

# INTRODUCTION

## **Definition:**

Heat exchangers are devices that transfer or exchange heat from one media to another. It is used either for cooling or for heating purpose.

The mediums flowing inside the heat exchanger may be gas or liquid depending upon the service requirements of the process.

The transfer of thermal energy (heat) can be accomplished in three ways:

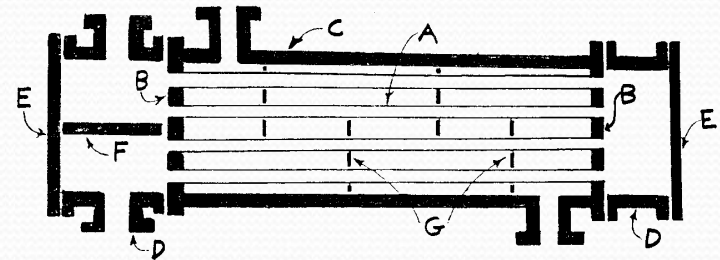
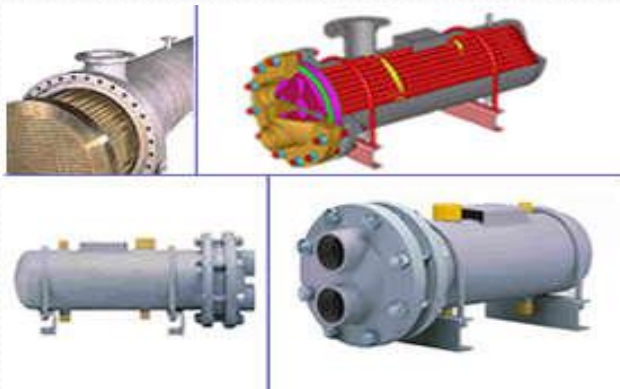
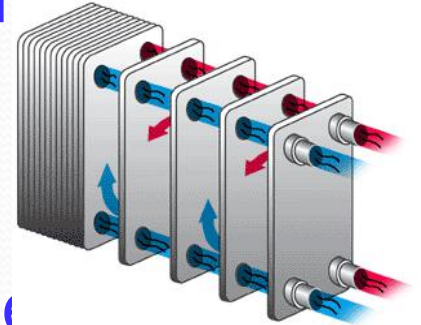
Radiation

