Orbital

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Construction of a Direct Water-Injected Two-Stroke Engine for Phased Direct Fuel Injection-High Pressure Charging Investigations

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Construction of a Direct Water-Injected Two-Stroke Engine for Phased Direct Fuel Injection -High Pressure Charging Investigations

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Abstract

The development of a water injected Orbital Combustion Process (OCP) engine was conducted to assess the viability of using the powerplant for high altitude NASA aircraft and General Aviation (GA) applications. An OCP direct fuel injected, 1.2 liter, three cylinder, two-stroke engine has been enhanced to independently inject water directly into the combustion chamber. The engine currently demonstrates low brake specific fuel consumption capability and an excellent power to weight ratio. With direct water injection, significant improvements can be made to engine power, to knock limits/ignition advance timing, and to engine NOx emissions. The principal aim of the testing was to validate a cyclic model developed by the Systems Analysis Branch at NASA Ames Research Center. The work is a continuation of Ames' investigations into a Phased Direct Fuel Injection Engine with High Pressure Charging (PDFI-HPC).

Introduction

The Orbital 1.2 liter two-stroke is a highly refined powerplant designed for automotive applications. It utilizes Orbital's unique pneumatically assisted fuel injection system to achieve high levels of fuel atomization which result in low hydrocarbon and nitrous oxides emissions in conjunction with low specific fuel consumption. The engine was chosen for this work primarily because of the potential to independently inject water and fuel, directly into the combustion chamber. This capability would theoretically make it possible to sustain high levels of power output for short periods, like those experienced during an aircraft's climb in altitude after take-off. A lightweight engine capable of a low fuel consuming cycle was also required for long durations of operation (loitering) at high altitude.

This report describes the engine modification and details a subset of the total testing and experimentation done over approximately 5 months. A very thorough approach was taken to the experimentation, however much of the data has not been summarized and must still be interpreted for validation of the NASA PDFI-HPC cyclic model which is shown in Appendix F.

Engine Configuration

Orbital's existing three-cylinder 1.2 liter two-stroke engine is currently known under the "Genesis" designation within the company. The name refers to the specification of 100 engines currently undergoing vehicle fleet trials in Australia. For the scope of this project, the Genesis engine was modified to simultaneously inject water and fuel and to survive extremely high levels of boost at temperatures up to 500°F (260°C). Its effective compression ratio is 6.33:1 and its geometric compression ratio is 10.5:1. It utilizes an electrically actuated exhaust valve and also has variable manifold injected EGR (exhaust gas recirculation). In order to achieve high levels of automotive refinement, a single balance shaft is employed. The engine, in its Genesis configuration is capable of US Tier I emissions, and although the engine is a two-stroke no oil is mixed with gasoline. Total loss oiling is accomplished with the use of a solenoid-driven oil pump. Compressed air is supplied to the engine fuel rail by a 43cc piston compressor which is coupled to the engine water pump and is known as the accessory pack (or acc pack) within Orbital.

The engine is a crankcase-scavenged in-line, two-stroke employing reed valves and nine ports in the wall of each engine cylinder for gas transfer. A specially modified loop-scavenged combustion chamber has been developed to operate in highly stratified, lean regimes from 40:1 air/fuel ratio to approximately 22:1. At higher speeds and loads the engine operation shifts toward less stratified, more homogenous running at air/fuel ratios nearer stoichiometric, on average about 18:1.

I. Modifications Required for Testing

A. Fuel Rails and Cylinder Head Construction

As the engine is crankcase scavenged and piston-ported, no valvetrain exists on the cylinder head. A fuel rail presently is centered on the top of the head and injection occurs directly below top dead center (TDC, the location of the spark plug for most two-strokes). The spark plug is therefore located approximately 30° from TDC as shown in Figure 1. On the side of the cylinder head opposite to the spark plug, there is a 14mm hole that is commonly used for in-cylinder pressure measurements. The hole is unused and plugged in Genesis vehicles but could be used for the location of another direct injector for the scope of this experiment. Another option was considered initially in the project's formulation stage. This consisted of placing the direct injector into the spacer plate that would be required to lower the compression ratio. This idea was shelved because of the potential to deform the injector leg (lower part of the injector that contains the moving poppet valve) when clampload was applied to the spacer plate. Thus, the earlier proposal was adopted. Orbital's E9 series injectors are 10mm in diameter and were installed in the pressure transducer location by spotfacing the seat so the injector was mounted flush with the combustion chamber. A threaded collar was used to reduce the size of the sparkplug hole.

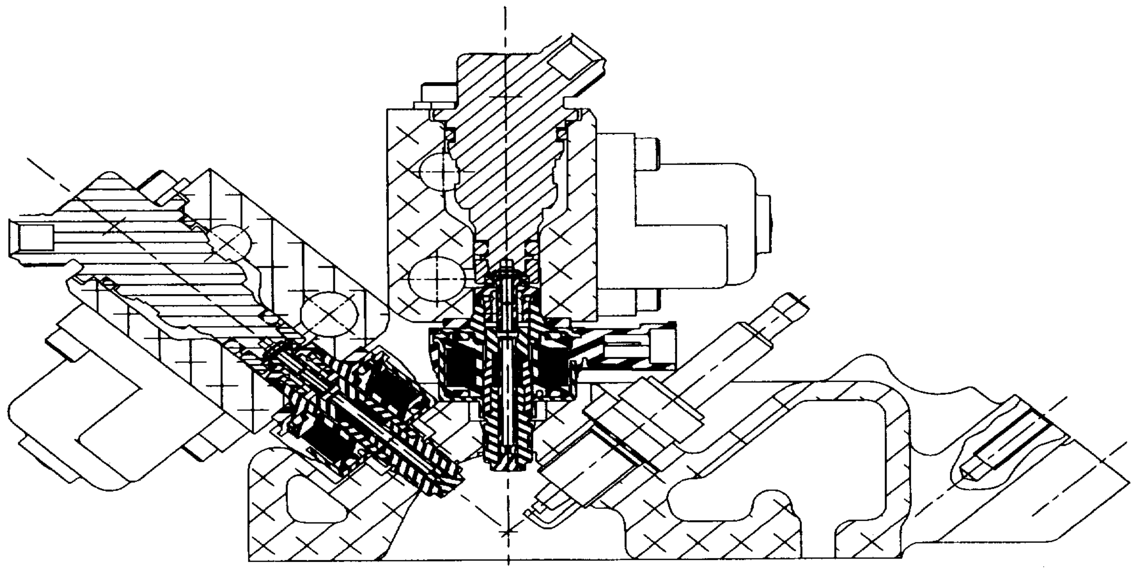

Figure 1. Cylinder Head Layout

The process of adapting the air injectors to the cylinder head was not as straight forward as initially thought. The initial design layout in the proposal (Figure 1) was produced using two-dimensional CAD techniques. This worked very well for the concept stage, however it was unfortunately carried over to the fabrication stage of the program. The two dimensional drawing did not accurately describe the engine cooling circuit resulting in unexpected break-throughs. Several large holes in the casting resulted. As is often the case with aluminum, welding such holes is not recommended. In addition to changing the base alloy material properties, it is common for the heat of welding to open up trapped porosity in the casting, which yields even more leakage paths.

The first of these break-throughs was found quickly during machining upon inspection of the injector pocket. To salvage the cylinder head, an aluminum insert was designed to be pressed into the casting to seal the intersection. Following assembly into the engine and charging of with pressurized coolant, the inserts developed leaks. Upon disassembly to fix the leaks, the insert was then secured in the cylinder head using a high temperature Loctite epoxy and re-pressed into the cylinder head. This repair took several weeks in November and December to rectify due to the un-availability of the epoxy.

After re-assembly to the cylinder block and subsequent engine running, slight water leaks were still seen. These were repaired, through several iterations, using several tubes of commercial radiator/cooling system repair compound (i.e. Silver Seal, etc). To date, no coolant leakage problems have resurfaced. In retrospect, using a solid model would have allowed a more proactive, engineered design for the water injector mounting locations. Using the 2-D model proved "penny-wise and pound-foolish" as the 3-D models of the cylinder head are readily available.

Due to the close proximity of both fuel rails (one for water, one for fuel injection), the standard "lateral" Genesis fuel rail could not be used. An "axial" fuel rail system, as used on Mercury Marine outboard engines, was used instead. Only slight modifications were required to install this system on the Genesis head. The "Mercury-style" fuel system was also a better choice for another reason. Higher delivery rates were indicated in the preliminary modeling done by NASA requiring higher flow fuel injectors to be used. The Siemens Deka-series injector used on Genesis has a nominal flow rate of approximately 2.0 grams per second of fuel per injector. The 2.5 liter Mercury engine fuel injectors have a peak output of nearly 4.7 grams per second each, which is much more suitable. Appendix G contains several photographs of the fuel system and combustion chamber layout.

The decision was made to conduct testing using standard unleaded gasoline with an 87 octane rating [(R+M)/2 method]. The NASA model did not specifically address this however it was thought that the high levels of water injection would render the use of high performance fuels unnecessary. In addition, the changeover to an aviation or premium grade could take place very quickly should testing indicate a need. Increasing the heating value of water injection charge, through the use of alcohols, hydrogen peroxide and others, has been of greater interest however. These were not addressed in the testing at Orbital.

B. Water Delivery

As accurate fuel flow is essential in most engine testing, so too was accurate water flow measurement. Several methods were devised to accomplish this. The first was to use the current fuel per cylinder per cycle with an adjustment made for the density and viscosity differences of water. A gravimetric delivery test was conducted to assess the affect of injecting water given a set of standard conditions (water pressure, air pressure, air/water injection durations). This consisted of pulsing the injectors a known number of times into a small beaker on a Sartorius scale.

As predicted, water delivery rates at the two speeds tested were higher than corresponding fuel deliveries. In the test representing 2000 rpm engine speed, an average delivery of 5.58 WPC ("water per cylinder" or milligrams per cylinder per cycle of water) was seen when running a nominal fueling level of 4.99 FPC ("fuel per cylinder"). When running 9.99 FPC at 2000 rpm, water delivery rates averaged 11.88 mg/c/c; and at 14.99 FPC, WPC averaged 16.37 mg/c/c. Further results of the delivery test are shown in Appendix C.

It should be noted that the 2000 "rpm" and 800 "rpm" injection rates shown above were used to maximize the amount of water captured in the gravimetric vessel. Other speeds were found to liberate more water vapor which escaped and could not be accounted for in the measurement.

The test was performed using a standard Genesis fuel rail which differs from the higher flow Mercury Marine style axial rail. Both the layout of the fuel injectors (with respect to the direct injector) and the type of fuel (water) injectors used differed. This was determined to be insignificant for the initial testing, however, should be confirmed with further testing. In addition, higher fuel/air differential pressures are known to increase delivery rates in a predictable manner when injecting fuel.

During engine testing, water flow was verified gravimetrically using a balance and a large water bottle. A Bosch EKP-3 roller cell pump was used to supply the water rail with 90-120 psi (617-822 kPa) pressure. A very small amount of rust inhibitor was added to the distilled injection water, however care was required to ensure all "fuel" system components were purged of water between uses. Luckily very few problems were encountered with corrosion in the aluminum and stainless steel components.

C. Engine Oil Delivery

An induction air temperature of 500°F (260°C) was specified in the initial proposal. The Orbital 1.2 liter engine employs a dry-sump, total loss, lubrication system, and very low oiling rates (fuel/oil ratios) are used. These typically range from over 400 to 1 fuel/oil ratios at idle to approximately 60:1 at wide-open throttle (WOT). Rates are controlled by an electrically-driven solenoid oil pump which delivers a metered amount of oil into the inlet manifold runners based on the engine's speed and load. The inlet runners connect with the engine's crankcase after passing through reed valves and thus, no oil mixes with gasoline in the process.

i. System Configuration

The Orbital electronic oil pump is a positive displacement device that operates in a relatively low-pressure environment. Inlet and crankcase pressures rarely exceed plus or minus 5.8 psi (40kPa) gage pressure during crankcase scavenging and compression. To maintain oilflow at higher boost pressures of up to 90 psi (620 kPa) gage, a new oiling strategy was required. An air over oil pressure container was constructed for this purpose. Pressure from the engine's crankcase was routed to a two-liter oil vessel that supplied oil to the current solenoid oil pump. As the boost pressure, and thus crankcase pressure, rose, so did the supply pressure to the oil pump. A small needle valve was placed in the crankcase pressure tap line to dampen any pulsations from the running engine. The system appears to adequately lubricate the engine although no delivery measurement has been done. As an added precaution, oil pump delivery rates have been increased to provide more lubrication and to ensure viscosity effects of the new lubricant (Lubrizol OS#139496) are allowed for. Oiling rates used were generally twice the fuel/oil ratios specified in the standard Genesis oil map. It was thought that marginal lubrication was a higher, near-term risk to the engine than that of spark plug fouling. Therefore, the change was implemented. A photograph of the oil vessel is shown in Appendix G.

The high temperature induction air was also thought to pose a durability risk to the engine because of piston expansion leading to interference, scuffing and seizure in the cylinder bore. A solid film lubricant (molybdenum disulfide + hexagonal boron nitride) coating was envisioned for use on the test engine but correct size pistons could not be sourced in time for the engine assembly. For expediency (correct profile pistons have a lead-time of eight weeks from Australia), this was not done. Instead, more temperature monitoring capabilities were installed and much higher oiling rates were used. An exhaust thermocouple was placed in close proximity to the bore inside the exhaust port to monitor the temperature near the edge of the port which is a good predictor of piston survivability.

ii. Lubricants Used in Testing

The current lubricants specified for Genesis specification engines are Lubrizol OCP 2-Stroke Oil, and Chevron CPS226486. Both are low ash, non-poisoning (in a two-stage oxidizing catalyst) and have high levels of detergency to accommodate the very low oiling rates used on the Orbital 1.2 liter engine. Chevron CPS226486 has a nominal flashpoint of 176°F (80°C). These oils typically oxidize at under 500°F (260°C) which is generally adequate for most 2-stroke gasoline engines. Oxidization results in a build-up of carbon deposits within the combustion chamber and varnishing often occurs on the cylinder bores. Varnishing has been shown previously to be a causative factor in piston ring-land sticking, piston scuffing and piston seizures. While the existing lubricants would likely be adequate, a higher temperature oxidizing oil was indicated if only as a margin of safety, especially since standard clearance pistons would be used.

Lubrizol of Wickliffe, Ohio was given the application and asked to supply a suitable lubricant. Lubrizol OS#139496 was supplied for the work. It has a slightly higher flashpoint (than the Chevron), of 320°F (160°C), and was not required to be non-poisoning because a catalyst was not used in the testing.

iv. Oil Testing

Both lubricants were subjected to a sustained temperature of 500°F (260°C) to subjectively assess their high temperature performance. The first sample, Chevron CPS226486, was placed in a 6-inch Pyrex dish on a hot plate in a hooded cabinet. The oil boiled and smoked vigorously at 300°F (260°C) for about 20 minutes. The boiling then stopped and smoking continued for 30 minutes. After 2-3 hours of constant 500°F heat, the smoking subsided, leaving tar-like consistency similar to hot grease. All of the base solvent and other light molecular weight compounds in the oil had likely evaporated.

The Lubrizol OS#139496 oil was then subjected to the same conditions. The oil began smoking around 350°F and continued for 15 minutes. Very light smoking then followed for the next 1.5 hours however the oil did not boil like the Chevron oil. At the completion of the experiment, the oil was more viscous than at the start but still measurably less viscous than the Chevron oil.

D. Engine Induction System

As the key tenant of the project was very high boost pressures at elevated temperature, modifications were required to the engines intake system. The crankcase scavenging system on the 1.2 liter engine employs a separate reed valve set for each cylinder. In a naturally aspirated condition, the reed valves allow air intake during the piston up stroke, preventing air backflow during the piston down stroke and subsequent crankcase compression. When an engine is externally scavenged, reed valves are eliminated. For this project, removal of the reed pack assemblies was simple and required no special modifications.

The Orbital 1.2 liter engine uses a hot-wire based mass airflow sensor (MAFS) for airflow measurement at high speed and load operation. The Genesis specification unit is a Delphi, frequency output model that is presently used on the Chevrolet Corvette and Lumina vehicles among others. Due to the high pressures and temperatures specified, the current MAFS was determined to be unsatisfactory. Don Tebeau, a Delphi MAFS engineer, did not recommend usage in an environment above 300°F (260°C) because softening (or heat deflection) and weakening would occur in the plastic main body. An additional problem was the output scaling in the Orbital ECU which had a peak output of 177 grams per second. For these reasons, an alternate airflow measurement strategy was required.

A venturi from Preso was purchased and set-up for the measurement of airflow as the Delphi MAFS was considered inadequate for some of the testing. It was mounted upstream of the air heater, along with a thermocouple to output a calculated mass flow. Several airflow tests were conducted using both the venturi and a new Delphi MAFS, up to the airflow limit of the hotwire unit. The venturi measurements (corrected for ambient pressure and temperature) were found to be within 1%-5% of the MAFS output. While not an ideally traceable device, the MAFS provided some assurance that the airflow measurement approximated the known reference. Orbital additionally has an extensive experience base with the unit and its operating characteristics from Genesis and earlier testing. A second MAFS was used in the testing to confirm the repeatability of the measurement.

An alternate method of airflow measurement was available from the emissions sampling system in the testcell. This was used in the testcell to verify fuel/air ratios, engine airflow, engine fuel flow and obviously other brake specific exhaust species (NOx, CO, hydrocarbons).

A two-inch brass manual gate valve was placed directly downstream of the inlet air heater before the piping entered the testcell. This required remote manual operation by an additional person with a two-way radio which functioned adequately. A finer control or trim method along with remote actuation would have improved testing productivity immensely. The induction airflow was delivered to the engine via insulated two-inch hard piping through a hole made in the test cell wall. A two-foot long flexible pipe with a quick-disconnect was attached directly to the engine throttle body. The throttle body required several modifications to withstand the high pressure/temperature conditions. First, thermocouple taps were placed in the casting for air temperature measurement and for the temperature controller input on the externally-mounted air heater. Secondly, the throttle shaft, blade and bearings were not required for the testing and the bearing dust seals would serve as a potential leak path (they in fact, blew out during the initial testing). All were thus, removed and the remaining bearing holes welded shut (see related photograph in Appendix G).

E. Induction Air Heater

In order to heat the high flow of induction air before delivery to the engine, a 480 VAC, 20kW heater was purchased from Warren electric and installed approximately 8 feet away from the engine intake manifold. The system was controlled using a commonly available PID controller from Omega with a feedback thermocouple at the engine inlet. It is believed the initial calculations were based on volumetric flow derived from a normally aspirated 1.2 liter engine rather than the model-predicted mass flow requirement seen at elevated pressures. This has not yet been confirmed but is likely given the problems maintaining the 500°F (260°C) temperature even at lower mass flow rates. The problem is also evident when considering the length of time it takes to increase the air temperature when running at speeds of only 2500 rpm and relatively low boost ratios (<200 kPa or <29 psig). During initial system testing, it would take up to 30 minutes to heat the air to even 93°C (200°F. It also is likely that the estimated air velocity or the heat transfer efficiency of the heater has significant error which yielded a lower output model than required. Part of the induction air heating system can be seen in a photograph in Appendix G.

Nonetheless, attempts were made to insulate the air piping to retain as much heat as possible. It is envisioned that an engine exhaust intercooler could yield much closer temperatures when used in conjunction with the electric heater.

F. Engine Sealing

In order to contain the high gas pressures in the engine's crankcase, new sealing systems were designed. The main sealing concerns were the front and rear main bearing seals. The rear main bearing on the 1.2 liter engine is a 109 mm (4.29 inches) dual race NTN ball bearing with an NOK dust seal. In normally aspirated operation, the bearing's dynamic rear seal must withstand approximately +/- 40kPa (5.8 psig). For higher pressure ratios, a pressurized dual seal system was devised. Two Torrington dynamic lip seals were placed in series on the outside of a hub bolted to the crankshaft. The space between the two seals was pneumatically connected to the engine's crankcase through a small needle valve. The operating differential pressure between the inner most seal and the crankcase pressure was regulated to be well within the seal's 343 kPa (90 psig) limits. The second seal was then subjected to approximately half of the crankcase to ambient pressure differential. In the course of the testing, the outer seal had to be replaced after a leak developed. It appeared to have melted and run without oil indicating that the pressure supply to the seal may have blown oil away from the sealing surface which is a common failure mode.

The engine's front main bearing seal is a Torrington pressed-in lipped oil seal with a garter spring retainer. It is capable of nearly 15 psi (102.7 kPa) differential pressure which is far lower than required for the project. A similarly constructed front seal was sourced from NOK that was capable of withstanding 50 psig (617kPa) pressure differential at moderate contact speeds. The seal was additionally available in Viton which is much more tolerant of high temperatures than the nitrile equivalent. A small steel keeper plate was designed and fabricated to retain the main body of the seal. Design detail for the keeper plate and rear seal assembly is shown in Appendix J.

