Lecture 19
Fuel System

Now next is, Basic Fuel System Components. Let us see, what are the basic components, in a fuel system?

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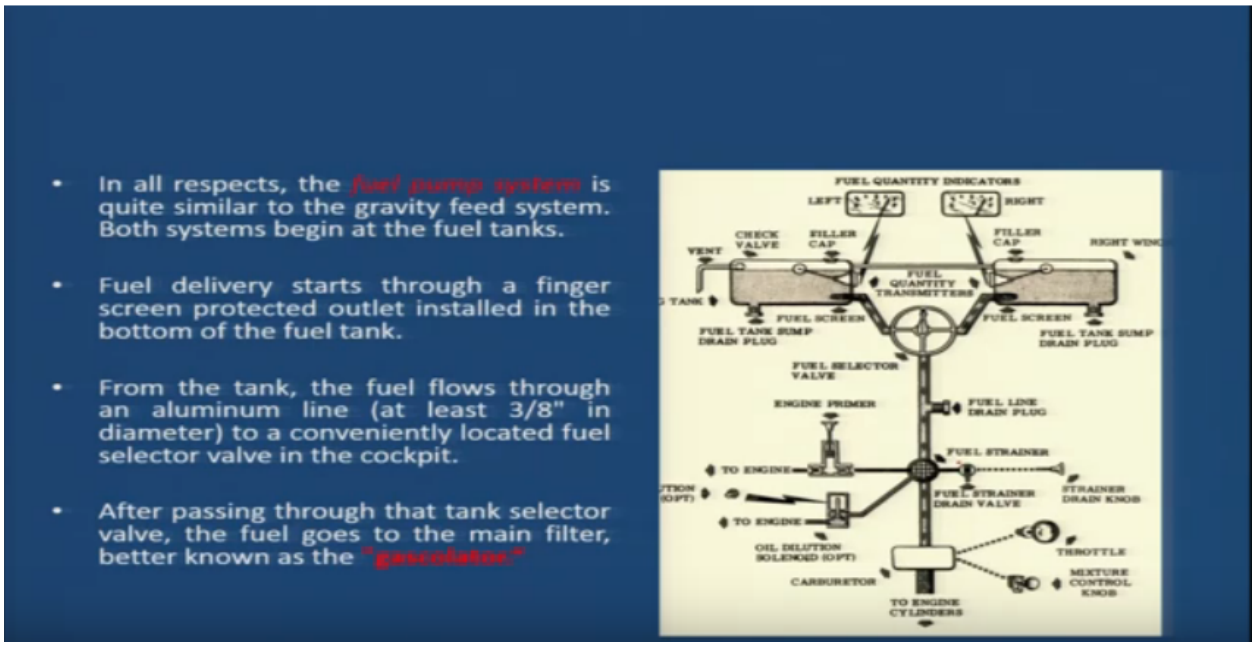

The fuel system of an aircraft, comprises of the aircraft fuel system and the engine fuel system, there are Some components, in the aircraft fuel system you can see in the figure, the fuel is stored in the tanks, there are two tanks, then from the tanks the fuel is coming to the selector valve, from the selector valve, it is coming to the fuel filter, from the filter, it is coming to the carburetor or the fuel injector unit. So, this is a basic very, basic kind of a system here you see, tanks, then you have the selector valve, from the selector valve, the fuel is being filtered, this is the fuel strainer and from the strainer, it is coming to the carburetor or the injector and from there it goes to the respective cylinders. So, this is a very, basic fuel system of an aircraft, mainly all the systems, they have a fuel pump and some aircrafts have a gravity feed system. But, in all respects the fuel pump system, is quite similar to the gravity feed system both systems begin at the fuel tanks. So, whether it is a gravity feed system or a pump system, you have fuel tanks, where the fuel is stored, fuel delivery starts, through a finger screen protected outlet installed in the bottom of the fuel tank. So, in the fuel tanks, the outlet where from where the fuel is coming out, they have the strainers or the finger screen, filters to which the fuel coming out of the tanks is filtered, from the tank the fuel flows through an aluminum line, to a conveniently located fuel selector valve in the cockpit. So, from the tanks the fuel is coming to the selector valve, after passing through the tank selector valve, the few goes to the main filter, better known as the gascolator. So, after passing from the selector valve, the fuel is going to the strainer or the filter which is also called the, ‘Gascolator’.

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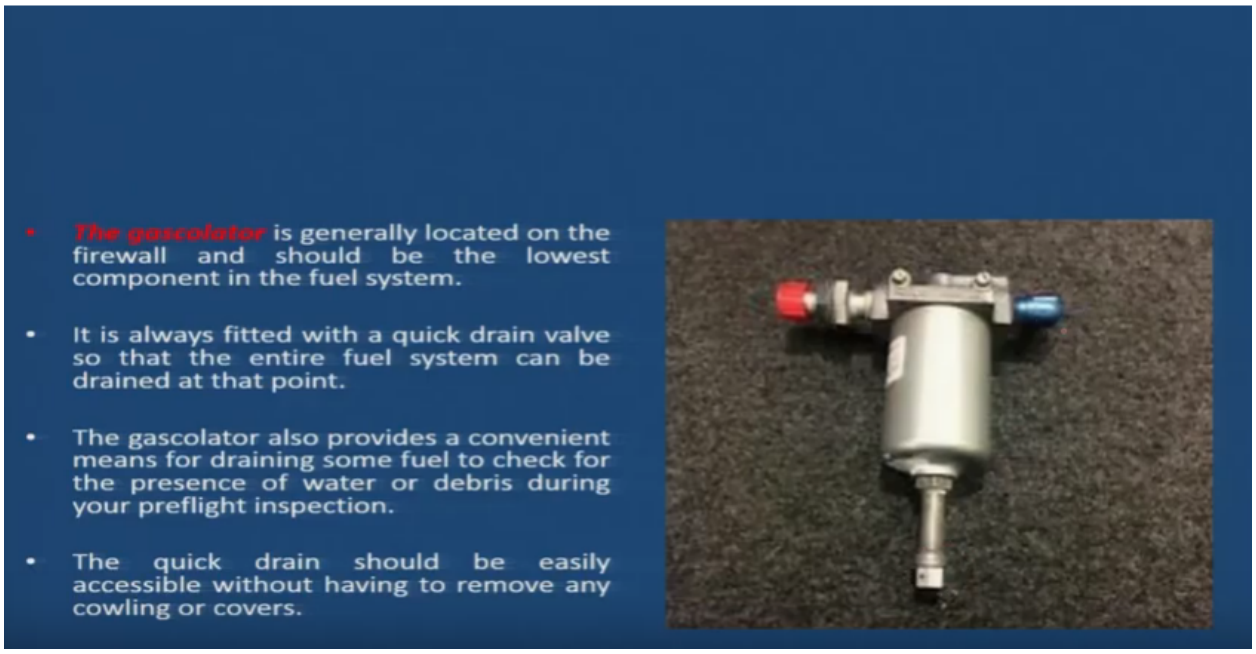

Now, the gascolator is generally located on the firewall and should be the lowest component in the fuel system. Since gascolator is a filter, it is located at the lowest, possible place in the fuel system and it is generally located on the firewall, it is always fitted with a quick drain wall. So, that the entire fuel system can be drained at that point. So, the gascolator the filters they are located at a lowest point in the system and they are equipped with a drain wall. So, that the complete fuel can be drained through this wall, the gascolator also, provides a convenient means for draining some fuel, to check for the presence of water or Deborah's, during your pre-flight inspections, during our pre-flight inspections as part of a regular maintenance, we also, take fuel samples and check for sediments in the fuels, check for water presence in the fuel. So, that sample can also, be drawn through these drain wall, which is at the bottom of the, gascolator. The quick drain should be easily, accessible without having to remove any cowling or scours. So, for ease of maintenance, the drain wall, the quick drain should be easily accessible. So, that we are not required to remove, the engine cowlings, all the time and sample, fuel sample can be easily taken for, a pre-flight inspection. In the figure you can see, this is a gascolator and at the bottom you see, there is a drain valve, this is your drain valve, one is your inlet and one is your outlet.

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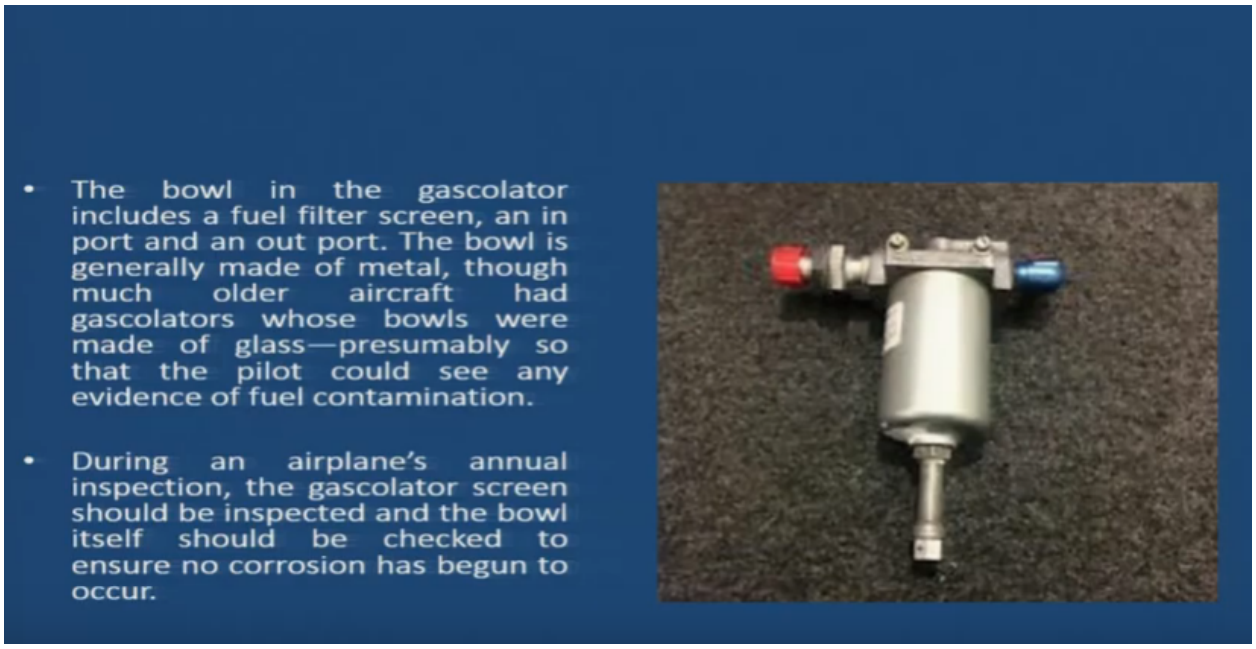

The bowl in the gascolator includes a fuel filter screen. So, this, this is your bowl, this bowl it has a filter screen and inlet port and an outlet port. So, this is your Inlet and here is your outlet, the bowl is generally made of metal, though much older aircrafts have, gascolator whose bowls were made of glass. So, that the pilot could see, any evidence of fuel contamination. So, mostly the gascolator they have the bowls, made of metal but in some of the versions, you we had glass bowls. So, that contaminants could be easily detected. During an airplanes annual inspection, the gas collector's screen should be inspected and the bowl itself should be checked to ensure, no corrosion has begun to occur. So, as part of our annual inspection, the screen, the gas collector filter element, needs to be cleaned, inspected and the bowl itself needs to be checked for any corrosion, for any presence of corrosion.

