AUTOEM'18

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AUTOEM'18

INDEX

Aerodynamics

Aerodynamics has become the most important part of racing during the latest years. It has nearly become the only way for engineers to gain considerable time on their opponents, considering the very strict regulations in today's motor sports. F1 is thereby the one to keep an eye on, as it is the sport where the most money is spent on technical developments. Though the engine power, the tyres and much more, the aerodynamic streamline is very important to make the cars that fast. Many problems should be faced before starting with the design of a car. Ensuring enough air gets to the car's radiators is critical, because it's important for the engine's power.

F1 configuration

F1 (and in general, all winged racing cars) can be considered to be canard configurations in the sense that the front and back wings are on opposite sides of the centre of gravity and both are "lifting" (strongly) in the same direction, in this case down.

The car should be considered in (at least) 3 parts; front wing, body and rear wing. Each of these parts should be optimized for down force (i.e. "lifting" down) and low drag, with the accent very definitely on down force. This down force can be likened to a "virtual" increase in weight, pressing the car down onto the road and increasing the available frictional force between the car and the road, therefore enabling higher cornering speeds.

This allows today's formula-1-cars to withstand centrifugal forces from 4G as to where a passenger car with sport chassis begins to slip at 1G.

Drag

The following table shows C, the drag coefficient, of some particular geometric objects.

To calculate the aerodynamic drag force on an object, the following formula can be used:

$F = \frac{1}{2} CDAV^2$	Where: F - Aerodynamic drag force C - Coefficient of drag D - Density of air A - Frontal area V - Velocity of object

In this system, D as air density is expressed in kg/m^3. The frontal area is the surface of the object viewed from a point that object is going to. It's expressed in m^3. The velocity should be placed in m/s, where 1m/s is 3,6 km/h.

The overall effect on lap times can be calculated with this "Law of Amdahl".

$$S_{eff} = \frac{S_f}{S_f(1-f)+f}$$

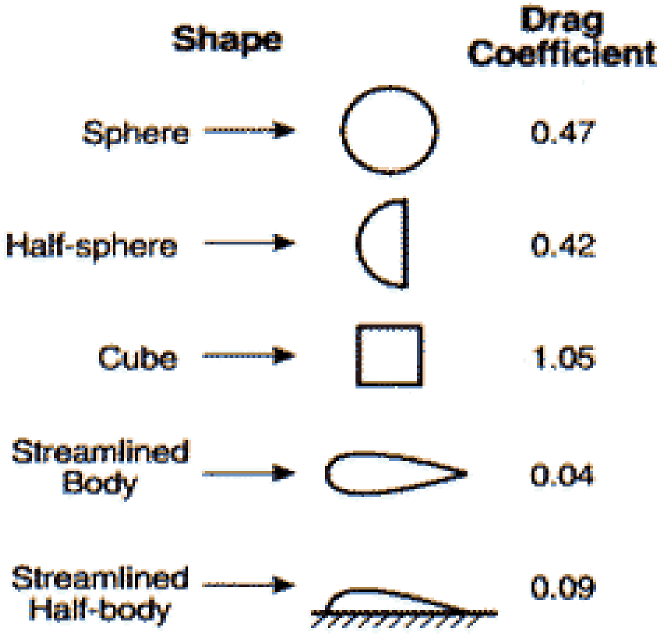
Here is *f* the fraction of the system (when this fraction generates 5% of the car's drag, then *f* is 0.05) that can be improved, S_f is the improvement factor on this fraction (division of the drag in Newton's and the new drag force after improving that element), and S_{eff} is the overall improvement that will be achieved.

Down force

Aero foils in motorsports are often called wings, referring to aircraft wings. In fact they are very similar. F1 wings and winglets aim to generate high down force, by having a high angle of attack, thus also increasing the drag of the aerofoil.

The evolution of an airfoil to what it is now is mainly thanks to our well-known friends Bernoulli and Newton, who initially had totally different views on generating down force.

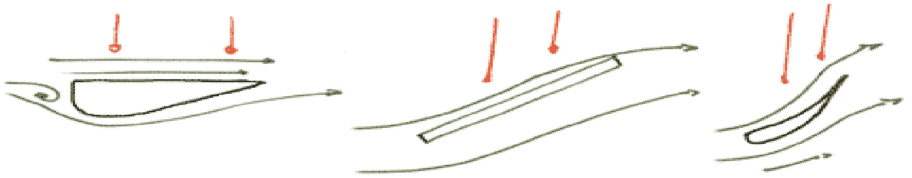
When a gas flows over an object (or when an object moves through a gas), the molecules of the gas are free to move around. They are not closely bound to one another as in a solid. Because the molecules move, there is a



Measured Drag Coefficients

velocity (speed plus direction) associated with the gas. Within the gas, the velocity can have very different values at different places near the object. Bernoulli's equation relates the pressure on the object to the local velocity; so as the velocity changes around the object, the pressure changes as well, in the opposite way.

Bernoulli Newton Today



Now adding up the velocity variation around the object instead of the pressure variation also determines the aerodynamic force. The integrated velocity variation around the object produces a net turning of the gas flow.

From Newton's third law of motion, a turning action of the flow will result in a re-action (aerodynamic force) on the object. So both "Bernoulli" and "Newton" are correct. Integrating the effects of either the pressure or the velocity determines the aerodynamic force on an object. These two equations have lead to the current airfoils used and make optimal use of both theories.

Design

Today's formula one cars are designed with CFD (computational fluid dynamics) and CAD (computer aided design) that allows engineers to design a car, and immediately simulate the airflow around it, incorporating environmental parameters like traction, wind speed and direction, and much more. Further on, the richest teams can now test fully scaled cars in their closed circuit wind tunnels, which operate 24h a day.

By

RAGHUL P

First Year

JETS GET BIGGER

You stow your luggage, settle into your seat and lean back as your plane speeds down the runway and lifts into the sky. Higher, faster, farther with less fuel is the airline industry's mantra. Driving the industry's progress is the machine that revolutionized aviation: the jet engine. Consider the behemoths that power Boeing's big 777, which the Guinness Book of Records certifies as the most powerful commercial jet engine ever built.

According to Guinness, General Electric's GE90-115B generated 123,000 pounds of steady-state thrust during its initial ground testing in 2001, a record it would later break. To put that achievement in historic perspective, the HE S-1, the hydrogen-powered turbojet prototype developed by German engineer Dr. Hans von Ohain and built by the legendary warbird manufacturer Ernst Heinkel in 1937, cranked out a modest 250 pounds of thrust. Seeing the potential, the Luftwaffe seized the opportunity well ahead of the Royal Air Force, scrambling jets into the air during the final months of World War II.

After the end of the war, civilian applications of jet transport quickly became apparent. While an assortment of commercial jets took wing during the 1950s, the real success only arrived in 1958 with the introduction of

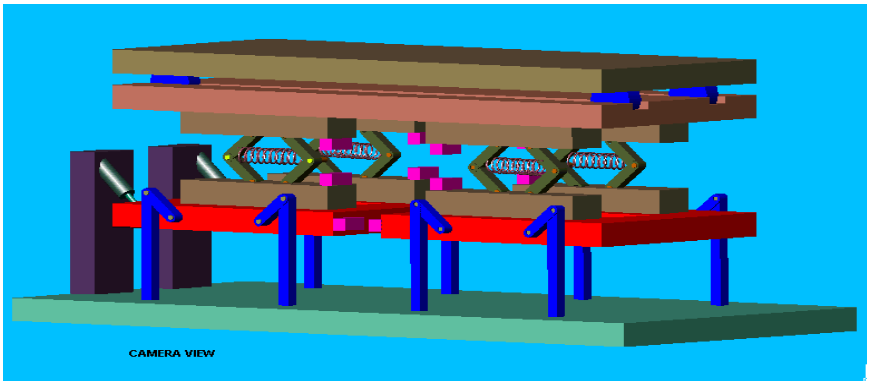
Boeing's 707. Since then, progress has been led by bigger and more powerful engines.