For other engine joints critical to the project, existing gaskets and seals have been retained. A Loctite anaerobic adhesive (515) currently seals the engine crankcase casting to the cylinder block casting. Orbital has used this sealant extensively for various other designs. A key example is the cylinder head to compressor body for an air compressor used on OCP systems. In this application, the seal must withstand 95 psi (650kPa) compressed air along with an operating 575°F (300°C) adiabatic temperature rise.

Other engine seals include the inlet manifold to block which is a molded nylon. It has a relatively thin cross section and a high enough heat deflection temperature that it will likely withstand the high inlet/crankcase pressures and temperatures for the duration of the testing. The accessory pack (compressor-water pump) to block gasket is nylon of similar construction and has also not been altered for the project.

G. Engine Control

Only several physical engine control-related modifications were required for the project. Most required slight changes to ECU software and calibration/map data which are easily done through Orbital's PC engine interface. There are 24 total injection events per engine revolution for the water and fuel injected engine. There are 2 air injection events, 1 fuel injection event and 1 water injection event per cylinder. In order to synchronize the two independent injections of fuel and water, the use of a common engine crank angle position system was required. The simplest method of doing this was to split the existing Hall-effect encoder signal and send it to two independent ECU's. Both ECU's then had a common position to reference each event. Each ECU ran the same or comparable injector driver algorithms and was controlled by separate PC interfaces.

Given the hotwire's incompatibility, engine airflow encoding required the use of an external flow measurement that did not provide a direct input to the engine control unit. When the existing hotwire MAFS was disconnected however, the engine software assumed a "limp home" mode which sets fixed fueling limits on the engine to prevent an unsafe run-away condition and to reduce the risk of rich or lean conditions which could cause damage. This fixed fueling necessitated an all manual (non-map-driven) operation which was cumbersome to do. Fueling levels had to be trimmed by hand using keystrokes which could often not keep up with engine airflow changes.

The Genesis engine is airflow limited at high speeds and high loads when running normally aspirated. Accordingly, fueling levels for the three-cylinder engine are limited to approximately 26 FPC in the engine control software. With the use of the higher flow fuel injectors and fueling levels up to almost 50 FPC, this limit had to be circumvented. Fortunately, the parameter is not hard coded into the engine controller and can easily be modified.

H. Engine Cooling

The high power levels predicted in the NASA model would likely require additional engine cooling capacity. During testing however, additional capacity was not required due to the lower power levels attained in the series of first stage tests. Adequate cooling was available in the testcell by lowering the closed-loop, water-ethylene glycol coolant temperature. By running the engine at approximately 80°C (176°F) when necessary, overheating was not encountered during the testing. If however, problems would have been encountered, a plan was made to overdrive the existing on-engine water pump with an externally-mounted electric motor. This has been regularly done at speeds up to 7200 rpm on other OEC compressor-water pumps with no durability problems or cavitation danger. Further lowering the test cell coolant temperature setpoint is also an available option.

I. Engine Exhaust System

As there were limited time and resources available, the exhaust system was changed as little as possible from the Genesis specification. A hollow catalyst volume of about 3.5 liters was used and kept at the same distance from the engine as on the vehicle exhaust. A simple exhaust throttling butterfly valve (the basic design is shown in Appendix J) was designed and built and used to modulate backpressure during the testing. For expediency, the valve was placed under the engine at a flexible joint connection. The engine exhaust system construction upstream of the valve is robust enough to handle high back pressures, however the downstream construction is typically a thin gage exhaust tube material and a fabricated thin stainless steel catalyst volume. A more deliberate and researched exhaust system should be considered for future work. Several photographs showing the engine exhaust and backpressure valve can be found in Appendix G.

J. Engine Operation

Engine starting was also difficult, especially at decreasing compression ratios. The lack of reed valves necessitates a small level of boost pressure to start the engine. Starting fueling levels are highly rich and it is likely that low compression ratios further enriched the trapped charge resulting in misfires and incomplete combustion. In addition, as the compression ratio was reduced, piston clearance or "squish" geometry was not maintained. By adding gaskets or the aluminum spacer plate, a smooth transition from the bore into the combustion chamber (as in the current Genesis head), was not maintained, which resulted in poorly fuel/air charge containment. This geometry is known to be critical especially in stratified charge, loop scavenged engines. For future work, more investigation and modeling would yield a better application-optimized design.

i. Spark Plug Fouling

Spark plug fouling was also a problem throughout the testing particularly when starting the engine or when running without water injection. High levels of soot along with fuel and oil fouling occurred regularly. Many plugs would not last longer than 5-10 minutes of engine cranking. It is believed the deliberate over oiling was causing crankcase puddling and subsequent transfer through the cylinder wall porting. Based on the initial plug deposits seen, a cooler running plug and better starting algorithms may have offered some relief from the short plug lives.

ii. Additional Observations

During several engine teardowns, a spray pattern of oil could be seen on the cylinder bore at the locations of the piston ring gaps which supported the earlier observations. While this was not a major concern it did show a potential location for varnishing and carbon build-up under elevated inlet air temperatures.

Following several weeks of testing, the engine was torn down for modifications and a preliminary durability assessment. The inspection found no untoward or remarkable problems following approximately 60 hours of baseline testing with water injection. The report is included in Appendix E. A final report has not been made on the engine condition as the engine has not been removed from the testcell.

II. Engine Test Cell Modifications

A. Overview

Orbital Engine Company – USA, has three dynamometer test cells for performance, quality audit, durability, development and hot testing. For the scope of this work, Test Cell 101 (TC101), was used. TC101 has a Schenck, dry-gap, eddy-current dynamometer nominally rated to 230kW (308Hp) with digital control. Its torque measurement capability is currently limited to 400Nm because of the load cell installed, but the unit can easily absorb higher torques. TC101 utilizes Ono Sokki gravimetric fuel flow measurement (dynamic) with a nominal accuracy of 10mg, and a 500 gram capacity. A Horiba emissions bench is used for exhaust sampling. The unit samples 5 primary gasses (HC's, O2, CO, CO2 and NOx) using Series 200 analyzers with no dilution. A heated line is used to ensure the extracted exhaust sample remains gaseous before entering the emissions bench and that water and other exhaust species do not condense out in the sampling line, which adversely effects measurement.

B. Temperature and Pressure Sensing

Other testcell instrumentation includes a multitude of temperature sensing devices via RTD's, thermocouples, and linear temperature devices (LTD's: a solid-state, highly linear temperature sensor). For this testing, engine bulk combustion temperature, various exhaust system temperatures, and head bolt temperatures were measured using K-type thermocouples. Engine head bolt temperature is used as a fast and accurate measure of cylinder bore temperature, which is monitored to ensure timely shutdown during engine overheating conditions. Inlet air temperatures and coolant temperatures are often measured using LTD's, however the high inlet air temperature potential for the testing precluded the use of an LTD. A K-type thermocouple was used instead. Wet and dry bulb temperatures for humidity measurement are also measured using the LTD's.

Pressure measurement for the project was done with a combination of Viatran absolute and gage pressure transmitters, and Rosemount differential pressure transducers (DP cells). Rosemount DP cells calibrated from 0-100 kPa (0-14.5 psi) and 0-800 kPa (0-116 psi) are specified for use on most Orbital fuel system testing. They are very robust units and have a moderate amount of over-ranging capability. A 0-4 kPa (0-0.6 psi) DP cell was installed on the airflow measurement venturi. Exhaust backpressure was measured using a DP cell calibrated from 0-800 kPa (0-116 psi) as well as the crankcase pressure and shop air pressure (before the induction air heater). A Viatran absolute pressure transducer calibrated from 27-33 inches of mercury was used for atmospheric pressure measurement inside the cell. Most sensors are conditioned and converted to current signal for transmission to a scanning voltmeter VME card in the control room data acquisition system.

Data acquisition in TC 101 is handled by a UNIX workstation running Orbital's TSYS ("Test System"). The system is capable of logging over 200 low speed data points at a maximum sampling rate of 3 per second, along with crankangle or time encoded high-speed data on 4 channels at approximately 100kHz. Unfortunately, high-speed data acquisition is only available in the adjacent cell, TC103. Discussions were held on how to use the TC103 data acquisition system in TC101 however it was decided the high torque and modifications required to the engine, driveshaft and testcell (to fit a high speed encoder) were beyond the scope of the project. The dynamometer in TC103 is a 130kW (174Hp) model which is poorly matched to the torque characteristics of the modeled engine.

Test Cell 101 also utilizes a fast-change cart system for testing. Engines can be quickly rolled into the test cell, tested and removed. The cart ensures maximum utilization of the resource and allows most repairs to be easily done outside the cell. The driveshaft in TC101 also has quick-disconnect capability through the use of a splined main shaft and a female splined receiver, which is bolted to the back of the engine via a rubber torsional vibration dampener. The shaft is nominally rated at 160Nm (118 ft. lbs.) at 6000 rpm, however because of the rubber coupling element and lower speeds, it was thought it would accommodate the higher torque levels with no ill effects. A final teardown and inspection is still required to assess any change in the shaft.

C. In-cylinder Pressure Measurement

In order to measure instantaneous cylinder pressures on the water injected engine, a new pressure tap had to be found, as the direct water injectors now occupied the former ports. A small 1/8th-inch hole was drilled into the number two-cylinder combustion chamber and a Kistler model 601B1 pressure transducer threaded into the head. In the installed condition, the transducer was approximately two inches (51mm) away from the combustion.

Given the geometry of the access hole, the transducer would likely suffer from tuning length effects and resonance interference above a speed of approximately 2500 rpm. This interference often masks the visible onset of detonation, making it difficult to diagnose. For this testing, the resonant effects surfaced at an even lower engine speed and a more reliable knock detection system was needed. The test technician on the project installed a simple but effective solution: a length of 1/4 inch copper tubing leading into the control room from a mount on the engine cylinder head bolt. A coffee can resonator was mounted at the control room end of the tubing which provided an excellent audible indication of engine knock and relative combustion stability.

As there was very little extra room on the engine cylinder head, only one pressure transducer was used. The output from this Kistler was directed to a close-coupled charge amplifier and then to digital storage oscilloscope or an analog storage scope. Its primary purpose was not the detection of knock however. Rather, the display quickly indicates the nature of the combustion and could also be scaled to yield peak pressure values. Unfortunately the high speed encoder and data acquisition system was not available for this testing due to their use on fuel system testing in the other testcell and the capacity mismatch with the engine, discussed above. Future performance testing would now certainly make use of these capabilities if possible.

It should be noted that Kistler pressure transducer sparkplug adapters (a working spark plug with a pressure port milled into the side of the plug) were available for the testing but suffered from the same long distance standoff problem and tuning effects.

For this project, the Kistler transducer and associated charge amplifier were calibrated to a reference of 1.000 volts per 1000kPa (145 psi) using a calibration rig with an oscillating pressure source. This made peak pressures easy to obtain and understand. The digital oscilloscope used, a Yokagawa 7300, was not the most ideal measurement system, but did output an automatically-measured RMS values and offered several advantages to a simple voltmeter or an analog scope. The scope has both wave storage (for say, comparisons before and after water injection) and printing capability which made rough cyclic analysis possible. An example of the oscilloscope output can be found in Appendix D.

C. Plant Air Supply

In order to provide induction air for the project, the plant air supply system was used. The current plant air capacity at OECUSA is approximately 338 SCFM. The use of a borrowed Ingersoll Rand engine-driven air compressor raised the output to approximately 450 SCFM. The cyclic model provided by NASA however, showed a peak demand of over 600 SCFM. While the testing to date has not run over 4000 rpm, there has been an unforeseen other demand for shop air from additional shifts of production. Shop air is used in various quantities for production CNC's and metrology CMM's. Both are very sensitive to drops in line pressure although their specific consumption is moderately low. Testing for the project was initially scheduled for 2nd shift running so as not to disturb the CMM's or CNC's that were not running at that time. An increase of production orders has brought back 2nd shift operations so most running had to be done using lower flows (and engine speeds) or during breaks and weekend hours. Several of the test runs faulted running CNC's and so testing windows have been limited during production hours.

It should be noted that plant air was also used as an air supply for the water injection fuel rail used during engine testing. The on-engine air compressor or accessory pack is currently sized to delivery a maximum of 2.2 grams per second of airflow to one fuel system. As there were two fuel systems used, an auxiliary air source was needed. While this was the most expedient solution, the fact should be considered when interpreting the engine torque output stated in the attached experiments. The parasitic power required to supply the water injection system is obviously not included in these measurements. A maximum of 2 Nm (1.5 ft. lbs.) is required for the compressor at the 550 kPa (80 psi) supply pressure.

D. Dynamometer Controller

Lastly, the Schenck W-230 dynamometer in Testcell 101 at the Tecumseh facility had been programmed and configured for the engine testing with a maximum torque of approximately 140 Nm (103 ft. lbs.). Several electrical and software changes were required to the dyno controller to accommodate the very high torque levels seen. This had not been done in about four years and required assistance from the manufacturer to alter the load cell amplifier gain circuit, before recalibrating the unit for 350 Nm (258 ft. lbs.) full scale. This required a board level replacement of a single resistor along with subsequent recalibration.

E. Testing Operation

The experimentation for the project took place in two steps, baselining and experimentation. First, an accurate baseline of engine performance was made. The baseline was important from several perspectives. As the engine fuel system and combustion chamber were modified and the configuration had never been run before, it was important to assess the effects of these changes with respect to the known Genesis reference engine. As alluded to earlier, there is a tremendous amount of Genesis performance testing data available within Orbital. Secondly, the baseline was important as it served as the known reference in experimentation done.

Following the baseline engine testing and engine modifications, a series of experiments were conducted using the common A-B-A protocol. This method tests first the reference hardware and then adds testing of the variable(s) in question. The reference point is then repeated without the test variable to verify that no test conditions have changed. This method ensures instrumentation drift, shifts in ambient conditions, and changes in hardware are accounted for and given quantitative significance.

F. Procedures Used

Several Orbital standard tests were used for most of the project testing. These included the Power Run and the NEDC 9-Point Emissions Test. The Power Run is a simple test where the engines speed is held constant by the dynamometer and the throttle is set to wide open (WOT). These can be done "hands-off" or ECU or map-driven, or they can be done "hands-on" and optimized using a number of variables such as exhaust valve position, fueling levels, and ignition advance. Both "hands-on" and "hands-off" procedures were used during this testing, yielding steady state information such as corrected torque output, peak pressures, fuel flow, air flow, ignition advance, and so on. Another important result is the determination of operational windows that exists for a given variable. These windows yield further opportunities for optimization which, in practice, is usually a series of trade-offs (example: higher fuel typically results in higher torque, however it also may result in unacceptably high catalyst temperatures). Appendix I at the end of the report shows a graphical depiction of the several of the key engine variables that related to the induction and injection processes.

The NEDC 9-Point is an Orbital-devised steady state simulation of a vehicle road load test adapted for engine dynamometer testing. Nine speed and load points are chosen as representative of a larger standardized drive cycle. Raw engine emissions are sampling at each of the 9 points and are given a certain time weighting to approximate the time a vehicle spends at similar speed and load during the drive cycle. Lastly, emissions quantities and time are multiplied to yield a composite with a fuel consumption profile which is useful in predicting engine performance in vehicle installations. For the scope of the NASA work, these tests were used by the test technician to gage relative system performance and combustion robustness compared to Genesis. The tests are primarily relevant at part-throttle and lower speeds where combustion stability is most critical and engine controls are at the center of their control bands.

Often during the testing, only a subset or part of an OEC standard test procedure was used. This was often done to get directional information that would assist in planning or completing the overall experiment. Usually, a simple one or two point operating test would signal a problem which would need to be corrected. A reference speed and load of 1500 rpm and 4.0 FPC is often used for this purpose. A standard fuel gain and offset test was also used to verify the Mercury style fuel rails injection delivery rates but is beyond the scope of this report.

When logging each data point during experiments, a standard procedure is generally used. First, the engine is warmed up to a standard coolant temperature at some nominal speed (often 2000 rpm and 40Nm). Next, a speed/load point and prescribed operating parameters are set using the engine ECU, dynamometer and other equipment. Once the engine has stabilized, emissions sampling is started and run for 1 minute. After a one-minute stabilization period, a data acquisition log starts and averages each test cell parameter over the next minute. Gravimetric fuel flow is simultaneously manually initiated using a sample time of 100 seconds. During the next 1-2 minutes, the technician records engine ECU parameters on test sheets. When the sample time is finished, the technician must then also input ECU parameters and the totalized fuel flow into the logging system. Often the next speed/load point has been set and stabilization is occurring as the last point is being transcribed into the logging system. Emissions bench purging and backflushing (to remove the last sample's residue, and to remove accumulated condensed water, respectively) also occur during the sampling.

This logging procedure is generally standardized throughout the corporation. Occasionally, fuel flow measuring time is decreased when very high flow rates are used. Sampling time may also be shortened when emissions and/or fuel flow measurement is not taken, or when the engine is running in unsafe operating regimes (at the onset of knocking, during high vibration levels, etc.).

The primary OECUSA personnel conducting the testing consisted of several technicians qualified to operate test cells and with experience developmental experiments. As discussed earlier, other personnel were required to assist in boost pressure airflow control and in various troubleshooting. The majority of the testing could be conducted by one person, however a team of others was required to support testcell electronics and instrumentation, part procurement, design layout (CAD), plumbing, and the extensive toolroom modifications to the engine hardware.

III. Testing Performed

Approximately all of the testing performed was made up of smaller experiments incorporating incremental changes to the engine or its operating conditions. The experiments were manually written down on test sheets and simultaneously logged into the Orbital data acquisition system. At OECUSA, all test data is stored in a Progress database for easy retrieval. Post processing was later done using Orbital's GEM software to format the data neatly and to graph parameters of interest. Experimental data has been included in Appendix A. The test points are presented in column format and each experiment's data appears in the order the experiment is discussed in the report. A key with definitions of each test parameter measured is additionally included in Appendix B.

Orbital's format for naming and logging experimental data has been standardized throughout the corporation. Each experiment has a three-letter designation which starts using "E1A". The "E" designates "experiment" and the next two numbers are incremented with each new experiment (i.e. E1B, E1C, E1D, etc.). Each test point in the experiment is also given a sequential identifying number, appended to the experiment number, that is: E1A1.1, E1A1.2, E1A1.3, and so on. Finally, each engine configuration is given a directory in the data acquisition system where all logged data is stored. Engine directories are changed when new engines are tested, when significant engine modifications are made, or when the test engine is completely rebuilt.

A. Baseline Testing

Once the cylinder head and fuel system modifications were completed, the test engine was assembled and given system checkout. An NEDC 9-Point test was run to compare the fueling and engine control to the Genesis data, given changes had been made to the combustion chamber and an untested (on the Orbital 1.2 liter engine) fuel rail was being employed.

Composite results of the test were within acceptable limits. Fuel consumption measured in grams per kilometer was 44.06, while hydrocarbon emissions were 1.069 grams per kilometer. Engine out carbon monoxide was 1.612 grams per kilometer and nitrous oxides (NOx) emissions were 0.5188 grams per kilometer. All were well within the Genesis limits except for NOx which was over double the tolerance limit, especially at mid-range and high load. For the scope of the project, this was accepted. Raw and composite data is shown as Experiment E1A in Appendix A.

Baseline power was also determined using a standard power run. With standard ECU maps (hands-off), the engine power compared well with Genesis, although peaked earlier due to a slight change in the exhaust system tuning for the testing. Peak torque of 133 Nm (98 ft. lbs.) was reached at 3000 rpm and maximum corrected power was 51.58 kW (69 hp) at 4000 rpm.

An optimized or hands-on power run was conducted using the LBT technique. LBT stands for least detonation, best torque and is commonly used in most engine testing. Here, power was optimized using engine exhaust valve position, ignition advance and fueling levels, but was limited by knock and exhaust temperatures in excess of 900°C (1652°F) at higher speeds. Torque and power improved to 140.3 Nm (103.5 ft. lbs.) at 3000 rpm and 58.18 kW (78.02 hp) at 4500 rpm. The hands-on and hands-off baselines can be found in Appendix A in Experiments E1B and E1C, respectively.