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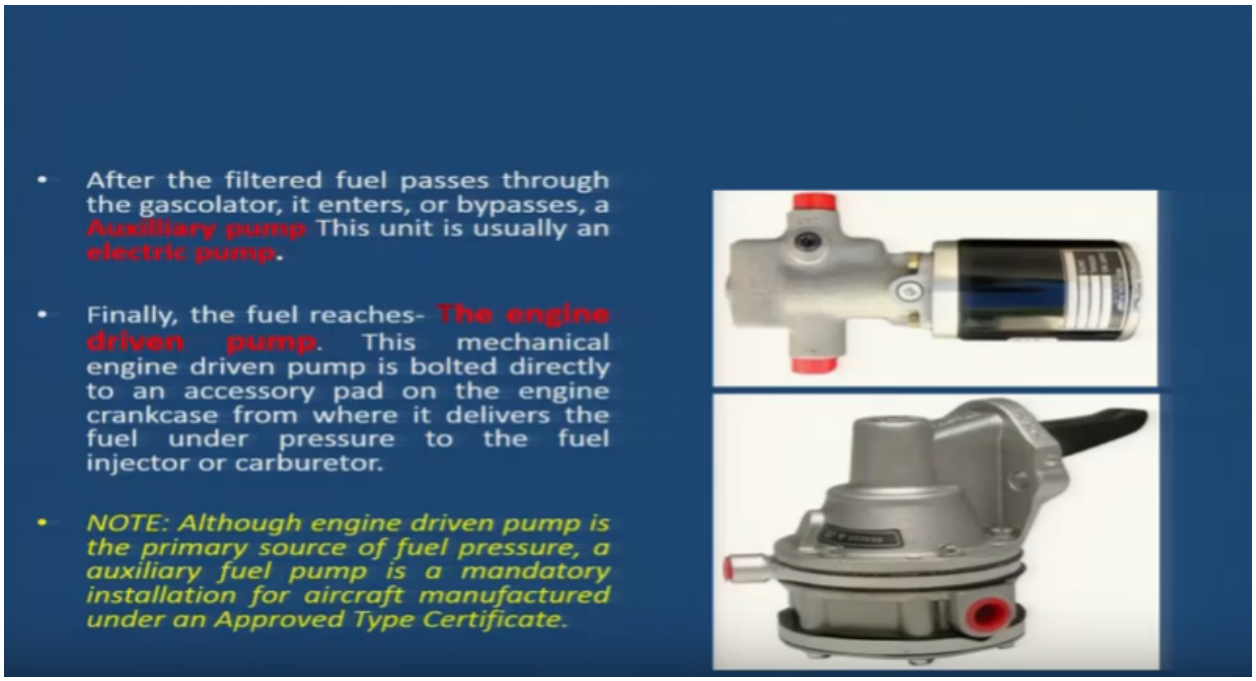

After the filtered fuel passes through the gascolator, it enters or bypasses, auxiliary pump, this unit is usually called an, 'Electric Pump'. So, the fuel system also, has an auxiliary pump or electrical pump or also called, 'An Electrical Fuel pump'. So, the fuel started from the tank, from the tank it reached, the selector valve, from the selector valve it came to the gascolator filter element and from the gascolator, the fuel is coming to the auxiliary pump or the electrical fuel pump, from the electrical fuel pump, the fuel is reaching, the engine driven pump. So, we have got two fuel pumps, one is the auxiliary pump or the electrical fuel pump which is also called a, Booster Pump' and second pump is the engine driven pump, your engine fuel system starts at this point, from the engine driven fuel pump, before engine driven fuel pump, that is up to the auxiliary pump, you the system is called an, 'Airframe fuel system'. And from the engine driven fuel pump, it is called an, Engine Fuel System'.

So, finally the fuel reaches the engine driven pump, this mechanical engineering pump is bolted directly to an accessory pad on the engine crankcase, from where, it delivers the fuel under pressure, to the fuel injector or carburetor. So, this pump, this is mounted on the accessory pad of the engine and it is engine driven, it is being driven by the engine, the three gears, are meshed to the engine gears and the fuel under pressure, is being delivered, to the fuel injector or carburetor. We need to note that the engine driven pump, is the primary source of fuel pressure. But, auxiliary fuel pump is also mandatory, for aircrafts, mentioned, manufactured under an approved type certificate. So, as part of the approval as part of the regulatory requirement, the auxiliary fuel pump is also an essential feature and although, engine reving pump is a primary source of fuel pressure, still auxiliary fuel pump is mandatory.

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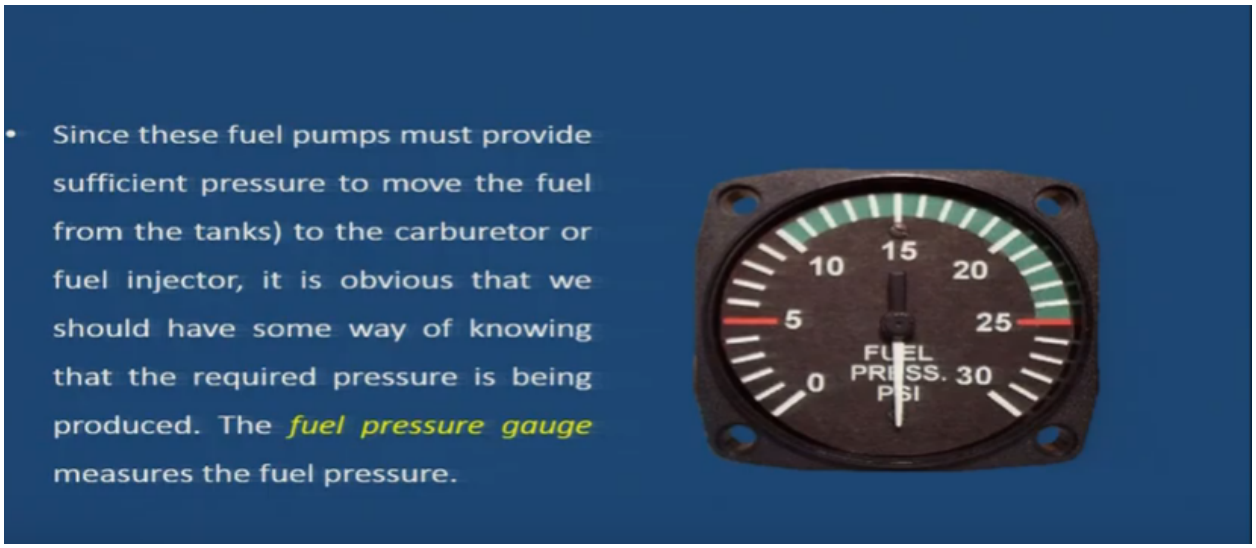

Now, since the fuel is flowing the fuel also has pressure. So, we need to measure the fuel pressure. So, there is a gauge, through which we can measure the fuel pressure, you can see in the figure, a fuel pressure gauge, now since these fuel pumps, must provide sufficient pressure to move the fuel from the tanks, to the carburetor or fuel injector, it is obvious that we should have Some ways of knowing, that the required pressure is being produced. So, the fuel pressure gauge measures the fuel pressure. So, this gauge this is used to, measure the fuel pressure and we need to verify that the system is attaining the pressure, as is specified by the manufacturer.

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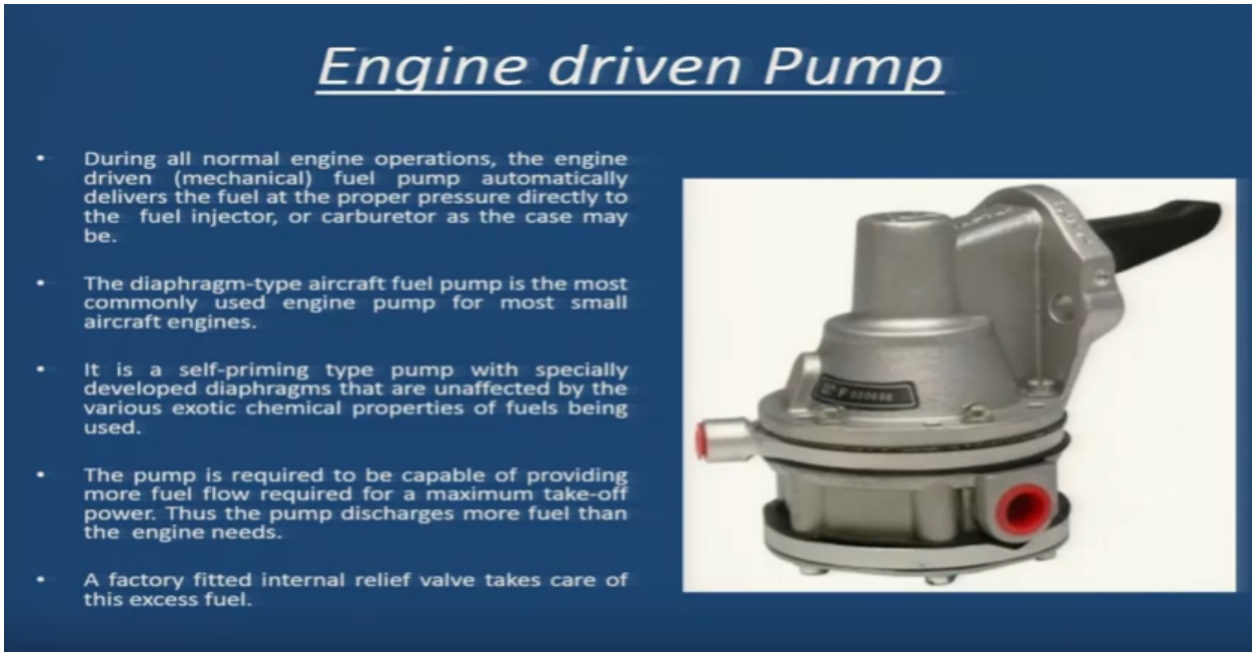

Next is the engine driven pump, the engine-driven pump during all normal engine operations, this mechanical pump engine driven, automatically delivers the fuel, at the proper pressure directly to the fuel

injector or carburetor as the case may be. So, this pump during normal operations, well automatically deliver fuel at proper pressure to the fuel injector or carburetor this diaphragm type a craft fuel pump, is the most commonly used pump for most small aircraft engines. Now, this pump, this is a diaphragm type pump and is most widely used, in small aircrafts. It is a self priming type pump, with specially developed diaphragms, that are unaffected by the various, exotic chemical properties or fuels being used. Now, this is, a self priming type pump and the diaphragms in this pump, they are so designed, that they are not affected by the properties by the chemical properties of fuel that is being used. The pump is required to be capable of providing more, fuel flow required for a maximum takeoff power. So, the pump is should be able to deliver fuel, more than, what is required? So, thus the pump discharges more fuel than the engine needs, a factory fitted internal revolt, takes care of this excess fuel. So, whatever excess fuel is being delivered is being sent back to the tank, by means of the relief wall, of the factory fitted internal relief wall.

