Chemical Process Safety
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Lecture 25 - Fire Extinguishers – 1

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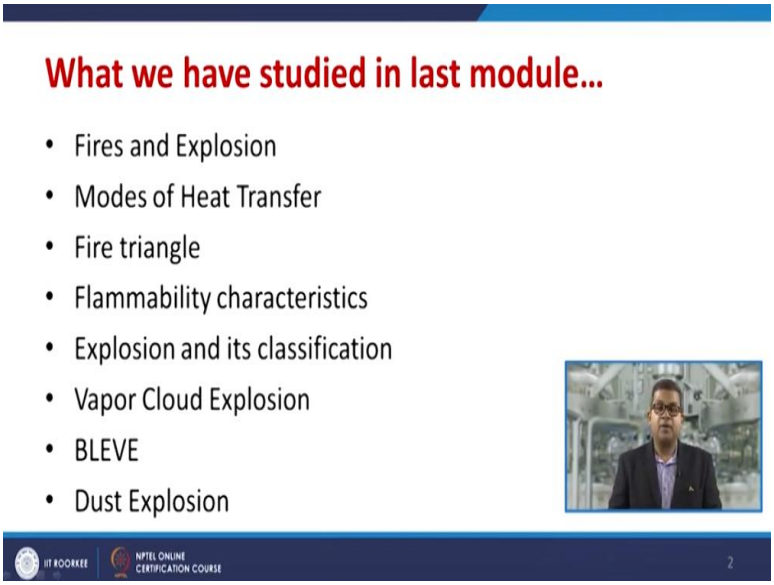

Welcome to this module of Fire and Explosion. In this module, we will study about the different type of fire extinguishers. So up till now we have studied in previous modules about fire and explosion, different modes of heat transfer through which fire can propagate, the fire triangle, flammability characteristics, what kind of different type explosions with their classification. We have gone through the vapor cloud explosion, BLEVE and the dust explosion.

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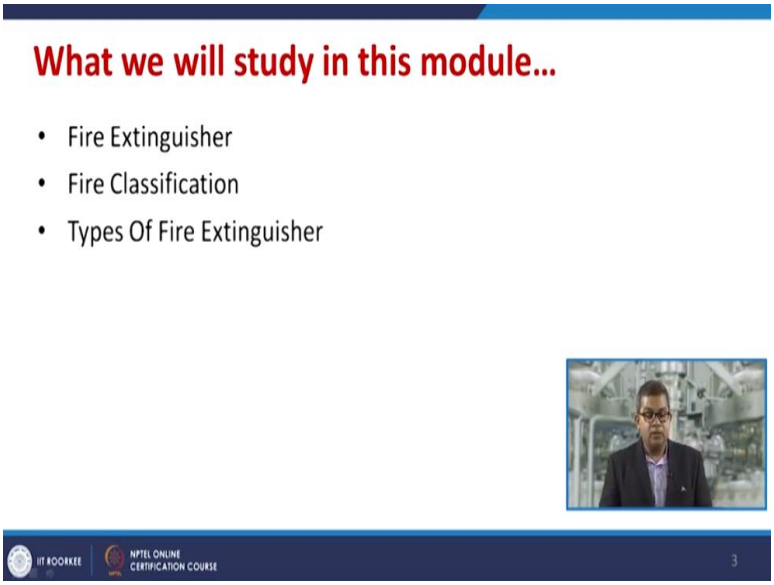

In the present module we will study about the fire extinguisher, how we can classify the fire and based on this particular classification what kind of different fire extinguishers are in place. See, the fire is of 2 types, positive approach and a negative approach. So when we are cooking food in our kitchen that is the positive approach but when fire adopts the destructive nature then it is a negative approach. So once it adopts a destructive nature that means we need to extinguish the fire in a scientific manner and there are different type of fire, so you need to know that which is which kind of fire it is and how to extinguish this particular fire.

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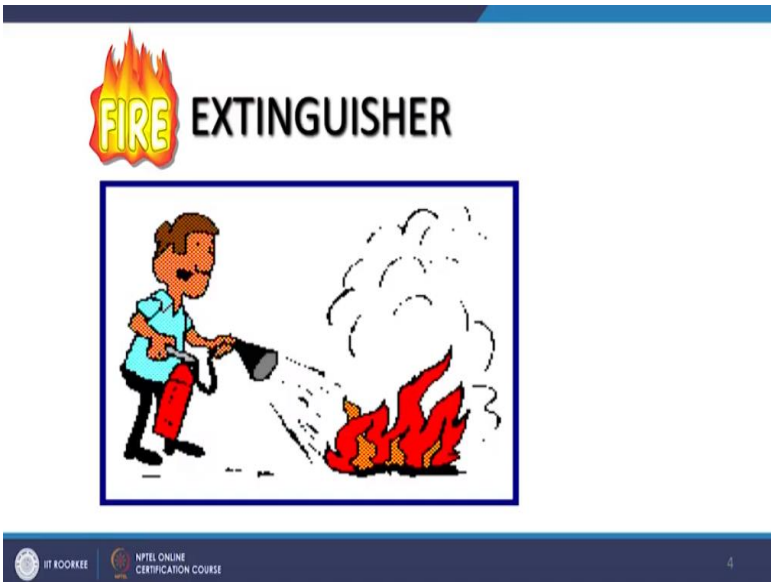

So in this particular module, we will have a look that what kind of different fire extinguishers are there and based on the different class of fire which kind of fire extinguisher we need to use for that particular kind of fire.

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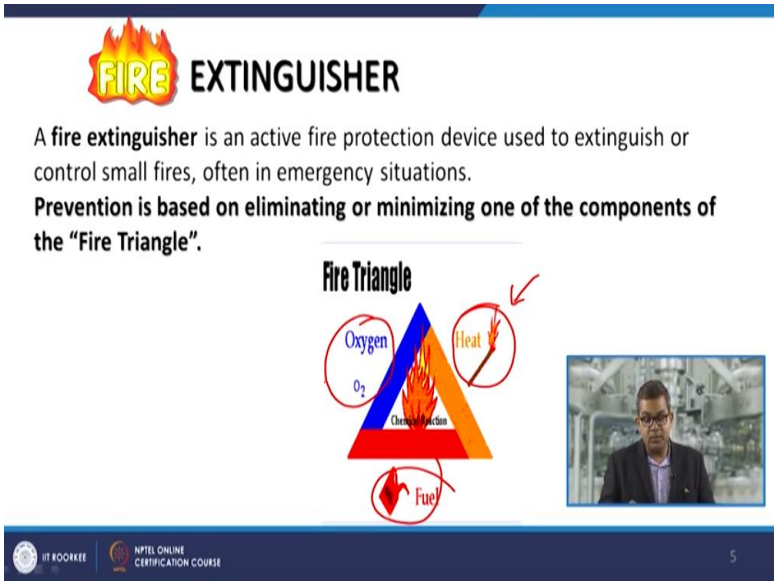

Now let us have a basic approach of fire extinguisher. A fire extinguisher is an active fire protection device used to extinguish or control small fires often in the emergency situation. Now usually prevention is based on elimination or minimizing one of the components of a fire triangle, so it is a rule of thumb. If you wish to produce the fire in the, obviously we have discussed the fire triangle in the previous modules, so if you wish to have a fire then you need to have 3 different ingredients of fire: fuel, you must have a source of ignition or net sustain net release of heat and sustainability aspect and oxygen.

So if you wish to have a positive approach for fire, then you need to have all arms of fire triangle intact. In the vice versa if you wish to extinguish the fire then you need to disable this fire triangle either by a way of blanketing it so that the supply of oxygen may be cordoned off or you wish to cut off the supply of fuel or you have to remove the excess amount heat being liberated so that it cannot sustain in due course of time.