Convection

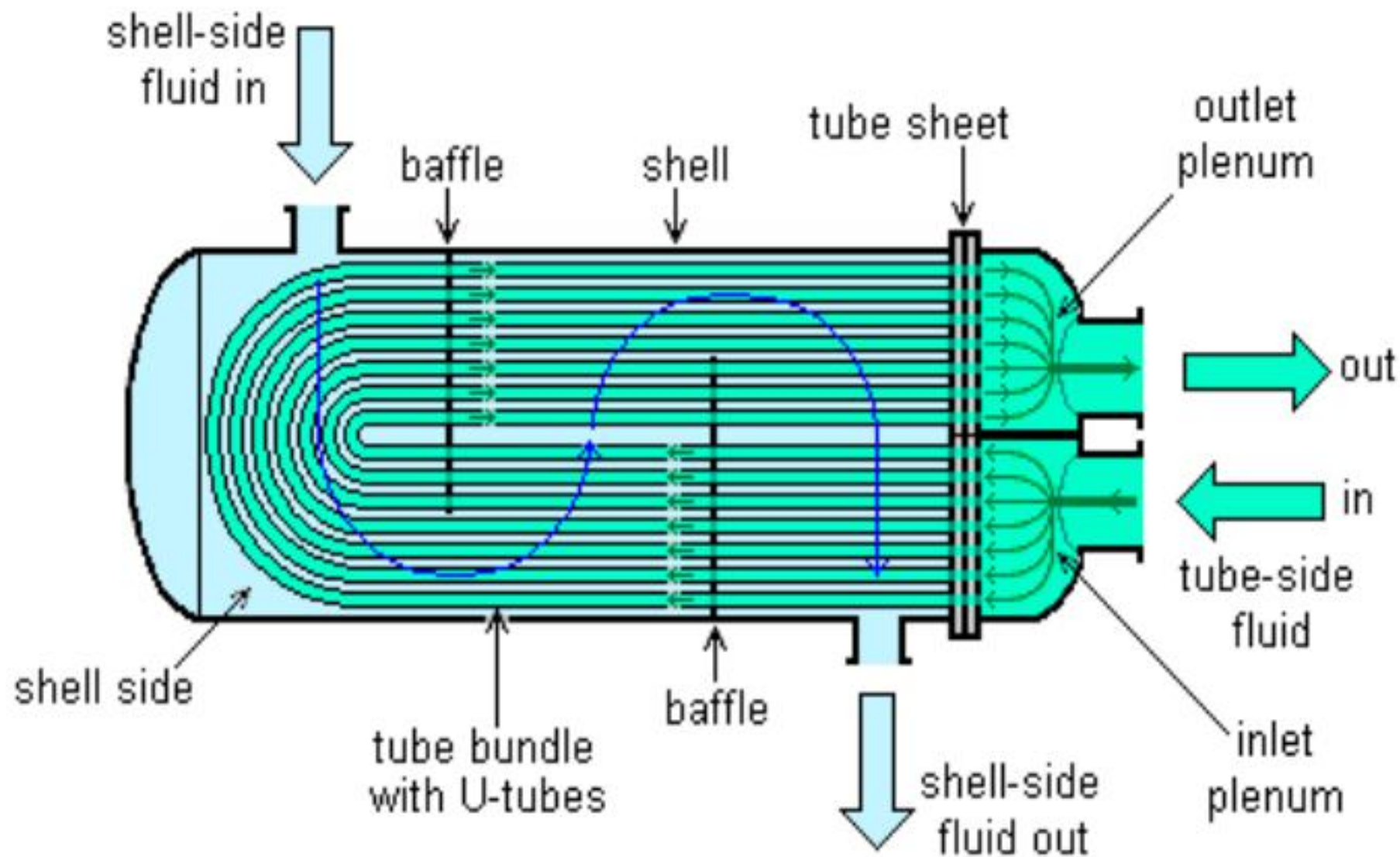
Conduction

# TYPES OF HEAT EXCHANGER

- ◆ Shell-and-tube heat exchangers
- ◆ Air-cooled heat exchangers
- ◆ Double-pipe heat exchangers
- ◆ Plate-and-frame heat exchanger



