MINISTRY OF AGRICULTURE AND WATER RESOURCES REPUBLIC OF UZBEKISTAN

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Department of Agricultural machinery

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FINAL QUALIFYINGPROJECT

Subject: Modernizationfuelsystem of engine LS PLUS-100 tractor to use natural gas.

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"Approved and put to the defense"

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INTRODUCTION

Annual grand meetings in the Uzbekistan Palace of International Forum son the occasion of the anniversary of the Constitution of Uzbekistan have become a good tradition. President Islam Karimov sums up the development of state and social reforms, and determines the title of the next year. Addressing the participants in a report entitled ‘Our objective is to decisively move toward the development, democratic renewal and modernization of the country’, the President of Uzbekistan emphasized, “The Day our Constitution was adopted, December 8, 1992, will remain a milestone in our history, a holiday that laid the groundwork for building an independent democratic state with a socially oriented market economy, and shaping a civil society with the key objective of ensuring human interests, rights and freedoms, with the rule of law, and equality of all the country’s citizens under the law.” Traditionally, the meeting focused on the past stage of development and the progress achieved. In due time, the country completely drew the line at various forms of the so-called ‘shocking therapy’ unacceptable for local people, which offered all former Soviet republics to rush into a raging whirlpool of a market economy, hoping for its self-regulation, without well-thought programs and not taking into account the historical, national and traditional peculiarities. With such a policy it would be difficult to predict our future.

The correctness of the way we have chosen, which is based on five principles, is primarily proved by the heights we have achieved in a historically short period of time on our way toward democratization and liberalization of the political, economic and humanitarian spheres of society, in the process of sustainable economic development and increasing the quality of life for the population. Since gaining its independence, Uzbekistan’s economy has grown by almost five times, the income per capita by 8,7 times, while the country’s population has increased by 1.5 times and on January 1, 2015 is expected to make up 31.5 million people. It is noteworthy that the country’s external debt does not exceed 15 percent, and internal debt, namely the government's debt to the population, stands at zero. Exports and foreign exchange reserves grow steadily.

Analyzing the progress achieved, President Karimov touched upon the law on the openness of state authorities and administration, which was adopted in 2014 following an extensive legal experiment, and which caused big international response and appreciation of the expert community. The act has undoubtedly increased the responsibility of governing bodies for quality decision making. Under the implementation of the 'Concept of intensifying democratic reforms and forming the civil society in the country', special attention has been paid to the issues of democratization and liberalization of the economy, creation of effective mechanisms of supporting small business and private entrepreneurship.

More than 160, or 44% of licensing procedures, 19 or 25% of activities subject to licensing have been canceled in recent years under the laws on licensing procedures in business, on the competition, on guarantees of freedom of entrepreneurship (in new edition) and other legislative acts. The form and frequency of the statistical, tax andfinancial reports submitted by business entities to state authorities have been reduced 1.5 - 2 times. There is a favorable environment for extensive development of family business - a new form of business, which is fully consistent with the traditions of the Uzbek people.

The speech highlighted the issues of national security in the face of growing geopolitical opposition, the escalating struggle for spheres of influence, radicalism,terrorism and extremism, the financial and economic crisis. In the context of the current situation, the President emphasized as follows: "... all of us need to soberly assess the situation, to mobilize all our forces and capabilities to face the challenges and make the appropriate changes and additions to our programs, especially the 'Concept of intensifying democratic reforms and forming the civil society in the country". This is particularly important for the development of agriculture.

Tractors are widely used in carrying out agricultural work. Their have the power phase-piston internal combustion engines. This engine does not have the highest economicindicators resistant and long-term performance, compactness enough common. 80% of the mechanical energy produced in the world ofinternal combustion engines. All over the world each year more than 50 million internal combustion engines.

This is to improve the technical and economic parameters of the engine, Moto resource-liter capacity will be increased by reducing the consumption of metal, which is relatively cheap fuel in today's engineering and technical staff in front of priorities.

It was reported in recent years in order to reduce the fuel consumption of motor work. One of them is carburetorto establish fuel and compressed gas injector engines. Diesel and gas to a number of difficulties due to the presence of gas is still somewhat behind them. Atpresent, the amountof compressed gas, oil products reserve 8 times, so it is currently used for agriculture would be appropriate to transfer gas to diesel fuel. Experimental points above madethese LS PLUS 100 tractorIvecoFPT5C diesel engines tocompressed natural gas fuel.

I. MAIN PART

1.1 COMPLETE INFORMATION ABOUT OF TRACTOR

LS PLUS 100

PLUS LS series is designed to bring more luxury, power and innovation in a variety of models. Characterized by its exceptional strength, luxury, comfort and practicality

PLUS series of tractors LS includes models from 70 to 100 hp, Proposing modifications to the cab or roll bar.

Specifically model LS Plus 100 is a power 100hp. and drive 4X4. Tractor is optimized for both medium and large farms and the animal farms. This model is only available with a cab, while versions with a protective roll bar is available in this series with a power 70 and 80 hp. every tractor of this LS series, whether it comes with a front loader or not, is equipped with a joystick control.

The moderndesign does predispose to very good visibility from the operator. Furthermore the headlightshave been added and two rear for better control during night work.

Picture 1. LS PLUS 100 tractor

The design of the tractor is not only consistent with current trends, but also innovative and practical. The length of the tractor is 3, 99 m., 1, 97 m width. Its height is 2, 62 meters, and its mass is 3056 kg.

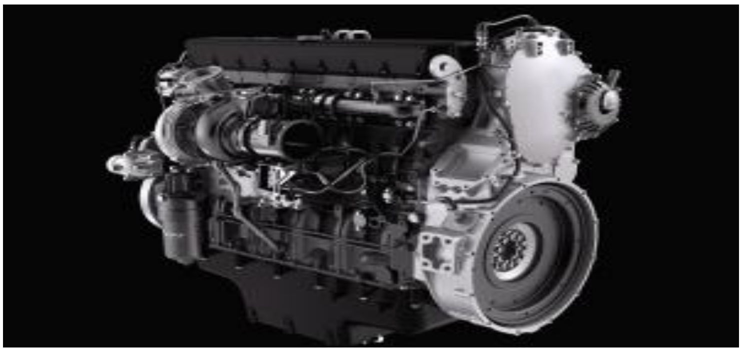
Factory tractor comes with 4 weights with the option to add more if needed. It is important to note that the model has high ground clearance, which allows preservation of cultures and ensure higher productivity especially when working on wetter rain.

Engine:

The engine hasa easy access andthehoodopenedwith one touch. The unit is a 4 cylinder diesel, IVECOturbo-intercoolers with water cooling. It has a volume of 3200 cc and 100 phpowers at 2600 rev. /min.

Extremely low levels of noise in 81detsibela and low vibration levels, allowing the tractor driver to work comfortably even in a very long time. The engine meets the highest eco-normitTier4 and is extremely economical.

The fuel in this model is 100 l.,which guarantees a long field work on a single charge.



Picture2.Ivecodieselengines.

Cabin:

The design of the tractor is alsoconsistent with the comfort of operator. U-like leather seatis hydraulic with several degrees of regulations. The position of all levers and is selected for maximum comfort and practicality.

The cabin of the LS is a luxury has heating, air conditioningand air filtration. It is equipped with appropriate sound stereo system consisting of optimally positioned speakers and a modern player.

Transmission and steering:

This model tractor is equipped with a gearbox type Power Shuttle. The speeds at the main model are 20 forward and 20 back. As an option, the tractor can be ordered with Creeper,where speeds are forward 40.

Creeper forwarded is used for applications that require extremely slow speeds.

The clutch in this seriestractors multidiscinoil bath. Reverse the tractor is managed very easily with small lever to the left of the steering wheel. Currently, dieselfuelusefor tractors LSPLUS100. It is grown on farms; high energy prices increase the cost of product. Tractorenginebased on engine gas fuel change in the structure andoperation ofthe system. Thefollowing Ivecoengine and part of the structure of the system.

Table 1

Thenameof indicatorsIndicators

A type	**Universal-cultivator**
Thewheelformula	4W4
Enginetypes	four-stroke, four-cylinder, water-cooled
Volume, l	4,48
Rated power kW (hp) / v / m	71 (95)/2300
Theprocessaircylinder	turbocharged
Transmission	mechanical
Number of gears Fwd / Back	20/20
Speed range km / h	1,80 – 36,4
Ahead	1,89 – 38,27
Back	
PTO	independent / 82
Type / hp.	540/750/1000
Frequencyrotation, min^{-1}	
Speeds I/II/III	
Tracktractor, мм	1602…1802
Ontherearwheels	1532…1830
Asthefrontwheels	
Basetractor	2290
Overalldimensions, mm	4342
Length	1967
Width (at the minimum gauge)	2650
Height	
Operating weight, kg. without ballast	3182

1.2.Supplysystemofthe IVECOengine

All these characteristics influence the fuel spray formation, combustion process, engine performance, and consequently economy and ecology characteristics.

For a mechanically controlled fuel injection system, the injection characteristics dependstrongly on its geometrical and setup parameters. Besides this, the injection characteristicscan be influenced by the rest of the fuel path (Pic.3), i. e., by the *coarse fuel filter*, *fine fuel filter*, *low pressure pump*, and so on.

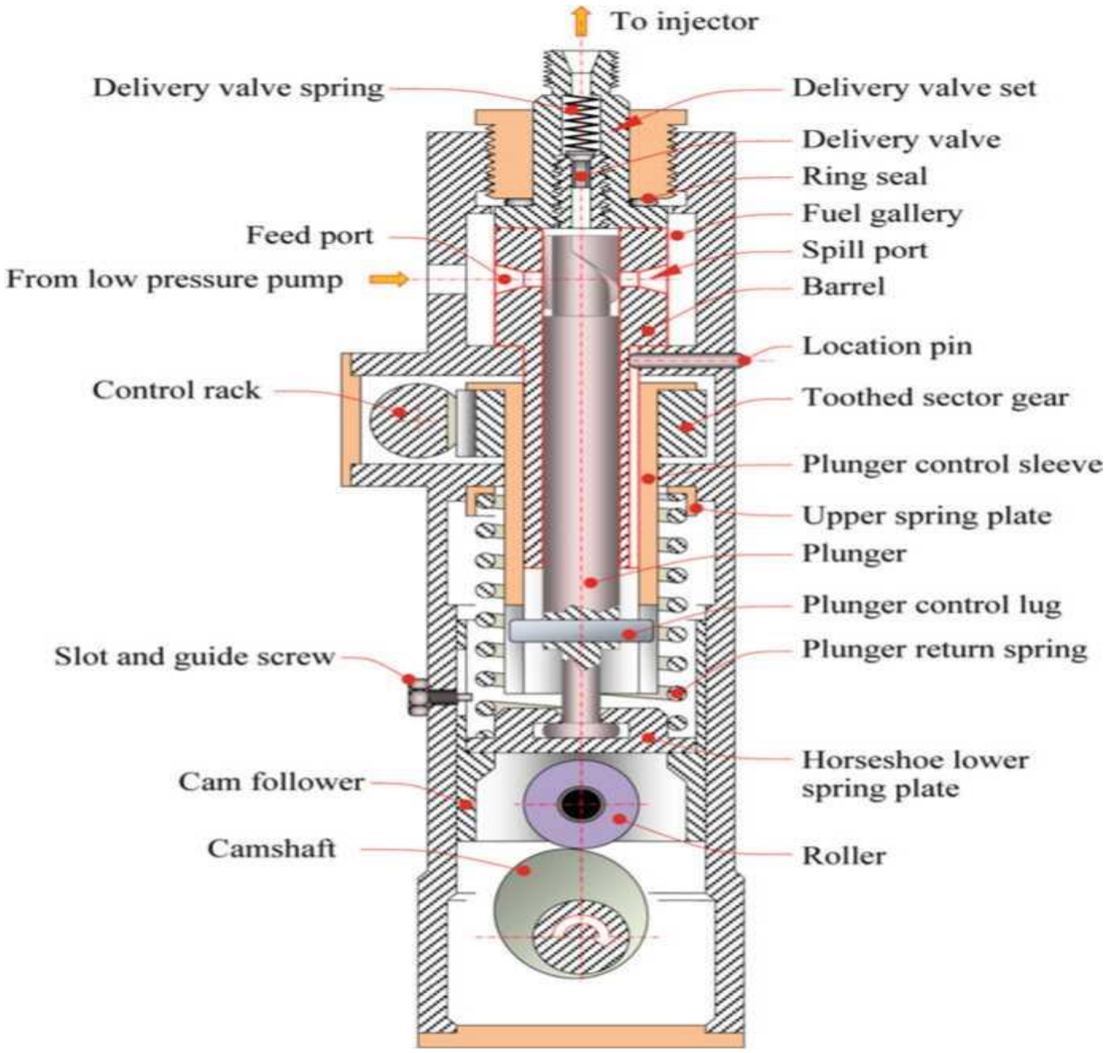
The *mechanically controlled fuel injection system* consists basically of a high pressure fuel pump, high pressure tubes, and injectors.(The *in-line fuel injection pump*, driven by a camshaft, has one pumping element for each cylinder. Pumping elements are mounted vertically in a straight line, side by side. The lower half of the pump housing supports and encloses a horizontally positioned cam shaft, which has so many cam profiles as there are pumping elements. Each pumping element consists of a pump plunger which reciprocates in the barrel in dependence on camshaft profile. The camshaft profile converts the angular movement of the camshaft into a linear plunger motion by the roller cam follower and plunger return spring. Of course, the individual cam profiles are arranged according to the engine's firing order sequence. The top of each barrel is enclosed by its own delivery valve and optional snubber valve assembly.

The fuel enters the fuel ports at gallery pressure up to 1,5 bar, filling the space between the plunger and delivery valve. The plunger moves up in dependence on camshaft rotation following the cam profile and cuts off the feed/spill ports.

When all feed/spill ports are closed, the *geometrical fuel delivery begins* (Pic.3). The in-barrel chamber pressure rises and eventually (dependent on the spring force and residual pressure in the high pressure tube) opens the delivery and the optional snubber valve. The pressure in the in-barrel chamber increases until theedge of the plunger helix unveils the feed/spill ports. Instantly, the in-barrel pressure collapses as fuel begins to escape down the vertical slot and exits through the feed/spill port. This is the moment of the *geometrical end of fuel delivery* (Pic.4).

The pressure rise in the in-barrel results in a pressure wave traveling towards the injector starts. After the fuel delivery ends, the pressure in the injector. When this pressure wave reaches the injector nozzle (Fig.3), the needle opens and the injection chamber falls, the needle closes, and the injection process terminates.

Injection pressure is the fuelpressure just before the injector nozzle holes. It depends on the type of injection system, on engine speed and load, and on fuel properties. Diesel engines with divided combustion chambers operate with high air speed in the pre-chamber or whirl chamber and main combustion chamber. Therefore, forindirect diesel engines, the injection pressure is typically about 350bars. For directinjection diesel engines, however, air speed in the combustion chamber is relatively low. Therefore, in order to achieve satisfactory air/fuel mixing, the fuel has to be injected into the combustion chamber at high pressure, typically up to 1,000 bars. In order to get good overallengine performance, the injection pressure history should in general exhibit a high mean/peak pressure ration, i. e., no extreme pressure peaks. Pictureshows a typical injection pressure history and other injection characteristics.