B. Combustion Stability Effects of Injecting Off-axis Air

Experiments E1F and E1G were conducted on January 26-27, 1998, to assess the effect of the placement of the water injector in the combustion chamber, particularly the impingement of the water injection event on the fuel injection event. The experiments also served to "shake-down" the system before injecting water, as only air injection was used. With locked fueling levels (2500 rpm / 3 milliseconds fuel duration), air start scans first took place between 70 to 165°BTDC (degrees before top dead center), at different levels of air duration from the water injector. In general, progressive combustion leaning by 1-2 air/fuel ratios resulted as expected. NOx output lowered and hydrocarbon emissions increased by 50-200% when the air duration was increased or when the air start was advanced. NOx output normally rises when in leaner conditions, however the air blast was likely both leaning the trapped mixture and disrupting the combustion. The impingement effects were judged to be only moderate at the midrange speed/load point, meaning that water injection would likely also be tolerated at higher speeds and loads.

Experiment E1F repeated the above experiment but at wide-open throttle. A similar result was seen although was less pronounced. Leaning naturally occurred although only by approximately 0.7 air/fuel ratios. HC and NOx output rose by up to 15% and 50% respectively and torque improved slightly with retarding the water injection event. At this higher speed and load, the effect was visible but less significant. Combustion stability is generally much more robust and tolerant of parameter changes at high load operation.

C. Initial Water Injection

The next experiments, E1H and E1I, essentially repeated the earlier two experiments with small and progressively larger amounts of water injected, respectively. Between 1.8 and 2.5 water FPC (fuel per cylinder per cycle) was used. Torque dropped from 42 to 38 Nm (31-28 ft. lbs.) as hydrocarbon output increased by over 100%. NOx was tremendously reduced from 363 to 42 ppm as the bulk combustion temperature fell by 17°C (63°F) from 183°C (361°F).

At the 2500/WOT point (2500rpm at wide-open throttle), higher water injection levels were introduced. With 6FPC water, the NOx output did not show any appreciable change, but an increase in torque resulted. At 22FPC water, a 50% decrease in NOx output was seen with a subsequent loss in torque. The large torque changes were probably due to a faulty experiment and changing ECU conditions. Fueling was not held constant and caused the measurements to drift and the A series (A-B-A experiment) not returning to the starting value. This experiment was judged invalid.

The earlier failed experiment was carried on in Experiment E1J with better results. The in-cylinder pressure transducer was also added to assess peak pressure changes. The engine was run at 2500/WOT with the fuel level locked at 21 FPC. Water injection of approximately 1.5% mass fraction (minimum, given the higher than stated water injector delivery), or 6 FPC was injected at various crank angles.

Firstly, as the water injection event retarded closer to TDC, bulk combustion temperatures fell slightly, while exhaust manifold temperatures first decreased (between 291 and 246°BTDC) and then steadily increased with further retarding. The differential temperatures were also marginal in magnitude equal to only 20°C at most exhaust locations. The effect on peak pressures was more pronounced. The reference point with no water injection was 4.52 volts or 4.52 Mpa (656 psi). At 6FPC water and 171°BTDC injection, an approximate 2% increase in torque resulted with a 0.52 Mpa (75 psi) decrease in peak pressure. During the scans, hydrocarbon emissions increased a maximum of 25% and NOx output was reduced by an approximately equal amount.

Combustion could generally be termed robust throughout the experiment with only minimal misfires or partial burns.

D. Increased Water Injection Rates

The next four experiments injected water levels of between 12 and 24 FPC. Experiment E1K was similar to E1J experiment but with 12 FPC water injection. Combustion pressures dropped from 4.8 to 3.7 volts (Mpa) while torque output remained nearly constant and only increased 2 Nm. Bulk combustion and the exhaust temperatures displayed a similar change to that seen in the Experiment E1J.

Experiment E1L was again conducted in the same manner as E1J with 18 FPC water injection. At the start of the scan the torque dropped from 127 to 124 Nm and continued to drop as the scan continued. The combustion voltage dropped from 4.5 to 3.28 volts at very retarded injection points, which was more dramatic than the earlier experiment. The NOx output also decreased considerably with near perfect correlation to the increase in hydrocarbon emissions. A decision was made to scan the ignition because of the slowing of the combustion. Brake specific fuel consumption climbed slowly from about 292 grams per kilowatt-hour (g/kW hr) to about 318 g/kW hr. The combustion chamber bulk temperature was reduced slightly more than in the earlier experiment.

E1N added ignition advance scans to the above experiment to optimize for best torque. Advancing the ignition timing 9 degrees increased the torque by 3%, especially when injecting the water at 131-degree BTDC. Combustion pressure voltage could only be reduced from 4.7 to 4.48 volts. The combustion chamber bulk temperature decrease was similar to the last experiment.

At 24 FPC water injection in Experiment E1O, torque was reduced substantially from 128 to 111 Nm (94-82 ft. lbs.). A corresponding very dramatic effect was seen on the combustion pressure which dropped from 4.6 to 2.9 Mpa pressure. Injection at the final point in the scan appeared to be dramatically affecting combustion resulting in a significant drop in combustion bulk temperature, moderately higher brake specific fuel consumption, and increased hydrocarbon emissions.

Ignition scans were again employed to optimize for maximum torque in Experiment E1P. Again, as in Experiment E1N, ignition advance could recover lost torque with an increase in combustion pressures. Torque improved from 128 to 132 Nm, a 3% increase, while combustion pressures went from 4.5 to 4.04 Mpa.

E. Optimizing for Best Brake Specific Fuel Consumption

The next two experiments, E1Q and E1R, were done to assess the potential to minimize fuel consumption while maximizing torque (MBT scans). The speed/load was again set at 2500rpm/WOT with 6 FPC water injection. Improvement on the torque from 128 to 135 Nm (94 to 100 ft. lbs.; or a 5.2% increase) was realized by increasing ignition advance by 3-5 degrees verses the E1I experiment. This time however, combustion pressures increased rather than decreased, from 4.6 to 4.84 Mpa (667 to 702 psi). Brake specific fuel consumption was reduced from 292 g/kW hr to 276 g/kW hr.

Experiment E1R was conducted with 12 FPC water injection and the same BSFC optimization as E1Q. Torque was improved from 128 to 134 Nm (5%) by using even more ignition advance than the last experiment. Between 4 and 7 degrees of additional ignition advance were recorded and BSFC was reduced from 291 g/kW hr to 272 g/kW hr. It should be noted that the increase in combustion temperature was less pronounced than E1Q. An operating air/fuel ratio of approximately 20 to 1 was measured throughout the scanned regime. For naturally aspirated operation at ambient temperatures, the additional 6 FPC seemed to be less significant in increasing power output.

F. Higher Speed Operation at 4500 RPM

As earlier scans thus far had been at 2500 rpm and wide-open throttle, an assessment was needed to characterize higher speed engine stability with water injection. Experiment E1S consisted of six, 4500 rpm data points at hands-off best torque, hands-on best torque, and 3, 6 and 12 FPC of water injection. Baseline torque (corrected) was 104 Nm (77 ft. lbs.) at 4.1 Mpa (595 psi) peak pressure (point 1 or E1S1.1). Hands-on, torque rose sharply to 124.5 Nm (92 ft. lbs.) with a marked increase in peak pressure to 5.0 Mpa (725 psi). While ignition advance was held constant, fueling levels were increased from 17 to 20 FPC. In addition, the direct fuel injection window was advanced and slightly widened. Data for the point is found in column E1S2.1 in experiment E1S in the appendix.

Water injection was added to the optimized 4500/WOT conditions first at the 3 FPC level. Ignition could now be advanced 8 degree BTDC and while ECU fueling levels remained constant, torque increased to 128.5 Nm (95 ft. lbs.), a 2.35% increase. Bulk combustion temperatures decreased by 4°C and peak pressures decreased by 100 kPa (14.5 psi). . Data for the point is found in column E1S3.1 in experiment E1S in the appendix.

At 6 FPC water injection, additional torque was not possible and output actually dropped slightly. Peak pressures were reduced only 60 kPa (8.7 psi) with a subsequent decrease in cylinder temperature of just over 5°C. Brake specific combustion of 246.8 g/kW hr was seen. When 12 FPC of water was next used, a larger, 3% loss in torque resulted and peak pressure dropped more rapidly to 4.3 Mpa (624 psi). Combustion temperatures also followed with an approximate 16°C decrease to 215.2°C (419°F). Ignition was advanced slightly (2° BTDC) but the fuel consumption increased markedly to over 278 g/kW hr.

Lastly, when returning to the reference conditions with no water injection and the hands-on optimization, a BSFC value of 286.7 g/kW hr was obtained (see column E1S6.1). This value did not correspond to the earlier measurement of 253.9 g/kW hr. The 13% difference is not fully explainable but could have resulted from fuel flow inaccuracies, significant airflow changes due to engine or exhaust cooling/heating, or some other instrumentation error. The same effect was seen in the next experiment where BSFC measurements also disagreed and airflow, calculated from the emission bench, was seen to be approximately 12% higher.

G. Effects of Lower FPC Water Injection at High Speed

Experiment E1T was conducted to give finer resolution to the data from experiment E1S, which determined that lower levels of water injection were more effective at increasing output when naturally-aspirated. Values of 2, 3, 4 and 6 FPC were used. Most parameters changed little from the earlier experiment although peak pressure increased slightly to a maximum of 5.0 volts from 4.6 volts, and downpipe temperature was decreased markedly from 878°C (1612°F) to 725°C (1337°F) with increasing water injection rates.

The most improvement was found to be at 2 FPC water injection levels. Here, torque increased from 126.5 Nm to 132 Nm (93-97 ft. lbs.). Lastly, the experiment gave a small measure of repeatability to earlier numbers, particularly brake specific fuel consumption, fuel flow, peak cylinder pressure, and exhaust temperatures.

H. Effects of Lower Injection System Pressures at 2500 rpm / WOT and 4500 / WOT

The last experiment in this section, E1U, was performed to assess the effect of running the fuel and water injection systems at lower supply pressures. This would then simulate the effect of injection at higher crankcase pressures. When running externally scavenged, the air injectors must be able to overcome higher pressures when opening to inject fluid. Both fluid (air and fuel or water) pressures were reduced accordingly; the fuel rail, fuel pressure set to 375 kPa (54 psig) and air pressure set to 445 kPa (64 psig). This represented a 40% and 20% drop in supply pressures, respectively for the fuel system. The water system setpoints were 377 kPa (55 psig) for water pressure and 452 (66 psig) for air. A specified 70 kPa differential pressure between the fluid (fuel and water) and the air was maintained to ensure stable and accurate delivery.

Two A-B-A experiments were run (data columns 1-3 and columns 4-6) using 6 FPC water at 2500 rpm /WOT and 3 FPC at 4500 rpm/ WOT point. Using hands-on techniques, torque increased approximately 4 Nm (3 ft. lbs.) when adding water injection at 6 FPC. Little else significant was changed. At the high-speed point of 4500 rpm, torque was increased again by about 4 Nm, from 124.5 to 128.6 Nm.

To be more thorough, high levels of water delivery should have also been investigated to fully determine the effects of lower supply pressures. In the first A-B-A experiment, the water-air injection pulse width was 5.6 milliseconds (mS) verses the fuel-air injection value of 6.32 mS. This resulted from the 6 FPC water and 21 FPC fuel used. The second part of the experiment was conducted with water-air and fuel-air pulse widths of 4.3 mS and 5.77 mS, respectively.

Had the injection at lower pressures not been comparable to the normal operation values discussed earlier, higher pressure bottled compressed air would have been used with increased regulator setpoints on the water and fuel supply pumps. This has, to date, been unnecessary however.

I. Reduced Compression Ratio, Externally-scavenged, High Temperature Testing

Following the above testing, the engine was disassembled and compression was reduced by using three cylinder head gaskets in place of one. A compression ratio worksheet is included in Appendix X.The engine was then reassembled with an effective compression ratio to 4.86 to 1. Final testing was performed using water injection, increased pressure ratios, and higher temperature induction at the 2500 rpm / WOT point. The experiment was conducted using hands-on techniques and unfortunately, could not be conducted in a thorough, linear manner because of test cell and engine problems mentioned earlier. Traditional A-B-A testing was not permitted however stable, steady state measurements were taken. As contract funding had run out, more rigorous validation was left for further testing beyond the scope of the project.

Several points were first run at an increased pressure of approximately 140 kPa (20.3 psig) and 3 FPC of water injection and again at 2500 rpm / WOT. With an exhaust backpressure of 112 kPa (16.2 psig), 148Nm (109 ft. lbs.) of torque was obtained, yielding a corresponding peak pressure of 4.0 Mpa (580 psi). Using a lower exhaust backpressure of 91 kPa (13.2 psig), the torque was increased to 161 Nm (119 ft. lbs.) at the same peak cylinder pressure. It was also noted that the cylinder bulk temperature decreased significantly from 207 to 183°C (405-361°F).

Next, exhaust backpressure was again reduced in the absence of water injection. Crankcase pressure was also lowered to 123 kPa, however higher fueling levels were introduced. With fueling levels of 40 FPC and no ignition advance optimization, 185 Nm (136 ft. lbs.) of torque was developed. Cylinder pressure transducer voltage increased to 4.56 volts, and bulk combustion temperatures was 229.5 °C (445°F). These three, aforementioned test points are shown in the back of Appendix A in Experiment NAS2725B1 E1F, columns E1F1, E1F2 and E1F3.

For the points following, water injection was added to increase knock limits and additional output was delivered. Both crankcase pressure and exhaust backpressure were incrementally raised to 145 kPa (21 psig) and 99 kPa (14.4 psig), respectively. Next, the induction air heater was started and allowed to stabilize to 119°C (246°F). With 10 FPC water and 40 FPC fuel, 196 Nm (145 ft. lbs.) was attained, with corresponding combustion pressures of 4.6 Mpa (667 psi). This data is shown in column E2A2.1. It is interesting to note that exhaust valve closure played a significant role in increasing the torque at this speed. This effect has not been sufficiently investigated but appears to be related to the charge trapping.

Point E2A2.1 was repeated in point E2A3.1, with slightly higher crankcase pressure of 160 kPa (23 psig) and an exhaust back pressure of 112 kPa (16 psig). With fueling levels and ignition angle left unchanged, a very slight increase in torque to 200 Nm (148 ft. lbs.) was seen. Combustion pressure measurements could not detect a change in peak pressure from the earlier point. Induction air temperature was only slightly lower at 99°C (210°F), perhaps due to a shorter stabilization time or increased cooling airflow across the heater element.

The next two points in the experiment, E2A4.1 and E2A4.2 were conducted to optimize for higher torque using increased pressures but under ambient air temperature conditions. For the first point, torque of 225 Nm (166 ft. lbs.) was obtained at crankcase pressures approximately equal to the earlier point (E2A3) but at a significantly higher peak pressure (5.2 Mpa verses 4.6 Mpa). This well illustrated the effect of (discontinuing) the heated air. Correspondingly higher fueling levels were also used up to 52 FPC.

Finally, the last point (E2A4.2) was run using approximately 198 kPa (29 psig) boost pressure and a similar fueling level (51 FPC). Over 253 Nm (187 ft. lbs.) was obtained but further increases were limited because of the restriction on shop air usage. Peak pressure was reduced to 4.0 Mpa (580 psi) with the use of a leaner air/fuel ratio (~21:1) and moderate exhaust valve closure (50%). This effect on peak pressure was not predicted and is currently unexplained.

V. Conclusions

Despite numerous difficulties due to unexpected engine and test cell problems, a significant experience base in direct water injection and externally scavenged operation has been developed. Limited running was conducted under increased temperature induction conditions and requires further testing to understand both the system's potential and its limitations at very high levels of boost. The modified engine has now achieved a high level of reliability during the latest testing and is a suitable test bed for other investigations.

A. Combustion

Overall, the combustion system is found to be very robust, especially at moderate speed during high load operation. Water injection is generally well tolerated in both stratified and near-homogeneous modes of operation. Varying amounts of water at a broad spectrum of injection angles were employed. Up to 24 FPC of water (~5% mass fraction) was injected with controllable combustion and acceptable stability. Cyclic effects of the water injection are presented in the experimental data but have not been analyzed in detail. The existing information will be helpful in tailoring the water injection event timing for specific goals such as knock reduction, peak pressure shaping and minimizing BSFC at high power levels. The effect of post-combustion chamber steam expansion and its effect on reducing knock production (from reflected plugging pulses) are of interest. Further studying the changes in exhaust gas velocity due to water injection is also merited.

High levels of boost are also well tolerated by the two-stroke process with several avenues, in addition to water injection, present for limiting the onset of detonation. To date, pressure ratios of only 2:1 or approximately 300 kPa have been tested at mid-range speeds (2500 rpm to 4000 rpm) due to system limitations. However, to obtain higher output, higher speed operation is obviously necessary. There are numerous challenges to trapping the high-pressure charge on a loop scavenged, high-speed two-stroke engine. Past work at Orbital has nearly repeated the mid-range result of 250 Nm (184 ft. lbs.) at 2500 rpm, however this output level dropped quickly with increasing speed. Direct water injection offers a potential solution which should be investigated with further testing.

B. PDFI-HPC Results

Several test points have been provided to for use in validating the NASA PDFI-HPC model. While they are at significantly lower water mass flow rates, intake air temperatures and boost pressures, they should give insight into engine's actual characteristics and predicted potential at high speed. Unfortunately more data is not currently available due to head gasket leakage (when using 3 stacked head gaskets) at the end of the last testing. Additional testing is currently scheduled and information will be provided to NASA personnel on a best-effort basis, beyond the scope of this project.

C. Scope of Further Work

Future optimization work and expanded testing is well warranted based on the preliminary experimental results. High speed, crank-angle resolved data acquisition data would give better insight and more detail in the combustion effects of water injection, increased boost and elevated intake air temperatures. Combustion chamber optimization is also indicated, given the experimental nature of the head used in the testing discussed earlier. Squish geometry, spark plug type and location and air injectors could also be optimized, to name only several options.

Spark plugs capable of higher temperatures with less fouling sensitivity would improve testing productivity and would likely be needed until stable engine calibrations were developed. Air injector types could additionally be better tailored to high temperature running and the optimized combustion chamber geometry. They are currently available in several variations including those with different nozzle construction and those with higher spray penetration rates.

As relatively little high temperature operation was conducted, an insignificant amount of experience was gained in this area. Increased running would no doubt highlight certain problems and deficiencies with the test engine. It is anticipated that these would consist primarily of sealing and gasketing problems should work continue. Similar problems to date have been quickly repaired making this area only a minor concern.

Additional design modeling and validation testing is required to improve exhaust system layout and tuning. This is an area vital to the two-stroke engine's performance. An application specific exhaust system, tuned to the characteristics of the scavenging source would also greatly assist in the process of optimizing for power. For the speeds tested, the system performed very well in this project, with very little design engineering required. At higher speeds however, thermal and tuning effects may restrict performance.

Lastly, it is important to note that the limiting factor in the higher temperature and high boost pressure testing was the air supply and heating capacity of the system. Engine peak pressures and knock were in general, easily controllable using several mechanisms. Additional output is likely quickly attainable with only minimal additional effort.

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Electronic Data

Electronic copies of the data can be requested from Orbital Engine Company – USA, should they be required by NASA personnel.

Confidentiality

Data in the appendices of this report is subject to the terms of the Confidential Disclosure Agreement signed by Orbital Engine Corporation Limited, of Perth, Australia (Orbital) and the National Aeronautics and Space Administration (NASA).