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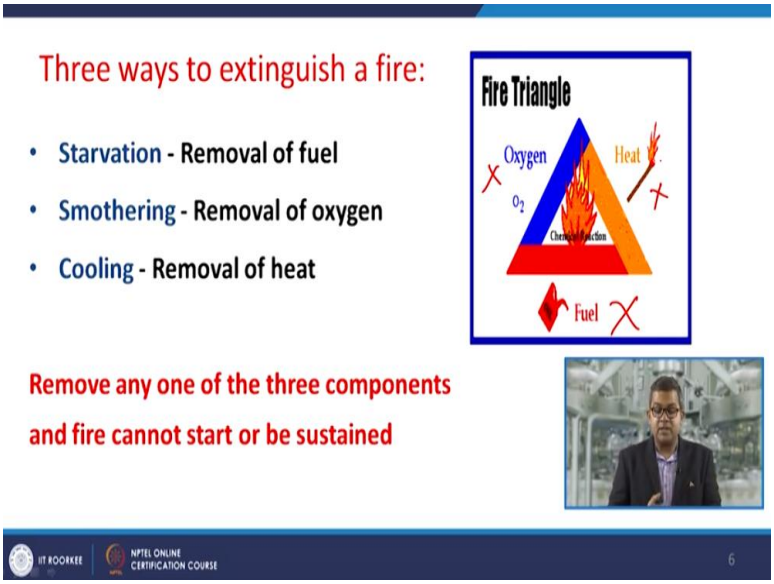

So in a nutshell, we can remove, we can have the fire extinguishment in 3 ways: one is starvation that means you remove the supply of fuel, another is that is smothering that you remove the supply of oxygen and then cooling that you remove the excess amount of heat being liberated. So remove any one of these components, then fire cannot be sustained. Now how we can remove these arms, that is a basic scientific question.

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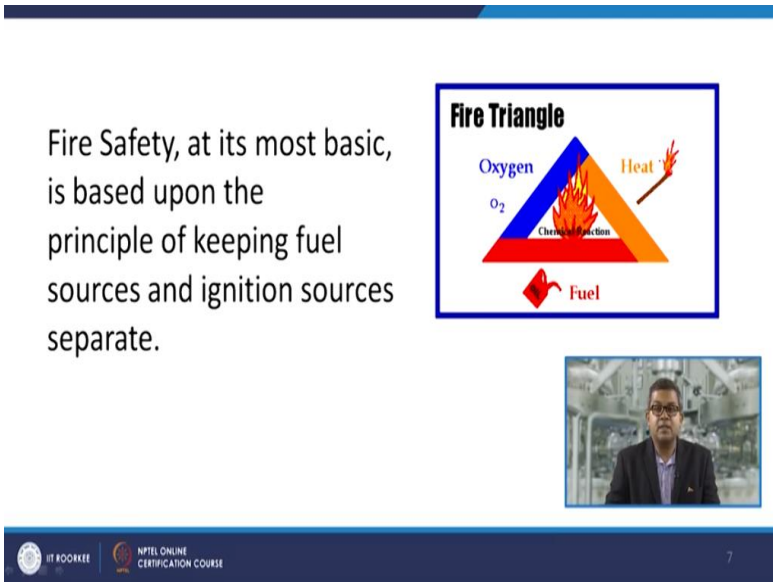

So fire safety at its most basic is based upon the principle of keeping fuel source and ignition source separate so that once fire initiated it do not propagate and if propagate then it should be extinguished in a simpler manner.

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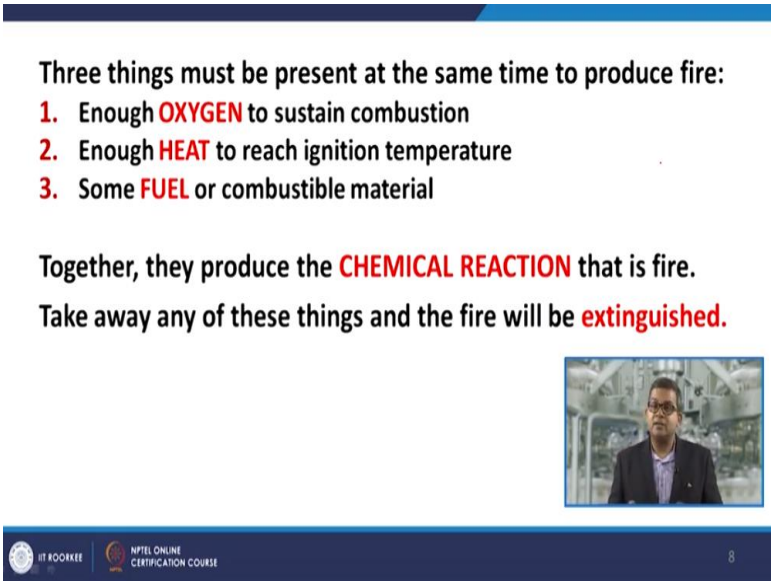

Now three things must be present at the same time to produce fire: Enough oxygen to sustain combustion that means one way is to remove the supply of oxygen so that it cannot it does not meet the stoichiometric demand of that particular fuel, enough heat to reach ignition temperature, another way in a positive sense is that you extract the excess amount of heat being liberated in due course of combustion process so that it cannot sustain, fuel or combustible material whatever is there it should not be there so that the fuel definitely the fire will not be sustained.

So together if all these things are together then definitely they will have a chemical reaction and that is called the fire and if it is not then definitely the fire will be extinguished. Now let us have a look of fire classification, because in our day to day affair you may see that there are different types of fire, fire through the electric circuit, fire through the chemical run away reaction, in a domestic approach your LPG that is purely a combustible reaction that is in the positive way. So based on this type of approach there are various way through which we can classify the things.

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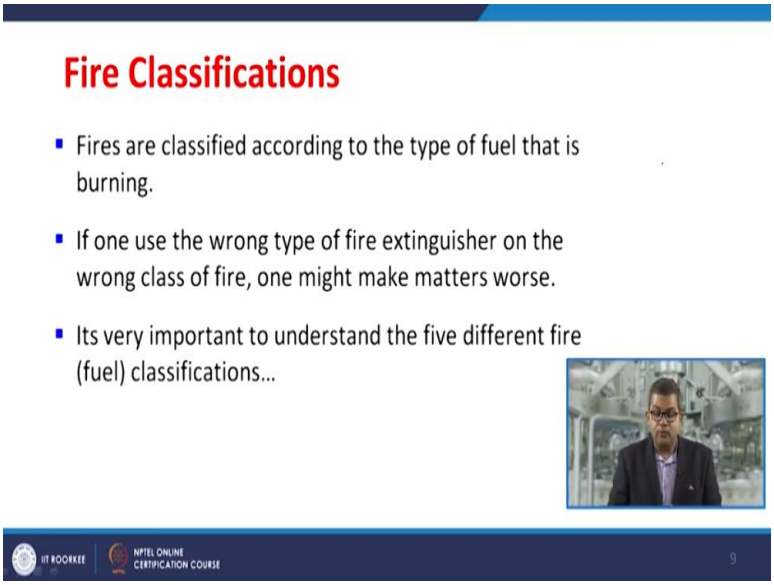

Low let us have a look of few line that fires are classified according to the type of fuel that is burning, that is one approach to classify the fire. Now if one use the wrong type of fire extinguisher on the wrong class of fire, one might make matters worse, like if you are in a domestic affair if you try to extinguish the fire that is based on the cooking oil with the help of say water then definitely the scenario would be extremely destructive, the reason is that the oil will sputter it out. So it may cause more danger compared to the fire. So it is very important to understand the different classes of fuel.