Picture.3.Pumping elements

Injection timing is the time span between the start of injection and the TDC of the engine piston. Injection timing has a strong influence on injection pressure, combustion process, and practically all engine emissions.

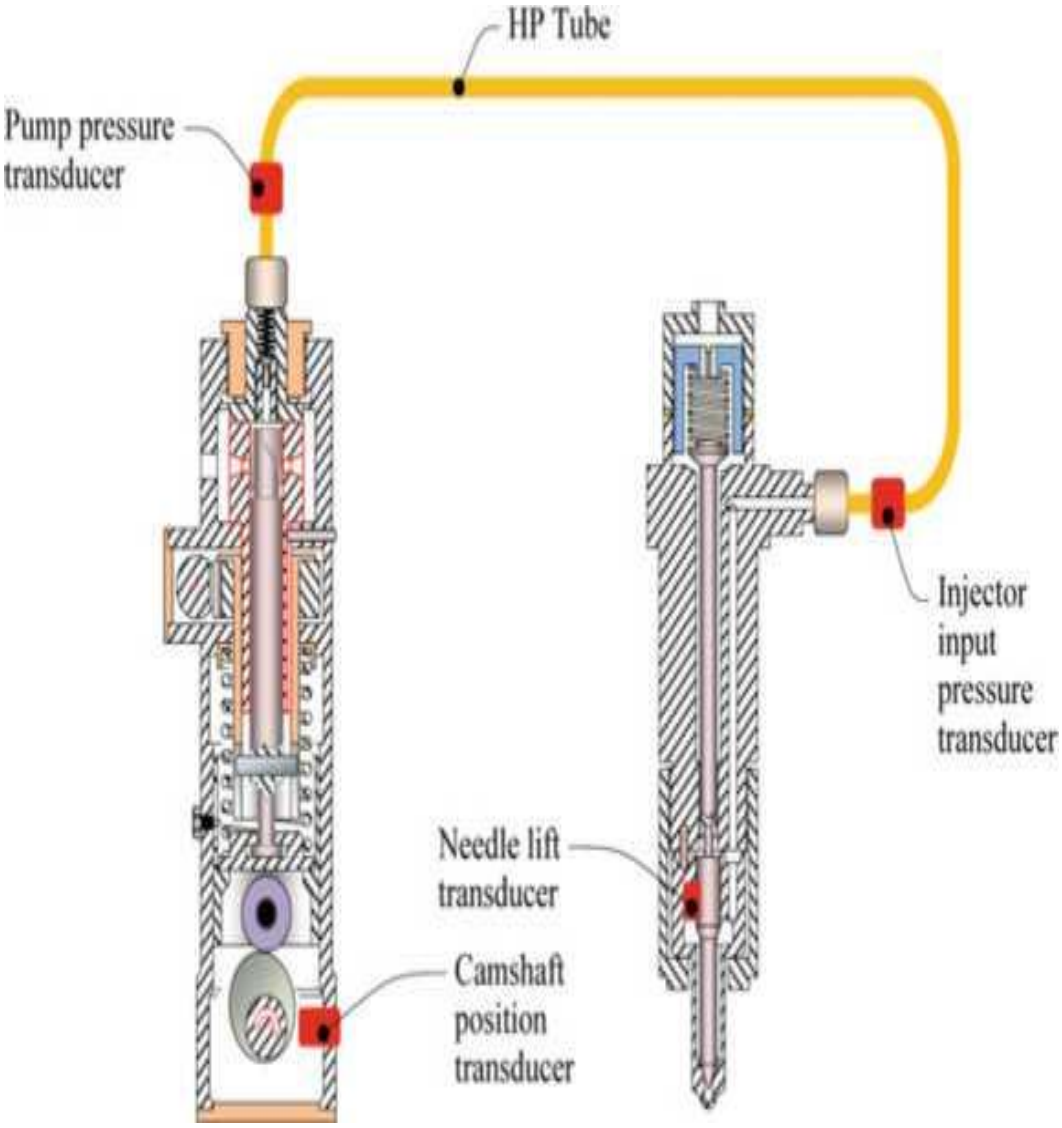
*Injection duration*isthe time span from the beginning to the end of injection. In general, injection duration should be as short as possible. At higher engine speeds, injection duration should become longer and the mean injection pressure should be reduced.

*Injection rate*represents the quantity of fuel injected per unit of time into the combustion chamber. Variations of injection rate history influence mixture preparation, combustion process, and harmful emissions.

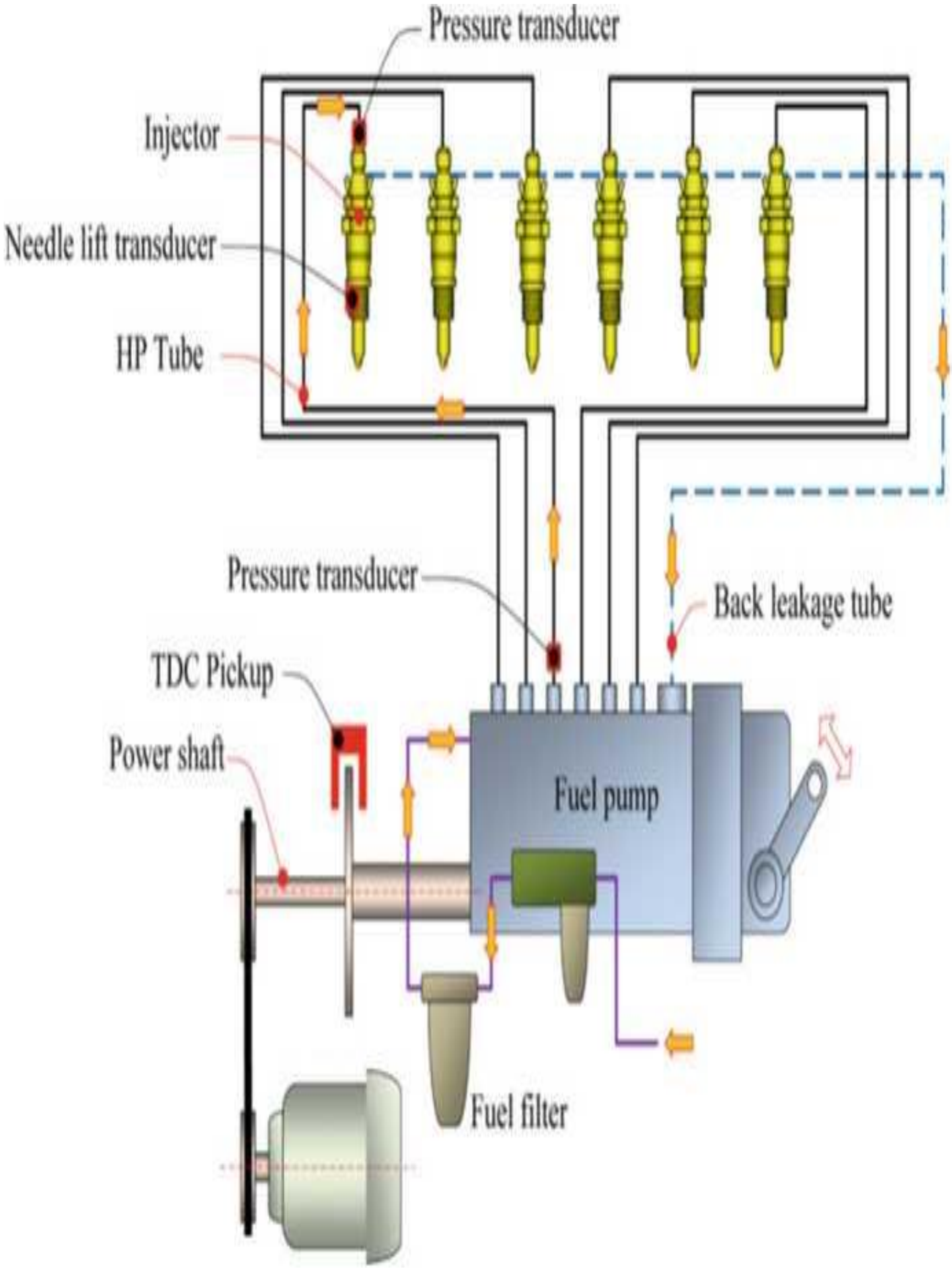
For a mechanically controlled fuel injection system the most basic test bench should allow to measure the pressures immediately after the pump and before the injector as well as the needle lift and fuelingillustrate possible positions of pressure and needle lift transducers.

The whole test bed of a fuel injection system should look something like the one depicted schematically in (Pic.5).One pressure transducer (e. g., a diaphragm type transducer) is located at the high pressure tube inflow just behind the injection pump. Another pressure transducer (e. g., a piezoelectric pressure transducer) is located at the high pressure tube just before the injector. The needle lift and the TDC position can be measured by a specially designed variable-inductance sensor and by an optic sensor, respectively.

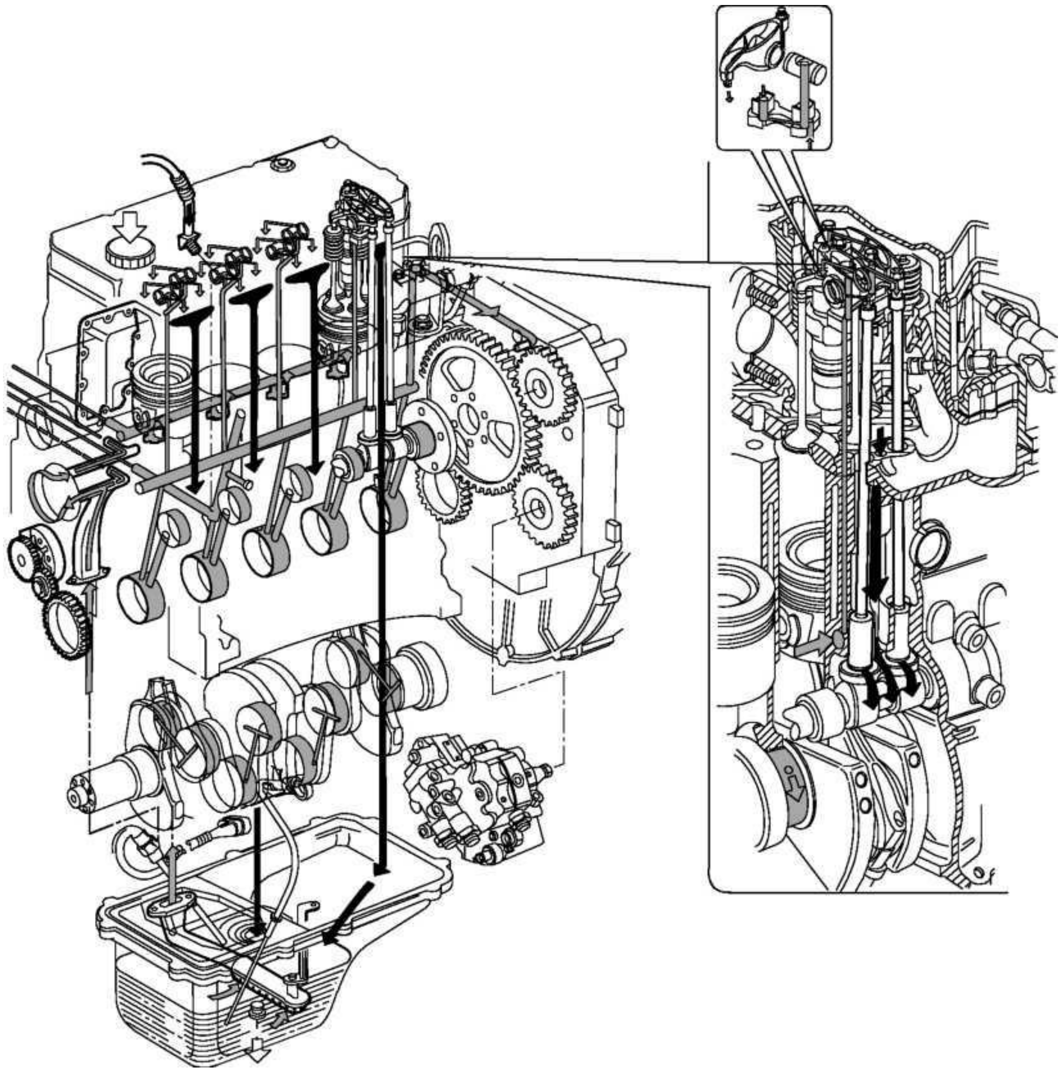
The injected fuel quantity is typically measured by collecting the injected fuel over 500 cycles into a test glass. The fuel temperature is measured at the inflow into and after the pump in order to account for possible fuel quantity correction. The testinghas to be performed at various temperatures. However, *low temperature testing* requires the most attention. For example, a special cooling system has to be developed and attached to the test bed in order to maintain the desired preset constant temperature conditions. A possible setup with two separated cooling systems, conditioning the fuel injection pump and fuel, respectively, is presented inPicture.4. In this setup the fuel injection pump is placed into an isolated metal case and connected to the electric motor drive of the test bench by a rigid shaft. Plate evaporators can be used as inner case walls in order to dispose sufficient energy to maintain temperatures well below the ambient one. A PID controller can be applied for temperature control in order to ensure the tolerances of the set temperature to be within ±0. 5 °C. Injectors should be mounted outside of the cooled case in order to enable simple measurement of the injected fuel amount. They can be connected to the injection pump by standard thermally isolated high pressure tubes. The fuel supply forms the second cooling system. A large fuel tank (e. g., 50 L) is placed into a refrigerator,