Appendix A

Experimental Data and Graphical Results

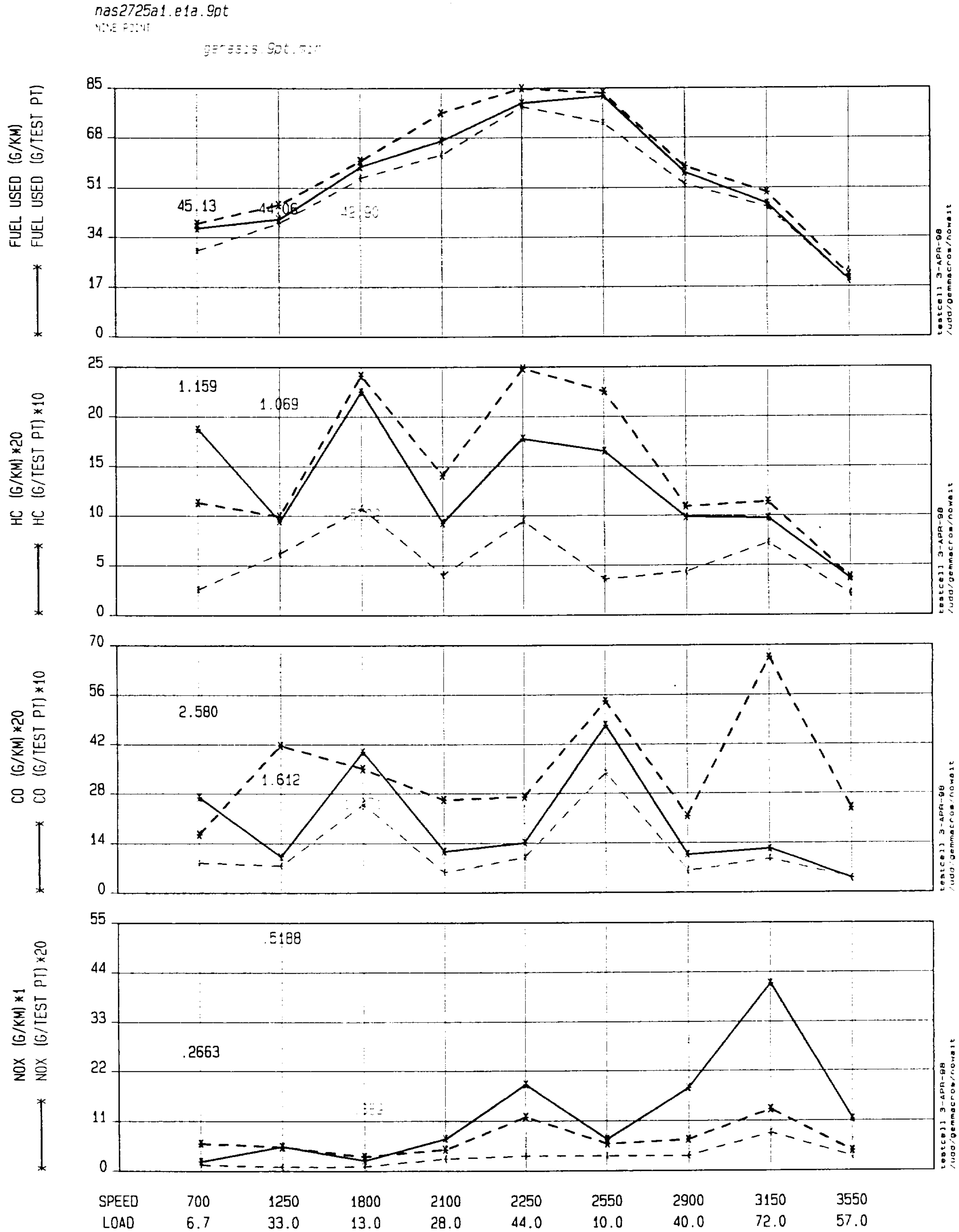
SEARCH="NAS2725A1"(1,9)
NO EGR PIPE
NO CATALYST
Two fuel rail Head
NINE POINT

	1	2	3	4	5	6	7	8	9
	E1A1.1	E1A2.1	E1A3.1	E1A4.1	E1A5.1	E1A6.1	E1A7.1	E1A8.1	E1A9.1
1									
2 Search BLK	1.000	2.000	3.000	4.000	5.000	6.000	7.000	8.000	9.000
3 Exp. Ref.	E1A1.1	E1A2.1	E1A3.1	E1A4.1	E1A5.1	E1A6.1	E1A7.1	E1A8.1	E1A9.1
4 Date Logged	19/01/98	19/01/98	19/01/98	19/01/98	19/01/98	19/01/98	19/01/98	19/01/98	19/01/98
5 Time Logged	13:21:43	13:32:44	13:39:20	13:45:43	13:52:04	14:00:32	14:07:01	14:13:54	14:20:38
6 SPEED (rpm)	699.1	1249	1802	2102	2251	2551	2901	3153	3553
7 TORQUE (NM)	6.759	32.90	13.54	28.22	44.26	10.76	40.59	71.81	57.35
8									
9 HC FID (PPM)	2983	2173	3212	1384	2290	1606	1741	2184	1829
10 CO (%)	.2121	.1157	.2807	.8590E-01	.8996E-01	.2272	.9348E-01	.1365	.9761E-01
11 CO2 (%)	5.416	8.932	7.720	9.800	9.984	7.634	9.670	9.798	9.228
12 O2 (%)	13.37	8.667	10.07	7.329	7.037	10.29	7.568	7.312	8.235
13 NOX (PPM)	49.90	185.3	49.31	159.7	369.8	102.8	486.6	1390	848.4
14									
15 AT PRESS (MM HG)	742.0	741.9	741.8	741.8	741.7	741.7	741.7	741.8	741.8
16 FUEL TMP (DEG C)	16.84	16.69	16.67	16.70	16.68	16.57	15.86	15.76	15.34
17 WET TMP (deg c)	14.12	14.15	14.19	14.31	14.45	13.55	13.22	12.19	11.30
18 DRY TMP (DEG C)	20.34	20.28	20.49	20.72	21.08	20.84	20.30	18.75	17.47
19 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20 AIRIN TMP (DEG C)	23.36	23.20	22.59	22.81	22.61	22.10	19.74	17.18	17.71
21 FUEL TIME (SECS)	200.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
22 FUEL MASS (GRAMS)	24.43	40.56	34.41	58.03	88.00	44.07	108.1	187.8	171.8
23 T.CPTORQUE (NM)	6.842	33.31	13.70	28.55	44.77	10.86	40.75	71.64	57.23
24 T.PPC.FAC ()	1.012	1.012	1.011	1.012	1.011	1.009	1.004	.9976	.9979
25 T.EXH A/F ()	36.00	23.36	25.75	21.49	20.89	26.78	21.74	21.24	22.75
26 T.REL HUM (Fraction)	.5026	.5085	.4995	.4948	.4837	.4357	.4421	.4566	.4671
27 T.FUELFLOW (g/s)	.2669E-01	.3950	.3379	.5774	.8958	.4369	1.082	1.879	1.716
28 CYL #2 TMP (DEG C)	113.8	145.8	138.2	161.1	176.3	154.0	190.7	199.5	191.9
29 DWNPIPE TMP (deg C)	134.6	206.8	189.0	263.3	347.3	229.2	386.0	533.4	500.8
30 CAT TMP1 (deg c)	114.4	182.8	156.3	237.1	325.3	195.3	372.8	511.0	478.5
31 CAT TMP2 (deg C)	114.1	179.9	156.1	230.1	317.2	194.5	359.8	501.3	468.3
32 CAT TMP3 (deg C)	120.7	192.9	169.5	242.8	324.8	208.1	364.5	500.7	473.0
33 HD BOLT TMP (DEG C)	90.22	89.05	89.30	90.30	90.23	89.70	89.70	89.26	89.46
34 H2OIN TMP (DEG C)	87.91	85.23	86.93	86.75	85.93	87.44	86.33	85.51	86.36
35 H2OOUT TMP (DEG C)	89.96	88.78	88.96	89.86	89.72	89.59	89.76	89.53	89.81
36 H20 FLOW (l/min)	18.64	33.75	49.13	56.51	59.92	68.85	78.06	84.97	95.94
37 DYNO TMP (DEG C)	26.69	27.38	28.38	30.11	33.33	31.19	34.76	35.02	34.09
38 EX SYS PRES (kpa)	-1.824	-1.832	-1.833	-1.839	-1.848	-1.858	-1.869	-1.857	-1.863
39 AL CELLTMP1 (DEG C)	26.00	26.00	25.00	26.00	26.00	26.00	26.00	26.00	26.00
40 ATMOS (KPA)	98.91	98.89	98.88	98.88	98.87	98.87	98.86	98.88	98.88
41 AIR PRESS (kPa)	533.4	534.7	540.6	539.7	537.9	542.5	540.7	539.4	540.3
42 F/A DIFF (kPa)	67.52	67.80	68.00	67.94	67.74	66.81	66.61	66.42	66.87
43 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
44 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
45 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
46 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
47									
48 ECU FPC ()	3.100	6.350	3.500	5.200	7.530	3.110	7.130	11.51	9.300
49 ECU TEMP ()	92.00	92.00	90.00	92.00	91.00	91.00	92.00	91.00	91.00
50 ECU SA ()	33.00	27.00	38.00	34.00	25.00	42.00	27.00	18.00	21.00
51 ECU AST ()	47.00	69.00	70.00	86.00	110.0	83.00	109.0	132.0	130.0
52 ECU EOA ()	27.00	28.00	27.00	28.00	28.00	27.00	29.00	30.00	29.00
53 ECU APW ()	4.500	5.460	3.920	4.590	5.310	3.650	4.590	5.420	4.750
54 ECU FPW ()	1.320	2.540	1.410	2.080	3.000	1.240	2.860	4.560	3.750
55 ECU SAPC ()	136.0	151.0	98.00	117.0	157.0	90.00	149.0	228.0	197.0
56 ECU FBAPC ()	136.0	151.0	98.00	117.0	157.0	90.00	149.0	228.0	197.0
57 ECU A/F ()	45.00	23.40	27.00	23.50	21.00	28.70	20.90	19.70	21.20
58 ECU EV ()	0.0	4.600	0.0	9.100	24.90	4.400	40.00	68.70	58.00
59 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60 ECU DAR ()	48.00	35.00	40.00	32.00	33.00	30.00	27.00	37.00	29.00
61 ECU PPOT ()	111.0	180.0	172.0	196.0	235.0	175.0	246.0	337.0	320.0
62 ECU AFL ()	4.200	9.200	9.200	12.40	17.50	11.60	21.30	36.00	35.00
63									
64 POWER (KWATTS)	.4948	4.305	2.555	6.211	10.43	2.875	12.33	23.71	21.33
65 FUELFLO (G/SEC)	.1222	.4056	.3441	.5803	.8800	.4407	1.081	1.878	1.718
66 AIRFLO (G/SEC)	4.397	9.477	8.862	12.47	18.38	11.80	23.49	39.88	39.08
67 EXH A/F (:1)	36.00	23.36	25.75	21.49	20.89	26.78	21.74	21.24	22.75
68 MASS A/F (:1)									
69									
70 BSPEFC (G/KWHR)	888.6	339.2	484.7	336.3	303.7	551.8	315.5	285.2	289.9
71 BSPEHC (g/kWh)	44.89	7.982	18.77	4.658	6.771	11.09	5.543	6.144	5.589
72 BSPECO (g/kWh)	64.69	8.615	33.26	5.861	5.391	31.79	6.032	7.785	6.047
73 BSPENOX (g/kWh)	2.500	2.266	.9594	1.789	3.640	2.362	5.157	13.02	8.631
74									
75 FFCC (mg/cyl/cyc)	3.494	6.492	3.820	5.521	7.820	3.455	7.450	11.91	9.672
76 AIRCC (mg/cyl/cyc)	125.8	151.7	98.38	118.6	163.3	92.52	161.9	253.0	220.0
77 MASS_HC (g/sec)	.6171E-02	.9544E-02	.1333E-01	.8037E-02	.1962E-01	.8855E-02	.1899E-01	.4046E-01	.3312E-01
78 MASS_CO (g/sec)	.8893E-02	.1030E-01	.2361E-01	.1011E-01	.1562E-01	.2539E-01	.2067E-01	.5127E-01	.3583E-01
79 MASS_NOX (g/sec)	.3436E-03	.2709E-02	.6811E-03	.3087E-02	.1055E-01	.1887E-02	.1767E-01	.8571E-01	.5115E-01
80									
81 EUDC									
82 EUDC_SPD	700.0	1250	1800	2100	2250	2550	2900	3150	3550
83 EUDC_LOAD	6.700	33.00	13.00	28.00	44.00	10.00	40.00	72.00	57.00
84 TIME (SECS)	303.9	99.30	168.9	115.4	90.70	186.5	51.90	24.20	11.10

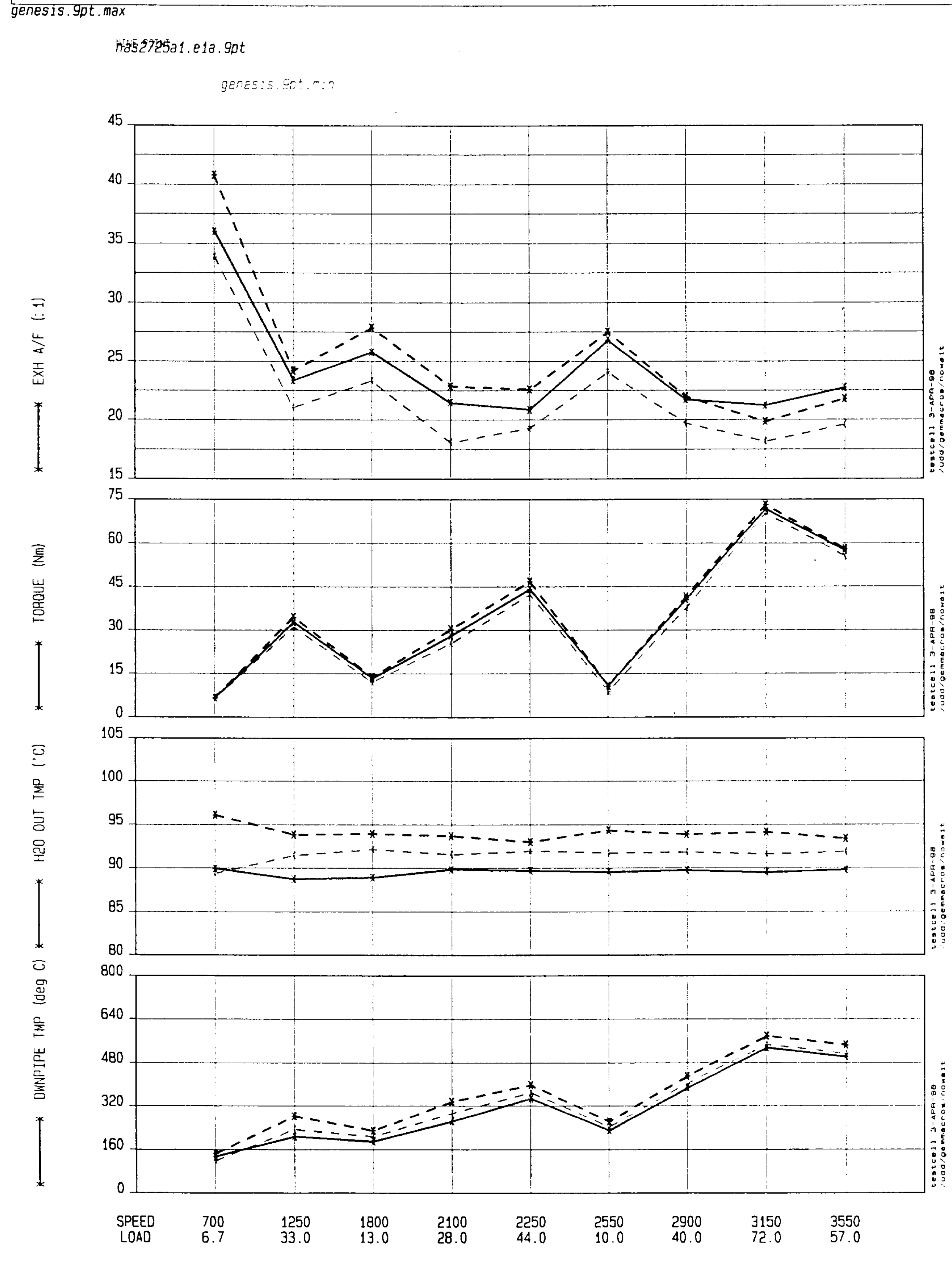
	1	2	3	4	5	6	7	8	9
	E1A1.1	E1A2.1	E1A3.1	E1A4.1	E1A5.1	E1A6.1	E1A7.1	E1A8.1	E1A9.1
85 KWHRS	.4177E-01	.1187	.1199	.1991	.2628	.1490	.1778	.1594	.6578E-01
86 FUELCON	37.12	40.28	58.12	66.97	79.82	82.19	56.09	45.45	19.07
87 FC_%	7.652	8.303	11.98	13.80	16.45	16.94	11.56	9.368	3.931
88 HCEMM	1.875	.9477	2.251	.9275	1.780	1.652	.9857	.9791	.3676
89 HC_%	15.94	8.056	19.13	7.883	15.13	14.04	8.378	8.322	3.125
90 COEMM	2.702	1.023	3.988	1.167	1.417	4.736	1.073	1.241	.3978
91 CO_%	15.23	5.765	22.48	6.577	7.986	26.69	6.045	6.992	2.242
92 NOXEMM	.1044	.2690	.1150	.3563	.9566	.3519	.9170	2.074	.5678
93 NOX_%	1.828	4.709	2.014	6.237	16.75	6.160	16.05	36.31	9.940
94 FC_G/KM	44.06								
95 HC_G/KM	1.069								
96 CO_G/KM	1.612								
97 NOX_G/KM	.5188								
98 SUMMATED FC	485.1								
99 SUMMATED HC	11.76								
100 SUMMATED CO	17.74								
101 SUMMATED NOX	5.712								
102									
103 INJ MIN (DEG)									
104 INJ MAX (DEG)									
105 IGN MIN (DEG)									
106 IGN MAX (DEG)									
107 MIN FBAPC (DEG)									