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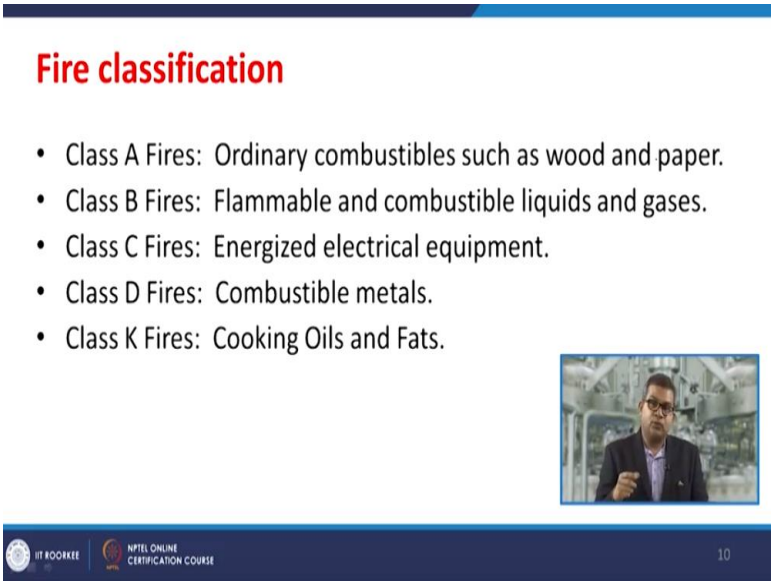

Now there are five different classes of fire: The class A, class B, class C, class D and class K. So the class A fire that is the ordinary combustible such as wood and paper, you can distinguish it with the normal water. Class B fire, flammable and combustible liquid and gases; class C fire, energized electrical equipments, so you cannot use water sprinklers etc because it will propagate the thing and that the result would be more destructive; class D fires that is combustible metals and class K fire, cooking oils and fats.

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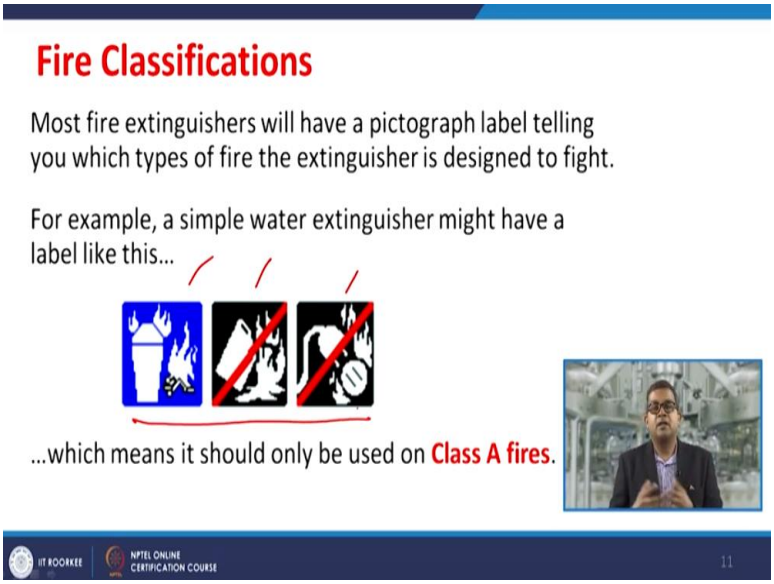

So most fire extinguishers will have a pictograph labeling telling you which type of fire the extinguisher is designed to fight like this. Let us have example, the simple water extinguisher might have a label like this which means that it should be only be used on class A type of fire.

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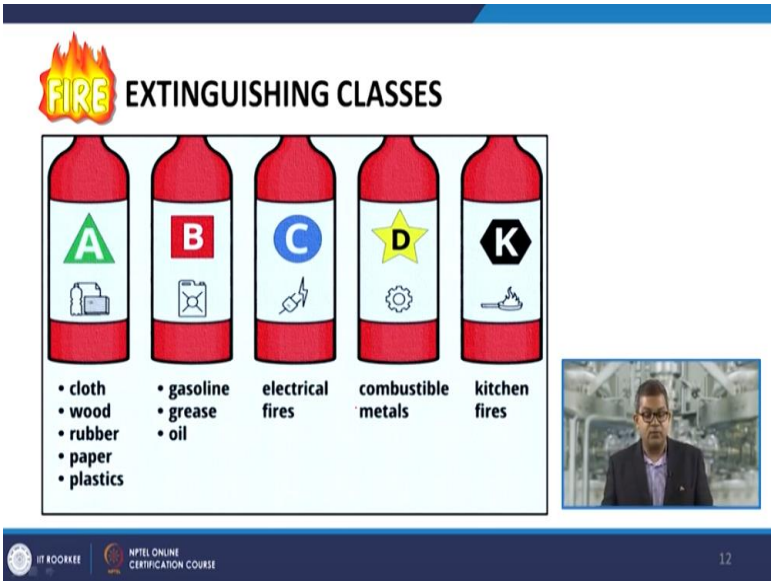

So you may see different type fire extinguishers in different places you visit or different industry you work upon, so there are different classes of fire extinguishers: one is the class A basically attributed to cloth, wood, rubber, paper, plastic; class B gasoline, grease, oil; class C, electrical fires; class D combustible metals; class K that is the kitchen fires etc.

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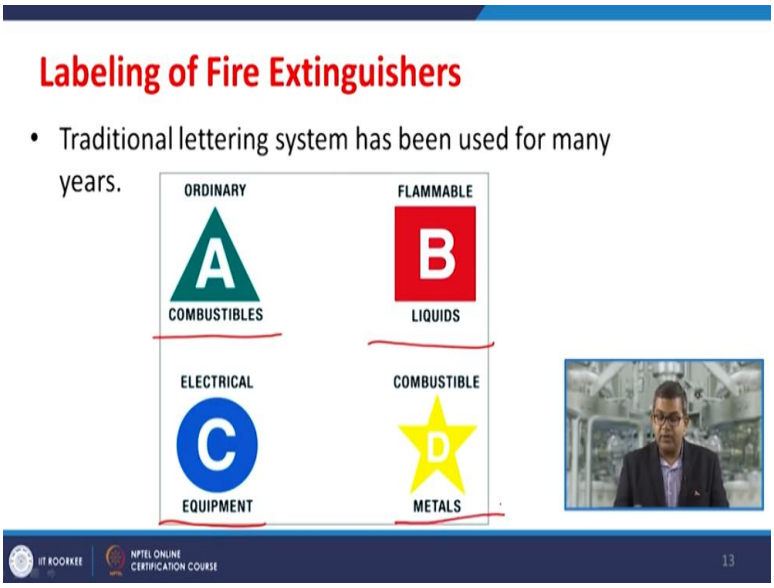

Now traditional lettering system has been used for many years that is for the labeling of fire extinguishers like ordinary class A ordinary combustible, flammable liquids class B, electrical equipment C and combustible metals D, these are the traditional one.