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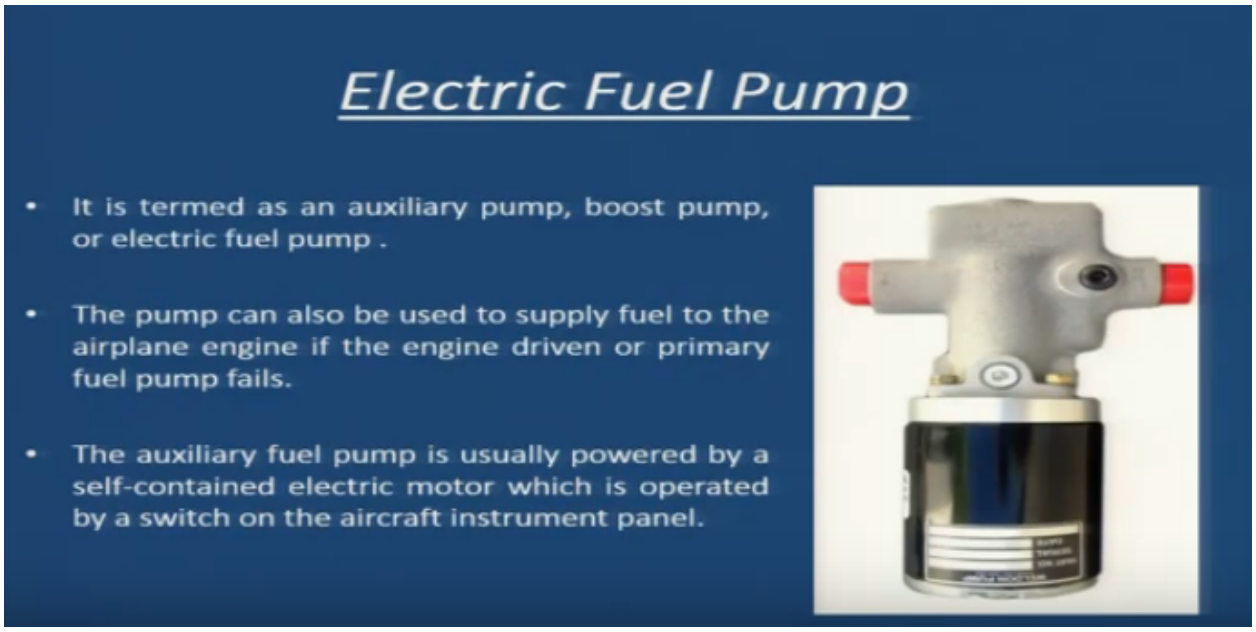

This electric fuel pump, apart from the engine driven fuel pump, we have one more fuel pump, which is the electric fuel pump. The earlier pump, we had seen was the injured driven pump, now this is your electric fuel pump, this is also called an, ‘Auxiliary Pump’ or a ‘Boost Pump’ or an ‘Electric Fuel Pump’. This pump can be used to supply fuel to the airplane engine, if the engine driven or primary pump fuel pump fails, since the primary pump is the engine driven fuel pump, in case the engine driven pump fails, the fuel can be delivered, to the engine by this auxiliary pump or the booster pump, the auxiliary fuel pump is usually powered by a self-contained electric motor, which is operated by a switch, on the aircraft instrument panel. Now, this pump has a motor, which is operated by a switch on the instrument panel, since this is an electrically operated pump.

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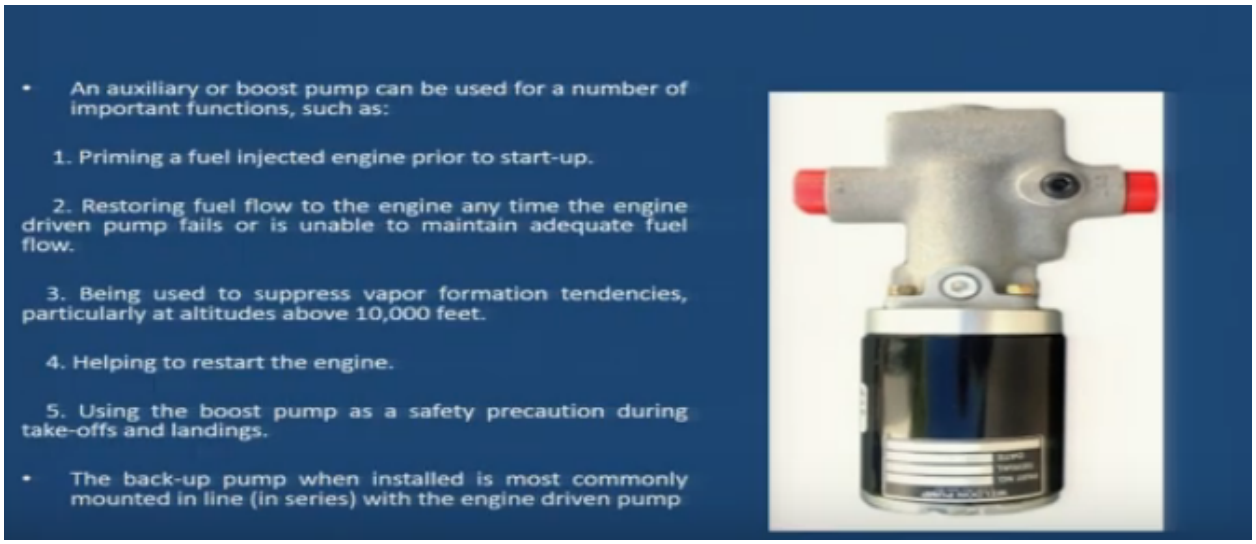

And auxiliary or boost pump can be used for a number of important functions. So, this pump this electrical pump, has got various purposes, it is used to prime a fuel-injected engine, prior to startup. So, it is acting as a primer also, so in engines, which are installed with a fuel injector, this auxiliary pump is used to prime the engine. Restoring fuel flow to the engine anytime the engine driven pump fails or is unable, to maintain adequate fuel flow. So, in case the, engine driven pump fails or is not able to, maintain the required, fuel flow in that case also, the electric fuel pump comes into picture and this supplies, fuel to the engine. Being used to suppress vapour formation tendencies particularly at altitudes above 10,000 feet. So, at high altitude operations, there are possibilities of vapour formation, during hot weather operations also, there is possibility of vapor formation, in the fuel lines. So, in that case also this booster pump, this electrical fuel pump, is used to suppress vapor formation. And helping to restart the engine, in case, if we are required to restart the engine, in that case also, this electric fuel pump is helpful, using the boost pump as a safety precaution, during takeoffs and landings. So, during takeoffs and landings it is a mandatory requirement to have the booster pump on, to have the electrical fuel pump on, this is a and this is an extra safety precaution, which is taken during the takeoffs and landings. So, that we have fuel supply, from two pumps. The backup pump, when installed is most commonly mounted, inline in series with the engine driven pump. So, this pump is mostly installed in line with the engine driven pump, it is in series, with the engine driven pump.

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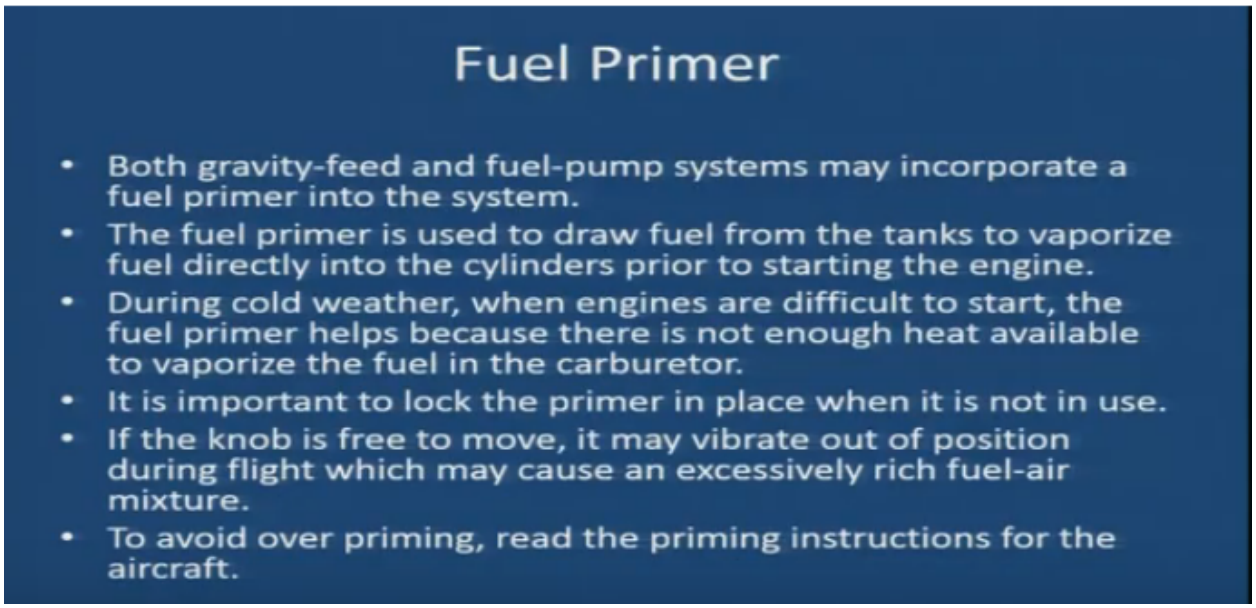

So, next is fuel primer and both the gravity feed and the fuel pump systems, fuel primer is used, the fuel primer is used to draw fuel from the tanks, to vaporize fuel directly into the cylinders prior to starting the engine. So, before starting the engine, this fuel primer is used to vaporize the few, to bring the fuel from the tanks, to vaporize it directly into the cylinders, just before starting the engine. So, during cold weather, when engines are difficult to start the fuel primer helps, because there is not enough heat available, to vaporize the fuel in the carburetor. So, during cold weather, operations also and it is difficult to start the engine, this fuel primer is used for starting the engine, it is important to lock the primer in place when not in use and if it is, left unlocked, then and the knob is free to move, it will vibrate out of position during flight and may cause excessively rich, fuel mixture. To avoid over priming, the priming instructions need to be read from the aircraft. Manuals the recommendations of the manufactures need to be followed.

