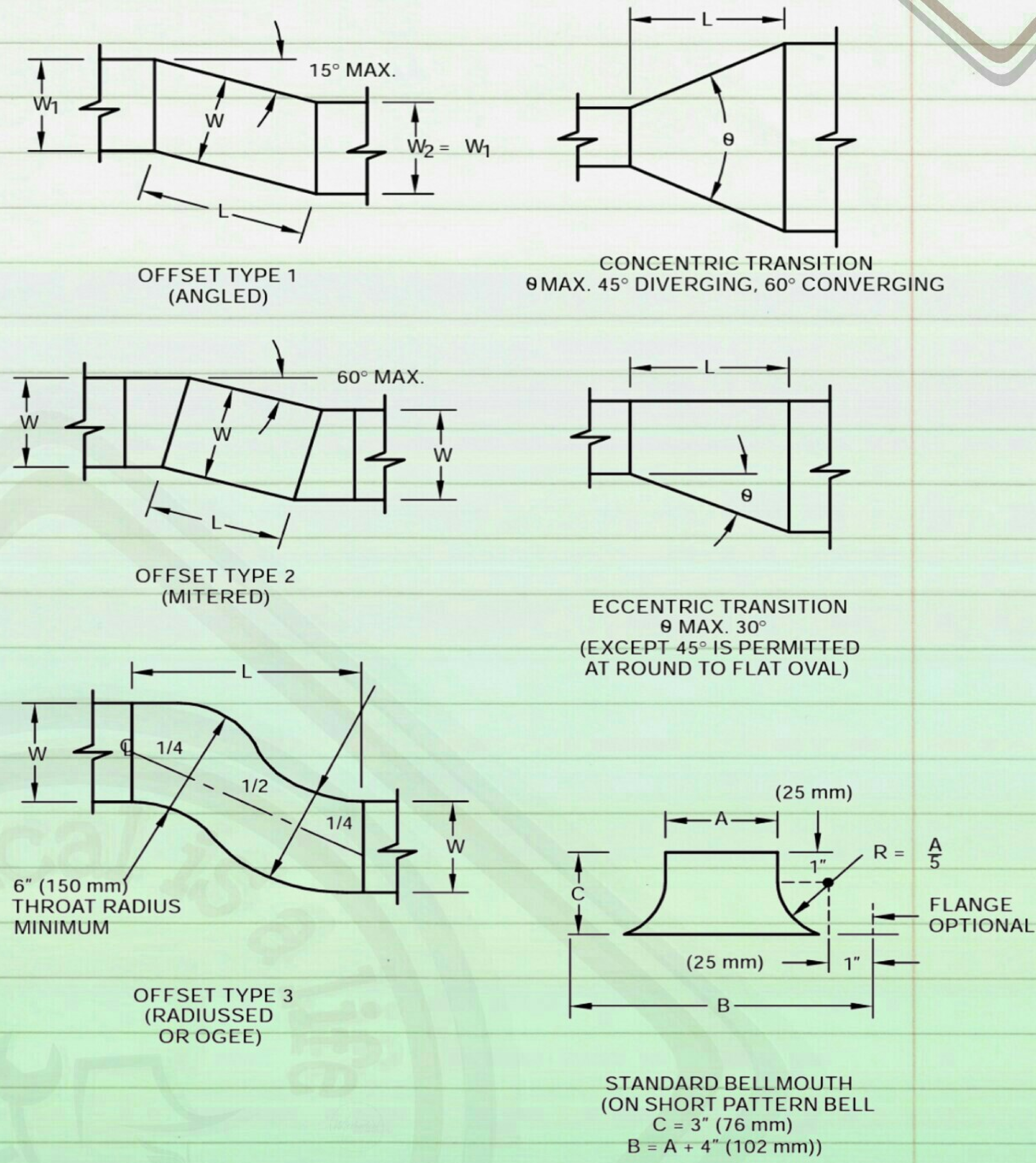


FIGURE 2-7 OFFSETS AND TRANSITIONS

Take off (Branch connection) types

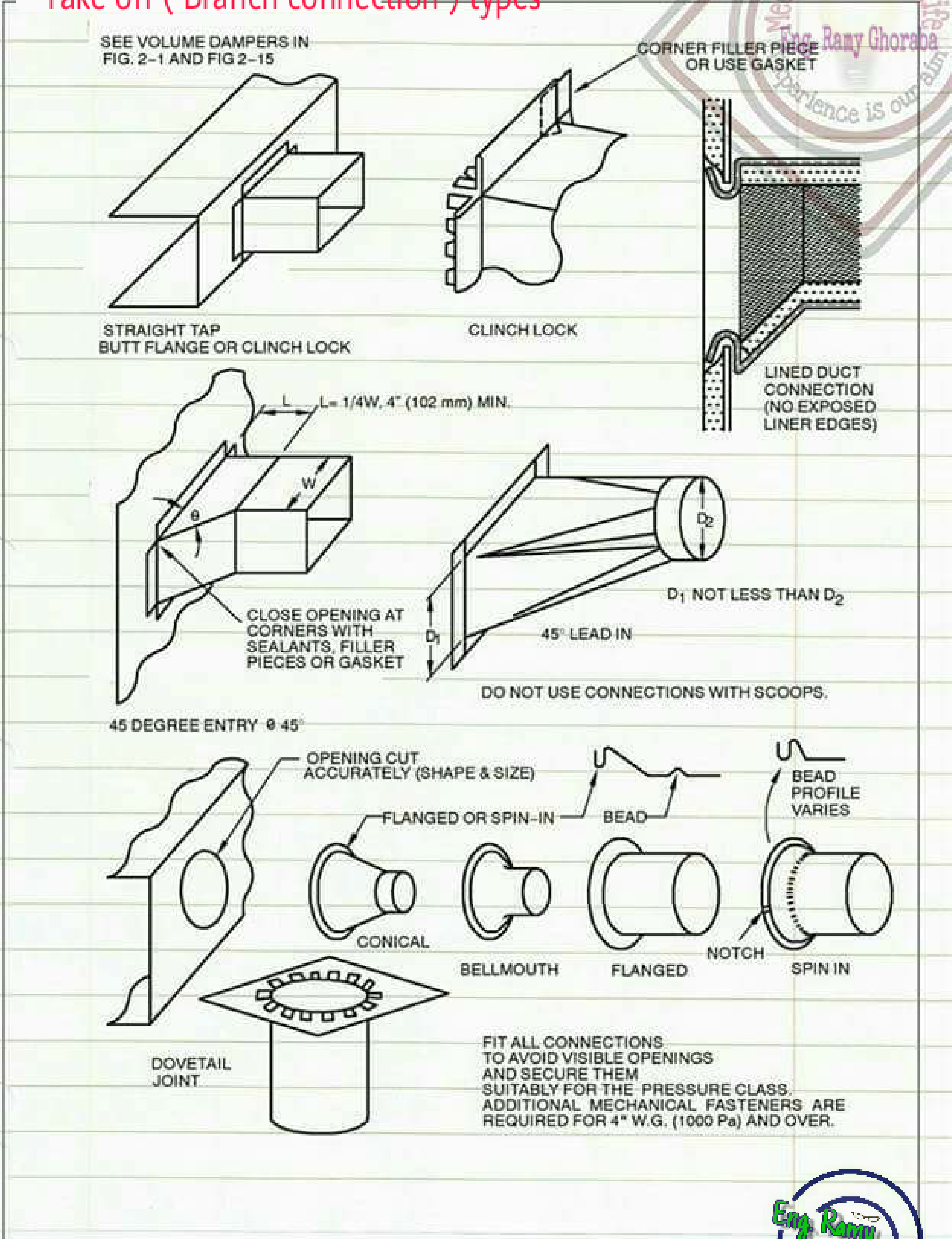


FIGURE 4-6 BRANCH CONNECTION

T connection types

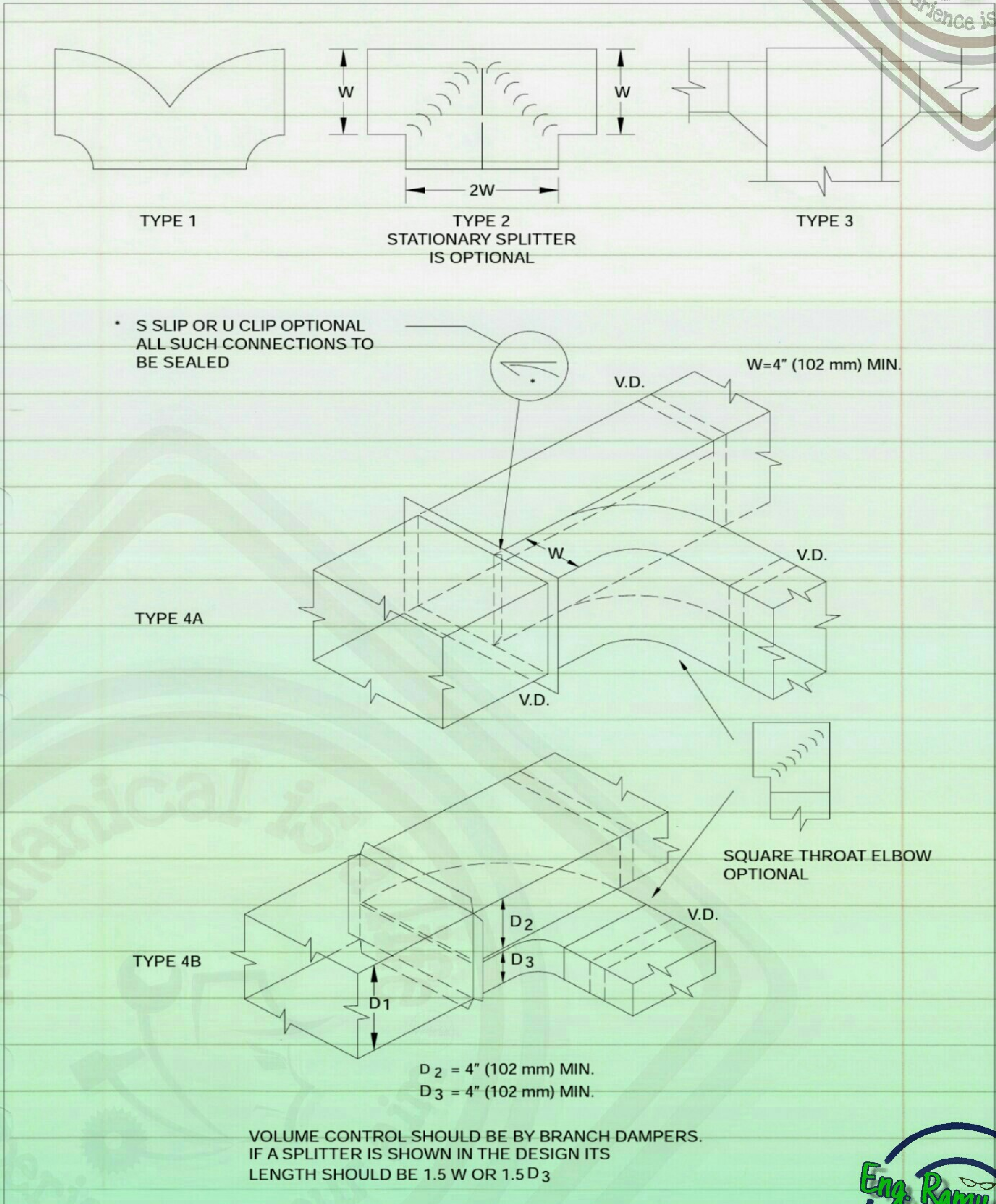
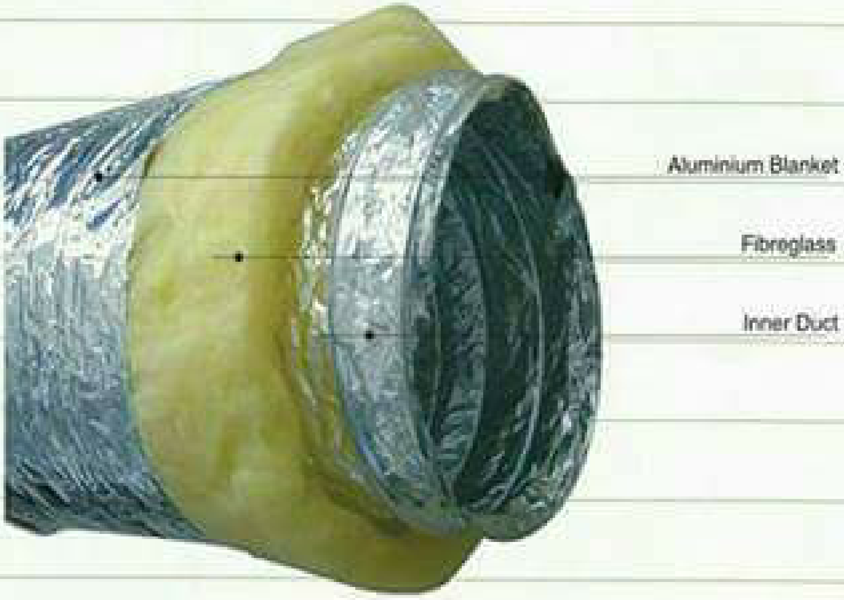


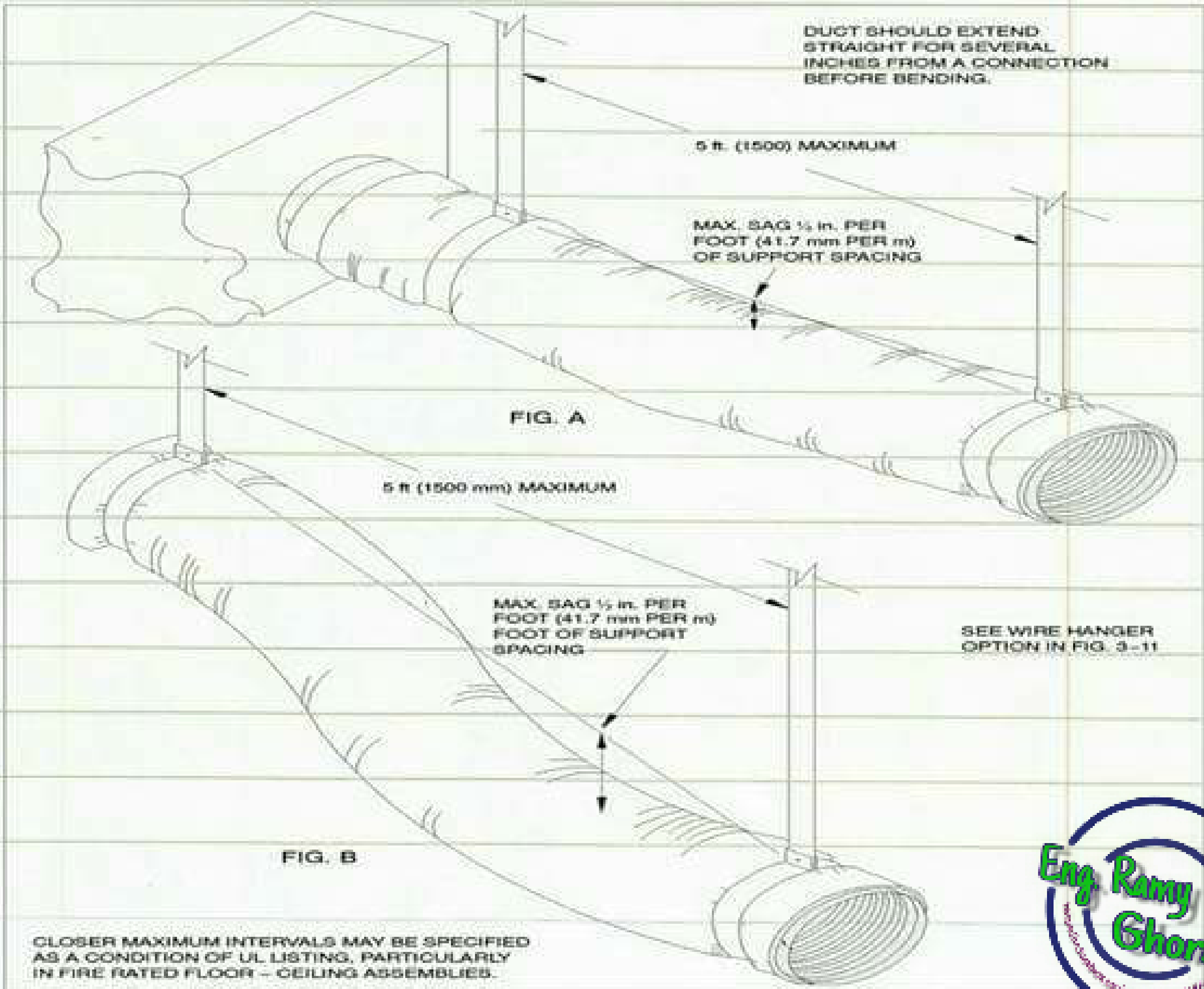
FIGURE 2-5 DIVIDED FLOW BRANCHES

• Flexible Duct,
• Duct Connector
AND
Planum Box

Eng. Ramy Ghoraba

Flexible duct





⊛ Flexible duct Connector

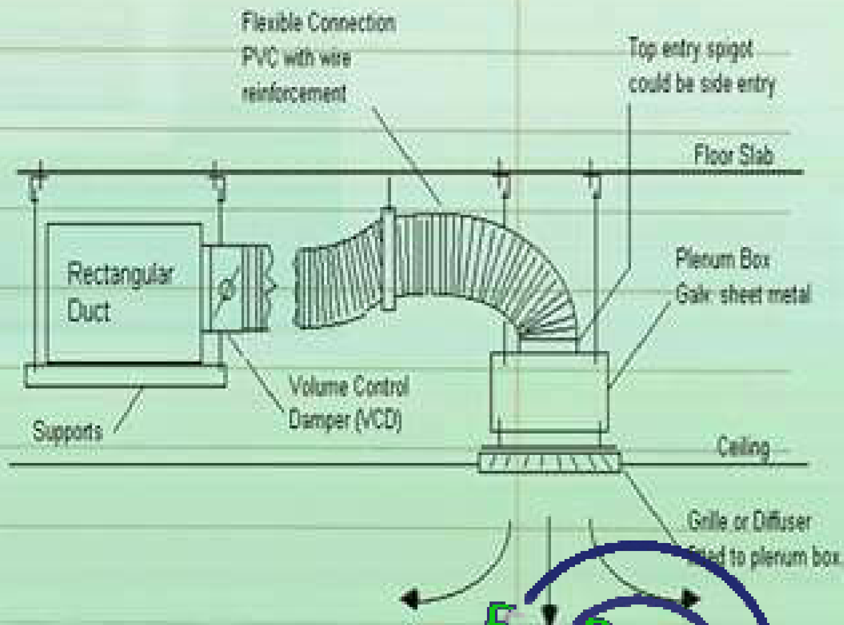
- Function → To prevent vibration transfer from the moving parts (AHU - PACU - Fan) to the duct.
- Location → Install on supply & return duct nearest of the unit.