GENESIS NEDC 9 POINT COMPARISON

genesis.9pt.max



GENESIS NEDC 9 POINT COMPARISON



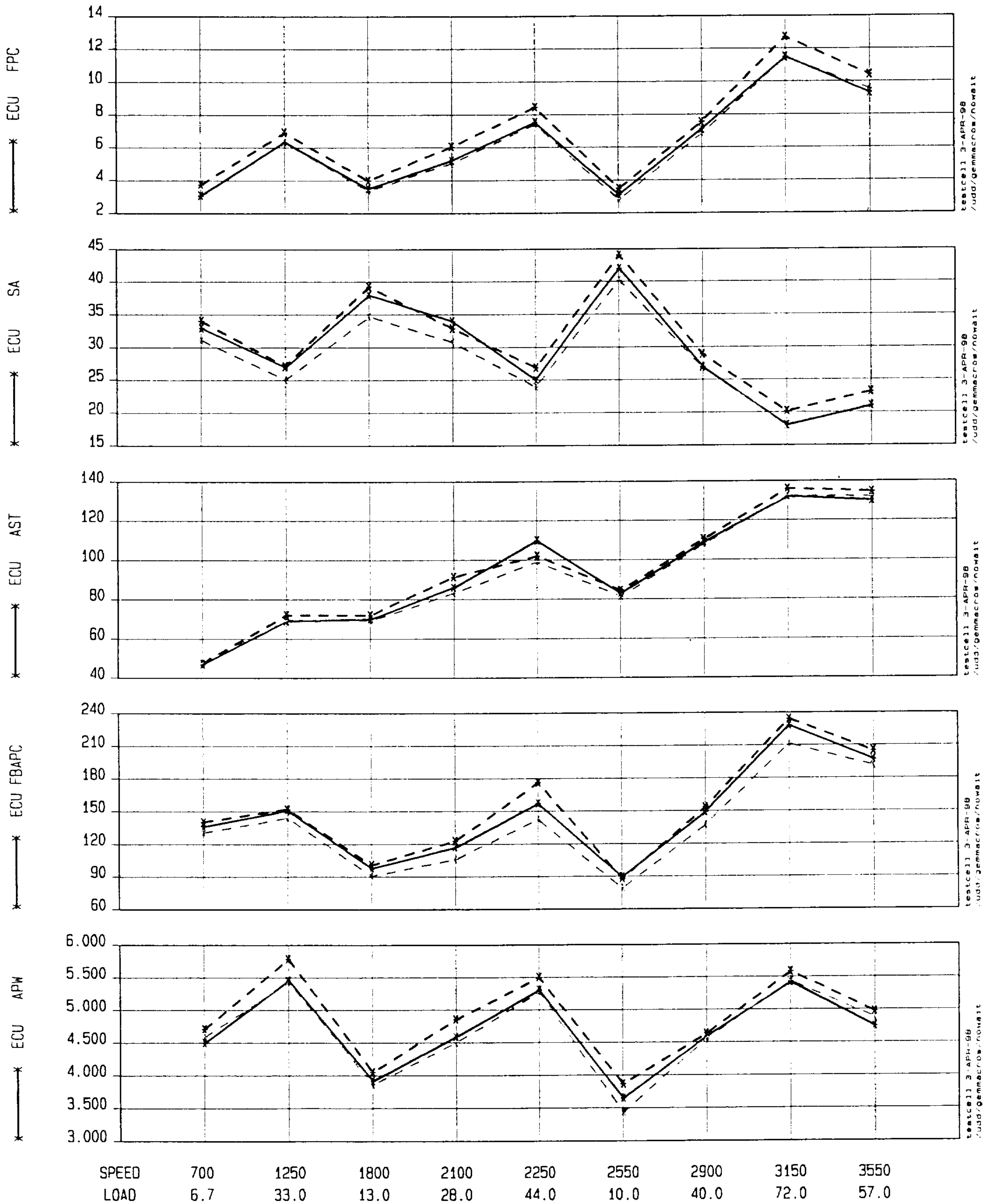
GENESIS NEDC 9 POINT COMPARISON

genesis.9pt.max

nas2725a1.e1a.9pt

NINE POINT

genesis.9pt.min



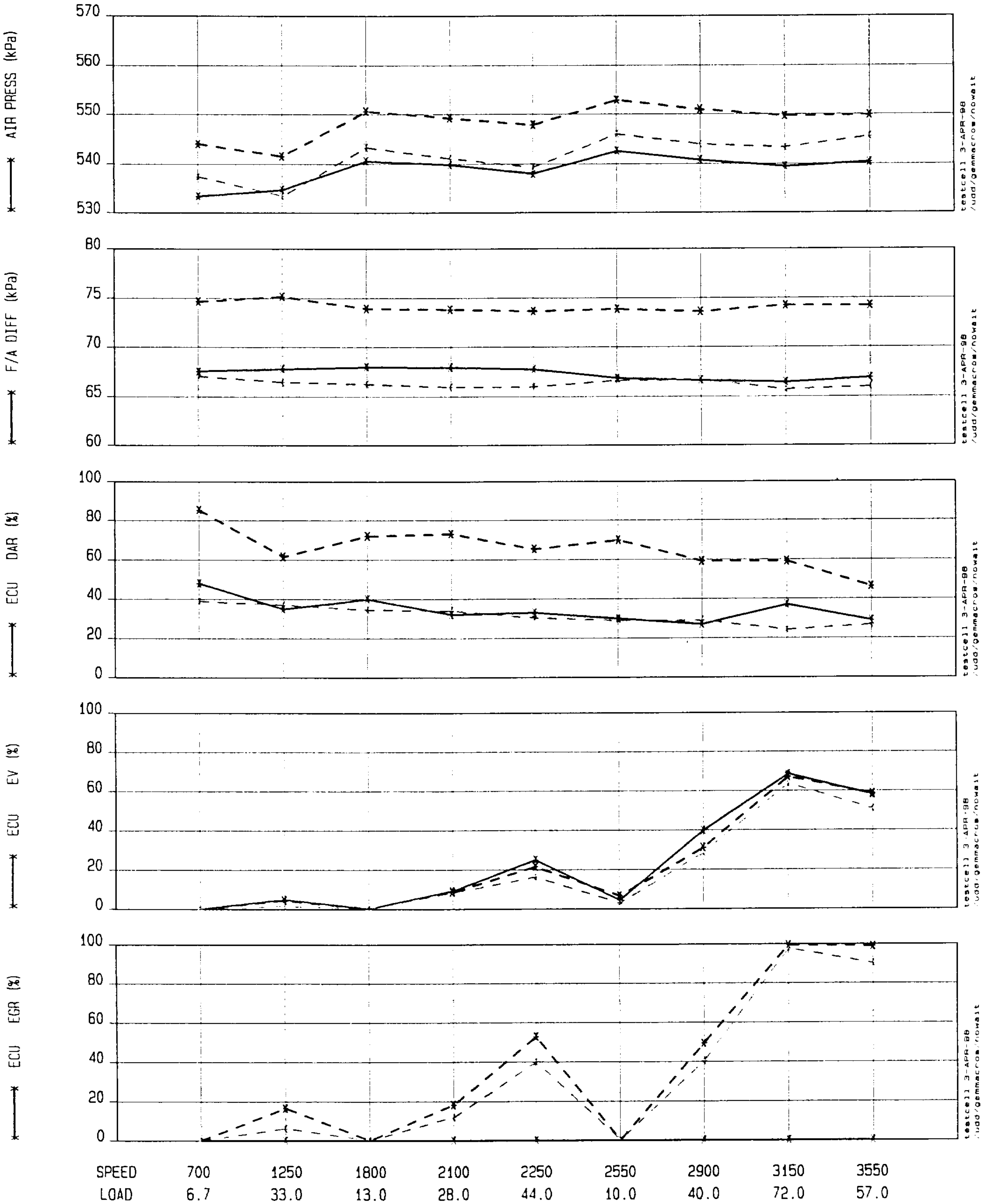
GENESIS NEDC 9 POINT COMPARISON

genesis.9pt.max

nas2725a1.e1a.9pt

NINE POINT

genesis.9pt.min



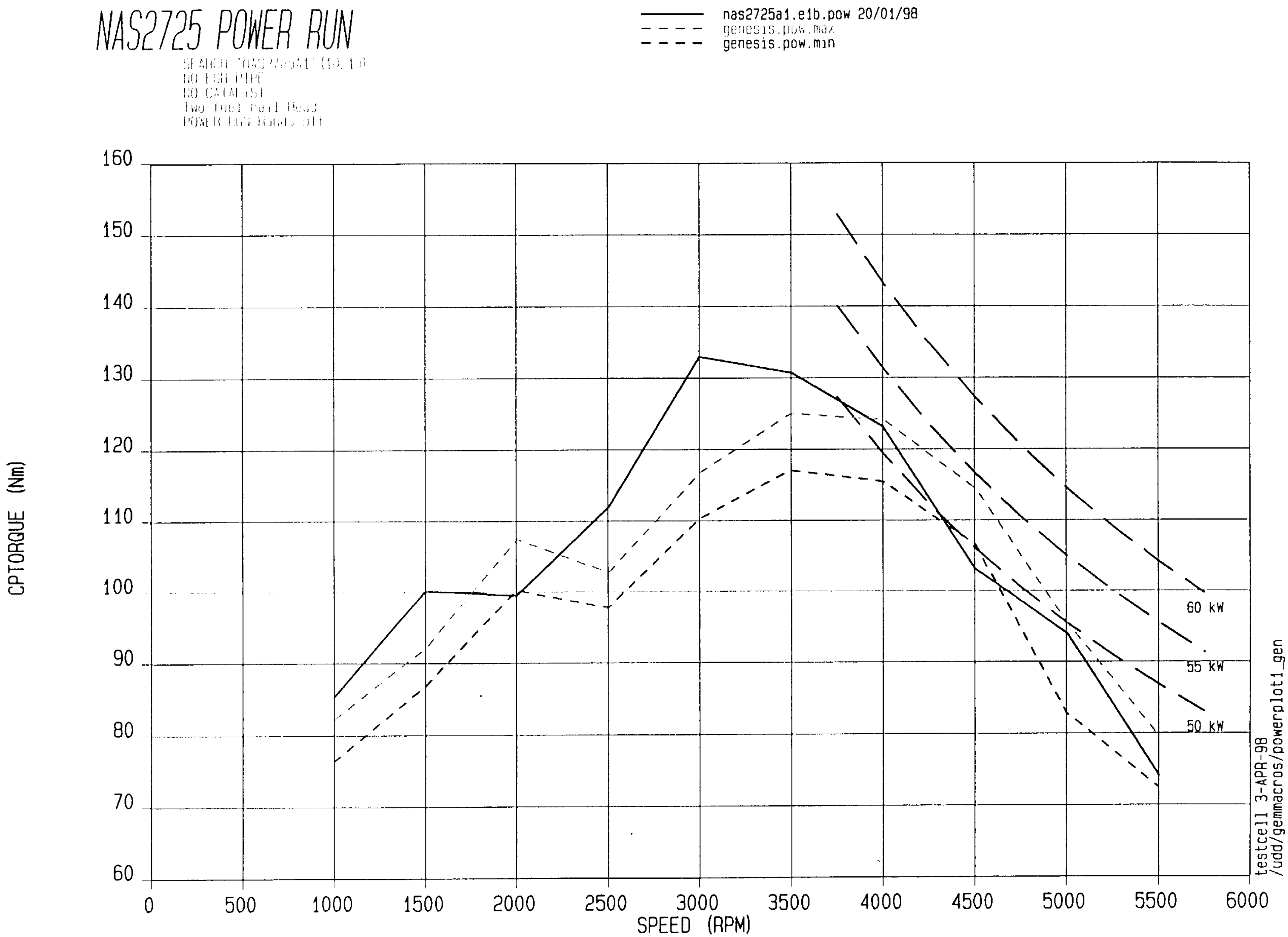
SEARCH="NAS2725A1"(10,19)
NO EGR PIPE
NO CATALYST
Two fuel rail Head
POWER RUN Hands off

	1	2	3	4	5	6	7	8	9
	E1B1.1	E1B2.1	E1B3.1	E1B4.1	E1B5.1	E1B6.1	E1B7.1	E1B8.1	E1B9.1
1									
2 Search BLK	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
3 Exp. Ref.	E1B1.1	E1B2.1	E1B3.1	E1B4.1	E1B5.1	E1B6.1	E1B7.1	E1B8.1	E1B9.1
4 Date Logged	20/01/98	20/01/98	20/01/98	20/01/98	20/01/98	20/01/98	20/01/98	20/01/98	20/01/98
5 Time Logged	13:35:25	13:42:32	13:47:42	13:54:40	14:00:06	14:05:11	14:11:09	14:16:14	14:21:22
6 SPEED (rpm)	1000	1501	2002	2502	3001	3501	3999	4501	5001
7 TORQUE (NM)	84.78	99.15	98.73	111.1	132.9	130.8	124.0	104.0	94.81
8 CPTORQUE (Nm)	85.32	100.1	99.43	111.9	133.0	130.7	123.2	103.1	94.01
9									
10 POWER (KWATTS)	8.880	15.58	20.70	29.11	41.76	47.96	51.93	49.00	49.65
11 CPPOWER (kW)	8.937	15.73	20.84	29.32	41.79	47.91	51.58	48.62	49.23
12									
13 HC FID (PPM)	4600	4976	5077	7803	.1078E+05	9864	6979	5477	2416
14 CO (%)	1.536	.7879	.1841	.8359E-01	.1785	.3371	.4467	.2709	.7519
15 CO2 (%)	7.695	9.152	9.525	9.598	9.738	9.922	10.21	9.540	10.49
16 O2 (%)	9.327	8.079	8.070	8.042	7.702	7.271	6.947	7.967	6.377
17 NOX (PPM)	618.2	1555	1999	1999	1999	1999	1999	1613	1294
18									
19 AT PRESS (MM HG)	746.3	746.1	746.0	745.9	745.9	746.0	746.2	746.4	746.6
20 FUEL TMP (DEG C)	21.37	15.19	14.14	14.28	14.15	14.38	14.30	14.20	14.24
21 WET TMP (deg c)	14.87	15.46	15.48	14.59	13.91	13.27	12.79	12.50	12.48
22 DRY TMP (DEG C)	21.95	22.91	23.30	22.70	21.43	20.27	19.15	18.27	18.17
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	23.77	24.83	23.71	24.38	21.42	20.75	18.11	17.66	17.53
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	85.80	133.6	165.9	233.6	344.5	368.1	394.2	362.0	368.5
27 T.CPTORQUE (NM)	85.32	100.1	99.43	111.9	133.0	130.7	123.2	103.1	94.02
28 T.PPC.FAC ()	1.006	1.009	1.007	1.007	1.001	.9990	.9932	.9922	.9917
29 T.EXH A/F ()	22.35	21.01	21.50	20.99	19.92	19.45	19.42	21.20	19.27
30 T.REL HUM (Fraction)	.4633	.4518	.4335	.4072	.4272	.4462	.4760	.5079	.5131
31 T.FUELFLOW (g/s)	.8715	1.343	1.721	2.315	3.366	3.675	3.932	3.646	3.654
32 CYL #2 TMP (DEG C)	158.4	181.1	185.9	204.3	221.6	226.5	225.9	218.3	224.2
33 DWNPIPE TMP (deg C)	319.5	407.0	466.0	534.7	610.8	648.9	677.6	650.0	712.4
34 CAT TMP1 (deg c)	287.8	388.2	454.9	523.2	591.3	626.8	663.0	633.0	703.5
35 CAT TMP2 (deg C)	280.6	375.4	438.0	507.0	578.2	616.1	655.9	627.0	697.1
36 CAT TMP3 (deg C)	291.3	379.1	434.7	501.7	570.6	608.3	655.1	627.3	698.1
37 HD BOLT TMP (DEG C)	90.72	90.36	90.03	89.78	89.64	89.30	89.08	88.87	88.72
38 H2OIN TMP (DEG C)	84.80	83.87	84.27	84.22	84.27	84.59	85.02	85.54	85.55
39 H2OOUT TMP (DEG C)	90.06	89.89	89.80	89.45	89.64	89.59	89.66	89.51	89.40
40 H20 FLOW (l/min)	26.21	39.68	53.76	67.76	81.89	95.65	109.1	122.8	134.4
41 DYNO TMP (DEG C)	30.03	33.09	35.86	35.32	40.04	39.20	39.53	39.40	39.38
42 EX SYS PRES (kpa)	-1.262	-1.278	-1.291	-1.313	-1.321	-1.295	-1.301	-1.316	-1.290
43 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
44 ATMOS (KPA)	99.49	99.46	99.44	99.43	99.43	99.44	99.47	99.49	99.52
45 AIR PRESS (kPa)	530.0	532.1	535.5	538.3	539.7	539.7	542.4	542.7	544.0
46 F/A DIFF (kPa)	68.08	67.93	67.67	66.96	66.02	66.33	66.51	66.86	67.00
47 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
48 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
49 PPC.FAC ()	1.006	1.009	1.007	1.007	1.001	.9990	.9932	.9922	.9916
50 DAT PRESS (kPa)	98.26	98.20	98.20	98.30	98.34	98.38	98.41	98.43	98.45
51 VAP PRESS (kPa)	1.221	1.262	1.240	1.123	1.090	1.061	1.055	1.066	1.070
52 NOX_HCF ()	.9105	.9178	.9139	.8939	.8884	.8835	.8825	.8842	.8848
53 CMASS_NOX (g/s)	.1663E-01	.6087E-01	.9882E-01	.1329	.1854	.1926	.2040	.1662	.1225
54 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
55 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
56									
57 ECU FPC ()	16.80	17.10	16.52	18.00	22.60	22.20	20.60	17.30	15.90
58 ECU TEMP ()	91.00	92.00	90.00	90.00	92.00	91.00	91.00	90.00	90.00
59 ECU SA ()	7.000	10.00	12.00	13.00	13.00	12.00	12.00	12.00	13.00
60 ECU AST ()	118.0	130.0	135.0	151.0	179.0	180.0	181.0	176.0	176.0
61 ECU EOA ()	79.00	72.00	63.00	57.00	66.00	47.00	38.00	31.00	30.00
62 ECU APW ()	6.320	6.320	6.350	6.320	6.320	6.320	5.950	5.380	4.900
63 ECU FPW ()	6.580	6.940	6.610	6.920	8.900	8.900	8.400	6.780	6.400
64 ECU SAPC ()	456.0	452.0	387.0	385.0	385.0	377.0	373.0	377.0	366.0
65 ECU FBAPC ()	345.0	337.0	317.0	330.0	407.0	393.0	365.0	333.0	278.0
66 ECU A/F ()	20.90	19.40	19.10	18.20	17.80	17.70	17.50	19.20	17.20
67 ECU EV ()	44.00	49.00	59.00	70.00	79.00	81.00	83.00	84.00	91.00
68 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
69 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70 ECU PPOT ()	844.0	844.0	845.0	846.0	846.0	847.0	847.0	848.0	849.0
71 ECU AFL ()	19.20	24.00	31.00	40.00	61.00	69.00	73.00	73.00	69.00
72									
73 FUELFLO (G/SEC)	.8580	1.336	1.659	2.336	3.445	3.681	3.942	3.620	3.685
74 AIRFLO (G/SEC)	19.18	28.05	35.67	49.04	68.63	71.59	76.55	76.73	71.03
75 EXH A/F (:1)	22.35	21.01	21.50	20.99	19.92	19.45	19.42	21.20	19.27
76									
77 BSPEFC (G/KWHR)	347.8	308.5	288.6	288.9	297.0	276.3	273.3	266.0	267.2
78 BSPEHC (g/kWh)	16.55	14.73	14.35	21.56	29.15	24.26	16.80	14.08	5.631
79 BSPECO (g/kWh)	112.1	47.27	10.55	4.682	9.782	16.80	21.80	14.12	35.53
80 BSPENOX (g/kWh)	7.406	15.32	18.81	18.39	17.99	16.36	16.02	13.80	10.04
81									
82 FFCC (mg/cyl/cyc)	17.16	17.80	16.58	18.67	22.96	21.03	19.72	16.09	14.74
83 AIRCC (mg/cyl/cyc)	383.5	373.8	356.4	391.9	457.4	409.0	382.8	340.9	284.1
84 MASS_HC (g/sec)	.4083E-01	.6375E-01	.8251E-01	.1743	.3381	.3231	.2424	.1916	.7765E-01

		10 E1B10.1
1		
2	Search BLK	19.00
3	Exp. Ref.	E1B10.1
4	Date Logged	20/01/98
5	Time Logged	14:27:26
6	SPEED (rpm)	5501
7	TORQUE (NM)	74.82
8	CPTORQUE (Nm)	74.02
9		
10	POWER (KWATTS)	43.10
11	CPPOWER (kW)	42.64
12		
13	HC FID (PPM)	1979
14	CO (%)	.7058
15	CO2 (%)	9.983
16	O2 (%)	6.923
17	NOX (PPM)	887.0
18		
19	AT PRESS (MM HG)	746.9
20	FUEL TMP (DEG C)	14.05
21	WET TMP (deg c)	12.23
22	DRY TMP (DEG C)	17.57
23	DEPRESS (MM H2O)	0.0
24	AIRIN TMP (DEG C)	16.63
25	FUEL TIME (SECS)	100.0
26	FUEL MASS (GRAMS)	358.7
27	T.CPTORQUE (NM)	74.02
28	T.PPC.FAC ()	.9893
29	T.EXH A/F ()	20.12
30	T.REL HUM (Fraction)	.5327
31	T.FUELFLOW (g/s)	3.779
32	CYL #2 TMP (DEG C)	218.5
33	DWNPIPE TMP (deg C)	695.0
34	CAT TMP1 (deg c)	677.4
35	CAT TMP2 (deg C)	667.5
36	CAT TMP3 (deg C)	666.0
37	HD BOLT TMP (DEG C)	88.74
38	H2OIN TMP (DEG C)	86.04
39	H2OOUT TMP (DEG C)	89.48
40	H20 FLOW (l/min)	144.5
41	DYNO TMP (DEG C)	37.73
42	EX SYS PRES (kpa)	-1.286
43	AL CELLTMP1 (DEG C)	26.00
44	ATMOS (KPA)	99.56
45	AIR PRESS (kPa)	544.2
46	F/A DIFF (kPa)	66.67
47	TESTCELL # (101_103)	101.0
48	TECHNICIAN (CLOCK#)	11.00
49	PPC.FAC ()	.9893
50	DAT PRESS (kPa)	98.49
51	VAP PRESS (kPa)	1.070
52	NOX_HCF ()	.8848
53	CMASS_NOX (g/s)	.8627E-01
54	FUEL DEN (G/CC @ 15+	.7481
55	FUEL TYPE (1-6)	3.000
56		
57	ECU FPC ()	13.10
58	ECU TEMP ()	90.00
59	ECU SA ()	16.00
60	ECU AST ()	170.0
61	ECU EOA ()	29.00
62	ECU APW ()	4.250
63	ECU FPW ()	5.200
64	ECU SAPC ()	356.0
65	ECU FBAPC ()	26.00
66	ECU A/F ()	18.20
67	ECU EV ()	96.00
68	ECU EGR ()	0.0
69	ECU DAR ()	0.0
70	ECU PPOT ()	852.0
71	ECU AFL ()	67.00
72		
73	FUELFLO (G/SEC)	3.587
74	AIRFLO (G/SEC)	72.18
75	EXH A/F (:1)	20.12
76		
77	BSPEFC (G/KWHR)	299.6
78	BSPEHC (g/kWh)	5.458
79	BSPECO (g/kWh)	39.46
80	BSPENOX (g/kWh)	8.144
81		
82	FFCC (mg/cyl/cyc)	13.04
83	AIRCC (mg/cyl/cyc)	262.4
84	MASS_HC (g/sec)	.6535E-01

	1	2	3	4	5	6	7	8	9
	E1B1.1	E1B2.1	E1B3.1	E1B4.1	E1B5.1	E1B6.1	E1B7.1	E1B8.1	E1B9.1
85 MASS_CO (g/sec)	.2764	.2046	.6064E-01	.3786E-01	.1135	.2239	.3145	.1922	.4899
86 MASS_NOX (g/sec)	.1827E-01	.6631E-01	.1081	.1487	.2087	.2180	.2311	.1879	.1385

	10
	E1B10.1
85 MASS_CO (g/sec)	.4724
86 MASS_NOX (g/sec)	.9751E-01


NAS2725 POWER RUN
NO EGR PIPE
NO CATALYST
Two fuel rail Head
POWER RUN Hands off
nas2725a1.e1b.pow 20/01/98
genesis.pow.max
genesis.pow.min
CPTORQUE (Nm)
SPEED (RPM)
60 kW
55 kW
50 kW
testcell 3-APR-98
/udd/gemmacros/powerplot1_gen