Picture.4. Positions of transducers



Picture.5. Fuel injection system test bed



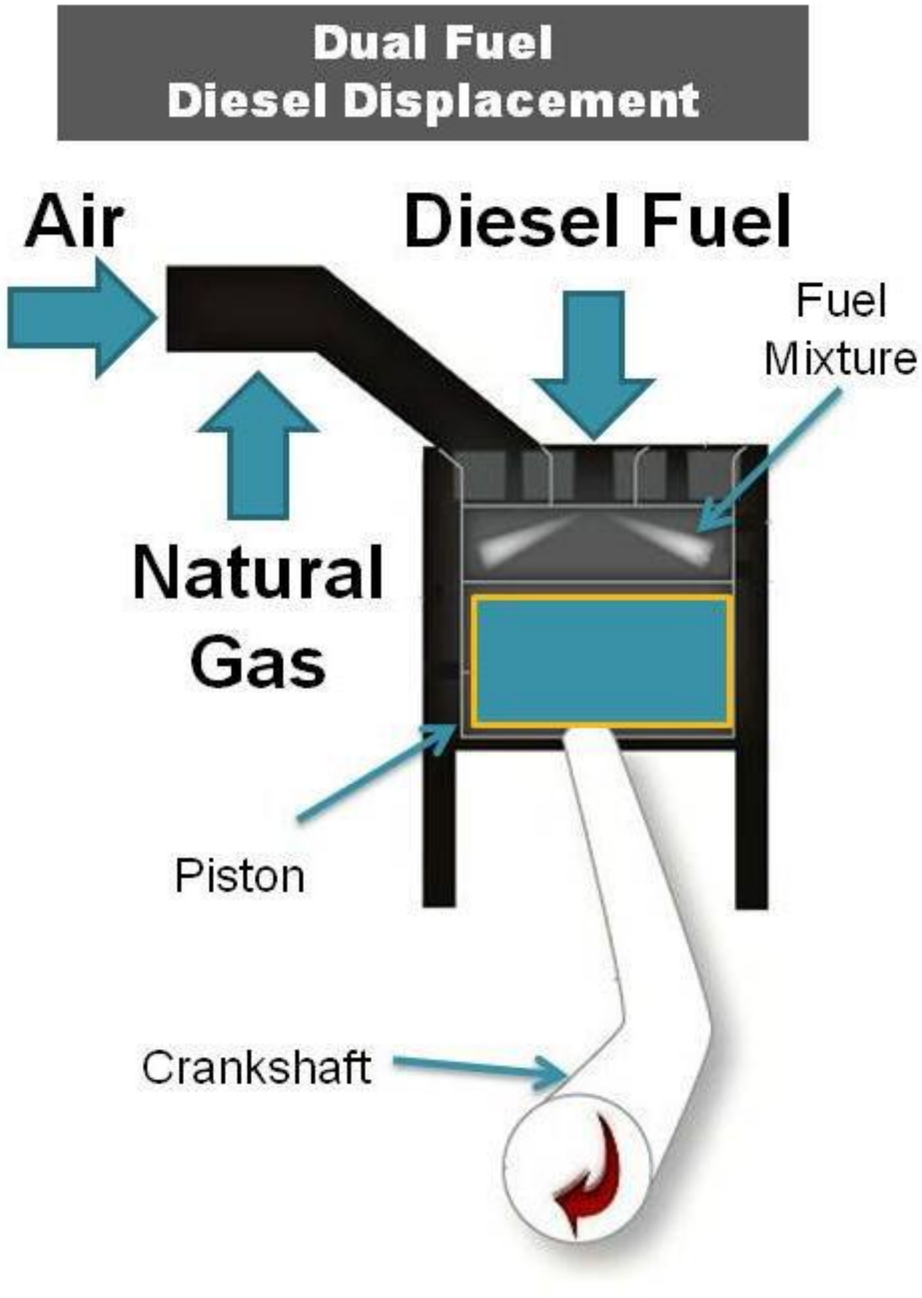
Picture.6.Routing of oil return by gravity to sump

The turbochargeris composed by the following main parts: one turbine, one transforming valve to regulate the boost feeding pressure, one main body and one compressor. During engine working process, the exhaust emissions flow through the body of the turbine, causing theturbine disk wheel's rotation. The compressor rotor, being connected by shaft to the turbine disk wheel, rotates as long as this last one rotates, compressing the drawn air through the air filter. The abovementioned air is then cooled by the radiator and flown through the piston induction collector. The turbocharger is equipped with a transforming valve to regulate the pressure that is located on the exhaust collector before the turbine and connected by piping to the induction collector. It’sfun chon is to restrict the exhaust of the emissions, releasing part of them directly to the exhaust tube when the boost feeding pressure, over the compressor, reaches the prescribed bar value. The cooling process and the lubrication ofthe turbocharger and of the bearings is made bytheoiloftheengine.

1.3. Recommendationprovidingsystemwhichworkswith the gas.

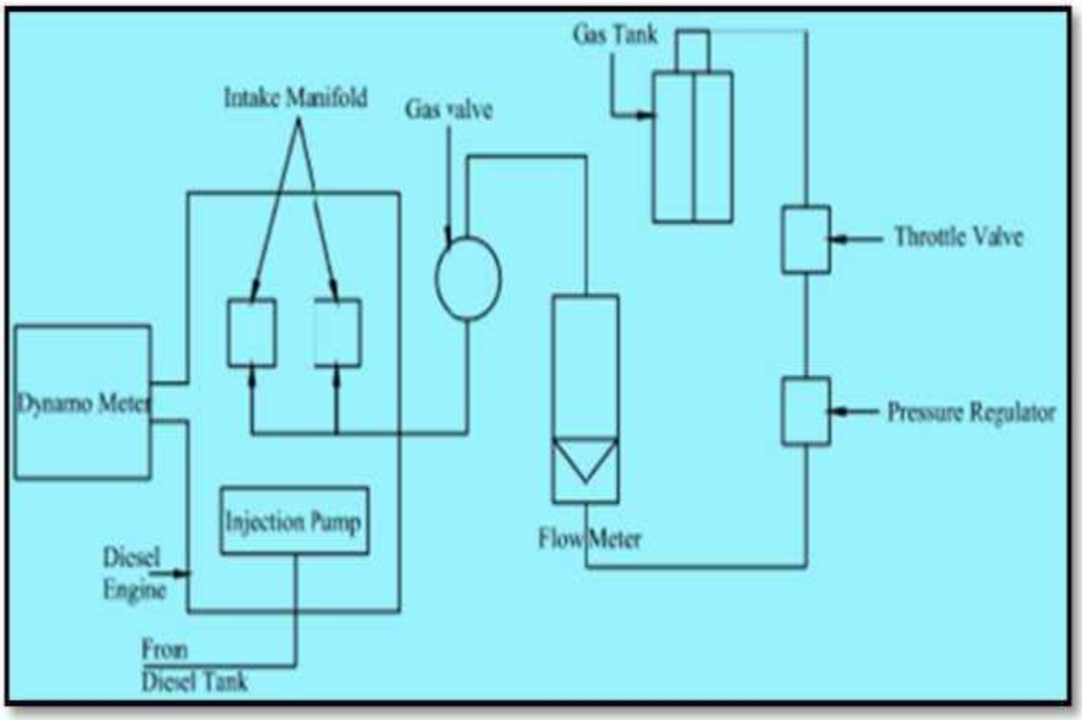
The technology of engine conversion is well established and suitable conversion equipment is possible. For Diesel engines to be converted or designed to run on natural gas, there are two available options. The first is a dual-fuel engine. This refers to diesel engines operating on a mixture of natural gas and diesel fuel. Natural gas has a low certain rating (a quantity indicating the ignition properties of diesel fuel relative to certain as a standard.) and is not therefore suited to compression ignition, but if a pilot injection of diesel fuel occurs within the gas/air mixture, normal ignition can be initiated. Between 50-75% of usual diesel, consumption can be replaced by gas when operating in this mode [9]. The enginecan also revert to 100% diesel operations. The second is dedicated natural gas engine. Dedicated natural gas engines are optimized for the natural gas fuel. They can be originated from petrol engines or may be designed for the purpose. Until manufactured OEM engines are available, the practice of converting diesel engines to spark ignition will continue, which involves the replacement of diesel fueling equipment by a gas carburetor and the addition of an ignition system and spark plugs. For compression ignition engines convert to spark ignition, the pistons must be redesigned to reduce the original compression ratio and a high-energy ignition system mustbe fitted along. The system is suitable for CNG and is ideally suited to time(sequential) port injection system but can also be used for single point and low pressure in-cylinder injection. Gas production provides greater precision to the timing and quantity of fuel provided, and to be further developed and to become better in fuel emissions performance. An approximate measureof the equivalent petrol or diesel fuel capacity of a cylinder filled with gas at 20Map has to be obtained by dividing the cylinder volume by 3. 5 –Thus a 60-litre cylinder will provide the energy equivalent of 17 liters of conventional fuel. The design and installation of appropriate high-pressure on board storage cylinders, plays an important part of the efficient and safe operation of CNG-fueled vehicle. The cost constitutes a good proportion of total vehicle installation cost. Most widely used are chrome molybdenum steel gas cylinders, which are the cheapest, but also one of the heaviest forms of storage containers. It is possible that the space required and weight of CNG fuel storage systems will fall in the future result of improved engine efficiencies (as with dedicated designs) and lightweight storage tanks. For example fibber reinforced aluminum alloy or even all composite.

In most dual fuel systems used in the oilfield, natural gas fuel in the form of vapor phase at low pressure is introduced into the air intake system of the engine, whereas Diesel engine fuel introduce directly into the combustion chamber near the end of the compression stroke part. The two fuels are mixed to form a lean mixture andare ignited by compression (on spark plug) in the cylinder. Dual fuel engine in this configuration provide many of the operational advantages of conventional diesel power. In particular, dual fuel diesels offer similar high transient load response, which is so important in hydraulic fracturing operation and had been proven to function well in this application. Dual fuel diesel enginecan also run individually on diesel should gas fuel be unavailable.



Picture.7. Dual fuel diesel displacement.

Natural gas fuel could be substituted for diesel fuel in varying proportion according to working conditions. Dual fuel engine substitution rate is controlled with a system of sensor and ECU fitted with the engine equipment. Many factors that affect actual diesel substitution rates of 50%-70% of gas on energy basis havebeen reported. The performance of the dual fuel engines is determined by affected by the amount of natural gas and diesel. To obtain high mass alternativerate, the amount of pilot diesel should be as little as possible. Too little pilot diesel, however should result in unstable operation of engine. Under suchconditions theengine almost renders unstable operation. The testing has detonation if higher mass alternative rate were used [12]. Confirmedthatthedual fuel engine would exhibitobvious.



Picture.8. Shows, the overall arrangements of the engine fuel led with diesel-natural gas.

As describedabove, too low of an amount of diesel would result in irregular burning or detonation. On the other hand, too little amount of natural gas will cause the misfire of the gas.

1. ***Intakestroke*.**

As the piston descends into the cylinder, a measured amount of gas in injected into the air inlet manifold and is sucked into the cylinder as a gas/air mixture.

2. ***CompressionStroke*.**

The piston continues down until it reaches BDC; it thenrises back up the cylinder, compressing the air/gas and increasing its temperature. Before the TDC, a measured quantity of diesel oil (pilot diesel) is injected into the combustion chamber.

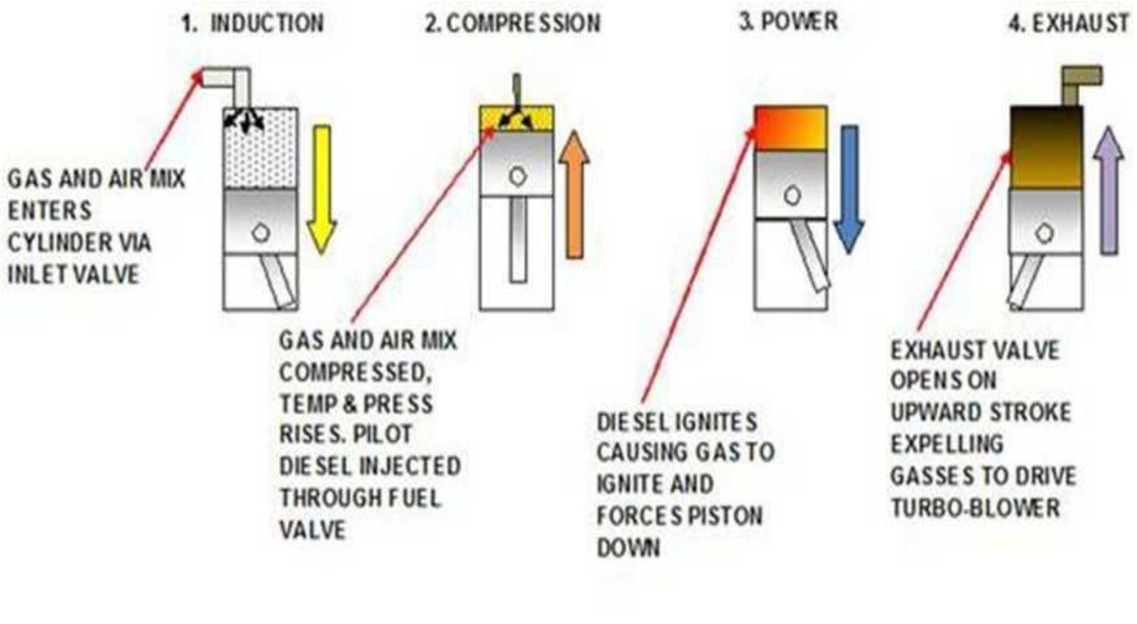
3. ***PowerStroke***.

The small amount of diesel ignites into hundreds of little sparks due to compression combustion. This inturn sets off the combustion of natural gas that powers the piston back down the cylinder.

4. ***ExhaustStroke***

The piston returns to BDC and, as it begins to rise up the cylinder, the exhaust valve opens expelling the exhaust gasses into the turbo.

When a diesel engine is converted into a dual fuel engine to run on CNG, it operates inmuch the same manner as the original diesel engine, changing over to gas/diesel mix when optimum engineoperatingtemperaturesarereached.



DIESEL/NATURAL GAS DUAL 4-STROKE ENGINE OPERA HON.

Picture.9. Shows - the operation of a typical dual fuel 4-stroke diesel/natural gas engine is examined below.

II. CALCULATING PART

2.1.Thetotalinformationabout gasfuelsusingintheinternalcombustionengines.

The mixture of the fuel and oxygen ignites only above the defined temperature. This temperature is called as the ignition temperature (self-ignition point). It is depended on many internal and external conditions and therefore it is not constant value. Besides that for many gases and vapors there are distinguished twopoints: lower and higher ignition points (detonation boundary). These twopoints determine the boundary values where the ignition of the mixture can follow. The Table 1 presents ignition temperatures of the stoichiometric mixtures of the different fuels with the air.

Table 2

Ignition temperatures of the fuels in the air (mean values)

Fuel	Ignition temperature [°C]	Fuel	Ignition temperature [°C]
Gasoline	350 - 520	Brown coal	200 - 240
Benzene	520 - 600	Hardcoalatomi	150 - 220
Furnace oil	« 340	Coking coal	« 250
Propane	« 500	Soot	500 - 600
Charcoal	300 - 425	Natural gas	« 650
Butane (n)	430	City gas	« 450
Furnace oil EL	230 - 245	Coke	550 - 600

The combustion mixture, which contains the fuel gas and the air, can ignite in strictly defined limits of contents of the fuel in the air. The natural gas consists manyhydrocarbons, however it includes mostly above 75% of methane. For the experimentaltest one used two types of the natural gas:

1. The certified model gas G20 which contains 100% of methane compressed in the bottles with pressure 200 bar at lower heat value 47. 2 - 49. 2 MJ/m^3

2. The certified model gas G25 that contain 86% of methane and 14% of N2 at lower heat value 38. 2 - 40. 6 MJ/m^3.

The natural gas delivered for the industry and households contains the following chemicalcompounds with adequate mean mass fraction ratios: methane - 0. 85, ethane – 0, 07,propane – 0,04, n-butane – 0,025,isobutene - 0.005,n-pentane - 0. 005, visopentane– 0, 005.

Because the natural gas contains many hydrocarbons with changeable concentration ofthe individual species the heat value of the fuel is not constant. It influences also on the ignition process depending on lower ignition temperature of the fuel and energy induced by secondary circuit of the ignition coil. For comparison in Table 2 the ignition limits and temperatures for some technical gases and vapors in the air at pressure 1. 013 bars are presented. The data show a much bigger ignition temperature for the natural gas (640 - 670 °C) than for gasoline vapors (220°C). For thisreason the gasoline-air mixture requires much lower energy for ignition than CNG-air mixture. However, higher pressure during compression process in the engine with higher compression ratio in the charged SI engine causes also higher temperature that can induce the sparking of the mixture by using also a high-energy ignition system. Because of lower contents of the carbon in the fuel, the engines fuel led by the natural gas from ecological point of view emit much lower amount of $CO_2$and decreases the heat effect on our earth.