Boeing's 777-300ER can carry as many as 365 passengers up to 7250 nautical miles. On still longer routes, airlines will operate the 777-200LR, which can carry 301 passengers 8865 miles.

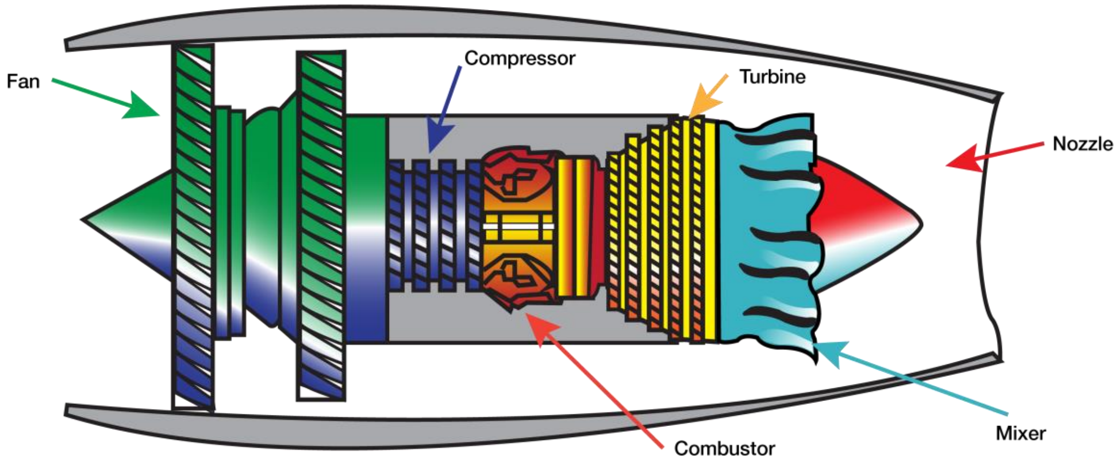
Hauling that much weight for such great distances takes plenty of power for a twin-jet aircraft. Under normal operations, the GE90-115B is rated at 115,000 pounds, yet it has shattered its Guinness record, reaching 127,900 pounds of thrust during tests in late 2002.

Unlike von Ohain's original turbojet, the GE90--and most of its competitors--is a turbofan. The basic principles are similar: Jets draw in outside air, which is compressed, mixed with fuel, then burned and exhausted at high speed, producing thrust. Turbo-fans add an additional set of spinning blades in front of the compressor. Much of that air bypasses the engine core, adding plenty of extra thrust without using more fuel.

Titanium blades would simply be too heavy in an engine this size. Composites provide the key. Extremely light, durable and efficient, they're



used for the front fan blades (see illustration, right). Their huge size allows them to run relatively slowly, which is a critical factor for noise control. That is good news for those living near urban airports.Composite blades require less torque to turn. And they're incredibly resilient. During their first five years in service, smaller versions of the GE-90 have had dozens of bird ingestion "events," yet they've remained fully serviceable.



In a business where profits turn on shaving pennies from the cost of transporting each passenger, the next generation of big engines spells good news for airline operators. General Electric says the GE90-115B turbofan offers the greatest propulsive efficiency of any commercial transport.

BY

PERIYANDAVAR . S

Second Year

Magnetic Suspension System for Ambulance Stretcher

We are familiar with the concept "The integration of various ideas result in a NOVEL CONCEPT". Yes, one such is the **MAGNETIC SUSPENSION SYSTEM FOR AMBULANCE STRETCHER.**

This paper deals with design and analysis of Magnetic Suspension system for effective vibration damping in ambulance stretcher and its application. Vibration is the dynamic phenomenon, which has to be reduced in some applications and which has to be enhanced for some other applications. The current vibration dampers used in any vehicle are confined to hydraulic or visco-elastic and metal springs only. These vibration dampers are highly in effective when exposed to low frequency shocks but low frequency shocks may cause consistent damages to the body of the human beings particularly patients lying inside the ambulance which are equipped with normal spring and dash pot dampers.

The potentialities of the magneto -spring and the spring dash pot mechanism can be combined to damp all the ranges of vibration frequencies. Further the above design can also be extended for various systems like high comfort cushion seat arrangements in aero planes, heavy duty trucks, and luxurious cars. Magnetic vibration isolator can also be used for low speed machining operations.

By

SETHU S

Second Year

SELF INFLATING

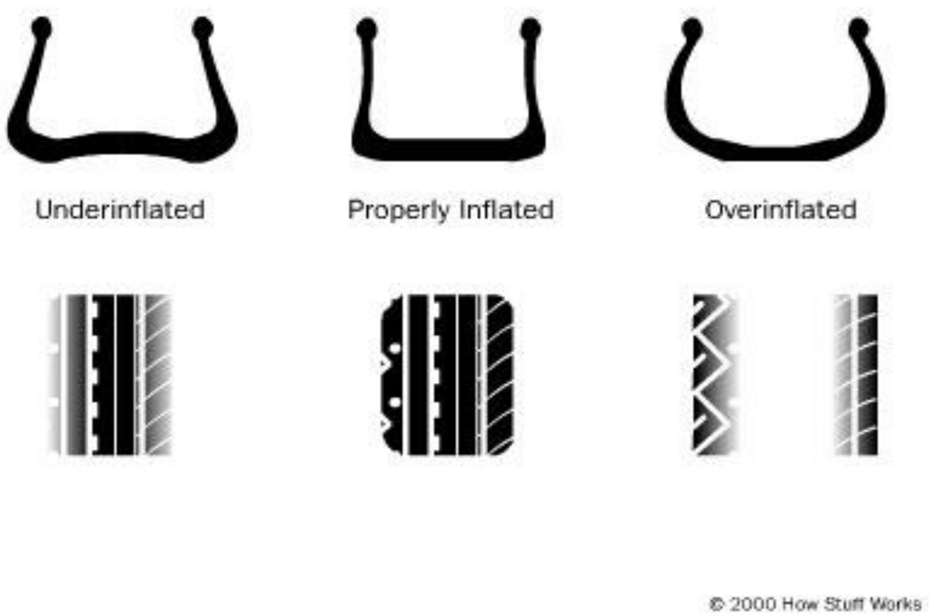
James Bond has them, Hummers have them, most truckers have them and the military has had them for years. Self-inflating tires allow a vehicle to adjust to the current terrain for ideal performance and safety in those conditions. Currently, lots of consumer vehicles are equipped with pressure-monitoring systems, but there's no way for the driver to do anything about it without an external air source. There are lots of self-inflating-tire systems on the market, but most of them are only available for commercial and military applications. The exception, of course, is the CTIS system on the Hummer.

In this article, we're going to learn about some of the tire-inflation systems out there and see when there might be one on the market for us regular people who drive regular cars.

Tire-inflation Basics

About 80 percent of the cars on the road are driving with one or more tires under inflated. Tires lose air through normal driving (especially after hitting pot holes or curbs), permeation and seasonal changes in temperature.

They can lose one or two psi (pounds per square inch) each month in the winter and even more in the summer. And, you can't tell if they're properly inflated just by looking at them. You have to use a tire-pressure gauge. Not only is under inflation bad for your tires, but it's also bad for your gas mileage, affects the way your car handles and is generally unsafe.