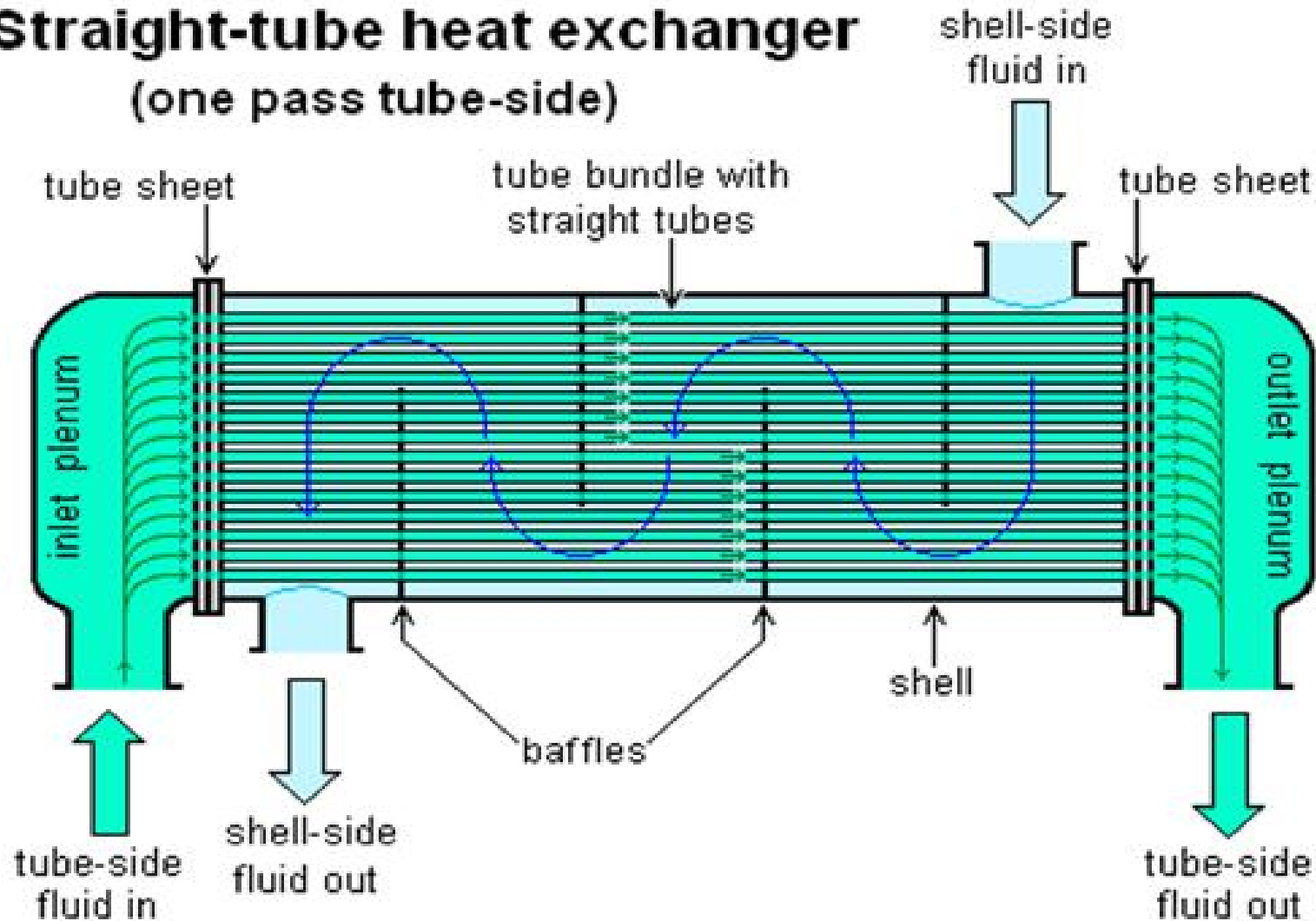
# U-tube heat exchanger





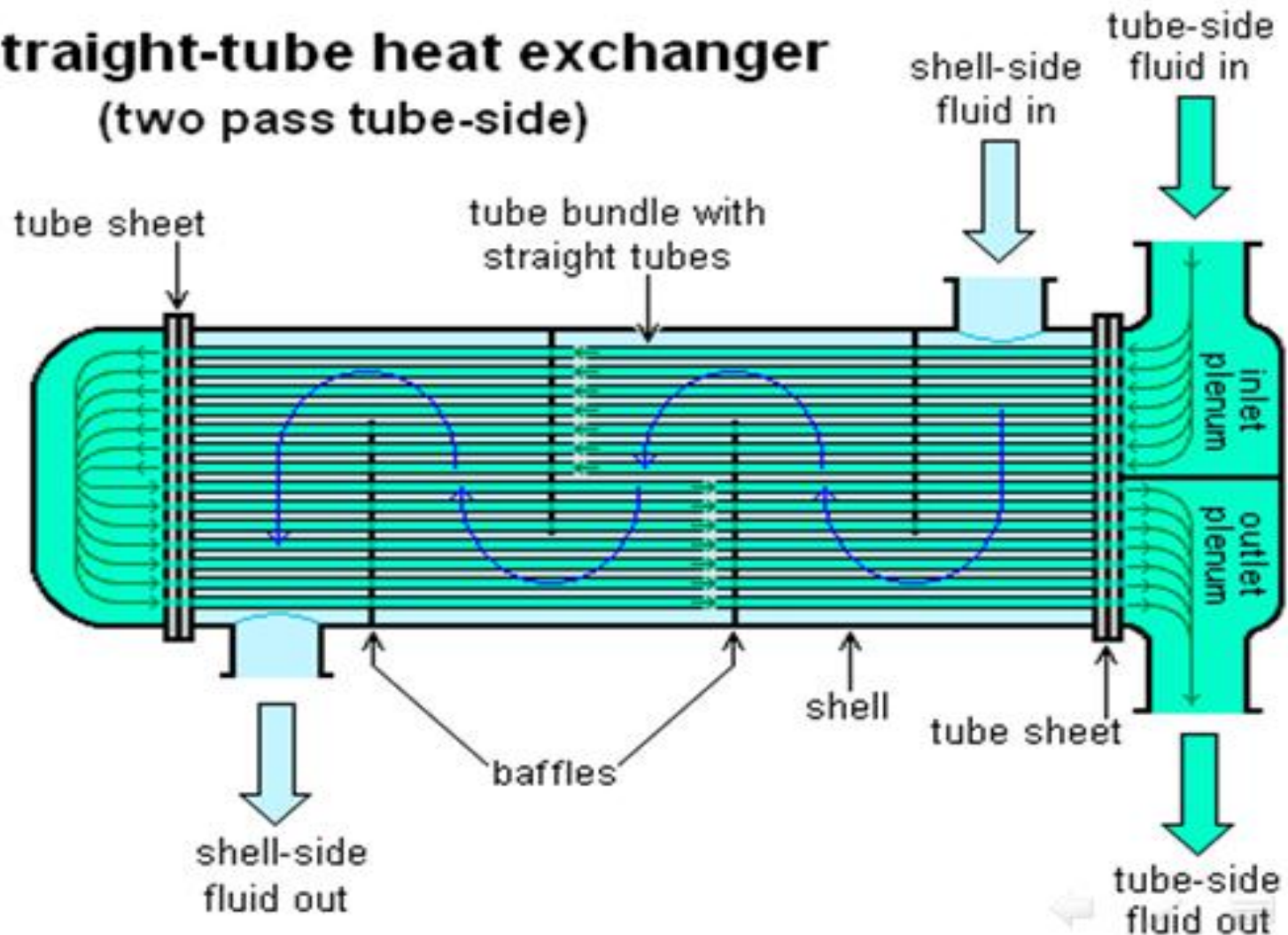
# TYPES OF HEAT EXCHANGER

## Straight-tube heat exchanger (one pass tube-side)

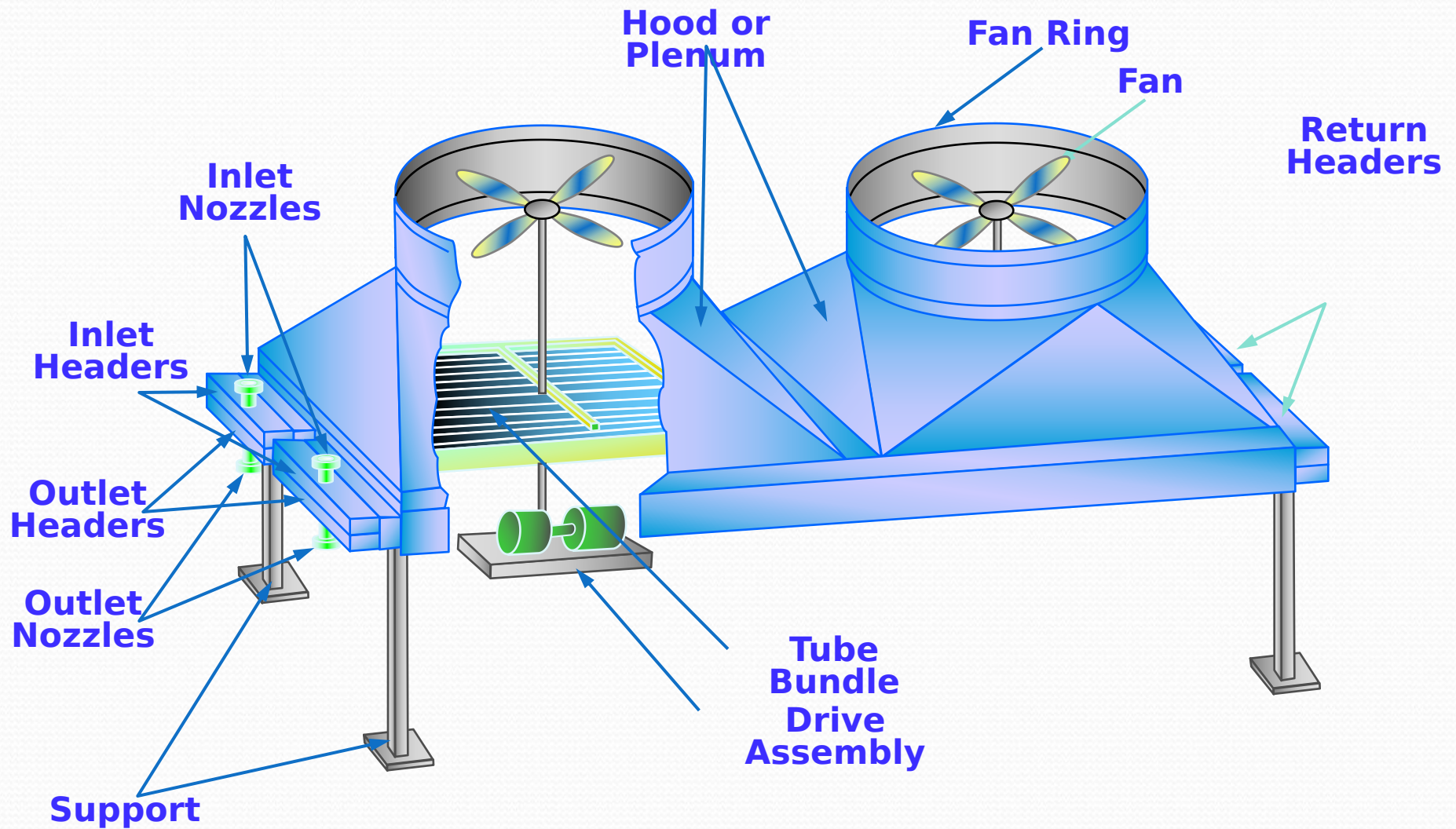


# TYPES OF HEAT EXCHANGER

## Straight-tube heat exchanger (two pass tube-side)



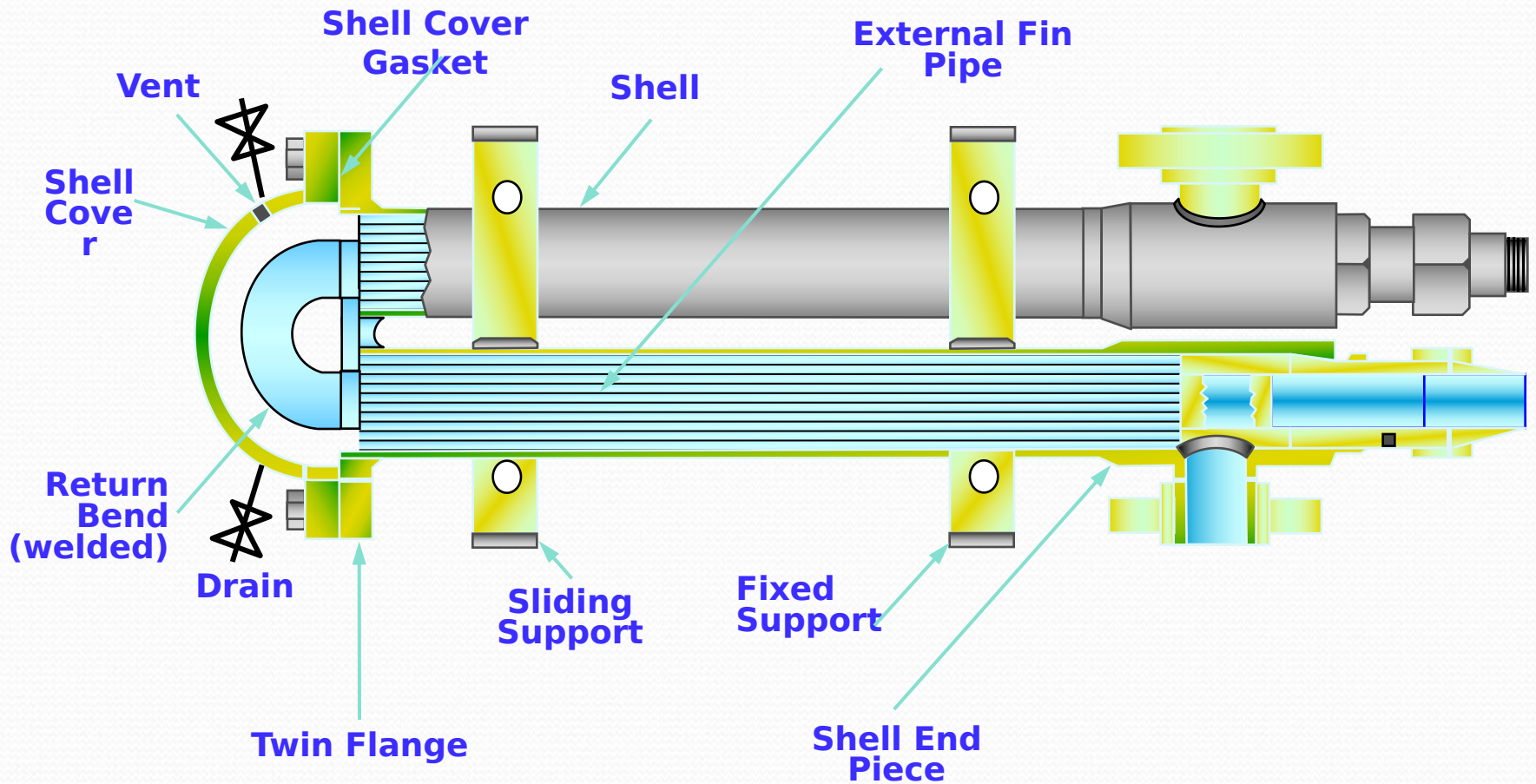
# Air-Cooled Heat Exchangers



Horizontal Tube, Induced-Draft Air-Cooled Heat Exchanger



## Double-Pipe Heat Exchanger



# SHELL AND TUBE HEAT EXCHANGER

- These types of heat exchangers are most commonly and widely used in process industries.
- Design criteria:
  1. TEMA Standards  
Tubular Exchanger Manufacturer's Association
  2. API 660 (American Petroleum Institute) Standards

Shell and Tube Heat Exchangers for  
General Services Refinery



# SHELL AND TUBE HEAT EXCHANGER

- Basic components of SHELL and TUBE heat exchanger are:

Tubes: Provide heat transfer surface

Shell or Body: Enclose the area in which fluids flow

Nozzles: Inlet and outlet for fluid flow

Tube Sheet: Hold the tube in place

# SHELL AND TUBE HEAT EXCHANGER

Baffles: Support the tubes in proper position and guide the shell side flow to increase heat transfer

Channel Cover: Allows tube inspection

Pass Divider: Separate the tube side Flow

# TYPES SHELL AND TUBE HEAT EXCHANGER

- Fixed Tube sheet

Tube sheet is welded to the shell.  
Tube bundle is permanently installed.

Used when the temperature range is limited and shell side fouling is limited.

- U-Tube or U-Bend:

Has only one tube sheet  
Tube bundle can be removed

Used where temperature difference between shell and tube side fluids are high.



# TYPES SHELL AND TUBE HEAT EXCHANGER

- Floating Head

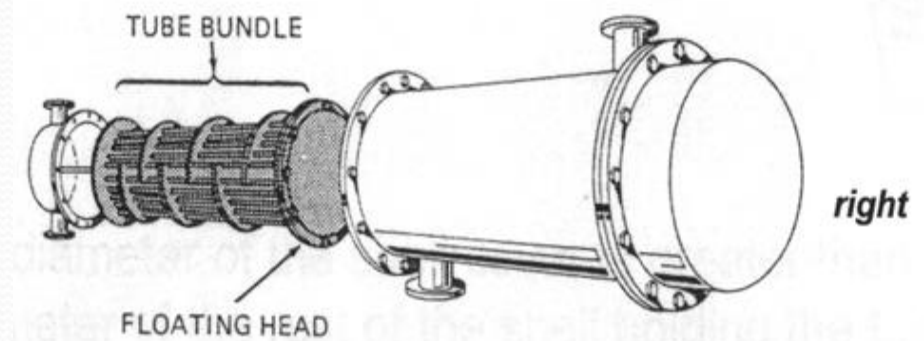
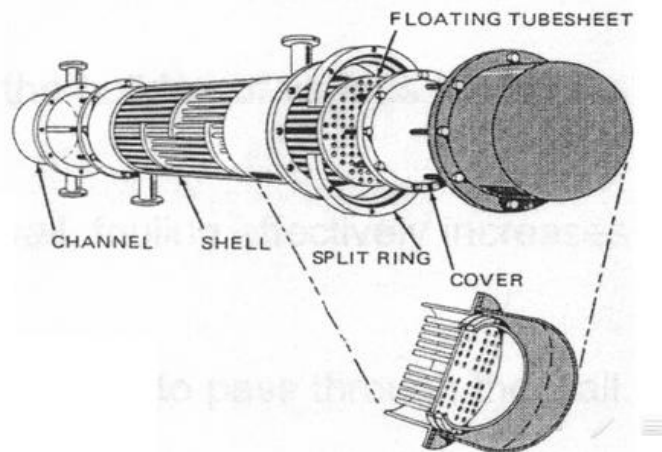
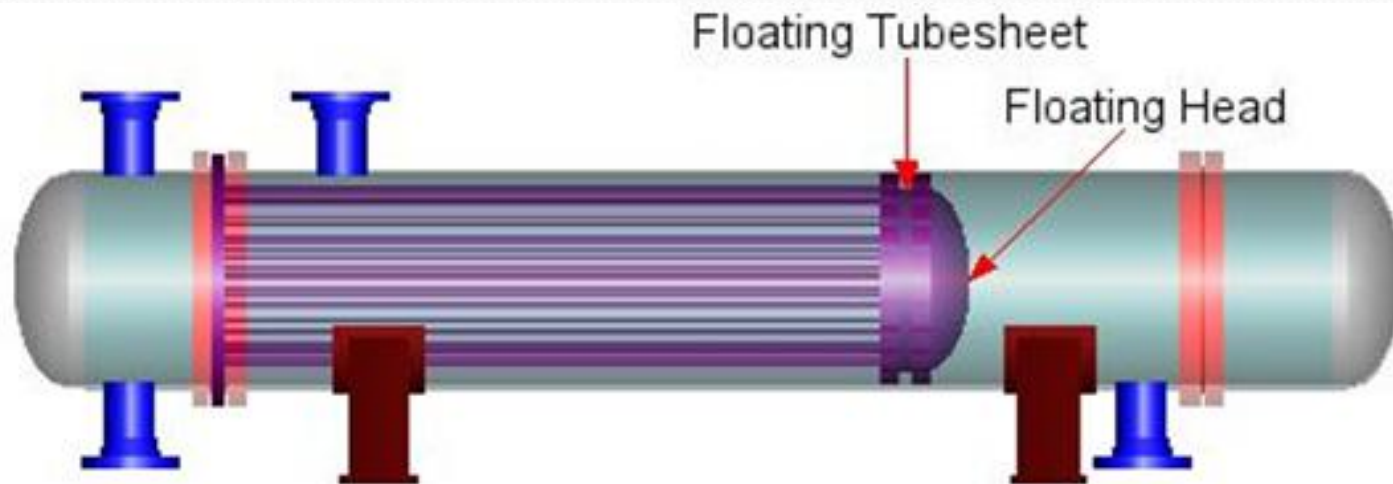
Tube bundle can be pulled out.