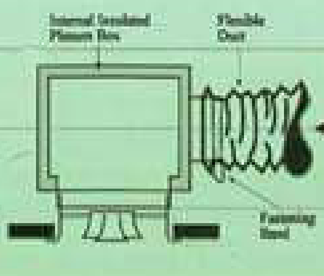


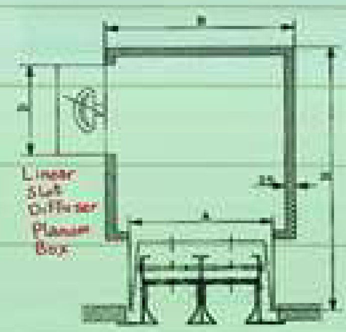
⊛ Planum Box

- Function → To collect the air from the mainduct and distribut it into the out let
- Location → above the false ceiling at the end of each duct line.







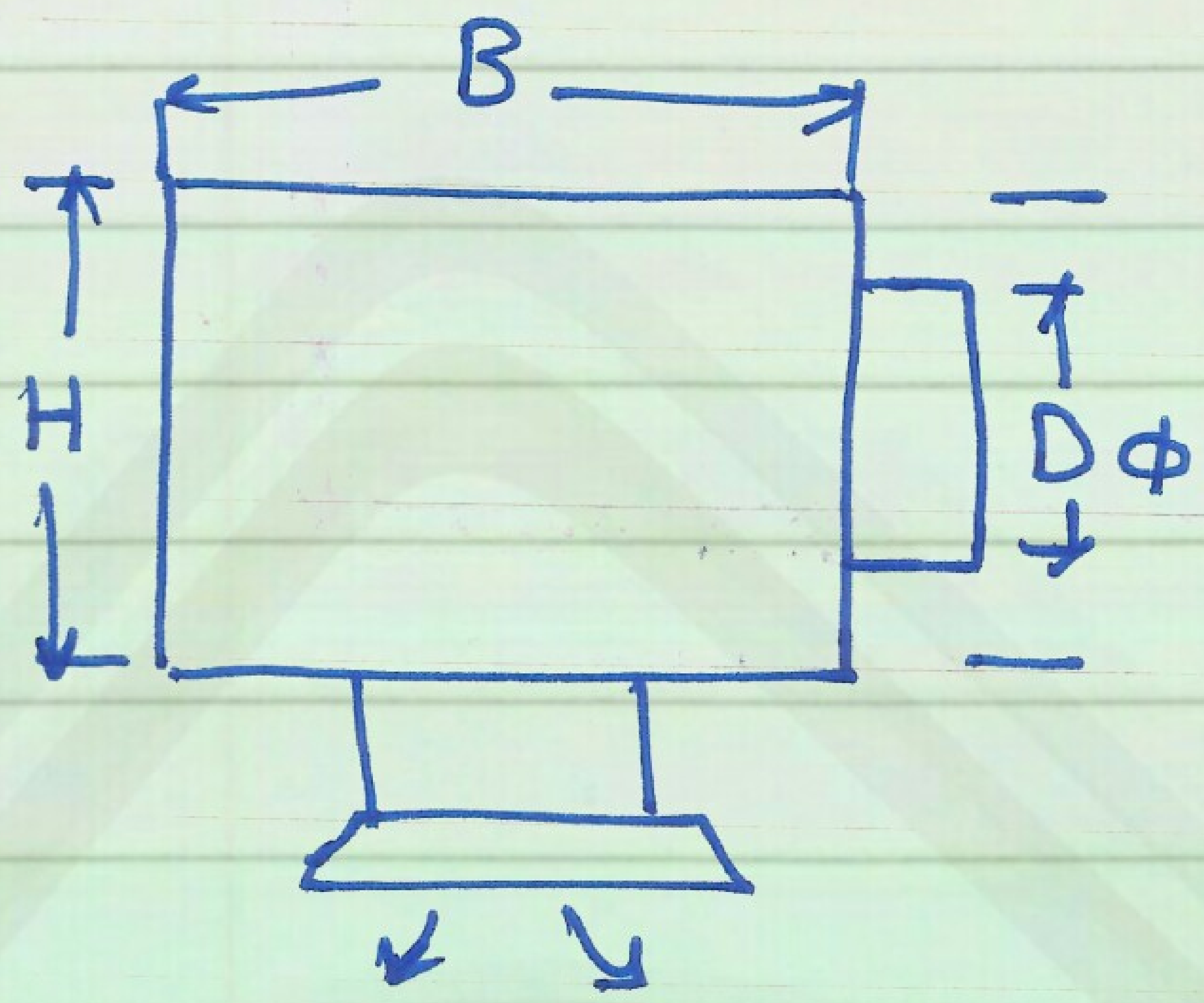


كيفية تحديد أبعاد planum box (*)

- أبعاد P.B تعتمد في الاساس على ابعاد (neck diffuser)

- بالنسبة slot diff. تعتمد على عدد slots والمسافة بينهم

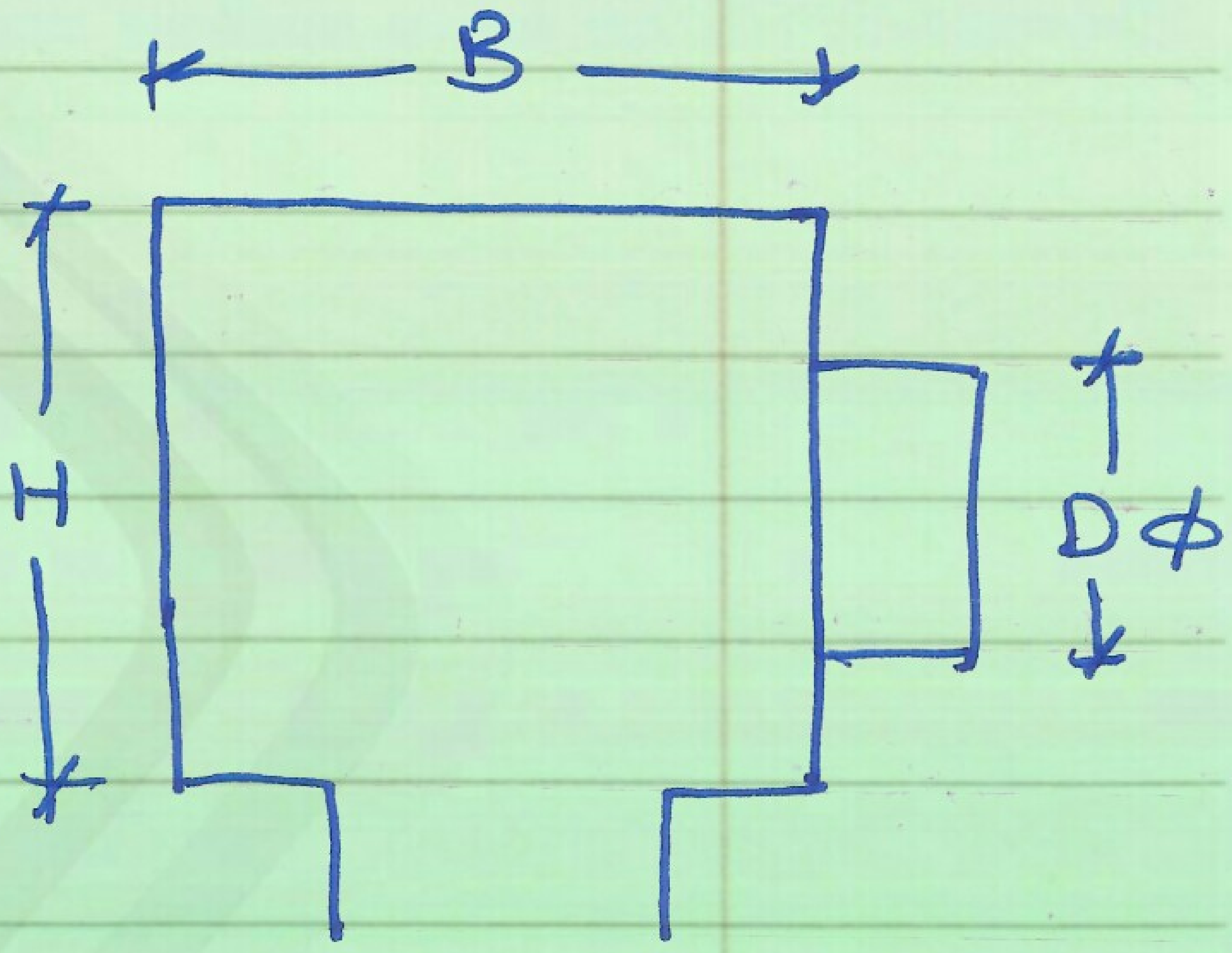
For diffuser



Dim	H	B	DΦ
150*150	200	250	150
225*225	300	330	250
300*300	350	400	300
370*370	400	500	350
450*450	450	550	400

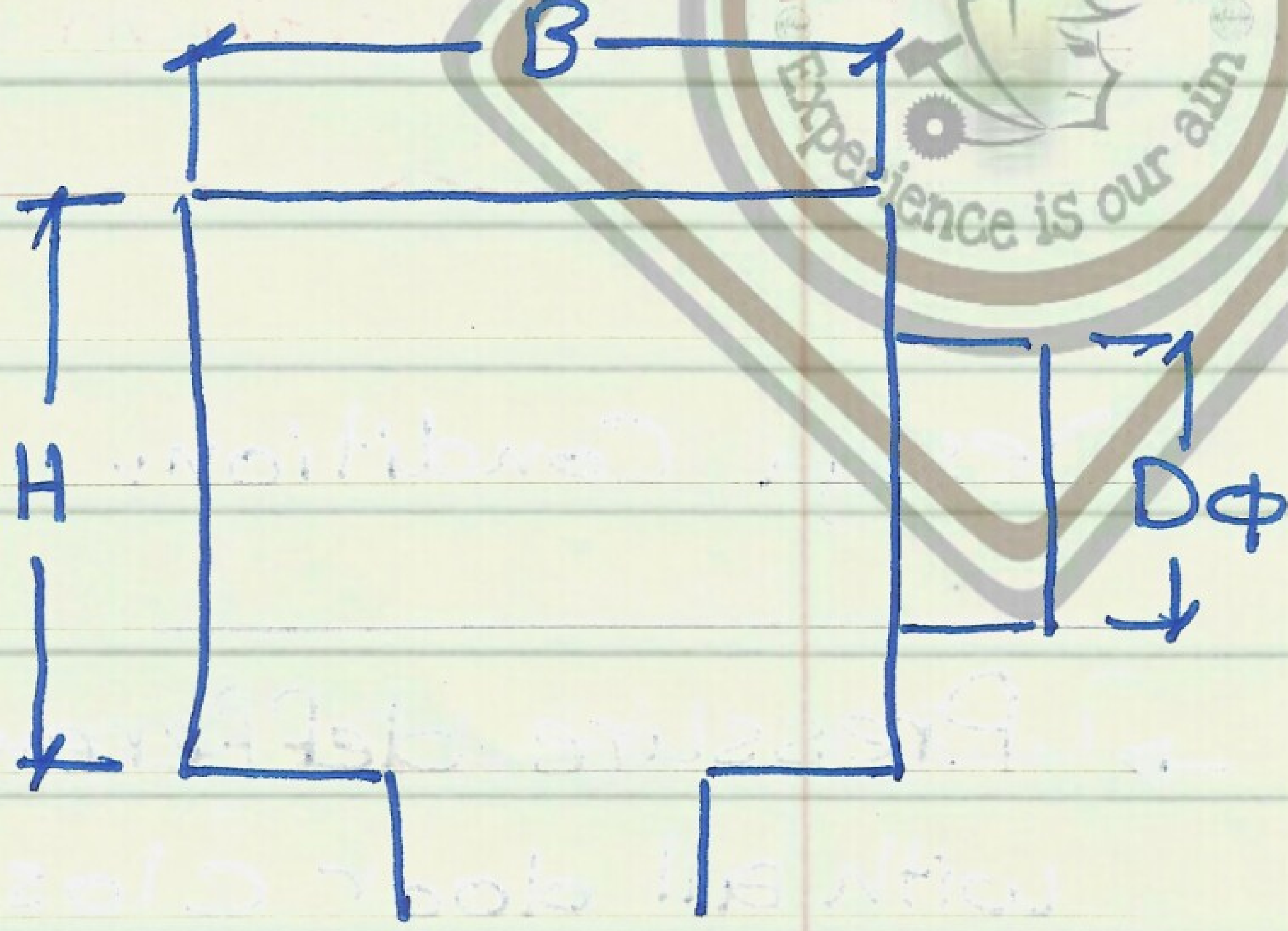
For slot diffuser

No. of slot	H	B	DΦ
1	240	155	127
2	240	190	150
3	290	225	200
4	290	265	200
5	330	300	250
6	370	335	300



(*) with inside Sound insulation

* Slot diffuser



No. of slot	H	B	DΦ
1	220	120	
2	220	160	
3	250	190	
4	250	~~220~~ 220	
5	300	250	
6	~~300~~		
	350	290	

* Non insulation.

Dampers

④ Dampers

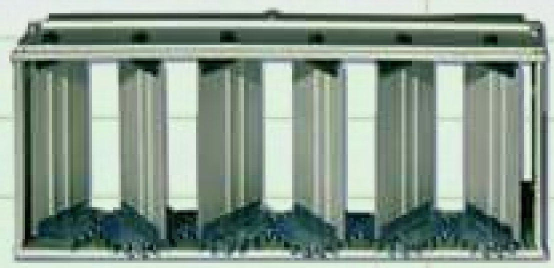
4-1) Volume dampers

- To Control the Air flow quantity in each branch
- Equalizing to friction or pressure drop.

⊛ Types of Volume dampers

Ⓐ Parallel blade

Ⓑ Opposed blade



Ⓒ Round single blade

Ⓓ Rectangular Single b.

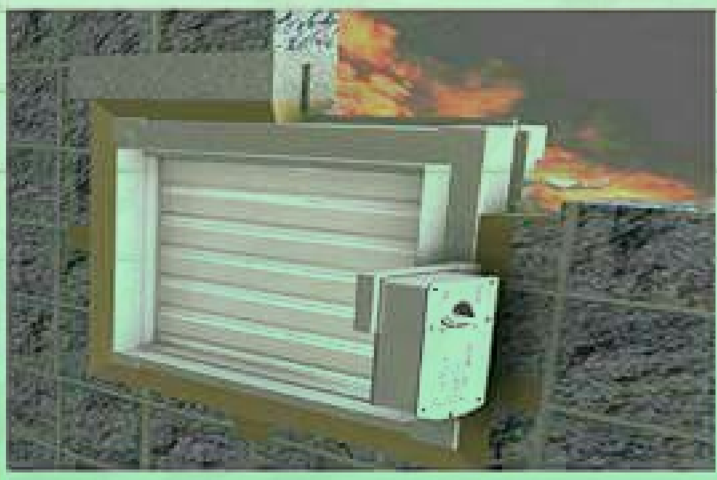
⊛ Located in Supply and return duct
⊛ There is manual type and motorized type
⊛ Should have access door for balancing.

4-2) Fire damper

- To prevent the spread of fire in side the building by HVAC equipements
- Should install on the fire rated wall
- It is a box assemlied in GI sleeve, with a curtain or blade inside the box and connected with spring with fusible link
- If the smoke pass through the duct, the link will fused and close the curtain or the blade.

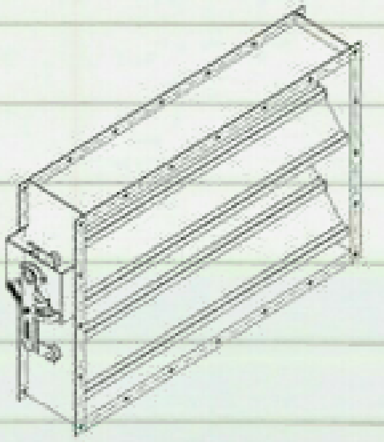
(*) Types of fire damper

(*) Located in supply and return duct
(*) There is a manual and motorized fire damper