SEARCH="NAS2725A1"(20,29)
NO EGR PIPE
NO CATALYST
Two fuel rail Head
POWER RUN Hands on

	1 E1C1.1	2 E1C2.1	3 E1C3.1	4 E1C4.1	5 E1C5.1	6 E1C6.1	7 E1C7.1	8 E1C8.1	9 E1C9.1
1									
2 Search BLK	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00
3 Exp. Ref.	E1C1.1	E1C2.1	E1C3.1	E1C4.1	E1C5.1	E1C6.1	E1C7.1	E1C8.1	E1C9.1
4 Date Logged	21/01/98	21/01/98	21/01/98	21/01/98	21/01/98	21/01/98	21/01/98	21/01/98	21/01/98
5 Time Logged	12:35:04	12:59:19	13:07:11	13:18:38	13:26:45	13:36:14	13:42:46	13:50:45	13:59:11
6 SPEED (rpm)	1000	1501	1999	2500	3001	3502	4003	4504	5000
7 TORQUE (NM)	86.87	101.3	106.3	128.5	141.1	138.0	134.3	124.7	102.9
8 CPTORQUE (Nm)	86.81	101.7	106.4	128.4	140.3	136.8	132.8	123.4	101.6
9									
10 POWER (KWATTS)	9.101	15.92	22.26	33.64	44.35	50.62	56.29	58.81	53.87
11 CPPOWER (kW)	9.096	15.99	22.28	33.62	44.09	50.17	55.67	58.18	53.22
12									
13 HC FID (PPM)	5135	5801	8907	7585	.1046E+05	.1046E+05	4613	1457	1169
14 CO (%)	1.805	2.031	1.824	1.815	1.116	1.350	1.036	.2117	.1217
15 CO2 (%)	7.410	8.376	8.514	8.323	9.434	9.577	10.62	12.21	12.23
16 O2 (%)	9.173	7.662	7.646	7.965	6.894	6.456	5.401	3.777	3.815
17 NOX (PPM)	510.2	859.5	865.9	1154	1960	1677	1972	1481	1021
18									
19 AT PRESS (MM HG)	747.3	746.9	746.8	746.6	746.6	746.4	746.4	746.2	746.1
20 FUEL TMP (DEG C)	17.06	17.62	17.66	18.01	17.84	17.65	17.93	18.27	17.86
21 WET TMP (deg c)	12.79	13.51	12.32	11.49	10.58	9.902	9.601	9.571	9.507
22 DRY TMP (DEG C)	21.91	23.50	22.97	21.87	19.75	18.23	17.43	17.37	17.28
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	23.14	25.25	24.38	23.91	21.10	19.51	18.38	18.47	17.61
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	87.24	141.3	197.5	284.1	353.0	394.6	402.0	418.2	423.4
27 T.CPTORQUE (NM)	86.81	101.7	106.4	128.4	140.3	136.8	132.8	123.4	101.6
28 T.PPC.FAC ()	.9994	1.004	1.001	.9995	.9940	.9911	.9891	.9894	.9879
29 T.EXH A/F ()	21.90	19.45	19.05	19.82	18.47	17.85	17.81	17.18	17.31
30 T.REL HUM (Fraction)	.3318	.3062	.2588	.2545	.2906	.3189	.3399	.3407	.3411
31 T.FUELFLOW (g/s)	.8758	1.393	2.007	2.865	3.508	3.958	3.976	4.073	4.317
32 CYL #2 TMP (DEG C)	161.9	183.8	199.9	226.4	231.6	234.2	240.8	237.3	229.1
33 DWNPIPE TMP (deg C)	303.0	396.5	425.3	499.2	613.1	658.7	743.8	875.4	875.8
34 CAT TMP1 (deg c)	269.9	380.4	415.2	488.8	593.1	637.6	746.9	847.1	835.4
35 CAT TMP2 (deg C)	265.1	369.2	401.4	476.8	580.2	626.1	748.4	836.8	826.9
36 CAT TMP3 (deg C)	277.1	372.8	401.1	473.4	573.2	618.2	754.0	827.7	820.1
37 HD BOLT TMP (DEG C)	89.96	89.96	89.66	89.71	89.97	89.70	89.92	89.91	89.36
38 H2OIN TMP (DEG C)	84.32	83.62	83.47	83.36	84.19	84.48	85.11	85.32	85.35
39 H2OOUT TMP (DEG C)	89.72	89.79	89.51	89.51	89.82	89.56	89.85	89.83	89.37
40 H20 FLOW (l/min)	26.69	39.64	53.28	67.31	81.14	95.39	109.4	121.6	133.4
41 DYNO TMP (DEG C)	26.79	31.32	35.08	36.41	39.57	40.96	39.61	40.16	39.86
42 EX SYS PRES (kpa)	-1.064	-1.133	-1.129	-1.178	-1.166	-1.187	-1.185	-1.186	-1.217
43 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
44 ATMOS (KPA)	99.61	99.56	99.54	99.53	99.52	99.50	99.49	99.47	99.45
45 AIR PRESS (kPa)	531.1	533.2	538.7	539.6	540.1	540.0	542.9	544.1	544.3
46 F/A DIFF (kPa)	71.58	71.14	70.71	70.02	68.60	68.85	69.13	69.19	69.14
47 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
48 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
49 PPC.FAC ()	.9994	1.004	1.001	.9995	.9940	.9911	.9891	.9894	.9879
50 DAT PRESS (kPa)	98.74	98.68	98.82	98.86	98.85	98.83	98.81	98.80	98.78
51 VAP PRESS (kPa)	.8719	.8861	.7255	.6671	.6682	.6674	.6764	.6757	.6724
52 NOX_HCF ()	.8534	.8556	.8318	.8234	.8236	.8235	.8248	.8247	.8243
53 CMASS_NOX (g/s)	.1303E-01	.3155E-01	.4226E-01	.8262E-01	.1637	.1517	.1797	.1355	.9526E-01
54 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
55 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
56									
57 ECU FPC ()	16.50	18.10	19.20	22.20	24.00	23.80	22.00	20.90	17.70
58 ECU TEMP ()	92.00	92.00	91.00	91.00	92.00	91.00	91.00	91.00	91.00
59 ECU SA ()	7.000	10.00	11.00	15.00	13.00	12.00	12.00	12.00	13.00
60 ECU AST ()	118.0	130.0	162.0	163.0	170.0	180.0	178.0	175.0	176.0
61 ECU EOA ()	80.00	73.00	87.00	67.00	55.00	47.00	35.00	24.00	29.00
62 ECU APW ()	6.320	6.390	5.990	6.320	6.320	6.320	5.920	5.770	4.900
63 ECU FPW ()	6.590	7.270	7.700	8.910	9.670	9.430	8.900	8.420	6.900
64 ECU SAPC ()	457.0	452.0	387.0	386.0	385.0	377.0	374.0	377.0	366.0
65 ECU FBAPC ()	350.0	335.0	340.0	390.0	404.0	394.0	377.0	339.0	282.0
66 ECU A/F ()	20.90	18.30	17.80	17.60	16.80	16.50	16.90	16.10	15.60
67 ECU EV ()	44.00	49.00	34.00	53.00	73.50	83.00	100.0	100.0	100.0
68 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
69 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70 ECU PPOT ()	845.0	848.0	849.0	850.0	850.0	852.0	852.0	852.0	852.0
71 ECU AFL ()	19.00	24.00	34.00	48.00	61.00	69.00	75.00	76.00	70.00
72									
73 FUELFLO (G/SEC)	.8724	1.413	1.975	2.841	3.530	3.946	4.020	4.182	4.234
74 AIRFLO (G/SEC)	19.10	27.49	37.63	55.89	65.19	70.44	71.58	71.83	73.27
75 EXH A/F (:1)	21.90	19.45	19.05	19.67	18.47	17.85	17.81	17.18	17.31
76									
77 BSPEFC (G/KWHR)	345.1	319.4	319.4	304.1	286.5	280.6	257.1	256.0	282.9
78 BSPEHC (g/kWh)	18.26	16.90	25.40	21.21	25.86	24.53	9.795	2.972	2.656
79 BSPECO (g/kWh)	130.2	120.0	105.4	102.9	55.92	64.23	44.59	8.758	5.607
80 BSPENOX (g/kWh)	6.041	8.338	8.218	10.74	16.13	13.10	13.94	10.06	7.723
81									
82 FFCC (mg/cyl/cyc)	17.44	18.82	19.76	22.73	23.52	22.54	20.09	18.57	16.93
83 AIRCC (mg/cyl/cyc)	381.9	366.2	376.4	447.0	434.4	402.3	357.7	319.0	293.1
84 MASS_HC (g/sec)	.4618E-01	.7476E-01	.1570	.1982	.3186	.3450	.1531	.4856E-01	.3975E-01

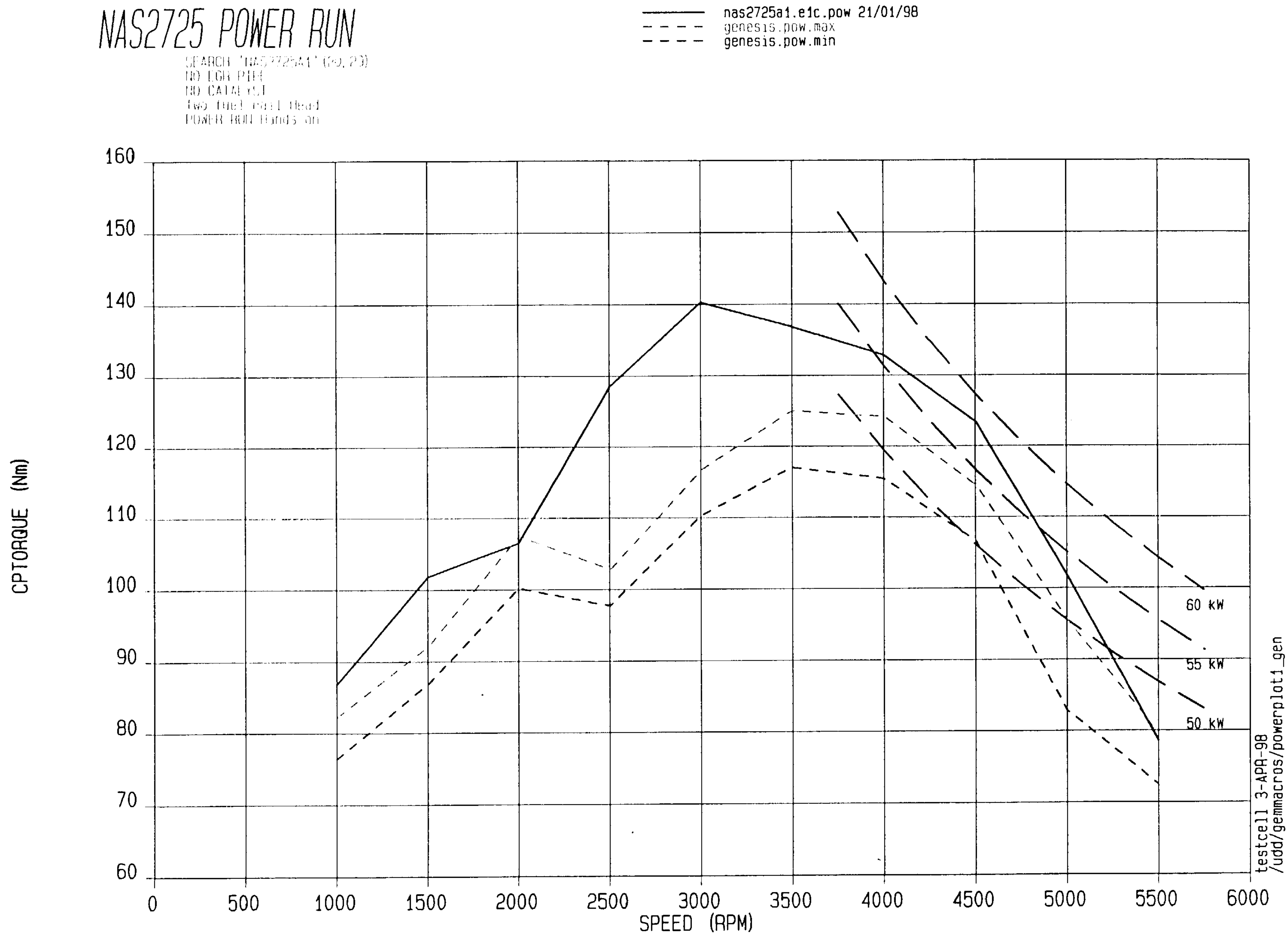
		10
		E1C10.1
1		
2	Search BLK	29.00
3	Exp. Ref.	E1C10.1
4	Date Logged	21/01/98
5	Time Logged	14:05:48
6	SPEED (rpm)	5499
7	TORQUE (NM)	79.69
8	CPTORQUE (Nm)	78.52
9		
10	POWER (KWATTS)	45.89
11	CPPOWER (kW)	45.21
12		
13	HC FID (PPM)	1675
14	CO (%)	1.143
15	CO2 (%)	11.02
16	O2 (%)	4.771
17	NOX (PPM)	724.6
18		
19	AT PRESS (MM HG)	746.1
20	FUEL TMP (DEG C)	16.96
21	WET TMP (deg c)	9.242
22	DRY TMP (DEG C)	16.92
23	DEPRESS (MM H2O)	0.0
24	AIRIN TMP (DEG C)	16.39
25	FUEL TIME (SECS)	100.0
26	FUEL MASS (GRAMS)	389.2
27	T.CPTORQUE (NM)	78.52
28	T.PPC.FAC ()	.9853
29	T.EXH A/F ()	17.53
30	T.REL HUM (Fraction)	.3413
31	T.FUELFLOW (g/s)	3.877
32	CYL #2 TMP (DEG C)	222.8
33	DWNPIPE TMP (deg C)	806.2
34	CAT TMP1 (deg c)	806.6
35	CAT TMP2 (deg C)	805.1
36	CAT TMP3 (deg C)	806.4
37	HD BOLT TMP (DEG C)	89.73
38	H2OIN TMP (DEG C)	86.26
39	H2OOUT TMP (DEG C)	89.90
40	H20 FLOW (l/min)	143.4
41	DYNO TMP (DEG C)	40.08
42	EX SYS PRES (kpa)	-1.246
43	AL CELLTMP1 (DEG C)	26.00
44	ATMOS (KPA)	99.45
45	AIR PRESS (kPa)	544.7
46	F/A DIFF (kPa)	69.27
47	TESTCELL # (101_103)	101.0
48	TECHNICIAN (CLOCK#)	11.00
49	PPC.FAC ()	.9853
50	DAT PRESS (kPa)	98.79
51	VAP PRESS (kPa)	.6578
52	NOX_HCF ()	.8222
53	CMASS_NOX (g/s)	.6276E-01
54	FUEL DEN (G/CC @ 15+	.7481
55	FUEL TYPE (1-6)	3.000
56		
57	ECU FPC ()	14.20
58	ECU TEMP ()	92.00
59	ECU SA ()	16.00
60	ECU AST ()	169.0
61	ECU EOA ()	29.00
62	ECU APW ()	4.280
63	ECU FPW ()	6.030
64	ECU SAPC ()	357.0
65	ECU FBAPC ()	237.0
66	ECU A/F ()	15.20
67	ECU EV ()	100.0
68	ECU EGR ()	0.0
69	ECU DAR ()	0.0
70	ECU PPOT ()	854.0
71	ECU AFL ()	66.00
72		
73	FUELFLO (G/SEC)	3.892
74	AIRFLO (G/SEC)	68.22
75	EXH A/F (:1)	17.53
76		
77	BSPEFC (G/KWHR)	305.4
78	BSPEHC (g/kWh)	4.159
79	BSPECO (g/kWh)	57.50
80	BSPENOX (g/kWh)	5.988
81		
82	FFCC (mg/cyl/cyc)	14.16
83	AIRCC (mg/cyl/cyc)	248.1
84	MASS_HC (g/sec)	.5301E-01

	1	2	3	4	5	6	7	8	9
	E1C1.1	E1C2.1	E1C3.1	E1C4.1	E1C5.1	E1C6.1	E1C7.1	E1C8.1	E1C9.1
85 MASS_CO (g/sec)	.3291	.5305	.6518	.9610	.6890	.9031	.6972	.1431	.8391E-01
86 MASS_NOX (g/sec)	.1527E-01	.3687E-01	.5081E-01	.1003	.1987	.1842	.2179	.1643	.1156

	10
	E1C10.1
85 MASS_CO (g/sec)	.7330
86 MASS_NOX (g/sec)	.7633E-01

NAS2725 POWER RUN

SEARCH 'NAS2725A1' (,23)
NO EGR PIPE
NO CATALYST
Two fuel rail Head
POWER RUN Bands on