When tires are under inflated, the tread wears more quickly. According to Goodyear, this equates to 15 percent fewer miles you can drive on them for every 20 percent that they're under inflated. Under inflated tires also overheat more quickly than properly inflated tires, which cause more tire damage. The faded areas below indicate areas of excessive tread wear.

Because tires are flexible, they flatten at the bottom when they roll. This contact patch rebounds to its original shape once it is no longer in contact with the ground. This rebound creates a wave of motion along with some friction. When there is less air in the tire, that wave is larger and the friction created is greater -- and friction creates heat. If enough heat is generated, the rubber that holds the tire's cords together begin to melt and the tire fails. Because of the extra resistance an under inflated tire has when it rolls, your car's engine has to work harder. AAA statistics show that tires that are under inflated by as little as 2 psi reduce **fuel efficiency** by 10 percent. Over a year of driving, that can amount to several hundred dollars in extra gas purchases.

Pressure-monitoring Systems

There are lots of tire-pressure technologies currently on the market and some soon to be on the market. Because of the TREAD Act, all vehicles will soon have to have a tire-pressure monitoring system so all drivers know when their car's tires are losing air pressure. These types of pressure-monitoring systems have been around for decades and are already standard in some car models. They simply monitor the air pressure in each of the car's tires and notify the driver if a tire drops below a preestablished, optimum pressure point.

Self-inflating Systems

Tire-inflation systems have three general goals:

Detect when the air pressure in a particular tire has dropped - This means they have to constantly (or intermittently) monitor the air pressure in each tire.

Notify the driver of the problem

Inflate that tire back to the proper level - This means there has to be an air supply as well as a check valve that opens only when needed.

Parts of Any Self-inflating System

While the available tire inflation systems vary in design, they share some common elements.

They all use some type of **valve** to isolate individual tires to prevent airflow from all tires when one is being checked or inflated.

They have a method for sensing the tire pressures. This is addressed in most cases with **central sensors** that relay information to an electronic control unit and then to the driver.

They have an **air source**, which is usually an existing onboard source such as braking or pneumatic systems. When using an existing system, however, they have to ensure that they don't jeopardize its original function. For this reason, there are safety checks to ensure that there is enough air pressure for the source's primary use before pulling air for tire inflation.

There has to be a way to **get the air from the air source to the tires**, which is usually through the axle. Systems either use a sealed-hub axle with a hose from the hub to the tire valve or else they run tubes through the axle with the axle acting as a conduit.

There has to be a **pressure relief vent** to vent air from the tire without risking damage to the hub or rear-axle seals.

By

SAIRAM. R

Second Year

Titanic

Returns

It is truly a Titanic endeavor. Tempting the fates, two newly formed shipping companies hope to revive the golden age of the transatlantic passenger liner by building full-scale replicas of the Titanic. The keel of the first ship could be laid as early as this month, in Durban, South Africa. If the work steams ahead on schedule, the replica's owner, RMS Titanic Shipping Holdings of Durban, could welcome passengers aboard for a Dec. 29, 1999, maiden voyage. About two years later, a second replica proposed by White Star Line Limited of Basel, Switzerland–a new company unrelated to the original White Star Line–could begin her maiden voyage.

Both transatlantic crossings will be largely ceremonial. After retracing-and hopefully completing–the Titanic's interrupted journey from Southampton, England, to New York City, they will head for southern waters to begin careers as vacation cruise liners.

A Titanic Obstacle

Creating floating steel palaces worthy of their namesake isn't as simple as placing an order with Harland and Wolff, the Titanic's builders. The biggest problem is the Titanic herself. After the 46,000-ton ship slid beneath the sea on April 15, 1912, killing 1523, seafaring nations tightened passenger ship construction and safety regulations. "There is no way you could rebuild the original Titanic," Capt. Christopher McMahon of the U.S. Merchant Marine Academy in Kings Point, N.Y., tells POPULAR MECHANICS. "They [the replicas] may look like the Titanic, but they won't be the Titanic." Even the Titanic's sister ship, the Britannic–under construction at the time of the disaster–couldn't be built to the original plans. And its older sister, the Olympic, was put into dry dock for a major overhaul that included massive structural changes. Even if some sort of special exemption could be granted to allow construction of a down-to-the-rivet replica, it is questionable how many passengers would be willing to pay $30,612 to $382,650 to spend four to five days tossing about the Atlantic on a ship with turn-of-the-century plumbing. And let's not forget superstition. The Britannic, which served as a World War I hospital ship, sank after it hit a mine, and suffered similar damage to the Titanic. Thirty of the 1100 on board died. Sarel Gous, managing director of the South African project, acknowledges that there will be differences. "Our Titanic will look identical to the original, but of course with the latest safety technology," he says.

Steel Dreams

The two would-be replica builders were still negotiating with naval architects and shipyards when PM went to press. So, we asked Neil Gallagher of Webb Institute in Glen Cove, N.Y., the country's foremost school for naval architects, how closely the replicas were likely to mimic the original. It depends how close you look, he said, because the great ship's most distinctive features will have to be faked. Not that fakery is new to the Titanic name.

In her era, the Titanic's most distinctive features were her four proudly raked funnels. Actually, only the three nearest the bow were real. A fourth, dummy funnel was added to make her look, well, titanic. Both replicas will have four funnels. However, all will be ornamental because the modern ships won't have steam engines. "I doubt you would find anyone who would build a reciprocating steam engine," said Gallagher. The same holds true for the Titanic's boldly riveted hull. Once again it isn't simply a matter of finding skilled labor. Today's ship hulls are welded. The shape of the hull will also need to change. "The hull design of the Titanic was pretty good for its day," said Gallagher. He quickly added that the same design could spell economic ruin in today's highly competitive cruise-ship industry.

The biggest change will occur just below the waterline, where the ships could be fitted with a bulbous protrusion that prevents the formation of an energy-robbing bow wave, explained Gallagher. This, in turn, will improve fuel economy by about 4%. That is the equivalent of a free fill-up for every 26th transatlantic crossing.

The Hotel Load

And fill up is exactly what the replicas will do when they arrive in port. While the Titanic's 159 furnaces burned 825 tons of coal a day, the replicas will sip diesel fuel. "They will probably use diesel generators so they can provide electricity for both propulsion and what we call a 'hotel load'," said Gallagher. Modern cruise ships are, in fact, floating hotels. To keep passengers happy as they tour tropical climates will require, among other things, air conditioning, more than double the three passenger elevators on the Titanic, and enough current to power all the hair dryers that will be turned on a half-hour before each dinner seating.

"The beauty of multiple diesel generators is that you can redirect the power from propulsion to the hotel load as needed," said Gallagher. In the space occupied by about five of the Titanic's 29 boilers, the replica's five diesel generators will crank out enough power for the ship's electric motors and today's electrical essentials.

Scrapping 29 boilers and 159 furnaces will free up lots of space, but pose another design problem. Weighing less than the original, the replicas will ride higher in the water. This, said Gallagher, will make them less stable. "They would probably need a permanent or sea water ballast," he said.

Ship owners will also have to worry more about what comes out of the cabins. In the Titanic's day garbage and waste, sanitary and bilge water were simply thrown overboard. McMahon says that to meet U.S. Coast Guard regulations the replicas will need modern sewage treatment plants and garbage compactors to store solid waste until it can be trucked away at port.