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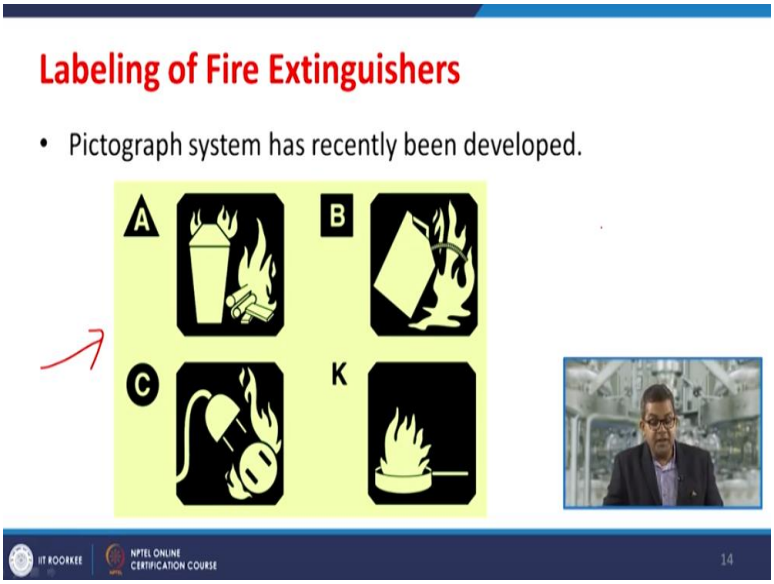

But nowadays it is being replaced to some pictographs etc, so the pictograph system which we recently developed that is based on this type of figure, you can have a look this figure that is A class, B class, C, K etc. Now this is more easier to understand for workers who use, those who are illiterate so that they can visualize the things based on these pictographs. So that is why there was a need of labeling with the help of this pictograph system.

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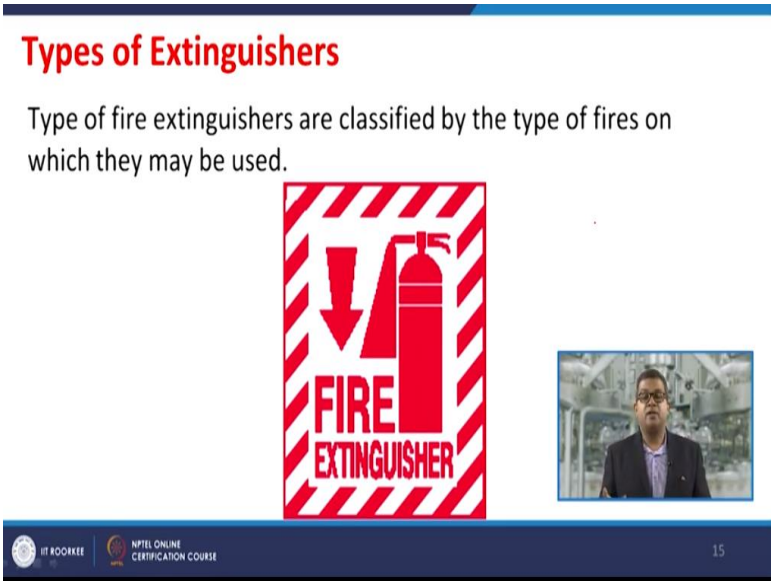

Now types of extinguishers, basically they are classified by the way of type of fires on which they may be used, like fire extinguisher, these are the pictographs used that you may find the fire extinguisher at particular place.

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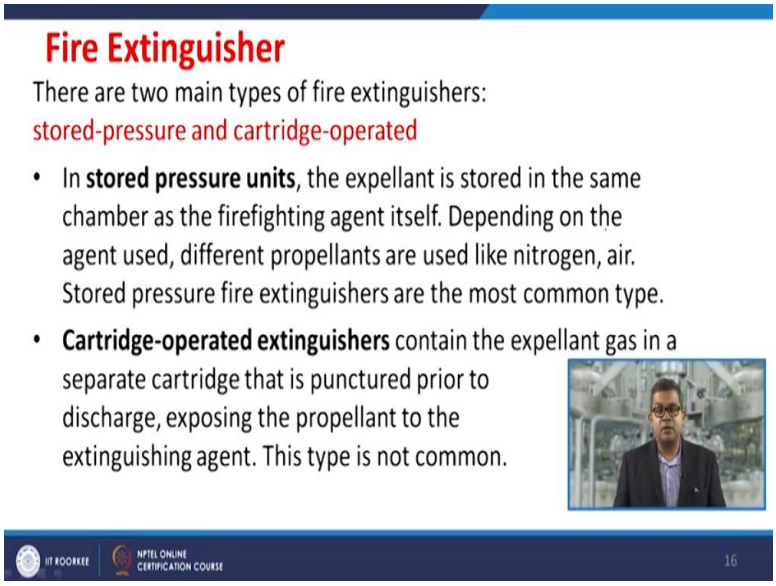

Now there are two main type fire extinguisher; one is based on stored pressure and cartridge operated. Now in stored pressure units, the expellant is stored in the same chamber as the firefighting agent itself, now depending on the agent used the different propellant are used like nitrogen, air etc. The stored pressure fire extinguishers are the most common type, even you can find it in your domestic affairs plus office places, industry etc.

They are certain cartridge operated extinguishers that contain the expellant gas in a separate cartridge that is punctured prior to discharge exposing the propellant to the extinguishing agent and usually this type is not common but for some specific use it is being used.

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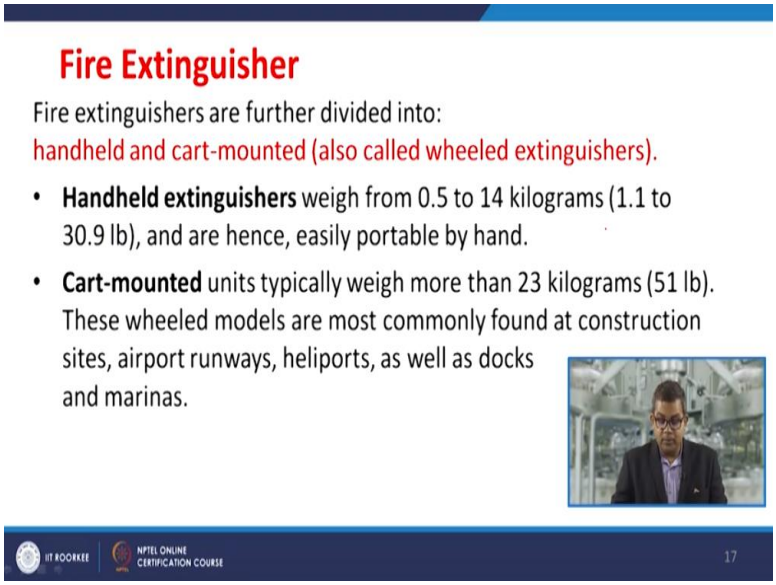

The fire extinguishers they are further divided into handheld and cart-mounted, also called the wheeled extinguishers. Sometimes in a big establishment you will find it this type of extinguishers, they are handheld extinguishers weigh from 0.5 to 14 kilogram and hence easily portable by hand so that in case of zonal fire you can use those handheld extinguishers even in the household some people they are using it. The cart mounted unit, typically weigh around 23 kilogram and these wheeled model are most commonly found at construction sites, airport runways, heliports as well as docks and marinas; so they usually used for the big fires and big establishments.

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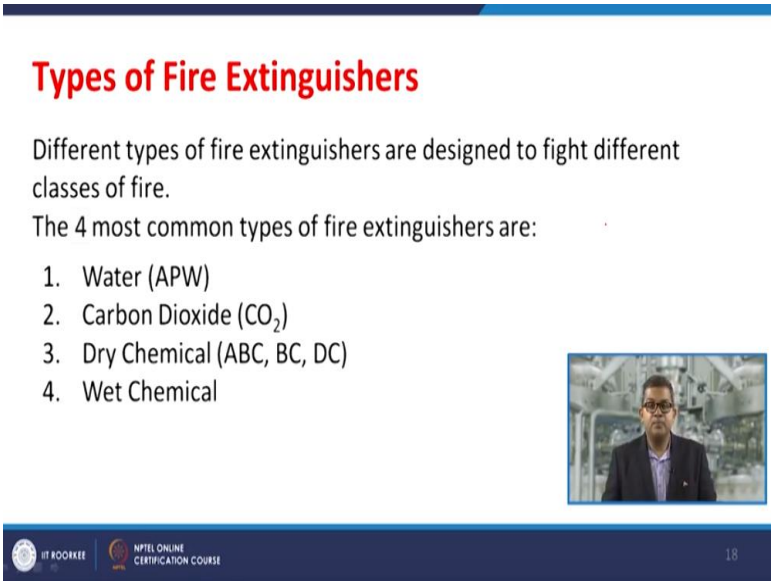

Now based on this particular knowledge we can have a different type of fire extinguishers to fight the different classes of fire. There are four most common type of fire extinguisher: water APW air pressurized water, carbon dioxide CO_2, dry chemicals ABC BC DC, and the wet chemicals.