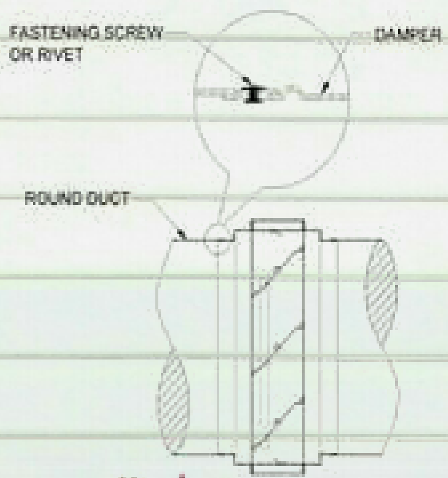


Volume damper installation

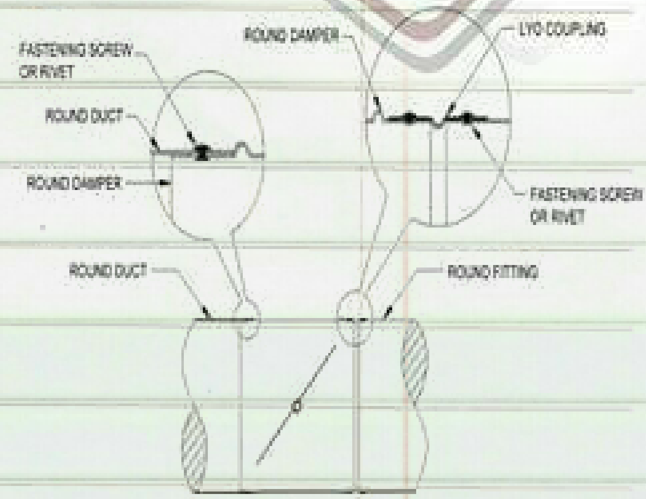
Flange Drilling



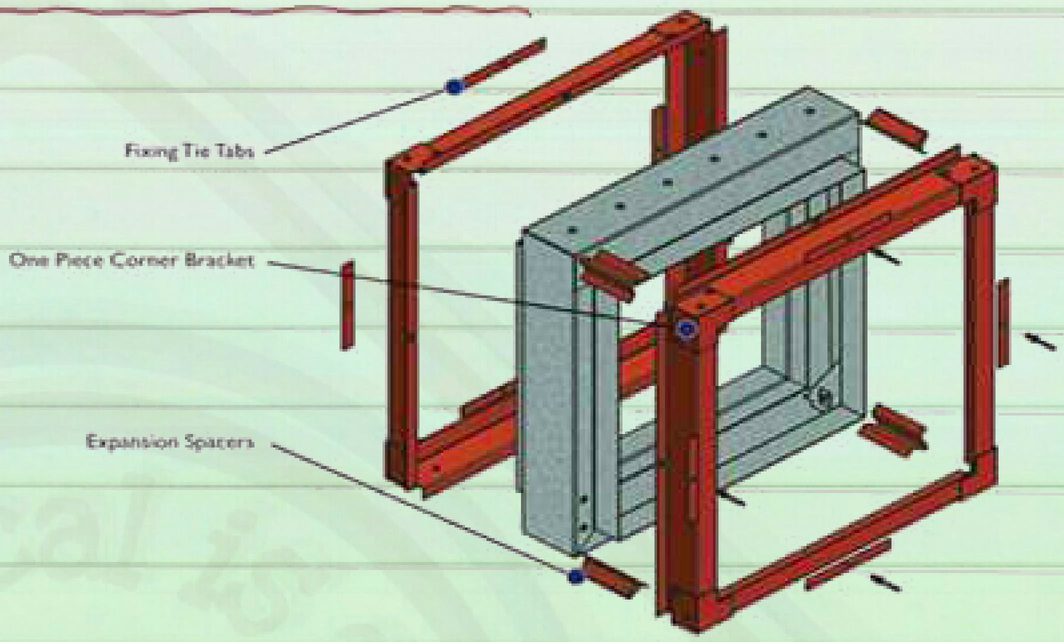
Circular and Oval

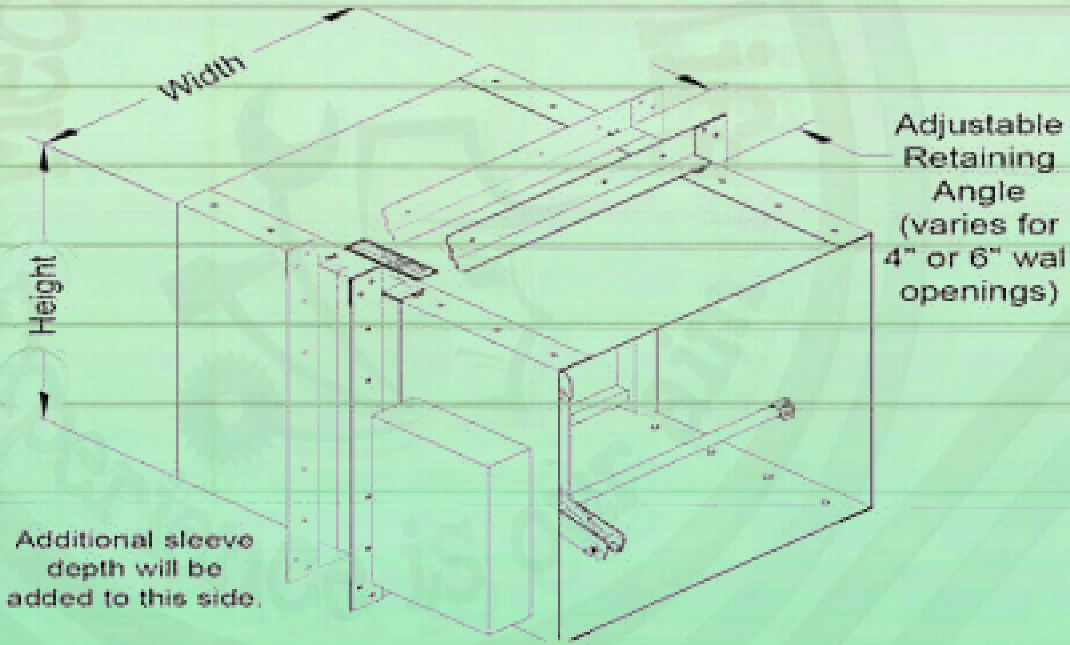


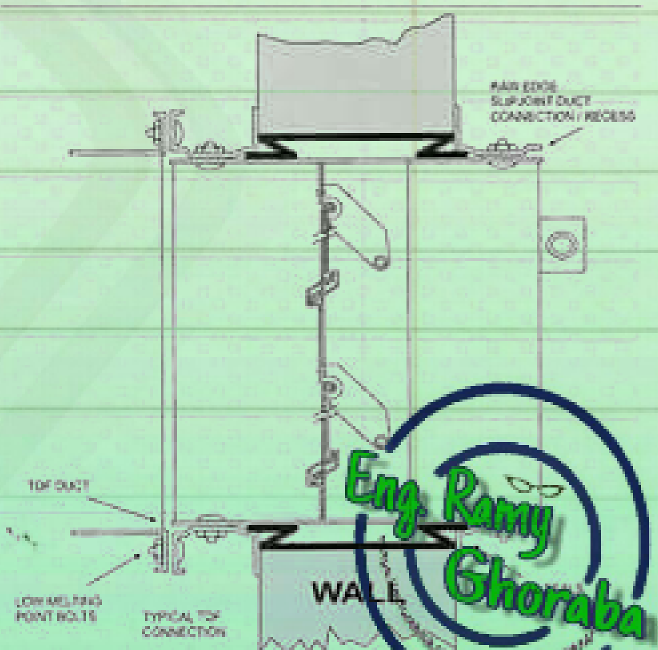
Round



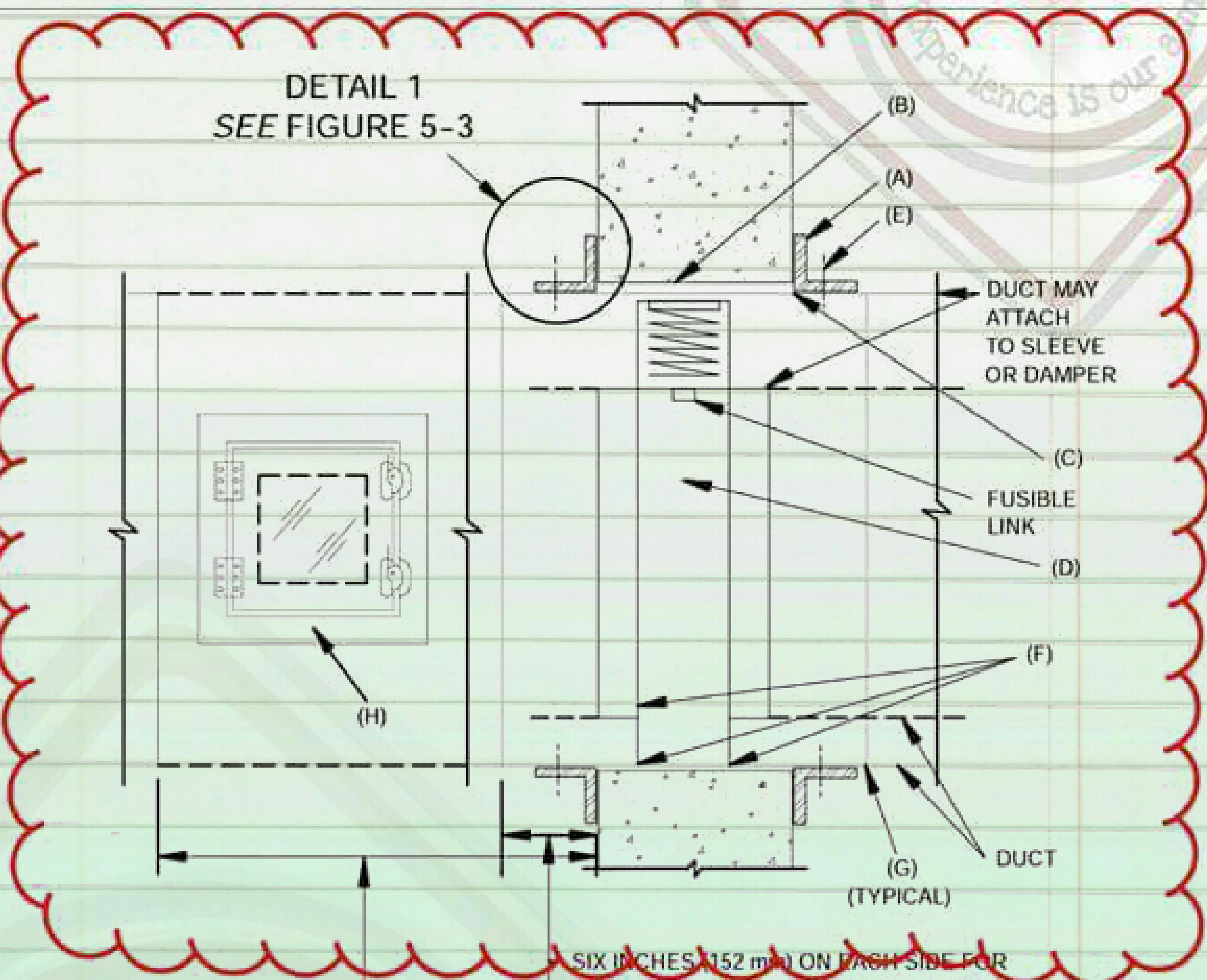
Fire damper installation







Fire damper installation



SIX INCHES (152 mm) ON EACH SIDE FOR DAMPERS INTENDED FOR USE WITHOUT AN ACTUATOR OR A FACTORY INSTALLED ACCESS DOOR IN THE SLEEVE.

SIX INCHES (152 mm) ON ONE SIDE AND SIXTEEN INCHES (406 mm) ON THE OPPOSITE SIDE FOR DAMPERS INTENDED FOR USE WITH AN ACTUATOR AND/OR A FACTORY INSTALLED ACCESS DOOR ON THE LONGER SIDE.

SIXTEEN INCHES (406 mm) ON EACH SIDE FOR DAMPERS INTENDED FOR USE WITH AN ACTUATOR ON ONE SIDE AND A FACTORY INSTALLED ACCESS DOOR ON THE OTHER SIDE.

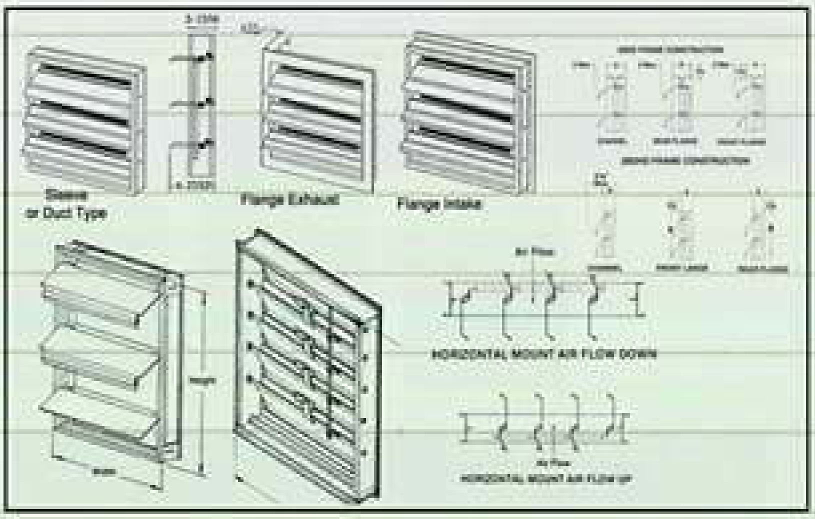
A - RETAINING ANGLES
B - EXPANSION SPACE
C - DAMPER SLEEVE
D - FIRE DAMPER/ COMBINATION FIRE/SMOKE DAMPER
E - RETAINING ANGLES FASTENED TO SLEEVE
F - DAMPER ATTACHMENT TO SLEEVE
G - CONNECTION TO DUCT
H - ACCESS DOOR OR PANEL

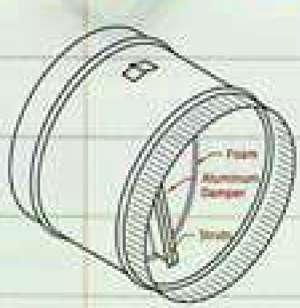
(*) Back Draft damper

Function _ To let the air moving in one direction only

Location _ Install before exhaust fan to prevent the Air to come back again

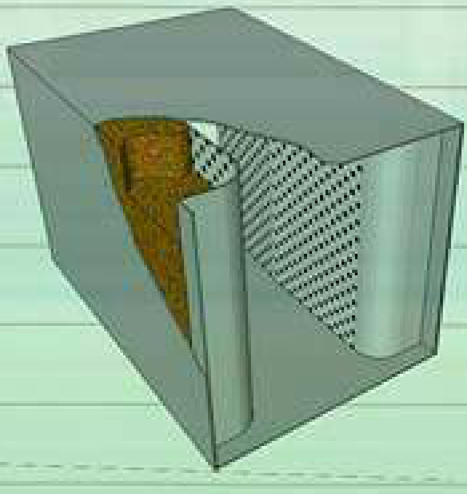
- Install in case that you have 2 unit (1 duty and 1 stand by) Connected to the same duct line



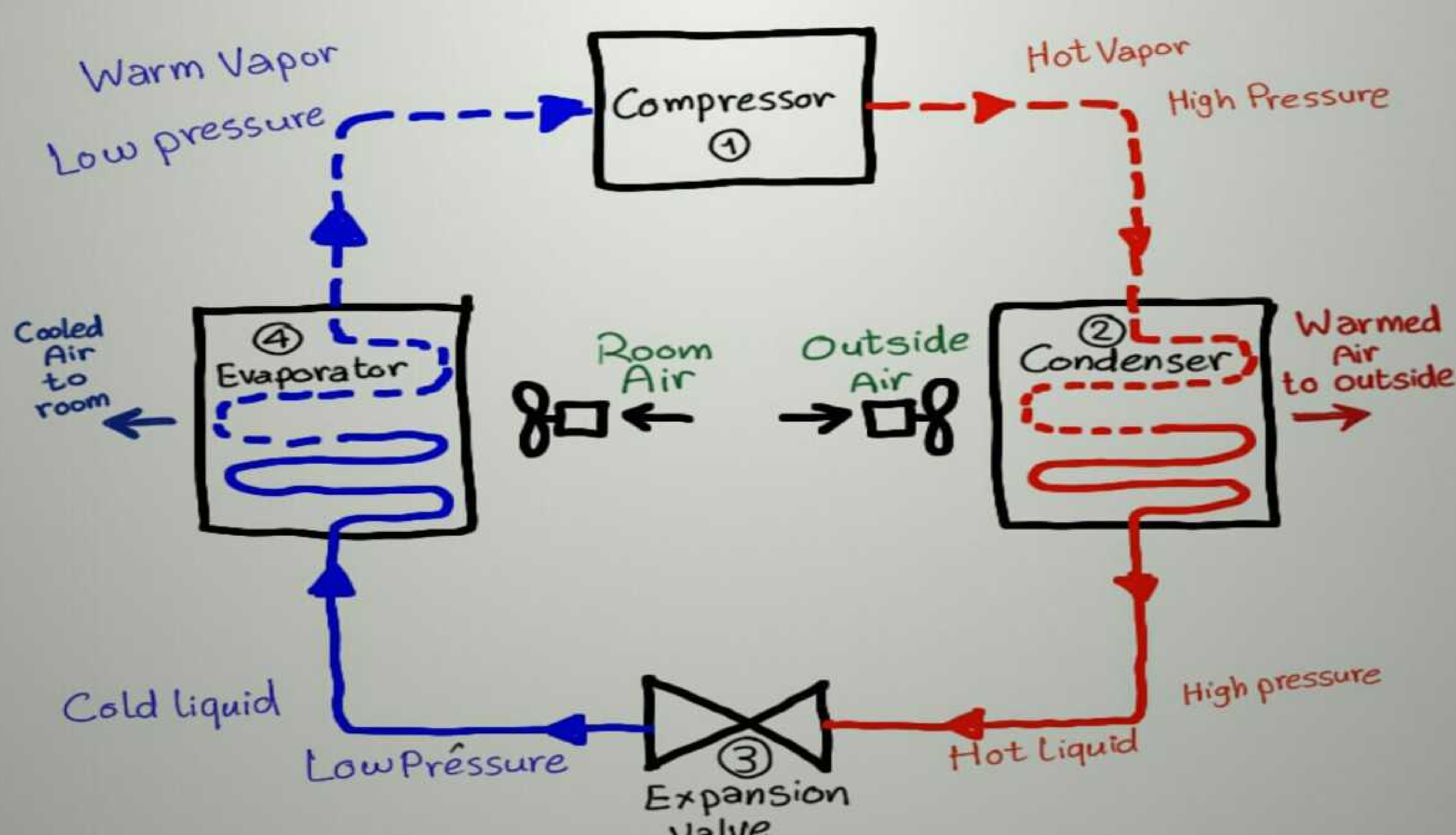


(*) Sound Attenuator

- Function → To reduce the Sound in the duct
- Location → Install in the supply duct nearest from the unit.



Heat
Ventilation
Air
Condition



Eng. Ramy Ghoraba

Mechanical is a life

HVAC

PART

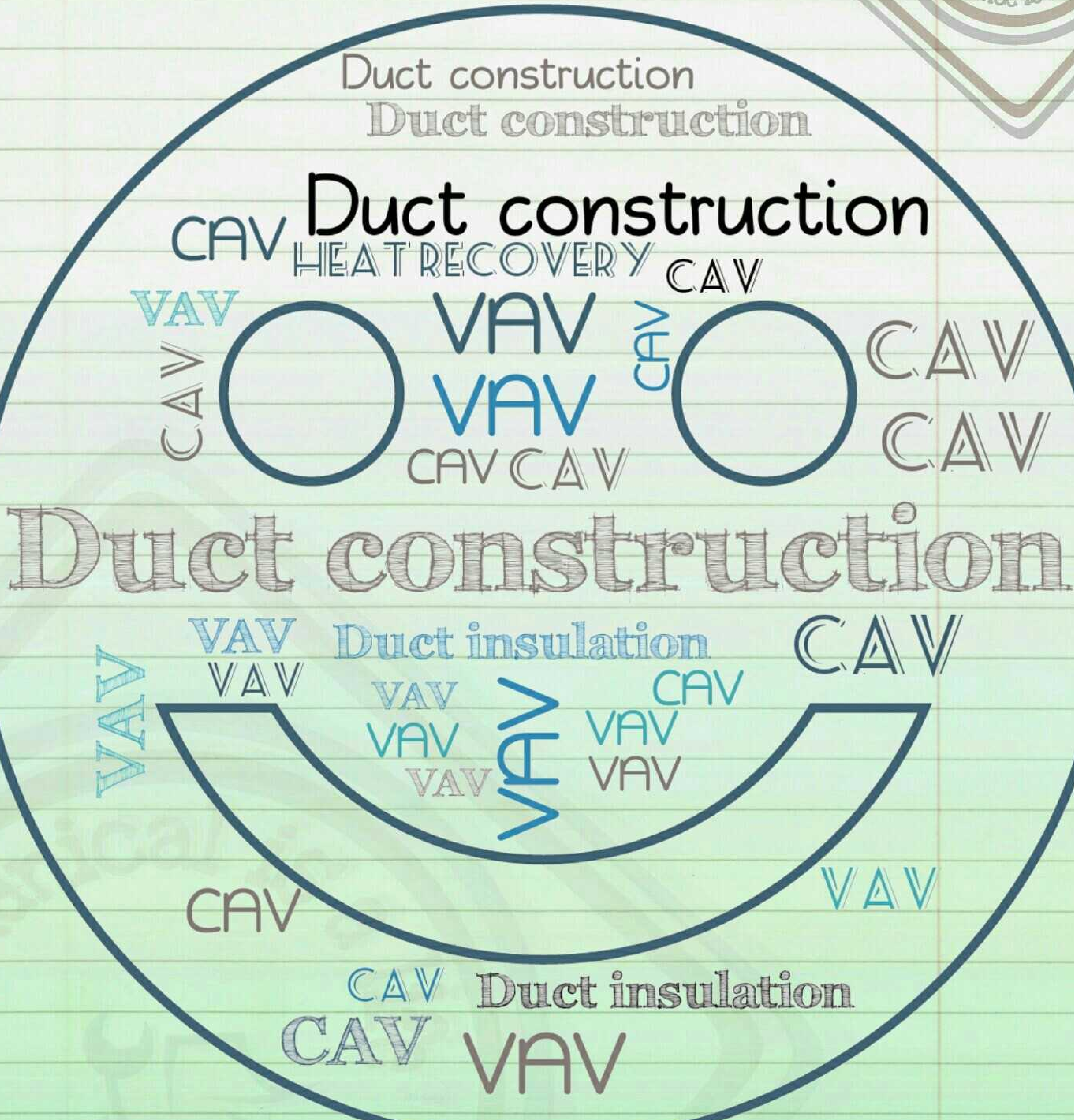
04

DUCT CONSTRUCTION 02

By

Eng. Ramy Ghoraba

HVAC



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GO! Part 04 contents

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Eng. Ramy Ghoraba

Materials

Materials

Duct insulation

Installation

MATERIALS

INSTALLATION Materials

Duct insulation

Installation

Installation

Materials

DUCT INSULATION

Duct insulation

Duct insulation

Duct insulation

ramygh.1982@gmail.com

Eng. Ramy Ghoraba

* Duct Insulation

A Sound Insulation

- Install in
  - Supply duct after the unit
  - Return duct before the Unit
  - Elbow (If needed)

- Insulation will be inside the duct.
- Insulation material is ArmaFlex

↳ Function

→ Damping the Sound level.