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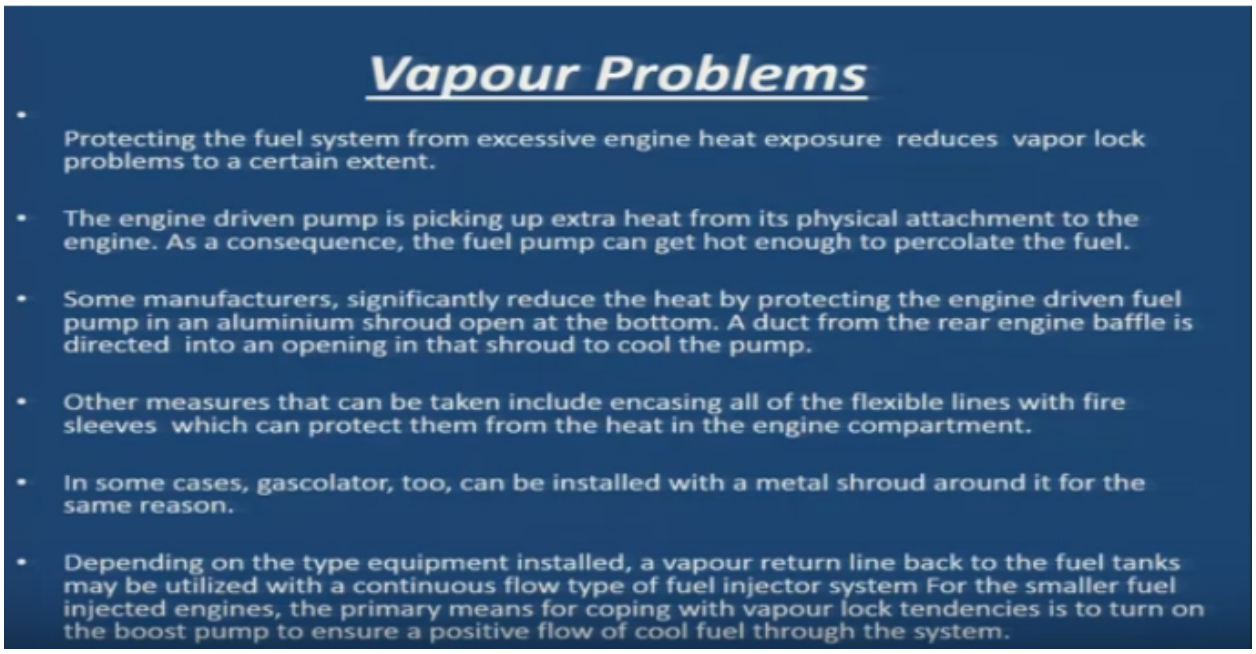

Next, vapor problems this is a very, common problem we face, in western Indian operation especially during high altitude operations, especially during hot weather operations. So, let us see, basically what this problem is? This problem is, basically due to the heat, basically due to the exposure of the engine to heat. So, to protect the fuel system, from excessive engine heat exposure, reduces vapor lock problems, to a certain extent. So, if we are able to protect our engine, from excessive heat, then vapor lock problem can be reduced, can we minimize, to a certain extent. The engendering pump, is picking up extra heat, from its physical attachment to the engine, as a consequence, the fuel pump can get, hot enough to preed, to percolate the fuel. Now, since the engine driven fuel pump is mounted on the engine accessory pad and it's, because of its physical attachment, because of its surroundings, the engine driven fuel pump, will also absorb, Some heat and as a result, the fuel pump, gets hot enough. So, that vapor for it, helps in vapour formation. Some manufacturers, significantly reduce the heat by protecting the engine driven fuel pump in an ammonium shroud, open at the bottom, a duct from the rear engine baffle is directed into an opening in that shroud, to cool the pump.

So, different manufacturers, they adopt different measures, to protect the engine driven fuel pump, from absorbing, this heat from its surroundings, other measures that can be taken include and casing all of the flexible lines with fire sleeves, which can protect them, from the heat in the engine compartment. Now, apart from the engine driven fuel pump, the fuel lines, they are also, exposed to the hot environment, over the engine, the fuel lines are running, just on top, of the cylinders and they are also, exposed to heat. So, these few lines, they help in forming vapors and some manufacturers, have taken some measures, by encasing all, the flexible lines with fire sleeves. So, all the flexible lines, they have tried to, put sleeves, over them. So, that they can be protected from the heat, in the engine compartment. But, still apart from flexible fuel lines, we have stainless steel lines, running over the cylinders, on top of the engine, these metallic lines, they absorb, heat and the fuel gets vaporized in these lines. So, this is a major problem, because of vapour formation, air pockets are formed in the lines and because of these air pockets, the fuel, is not reaching the cylinders and it is very, difficult to start the engine, during hot weather, in case if, vapor pockets have formed in the lines. In some cases, gascolator, two can be installed with a metallic shroud, around it for the same reason. So, apart from gas about from the engine driven fuel pump, the

metallic lines gascolator can also, help in vapour formation. So, in gascolator, also needs to be covered, by some metal shroud and some manufacturers have, taken steps to cover the gascolator, in order to avoid, vapor formation. Depending on the type equipment installed, a vapor return line back to the fuel tanks may be utilized, with a continuous flow type of fuel injector system, for the smaller fuel injected engines the primary means, for coping with vapor lock tendencies, is to turn on the boost pump, to ensure a positive flow of cool, fuel through the system. So, some manufacturers, depending on the type of equipment, they have incorporated a vapor return line, back to the fuel tanks. So, that the vapor is sent back to the tank and from the tank it is vented out. In some smaller aircrafts, this vapor lock tendencies, they are tackled by boost pumps, which ensure positive flow of cool, fuel through the system.

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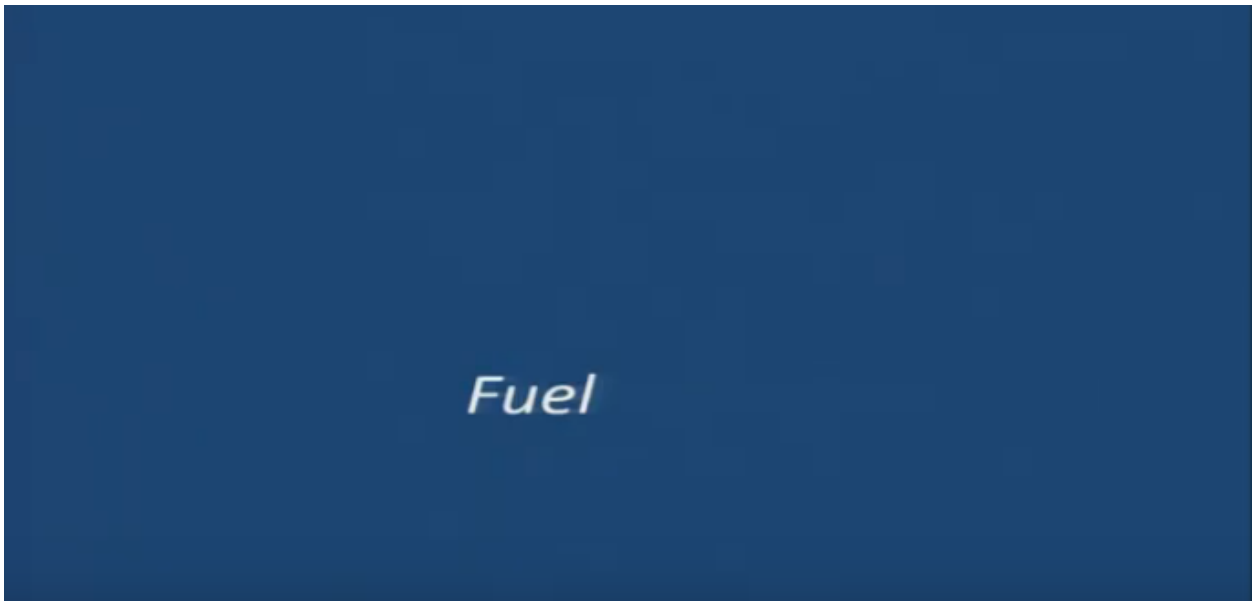

So, this was, about the vapor problems. Next let us see, since we are studying the fuel system, let us read something, about the fuel being used, what are the types of fuel? And what are the precautions, taken while handling fuels.

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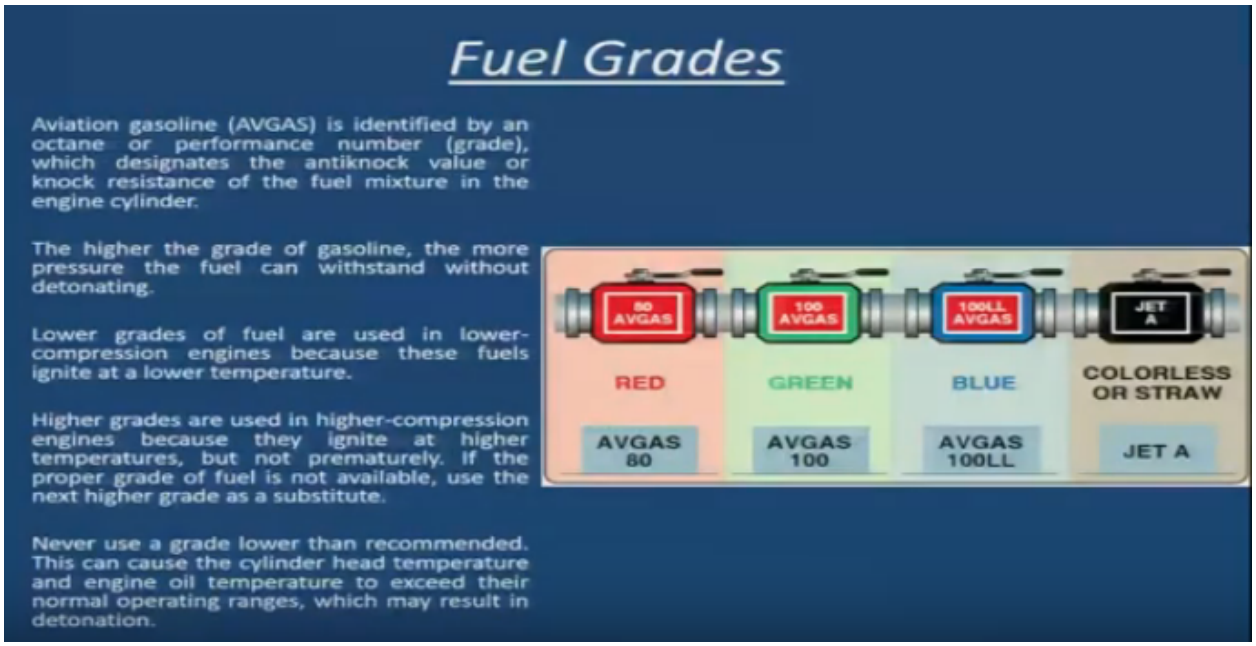

Now let us see, what are the different grades of fuel being used, in the aviation, the aviation gasoline, we call it, 'AVGAS' is identified by an octane or performance number that is grade, which designates the anti-knock, value or knock resistance of the fuel mixture, in the engine cylinder. We have read about this anti-knock value, we have read about the octane rating, in our initial lecture, of the fuel system. So, this AVGAS, is identified by an octane number or performance number or grade number which designates the anti-knock quality, of the fuel, mixture in the cylinder, the higher the grade of gasoline, the more pressure the fuel can withstand without detonating, So, the higher the number, the more pressure, fuel can withstand without detonating. Lower grades of fuel are used in low, lower compression engines, because these fuels ignite at a, lower temperature. So, in low compression engines, we can use fuels of lower grades, because ignition is happening at lower temperatures, higher grades are used in high compression engines, because they ignite at higher temperatures, but not prematurely, if the proper grade of fuel is not available, use the next higher grade as a substitute.