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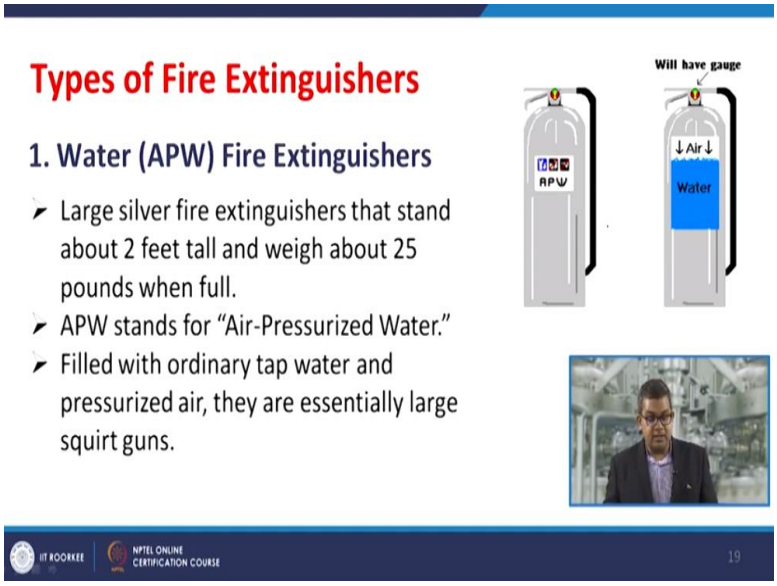

Snow first let us have a look of water or air pressurized fire extinguishers, so usually they are large silver fire extinguishers that stand about 2 feet tall and weigh about 25 pounds when they are full. As I told you earlier that APW stands for air pressurized water, so air is usually

pressuring to the water droplet so that it can squeeze it out in a pressurized manner, so the pressure acts in a two-fold, one is that it promotes the usual way of water to reach the fire and another one is it promotes the formation of fine droplets.

So fine droplets they are having the large surface area so that the fire can be extinguished easily. The basic purpose is to extract as much as heat you can extract from that the firing surfaces so that the one arm of fire triangle can be eliminated in such a way that heat is gone away. So filled, usually they are filled with ordinary tap water and pressurized air they are essentially large squirt guns.

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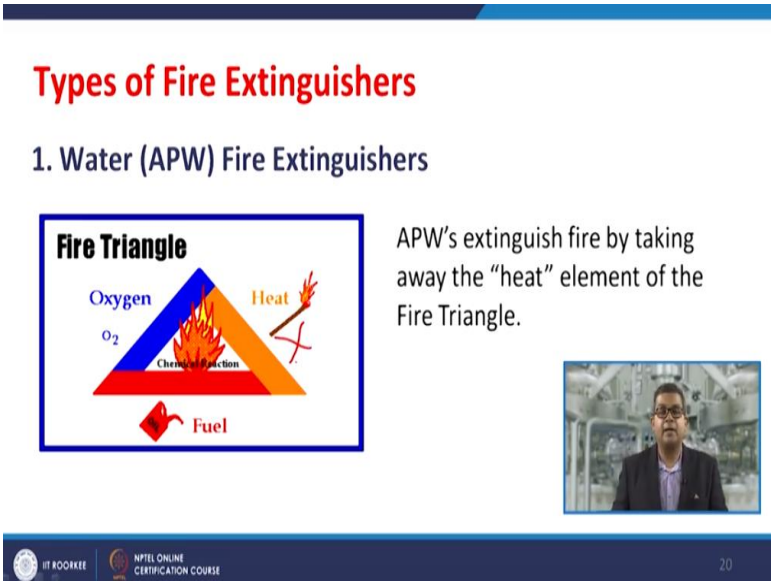

Now APWs they extinguish fire by taking away the heat element of the fire triangle because of the formation of small droplets.

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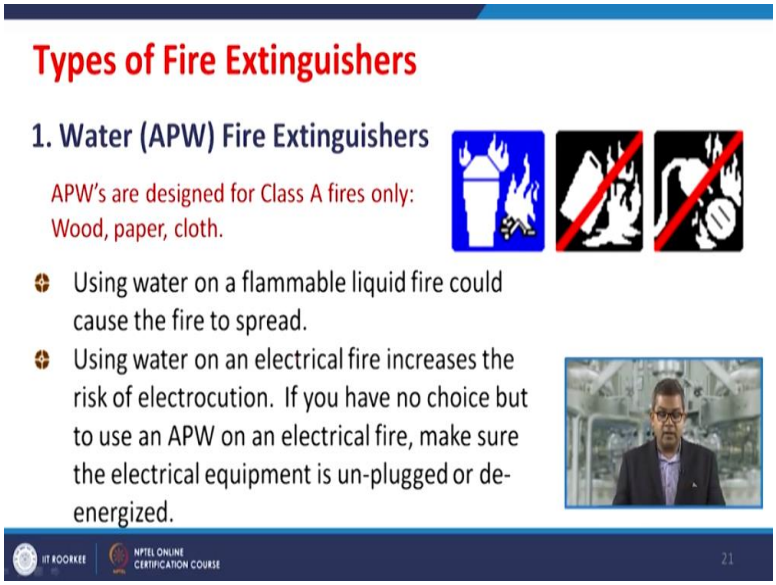

Now they these air pressurized water extinguishers are designed for class A fires only, that is attributed to wood, paper, cloth. Using water on flammable liquid fire could cause the fire to split, using water on the electrical fire increases the risk of electrocution. If you have no choice but to use an APW on an electrical fire, make sure the electrical equipment is unplugged or de-energized, otherwise the person who is using this APW may get may be in danger.

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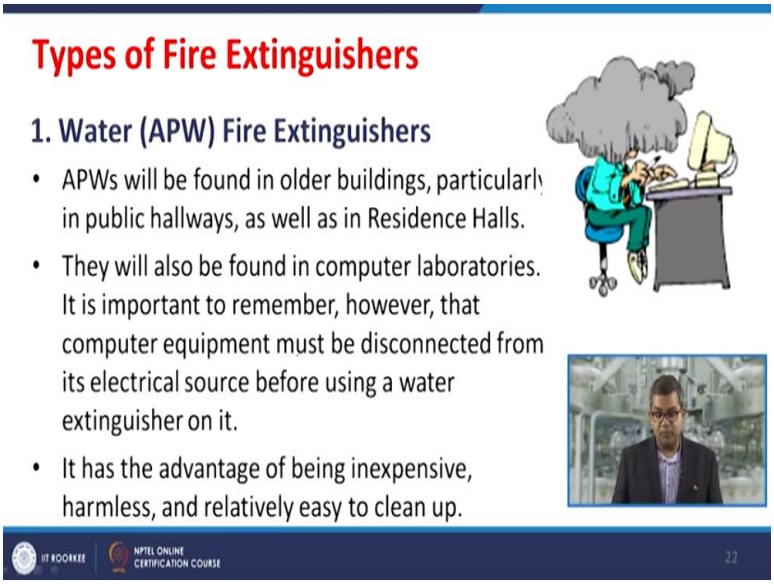