Till now there are conducted only some laboratory experiments with the high-energy ignition system for spark ignition engines with direct CNG injection. There areknown the ignition systems for low compressed diesel engines fuel led by CNG by the injection to the inlet pipes.

Table.3

Ignition limits and ignition temperatures of the most important

Type of gas	Chemical formula	Normalized density (air = 1)	Ignition limits in the air (% volumetric)	Ignition temperature in the air [°C]
Gasoline	~C8H17	0. 61	0. 6 - 8	220
Butane (n)	C4H10	2. 05	1. 8 - 8. 5	460
Natural gas H		0. 67	5 - 14	640
Natural gas L		0. 67	6 - 14	670
Ethane	C2H6	1,047	3 - 12. 5	510
Ethylene	C2H4	1,00	2. 7 - 34	425
Gas propane-butane 50%		1. 79	2 - 9	470
Methane	CH4	0. 55	5 - 15	595
Propane	C3H8	1. 56	2,1 - 9. 5	470
City gas I		0. 47	5 - 38	550
City gas II		0. 51	6 - 32	550
Carbon monoxide	CO	0. 97	12. 5 - 74	605
Hydrogen	H_2	0. 07	4 - 76	585
Diesel oil		0. 67	0. 6 - 6. 5	230

Technicalgasesand vaporsin the air at pressure 1,013 bar

Table.4

Composition andproperties of natural gas used in experimental tests are presented in

№	Parameter	Nomenclature or symbol	Unit	Value
1	Combustion heat	Q_c	[MJ/Nm^3]	39,231
2	Calorific value	W	[MJ/Nm^3]	35,372
3	Density in normal conditions	Pg	[kg/Nm^3]	0,756
4	Relative density	*л*	-	0,586
5	Coefficientof compressibility	z	-	0,9980
6	Wobble number	W	[MJ/Nm^3]	51,248
7	Stoichiometric constant	L_0	[Nm^{3}fuel/Nm^{3}air]	9,401
8	CO_2 from the combustion	-	[Nm^3/Nm^3]	0,999

Table.12. Properties of the natural gas used in experimental research

2.

2HeatingaccountoftheengineIvecowhichworkswithgasandliquiddieselfuels.

Account in order to complete the heat

Engine heat engine type will be for the account of, the location and number of cylinder - i, air cylinder input, the compression ratio - ε, the clock rate -τ, the rate of airsuperlative - α, indicators such as engine parameters We recommend the same.

The working parameters of the body

An engine running on a mixture of gas and liquid fuels has different physical properties than the envisaged use two types of fuel, so different from his account or diesel engines, the carburetor heat. Diesel and gas engine heat balance and determine the most optimal ratio. The above-notedLSPLUS100 tractor engines refers to the use of compressed natural gas and gas to the lower specific heat of combustion, Q = 35000 kJ / m^3, the average composition of the following elements:

CH_4 = 90, 61%, C_2H_6 = 2, 96%, C_3H_8 = 0, 17%, C_4H_{10} = 0, 55%, H_2 = 0, 28%,CO = 0, 28%, N_2 = 5, 15% diesel fuel 'allusions to the lower specific heat of combustion, Q = 42500 kJ / kg, the element composition is as follows:

C = 85. 7%, H = 13. 3%, O = 1%. Kg

Roll cleaning and filling parameters 1 k*moll gaseous fuel to determine the theoretical amount of air required for combustion k/moll,k/mollor m^3/ m^3

$$L_0 = \frac{1}{0,21}\left[\frac{CO}{2} + \frac{H_2}{2} \div \sum\left(n + \frac{m}{4} - \frac{2}{2}\right)C_n H_m O_2\right]$$

Here $CO_2H_2$and $C_n H_m O_2$ gaseous fuel components as part of the size.

To determine the coefficient of residual gases:

$$\gamma_r = \frac{T_{op} + \Delta T}{T_r} \cdot \frac{P_a}{\varepsilon P_0 - P_r}$$

there

T_{ar} – The temperature of the mixture

ΔT – Heating the mixture into the cylinders during the

T_r – The residual gas temperature of 700 . . . 900 K

P_r – The residual gas pressure mPa

P_o – At the end of the process, the pressure mPa

$\varepsilon -$ Compression degree

To determine the temperature of the combustible mixture:

$T_{ar} = \frac{T_r + \alpha_1 L_0^2 T_a}{1 + \alpha_1 L_0^2}$ there

α_1 – Gas and air mixture ratio of air superlative

T_r – Temperature ofgas $T_2 = T_a + \Delta T_g$

ΔT_g – Thetemperatureof the results of the evaporation of gas $\Delta T_g = 5...10^0 C$

To determine the coefficient of filling:

$$\eta_v = \frac{T_{ar}(\varepsilon P_0 - P_a)}{(T_{ar} + \Delta T)(\varepsilon - 1)P_{ar}}$$

To determine the temperature at the end of the process:

$$T_a = \frac{T_{ar} + T + y_2 T_2}{1 + \gamma_\varepsilon}$$

The working parameters of the compound

1 kg of air required for the combustion of liquid fuels theoretically, kmoll / kg. $L_0^c = \frac{1}{0,21}\left(\frac{C}{12} + \frac{H}{4} - \frac{O_T}{32}\right)$

Where C, H,O content of the fuel, the amount of entrants.

Gas engines in 1 k*moll the right to determine the mass of the liquid fuel.

$$g = \frac{22,4 G_C}{V_2} = 22,4 \frac{H_u^2}{H_u^c} \cdot \frac{q}{1-q}$$

There

G_C – The amount spent on the mass of liquid fuel per hour, kg / h;

V_2 – Normal hours is the amount of gaseous fuelamount, m / hour

H_u^c – Heat from the liquid fuel

H_u^g – Heat gaseous fuel

q – Liquid fuel part of the total heat kJ of heat.

Heating the total heat score of diesel fuelaccounted for 10, 15, 20, 25, 30% of the campaign were detected in engine performance.

Gas fuelwith liquid fuel to determine the theoretical amount of air required for combustion, moll / kmol.

$$L_0^{c,2} = L_0^2 + gL_0^c$$

To determine the amount of new products, k*moll .

$$M_1 = 1 + \alpha_1 L_0^2$$

1 k.molg per kg of liquid fuel gas lights to determine the total amount of kmol. The amount ofcarbondioxide.

$$M_{CO_2} = g\frac{C}{12} + \left(CO + \sum nC_nH_m + CO_2\right)$$

The amount ofwater vapor .

$$M_{H_2O} = H_2\sum\frac{m}{2}C_nH_m + g\frac{H}{2}$$

The amount ofoxygen.

$$M_{O_2} = 0{,}21\left[(\alpha_1 - 1)L_0^2 - gL_0^c\right]$$

The amountof nitrogen.

$$M_{N_2} = 0{,}79\alpha_1 L_0^2 \div N_2$$

There

α_1 – Cylinder gas mixture with air introduced into the air superlative ratio.

The total amountof products to be burned.

$$M_2 = M_{CO_2} + M_{H_2O} + M_{O_2} + M_{N_2}$$

1 moll Volume of gas and liquid fuel combustion, moll.

$$\Delta M = M_2 - M_1$$

Molecular changes and to determine the coefficient.

$$\mu_0 = \frac{M_2}{M_1}$$

The actual ratio of the molecular changes.

$$\mu = \frac{\mu_0 + \gamma_2}{1 + \gamma_2}$$

1 moll gas g per kg of liquid mixturefrom thebottom to determine the heat of combustion of the fuel.

$$H_u^{g,s} = \frac{22{,}4H_u^2 + gH_u^C}{1 + \alpha_1 L_0^2}$$

To determine the coefficient of air compression and expansion of the line superlative.

$$\alpha_2 = \frac{\alpha_1 L_0^2}{L_0^{2.c}}$$

To determine the pressure at the end of the compression process mPa

$$P_{\tilde{n}} = P_a \varepsilon^{n_1}$$

There n_1 – polytrophic indicator $n_1 = 1.36...1.38$ vary between squeeze.

To determine the temperature at the end of the compression process, K.

$T_{\tilde{n}} = T_a \varepsilon^{n_1 - 1}$

Heatcapacitywhich oftheworking gases.

Inflammable product temperature Tc average molecular determine the capacity of the heat exchange capacity kJ / k*moll hail.

$C_V^1 = \sum \eta_k \cdot C_{uk}^1$

There

η_k – Combustible products as part of those volumes;

C_{vk}^1 – The average gas content of those specific heat capacity, kJ / k*moll.Glow of the product to determine the amount of change the averagemolecular heat, kJ / k*moll hail.

$$C_v^1 = \left(\frac{1}{M_2}\right)\left[M_{CO_2} \cdot C_{vCO_2} + M_{H_2O} \cdot C_{vH_2O} + M_{O_2} \cdot C_{vO_2} + M_{N_2} \cdot C_{vH_2}\right]$$

There $M_{CO_2}, M_{H_2O}, M_{O_2}, M_{N_2}$ – the number of fire productsmolar.

$C_{vCO_2}, C_{vH_2O}, C_{vO_2}, C_{vN_2}$ – burned them products of the molecular CO_2, H_2O, O_2, N_2 mass of the heat.

Glow of a product from a temperature range of 1800 . . . 1900 K, the average of those in the molecular heat capacity is determined by the following equations.

$C_{vCO_2} = 41.205 \div 2.428 \cdot 10^{-3} Tz$

$C_{vH_2O} = 26.975 \div 3.517 \cdot 10^{-3} Tz$

$C_{vO_2} = 23.228 \div 1.591 \cdot 10^{-3} Tz$

$C_{vN_2} = 22.009 \div 1.339 \cdot 10^{-3} Tz$

The capacity of the heat glow of a product's average molecular constant pressure, (kJ / kmol hail).

$$C_p^{11} = C_v^{11} + 8.314$$

The combustion process account.

As a result of the combustion process and the expansion of gases in the engine cycle. Engine reliability, power and economic indicators of this process will depend on the dynamic characteristics. The dynamics of the combustion process depends on a number of factors, including the composition and the quality of the fuel.

Liquid fuel combustion products constant pressure average wealth thermal capacity:

$$\mu s_{pz} = (20{,}2+(0{,}92/\alpha))+(15{,}5+(13{,}8/\alpha))*10^{-4}*T_z+8{,}314 \text{ kJ / (k*moll * grad)}$$

The combustion temperature in the process of putting the value of the nominal ownership of mathematical steps do then leads to the following equation:

$$\mu s_{pz} = B+A*T_z \text{ kJ/ (k*moll*grad)}$$

ThereA and B of mathematical steps that the exact numbers.

The number of post-combustion gases molar:

M = M + M, k*moll

The rate of change in the working mixture molecular:

$M_z = M_2 + M_r$, k*moll

The value of the coefficient of heat of combustion of all heat losses, we will bring attention = 0. 7..0. 9. borage 1 kg of fuel burning gas indicator diagrams is equal to the amount of heat transferred is not

$Q = \xi * Q_n$ kJ/kg.Duringthecombustion of diesel engines for the value of the rate of pressure increase λ = 1,4…2,2at the end of the combustion temperature T will use the combustion process to determine the heat balance equation:

$\beta * \mu s_{pz} * T_z = (Q/ \ (\alpha * L_0 * (1+\gamma_r))) + (\mu s_{vy} + 8{,}314 * \lambda) * T_s$ it can write this equation in the following form:

$\mu s_{pz} * T_z = ((Q/ \ (\alpha * L_0 * (1+\gamma_r))) + (\mu s_{vy} + 8{,}314 * \lambda) * T_s) / \beta$

These can’tsolve quadratic equations.

The pressure at the end of the combustion process of the following elements:

$P_z = \lambda * P_s$ MPa

Account the enlargement process

First determine the level of expansion:

$\rho = \beta * T_z / \lambda * T_s$

The next level of expansion:

$\delta = \varepsilon / \rho$

The process ofenlargement of the literature to determine the enlargement of process parametersneed to get the value of the polytrophic index . ThisFigureis equal to the value n = 1,18 ....1,28. The process ofenlargement after the adoption of thisFigureis determined by the temperature and pressure at the end of the following.

$P_B = P_z / \delta^{n2}$,mPa

$T_B = T_z / \delta^{n2-1}$,K

MDG indicators

Heat accounting to determine the parameters that characterize the work of the engine on the basis of the results:

The average indicator pressure expressed in the following analytical: $P_i = (P_s / (\varepsilon - 1)) * ((\lambda * (\rho - 1) + (\lambda * \rho / (n_2 - 1)) * (1 - (1/\delta^{n2-1})) - (1/n_1 - 1)) * (1 - (1/\varepsilon^{n-1})))$, mPa

The actual average indicator pressure:

$P_i = Pi * \nu$, mPa

Here, the indicatorschartwhich ofguppyequivalent ratio = 0, 92...0,95

Indicator coefficient:

$\eta_i = P_i * L_n / Q_P * \rho_k * \eta_v)$

Natural gas consumption indicator

$$V_i = \frac{3600(1-q)}{H_u^g \cdot \eta_i}$$

Indicators in specific fuel consumption:

$g_i = 3{,}6*10^3 / (Q_P * \eta_i)$, g/(kVt*S)

Effective indicators of a motor

The average piston speed:

$C_P = S*n_n / (3*10^4)$, m/s

Separated by half the average for the diesel combustion chamber pressure used for the mechanical losses:

$P_M = 0{,}105 + 0{,}013 * C_P$, mPa

The mean effective pressure:

$P_e = P_i - P_M$, mPa

Mechanical coefficient:

η_M = P_e/P_i

Effective coefficient:

$\eta_e = \eta_i * \eta_M$

Effective specific fuel consumption:

g_e=3,6*10^3/ ($Q_P * \eta_e$), g/ (kVt*S)

Effective to identify the specific consumption of natural gas. $m^3/kVts$

$$V_e = \frac{3600(1-q)}{\eta_e \cdot H_u^c}$$

Efficient consumptionof liquidfuel. g / kW h

$$g_e = \frac{3600 \cdot q \cdot 10^3}{\eta_e \cdot H_u^c}$$

Motor fuel, working hours in normal mode:

G_{yo} =N_{en} * g_e*10^{-3}, kg / hour

Specific indicatorsof engine.

Effective engine power:

N_{en}=P_e*V_l*n_n/ (30*τ), kVt

The surface of the piston floor:

$F_P = \pi D^2/4$, dm^2

Effectiveangle torque of engine:

Mб=9550*N_{en}/n_n, N*m

Expected literscapacity:

$N_l = N_{en} / V_L$, kVt/l

The specific capacity of the piston:

$N_P = N_{en} / (i*F_n)$,kVt/dm^3

Liter weight:

$g_L = G_{kur} / V_L$,kg/l

Specific weight:

$g_N = G_{kur} / N_{en}$,kg /kVtExcel program was used to perform account of the heat engine. The results of the compound used in the engine heat content of less than 20% of the share of diesel fuel, the gas engine will be less than the nominal power of the nominal capacity of the prototype engine. Compound content exceeds 20%, the share of dieselfuel which engine capacity, but at the same time because of the pressure and temperature cylinder engine working conditions exacerbated the deterioration in engine efficiency and performance. Taking into account the above points LS PLUS 100 a tractor diesel engine burning theshare of liquefied fuel 20%, the share of liquefied natural gas equal to 80%. It is the ratio of heat for keeping the results in Table 3 below.