So, in case if the fuel is not available, of a proper gate. So, it is better to use a fuel of next higher grade as a substitute. Never use a grade lower than recommended. This can cause the cylinder head temperature and engine oil temperature to exceed, the normal operating ranges, which may result in detonation. So, a few of a higher-grade can be used but, a fuel of a lower grade cannot be used. So, here in the figure you can see, different types of fuels, different types of AVGAS, aviation gasoline, you can see one is red, red one is green, one is blue, AVGAS 80 is the red, AVGAS 100 is green, AVGAS 100 L is blue and then another type of fuel, JET A, which is colorless or straw in color, with all straw. So, the fuel being generally used, in piston engines, in reciprocating engines is aviation gasoline 100 LL, the blue fuel, is being generally used.

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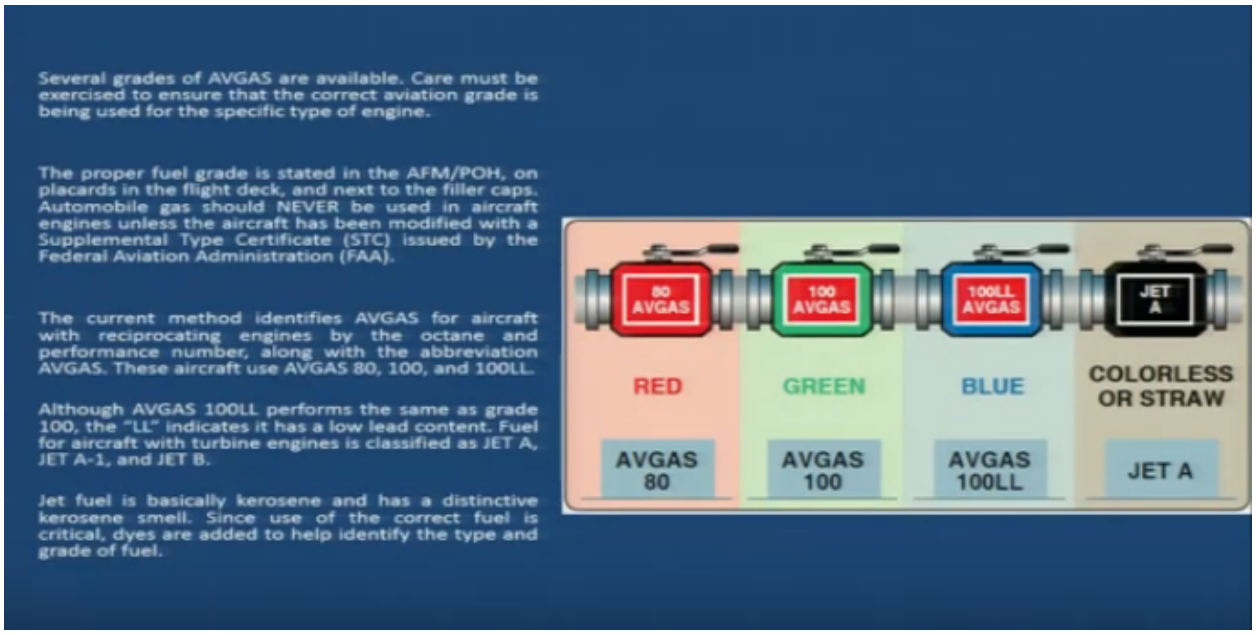

Several grades of AVGAS are available; care must be exercised to ensure that the correct aviation grade is being used, for the specific type of engine. So, as we have seen the different types of fuel grades are available and the fuel to be used, on a particular engine, should be as per the manufacturer's recommendation and in case, if the fuel of the proper grade, is not available, in that case, of the fuel of higher grade should be used, the proper fuel grade is stated in the aircraft flight manual or POH, on placards in the flight deck and next to the filler caps. So, there are various places where you can find, which type of fuel to be used on the aircraft, it will be mentioned, on the pilots operating handbook or the flight manual of the aircraft it would be placarded on the flight deck, it would be play carded on the filler caps. So, you will come to know that, which type of fuel is required on which aircraft, automobile gas should never be used in aircraft engines, unless the aircraft has been modified with a, supplemental type certificate issued by FAA. So, automotive fuels should not be used, until and unless, they the aircraft's are certified to use it. The current method identifies AVGAS, for air craft with reciprocating engines, by the octane and performance number, along with the abbreviation AVGAS, these aircrafts use AVGAS 80 hundred and hundred LL. So, we have read earlier, in our initial lectures, what is an octane number? What are these numbers and how, are they designated. So, generally these, AVGAS fuels, they are rated as 80, 100 and 100 LL.100 LL, performs the same grade same as grade 100, the LL, indicates it has a low lead content. So, LL means low lead, fuel for aircraft with turbine engines is classified as JET A, JET A1 and JET B. So, this JET A fuel, is basically for turbine engines and for turbine engines also, JET A, JET A1 and JET B are the fuels and grade AT AVGAS, 80 AVGAS 100, AVGAS, hundred LL, they are for, reciprocating engines, piston engines.JET fuel is basically kerosene and has a distinctive kerosene smell, since use of the correct fuel is critical dyes, are added to help identify the type and grade of fuel. So, the type of fuel is very important, which type of fuel to be used on which aircraft, this is very, very critical and so, in order to, is in order to, help these fuels are dyed, in color so that, they can be easily identified.

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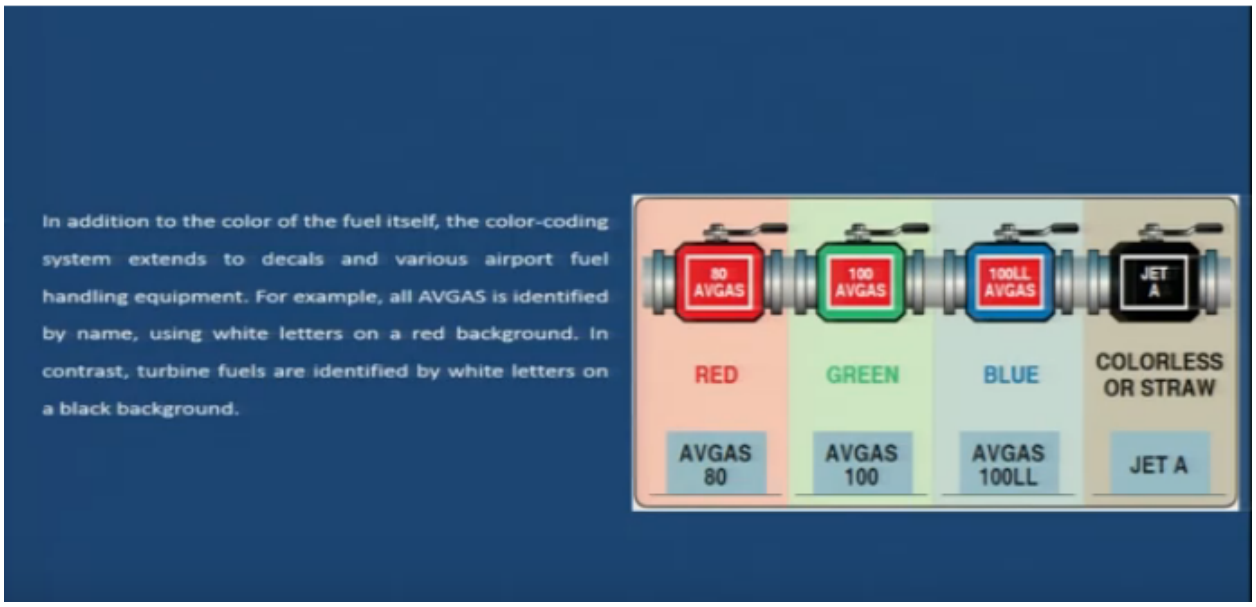

In addition to the color of the fuel itself, the color coding system extends to decals and various airport fuel handling equipments. So, apart from the fuel itself, the placard in these decals, they are also, mentioned on the equipments, on the lines, through which these fuels will be used, for example, all AVGAS is identified by name, using white letters, on a red background, in contrast turbine fuels are identified by white letters, on a background. So, here in the picture you see that, AVGAS 80 is written with, white letters, in a red background. I have gas 100 is written, in white with green background and AVGAS 100 LL, is written in white letters, with blue background and JET A is in white letters, with a black background.

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So, after seeing the types of fuel, let us see what are the inspections? What is, what are the quality control? That needs to be done on the fuel, aviation fuel, is used in to an aircraft for the generation of engine power and augmentation of thrust, the minimum requirements that an approved organization must comply are summarized as following, proper quality control and reef and fueling are referred to sampling tests of the fuel and inspections are correctly completed and records kept. So, the fuel which is being used, on the aircraft's they need to be inspected, they need to be tested, at proper intervals ,proper quality control checks, of the fueling, of the fuel, needs to be carried out, proper quality control checks, of the places where the fuel is stored, how the fuel is being dispensed, from the storage tank to the aircraft's, proper inspections of the complete procedures, sampling tests of the fuel and completion of records, they are all part of quality control, of aviation fuel.

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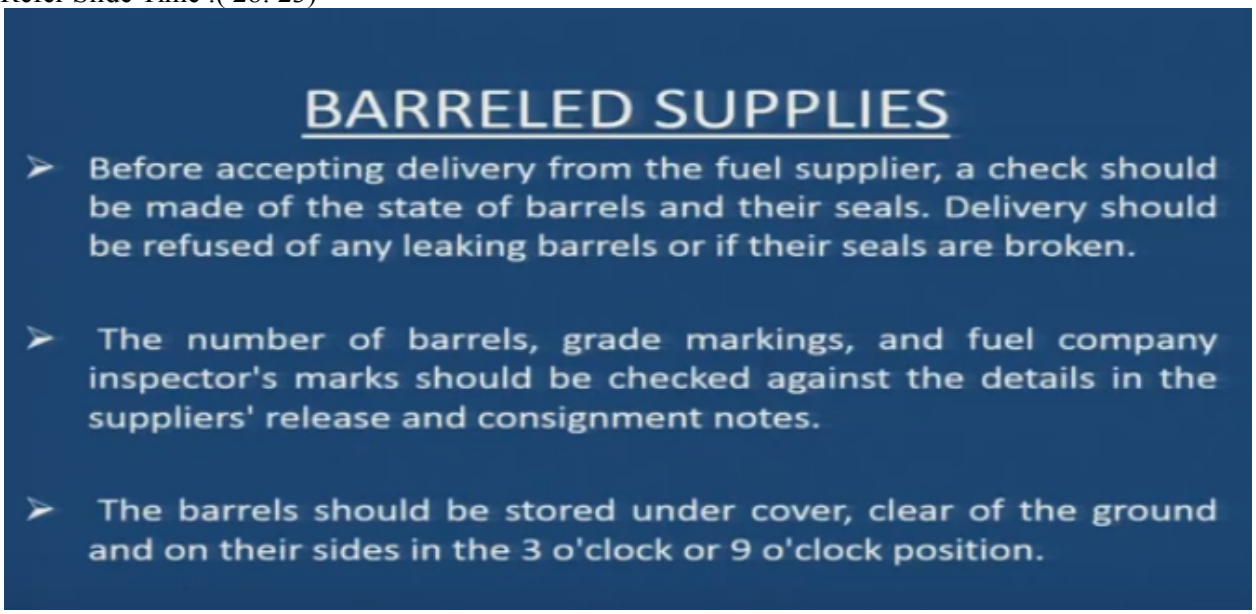

Now, the fuel may be stored in barrels, in case of barrel supplies, before accepting delivery from the fuel supplier, because the fuel is being supplied, by the suppliers, in barrels, before accepting the delivery, we need to ensure that the state of barrels, is fine they are properly sealed and in case if we find the barrels leaking or the seal, is broken, the delivery should be refused and we should not use that fuel on the aircraft, the number of barrels grade markings, fuel companies, inspectors marks, should be checked against the details in the suppliers release and consignment notes. So, all the papers which are being given but while taking the fuel these grade markings, the fuel company inspectors marks, inspection reports they should be checked, the barrels should be stored under cover, clear of the ground and on their sides in 3 o'clock or 9 o’ clock position. So, there is a proper procedure of storing the barrels also, so and they need to be stored and a cover clear of the ground.