Tube sheet on one side is bolted between channel and shell.

Tube sheet on the other side floats inside the shell and free to move horizontally.

Test ring is required for hydro test.

# TYPES SHELL AND TUBE HEAT EXCHANGER



# **FIN FAN COOLER**

Tubes are Round or Rectangular.

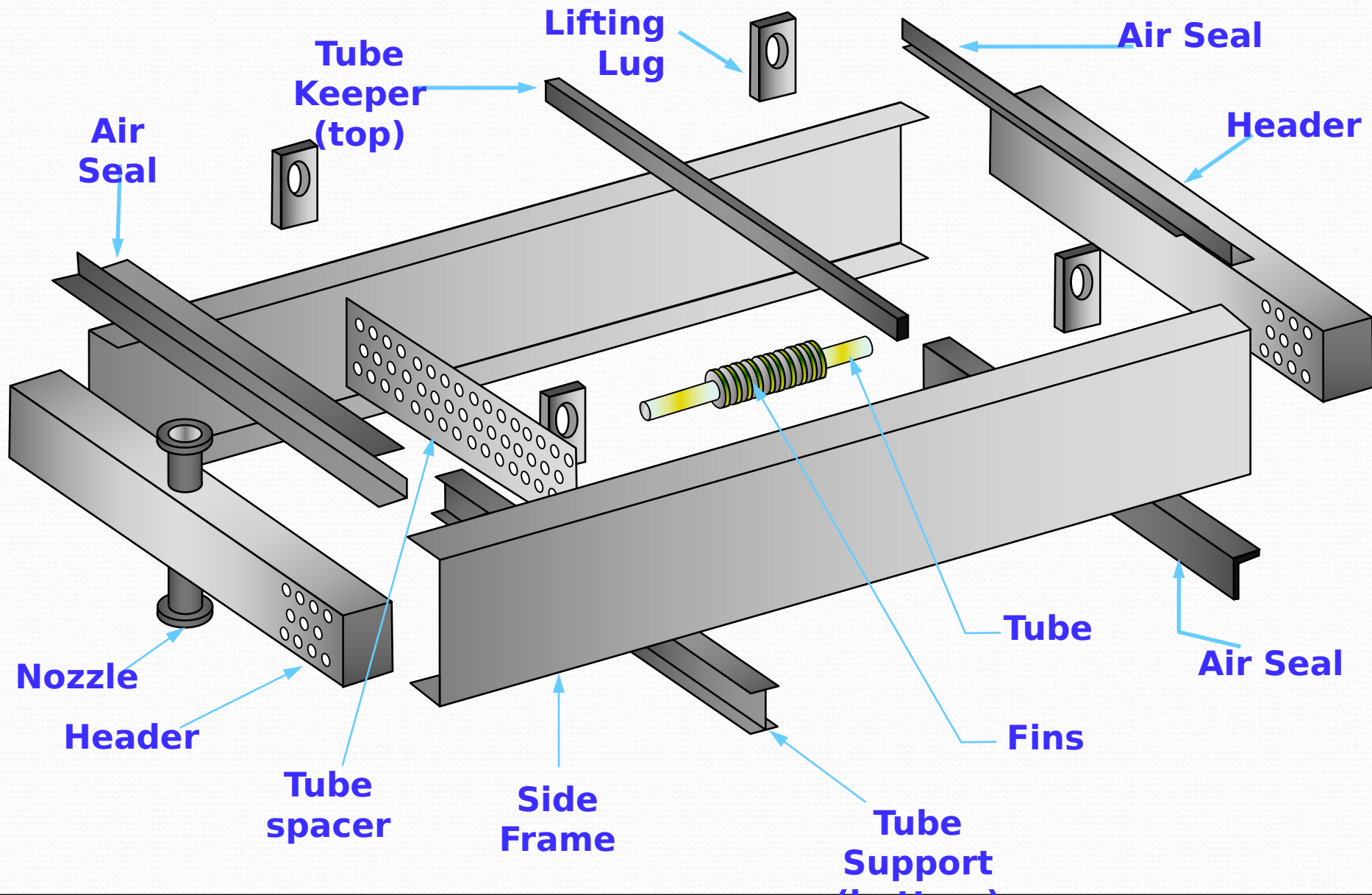
Fins generally on the outside of the tubes.