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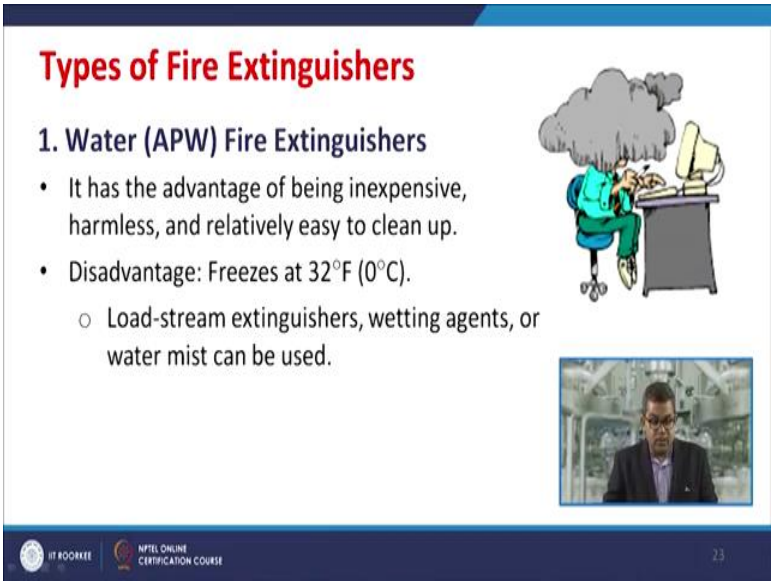

This APW will be found in older buildings particularly in public hallways as well as the (residence) residential houses etc, they will also be found in the computer laboratories. It is important to remember, however that the computer equipment must be disconnected from the electrical source before you use this APW. Now it has the advantage of being inexpensive, harmless, relatively easy to cleanup because you are using water, a normal tap water.

So they are relatively inexpensive, they are usually harmless because you are not using any kind of chemical to extinguish the fire and you can easily cleanup even because after extinguishment you are having only water, so you can easily cleanup this water. So that is why they are having this particular advantage. It has the advantage of being inexpensive, harmless and relatively easy to cleanup. And disadvantage, because when anything is having advantage simultaneously they are having the disadvantage, that they the water inside within the fire extinguishers freezes at around it 32 degree Fahrenheit or 0 degree Celsius.

So you cannot use this fire extinguisher when the temperature is at around 0, atmospheric temperature is around 0 or the subzero. Now another disadvantage is that the load-stream extinguishers sometimes wetting agents or water mist can be formed, so in other way in the positive sense you can use certain wetting agent so that the normal freezing point can be changed or the water mist.

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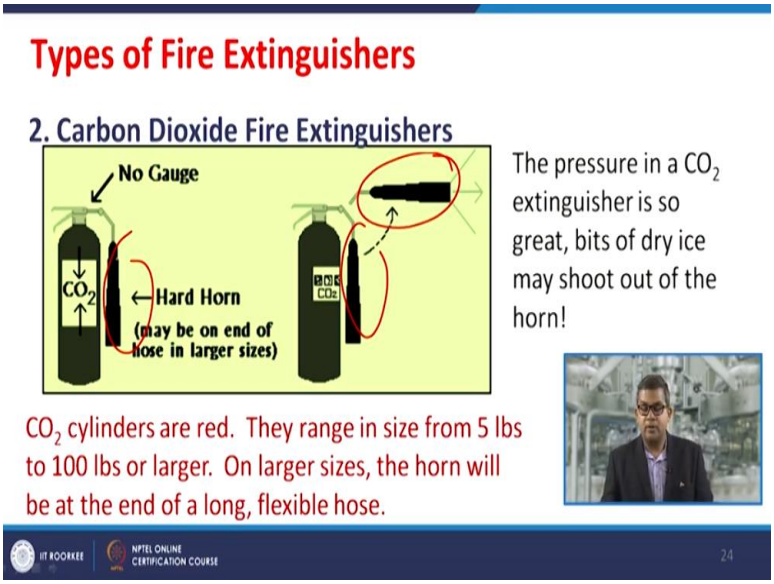

Now there is another class of fire extinguisher that is carbon dioxide fire extinguisher and usually they are denoted in red color. They ranges in the size from 5 pounds to 100 pounds or larger. On larger size the horn, this is the horn be at the end for a long flexible hose, the pressure in CO_2 extinguisher is so great that a bit of dry ice may be shoot out of the horn, so sometimes they are called the dry ice extinguishers.

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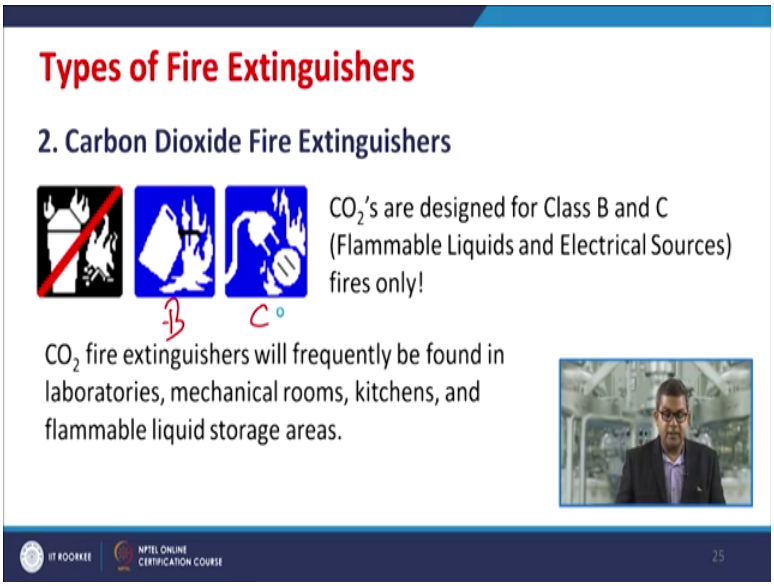

Now CO_2 are designed for class B and class C type of fires, flammable liquid and electrical sources fire. CO_2 fire extinguishers will frequently be found in laboratories, mechanical rooms,

kitchen, flammable liquid storage arena, so they are having the wide spectrum, so they are applicable for class B and class C type of fire.

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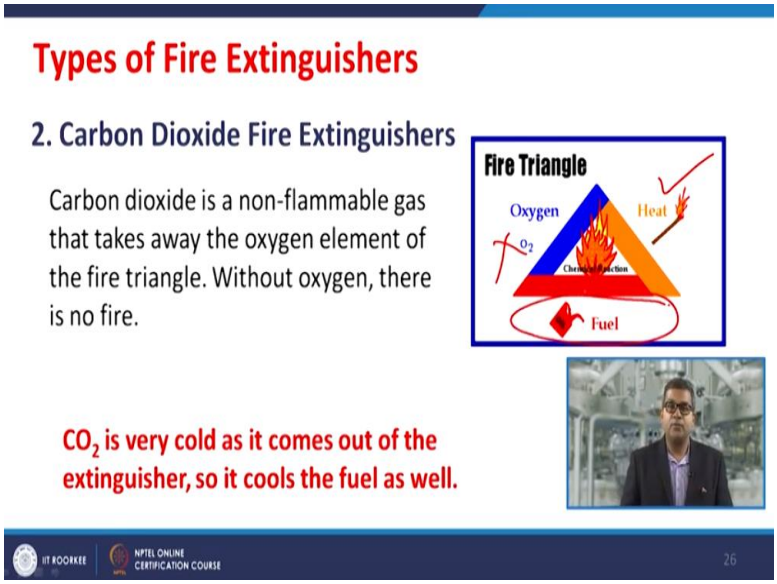

Now why we are taking this CO_2 fire extinguisher? Now CO_2 is a non-flammable gas that is takes away the oxygen element of the fire triangle and without oxygen there is no fire, so this is the plus point or this is the basic advantage of this CO_2 fire extinguisher. Now CO_2 is very cold as it comes out to of the extinguisher, so it cools the fuel as well. So you can utilize this aspect to eliminate the excess heat even you can utilize the preheating of the fuel if the fire is propagating, so it is having the multifold advantage.