(B) Heat Insulation

Function → To prevent the heat transfer
→ To prevent Condensation of water vapor on the duct surface.
→ Install for all duct network.

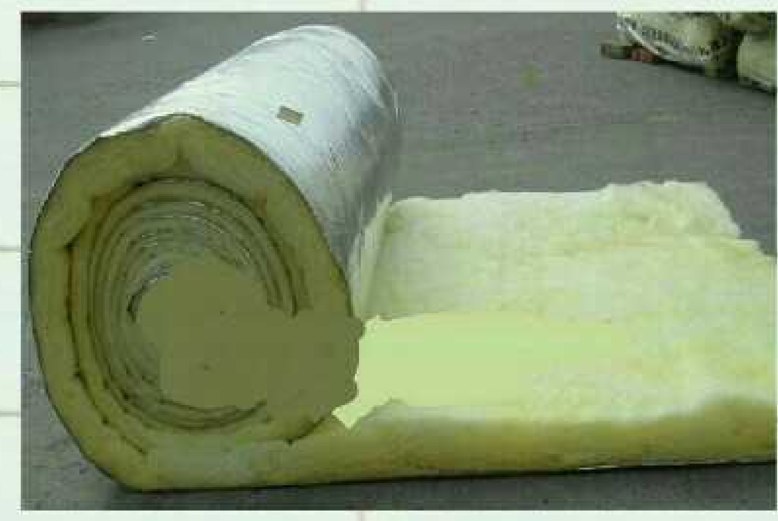
⊗→ Insulation material
→ Fiber glass

Density

12 Kg/m³

24 Kg/m³

48 Kg/m³



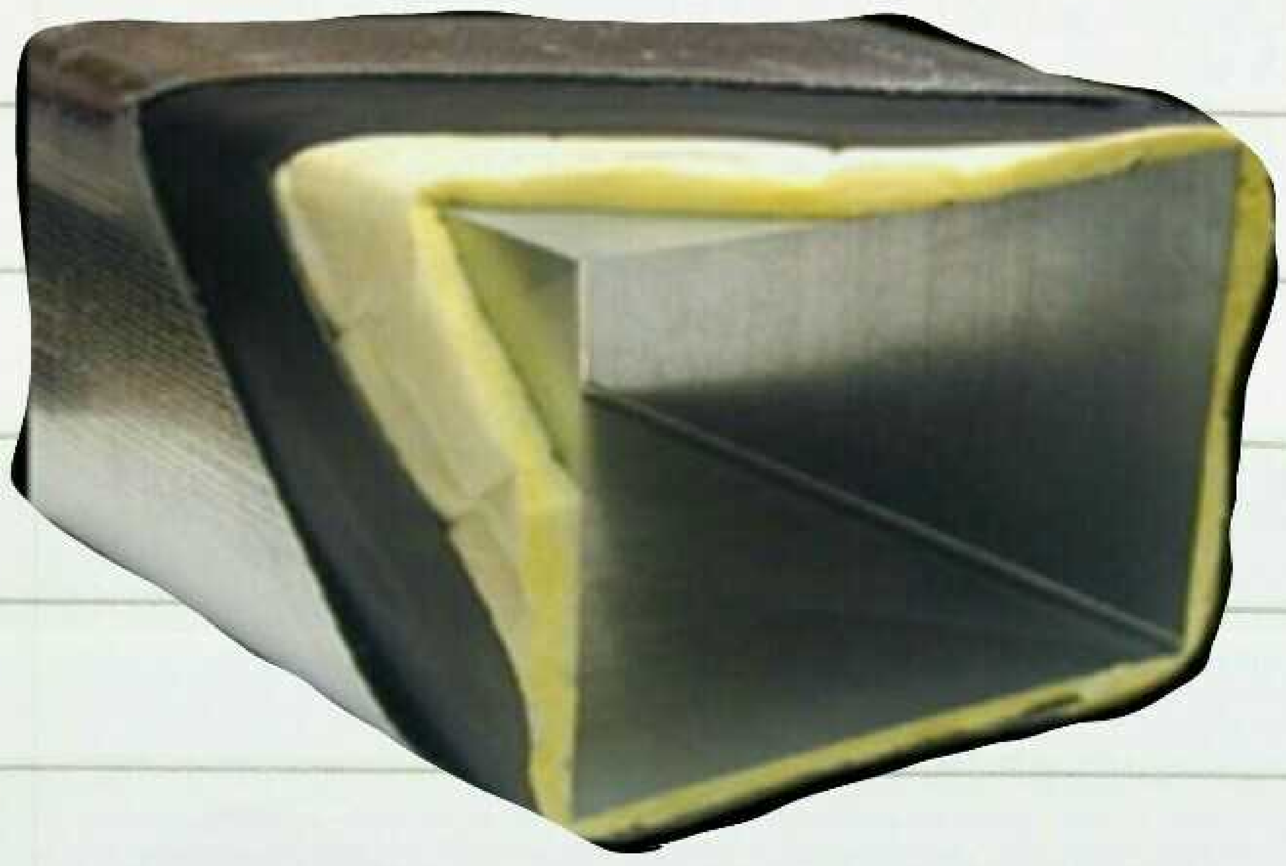
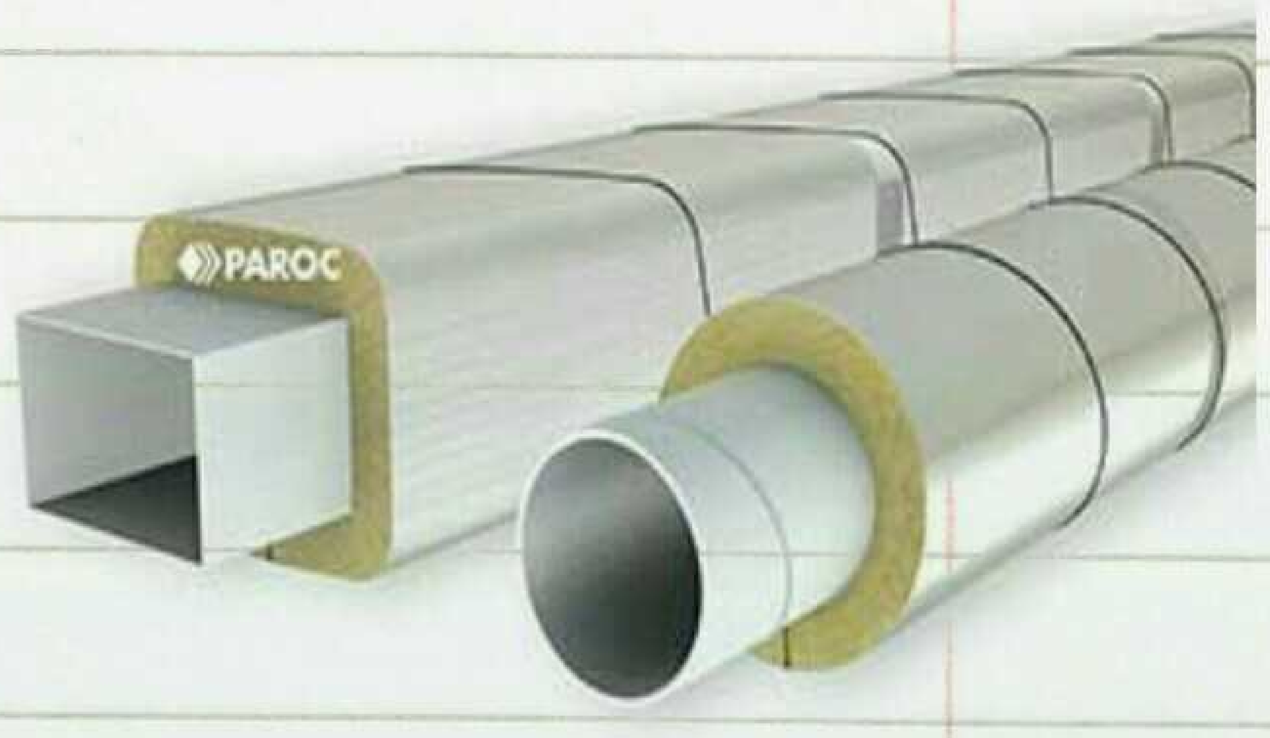
Thickness

1 inch

2 inch

- Indoor duct

Installed with 24 Kg/m³ density & 1" thickness
or as project specs.

- Outdoor duct

Installed with 48 Kg/m³ density & 2" thickness
Or as project specs.
Then we install Aluminum Cladding



Materials

Materials

Duct insulation

Installation

MATERIALS

INSTALLATION Materials

Duct insulation

Installation

Installation

Materials

DUCT INSULATION

Duct insulation

Duct insulation

Duct insulation

(*) Duct Insulation Steps

① Clean the duct surface very well

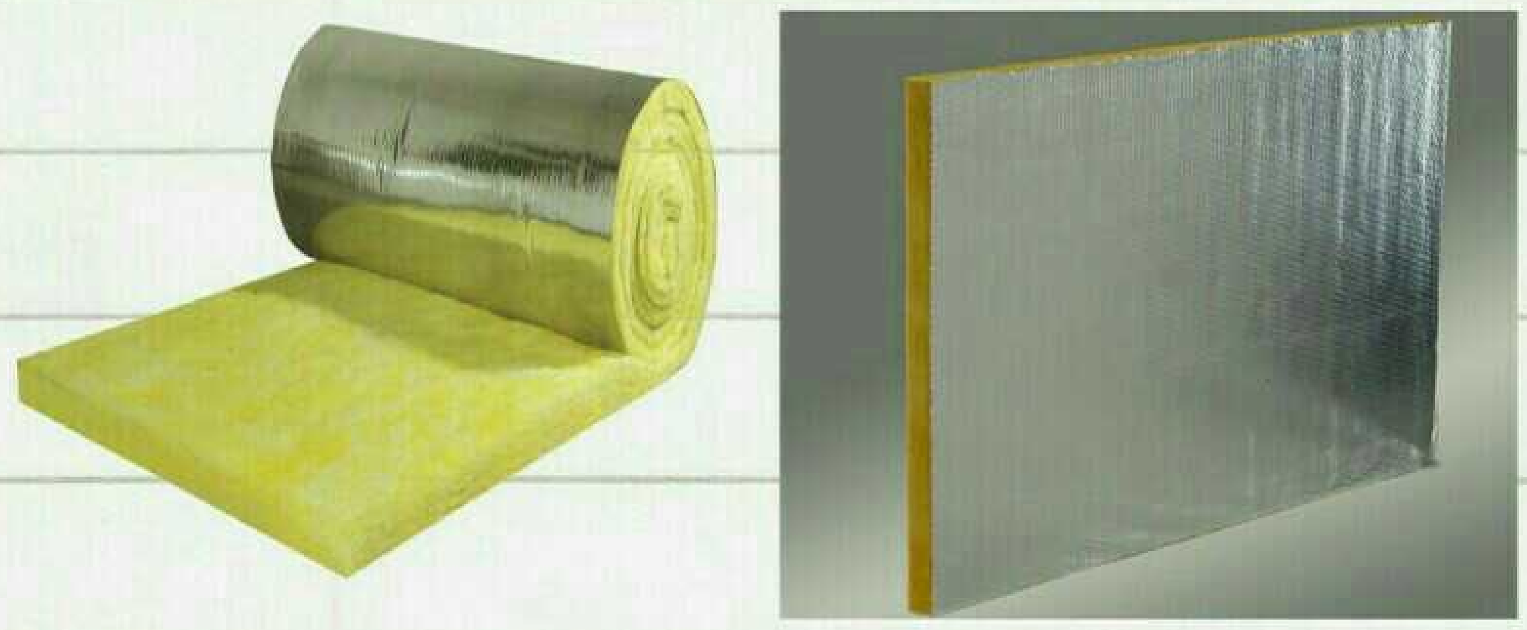
② paint an adhesive called (Pattix) on all duct surface with brush.

③ Install the insulation on the painting area one area by one area, then cut the extra insulation. and plast the insulation with tap.

④ After insulate the duct, Install aluminum or GI angle bar on each corner and tight the duct with angle bar strongly by the plastic strape and clamps

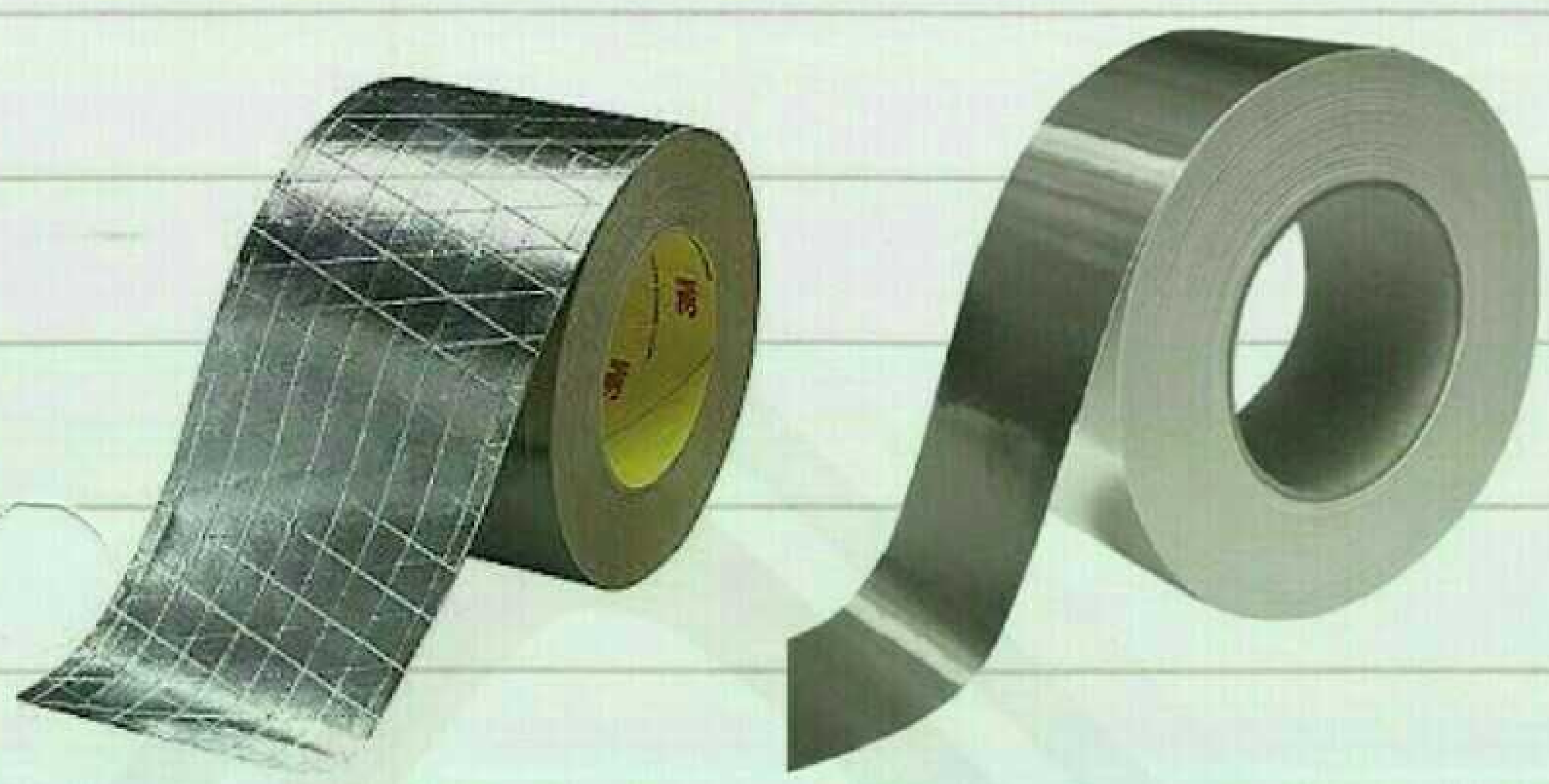
⑤ Install cloth cladding on the insulation

(*) Insulation Material



Insulation (Roll - Board)

Stick pin



Aluminum tape

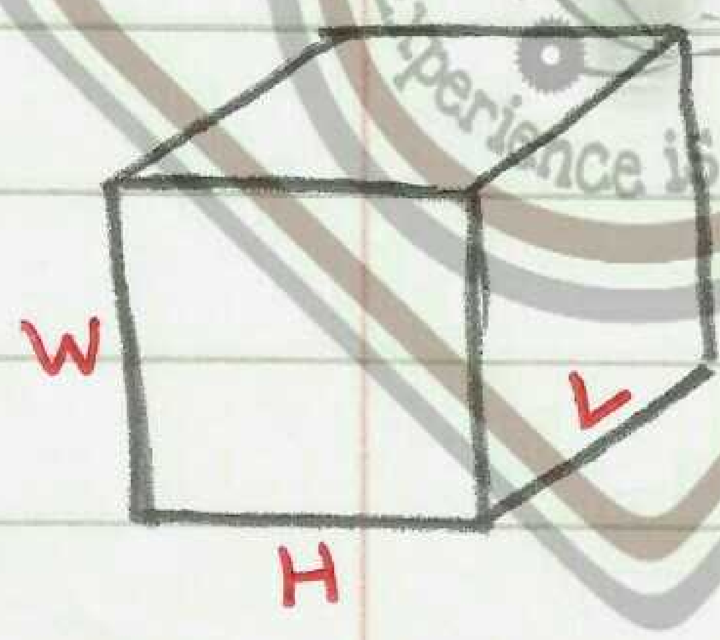
Plastic strap with clips

Canvas Coat -30 36

Cloths cladding

Aluminum cladding

(*) Duct Calculation



$$\underset{m^2}{\text{Area}} = 2 * (\underset{m}{W} + \underset{m}{H}) * \underset{m}{L}$$