For some applications fins may be inside of the tube.

Fins are attached to the tubes by a tight mechanical fit, tension winding, adhesive bonding, soldering, brazing and welding etc.



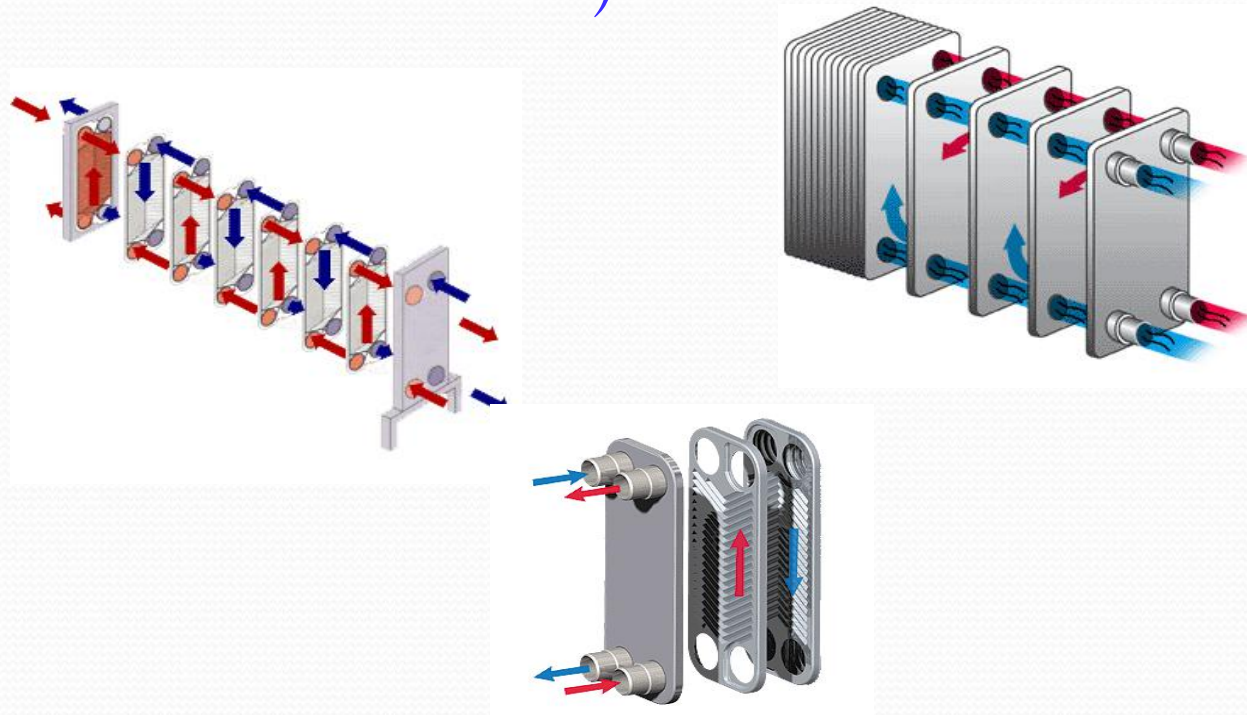
# Typical Air-Cooled Heat Exchanger



# PLATE HEAT EXCHANGER

Consist of a number of corrugated metal plates in mutual contact.

Each plate having four ports( Inlet and Outlet).