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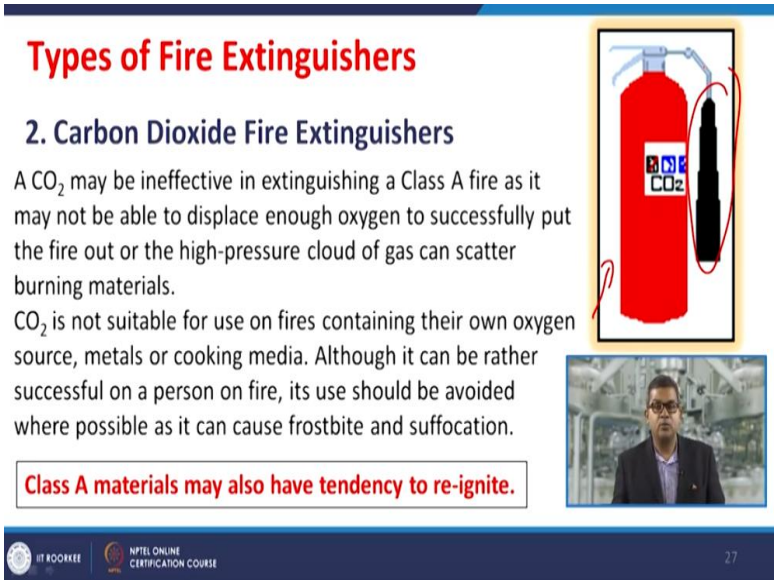

Now CO_2 may be ineffective in extinguishing a class A fire as it may not be able to displace enough oxygen to successfully put the fire out or the high pressure cloud of gas can scatter the burning material. Now you can see that they are in the red color and this is this one is the horn. CO_2 is not suitable for use on fires containing their own oxygen source, metal or cooking media although it can be rather successful on a person on fire, its use should be avoided where possible as it can cause frostbite or suffocation. So that is why this is one of the disadvantage of using CO_2 fire extinguisher. So class A material may also have tendency to reignite, so that is why it is again very sensitive case, so you be particular about the using of CO_2 fire extinguisher in specially in class A.

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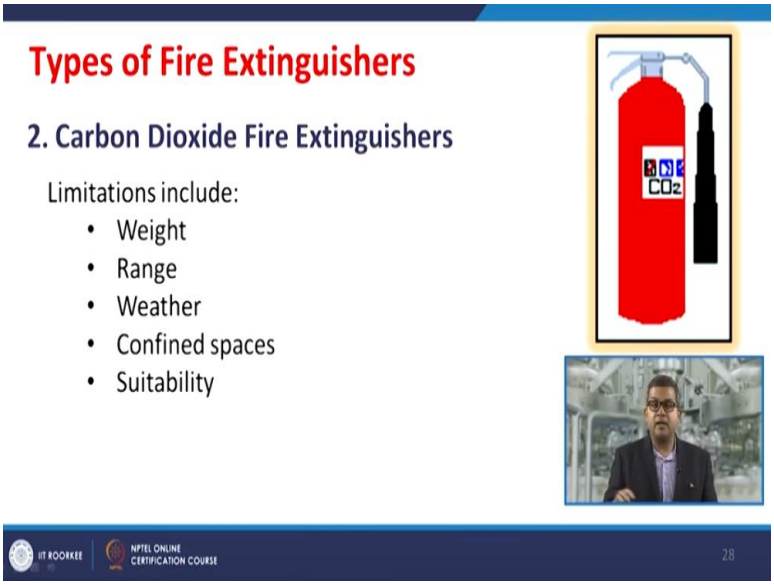

Now this limitation includes another, they are certain limitations with the carbon dioxide fire extinguisher and this limitation includes the weight because it is a bit heavy, the range because of pressurized CO_2 range is limited; weather conditions, confined spaces and suitability with different class of fire and different type of environment.

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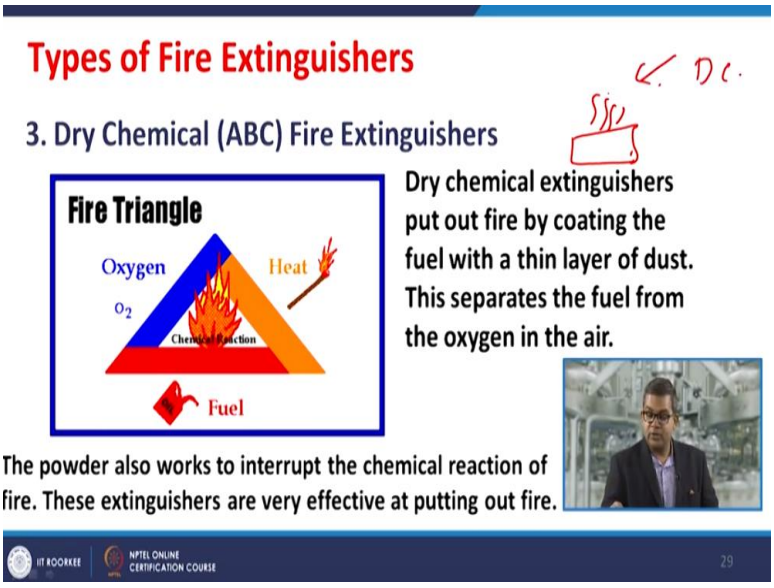

The next class of fire extinguisher is dry chemical ABC fire extinguishers. So dry chemical extinguishers they put out fire by coating the fuel with a thin layer of dust and this separates the fuel from the oxygen in the air. So suppose you are having the fire over here, this is a pool and

when you apply the dry chemical fire extinguisher then it will cordon off the things, so it is separates the fuel from the oxygen in the air. So by this way it can extinguish the fire. The powder also works to interrupt the chemical reaction of fire and these extinguishes are very effective at putting out fire.

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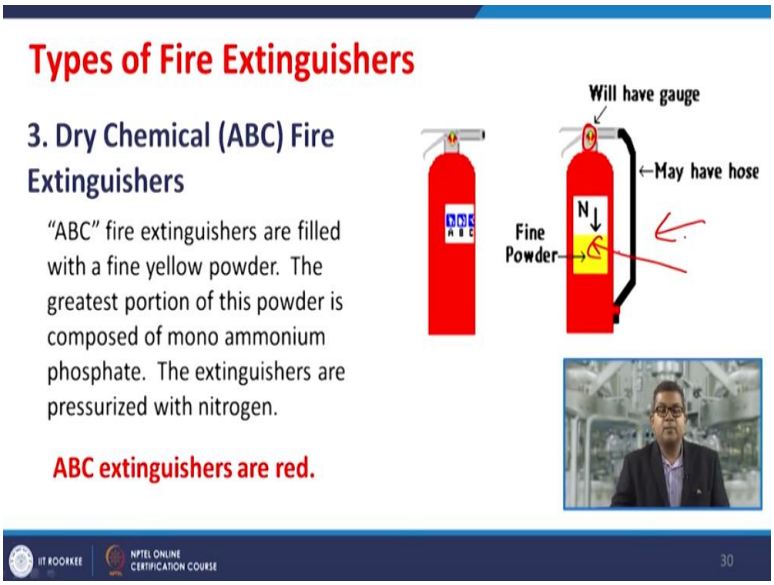

Now ABC they are filled with the fine yellow powder, the greatest portion of this powder is composed of mono ammonium phosphate, and these extinguishers are pressurized with the help of inert nitrogen. So they are usually like this: the anatomy of these fire extinguishers is like this, they are fine powder and they are supported with this nitrogen and here is the pressure gauge and it may have a hose or horn etc that depends on the situation. So usually the color code for these ABC type of fire extinguishers are red.