Capt. Tom Pineault of the American Bureau of Shipping, an organization that certifies the structural and mechanical fitness of ships, says that although the replica projects face substantial challenges, the problems are all solvable, for a price. Project backers have placed the cost of their ships between $400 million and $600 million, about twice as much per passenger as modern cruise liners, estimates McMahon. Annette D. Volcker, of the White Star Line, believes the expense will be worth it. "We are giving back to sea travel what it has lost in modern times–an air of magnificent elegance."

By

Hariprasath. B

Second Year

SCRAM JET

They call it a "scramjet," an engine so blindingly fast that it could carry an airplane from San Francisco to Washington, D.C., in about 20 minutes -- or even quicker. So fast it could put satellites in space. So fast it could drop a cruise missile on an enemy target, almost like shooting a rifle.

NASA plans to break the aircraft speed record for the second time in 7 1/2 months by flying its rocket-assisted X-43A scramjet craft 110,000 feet above the Pacific Ocean at speeds close to Mach 10 -- about 7,200 mph, or 10 times the speed of sound. The flight will last perhaps 10 seconds and end with the pilotless aircraft plunging to a watery grave 850 miles off the California coast. But even if the X-43A doesn't set the record, it has already proved that the 40-year-old dream of "hypersonic" flight -- using air-breathing

engines to reach speeds above Mach 5 (3,800 mph) -- has become reality.

Unlike rockets, which must carry oxygen with them as a "combustor" to ignite the fuel supply, scramjets take oxygen from the atmosphere, offering a huge savings in aircraft weight, and researchers around the world would like to take Advantage. In northeast Australia, a scramjet team funded by the U.S. and Australian armed forces will try for Mach 10 next year as a first step in using a scramjet to put satellites in space. The U.S. Air Force hopes to demonstrate within five years a scramjet-driven cruise missile fast enough to drive explosives deep into hardened targets. Other projects are moving forward in France and Japan. Under NASA's $250 million Hyper-X program, engineers at Langley Research Center here and the Dryden Flight Research Center in Edwards, Calif., designed and built three aluminum scramjet aircraft, each one 12 feet long and weighing about 2,800 pounds . Controllers aborted the first test flight in 2001 after the rocket booster malfunctioned.

But the second, on March 24, reached Mach 6.83 (5,200 mph), shattering the world speed record for air-breathing, non-rocket aircraft, previously held by a jet-powered missile. The highest speeds by manned aircraft were achieved by SR-71, the U.S. spy plane known as the "Blackbird," capable of flying in excess of Mach 3 (2,300 mph). "The idea was to demonstrate these technologies," said Luat T. Nguyen, deputy manager for the program that designed X-43A. "We've done that. This is the first scramjet to work, and it is the only one at this point."It is more of a challenge to get it to operate at Mach 10 rather than Mach 7. You want it to be robust enough to give us the level of performance we're looking for, and at Mach 10, the constraints are a little narrower.

Lay the foundation

About 50 miles off the California coast, the B-52 will drop the craft at an altitude of 40,000 feet. The booster rocket will ignite and bring the X-43A's speed close to Mach 10 at an altitude of 110,000 feet. At that point, controllers will fire two small pistons to jettison the rocket. Then they will open the cowl covering the X-43A's air intake and light the engine. Scramjets work on the same principle as all jet engines igniting fuel in compressed air and aiming the expanding gases to the rear to propel the aircraft forward. Standard turbojets use fans to compress the air and can reach speeds of about Mach 2.2 (1,600 mph). Ramjets can reach supersonic speeds of perhaps Mach 6 (4,600 mph) by using the plane's forward motion alone to bring air into the combustion chamber. But the air must be slowed to subsonic speed for ignition.

Lighting a match in a hurricane

Scramjets (short for "supersonic combustion ramjets") are ramjets that ignite fuel in air traveling at supersonic speeds, a feat that NASA compares to "lighting a match in a hurricane." For this to work, virtually the entire aircraft becomes an enormous scoop, opening to receive the air and compressing it before injecting a chemical called silane, which ignites in the presence of air. The hydrogen fuel is added once the flame is lighted. Neither a ramjet nor a scramjet can operate from a standing start. The Blackbird used a turbojet to reach high enough speeds for its ramjet to work. The X-43A uses the rocket, and Nguyen said Langley engineers predict the X-43A will reach a peak speed of Mach 9.6 or Mach 9.7 before it burns all its liquid hydrogen fuel and glides into the sea.The X-43A will leave behind both a body of data and a practical demonstration of an idea that aeronautical engineers have worked on by fits and starts, through good and bad funding years, for more than four decades.

The Air Force's cruise missile program, known as "HyTech," is developing a scramjet that burns hydrocarbon fuels -- easier to handle than liquid hydrogen. "The scramjet can travel hundreds of miles in minutes to defeat time-critical targets," said Bob Mercier, deputy for technology in the Air Force laboratory's aerospace propulsion division. "In addition, the high speed could improve penetration of hardened and deeply buried targets."

It takes a speed of 25,000 mph to escape the pull of Earth's gravity and get into orbit, and we'd like to get 18,000 [mph] from a scramjet. Can we do it? We don't know the answer. If it doesn't work out, we'll just say, 'A rocket's the best you can do, mate and pack it up.

By

AZHAGUVEL .G

Fourth Year

FORMULA-1 SECTION

Front Wing Design

Front wing aerodynamics

The front wing of a Formula One car creates about 25% of the total cars downforce. Although this only occurs in ideal circumstances. When a preceding car runs less than 20m in front, the total downforce generated by the front wing may become as little as 30% of its normal downforce. Although this reduce of drag (because the air pressure is lower behind a car's rear wing), enables higher speeds at the end of straight, it significantly hinders the pursuing car in corners, as he cannot take these at normal speeds. This problem mostly occurs in fast corners, and is one of the most important reasons of the overtaking problem currently in Formula One. It is therefore a hard job to create a performing front wing, even more because disturbing the airflow too much will affect the rest of the car's aerodynamic efficiency too.

Regulations

Bodywork width ahead of the rear wheel centre line must not exceed 1400mm.

In order to prevent tyre damage to other cars, the top and forward edges of the lateral extremities of any bodywork forward of the front wheels must be at least 10mm thick with a radius of at least 5mm.

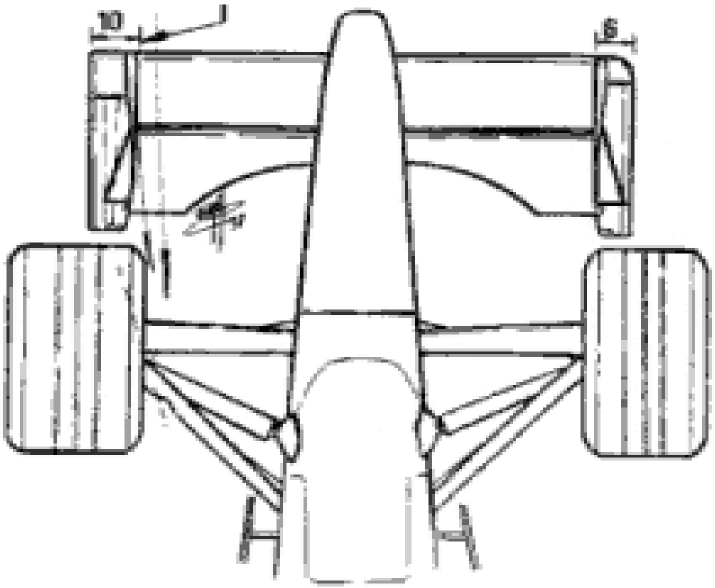
Front bodywork height:

All bodywork situated forward of a point lying 330mm behind the front wheel centre line, and more than 250mm from the centre line of the car, must be no less than 100mm and no more than 300mm above the reference plane.