Ivecowas put heat accounting results.

Engine account for the primary indicatorsTable.5

V_l	V_h	N_n	n_n	α	ε	D	S	i	τ
L	l	KVt	M I N			M M	M M		
4,50	1,13	71	2300	1,4	16,5	104	132	4	4

Table.6

Indicators of diesel and gas fuel

C	H	O	CH_4	C_2H_6	C_3H_8	C_4H_{10}	H_2	CO	N_2
Compositionofdieselfuel			Compositionofgasfuel						
0,857	0,133	0,010	0,9061	0,0296	0,0017	0,0055	0,0028	0,0028	0,0515

Table.7

The working parameters of the body

l_0	l_o	L0	$L0_{d\,f+g}$	T_m	g	q	μ_0	Q_{pdf}	Q_{pg}
m kub/m kub	Kg	k*moll	K*moll	K	kg/k*moll			kJ/kg	kJ/m kub
9,68	14,52	0,50	11,190	284	3,003	0,140	1,0044	42500	35000

Table.8

Imdicators of Inviroment and the rest gas

P_0	T_0	P_r	T_r	M_{CO_2}	M_{H_2O}	M_O	M_{N_2}
Mpa	K	Mpa	K	k* m o ll	k*moll	k*moll	k*moll
0,1	283	0,112	680	1,213	2,127	0,493	10,790

N_k	M_1	M_2	ΔM	μ	$Q_{p\ df+g}$	α_2
	K*moll	K*moll	K*moll		KJ	
1,6	14,558	14,622	0,064	1,0043	62619,9	1,21

Table.9

Intake process

ρx	$(\beta+\xi_{in})$	ω_{in}	Rx	Δt	ΔPa	Pa	γ_g	Ta	ηv
Kg/m		m/s	J/ (kggr)	C	MPa	MPa		K	
1,52	3,1	100	287	30	0,024	0,116	0,032	361	0,763

Table.10

Compression process

N_1	Pc	Tc	μ cyl	M_g	Mc	CvTc
	MPa	K	kJ/ (k*mollgr)	k*moll	k*moll	
1,37	5,37	1009	21,92	0,022	14,581	22,3

Table.10

Combustion process

M_z	β	Q	C	B	A	T_z	P_z	T'r	Δ
k*moll		KJ/kg				K	MPa		%
14,645	1,00	36125	89521	32,68	0,00175	2424	9,13	649	4,7

Table.11

Process of selecting indicators

ξ	λ	N2	ν	W_{pn}
				m/s
0,85	1,7	1,28	0,94	10

Table.12

Expendprocess

ρ	δ	P_v	T_v
		MPa	K
1,42	11,63	0,39	1219

Table.13

Motor indicators of effective

P'i	Pi	ηi	gi	Yi
MPa	MPa		g/kVt s	m kub/kVt s
1,123	1,06	0,52	23	0,1697

Table.14

Motorindicatorsofeffrctive

$W_{p.n}$	P_m	P_e	η_m	η_e	g_e	Y_e
m/s	MPa	MPa			g/kWth	m^3/kWth
10.1	0.225	0.830	0.79	0.41	29	0.2157

Table.15

The specific indicators of engine

N_N	M_e	G_f	Gg	N_p

k Vt	Nm	kg/s	m^3/h	KVt/dm
71.6	297.3	2.1	15.4	21.1

EPR and indicators of residual gases

According to the account ofheattractor roof of the booth from 3 to 50 liters gas cylinder installation. Gas cylinder drawing of tractor gas engine which of crankshaft affect the elements of the mechanism of power and torque engine will need to perform a dynamic account.

2.3.Thedynamicaccountoftheengine.

ENGINE SPEED. Increases in engine speed at constant load result in a slight decrease in ignition delay when measured in milliseconds; in terms of crank angle degrees, the delay increases almost linearly. [48]

A change in engine speed changes the temperature/time and pressure/time relationships. Also, as speed increases, injection pressure increases. The peak compression temperature increases with increasing speed due to smaller heat loss during thecompressionstroke.

COMBUSTION CHAMBERWALL EFFECTS. The impingement of thespray on the combustion chamber wall obviously affects the fuel evaporation and mixing processes. Impingement of the fuel jet on the wall occurs, to some extent, in almost all of the smaller, higher speed engines.

With the “M” system, this impingementis desired to obtain a smooth pressure rise. The ignition delay with the“M” system is longer than in conventional DI engine designs. [47]Engine andcombustion bombexperiments have been carried out to examine the effect of wall impingement on the ignition delay.

Figure 10-38 shows the effect of jet wall impingement on ignition delay measured in a constant-volume combustion bomb, for a range of air pressures and temperatures, and wall temperatures. [29]

The wall was perpendicular to the spray and was placed 100 mm fromthe nozzle tip. The data shows that the presence of the wall reduces the delay at the lower pressureand temperatures studied, but has no significant effect at the high pressures and temperatures more typical of normal diesel operation. Engine experi-mentswhere the delay was measured while the jet impingement process was varied showed analogous trends. The jet impingement angle (the angle between the fuel jet axis and the wall) was varied from almostzero (jet and wall close to parallel) to perpendicular. The delay showed a tendency to become longer as the impingement angle decreased.

The most important result is not so much the ' modest change in delay but the difference in the initial rate of burning that results from the differences in fuel evaporation and fuel-air mixing rates.

Inertial Forces of the rotating parts are determined by:

$P_R = 10^{-6}. M_R m^2.R = const, MN$

Where:

m - Mass particles having rotational motion, [*kg*];

$P_z = P_z + Pj$ - the sum of all forces acting on the piston [*MN*]

Determination of the Centrifugal Forces:

P= 10~m. $Rm^2 = 10^{6}. 0,496. 0,032. 628^2 = 0,06245$MN - centrifugal force caused bythe mass of the connecting rods, reduced to the axis of the crankshaft

$P_K = 10^{6} m_K. Rm^2 = 10^{-6}. 0,81. 0,032. 628^2 = 0,01022MN$ - centrifugal force generated by unbalanced mass of a crank of the crankshaft.

Forces and momentsacting on crank mechanism, change their direction and value,so if they are not in equilibrium condition they cause vibrations in the engine and its bearings.

In engine usually inertia forces offirst and second order of reciprocatingmovingmasses*P*,*P*, centrifugal forces of rotating mass P and their respectivemoments *M j M j* , remain unbalanced. Reactive moment M_p = -M_B**,** alwaysact on the supports of the engine and cannot be balanced. Therefore, one engine is considered to be balanced, if the following conditions are met:

a) Resultant inertia forces in first order and their moments to be zero -ZP = 0 and EM = 0

The total torque is a periodic function with period that causes angular velocity inequality of the crankshaft. To provide the necessary equability the flywheel with a mass is placed on the crankshaft

. To be determined the flywheel mass, the acceptable level of fluctuation of angular velocity *5* is used. For an automobile engine it is in range 5 = (0, 01 ^ 0, 02). In our case 5 = 0,015;

The results dynamic calculation of engine

Table.16.

Turning corner of the engine crankshaft	Gaspre ssurein cylinde r	Pressure power of the gas in cylinder	Inersio n power of CM tools	The sum of all forces	Normal power	Force of acting shaft	Radial power	Tangens ial force	The power of CM for X	Pressur e power of the gas in cylinde r	Inersio n power of tools in CM	The sum of all forces	Tangens ial power of diagram for X	Tange nsialf orce,
φ, grad	Pg , M P a	Pg , k N	P j , k N	P a, k N	N , k N	K , k N	R , кН	T , k N	M n	Pg , mm	P j, mm	P a, mm	mm	T , mm
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0.12	0.14	-13.06	-12.92	0.00	-12.92	-12.92	0.00	0.0	0.4	-38.5	-38.0	0.0	0.0
10	0.12	0.14	-12.73	-12.59	-0.61	-12.61	-12.30	-2.79	1.3	0.4	-37.5	-37.1	10.0	-8.2
20	0.12	0.14	-11.78	-11.64	-1.11	-11.69	-10.56	-5.03	5.1	0.4	-34.7	-34.3	20.0	-14.8
30	0.12	0.14	-10.27	-10.13	-1.42	-10.23	-8.06	-6.30	11.1	0.4	-30.2	-29.8	30.0	-18.5
40	0.12	0.14	-8.32	-8.18	-1.49	-8.32	-5.31	-6.40	19.2	0.4	-24.5	-24.1	40.0	-18.8
50	0.12	0.14	-6.08	-5.94	-1.29	-6.08	-2.82	-5.38	29.0	0.4	-17.9	-17.5	50.0	-15.8
60	0.12	0.14	-3.69	-3.55	-0.88	-3.66	-1.01	-3.51	39.9	0.4	-10.9	-10.5	60.0	-10.3
70	0.12	0.14	-1.32	-1.18	-0.32	-1.22	-0.10	-1.22	51.5	0.4	-3.9	-3.5	70.0	-3.6
80	0.12	0.14	0.90	1.03	0.29	1.08	-0.11	1.07	63.4	0.4	2.6	3.0	80.0	3.2
90	0.12	0.14	2.84	2.98	0.86	3.10	-0.86	2.98	75.2	0.4	8.4	8.8	90.0	8.8
100	0.12	0.14	4.44	4.58	1.30	4.77	-2.08	4.29	86.4	0.4	13.1	13.5	100.0	12.6
110	0.12	0.14	5.67	5.81	1.57	6.02	-3.47	4.92	96.7	0.4	16.7	17.1	110.0	14.5

120	0.12	0.14	6.53	6.67	1.65	6.87	-4.77	4.95	105.9	0.4	19.2	19.6	120.0	14.6
130	0.12	0.14	7.06	7.20	1.57	7.37	-5.83	4.51	113.8	0.4	20.8	21.2	130.0	13.3
140	0.12	0.14	7.34	7.48	1.36	7.60	-6.60	3.76	120.3	0.4	21.6	22.0	140.0	11.1
150	0.12	0.14	7.43	7.57	1.06	7.64	-7.09	2.86	125.5	0.4	21.9	22.3	150.0	8.4
160	0.12	0.14	7.43	7.57	0.72	7.60	-7.36	1.91	129.1	0.4	21.9	22.3	160.0	5.6
170	0.12	0.14	7.39	7.53	0.36	7.54	-7.48	0.95	131.3	0.4	21.8	22.2	170.0	2.8
180	0.12	0.14	7.38	7.52	0.00	7.52	-7.52	0.00	132.0	0.4	21.7	22.1	180.0	0.0
180	0.12	-0.14	-7.38	-7.52	0.00	-7.52	7.52	0.00	132.0	-0.4	-21.7	-22.1	180.0	0.0
190	0.12	-0.15	-7.39	-7.54	0.36	-7.55	7.49	0.95	132.7	-0.4	-21.8	-22.2	190.0	-2.8
200	0.12	-0.17	-7.43	-7.60	0.73	-7.63	7.39	1.92	134.9	-0.5	-21.9	-22.4	200.0	-5.6
210	0.12	-0.21	-7.43	-7.64	1.07	-7.71	7.15	2.89	138.5	-0.6	-21.9	-22.5	210.0	-8.5
220	0.13	-0.26	-7.34	-7.60	1.38	-7.72	6.71	3.83	143.7	-0.8	-21.6	-22.4	220.0	-11.3
230	0.14	-0.35	-7.06	-7.41	1.61	-7.58	6.00	4.64	150.2	-1.0	-20.8	-21.8	230.0	-13.7
240	0.15	-0.46	-6.53	-6.99	1.73	-7.20	5.00	5.19	158.1	-1.4	-19.2	-20.6	240.0	-15.3
250	0.17	-0.62	-5.67	-6.29	1.70	-6.52	3.75	5.33	167.3	-1.8	-16.7	-18.5	250.0	-15.7
260	0.20	-0.84	-4.44	-5.29	1.50	-5.50	2.40	4.94	177.6	-2.5	-13.1	-15.6	260.0	-14.6
270	0.24	-1.16	-2.84	-4.00	1.16	-4.16	1.16	4.00	188.8	-3.4	-8.4	-11.8	270.0	-11.8
280	0.29	-1.62	-0.90	-2.51	0.71	-2.61	0.27	2.60	200.6	-4.8	-2.6	-7.4	280.0	-7.6
290	0.37	-2.30	1.32	-0.99	0.27	-1.02	-0.09	1.02	212.5	-6.8	3.9	-2.9	290.0	-3.0

300	0.50	-3.39	3.69	0.30	-0.07	0.31	0.09	-0.30	224.1	-10.0	10.9	0.9	300.0	0.9
310	0.71	-5.17	6.08	0.91	-0.20	0.93	0.43	-0.82	235.0	-15.2	17.9	2.7	310.0	2.4
320	1.07	-8.21	8.32	0.12	-0.02	0.12	0.07	-0.09	244.8	-24.2	24.5	0.3	320.0	0.3
330	1.71	-13.67	10.27	-3.40	0.48	-3.43	-2.71	2.11	252.9	-40.3	30.2	-10.0	330.0	-6.2
340	2.83	-23.20	11.78	-11.42	1.09	-11.47	-10.36	4.93	258.9	-68.3	34.7	-33.6	340.0	-14.5
350	4.45	-36.93	12.73	-24.20	1.17	-24.23	-23.63	5.35	262.7	-108.7	37.5	-71.2	350.0	-15.8
360	5.37	-44.73	13.06	-31.67	0.00	-31.67	-31.67	0.00	264.0	-131.7	38.5	-93.3	360.0	0.0
360	9.13	76.64	-13.06	63.58	0.00	63.58	63.58	0.00	264.0	225.7	-38.5	187.2	360.0	0.0
370	9.13	76.64	-12.73	63.91	3.09	63.98	62.40	14.14	265.3	225.7	-37.5	188.2	370.0	41.6
380	7.85	65.77	-11.78	53.99	5.16	54.23	48.97	23.31	269.1	193.7	-34.7	159.0	380.0	68.6
390	4.89	40.68	-10.27	30.41	4.27	30.71	24.20	18.90	275.1	119.8	-30.2	89.5	390.0	55.7
400	3.14	25.84	-8.32	17.52	3.18	17.80	11.37	13.70	283.2	76.1	-24.5	51.6	400.0	40.3
410	2.14	17.34	-6.08	11.27	2.46	11.53	5.36	10.21	293.0	51.1	-17.9	33.2	410.0	30.1
420	1.54	12.25	-3.69	8.56	2.12	8.82	2.44	8.48	303.9	36.1	-10.9	25.2	420.0	25.0
430	1.17	9.09	-1.32	7.77	2.10	8.05	0.68	8.02	315.5	26.8	-3.9	22.9	430.0	23.6
440	0.93	7.04	0.90	7.93	2.26	8.25	-0.85	8.21	327.4	20.7	2.6	23.4	440.0	24.2
450	0.77	5.65	2.84	8.49	2.46	8.84	-2.46	8.49	339.2	16.6	8.4	25.0	450.0	25.0
460	0.65	4.69	4.44	9.14	2.60	9.50	-4.15	8.54	350.4	13.8	13.1	26.9	460.0	25.2
470	0.57	4.00	5.67	9.67	2.62	10.02	-5.77	8.20	360.7	11.8	16.7	28.5	470.0	24.1