(*)

Duct weight (Kg) = Area (m^2) x below Table

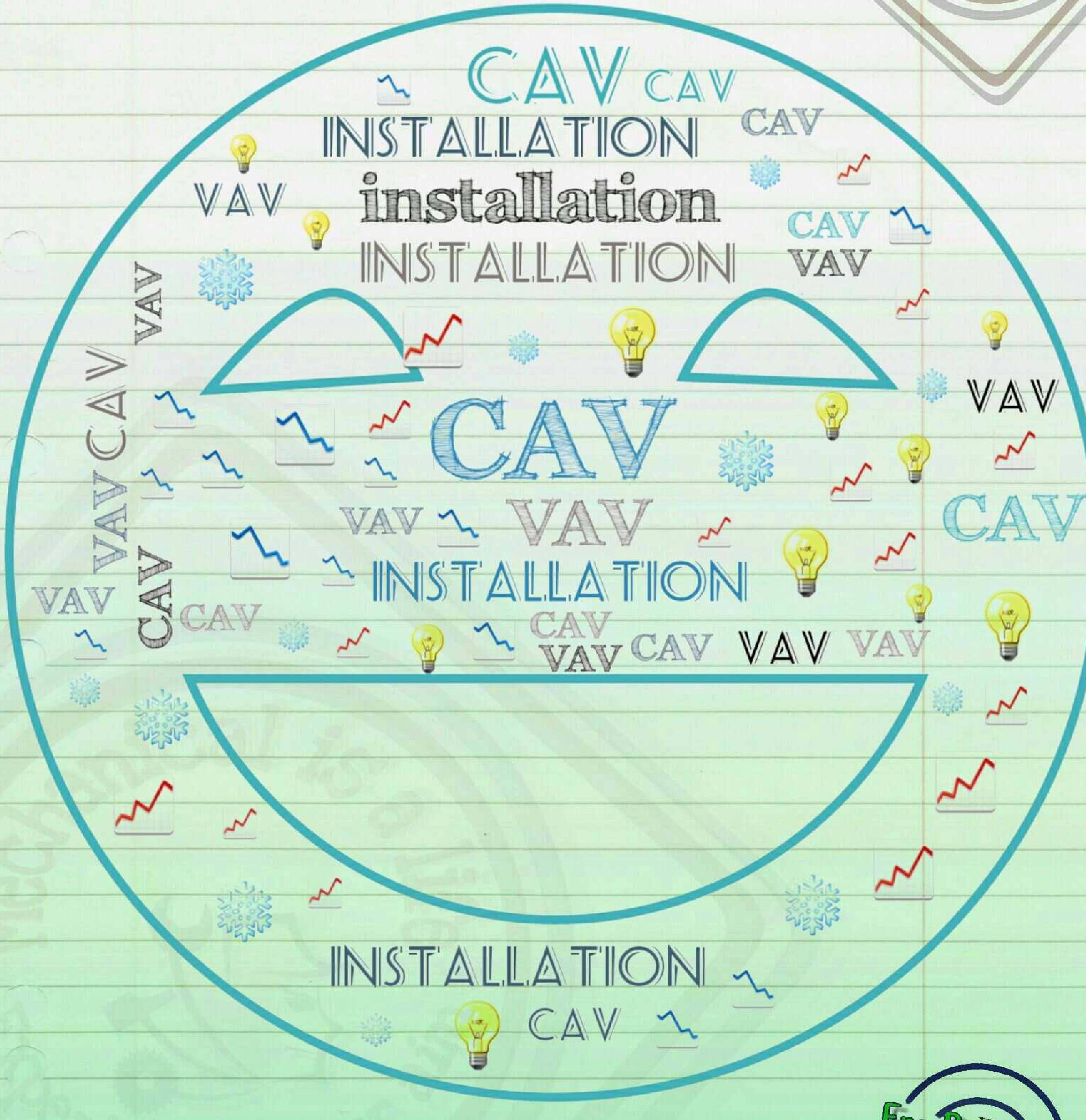
Gauge	thickness (mm)		By	To obtain
26	0.55	x	4.42	(kg)
24	0.7	x	5.64	(kg)
22	0.85	x	6.86	(kg)
20	1	x	8.1	(kg)
18	1.3	x	10.52	(kg)
16	1.61	x	12.96	(kg)

(*) Insulation area Calculation

$$\underset{(m^2)}{\text{Area}} = 0.05 (\underset{inch}{W} + \underset{inch}{H}) * \underset{m}{L}$$

(*)

HVAC



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Experience is our aim

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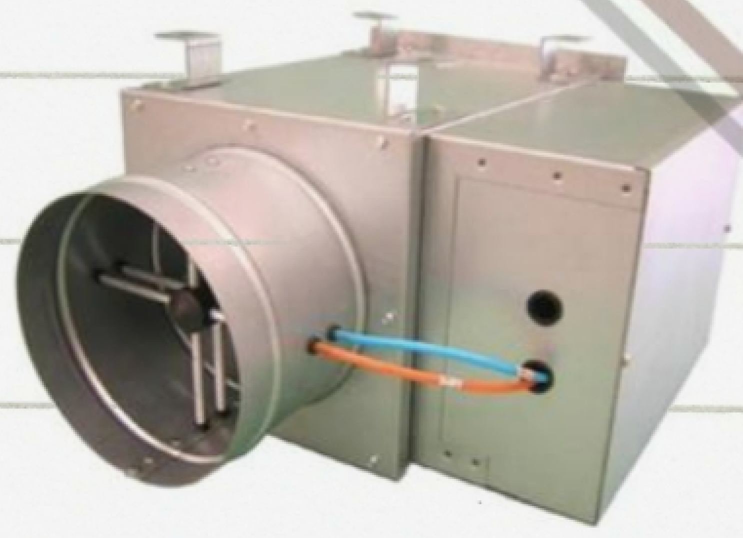
(*) VAV & CAV

① VAV - Variable air Volume



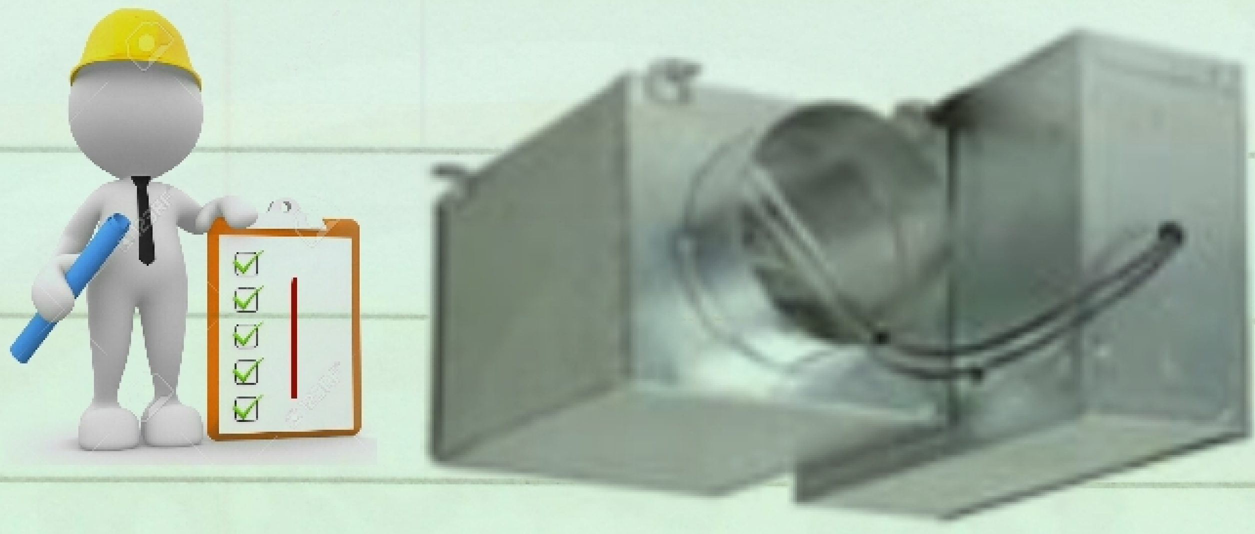
→ Temperature is constant.

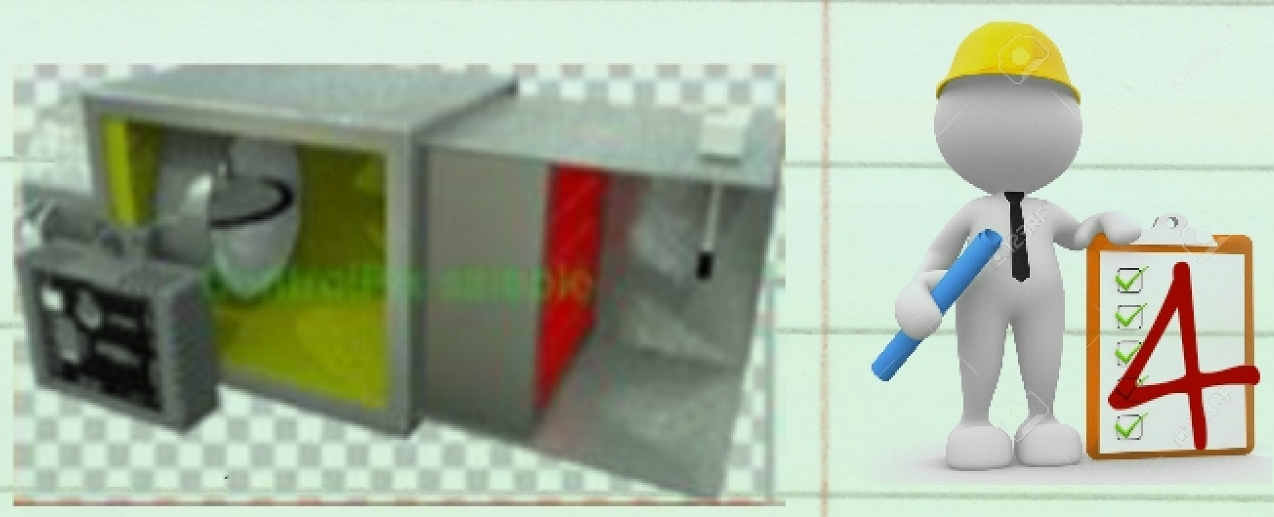
→ Air Flow is Varied.

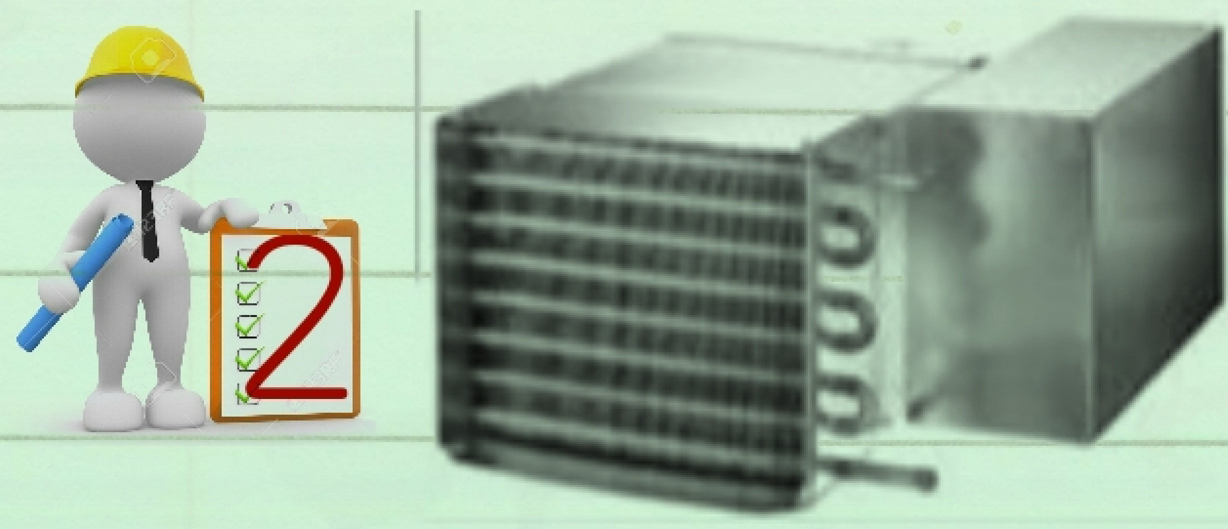
→ Separate temperature Control for each room by thermostate

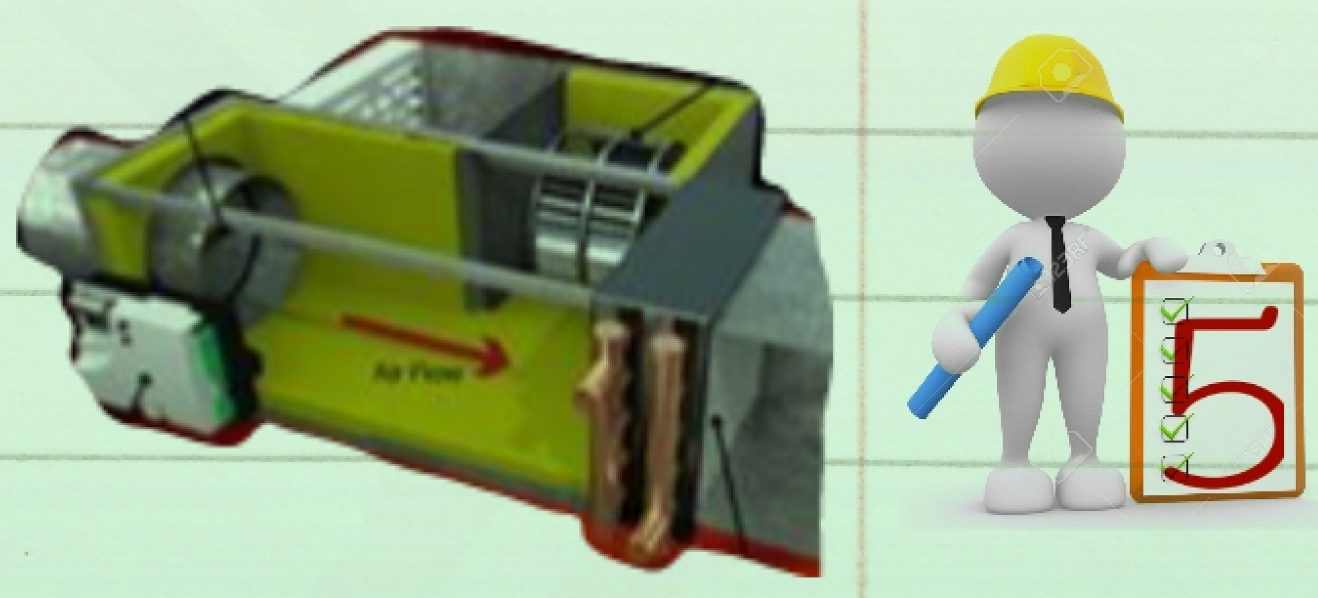
→ Types

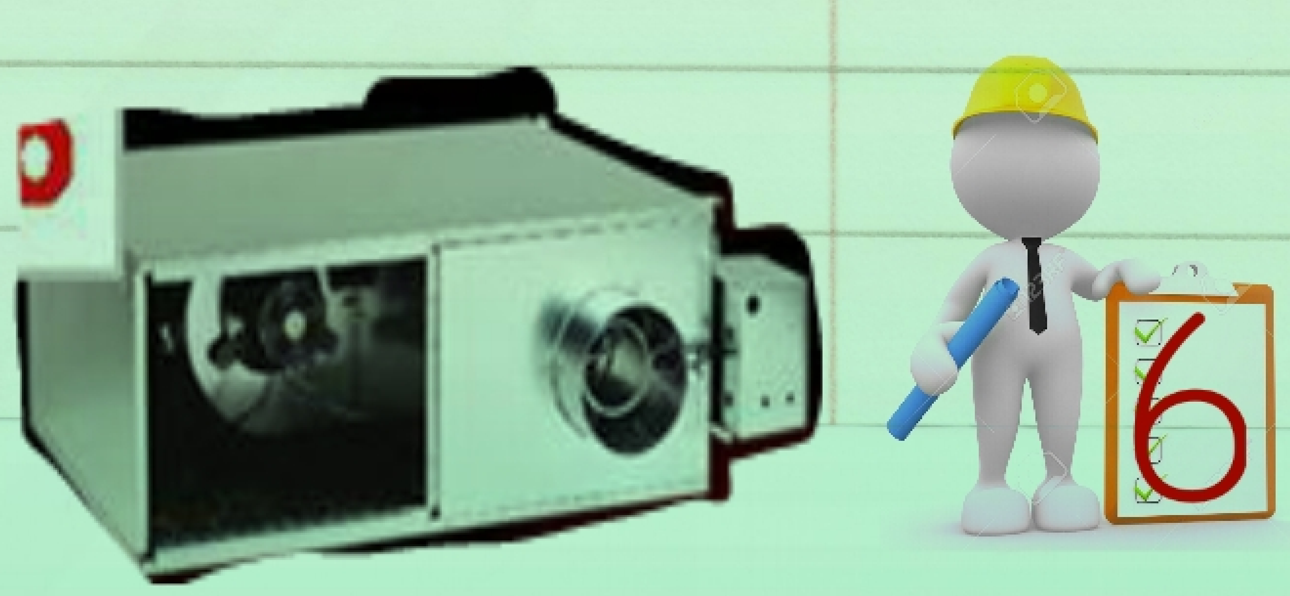
—— ① single duct Cooling only
② Single duct Cooling with hot water Coil
③ Dual duct unit
④ Parallel fan - powered unit Cool only
⑤ Parallel fan - Powered unit with hot water coil
⑥ Parallel fan - Powered Unit with electric coil