Bodywork may deflect no more than 5mm vertically when a 500N load is applied vertically to it 700mm forward of the front wheel centre line and 625mm from the car centre line. The load will be applied in a downward direction using a 50mm diameter ram and an adapter 300mm long and 150mm wide. Teams must supply the latter when such a test is deemed necessary.

Front wing design

A regular front aerofoil is made as a main plane running the whole width of the car (almost at least, limited by FIA regulations) suspended from the nose. Onto this are fitted one or more flaps which are the adjustable parts of the wing. On each end of the mainplane there are endplates. These make sure the airflow passes above and beneath the wing rather than around it. In recent years these endplates have played a crucial role in influencing the airflow around the front tyres, especially after the rule changes at the beginning of 1998 (wheelbase made smaller from 220cm to 180cm). These changes made front wing airflow interfere with the rotating airflow around the front wheels. When Ferrari introduced such a front wing at the end of 1997, it was produced in such a way that the wing would flex under aerodynamic loads. This means that as the speed increased, a force was produced that pushed the wing towards the ground. By means of a ground effect, this was particularly interesting for front wings because if would increase downforce at high speeds without an increase of drag. As rear wings began to fail and flew off during races, the FIA thought it was time to act change to the technical regulations of Formula One.



At the beginning of 2001, front wing regulations had changed in such a way, that the wing should be 100mm above the ground at least, instead of the 40mm until then. The FIA introduced this change to limit the cornering speeds of the cars. The idea was to decrease the ground effect that was generated by front wings close to the ground, working just like a diffuser.

Immediately at the start of the season, Ferrari introduced a front wing that was bent down in the center line or the car. This new concept makes a handy use of a little hole in the regulations. The whole is the result of a rule, added in 1994, where the wooden bottom made it's entry. This wooden plate can be hung up as low as possible to the ground. As this plate is 50 cm wide, it was not foreseen that the front wing may be placed that low to the ground in 25cm at each side of the center of the car. Since the introduction by Ferrari, more and more teams have adopted the idea of curved front wings, with them also McLaren and Renault (see picture).

Though the reason that McLaren didn't make any of those changes until 2002, might have to do with the curve of the front wing before the change of regulations. It was namely curved up in the middle, so that the inner side was higher above the ground then both outer sides of the front wing. This type of wing is mostly useful on fast tracks where not much downforce is needed. It is there that airflow in the centre of the car can be more used by the diffuser in the back instead of lifting it up and create downforce in the front.

End plates

As some of the air that is needed to generate the front wing's downforce interferes with the rotating air around the front wheels, F1 teams have been developing the end plates from a simple plate to an integral part of the wing. To overcome the main problem of turbulence around the wheel, McLaren, and later Ferrari made in 1998 the inside edges of the front wing endplates curved to direct the air between both front wheels. One year after, all teams had adopted this technique to maintain front wing efficiency. Some other teams decided to decrease the width of the main plane just to the width between the front wheels. This left some room for extra wings and flaps, which caused the beginning of intensive end plate research. In 1998 changes were so radical that Ferrari produced six different designs of front wings throughout 1999, in order to reclaim the lost downforce by regulation changes.

By

THIRUMALAIKUMARAN T K

Third Year

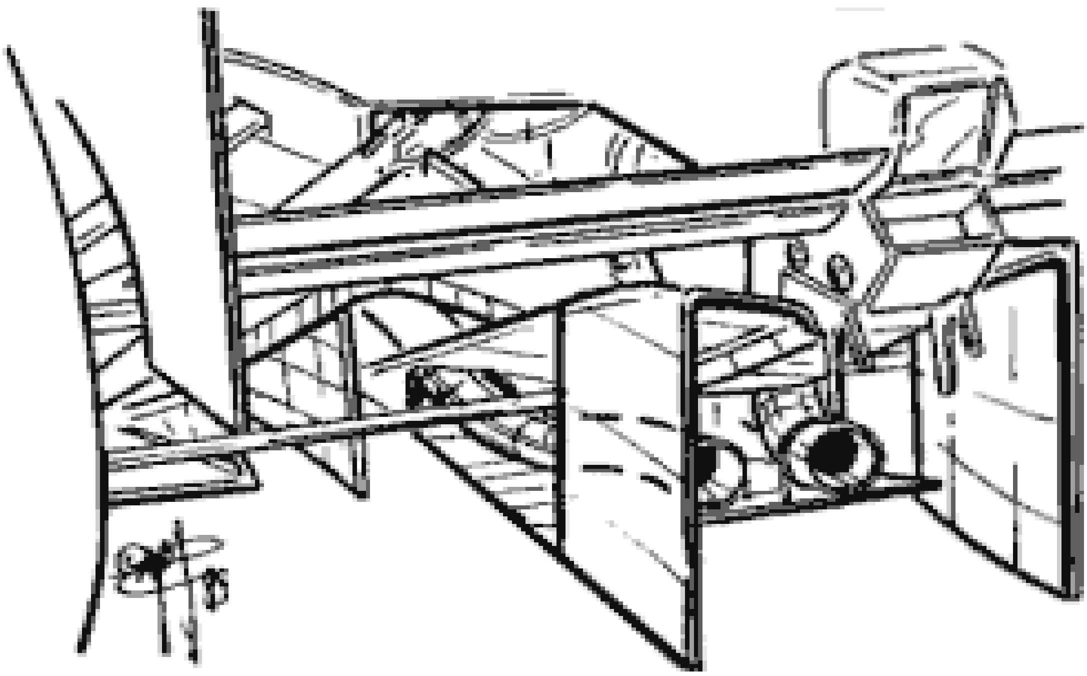
Rear Wing Efficiency

The basic principle of a formula one wing is exactly the same as with a common aircraft. The greatest difference is the direction air is pressed and how that aerodynamic force is generated. Knowing that an aircraft wing does the opposite of an F1 wing, I'll explain a formula one wing. I will start from the idea that we are testing a single rear wing in a wind tunnel. The main advantage of this theoretical example is that it leaves out some natural factors. With a single wing, we do not have to think about turbulence that is generated by the car itself (the engine cover mainly), neither do we have to take in account the direction and speed of outside wind. It is obvious that both these factors decrease the efficiency of a aerofoil. As you can see in the picture below, air flows onto the rear wing with a straight direction (which is often called clean air) at the speed of the car. The white flaps push the air up. Following Newton's law, an action causes a reaction, which is why the aerofoil is being pushed towards the ground by the air. Having in mind that air flowing onto the flaps is pushed upwards, and underflowing air keeps going its own way, a low pressure area (nearing a vacuum at very high speeds) is created right behind the horizontal aerofoils. This 'vacuum' causes a suck up of the air passing under that flap. The underpassing air on the other hand again flows faster in an attempt to equalize pressure on both sides of the aeleron, and thereby increasing the total wing efficiency. Because of the car's speed this is impossible, which is why the effect is maintained. The force that is created by this type of wing, so that the car is pressed onto the ground, is called downforce.

Straight forward gong air at the speed of the car.

Rear wings

About a third of the car's total downforce can come from the rear wing assembly. The rear wings are the ones that are varied the most from track to track. As the rear wings of the car create the most drag the teams tailor the rear aerodynamic load to suit a particular track-configuration.



As air flows over the wing, it is disturbed by the shape, causing a drag force. Although this force is usually less than the lift or down force, it can seriously limit top speed and causes the engine to use more fuel to get the car through the air. From the year 2001, the FIA regulations have changed

concerning the rear wing. To increase the ability of overtaking and slipstreaming, the number of rear wing elements is now being limited to 3. This should decrease the down force and acceleration. The only effect that might have come with this regulation change, is at high downforce circuits, there will be a little more air resistance to produce the same downforce.