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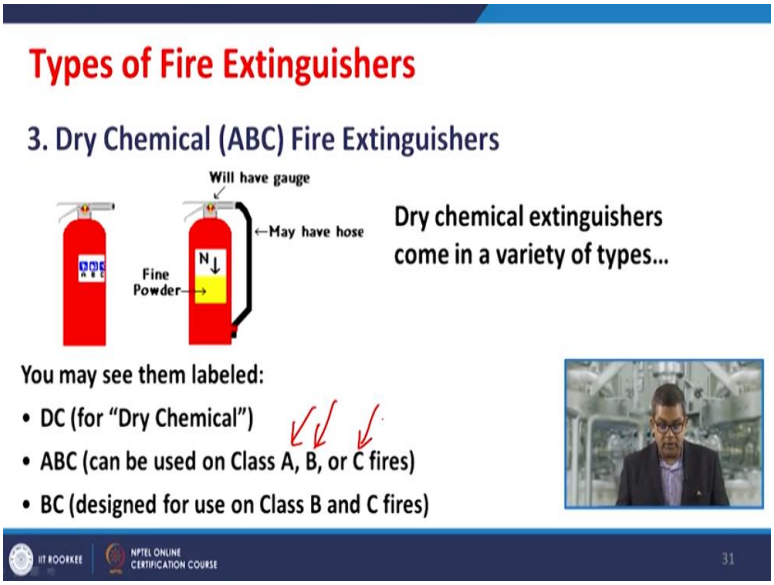

Now these dry chemical extinguishers they come in variety of types and you may see the different type of label in these dry chemical fire extinguisher. One class is the DC that is stands for dry chemical, another is ABC it can be used for class A, class B, and class C of fire. BC that is designed for the use in class B and class C of fire, so it can have a variety of classes.

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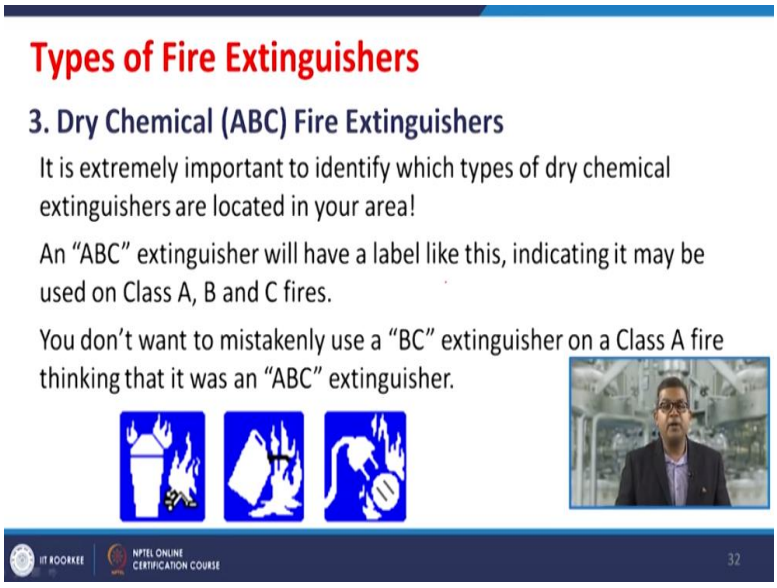

Now it is extremely important to identify which type of dry chemical extinguishes are located in your area or at your workplace so that is case of a fire you can use appropriate type of fire extinguisher and ABC extinguisher will have a label like this that indicating may be used for A B

or C class of a fire. You do not want to mistakenly use a BC extinguisher on a class A fire thinking that it was an ABC extinguisher, so do not be get confused, you have to use the appropriate type of fire extinguisher for the fire in question.

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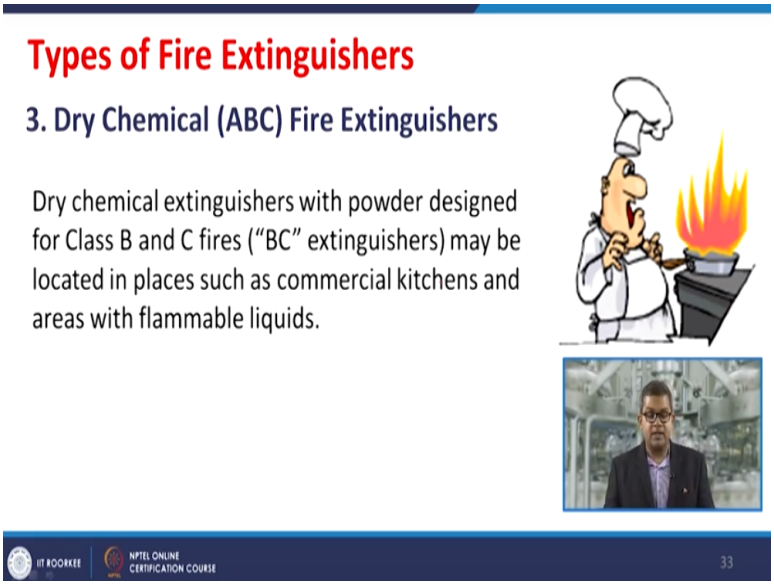

The dry chemical extinguishers with powder designed for class B and C fires may be located in place such as commercial kitchen and area where you may have a flammable liquids etc, some industrial locations and so on.

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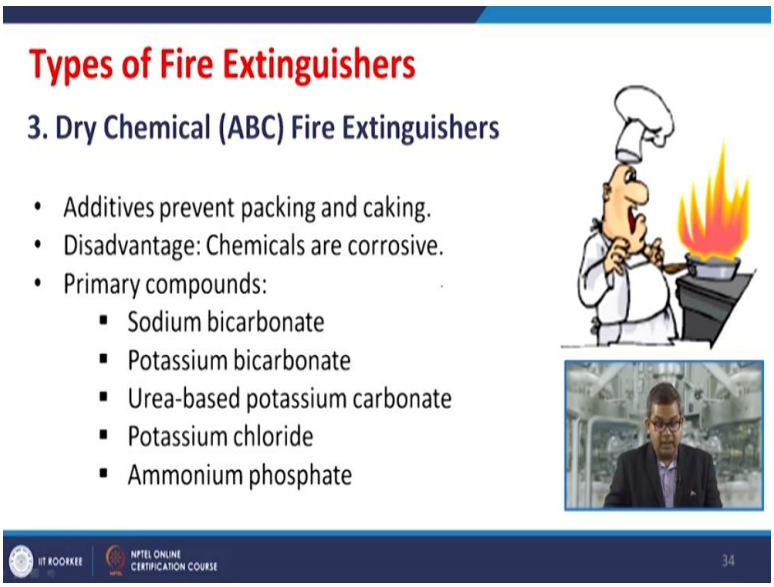

Now the additives, you may use a different additives to prevent the packing and caking. Sometimes they may form a lump if they are rose, that is why you may observe that some of the fire extinguishers they do have some expiry dates. Now disadvantage of this dry chemical extinguishers are the chemicals which are used in the dry chemical extinguishers they are corrosive in nature and the primary compounds which are used in the dry chemicals are sodium bicarbonate, potassium bicarbonate, sometimes urea based potassium carbonate, potassium chloride, ammonium phosphates etc.

So in this particular module, we have studied 3 different type of fire extinguishers and before study of these different type of fire extinguishers we have classified the fire and based on this classification we have gone through 3 different type of fire extinguishers; APW, dry chemical, and CO_2 type of. Subsequent module, we have other type of fire extinguisher along with the methodology and anatomy of and how to use those fire extinguishers. Thank you very much.