480	0.51	3.51	6.53	10.04	2.49	10.35	-7.18	7.45	369.9	10.3	19.2	29.6	480.0	21.9
490	0.47	3.15	7.06	10.22	2.23	10.45	-8.27	6.39	377.8	9.3	20.8	30.1	490.0	18.8
500	0.44	2.89	7.34	10.23	1.86	10.40	-9.03	5.15	384.3	8.5	21.6	30.1	500.0	15.2
510	0.42	2.71	7.43	10.14	1.42	10.24	-9.50	3.84	389.5	8.0	21.9	29.9	510.0	11.3
520	0.41	2.59	7.43	10.02	0.96	10.07	-9.74	2.53	393.1	7.6	21.9	29.5	520.0	7.4
530	0.40	2.53	7.39	9.92	0.48	9.93	-9.85	1.25	395.3	7.4	21.8	29.2	530.0	3.7
540	0.39	2.50	7.38	9.88	0.00	9.88	-9.88	0.00	396.0	7.4	21.7	29.1	540.0	0.0
540	0.39	-2.50	-7.38	-9.88	0.00	-9.88	9.88	0.00	396.0	-7.4	-21.7	-29.1	540.0	0.0
550	0.11	-0.10	-7.39	-7.50	0.36	-7.51	7.45	0.94	396.7	-0.3	-21.8	-22.1	550.0	-2.8
560	0.11	-0.10	-7.43	-7.53	0.72	-7.56	7.32	1.90	398.9	-0.3	-21.9	-22.2	560.0	-5.6
570	0.11	-0.10	-7.43	-7.53	1.06	-7.61	7.05	2.85	402.5	-0.3	-21.9	-22.2	570.0	-8.4
580	0.11	-0.10	-7.34	-7.44	1.35	-7.56	6.57	3.75	407.7	-0.3	-21.6	-21.9	580.0	-11.0
590	0.11	-0.10	-7.06	-7.16	1.56	-7.33	5.80	4.48	414.2	-0.3	-20.8	-21.1	590.0	-13.2
600	0.11	-0.10	-6.53	-6.63	1.65	-6.83	4.74	4.92	422.1	-0.3	-19.2	-19.5	600.0	-14.5
610	0.11	-0.10	-5.67	-5.77	1.56	-5.98	3.44	4.89	431.3	-0.3	-16.7	-17.0	610.0	-14.4
620	0.11	-0.10	-4.44	-4.55	1.29	-4.73	2.06	4.25	441.6	-0.3	-13.1	-13.4	620.0	-12.5
630	0.11	-0.10	-2.84	-2.94	0.85	-3.06	0.85	2.94	452.8	-0.3	-8.4	-8.7	630.0	-8.7
640	0.11	-0.10	-0.90	-1.00	0.28	-1.04	0.11	1.03	464.6	-0.3	-2.6	-2.9	640.0	-3.0
650	0.11	-0.10	1.32	1.22	-0.33	1.26	0.11	-1.26	476.5	-0.3	3.9	3.6	650.0	3.7

660	0.11	-0.10	3.69	3.59	-0.89	3.70	1.02	-3.55	488.1	-0.3	10.9	10.6	660.0	10.5
670	0.11	-0.10	6.08	5.97	-1.30	6.11	2.84	-5.41	499.0	-0.3	17.9	17.6	670.0	15.9
680	0.11	-0.10	8.32	8.22	-1.49	8.35	5.34	-6.43	508.8	-0.3	24.5	24.2	680.0	18.9
690	0.11	-0.10	10.27	10.17	-1.43	10.27	8.09	-6.32	516.9	-0.3	30.2	29.9	690.0	18.6
700	0.11	-0.10	11.78	11.68	-1.12	11.73	10.59	-5.04	522.9	-0.3	34.7	34.4	700.0	14.8
710	0.11	-0.10	12.73	12.63	-0.61	12.65	12.33	-2.79	526.7	-0.3	37.5	37.2	710.0	8.2
720	0.11	-0.10	13.06	12.96	0.00	12.96	12.96	0.00	528.0	-0.3	38.5	38.2	720.0	0.0

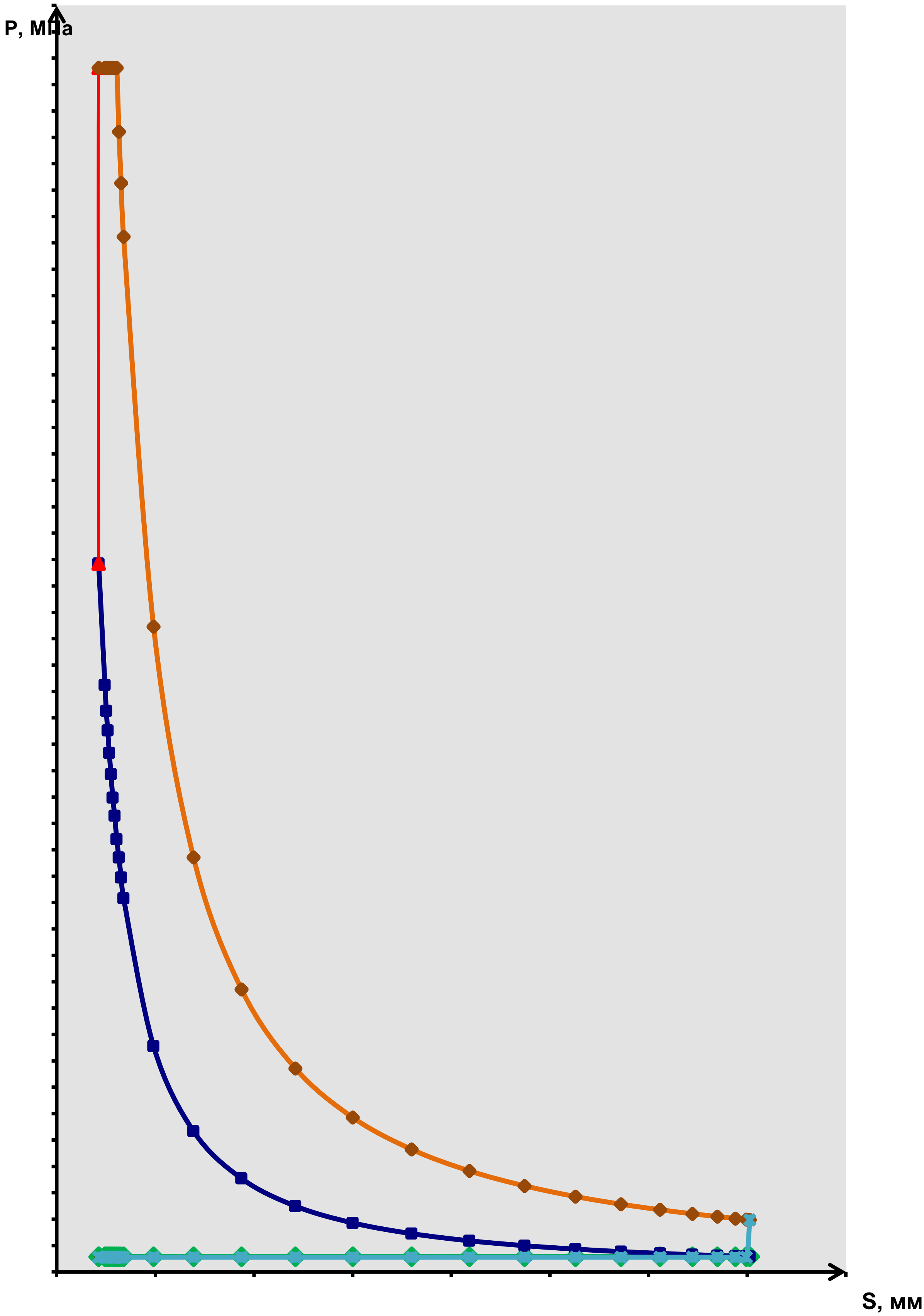

P, МПа
S, мм

Diagram.1Indicator diagram of engine.

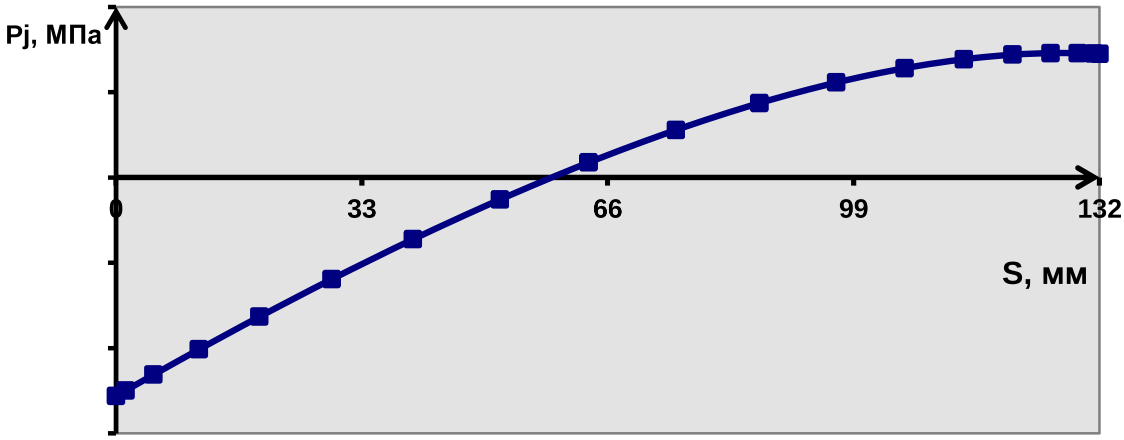


Diagram.2Diagram of the engine which of inersion power.