The pictures below both show David Coulthart in his MP4/17 from 2002. The picture of the left shows him at Monza 2002, whilst the picture on the right was taken at the Nurburgring. You can see that the rear wing profiles are very different. On the left picture, very little of the rear wing can be seen, whilst the Monaco wing has much of the profile visible:

THE DIFFUSER

The smallest thing which you can count to the wings part is the diffuser. Acually, it does exactly the opposite of a rear or front wings. Instead of pushing the air up, it sucks the air up. The volume of the diffuser increases towards to the end of the car. Where a certain amount of molecules filled for example 1dm³ under the car, these now fill 2dm³. This drop of pressure causes a car to be sucked towards the ground. Driving at a speed of 300 km/h, the ground effect of the car would be extreme if there was no air under the car itself. Therefore, the FIA has forbidden strokes and sloping car bottoms because of safety reasons. Instead of raising the back of the car, the diffuser sucks the air away from under the car because the low pressure. The diffuser us placed under the rear wing and is actually a sweep up of the car's floor. It consists of many tunnels and spliters which carefully control the airflow to maximize this suction effect. The design of the bottom of the car, and thereby the diffuser is a critical area, because it can greatly influence the car's behaviour in corners. More importantly, the designers have to be carefull that the car keeps working good in all circumstances, and at any distance from the ground. Losing all of the diffuser's generated downforce when riding over a curb will greatly generate a nervous behaviour of the car itself. The strokes and flips withing the diffuser have lately become that advanced (curbed and even foreseen by gurney flaps sometimes) that any track distance is insufficient to guarantee good performance. It is still a part where a lot of time can be gained on current F1 cars, partly by pulling more air towards the diffuser by inducing the coke-bottle effect.

By

Vishnu Prasad M

Third Year

AUTOMOBILE SUSPENSION SYSTEM

Automobile Suspension System is used to absorb Shock and Vibration occurring in the vehicle during running. It gives the passenger comfortable journey and provides safety while carrying goods.

TYPES OF SUSPENSION:

AIR SUSPENSION:

This suspension system uses air rather than metal springs to support the vehicle and control ride motions. Air springing results in a smoother ride, because the natural frequency of vibration of an air spring does not vary with loading as it does with metal springs. Air springs can be made very soft for the lightly loaded condition and the pressure automatically increased to match any increase in load, thus maintaining a constant spring vibration period any load.

LEAF SPRING SUSPENSION:

The leaf spring suspension was made up of several pieces of semi-elliptical metal leaf fixed to the chassis at both ends with the load point at the center. These springs were popular as they were easy to manufacture. The spring's work by making use of the fact that to deform a metal requires an input of energy. And as long as this work doesn't permanently deform the metal, then it can absorb a lot of energy dissipating it is heat and so stop the vibrations in the wheels being transmitted to the chassis and passengers by absorbing it.

COIL SPRING SUSPENSION:

In coil spring suspension, leaf is replaced by coil spring. The advantages of coil springs are that they are able to cope better with irregularities in the road surface, they are more practical in terms of ride quality and handling and as coil springs are not in contact with other surfaces they have negligible internal resistance.

McPHERSON STRUT:

It consists of combined damper of spring unit. This simple system utilizes the piston rod of the built – in- telescopic shock absorber to also serve as the kingpin axis. The advantage of McPherson strut includes its simple design of fewer components, widely spaced anchor points that reduce loads, and efficient packing. McPherson struts also allow relatively long springs that can increase suspension travel and increase bump absorption capability.

BOGIE SUSPENSION:

An assembly of four wheels on two axles with common suspension usually on heavy commercial vehicles, trailers.

By

Dhivakar S

III YEAR

HEMI ENGINES

If you are familiar with cars,you will be familiar with the HEMI ENGINE too.A 426 Hemi Engine is popular in car racing because of its performance. Chrysler used this engine in the '03 Dodge Trucks. The term HEMI now means a" Big & Powerful" engine.

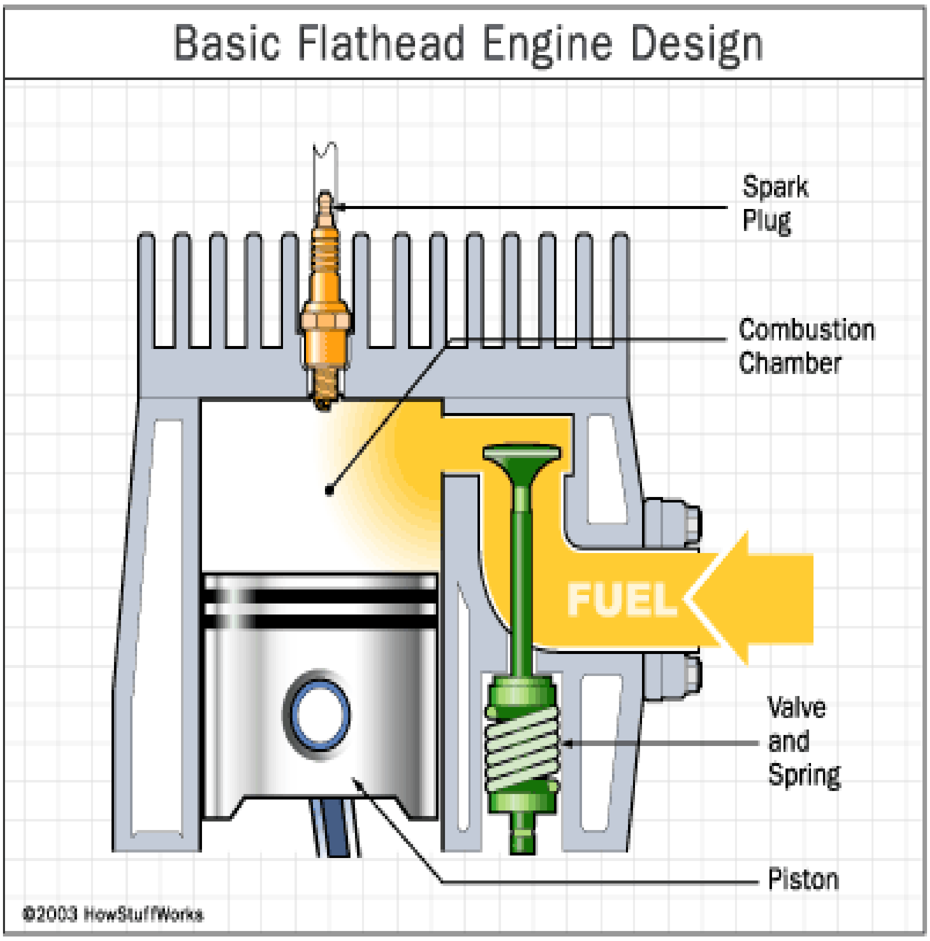
ORIGIN:

It was created in 1948 by Harry Westlake and his group.It was a 6-cylinder engine made for a Jaguar.In 1951,Chrysler introduced a 180hp hemi engine.It had a displacement of 331cc and they called it as the **"331 Hemi".**

Nowadays 180hp sounds nothing. But in 1951, 180 horsepower was unheard of. It was an amazing amount of power for the day, and it fueled the **"HEMI legend."**