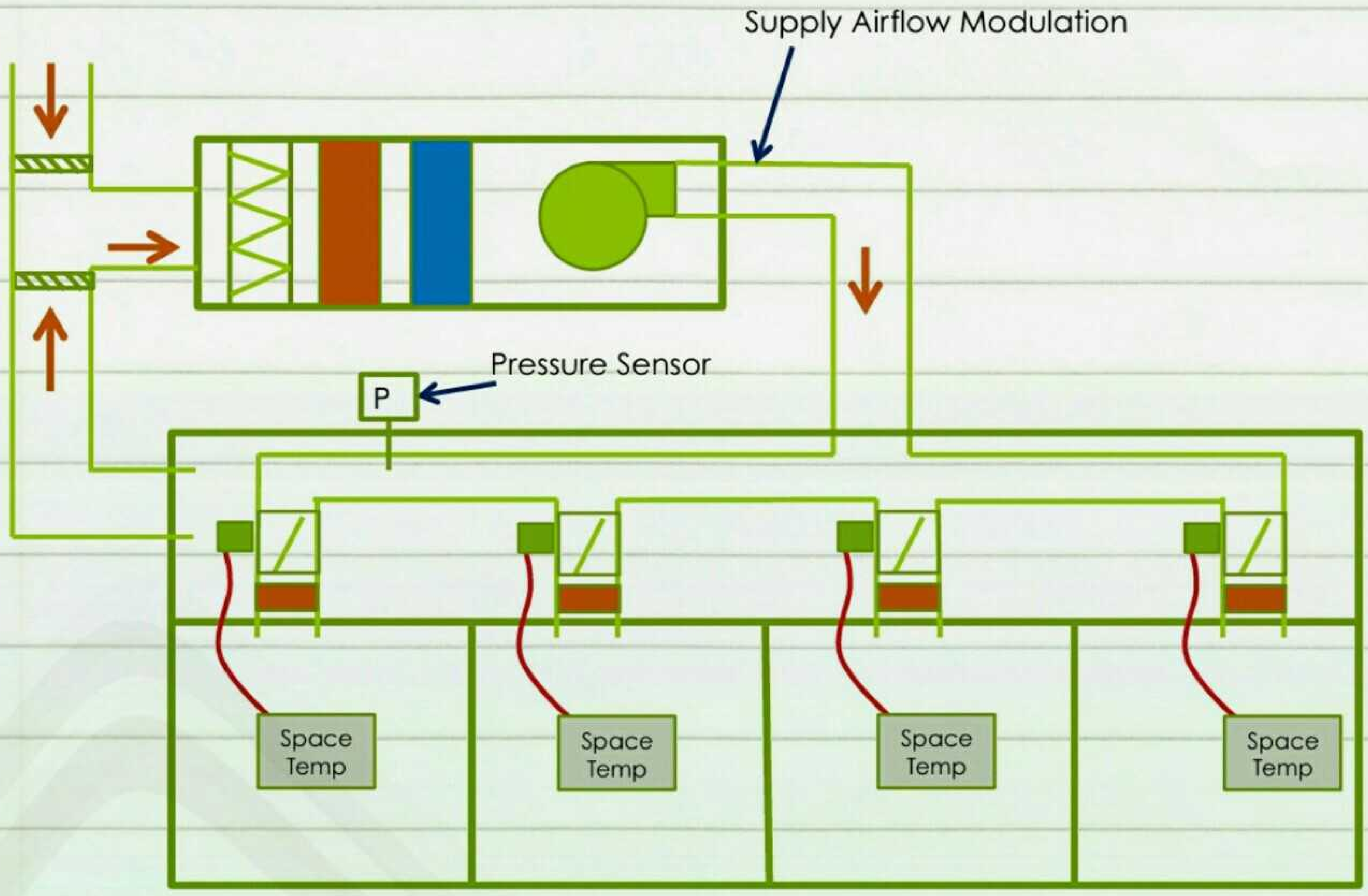


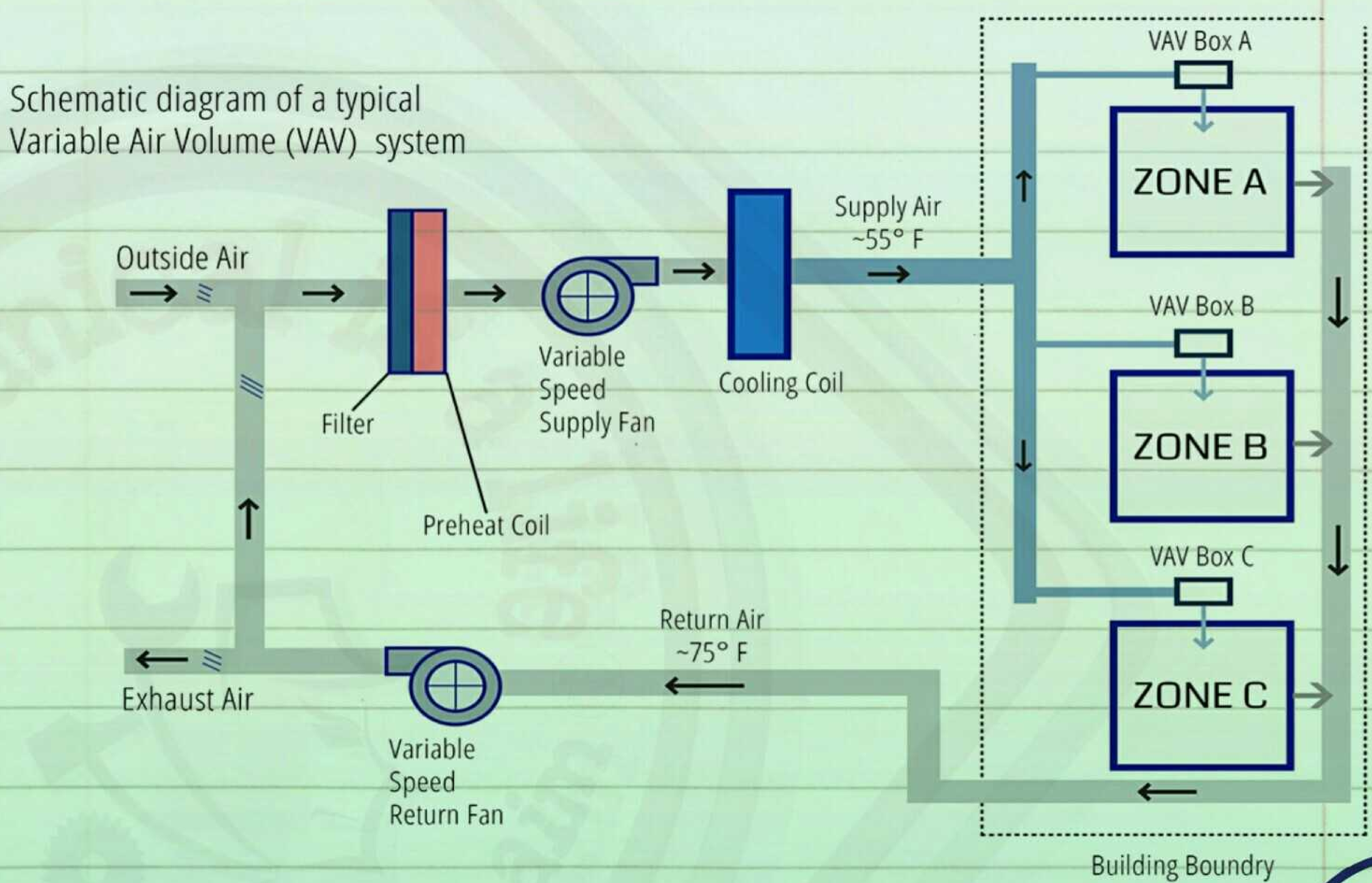




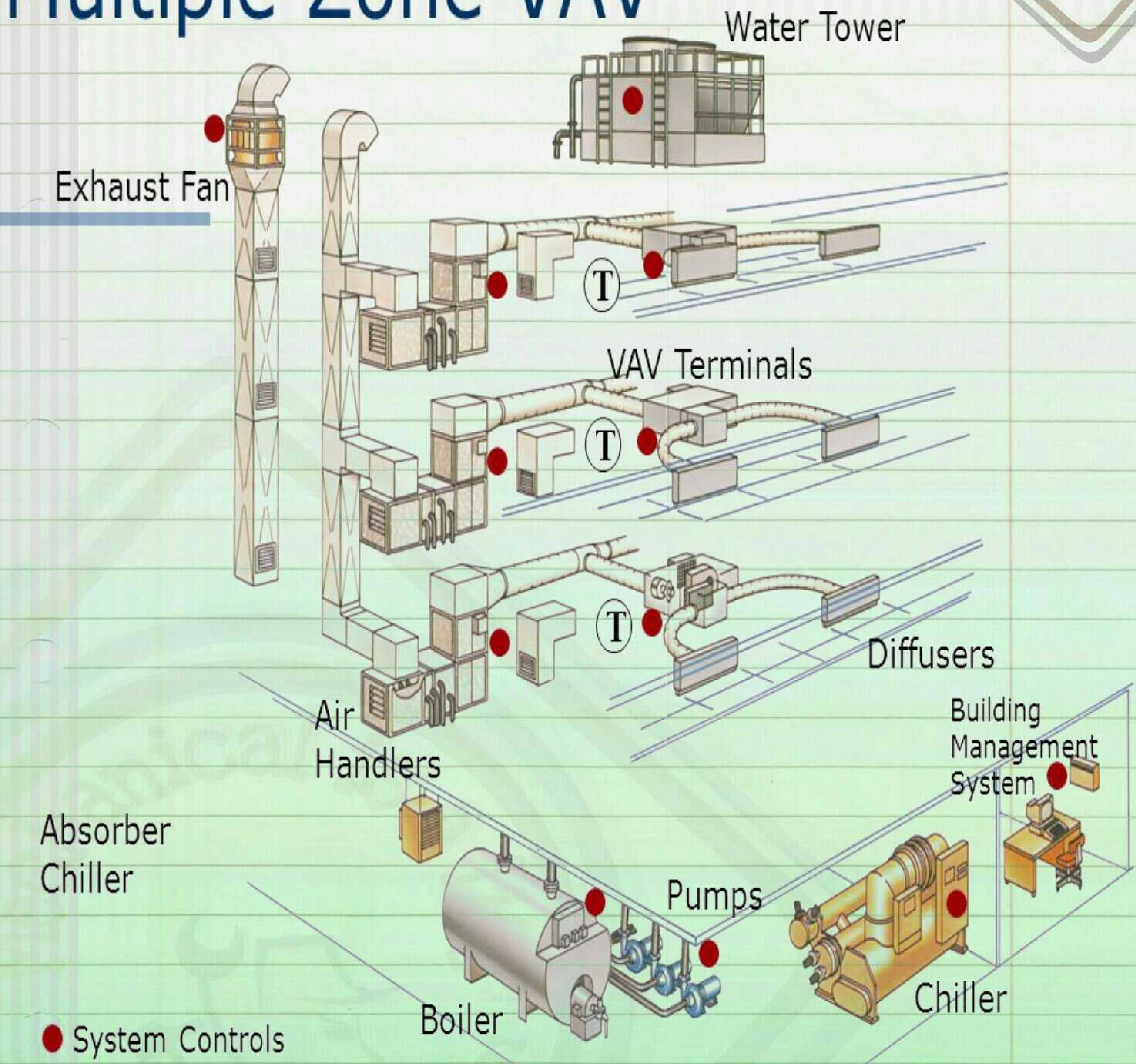
VAV System

Basic Concept

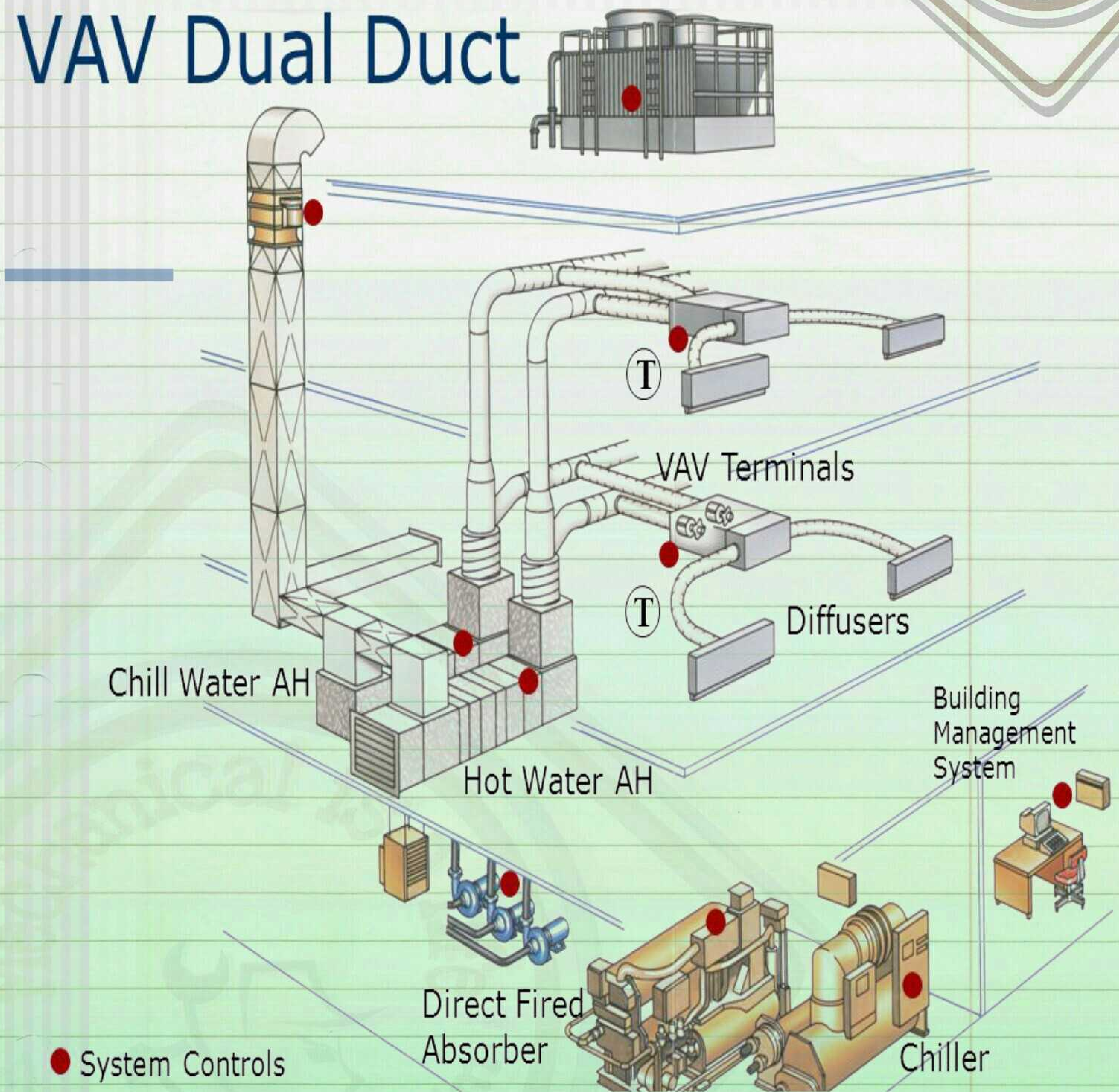




Multiple Zone VAV



VAV Dual Duct

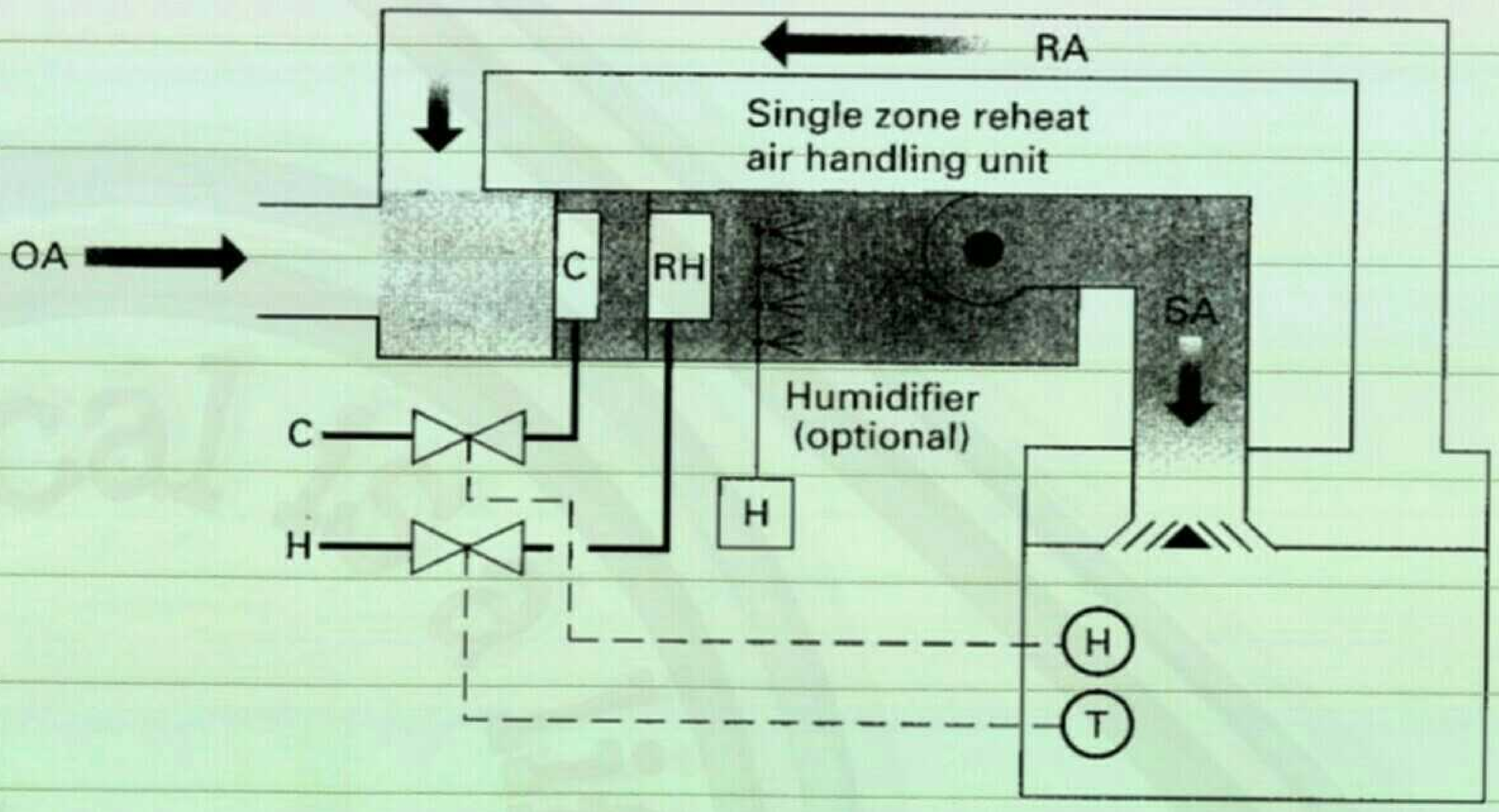


② CAV - Constant air Volume

→ Temperature is Varied
→ Air Flow is Constant
→ Serve only a single zone

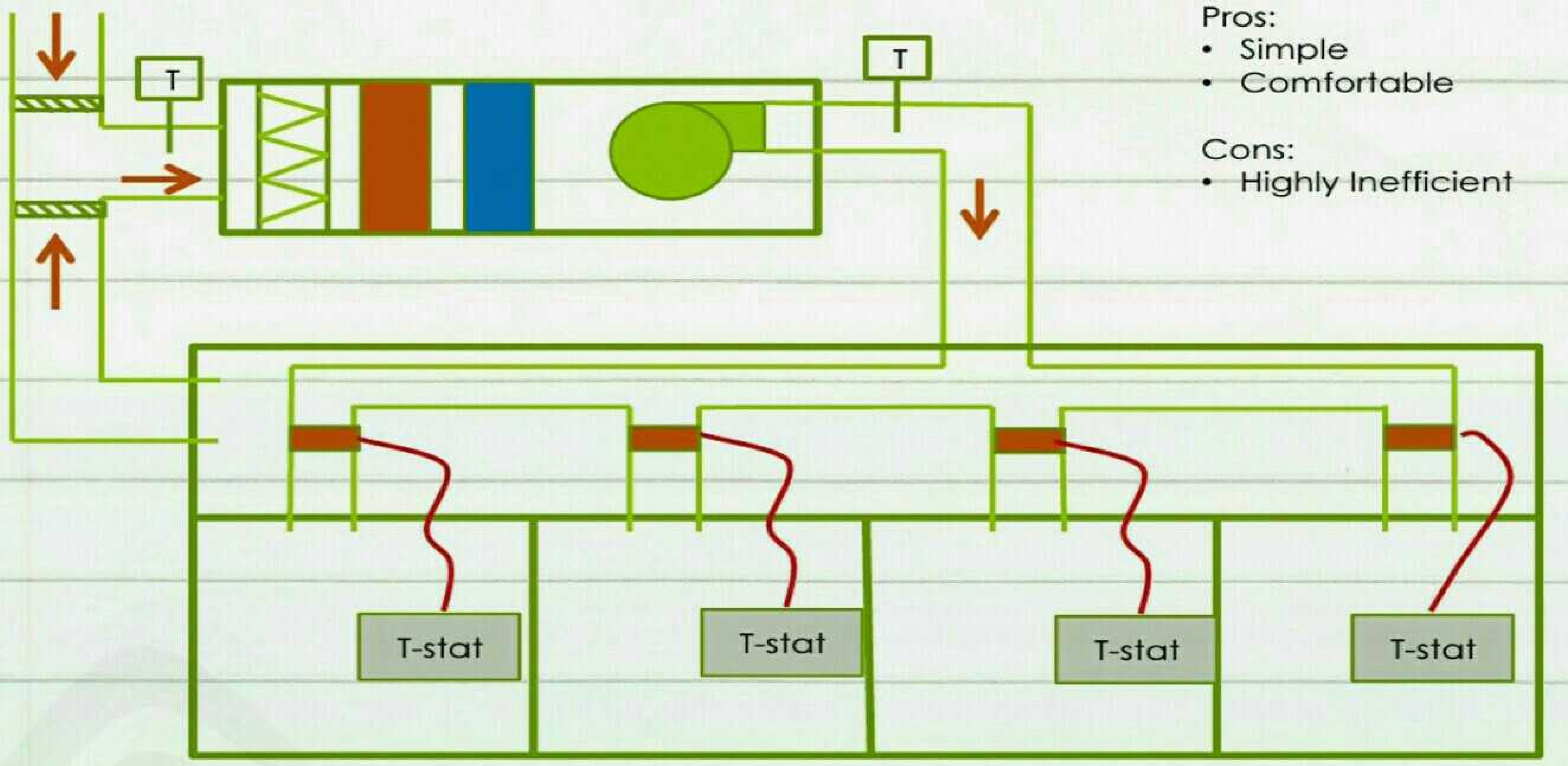
→ Types
① CAV single Zone
② CAV with reheat
③ CAV primary - secondary
(Can serve multiple Zones)

Single zone CAV



Constant Volume System

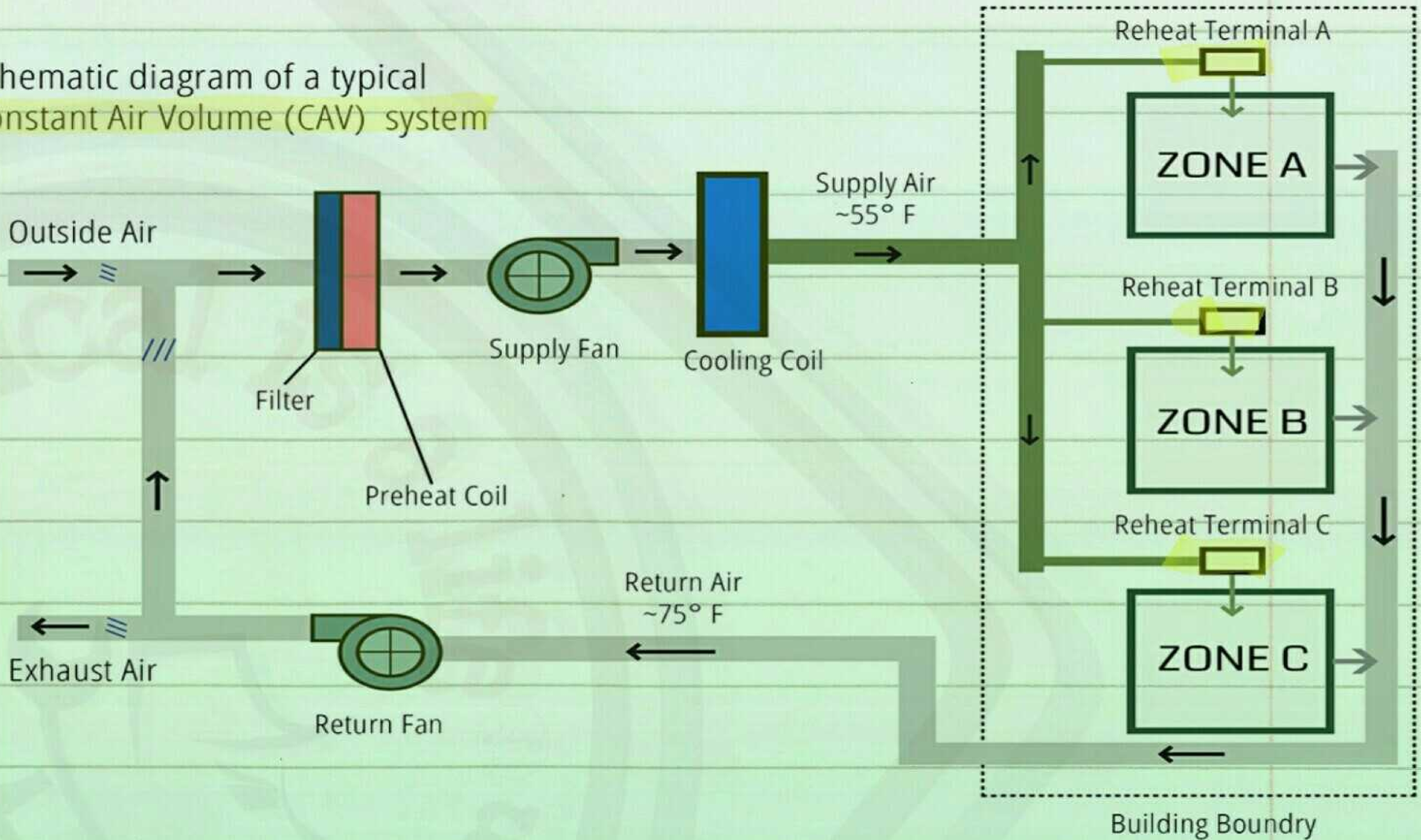
Zone Reheat – Space Control



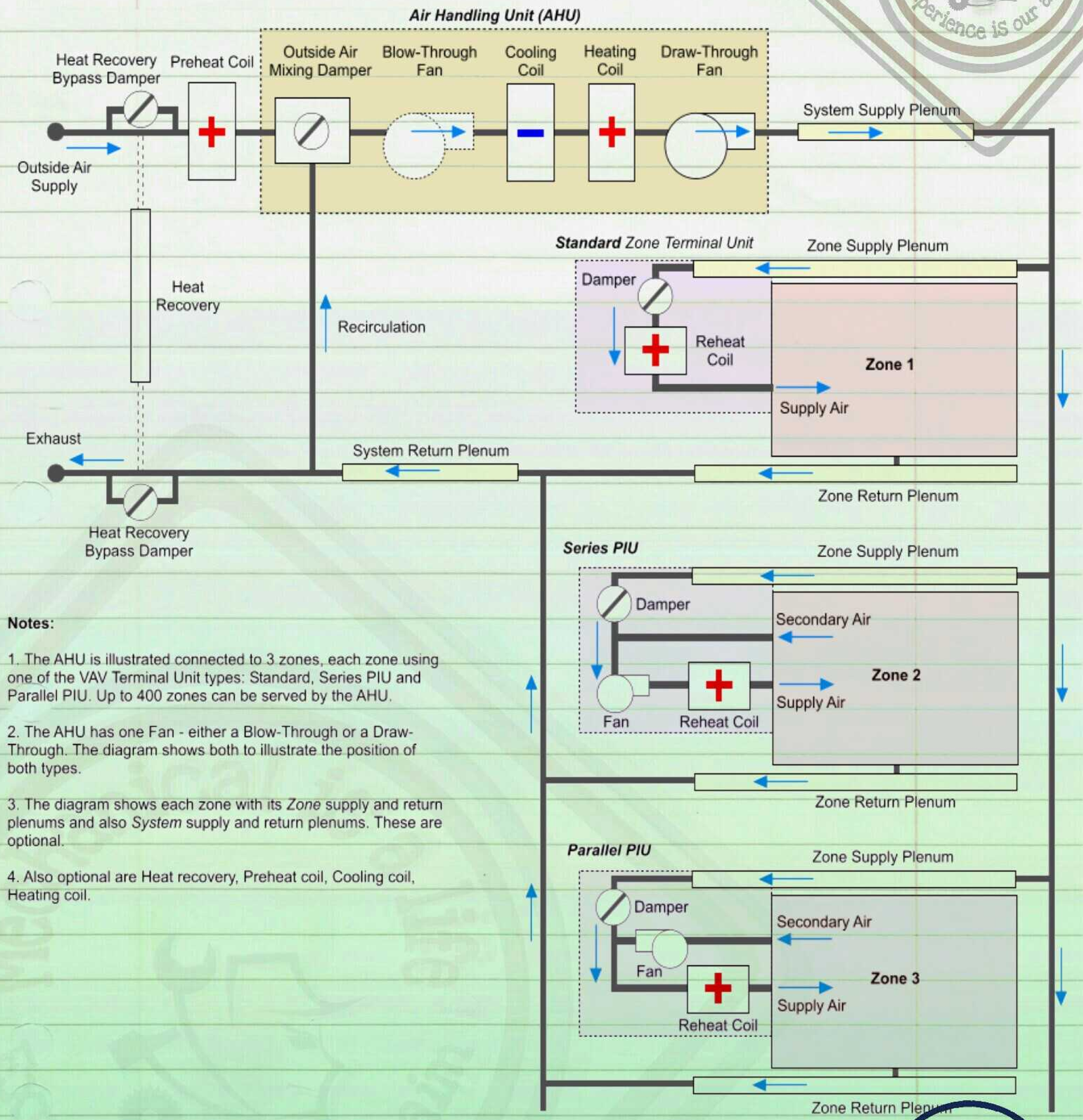
Pros:
- Simple
- Comfortable

Cons:
- Highly Inefficient

Schematic diagram of a typical
Constant Air Volume (CAV) system



VAV Compact HVAC Airflow Schematic



Notes:

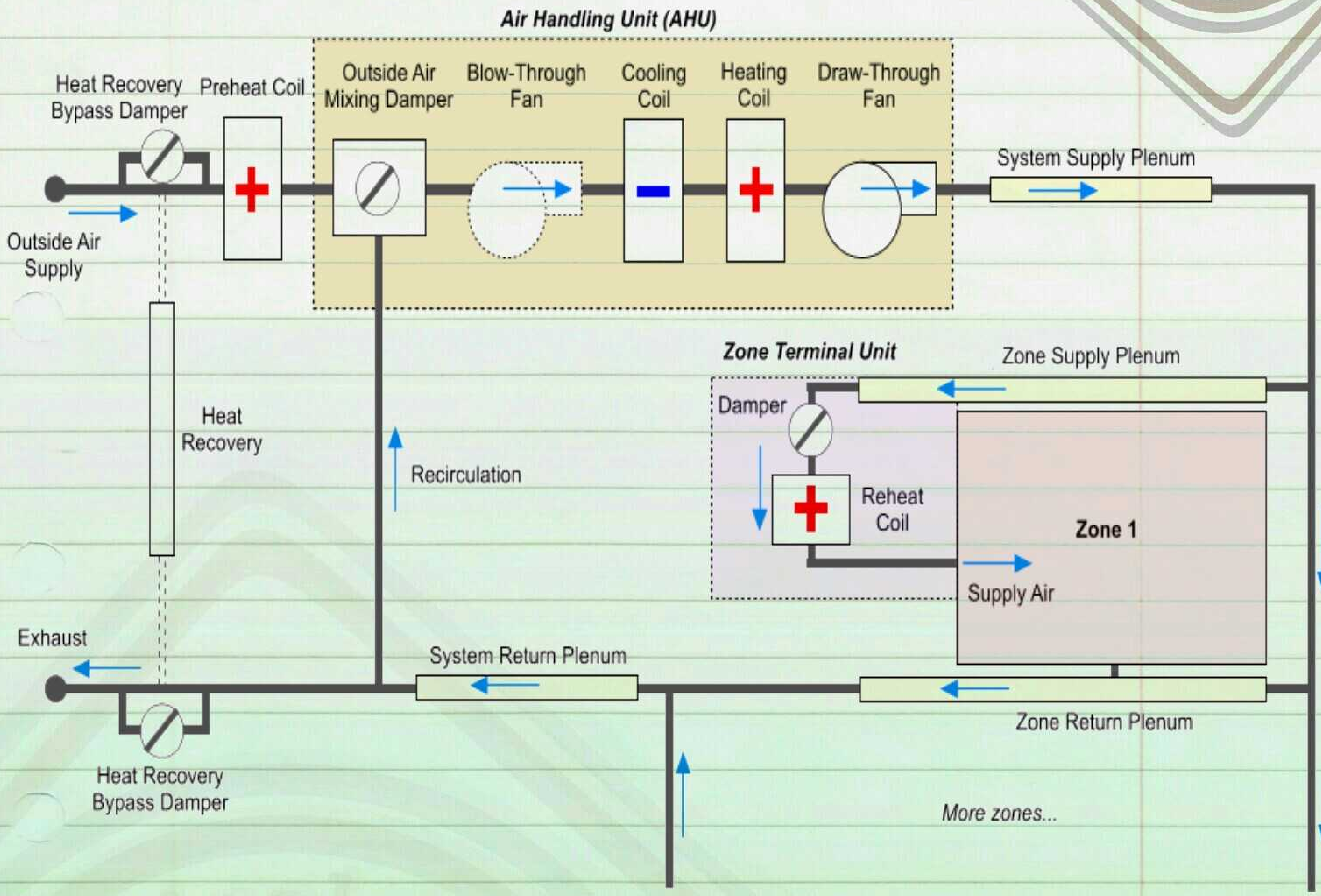