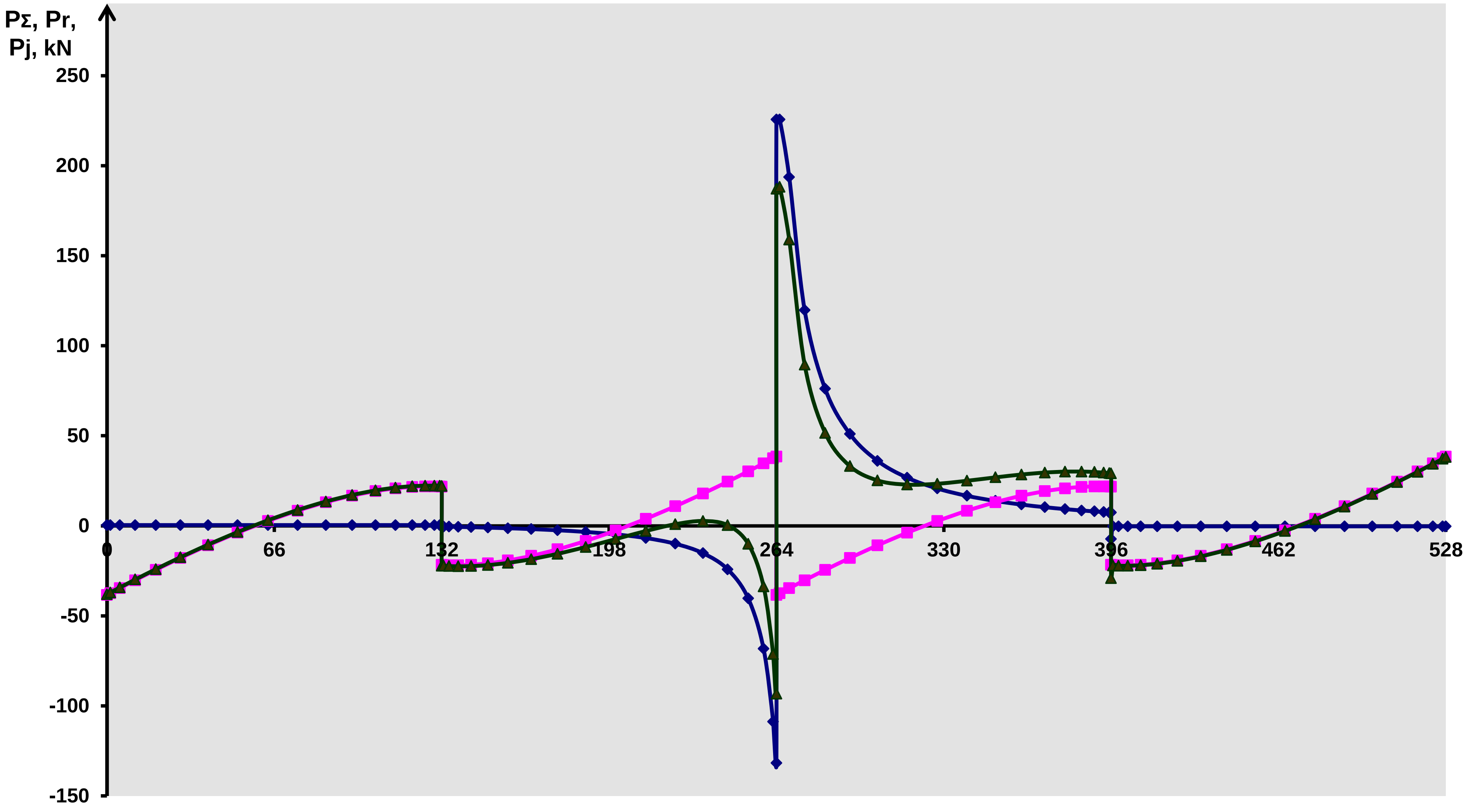


Diagram.3Diagram oftotal force

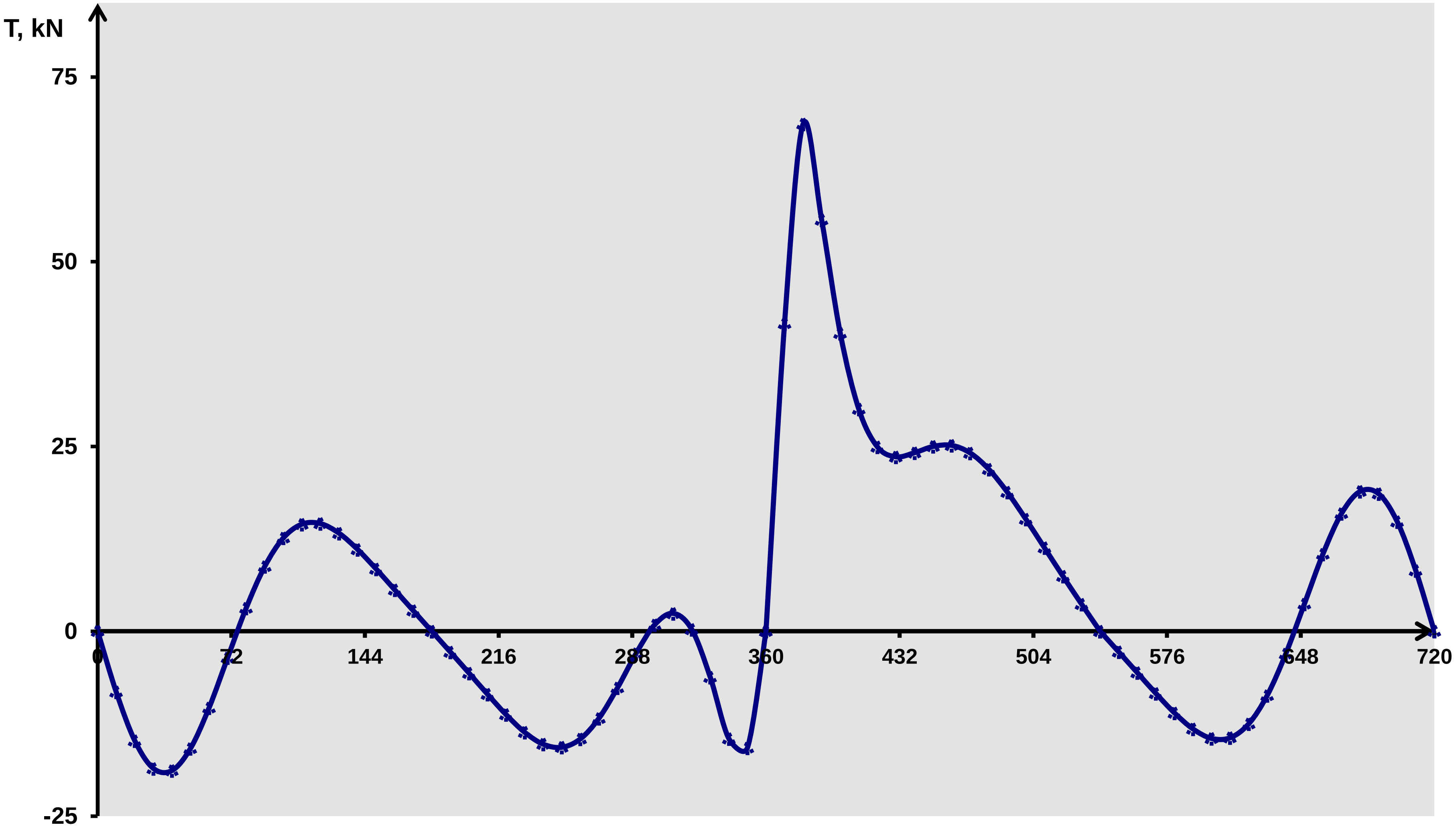


Diagram.4 Diagram of the tangential force

III. Theplowing processofthefield withthetractorLSPLUS 100 formakingoperationmap.

The specific fuel consumption of correctly aggregated machines performing agricultural operations does not depend on the capacity of the tractor but on its economy, which is determined by the specific fuel consumption of the engine for the production of a unit of energy g_e (kWh) and the coefficient of its employment for the useful work k_u (soil tillage, manure spreading, sowing, transport, etc.) [2].

The last coefficient cucharacterizeswhich part of the energy produced by the engine is used up in the technological operations. The lower is the specific fuel consumption of the engine and higher the coefficient k_u of the useful work (for example, the draft coefficient [2, 3]), the more economic may be the work of the tractor. Therefore, in order to save fuel, the tractors with the most economic engines should be used. In addition, to avoid excessive consumption of fuel, due attention should be paid also to a correct setting of the tractor fuel system, its timely control and adequate maintenance. An important factor in fuel consumption is the engine loading. presents generalized curves of the diesel engine loads that show the variations in the values of indices characterizing the operation of the engine: the total fuel consumption G, the torsional moment (the moment of rotation) M, the number of crankshaft revolutions n and the specific fuel consumption g_e depending on the effective power N_e developed by the engine (also in percentage). It is obvious from the picture that if the engine loading falls, the specific fuel consumption rises, at first, at a slower rate (up to about 80 % loading), but further it increases more and more rapidly. For instance, at full engine loading of the Belarus tractor the specific fuel consumption is 250 g/kWh, whereas at an 80 % loading it is 260 g/kWh, i. e. by 4 % higher, but at a 50 % loading it is 322 g/kWh, that is, by 29 % higher. The specific fuel consumption changes in a similar way also during the work. Forexample, in soiltillage, if, working at full loading, the specific fuel consumption in ploughing is 16 kg/ha, then at an 80 % loading it is 16. 6 kg/ha, but at a 50 % loading (insufficient gripping, low speed) it is 20.6 kg/ha (by 4.6kg/ha higher). This extra fuel consumption raises the cost of ploughing by 2 Ls/ha [2]. Yet that is not all. Running under loaded engine decreases correspondingly the efficiency of the aggregate, increases the time spent on ploughing and, as a result of it, salaries, which makes ploughing still more expensive. A similar picture is observed also with other ways of soil tillage.

SELECTION OF TRACTOR

Selection of tractors depend up on following factors

1. **Land holding:** Under a single cropping pattern, it is normally recommended to consider 1 hp for every 2 hectare of land. In other words, one tractor 20-25 hp is suitable for 40 hectare farm

2. **Cropping pattern:** Generally 15 hectare/hp has been recommended where adequateirrigation facilities are available and more than one crop is taken. So a 30-35 hp tractor is suitable for 40 hectare of land.

3. **Soil condition:** A tractor with less wheel base, higher ground clearance and low overall weight may work successfully in lighter soils buy will not be able to give sufficient depth in black cotton soils.

4. **Climatic condition:** For very hot zone and desert area, air cooled engines are preferred over water cooled engines. Similarly for higher altitude air cooled engines are preferred because water cooled engines are liable to be frozen at high altitudes

5. **Repair facilities:** It should be ensured that the tractor to be purchased has a dealer atnearbyplace with all the technical skills for repair and maintenance of the machine.

6. **Running cost:** Tractors withless specific fuel consumption should be preferred over others so that the running cost may be less.

7. **Initial cost and resale value:** While keeping the resale value in mind, the initial cost should not be very high, otherwise higher amount of interest have to be paid

8. **Test report:** Test report of tractors released from farm machinery testing stations should be consulted for guidance.

Quality specifications to the requirements of agriculture and the rules laid down in the pirate. At the same time, increase soil fertility yield and maturity.

Standard Operating technology, as well as the technical requirements expressed by the following key indicators:

a) The duration of the work period;

b) Technological parametersofagricultural operations;

c) The material (seeds, oil, fertilizers, etc.) consumption indicators;

d) Thelevel of the area occupied by the product and the amount of food grain beginning.

Execution requirements agro (fieldposition, the relief processing and the physic mechanical properties ofthe material) as well as the use of additional modes (speed, and smooth movement lineally, method, etc.

Working visit of the units of the park mode and in accordance with local conditions toadjust the technical requirements for the year. The exact conditions of information, describing the event is achieved by improving the technology and vehicles.

Theparametersofthe production process.

These indicators

- The primary efficacy modularstructure, and shift work;

- The required amount of planting, scattering and others;

- The number of auxiliary units, and the efficiency of shift work.

Quality controltask.

In this section, read the instructions on the technical requirements, the use of methods and tools for the implementation of quality control schemes.

Mapping technology for the cultivation process

Table.17

To makeatechnologic map forplowingprocess.

№	The indicators and sizes of process	Indicators	Executerpersons
1	The process conditions (first information)	The surface of the field, g a - 10 Length of the field, m - 400 Soil type - soil Resistance, k N / $м^2$ - 40 Place, the slope of hail. - 3 Field niques - emptysoil	Agronomist
2	Agrotechnical demands and indicatorsofworking mode	the drive depth of 35 cm, the plant balance burial depth of 10 cm soil surface roughness of up to 5 cm	Agronomist Engineer Tractordriver
3	The structure of	(Technological) additional:**Arion-640C +** plows	Engineer

№	The indicators and sizes of process	Indicators	Executerpersons
	aggregate and to prepare it for work	- kinematics length of, m - 8.18 - the coverage width of ,m -1.75 - exit length, m - 0.82 - radius of the turning, m - 4.8 - widthof constructive - 2.45 Adjustments are carried out in a special landing	Tractordriver
4	The indicator movement of aggregates	working speed, km / h - 6.4	Tractordriver
5	The movement method of aggregate in the field	themethod of phase: lasso to walkback the movement method of aggregate…….oval the length of field to walk back, m……….25.6 length of field, m…………………………..386 width of field , m…………………….....250 the number of turning to walk back, m...142 the coefficient of working ways………..0.93	Tractordriver Agronomist Engineer
6	Theindicators of theorganizingmainwork	the control line of return corridor and the first attempt to set seed midline.	Tractordriver Agronomist

№	The indicators and sizes of process	Indicators	Executerpersons
7	Theindicatorto organizeassistantwork.	Shift time, hour……………………………………………..7 Aggregate the used coefficient of shift time………..... 0.84 effect of work an hour g a/h………………….. 0.94 Shift working efficiency……………………….6.58 Fuel expenditure of shift time………………….27.6 labor expenditure of shift time, man-hours/g a...1.06	Tractordriver Agronomist Engineer
8	Controllingthequalityofthework	***Collects instruments:***used for measuring, metall or wooden rod in a rectangular frame and special measuring equipment. ***The results of quality control:*** control with the implementation of quality and technical demands full by marked parameters evaluated.	Agronomist
9	Laborsafety	A person who have a technic safety introduced with instructional advice and hasa rightto managegiveemployment. Tractorsandtechnicconditionsofagriculturemechanization shouldprovidesafetyworkandtractormachinesinthefarmshouldanswerall demands andrules	Tractordriver Agronomist

IV. Lifeactivitysecurity.

With the development of science and technical problems related to labor protection. These problems cannot be disregarded feedback.

At present, the agricultural cultivation of agricultural crops and harvesting, in animals raised, equipment repair, and transportation of cargo and other technological processes many different types of cars. An enhanced security requirement for each of these machines, these requirements is used. To improve the working conditions at the workplace, factory or shop regardless of the tractor cab may directly affect the productivity and reduce the number of industrial injuries. To create a healthyand safe working conditions for the production of a broad set of capabilities.

LS PLUS 100 tractor performance and monitor the result of the following weaknesses identified

- Tractor cockpit usual high temperatures in summer;

In most cases, the tractor of cockpit doors don`tclosure tightly then tractordriversare breathing dirty air.

As a result, the air of harmful dust, soot and harmful gases are gathering in the body of the person. This will lead to a gradual weakening of the organism, and ultimately the human body will not be able to provide enough resistance to various infections, leading to various diseases such as asthma, eye disorders, blood pressure, cancer, bronchitis, will lead to an increase in diseases of the lungs and respiratory tract, more than 40% of the cardiovascular systemavailable. Tractor driverdoes not comply with the provisions of security.

Thetractordriverto improve the working conditions of farm production in order to reduce the accumulated wounds can offer the following effects:

1. To raise the level of the quality of the work relating to labor protection.

2. To study the causes of farm injuries.

3. Assessment of the protection of farm labor and the development of its control system.

4. The development of the field work within its security.

5. Agricultural machinery and tractors note to the safety measures.

6. The machine works is the development of the situations measures to improve

7. Tractor cockpit heating and optimal improvement.

8. Tractor cockpit air pollution control.

By the persons responsible for the execution of the rules of labor protection requirements and constantly monitored. And a variety of measures against persons who violate the rules will be applied. Such persons deprived of awards, fines, serious and repeated violation of the rules and regulations that require the application of measures such as the removal of the work.

FOR PROPER USE OF THE ENGINE

(With the exception of power generator engines)

Do not leave the key turned to the start position 1C, when the engine has started.

□ It is not efficient to leave the engine running at minimum speed while waiting for it to reach the proper working temperature; it is preferable that, after approximately one minute from start-up, you gradually increase the engine load.

□ Do not leave the engine running at minimum speed for long as this increases the production of harmful emissions and does not guarantee the best performance.

□ The engine speed must be increased and decreased gradually, to allow regular combustion and proper operation of all engine components.

□ The runningspeed and power values must comply with the specifications on the technical and commercial documentation.

During use, periodically check that:1. The engine coolant temperature does not reach the alarm threshold. 2. The oil pressure remains within normal values. If the temperature is considered too high, reduce speed and stop to check the state of the cooling system circuits; also check and have checked:a)the tension of the auxiliary member drive belt;b) operation of the thermostat valve;c) whether or not the heat exchanger is clean.

V. MEASURES ON PROTECTION OF NATURE.

The human contributes to the emission of gas pollutants activities. The atmospheric pollution does not only affect the air, but also by an indirect way pollutants are transported to the ground via atmospheric precipitations (rain, snow), to the water and then to the flora and fauna, and finally to humans. The atmospheric pollutiondiffers from one country to another. Due to the fact that in each country there a different number of vehicles. Another factor that effects the atmospherepollution isthe industrial development of each country, the fuels that are being used and other factors. The impact of the pollutants has consequences notonly during the production but also for a longer time period. In additionit affects not only the place of production but other as well. Gas emissions cause many human diseases and some pollutants are considered as carcinogenic. Agriculture is generally considered as an activity with low energy consumption. In most developed countries consumes about 2-3% of the total energy consumed. In Greece this consumption is about 7% of the total energy spent. Additionally engine emissions are released in the open air where the effects to the environment are considered of lower importance than the emissions in the Cities. But emissions even in open air can contribute to air pollution and it is worth estimating them. Tractors need a significant amount of energy in order to produce power.

Nowadays, tractors havediesel engines and they use petroleum-based fuels. Petroleum-based fuels are not renewable; sometime in the future they will be depleted. Diesel engines can also use biomass as source of energy. Tractors could use fuels produced from biomass. However, this can`t be happened at the moment, due to the fact that the use of renewable sources of energy is still in an early stage. As a consequence this will continue for many years in the future.

The basic exhaust emissions from engines contain combinations of NO and NO_2 that is indicated as NOx by emission analysts, free carbon and unburned hydrocarbons . The effect of nitrogenous pollutants on plants is somehow complicatedbecause all plants for their growth process require nitrogen. Uptake of excess N into leaves can cause mineral nutrient imbalances in plants. The exposure of plants to NOx pollution has been shown to lead to changes in activities of nitrate and nitrite reluctances in leaves. High concentration of NO2 to the atmosphere can also cause many health problems such as breathing. NOx can also contribute to the acid rain formation. Carbon monoxide can be a problem for people in high concentrations. CO reacts with hemoglobin causing a reduction of oxygen capacity of the blood. Hydrocarbons arerelated with atmospheric pollution because of the direct toxicity of some compounds and their role as precursors of photochemical ozone. The quality of fuel affects diesel engine emissions (HC, CO, NOx and particulate emissions) very strongly. The fuel that is used in diesel engines is a mixture of hydrocarbons and its boiling temperature is approximately 170 to 360^{o}C. Diesel fuel emissions composition and characteristics depend on mixture formation andcombustion. In order to compare the quality of fuels the following criteria are tested: ketene rating, density, viscosity, boiling characteristics, aromatics content and sylph content. For environmental compatibility, the fuel must have low density, low content of aromatic compounds, low sylph content and high ketene rating . This paper examines how the tractor's gas emissions affect the environment during fieldwork, by using diesel as fuel. Furthermore, the timethat the same tractor needs for working under real conditions is measured for grain and maize tillage.