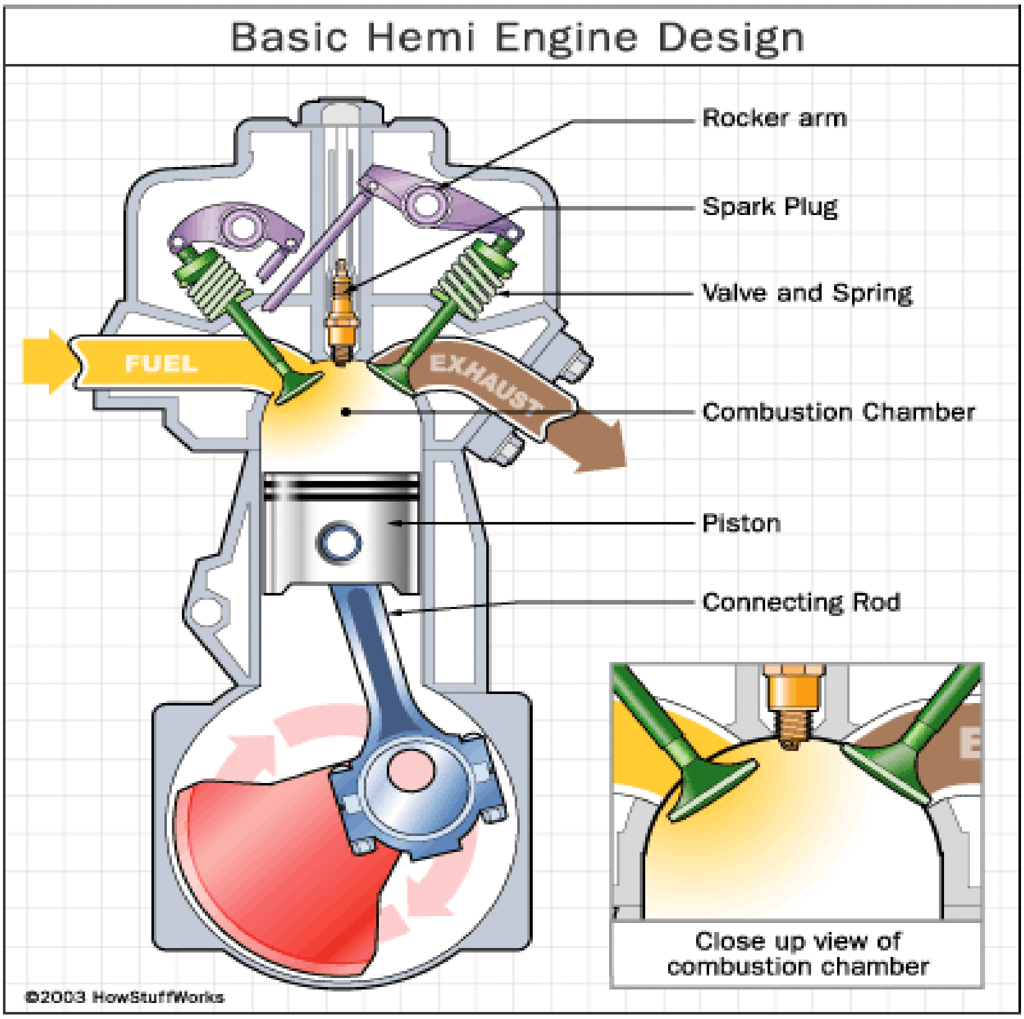
Chrysler released a 354cc in 1956,392cc in 1957 and a 426cc in 1964.This 426 engine became the legend when it won the 1st ,2nd & 3rd place in the 1964 Daytona500 Nascar race.It produced around 425hp.The 426 engine is still available with Dodge.

The powerful creativity of Chrysler was mainly due to the efficiency of the **combustion chamber**.



In a HEMI head, the spark plug is normally located at the top of the combustion chamber, and the valves open on opposite sides of the combustion chamber.

In 1950's the car manufacturers used the **flathead** since it is less expensive to manufacture.in this the valves are in the block, rather than in the he and they



open in a chamber beside the piston. A basic flathead engine design is shown below.

The head is easy to manufacture.It is a solid metal casting with a hole drilled in it to accept the spark plug. The camshaft in the block pushes directly on the valve stems to open the valves, eliminating the need for pushrods and rocker arms. Everything is simpler in the flathead design.The main problem in the flathead engine is its thermal efficiency.

The Dodge Hemi Magnum:

The Dodge HEMI engine builds off the tradition of HEMI power to deliver a 345 cubic inch (5.7 liter) V-8 engine with hemispherical heads. The engine produces 345 horsepower, and compares very favorably with other gasoline engines in its class. For example,

- Dodge 5.7 liter V-8 produces 345 hp @ 5400 rpm
- Ford 5.4 liter V-8 produces 260 hp @ 4500 rpm
- GMC 8.1 liter V-8 produces 340 hp @ 4200 rpm
- Dodge 8.0 liter V-10 produces 305 hp @4000 rpm
- Ford 6.8 liter V-10 produces 310 hp @ 4250 rpm

The HEMI Magnum engine has two valves per cylinder as well as two spark plugs per cylinder. The two spark plugs help to solve the **emission problems** that plagued Chrysler's earlier HEMI engines. The two plugs initiate two flame fronts and guarantee complete combustion.

ADVANTAGES:

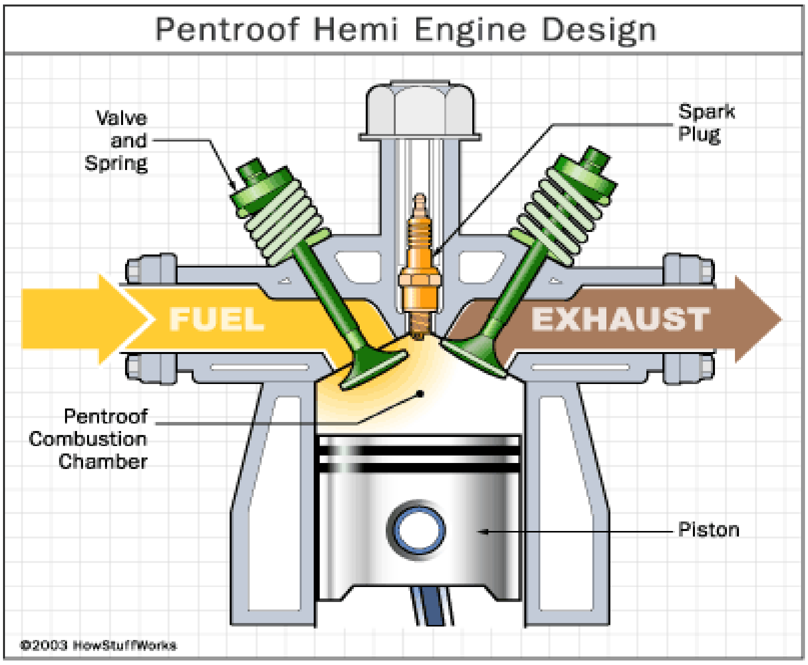
You want to lose as little heat as possible to the heads and the cylinder walls. Heat is one of the things creating pressure in the cylinder, so lost heat means lower peak pressures.

This is one of the key advantages of the HEMI head versus the flathead engine. **Surface area** causes heat loss. Fuel that is near the head walls may be so cool that it does not burn efficiently. With a flat head, the amount of surface area relative to volume of the combustion chamber is large. In a HEMI engine, the surface area is much smaller than in a flat head, so less heat escapes and peak pressure can be higher.

Another factor with a HEMI head is the **size of the valves**. Since the valves are on opposite sides of the head, there is more room for valves. The engine design that preceded the HEMI was a wedge-shaped combustion chamber with the valves in line with each other. The inline arrangement limited valve size. In a HEMI engine, valves can be large so the airflow through the engine is improved.