1. The AHU is illustrated connected to 3 zones, each zone using one of the VAV Terminal Unit types: Standard, Series PIU and Parallel PIU. Up to 400 zones can be served by the AHU.

2. The AHU has one Fan - either a Blow-Through or a Draw-Through. The diagram shows both to illustrate the position of both types.

3. The diagram shows each zone with its *Zone* supply and return plenums and also *System* supply and return plenums. These are optional.

4. Also optional are Heat recovery, Preheat coil, Cooling coil, Heating coil.

CAV Compact HVAC Airflow Schematic



Notes:

1. The AHU is illustrated connected to a single zone.Up to 400 zones can be served by the CAV AHU.

2. The AHU has one Fan - either a Blow-Through or a Draw-Through. The diagram shows both to illustrate the position of both types.

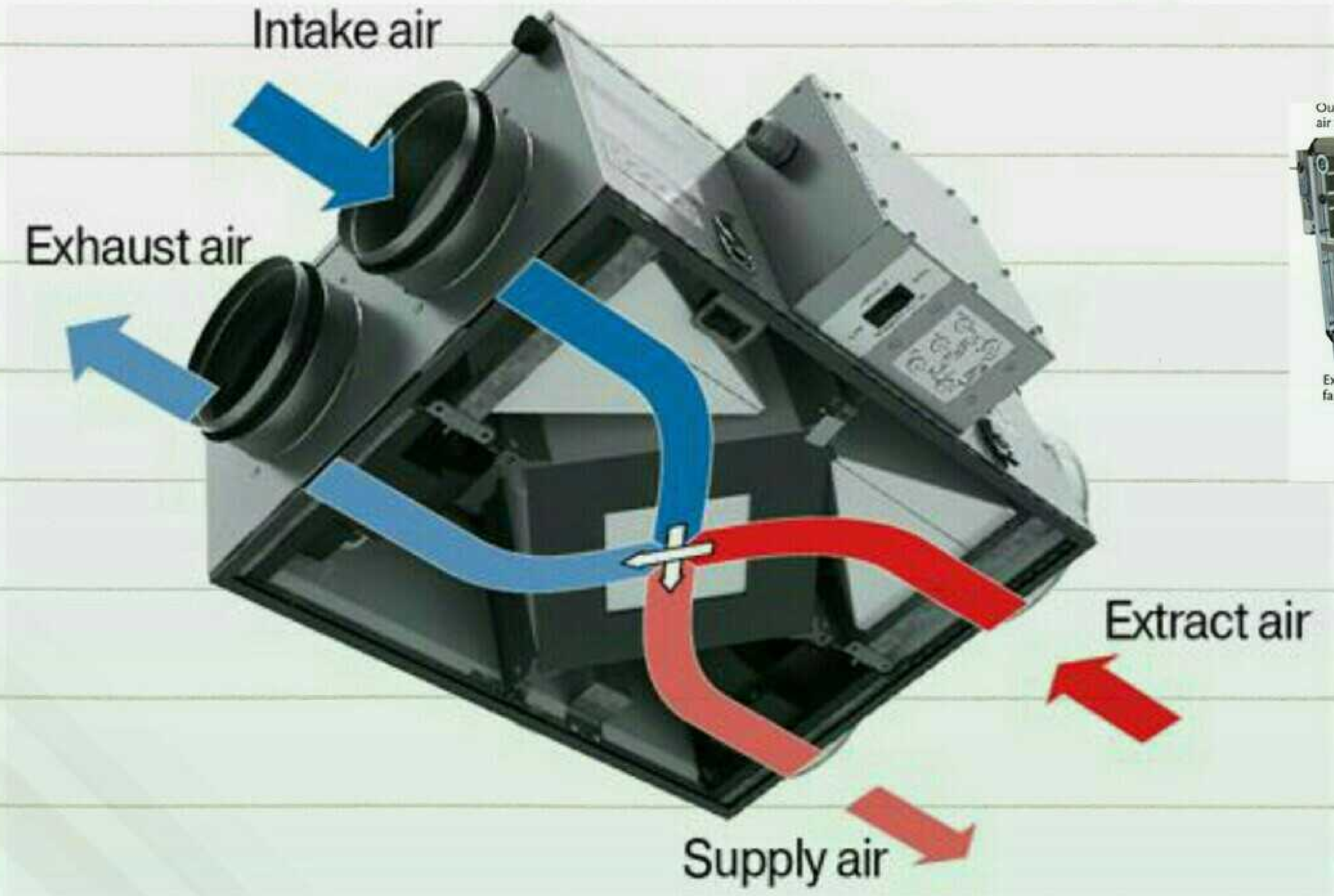
3. The diagram shows each zone with its *Zone* supply and return plenums and also *System* supply and return plenums. These are optional.