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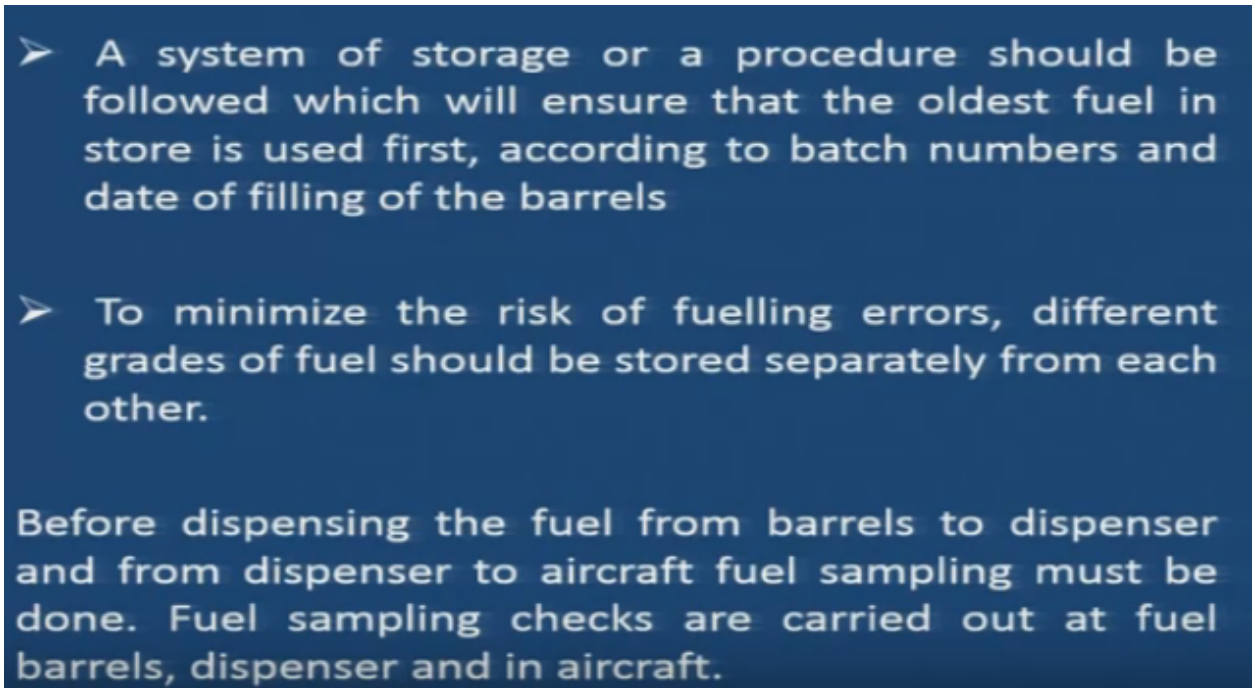

A system of storage or a procedure should be followed which will ensure that the oldest fuel is in store is used first according to batch numbers and date of filling of the barrels. So, the because the fuel before is delivered to an organization, is properly checked is, is inspected is tested, it and it is given a test report, while the fuel is in store, it should be ensured, there should be a proper system, to ensure that the fuel with the oldest date, is with the oldest batch number, is used first and then the barrels. With later dates, should be used, to minimize the risk of fueling errors, different grades of fuel, should be stored separately from each other. So, it is always advisable, to store different blades of fuel at different places. So, that we are we do not, mix up, with the wrong type of fuel. Before dispensing the fuel from barrels, to dispenser and from dispenser to aircraft fuel sampling must be done. It is very, important to check the fuel samples, before the fuel is dispensed from the barrels, to the aircraft fuel sampling checks are carried out, at fuel barrels, dispensers and in aircraft. So, fuel sampling checks are carried out, at various places.

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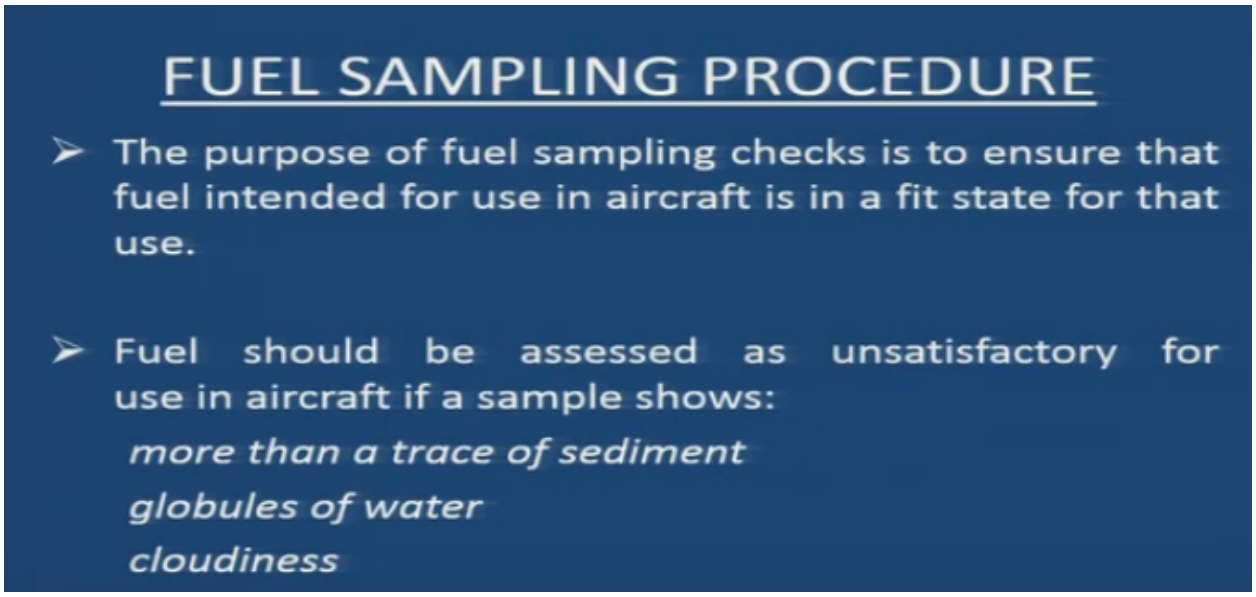

Now, what is the fuel sampling procedure? The purpose of fuel sampling checks, is to ensure that fuel intended for use in aircraft is in a, fit state for that use. So, the purpose of the fuel sample is to see that, the fuel being used is in a proper condition. Fuels should be assessed as, unsatisfactory for use in aircraft if a sample shows; more than a trace of sediment, globules of water or cloudiness. So, in case, if we find a sediment, you find water traces, we find cloudiness, in that case, the fuel should be rejected.

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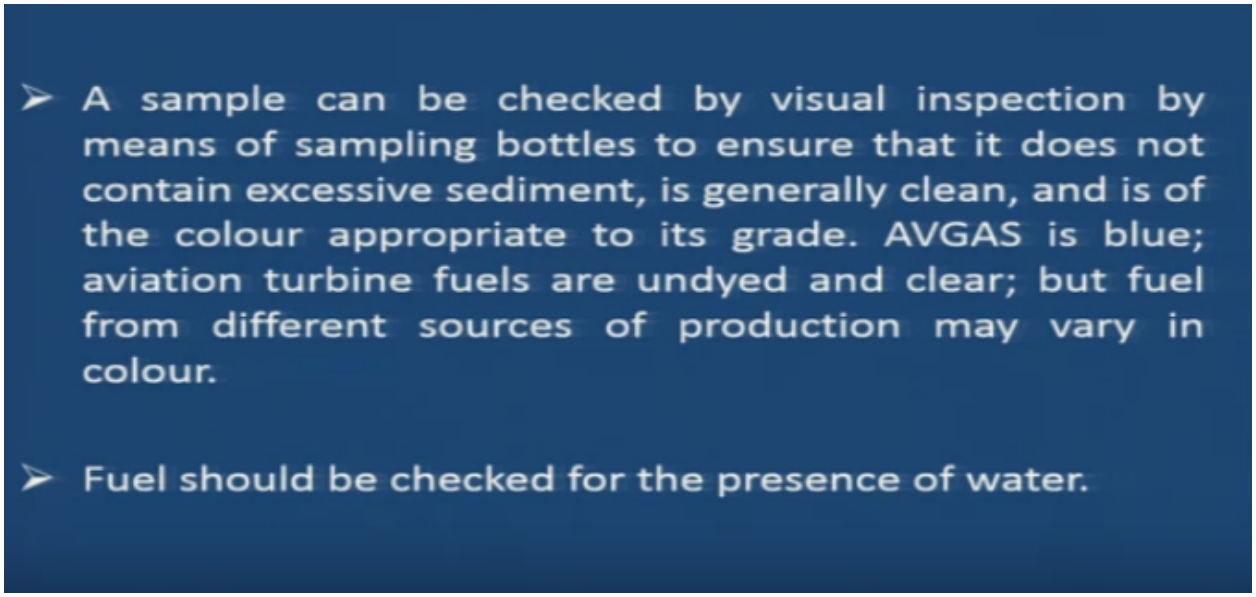

A sample can be checked by visual inspection, by means of sampling bottles, to ensure that it does not contain excessive sediment, is generally clean and is out of the color, appropriate to its grade. AVGAS is blue, ATF's are undyed and clear; but fuel from different Sources of production, may vary in color. So, during the sampling check, we need to ensure that, the fuels do not have sediments, they are generally clean, the fuel is of the proper color, appropriate to its grade and generally the fuel being used in piston

engine aircraft, is AVGAS, 100 LL, which is blue in color. During the sampling check, apart from the stresses of sediment, we need to check, the presence of water, we need to check, whether any cloudiness, is there in the fuel. So, the pure should be properly checked while taking the samples.