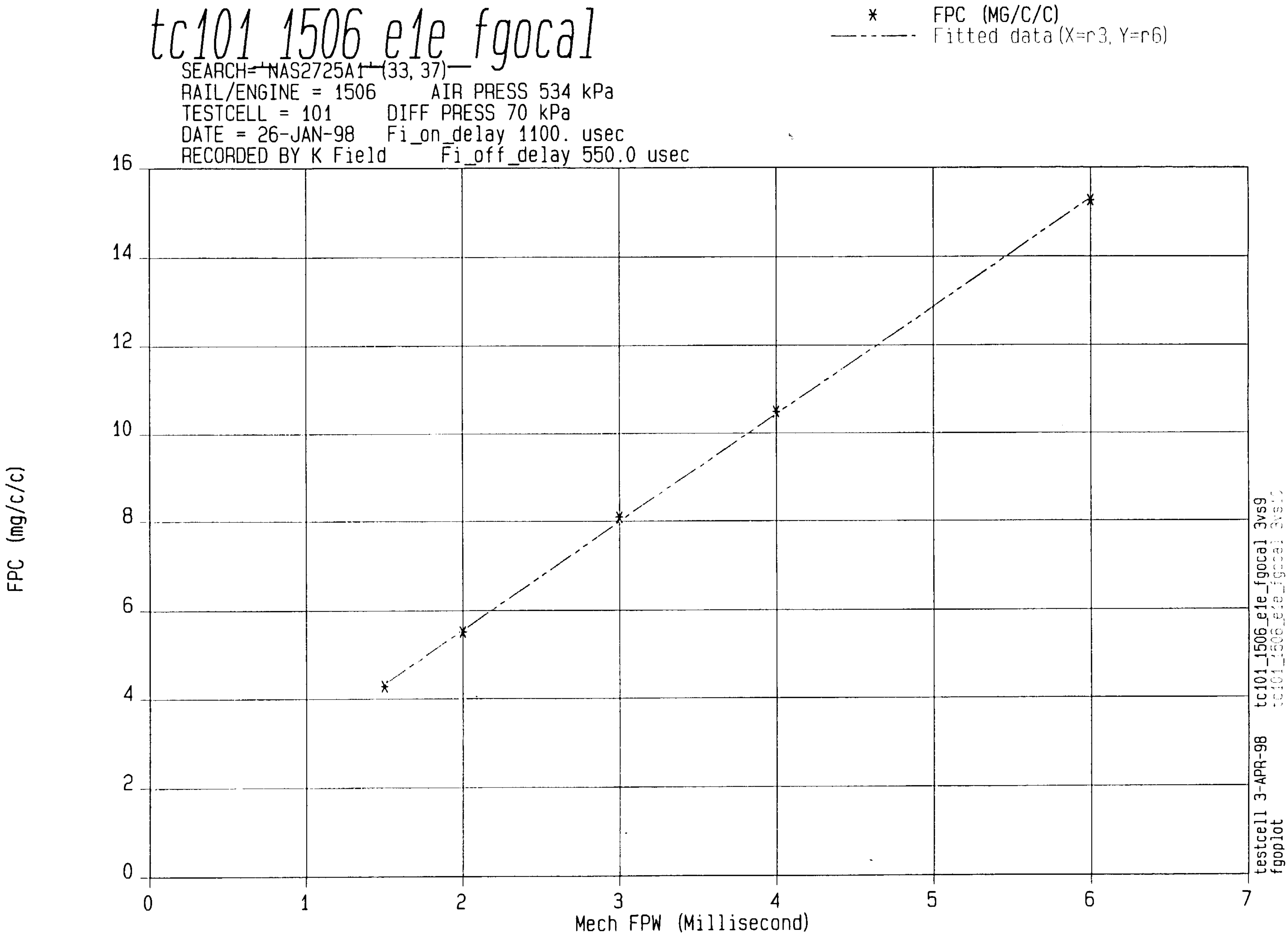


SEARCH="NAS2725A1"(30,31)
NO EGR PIPE
NO CATALYST
Two fuel rail Head
1500 point

		1	2
		E1D1.1	E1D2.1
1			
2	Search BLK	30.00	31.00
3	Exp. Ref.	E1D1.1	E1D2.1
4	Date Logged	23/01/98	23/01/98
5	Time Logged	11:00:33	11:07:53
6	SPEED (rpm)	1501	1501
7	TORQUE (NM)	18.66	18.65
8			
9	HC FID (PPM)	3300	2134
10	CO (%)	.2290	.1673
11	CO2 (%)	7.976	6.257
12	O2 (%)	9.616	12.05
13	NOX (PPM)	43.46	194.8
14			
15	AT PRESS (MM HG)	739.8	739.8
16	FUEL TMP (DEG C)	14.79	14.71
17	WET TMP (deg c)	11.71	11.85
18	DRY TMP (DEG C)	18.55	18.74
19	DEPRESS (MM H2O)	0.0	0.0
20	AIRIN TMP (DEG C)	20.14	20.35
21	FUEL TIME (SECS)	100.0	100.0
22	FUEL MASS (GRAMS)	32.18	32.51
23	T.CPTORQUE (NM)	18.77	18.77
24	T.PPC.FAC ()	1.006	1.007
25	T.EXH A/F ()	24.96	31.94
26	T.REL HUM (Fraction)	.4335	.4328
27	T.FUELFLOW (g/s)	.3275	.3246
28	CYL #2 TMP (DEG C)	136.5	140.6
29	DWNPIPE TMP (deg C)	183.9	187.5
30	CAT TMP1 (deg c)	156.0	170.4
31	CAT TMP2 (deg C)	155.0	166.2
32	CAT TMP3 (deg C)	168.5	175.6
33	HD BOLT TMP (DEG C)	89.14	89.99
34	H2OIN TMP (DEG C)	86.28	87.09
35	H2OOUT TMP (DEG C)	88.84	89.68
36	H20 FLOW (l/min)	41.36	41.02
37	DYNO TMP (DEG C)	23.23	23.44
38	EX SYS PRES (kpa)	-2.120	-2.162
39	AL CELLTMP1 (DEG C)	26.00	26.00
40	ATMOS (KPA)	98.61	98.62
41	AIR PRESS (kPa)	538.2	538.4
42	F/A DIFF (kPa)	70.78	70.72
43	TESTCELL # (101_103)	101.0	101.0
44	TECHNICIAN (CLOCK#)	11.00	11.00
45	FUEL DEN (G/CC @ 15+	.7481	.7481
46	FUEL TYPE (1-6)	3.000	3.000
47			
48	ECU FPC ()	4.000	4.000
49	ECU TEMP ()	92.00	92.00
50	ECU SA ()	35.00	35.00
51	ECU AST ()	67.00	67.00
52	ECU EOA ()	30.00	30.00
53	ECU APW ()	4.080	4.080
54	ECU FPW ()	1.600	1.600
55	ECU SAPC ()	110.0	140.0
56	ECU FBAPC ()	110.0	140.0
57	ECU A/F ()	27.30	34.50
58	ECU EV ()	0.0	0.0
59	ECU EGR ()	0.0	0.0
60	ECU DAR ()	40.00	34.00
61	ECU PPOT ()	147.0	147.0
62	ECU AFL ()	8.300	10.30
63			
64	POWER (KWATTS)	2.933	2.931
65	FUELFLO (G/SEC)	.3218	.3251
66	AIRFLO (G/SEC)	8.033	10.38
67	EXH A/F (:1)	24.96	31.94
68	MASS A/F (:1)		
69			
70	BSPEFC (G/KWHR)	395.0	399.3
71	BSPEHC (g/kWh)	15.33	12.88
72	BSPECO (g/kWh)	21.56	20.47
73	BSPENOX (g/kWh)	.6719	3.914
74			
75	FFCC (mg/cyl/cyc)	4.288	4.332
76	AIRCC (mg/cyl/cyc)	107.0	138.4
77	MASS_HC (g/sec)	.1249E-01	.1049E-01
78	MASS_CO (g/sec)	.1757E-01	.1667E-01
79	MASS_NOX (g/sec)	.5474E-03	.3186E-02
80			

SEARCH="NAS2725A1"(33,37)
RAIL/ENGINE = 1506 AIR PRESS 534 kPa
TESTCELL = 101 DIFF PRESS 70 kPa
DATE = 26-JAN-98 Fi_on_delay 1100. usec
RECORDED BY K Field Fi_off_delay 550.0 usec

	1	2	3	4	5
1 SPEED (rpm)	2002	2002	1999	1999	1999
2 FUEL MASS (GRAMS)	100.0	100.0	100.0	100.0	100.0
3 ECU FPW ()	1.500	2.000	3.000	4.000	6.000
4 Elec. fuel duration+					
5 Elec. fuel duration+	2.090	2.590	3.590	4.590	6.590
6 FUEL TIME (SECS)	233.2	181.2	123.7	95.38	65.56
7 ECU FPC ()	3.740	4.990	7.490	9.990	14.99
8 FPC (MG/C/C) is cal+					
9 FPC (MG/C/C)	4.285	5.515	8.086	10.49	15.26
10 Fitted data(X=r3,Y=+	4.334	5.554	7.994	10.43	15.31
11 % difference(X=r3,Y+	1.152	.7222	-1.131	-.5104	.3657
12 CorrCoef;err int;er+	.9999	.8022E-01	.2187E-01		
13 Poly coefs(X=r3,Y=r+	.6746	2.440			
14 FI_ON_DELAY (USEC)	823.5				
15 METER_GAIN (10*USEC+	4099				

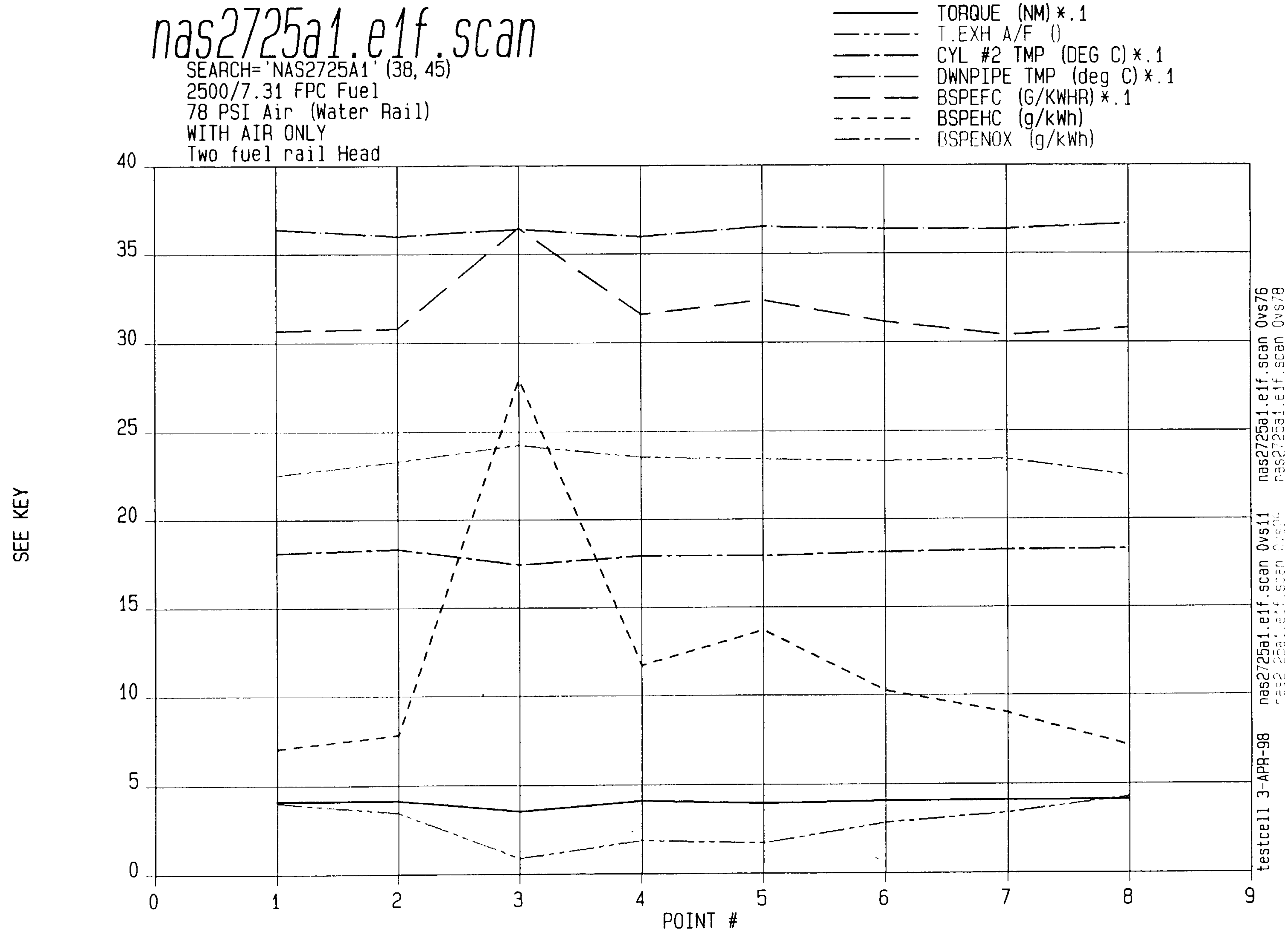


tc101_1506_e1e_fgocal
SEARCH=NAS2725A1 (33, 37)
RAIL/ENGINE = 1506 AIR PRESS 534 kPa
TESTCELL = 101 DIFF PRESS 70 kPa
DATE = 26-JAN-98 Fi_on_delay 1100. usec
RECORDED BY K Field Fi_off_delay 550.0 usec
* FPC (MG/C/C)
Fitted data (X=r3, Y=r6)
FPC (mg/c/c)
Mech FPW (Millisecond)
0
2
4
6
8
10
12
14
16
1
3
5
7
tc101_1506_e1e_fgocal 3vs9
testcell 3-APR-98
fgoplot

SEARCH="NAS2725A1"(38,45)
2500/7.31 FPC Fuel
78 PSI Air (Water Rail)
WITH AIR ONLY
Two fuel rail Head

	1	2	3	4	5	6	7	8
	E1F1.1	E1F2.1	E1F3.1	E1F4.1	E1F5.1	E1F6.1	E1F7.1	E1F8.1
1								
2 Search DIR	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+
3 Search BLK	38.00	39.00	40.00	41.00	42.00	43.00	44.00	45.00
4 Exp. Ref.	E1F1.1	E1F2.1	E1F3.1	E1F4.1	E1F5.1	E1F6.1	E1F7.1	E1F8.1
5 Date Logged	26/01/98	26/01/98	26/01/98	26/01/98	26/01/98	26/01/98	26/01/98	26/01/98
6 Time Logged	13:56:11	14:07:36	14:13:44	14:20:43	14:27:05	14:33:23	14:39:30	14:45:02
7 Hi Spd Var [cham#]	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt
8 Validity Lo Spd Dt	good	good	good	good	good	good	good	good
9 Error Code (calc pa+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+
10 SPEED (rpm)	2503	2503	2503	2503	2503	2503	2503	2503
11 TORQUE (NM)	41.32	41.52	35.52	41.00	39.64	40.79	40.99	41.22
12 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
13 HC FID (PPM)	2198	2351	6760	3395	3893	3050	2730	2231
14 CO (%)	.9193E-01	.9792E-01	.1855	.1119	.1171	.1031	.9667E-01	.8967E-01
15 CO2 (%)	9.290	8.954	7.988	8.741	8.735	8.890	8.885	9.327
16 O2 (%)	8.180	8.664	9.797	8.967	8.972	8.756	8.781	8.142
17 NOX (PPM)	378.0	312.8	64.89	163.8	147.0	254.5	309.4	400.6
18 AT PRESS (MM HG)	746.8	746.7	746.7	746.7	746.6	746.6	746.6	746.6
19 FUEL TMP (DEG C)	16.57	16.17	16.06	16.19	15.92	15.87	15.82	15.96
20 WET TMP (deg c)	10.63	10.85	10.93	10.83	10.61	10.86	11.13	11.14
21 DRY TMP (DEG C)	18.44	18.73	18.83	18.77	18.48	18.76	19.22	19.32
22 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23 AIRIN TMP (DEG C)	19.81	19.97	20.08	20.02	19.60	20.08	20.64	20.88
24 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
25 FUEL MASS (GRAMS)	92.35	93.14	94.31	94.35	93.46	92.55	90.73	92.47
26 T.CPTORQUE (NM)	41.00	41.23	35.28	40.72	39.32	40.51	40.76	41.01
27 T.PPC.FAC ()	.9923	.9929	.9932	.9930	.9920	.9932	.9945	.9949
28 T.EXH A/F ()	22.56	23.33	24.26	23.57	23.45	23.30	23.42	22.48
29 T.BSPEHC (G/KWHr)	7.111	7.802	27.41	11.38	13.51	10.17	9.051	7.218
30 T.BSPENOX (G/KWHr)	4.070	3.455	.8759	1.827	1.698	2.823	3.414	4.314
31 T.BSPECO (G/KWHr)	6.028	6.586	15.25	7.601	8.239	6.968	6.496	5.880
32 T.BSPEFC (G/KWHr)	309.7	307.1	357.5	307.0	319.7	309.0	305.9	310.9
33 T.AIRFLO (g/s)	21.01	21.66	22.43	21.61	21.64	21.38	21.38	20.97
34 T.REL HUM (Fraction)	.3600	.3597	.3598	.3566	.3561	.3586	.3532	.3491
35 T.FUELFLOW (g/s)	.9314	.9284	.9244	.9167	.9228	.9174	.9128	.9328
36 CYL #2 TMP (DEG C)	181.2	183.3	174.5	179.5	179.3	181.4	182.6	183.1
37 DWNPIPE TMP (deg C)	363.9	360.1	364.1	359.7	365.4	363.9	363.7	366.8
38 CAT TMP1 (deg c)	348.5	346.7	348.7	346.0	350.4	349.9	349.5	350.9
39 CAT TMP2 (deg C)	338.7	336.6	338.5	336.0	340.2	339.8	339.4	341.1
40 CAT TMP3 (deg C)	344.2	340.7	342.6	340.2	345.0	343.9	343.6	346.6
41 HD BOLT TMP (DEG C)	90.25	89.93	90.02	89.75	89.94	89.94	90.15	90.15
42 H2OIN TMP (DEG C)	86.43	86.39	86.63	86.22	86.46	86.42	86.57	86.44
43 H2OOUT TMP (DEG C)	89.79	89.57	89.60	89.38	89.56	89.58	89.73	89.71
44 H20 FLOW (l/min)	68.33	68.59	68.52	68.51	68.42	68.42	68.36	68.44
45 DYNO TMP (DEG C)	33.46	34.11	34.53	32.36	33.54	34.26	34.93	32.64
46 EX SYS PRES (kpa)	-1.112	-1.139	-1.136	-1.137	-1.170	-1.116	-1.173	-1.157
47 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
48 ATMOS (KPA)	99.54	99.53	99.53	99.53	99.53	99.52	99.52	99.53
49 AIR PRESS (kPa)	539.8	539.7	539.8	539.5	539.9	539.9	539.7	539.8
50 F/A DIFF (kPa)	69.42	69.46	69.37	69.70	69.44	69.48	69.62	69.48
51 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
52 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
53 ECU FPC ()	7.310	7.310	7.310	7.310	7.310	7.310	7.310	7.310
54 ECU TEMP ()	91.00	91.00	91.00	91.00	91.00	91.00	91.00	91.00
55 ECU SA ()	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
56 ECU AST ()	103.0	103.0	103.0	103.0	103.0	103.0	103.0	103.0
57 ECU EOA ()	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
58 ECU APW ()	4.990	4.990	4.990	4.990	4.990	4.990	4.990	4.990
59 ECU FPW ()	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
60 ECU SAPC ()	156.0	156.0	156.0	156.0	156.0	156.0	156.0	156.0
61 ECU FBAPC ()	156.0	156.0	156.0	156.0	156.0	156.0	156.0	156.0
62 ECU A/F ()	21.20	21.20	21.20	21.20	21.20	21.20	21.20	21.20
63 ECU EV ()	31.30	31.30	31.30	31.30	31.30	31.30	31.30	31.30
64 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65 ECU DAR ()	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
66 ECU PPOT ()	235.0	235.0	235.0	235.0	235.0	235.0	235.0	235.0
67 ECU AFL ()	19.60	19.60	19.60	19.60	19.60	19.60	19.60	19.60
68 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
69 POWER (KWATTS)	10.83	10.88	9.310	10.75	10.39	10.69	10.74	10.81
70 FUELFLO (G/SEC)	.9235	.9314	.9431	.9435	.9346	.9255	.9073	.9247
71 BSPEFC (G/KWHR)	306.9	308.1	364.7	316.1	323.8	311.7	304.0	308.1
72 AIRFLO (G/SEC)	20.83	21.73	22.88	22.24	21.91	21.57	21.25	20.79
73 VOL EFF (%)	70.86	73.96	77.92	75.73	74.50	73.45	72.51	70.99
74 EXH A/F (:1)	22.56	23.33	24.26	23.57	23.45	23.30	23.42	22.48
75 CCMB EFF (%)	96.71	96.41	90.77	95.16	94.62	95.63	95.99	96.70
76 BSPEHC (g/kWh)	7.048	7.825	27.96	11.71	13.69	10.26	8.995	7.152
77 BSPECO (g/kWh)	5.975	6.605	15.55	7.824	8.343	7.028	6.456	5.826
78 BSPENOX (g/kWh)	4.035	3.465	.8934	1.881	1.720	2.849	3.394	4.275
79 Sx ()	16.38	17.14	18.81	17.63	17.64	17.30	17.32	16.31
80 CEXH A/F (:1)	22.30	22.99	23.07	22.98	22.76	22.81	22.98	22.20
81 OEXH A/F (:1)	21.88	22.57	21.95	22.46	22.18	22.32	22.54	21.80
82 FFCC (mg/cyl/cyc)	7.378	7.442	7.536	7.539	7.467	7.396	7.248	7.388
83 AIRCC (mg/cyl/cyc)	166.4	173.6	182.8	177.7	175.1	172.3	169.8	166.1
84 MASS A/F (:1)								

	1	2	3	4	5	6	7	8
	E1F1.1	E1F2.1	E1F3.1	E1F4.1	E1F5.1	E1F6.1	E1F7.1	E1F8.1
85 MASS_HC (g/sec)	.2121E-01	.2366E-01	.7229E-01	.3496E-01	.3950E-01	.3046E-01	.2685E-01	.2147E-01
86 MASS_CO (g/sec)	.1798E-01	.1997E-01	.4021E-01	.2336E-01	.2408E-01	.2087E-01	.1927E-01	.1749E-01
87 MASS_NOX (g/sec)	.1214E-01	.1048E-01	.2310E-02	.5616E-02	.4964E-02	.8461E-02	.1013E-01	.1283E-01
88 AIR_DEN (G/L)								
89 SWEPT_VOL (CCS)	1195	1195	1195	1195	1195	1195	1195	1195
90 DRY_HOTHC (ppmC)								
91 DRY_HOTNOX (ppm)								
92 MASS_HOTHC (g/sec)								
93 MASS_HOTNOX (g/sec)								
94 BSPEHOTHC (g/kWh)								
95 BSPEHOTNOX (g/kWh)								