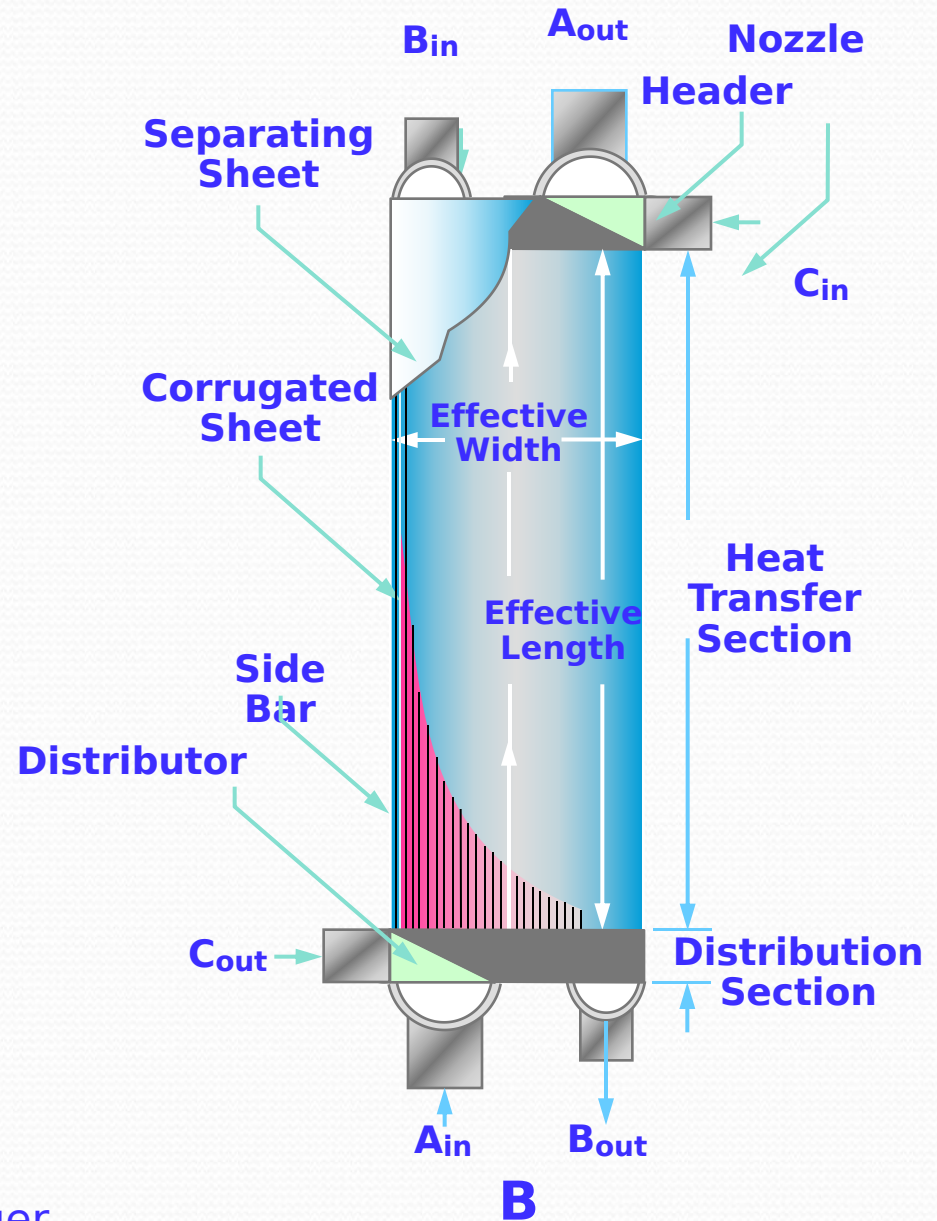
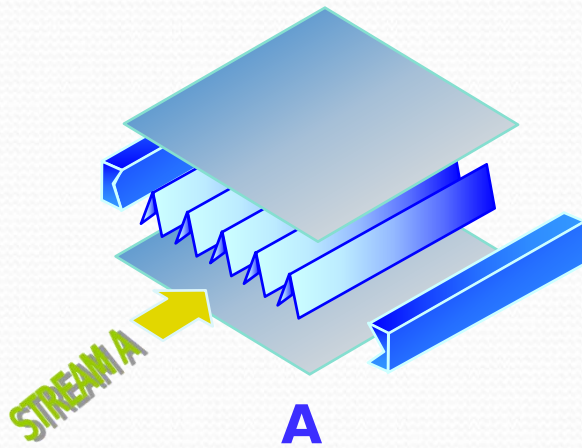


Plate-and-Frame Heat Exchanger



# PROBLEMS IN HEAT EXCHANGER

## – Fouling:

Fouling is the build-up of different kinds of deposits on the parts of an exchanger.

Fouling effectively increases tube wall thickness due to fouling particles.

Pressure drop across exchanger increases.

Due to fouling, time of heat transfer increases.

# PROBLEMS IN HEAT EXCHANGER

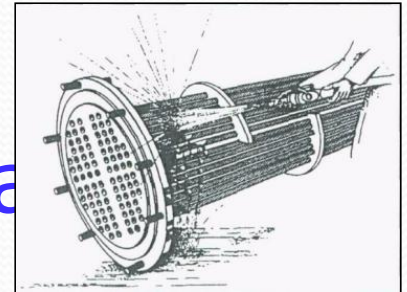
- \_ Tube leakage:
  - Removal of metal due to fluid flowing in or across the tube.
  - Can eat away and weaken tube metal which may lead to tube leak
- \_ Scale Formation:
  - Build up of solid impurities on the inside of a tube wall.
- \_ Tube Leak:
  - It affects heat transfer process.



# CLEANING OF HEAT EXCHANGER

- The method of cleaning is selected depending upon type of deposit and facilities in the plant.

1. High pressure water jet washing  
Hydro jet machine is used .



Water jet pressure around 5000 to 10000 PSI.

During hydro jet cleaning all required PPE shall be used as the water jet can easily puncture and tear the skin.



# **CLEANING OF HEAT EXCHANGER**

## **2. Chemical cleaning:**

Involves circulation of hot wash oil or light distillate through tubes or shell.

Cleaning compounds should be compatible with the metallurgy of the exchanger.

Sometimes commercial cleaning solutions are used.

## **3. Mechanical Cleaning:**

Involves tube cleaning using a wire brush or scrappers.

Care should be taken to avoid damaging the tubes

# HEAT EXCHANGER MAINTENANCE

## ACTIVITIES:

1. SCAFFOLDING
2. BLINDING
3. INSULATION REMOVAL
4. DRAINING
5. HEAD COVER REMOVAL
6. PRE-INSPECTION
7. BUNDLE PULLING OUT/HYDROJET CLEANING
8. TUBE BLOWING
9. SHELL SIDE/TUBE SIDE HYDROTEST/PNEUMATIC TEST
10. IRIS TEST
11. PLUG INSERT/WELD
12. RE-HYDROTEST
13. HEAD COVER BOXUP
14. BLIND REMOVAL

***THANKS***