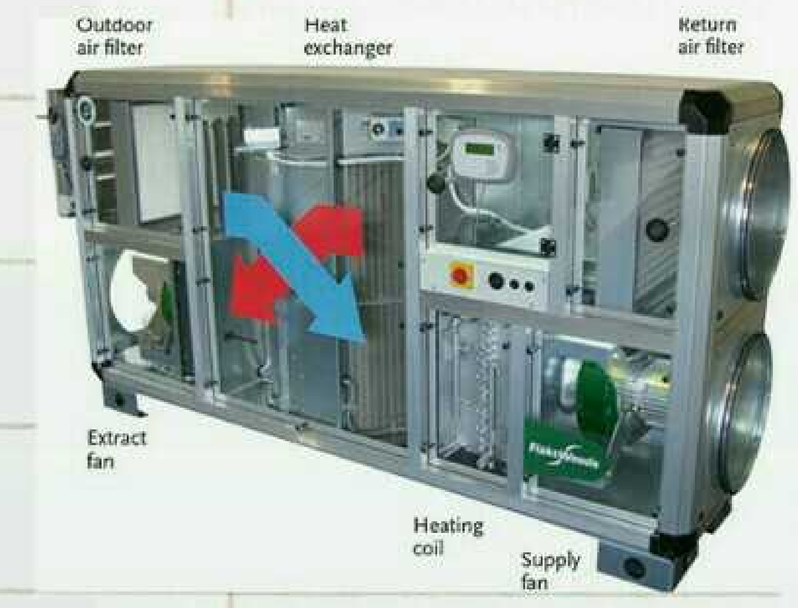
4. Also optional are Heat recovery, Preheat coil, Cooling coil, Heating coil.

Energy Recovery Ventilation - ERV

The recovery of heat by the heat transfer between the exhaust air (cold air) and the fresh air from outside

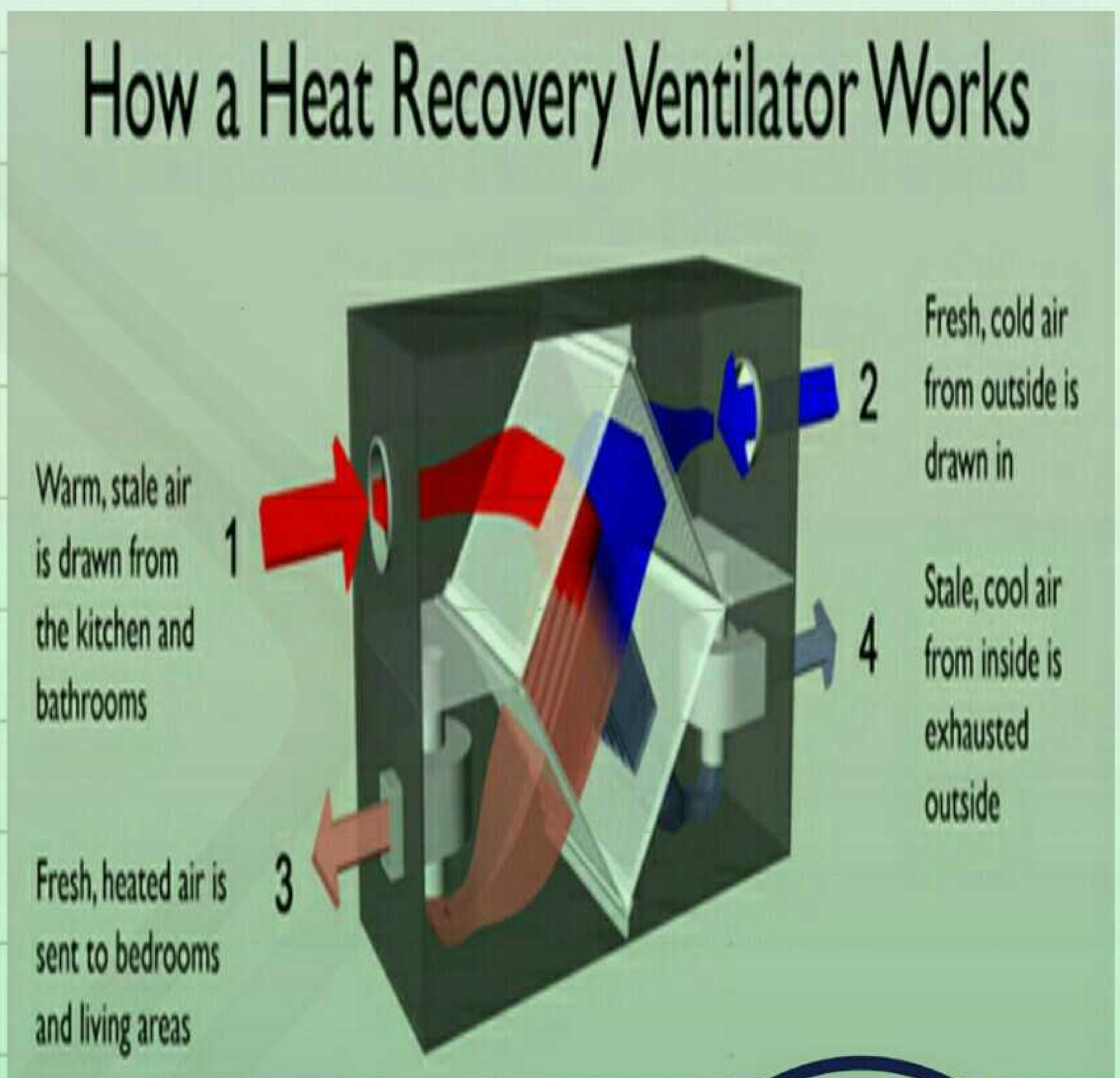
It reduce the energy cost and the capacity of the equipement

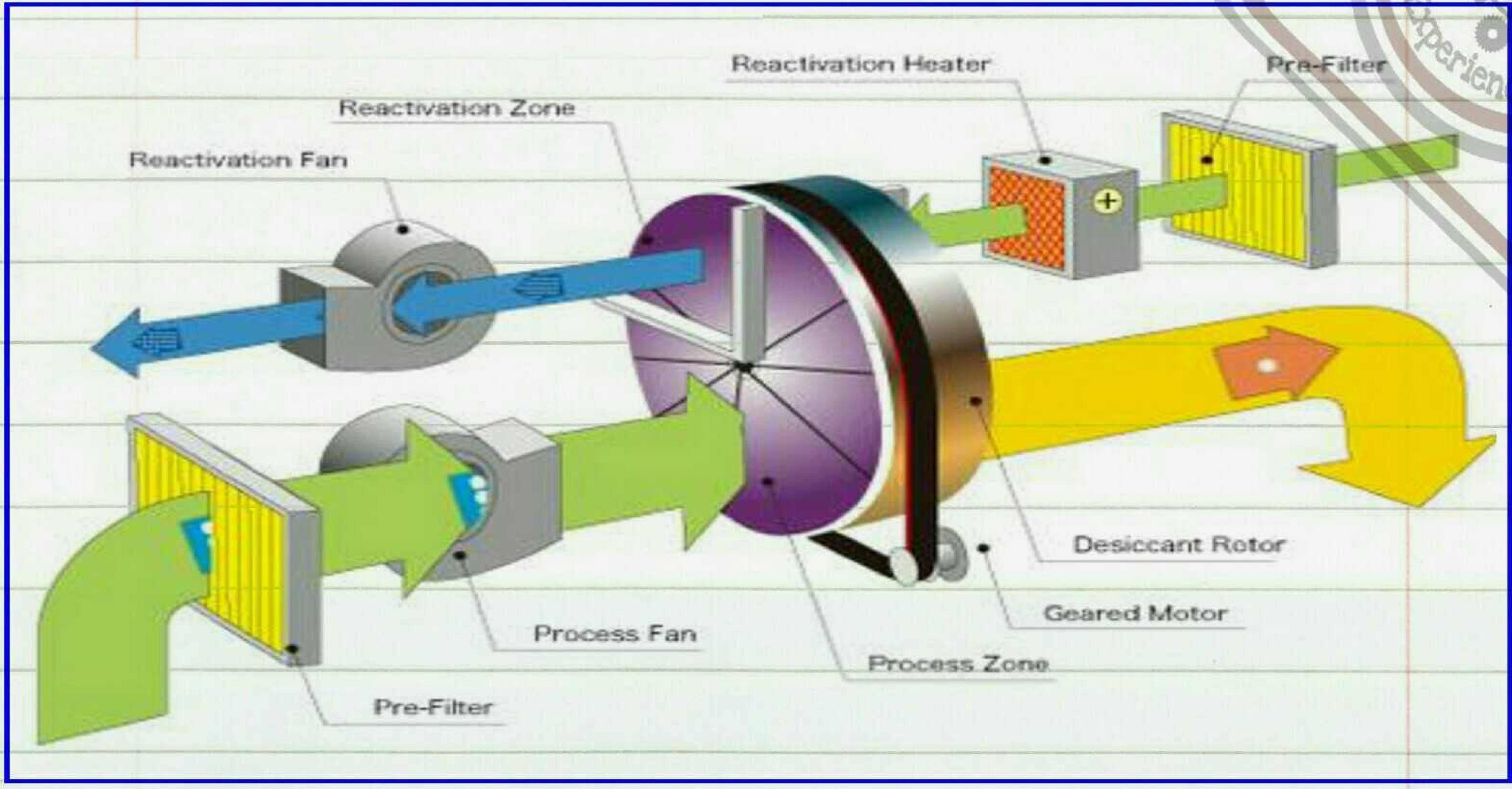


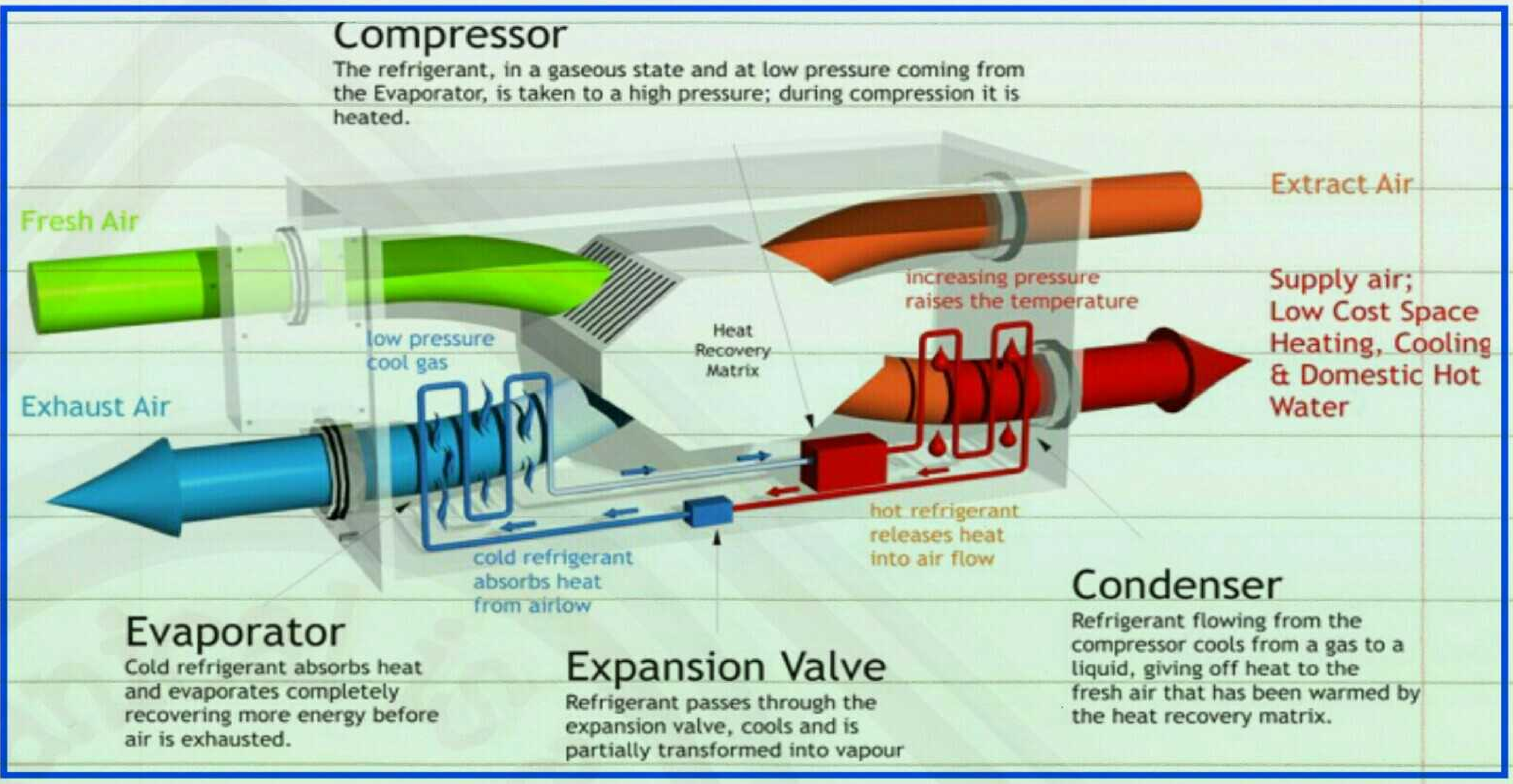


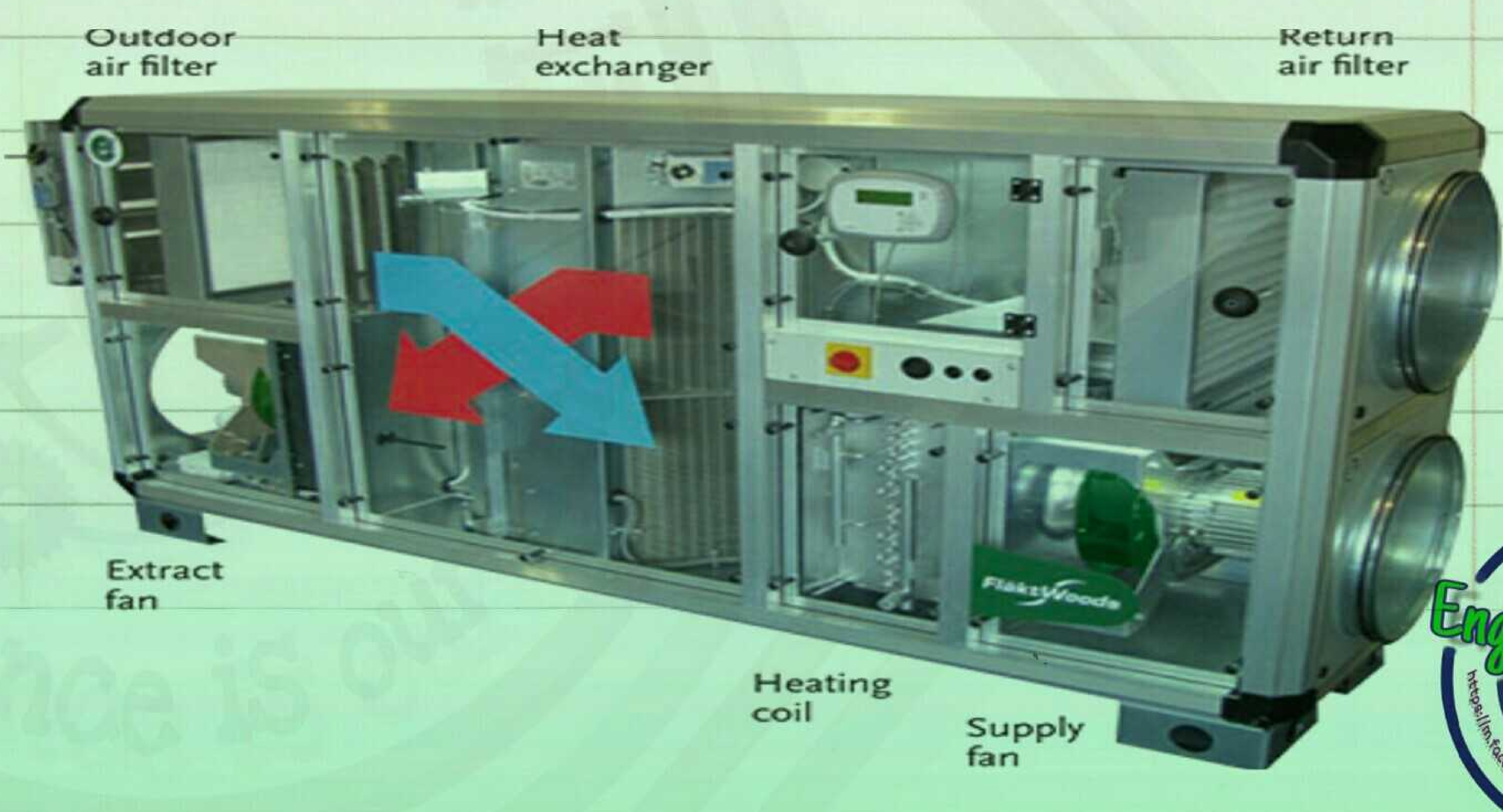
Heat Recovery Wheel / Desiccant Cooling

- The wheel is positioned typically in the duct system so that return air is drawn through its one half and outdoor air is drawn through its other half in a counter flow pattern.
- The wheel is rotated at 2 to 20 rpm
- Sensible heat is transferred as the metallic substrate picks up and store heat from the hot air steam and gives it up to the cold one.
- Latent heat is transferred as the desiccant on the wheel absorbs moisture from the higher humidity air stream and releases the same into the air stream that has a lower humidity ratio




Reactivation Heater
Pre-Filter
Reactivation Zone
Reactivation Fan
Desiccant Rotor
Geared Motor
Process Fan
Process Zone
Pre-Filter


Compressor
The refrigerant, in a gaseous state and at low pressure coming from the Evaporator, is taken to a high pressure; during compression it is heated.
Extract Air
Fresh Air
increasing pressure raises the temperature
Supply air; Low Cost Space Heating, Cooling & Domestic Hot Water
low pressure cool gas
Heat Recovery Matrix
Exhaust Air
hot refrigerant releases heat into air flow
cold refrigerant absorbs heat from airlow
Condenser
Refrigerant flowing from the compressor cools from a gas to a liquid, giving off heat to the fresh air that has been warmed by the heat recovery matrix.
Evaporator
Cold refrigerant absorbs heat and evaporates completely recovering more energy before air is exhausted.
Expansion Valve
Refrigerant passes through the expansion valve, cools and is partially transformed into vapour


Outdoor air filter
Heat exchanger
Return air filter
Extract fan
Heating coil
Supply fan

Ramy Ghoraba