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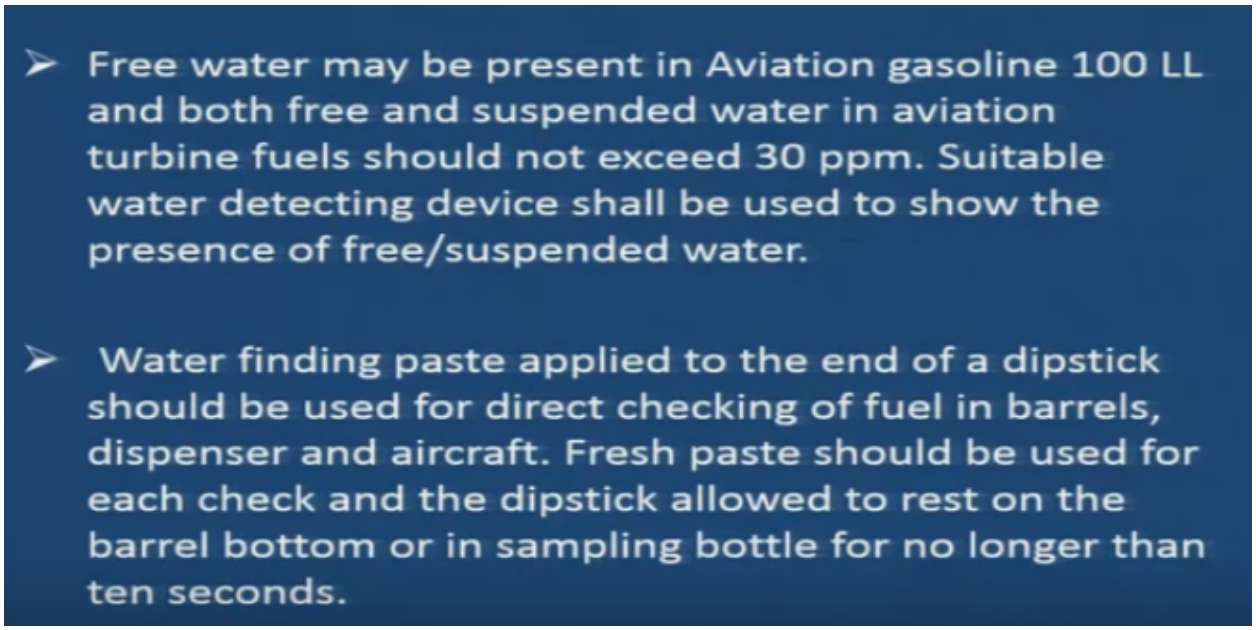

Free water may be present in aviation gasoline 100 LL and both free and suspended water in ATF's, should not exceed 30 PPM. Suitable water detecting device shall be used to show the presence of free or suspended water. So, there are devices through which, we can see, whether the fuel has got some water content, water finding paste applied to the end of a dipstick, should be used, for direct checking of fuel, in the barrels. So, the fuel which is stored in the barrels, should also, be checked by placing a dipstick and applying a water finding paste at the end of it. This dipstick can be can be used, to check the fuel and barrels, dispensers and aircraft. Fresh paste should be used for each check and dipstick allowed to rest, on the barrel bottom or in the sampling bottle for no longer than 10 seconds. So, this dipstick with a water finding paste, should not be in the fuel for more than, 10 seconds.

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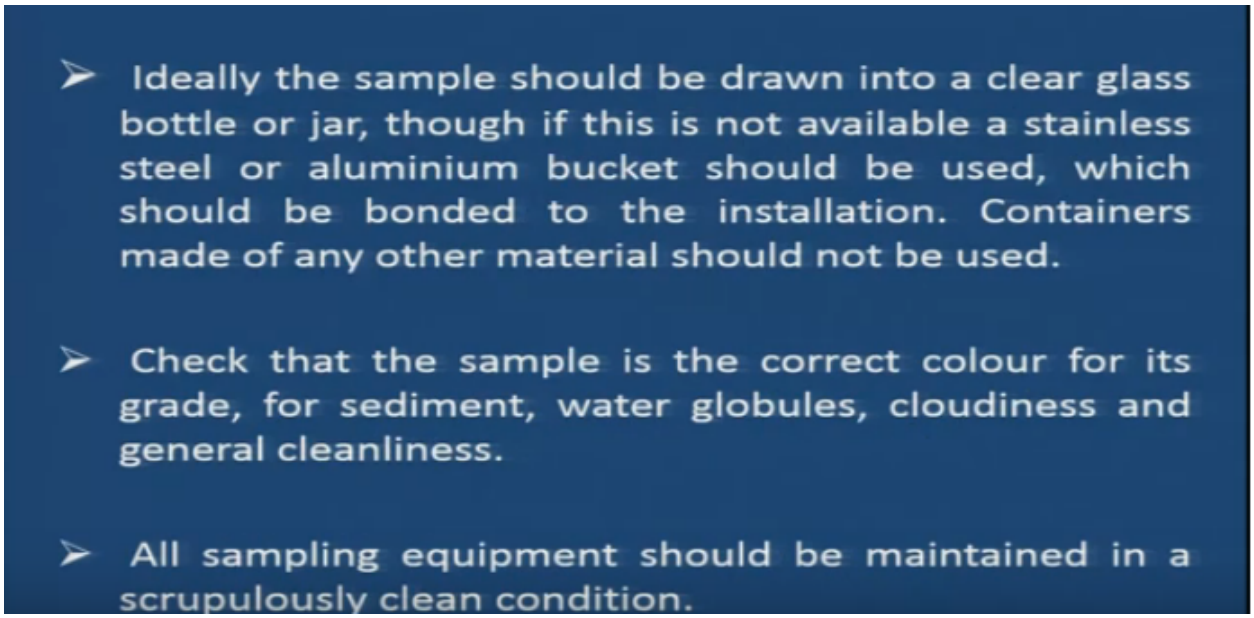

Ideally the sample should be drawn into a clear glass bottle or jar, though this is not, though if this is not available a stainless steel or aluminium bucket should be used, which should be bonded to the installation. Containers made of any other material should not be used. So, generally the fuel sample is taken in a glass transparent bottle and in case, if we, do not have this glass jar, then stainless steel or aluminum buckets can also be used, but any other material is not advisable. Check that the sample is the correct color for its great, for sediment, water globe, globules, cloudiness and general cleanliness. All sampling equipment should be maintained, in a clean condition. So, these are the general checks, general inspections, general precautions, to be followed while handling pure.

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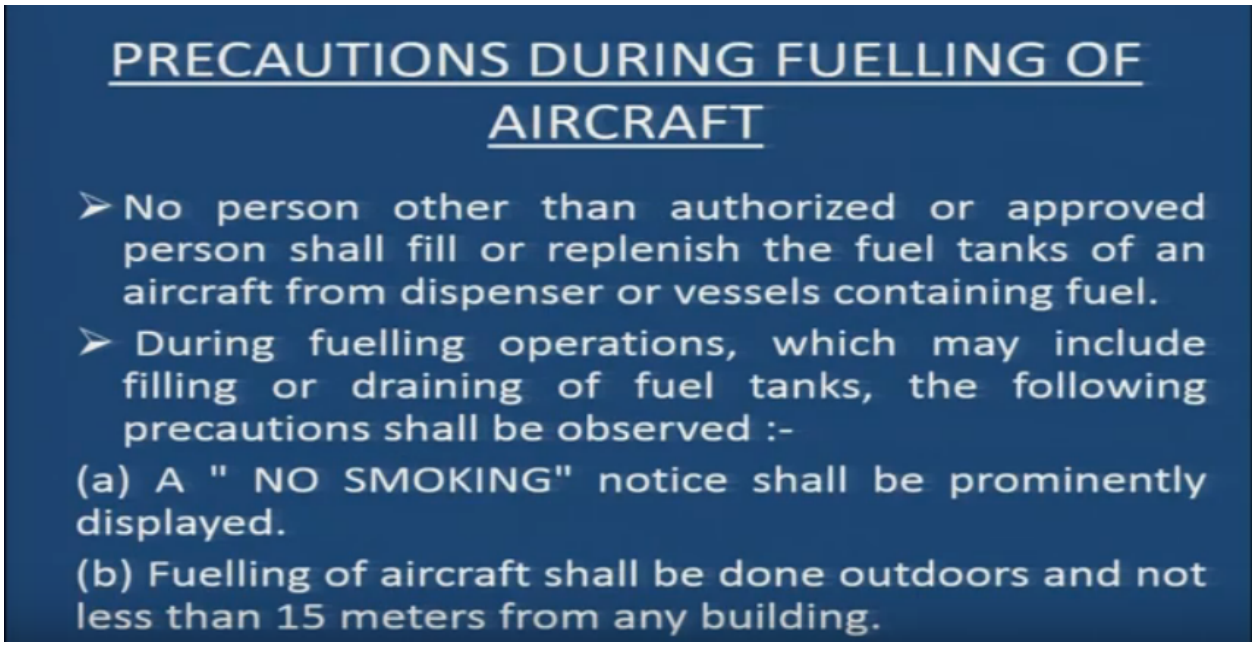

Now, what are the precautions during fueling of aircraft? no person other than the authorized or approved person, shall fill or replenish the fuel tanks of an aircraft, from dispenser or vessels containing fuel. So, the fueling has to be carried out by authorized people only, during fueling operations, which may include filling or draining or few tanks, the following precautions shall be observed, there are certain precautions, while handling these fuels, while replenishing the fuel in tanks or draining the fuel from the tanks, are no smoking notice shall be prominently displayed, very essential, no smoking notice requires to be displayed, fueling of a curve shall be done outdoors and not less than 50 meters from any building. So, very important thing that, fuelling should be done, out in an open and it should be at least 15 metres away from any building.

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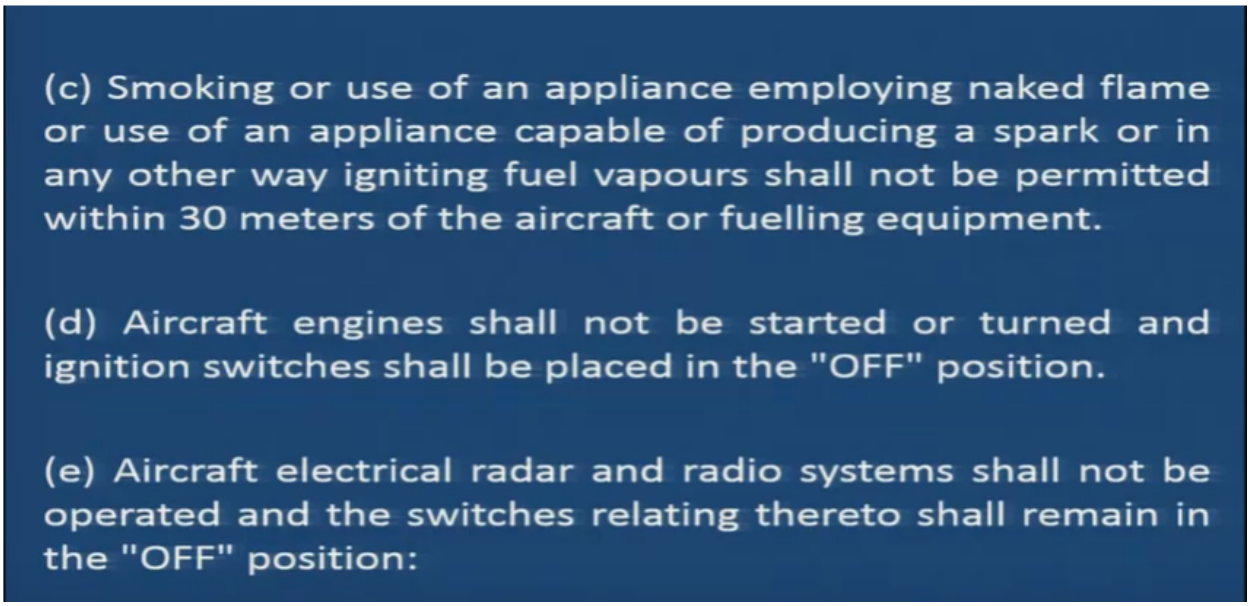

Smoking or use of an appliance, employing naked flame or use of an appliance, capable of producing a spark or in any other way igniting fuel vapors, shall not be permitted within 30 metres of the aircraft or fearing equipment. So, within 30 meters, there should not be any spark or naked flame, where this fuelling is taking place. Aircraft engines shall not be started or turned and ignition switches shall be placed in the off position. So during fueling, all the ignition switches, should be kept in off position, the engine should not be started. And we need to observe these precautions, aircraft electrical radar and radio systems shall not be operated and switches relating thereto shall remain in the off position. So, no ignition switches ,no electrical switches, no radio systems, being operated during the fuelling procedure, during the fuelling time.