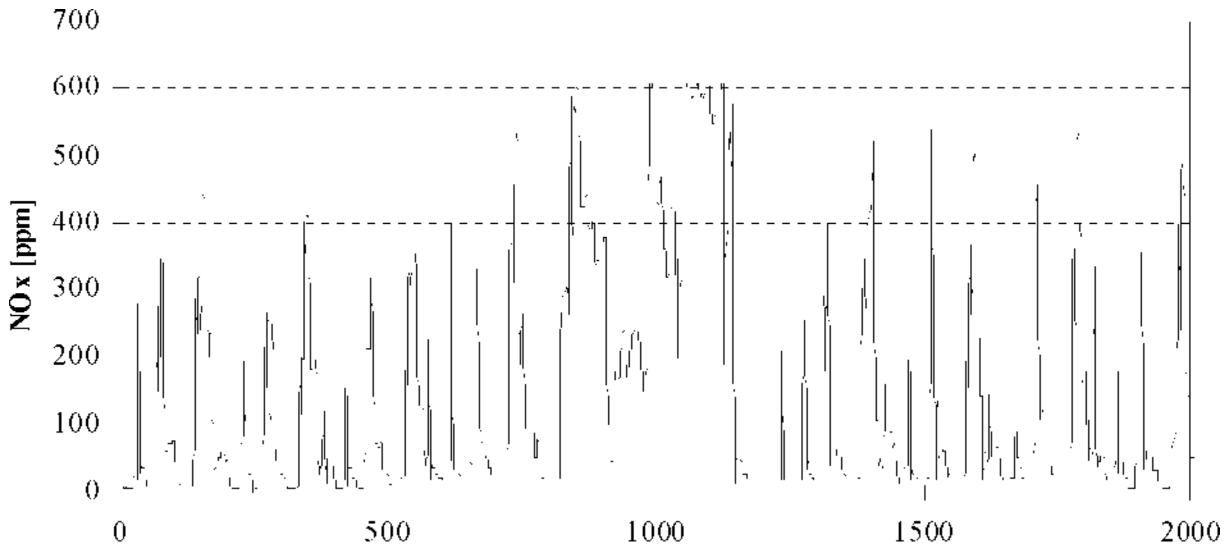


Diagram.5The power output variation vs engine speed during the PTO test

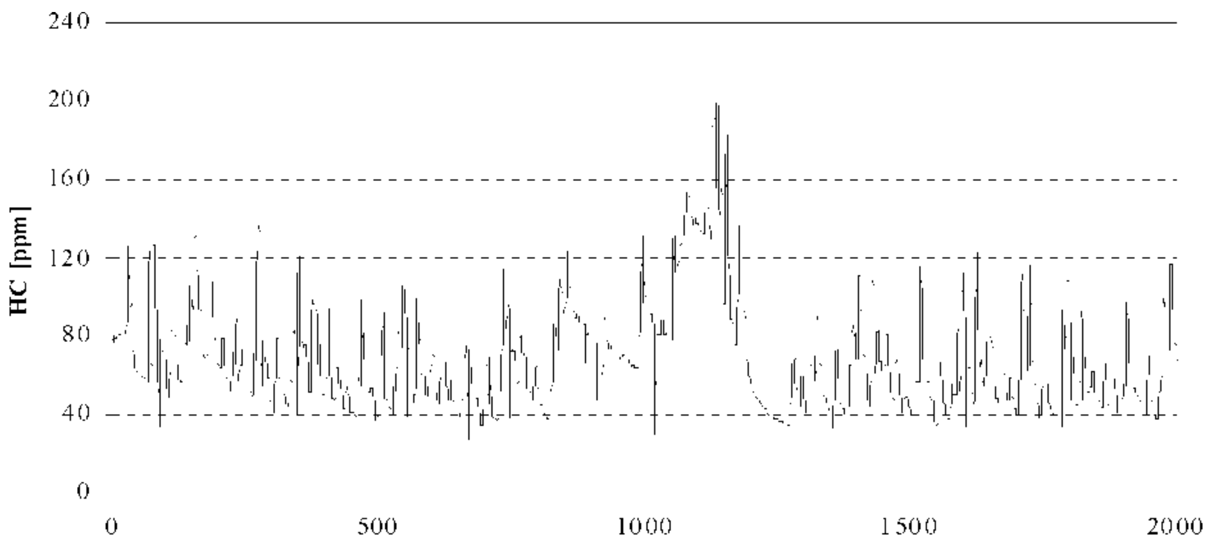


Diagram.6 NOx emissions of the tractor engine during ploughing the field The power output variation vs tractor engine speed during the PTO test is presented in the D6.

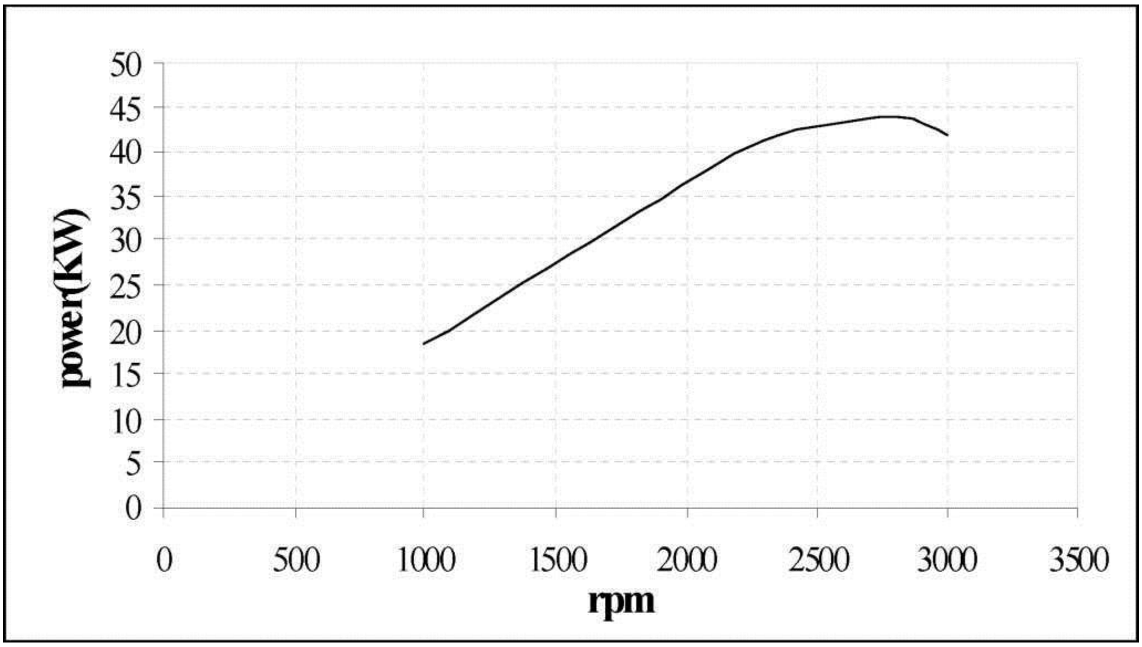


Diagram.7 HC emissions of the tractor engine during ploughing the field

Diagram.7 shows that the maximum enginepower it is produced at 2800rpm. It isalso observed that the maximum engine power does not correspond with the maximum rpm.

Fuel quality affects diesel engine emissions even more strongly than emissions of spark-ignition engines. HC, CO and particulate emissions are the main pollutants affected by the fuel quality. The effect on nitrogen oxides is negligible. Similar to gasoline for spark-ignition engines, diesel engine fuel is a mixture ofhydrocarbons, although its boiling temperature is approximate 170 ^{o}C to 360^{o}C. Depending ondiesel fuel composition and characteristics, the major differences on mixture formation and combustion and, hence, exhausts emissions. Major quality criteria are ketene rating, density, viscosity, boiling characteristics, aromatics content and Sulphur content. With regard to environmental compatibility, the following requirements have to be met: low density, low content of aromatic compounds, low Sulphur content, high ketene rating. To a certain degree, the above requirements contrast with the demands for engine power and fuel economy. This becomes evident when the relationship between parameters such as density, content of aromatic substances and ignition quality (readiness to ignite) is considered: "High density = high content of aromatic substances = low ignition quality". All ofthe petroleum-based fuels are fossil fuels that have been stored in the earth for many centuries. They are non-renewable and will be depleted at some future date. Production of crude oil in United States is already declining, and it is expected that world petroleum construction in the United States, but South Africa produces large quantities of liquid fuel from coal. Engines can be operated on liquid fuels produced from biomass. Alcohol fermented from farm crops has been used as a fuel for spark-ignition engines. Soybean, sunflower, and other vegetable oils have been used as fuel for diesel engines. Such fuels might become available in sufficient quantities to supply the fuel needs of farm tractors, but not ugh would be available to fulfil the needs of transportation, manufacturing, and other industries. The tests they were realized using as fuel diesel, the comparison however it can become independent fromkind of fuel. All emission measurements were carried under real conditions when the tractor was used for ploughing the fields.

VI. ECONOMY PART.

Economics ofliquidnaturalgas

The most obvious economic comparison to make is fuel cost, because fuel is the second largest operational cost after labor. However, comparing the cost of liquidnaturalgasto that of diesel is not as straightforward as it might seem because: (1) distribution costs for liquidnaturalgasare not included in the fuel price as they are for diesel; (2) state tax rates are generally different for each fuel and vary from state to state; (3) federal tax rates are different for each fuel; and (4) fuel energy content is different for each fuel. Table 2 shows the national cost averages obtained by TRI from the Congressional Research Service and the Natural Gas Vehicle Coalition. The energycontent is provided and was used to calculate the equivalent fuel cost in dollars per diesel equivalent gallon (DEG). A diesel equivalent gallon is the quantity of fuel that has the same energy content as a gallon of diesel fuel (please see Appendix C for fuel specification).

Liquid Carbonicliquidnaturalgasfuel cost was a little more competitive because they did not incur any distribution costs; the tractors were fueled on site. Liquidnaturalgasfuel costswill vary dramatically by geographic region based on the distribution costs and state taxes. It should also be mentionedthatliquidnaturalgascosts have decreased since the project ended because of the Taxpayer Relief Act of 1997. This act, which allows transportationfuels to be taxed based on their energy content, changed the federal tax rate on liquidnaturalgasfrom $0.189 per gallon $0.119 per gallon.

Following labor and fuel cost, capital investment is the next most important consideration to a fleet's profitability. At the time of this project, some of the natural gas engine assembly was done off-line. The low volume of natural gas engines did not justify the coordination, scheduling, and tooling changes required to completely manufacture the engines on the production assembly line. Rather, manufacturers partiallyassembled natural gas engines on the regular production line and completed them off-line. This off-line manufacturing process imposes a significant cost premium in the price of each engine. In the case of Liquid Carbonic, the total differential cost of the lease (broken down in Table 3) was $570 per week over a comparable diesel. Today, however, the demandfor natural gas engines is higher. Thus it is more common for engine manufacturers to assemble them on the production line, which has reduced the differential costs between diesel and natural gas engines.

6.1.FindouttheefficiencyofthetractorLSPLUS 100 inorderto changeittothegas.

LS PLUS 100tractor engines to compressed natural gas engine system for the following changes: 350 liter gas cylinders, valves, gas filter, pressure gauge, gear and adjust the amount of the gas dosage unit. These devices require additional costs are shown in Table 6 below:

In general 7250 000 soum is needed forrealizingthe change which recommending

Table 18

Additional costs which change gas of the diesel engine

№	**Nameofparts**		**numberofparts**	**wholesale price**
1	Gasballoons	400000	3	1 050 000
2	Valve	40000	3	120 000
3	manometerofgaspressure	50000	1	50 000
4	Gas filter	70000	1	70 000
5	Reducer heating	100000	1	100 000
6	Dosing Devices	120000	1	120 000
7	Installation wage costs			2000000
8	Other expenses			150000
	total			**7 250 000**

Weidentifythe heat amountusing hourly fuel consumption oftractor.

For axis tractor

$G_{yo} = N_Y \cdot g_y = 59.6 \cdot 0.245 = 14.6 kg / h$

Whenworking with projectingtractor.

$G_{yo} = N_y \cdot g_y = 58.3 \cdot 0.051 = 2.9 kg / h$

Now wefind spent money forfuel

$G_{gaz} = N_y \cdot \gamma_y = 58.3 \cdot 0.2474 \cdot 08 = 11.5 m^3 / h$

For axis tractor

$G^M = G \cdot W_{yo} = 14.6 \cdot 1665 = 24309 soum / h$

Whenworking with projectingtractor.

$G_f = 2.9 \cdot 1665 = 4828 soum$ $G = 11.5 \cdot 600 = 6900 soum$

Table.19

	g_e	Y_e	$N_н$	G_{yo}	G_g
	g/kVt s	m^3/kVt s	kVt	kg/s	m^3/s
Liquidfuel	**Effective specific consumption of fuel**	**Effective discharge of gas**	**Effectivepowerofengine**	**Losefuel a hours**	**Lose of gas fuel a hours**
0,10	26	0,2792	51,60	1,30	13,00
0,15	38	0,2636	54,70	2,10	12,30
0,20	51	0,2483	58,07	2,97	11,50
0,25	54	0,2333	61,80	4,00	10,80
0,30	77	0,2179	66,20	5,10	10,10

Table.20

Economyindicators

For axis tractor		**When Gas-diesel system changed**					Savings funds
Consumption of diesel fuel kg/h	The cost of fuel	Consumptionof diesel fuel kg / h	Consumptionofgas fuel m^3/h	The cost of diesel fuel soum	The cost of gas fuel soum	TotalConsumption	
14. 6	24309	2. 1	14	4320	9930	14250	10059

Economic efficacyfor one tractor

$$E_{i.s} = 1 \cdot 10059 \cdot 4 \cdot 6 \cdot 52 = 12553632 soum$$

Time of extraconsumption

$$T = \Delta K / E_{i.s} = 7250000 / 12553632 = 0.57 y$$

CONCLUSION

Atpresenttimeit`sanimportantproblemtoproducemuchfoodinsteadoflittleexpenditureinthefarmsofouragriculture. Thegraduationworkdirectedto decreasefuelexpenditureinordertomechanizefarmworks. Wecanmakeaconslucionon thiswork.

1. We canstartwiththetransporttractors tochangediesel intogashaveastrongstructure at the schemeschangedieselsintogas.

2. It`simpossibletochange100 % ofgasfuelwithoutchangingtheconstructionofdieselofthetractorengine.

3. Ithasshowntheenergynearto58. 3 kWtwheretheresultofheatingaccountisIvecoin theengines80 % withthepressednaturalgasand20 % opfdieselfuel.

4. Accordingtothegiventractortheexpendituresofthefueloftheprojectedtractordecreased to 48 %.

5. Theamountofpoisonousgaseswhichemittedintotheatmospheredecreasedfor3-4timesintheengineIvecochangedintogas.

6. Themeasurewhichwasworkedoutonlifeactivitysecurityimprovesworkingconditionsoftractor drivers.

7. Theeconomicefficiencyofthesingletractorwhichwastakenunderworking resultsareequalto 7250000 soumina yearwiththeprojectedengineIvecoandthedateoftofulfiltheexpendituremakes4 year.

DICTIONARY

Supplysystem – ta`minlashtizimi

Crank – krivoship

Cross – kristovina

Cam – kulachok

Bonnet- kallak

Carburator – karburyator

Flap – zaslonka

Plungerpair – plunjerjuftligi

Sleeve – vtulka

Faucet – forsunka

Yoke – xomut

Pump – nasos

Piston – porshen

Shaft – val

Trailer – tirkagich

Sulfur – oltingugurt

Nitrogen – azot

Agriculturist – agronom

Vapor – bug`

Liquefied – suyultirilgan

Mixer – aralashtirgich

LNG – liquid national gas

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