DISADANTAGES:

Even though it has many advantages , all the engines don't use hemispherical heads because there are better configurations available today.



One thing that a hemispherical head will never have is **four valves per cylinder**. The valve angles will be such that the head would be nearly impossible to design. Having only two valves per cylinder is not an issue in drag racing or NASCAR because racing engines are limited to two valves per cylinder in these categories. But on the street, four slightly smaller valves let an engine breathe easier than two large valves. Modern engines use a **pentroof** design to accommodate four valves. A pentroof hemi engine is shown above.

Another reason most high-performance engines no longer use a HEMI design is the desire to create a smaller combustion chamber. The compact pentroof design is helpful here, as well.

By

Manikandan V

I YEAR

Bio-diesel – As an effective alternative to fossil fuels

Introduction:

"Depletion of fossil fuels ", it is the phrase running high globally. It is past-time to have a kick start to resolve this energy deficit. In India, though the government and NGOs are endeavoring to their best to resolve this crisis, there **is no good effective solution arrived yet**. In this aura, we have a well-known secret to propose to the nation, it is **"BIO-DIESEL"**, an effective alternative to conventional diesel (CD)

Why not India can meet its energy requirement completely inland, paving way for an effective control over the fuel tariff throughout the nation?! Every day and moment we pass by witnesses that **fossil fuel, over which more than 75% of the world population rely is costing them higher and more** and going to be the worst, a day in the near future. When bio-diesel (BD) is used in this scenario, the first point of consideration is that **all raw materials and amenities needed for its production can be met inland 100 %,** which favors the argument for it being an economic booster. Subsequently usage of BD is also going to help India in maintaining an eco-friendly atmosphere throughout the nation; this is possible because **BD is proved to have very low emission compared to CD in all fronts.**

Definition of BIO-DIESEL:

The term BD has no unambiguous definition. BD verbally apparently means "**a fuel called diesel being derived biologically"**. BD can be otherwise explained as **a diesel-simile which is produced just by chemical reaction of biological agents and some alcohol**.

BD is chemically an ester produced by **trans-esterification process**. Basically it is derived from fats (oil) and alcohol with **lye (NaOH)** as a reactant cum catalyst, which are the basic reagents for the formation of the same. It is organically an **ester compound** characterized by (R - *C* - *O* - *R*) chain.

Oil that is chiefly preferred in this production is oil from **"jatropha curcus",** which is **a terrestrial shrub** which requires neither adequate water nor at most maintenance. Other oils that are used are coconut oil, groundnut oil, canola oil, castor oil. The east is believed to use oil from numerous regional plants of which the knowledge is poor across the globe. **The fat in the oil is known to cause the reaction**, while the other constituent of the oil is precipitated as glycerol. Methanol and ethanol are the two primarily used simple chain alcohols while others (complex chains) are of rare use. **Simple chain alcohols are best preferred as they are capable to dissociate into their content ions readily**, which makes the reaction faster and simpler. Moreover, complex alcohol chains are found evidently to produce ester solution (bio-diesel) as a mixture of various esters.

Thus uniformity of the ester composition in Bio-diesel is at stake on usage of complex chains. Sodium hydroxide (NaOH) which is commonly called as lye is used in the process as the best reagent cum catalyst. **NaOH is not directly applied to the oil, while it is primarily mixed up with the alcohol.** The product after mixing is a solution of sodium- ethoxide. So it is evident that lye acts as a reagent in the reaction along with the alcohol used. **Lye is also known to contribute to help in driving the reaction in the forward direction** avoiding back roll of the process. So it is called as a catalyst cum reagent.

Properties of BIO-DIESEL:

- **Color:** BD is **pale yellowish** or saffron.
- **Aroma**: Got **pleasant fruity odour** (characteristics of esters) unlike CD.
- **Density**: less than CD, around **750 – 800 kg/m^3**
- **Flash point**: 50 – 55 ^{0}C
- **Fire point:** 55 – 60 ^{0}C
- **Cetane number:** 50 – 65

BIO-DIESEL as an effective alternative:

Pollution by emission! It is a fact known widely but still the government and the public have not realized its consequences and any **concern raised towards such matter are just ignored by treating it as a farce.** Sine India is depending on fossils fuels for more than 90% of its energy consumption, installation of alternate energy method is an action with **"hands near inferno",** and any mishap will demand deterioration in the nation's economy. Herein, **BD is proven to have very low emission than CD,** as said above. **The exhaust is less toxic and theoretically can be called non-toxic,** and thus it poses no threat to the atmosphere, the surrounding or the environment as well. The **gases known to pollute** the environment **are present in the outlet but only as very low compositors.** Crude oil which is the **raw material for CD** cost the all high and it is **only imported from the east** (inland usage), namely **the OPEC (organization of petroleum exporting countries).** But variably, the **raw materials of BD are found and capable of production 100% inland** and beneficially they can be availed at a comparatively less cost.

BIO-DIESEL as an eco-friendly fuel:

BD is called so, just not because it derived biologically but the name is also attributed to its concern towards the biology of the surrounding which caused to term BD to have an ambiguous name. **"Exhaust gases are the main pollutants of the atmosphere" says NASA, Washington D.C.** exhaust gases of automobiles are chiefly **composed of NO_x, CO, CO_2, HC, traces of S_2 and non-combusted O_2.** To be still specific it is NO_x which forms the major part of the pollutant as far as diesel engines (CI engines) are concerned.

Exhaust gas content	% in CD*	% in BD*
NO_x	40	15

HC	15	10
CO	15	05
CO_2	10	07
S_2, O_2	05	05
air	15	58

The above chart vindicates the claim that BD can safeguard the environment to a greater extend than CD, while quenching India's energy thirst. **Oxides of nitrogen (NO_x) are known to increase the composition of nitrogen in atmosphere**; increase of its concentration can be health hazards. CO is known to produce **adverse effects such as suppression of mental growth** in children and still more in adults, and a generally known fact is that increase in **CO_2 leads to breathing disorders and at most suffocation.** If BD is widely brought into use, it is obvious that the concentration of various exhaust gases will go down in the atmosphere.

BIO-DIESEL as an economic-booster:

Profusely accepted is the fact that, fossil fuels in the present global scenario cost higher and higher every moment that is passed by. The **current global price of crude oil (the raw material) is US$ 67+ per barrel** (hike after attack by *Katrina* along southern America). News dailys are witnessing one same fact every now and then, it is "**oil producing PSUs are encountering**

more than 4500 crores loss quarterly". As far as India is concerned, **the problem lies in marketing**, due to various political reasons and nugatory public interest the products are sold well below their prescribed sales price. So it is natural for the PSUs to face a huge loss, **to project a healthy financial status of the PSUs in the global market, these losses are incurred by the government by means of subsidies to the PSUs** which is economically called as money bonds. The government is known to spend **Rs. 75 on every LPG cylinder** that is sold and **Rs. 10-15 over every gallon of kerosene** sold and around **Rs. 10 on an average over every gallon of fossil fuel** sold *(statistics based on 2003 news daily)*. This amounts to a huge some of around 15,000 crores annually. It is to be noted that the subsequent hikes made by the government were due to the pestering attitude of the oil PSUs in this concern, invariably the demand for the hike claimed by them is still higher, in particular **the PSUs demand a hike of 15% over LPG and the highest as 30% over kerosene** and they are reluctantly sufficed with the hike in petrol and diesel prices.

By

Adithyan M

First year

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