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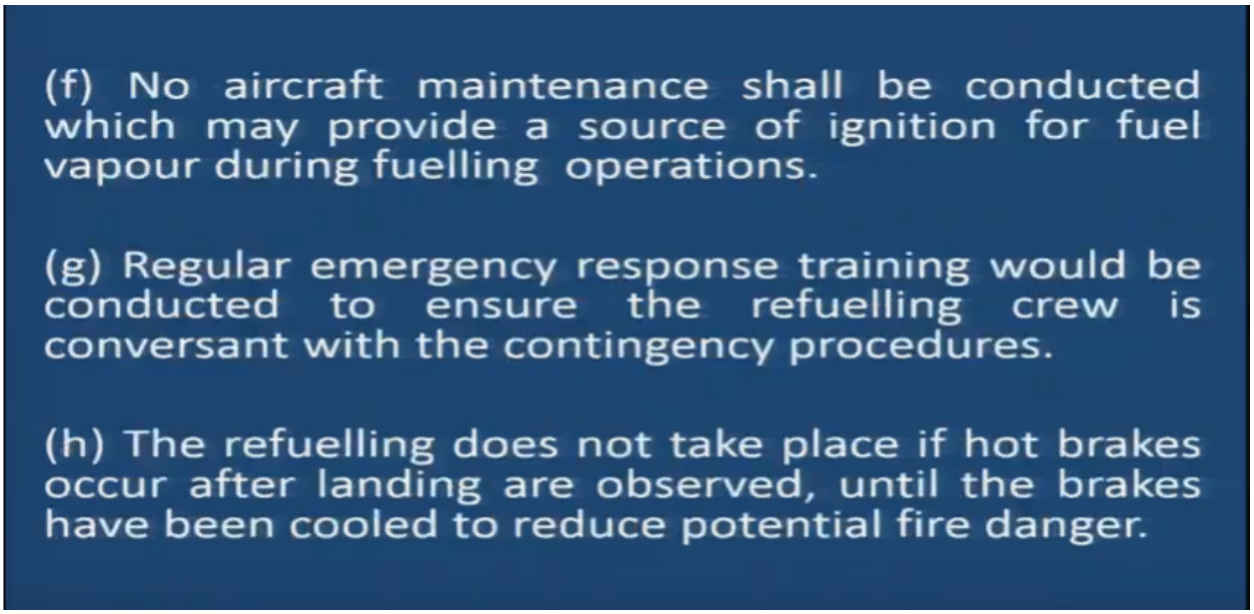

No aircraft maintenance shall be conducted, which may provide a Source of ignition, for fuel vapor during fueling operations. So, during fueling operations, we should not perform any maintenance, which is, which can produce, any Source of ignition for fuel vapor. Regular emergency response trainings, should be conducted to ensure, the re-fuelling crew is conversant with the contingency procedures, the re-fuelling does not take place, if hot breaks occur, after landing, until the brakes have been cooled, to reduce potential fire danger. So, some basic precautions in case of your or aircraft has come with hot brakes, we need to wait till the brakes have, cooled it down and then, only the aircraft should be refueled.

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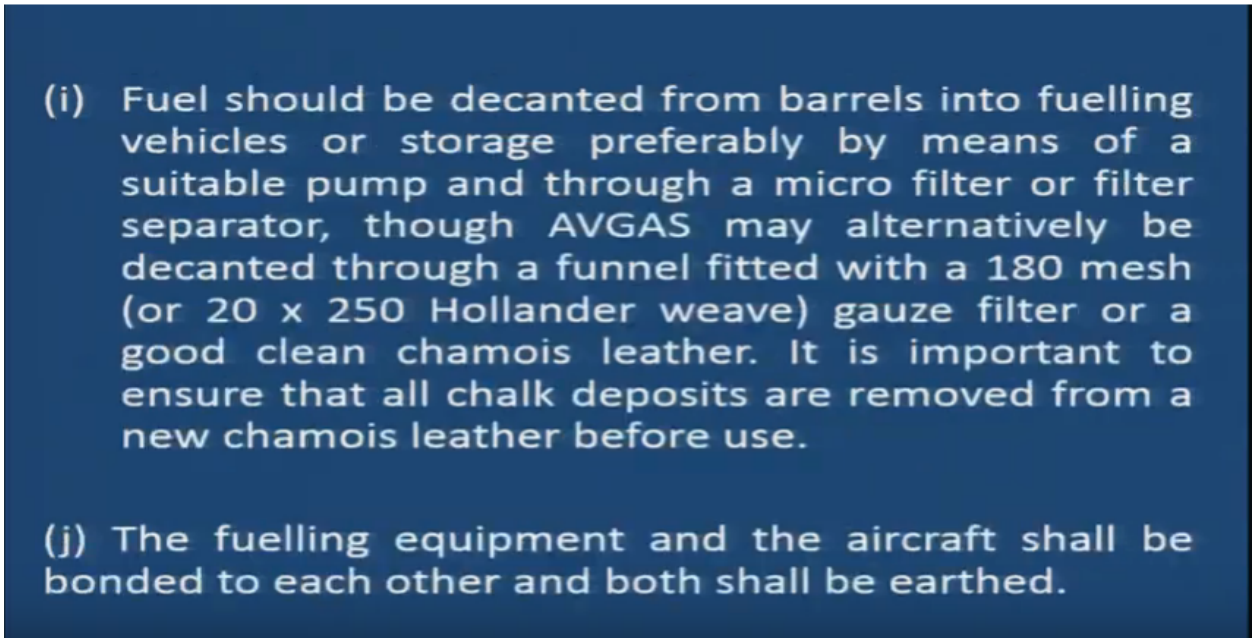

Fuel should be decanted from barrels, into fueling vehicles or storage, preferably by means of a suit pump and through a micro filter or filter separator, though AVGAS may alternatively, be decanted through a funnel fitted with a 180 mesh filter. Or a good clean shameless leather. It is important to ensure, that all job deposits are removed from a new Shameiess leather before use. So, these are some of the precautions, when the fuel is decanted from the barrels, into the fueling vehicles or storage or into the aircraft. So, the fuel needs to be properly filtered and some precautions needs to be observed. The fuelling equipment and the aircraft shall be bonded to each other and both shall be earthed. So, very important precaution, that during the fuelling procedure, the fuelling equipment and the aircraft, shall be properly drawn, bonded to each other and shall also be earth.

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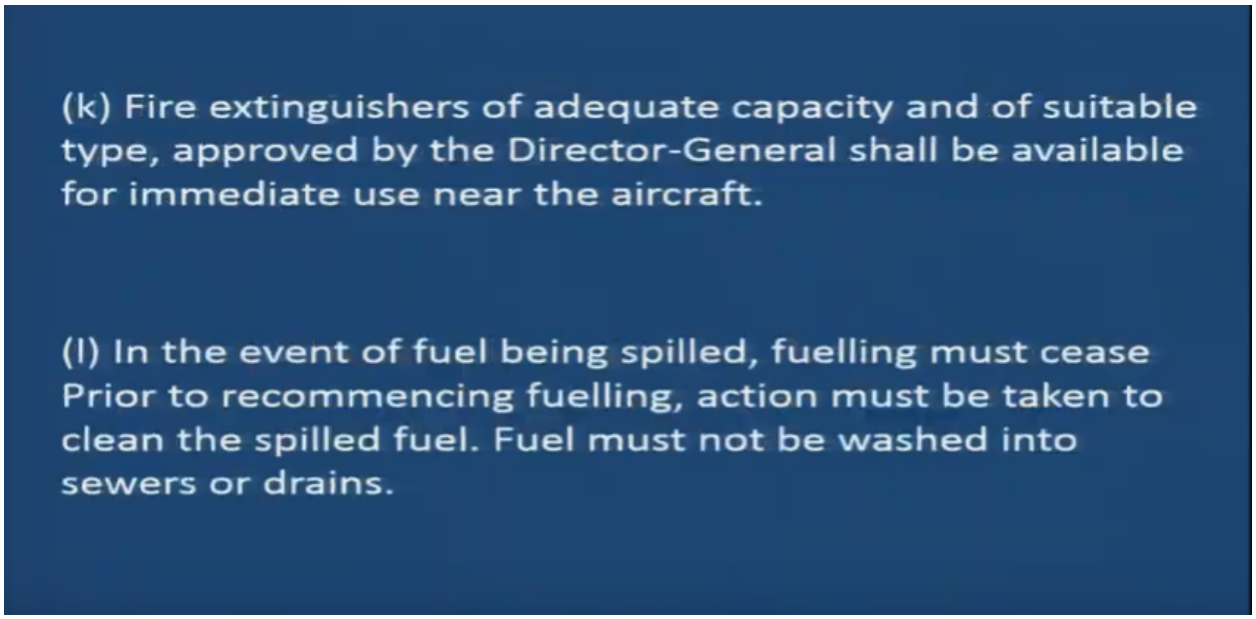

Fire extinguishers of adequate capacity and of suitable type, approved by the DGCA, shall be available for immediate use near the aircraft. So while the fueling operation is on, we need to park fire extinguishers, we need to position fire extinguishers, of adequate capacity and suitable type, which are approved by the aviation authorities, for immediate use near the aircraft. In the event of fuel being spilled, fueling bus cease, prior to recommend sink fueling, action must be taken to clean the spilled fuel. Fuel must not be washed into servers or drains. So, in case if the fuel is a spilled or grade, we need to take action to clean the spilled fuel. And the waste fuel should not be, washed into the grains. So these were some of, the precautions that we need to follow, while handling the fuel, while refueling the aircraft's. So, we have in this fuel system chapter, seen what is the basic fuel system? What are the different types of carburetors? What is a fuel injector? The different types of fuels, the precautions and the quality control, inspections of the few. Thank you.