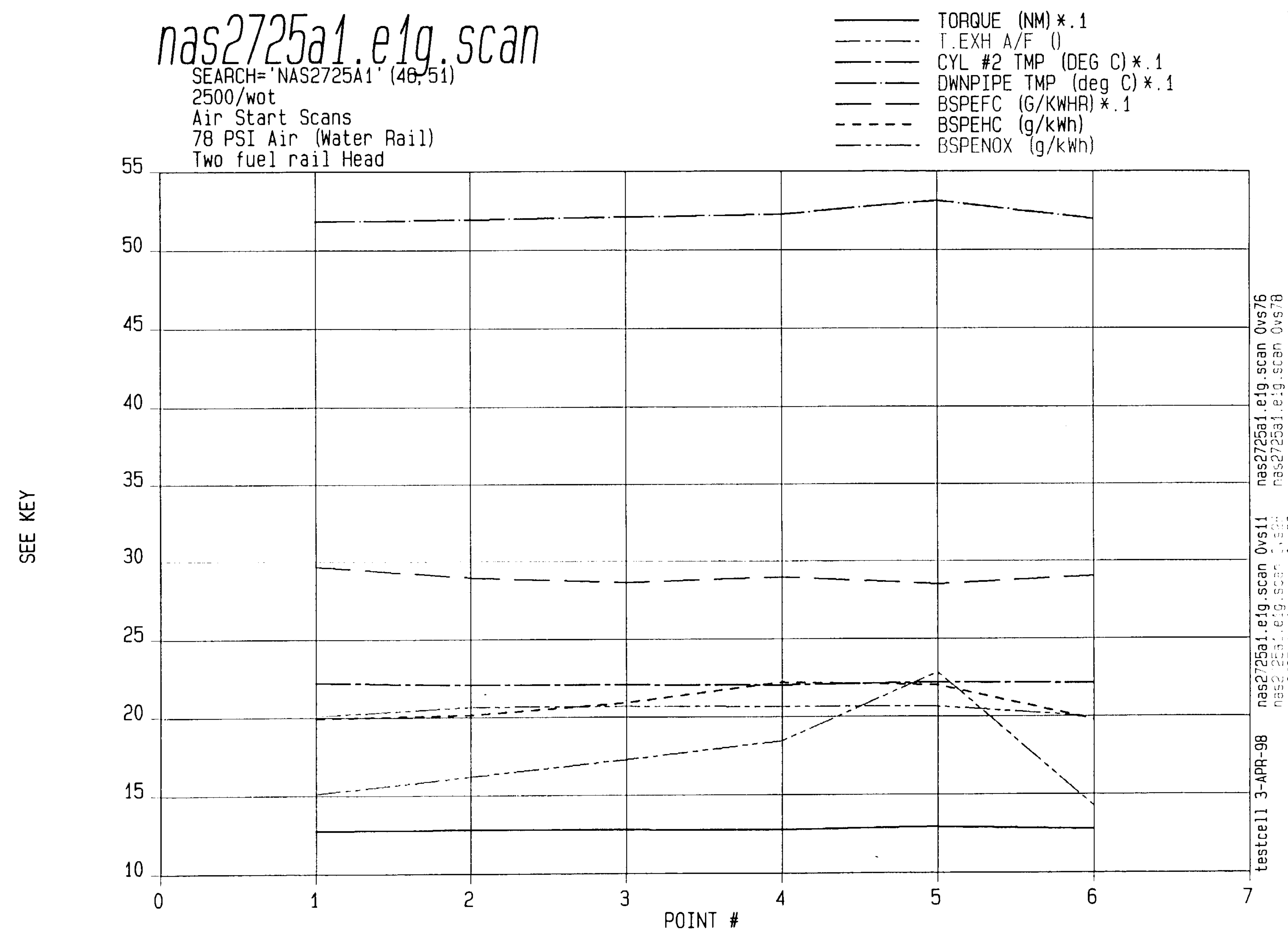


nas2725a1.e1f.scan
SEARCH='NAS2725A1' (38, 45)
2500/7.31 FPC Fuel
78 PSI Air (Water Rail)
WITH AIR ONLY
Two fuel rail Head
TORQUE (NM)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPENOX (g/kWh)
SEE KEY
POINT #
0
5
10
15
20
25
30
35
40
1
2
3
4
6
7
8
9
testcell 3-APR-98
nas2725a1.e1f.scan 0vs11
nas2725a1.e1f.scan 0vs36
nas2725a1.e1f.scan 0vs76
nas2725a1.e1f.scan 0vs78

SEARCH="NAS2725A1"(46,51)
2500/wot
Air Start Scans
78 PSI Air (Water Rail)
Two fuel rail Head

		1	2	3	4	5	6
		E1G1.1	E1G2.1	E1G3.1	E1G4.1	E1G5.1	E1G6.1
1							
2	Search DIR	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+
3	Search BLK	46.00	47.00	48.00	49.00	50.00	51.00
4	Exp. Ref.	E1G1.1	E1G2.1	E1G3.1	E1G4.1	E1G5.1	E1G6.1
5	Date Logged	27/01/98	27/01/98	27/01/98	27/01/98	27/01/98	27/01/98
6	Time Logged	09:37:03	09:42:42	09:48:34	09:53:50	10:00:46	10:05:54
7	Hi Spd Var [cham#]	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt
8	Validity Lo Spd Dt	good	good	good	good	good	good
9	Error Code (calc pa+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+
10	SPEED (rpm)	2503	2502	2503	2503	2503	2503
11	TORQUE (NM)	127.7	128.2	128.3	127.9	129.6	127.8
12	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481
13	HC FID (PPM)	7186	7245	7592	7982	8047	7310
14	CO (%)	1.154	.9256	.7864	.6785	.3426	1.191
15	CO2 (%)	8.826	8.773	8.855	8.944	9.273	8.808
16	O2 (%)	7.841	8.116	8.108	8.065	7.852	7.778
17	NOX (PPM)	1637	1751	1884	1993	2508	1579
18	AT PRESS (MM HG)	745.1	745.0	744.8	744.6	744.5	744.5
19	FUEL TMP (DEG C)	20.41	20.59	20.54	19.44	18.28	17.48
20	WET TMP (deg c)	11.87	12.03	11.83	11.99	11.88	12.13
21	DRY TMP (DEG C)	21.38	21.63	21.19	21.44	21.30	21.60
22	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0
23	AIRIN TMP (DEG C)	22.83	23.49	22.38	23.35	22.77	23.53
24	FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0
25	FUEL MASS (GRAMS)	275.6	270.1	267.4	269.6	269.0	270.1
26	T.CPTORQUE (NM)	127.8	128.6	128.3	128.2	129.9	128.3
27	T.PPC.FAC ()	1.001	1.003	1.001	1.003	1.002	1.004
28	T.EXH A/F ()	20.11	20.65	20.70	20.65	20.65	19.99
29	T.BSPEHC (G/KWHr)	19.44	20.54	21.23	22.41	21.65	20.25
30	T.BSPENOX (G/KWHr)	14.74	16.52	17.54	18.63	22.46	14.57
31	T.BSPECO (G/KWHr)	63.29	53.19	44.58	38.62	16.68	66.92
32	T.BSPEFC (G/KWHr)	289.0	295.2	290.6	292.4	280.4	297.0
33	T.AIRFLO (g/s)	54.02	56.92	56.15	56.22	54.62	55.27
34	T.REL HUM (Fraction)	.2987	.2981	.3052	.3038	.3033	.3055
35	T.FUELFLOW (g/s)	2.686	2.756	2.713	2.722	2.646	2.764
36	CYL #2 TMP (DEG C)	222.2	220.7	220.7	220.2	222.0	221.2
37	DWNPIPE TMP (deg C)	518.4	519.5	521.1	522.7	531.4	519.6
38	CAT TMP1 (deg c)	507.4	507.4	509.0	511.0	520.4	509.4
39	CAT TMP2 (deg C)	495.6	495.9	497.5	499.4	508.1	497.5
40	CAT TMP3 (deg C)	491.1	491.2	492.8	494.9	502.9	493.4
41	HD BOLT TMP (DEG C)	89.98	89.96	89.59	90.00	89.95	89.93
42	H2OIN TMP (DEG C)	83.66	83.80	83.45	83.81	83.67	83.81
43	H2OOUT TMP (DEG C)	89.70	89.72	89.40	89.78	89.72	89.74
44	H20 FLOW (l/min)	67.77	67.88	67.78	67.68	67.66	67.69
45	DYNO TMP (DEG C)	38.22	36.58	37.92	36.93	36.98	37.45
46	EX SYS PRES (kpa)	-1.418	-1.427	-1.445	-1.457	-1.475	-1.469
47	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00
48	ATMOS (KPA)	99.32	99.30	99.28	99.26	99.24	99.24
49	AIR PRESS (kPa)	538.1	537.9	538.1	537.8	537.7	538.0
50	F/A DIFF (kPa)	69.04	69.02	69.08	69.26	69.32	69.36
51	TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0
52	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00
53	ECU FPC ()	21.30	21.30	21.30	21.30	21.30	21.30
54	ECU TEMP ()	91.00	91.00	91.00	91.00	91.00	91.00
55	ECU SA ()	13.00	13.00	13.00	13.00	13.00	13.00
56	ECU AST ()	163.0	163.0	163.0	163.0	163.0	163.0
57	ECU EOA ()	67.00	67.00	67.00	67.00	67.00	67.00
58	ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320
59	ECU FPW ()	8.760	8.760	8.760	8.760	8.760	8.760
60	ECU SAPC ()	386.0	386.0	386.0	386.0	386.0	386.0
61	ECU FBAPC ()	386.0	386.0	386.0	386.0	386.0	386.0
62	ECU A/F ()	18.10	18.10	18.10	18.10	18.10	18.10
63	ECU EV ()	53.00	53.00	53.00	53.00	53.00	53.00
64	ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0
65	ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0
66	ECU PPOT ()	851.0	851.0	851.0	851.0	851.0	851.0
67	ECU AFL ()	47.00	47.00	47.00	47.00	47.00	47.00
68	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000
69	POWER (KWATTS)	33.46	33.60	33.62	33.51	33.98	33.51
70	FUELFLO (G/SEC)	2.756	2.701	2.674	2.696	2.690	2.701
71	BSPEFC (G/KWHR)	296.6	289.4	286.3	289.7	285.1	290.2
72	AIRFLO (G/SEC)	55.41	55.79	55.33	55.69	55.54	54.01
73	VOL EFF (%)	190.9	192.7	190.4	192.3	191.4	186.6
74	EXH A/F (:1)	20.11	20.65	20.70	20.65	20.65	19.99
75	COMB EFF (%)	87.58	88.26	88.55	88.70	90.19	87.33
76	BSPEHC (g/kWh)	19.94	20.14	20.91	22.20	22.01	19.79
77	BSPECO (g/kWh)	64.92	52.15	43.92	38.25	18.99	65.40
78	BSPENOX (g/kWh)	15.12	16.20	17.28	18.45	22.83	14.24
79	Sx ()	17.13	17.27	17.19	17.08	16.51	17.09
80	CEXH A/F (:1)	19.03	19.53	19.53	19.44	19.47	18.95
81	OEXH A/F (:1)	18.21	18.68	18.62	18.47	18.44	18.07
82	FFCC (mg/cyl/cyc)	22.02	21.59	21.36	21.55	21.50	21.58
83	AIRCC (mg/cyl/cyc)	442.8	445.9	442.1	445.0	443.8	431.5
84	MASS A/F (:1)						

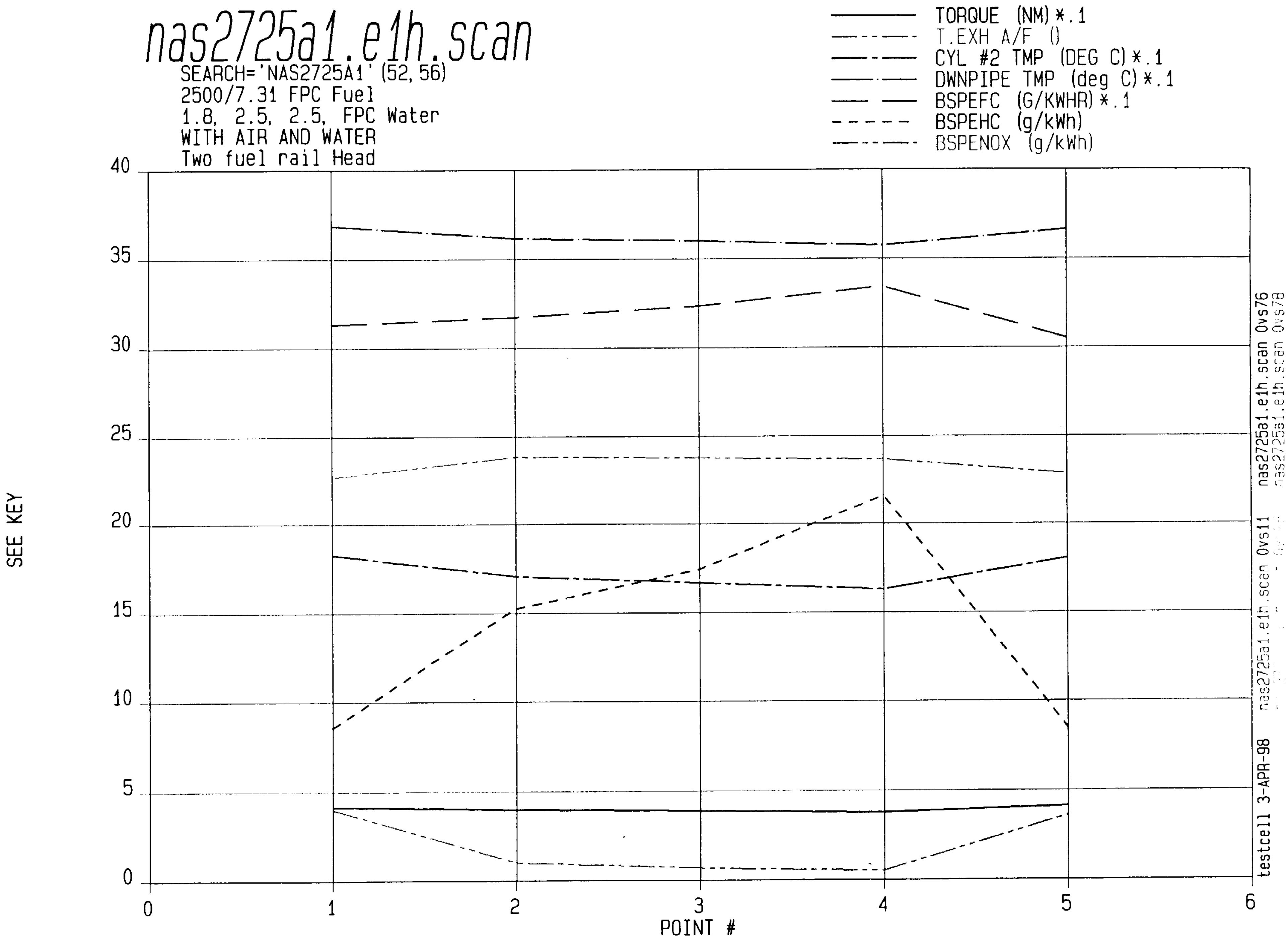
	1	2	3	4	5	6
	E1G1.1	E1G2.1	E1G3.1	E1G4.1	E1G5.1	E1G6.1
85 MASS_HC (g/sec)	.1853	.1880	.1953	.2067	.2077	.1842
86 MASS_CO (g/sec)	.6034	.4867	.4101	.3561	.1793	.6088
87 MASS_NOX (g/sec)	.1405	.1512	.1613	.1718	.2155	.1325
88 AIR_DEN (G/L)						
89 SWEPT_VOL (CCS)	1195	1195	1195	1195	1195	1195
90 DRY_HOTHC (ppmC)						
91 DRY_HOTNOX (ppm)						
92 MASS_HOTHC (g/sec)						
93 MASS_HOTNOX (g/sec)						
94 BSPEHOTHC (g/kWh)						
95 BSPEHOTNOX (g/kWh)						


nas2725a1.e1g.scan
SEARCH='NAS2725A1' (46,51)
2500/wot
Air Start Scans
78 PSI Air (Water Rail)
Two fuel rail Head
TORQUE (NM)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPENOX (g/kWh)
SEE KEY
POINT #
55
50
45
40
35
30
25
20
15
10
0
1
2
3
4
5
6
7
nas2725a1.e1g.scan 0vs76
nas2725a1.e1g.scan 0vs78
nas2725a1.e1g.scan 0vs11
nas2725a1.e1g.scan 0vs36
testcell 3-APR-98

SEARCH="NAS2725A1"(52,56)
2500/7.31 FPC Fuel
1.8, 2.5, 2.5, FPC Water
WITH AIR AND WATER
Two fuel rail Head

		1	2	3	4	5
		E1H1.1	E1H2.1	E1H3.1	E1H4.1	E1H5.1
1						
2	Search DIR	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+	"NAS2725A+
3	Search BLK	52.00	53.00	54.00	55.00	56.00
4	Exp. Ref.	E1H1.1	E1H2.1	E1H3.1	E1H4.1	E1H5.1
5	Date Logged	27/01/98	27/01/98	27/01/98	27/01/98	27/01/98
6	Time Logged	11:20:43	11:26:44	11:32:22	11:37:48	11:43:01
7	Hi Spd Var (cham#)	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt	No HiSpDt
8	Validity Lo Spd Dt	good	good	good	good	good
9	Error Code (calc pa+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+	54,0,0,22+
10	SPEED (rpm)	2503	2503	2503	2504	2502
11	TORQUE (NM)	41.75	39.78	39.03	37.78	41.31
12	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481
13	HC FID (PPM)	2589	4333	4874	5843	2604
14	CO (%)	.7707E-01	.1115	.1216	.1378	.7875E-01
15	CO2 (%)	9.161	8.497	8.454	8.369	9.089
16	O2 (%)	8.304	9.218	9.262	9.348	8.391
17	NOX (PPM)	363.9	86.89	58.87	42.23	334.3
18	AT PRESS (MM HG)	744.0	744.0	744.0	743.9	743.8
19	FUEL TMP (DEG C)	14.37	14.26	14.31	14.28	14.29
20	WET TMP (deg c)	11.35	11.09	11.30	11.11	11.18
21	DRY TMP (DEG C)	19.25	18.98	19.32	18.99	18.97
22	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0
23	AIRIN TMP (DEG C)	19.90	19.86	20.42	19.85	19.69
24	FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0
25	FUEL MASS (GRAMS)	95.24	91.96	92.00	92.04	91.86
26	T.CPTORQUE (NM)	41.65	39.67	38.98	37.68	41.20
27	T.PPC.FAC ()	.9975	.9972	.9985	.9974	.9973
28	T.EXH A/F ()	22.72	23.86	23.78	23.69	22.88
29	T.BSPEHC (G/KWHr)	8.248	15.31	18.08	22.20	8.644
30	T.BSPENOX (G/KWHr)	3.859	1.022	.7271	.5339	3.694
31	T.BSPECO (G/KWHr)	4.977	7.985	9.144	10.61	5.298
32	T.BSPEFC (G/KWHr)	301.6	318.3	335.1	344.1	312.0
33	T.AIRFLO (g/s)	20.83	22.00	22.65	22.43	21.46
34	T.REL HUM (Fraction)	.3682	.3645	.3607	.3654	.3708
35	T.FUELFLOW (g/s)	.9167	.9222	.9524	.9468	.9383
36	CYL #2 TMP (DEG C)	182.8	170.9	167.0	163.0	180.7
37	DWNPIPE TMP (deg C)	368.7	361.7	360.2	357.5	366.5
38	CAT TMP1 (deg c)	355.6	347.3	345.7	343.4	353.0
39	CAT TMP2 (deg C)	344.7	336.6	335.0	333.2	342.4
40	CAT TMP3 (deg C)	348.2	340.2	338.5	336.7	346.3
41	HD BOLT TMP (DEG C)	90.61	90.06	90.57	90.59	89.98
42	H2OIN TMP (DEG C)	86.92	86.92	87.34	87.55	86.35
43	H2OOUT TMP (DEG C)	90.15	89.73	90.10	90.17	89.54
44	H20 FLOW (l/min)	68.59	68.71	68.56	68.77	68.38
45	DYNO TMP (DEG C)	33.95	34.69	34.71	34.38	34.46
46	EX SYS PRES (kpa)	-1.449	-1.461	-1.469	-1.471	-1.489
47	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00
48	ATMOS (KPA)	99.18	99.17	99.17	99.16	99.15
49	AIR PRESS (kPa)	539.5	539.4	539.4	539.2	539.6
50	F/A DIFF (kPa)	70.53	70.40	70.28	70.47	70.14
51	TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0
52	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00
53	ECU FPC ()	7.310	7.310	7.310	7.310	7.310
54	ECU TEMP ()	92.00	92.00	92.00	92.00	92.00
55	ECU SA ()	26.00	26.00	26.00	26.00	26.00
56	ECU AST ()	103.0	103.0	103.0	103.0	103.0
57	ECU EOA ()	28.00	28.00	28.00	28.00	28.00
58	ECU APW ()	4.990	4.990	4.990	4.990	4.990
59	ECU FPW ()	3.000	3.000	3.000	3.000	3.000
60	ECU SAPC ()	158.0	158.0	158.0	158.0	158.0
61	ECU FBAPC ()	158.0	158.0	158.0	158.0	158.0
62	ECU A/F ()	21.20	21.20	21.20	21.20	21.20
63	ECU EV ()	31.30	31.30	31.30	31.30	31.30
64	ECU EGR ()	0.0	0.0	0.0	0.0	0.0
65	ECU DAR ()	29.00	29.00	29.00	29.00	29.00
66	ECU PPOT ()	237.0	237.0	237.0	237.0	237.0
67	ECU AFL ()	20.00	20.00	20.00	20.00	20.00
68	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000
69	POWER (KWATTS)	10.94	10.43	10.23	9.907	10.83
70	FUELFLO (G/SEC)	.9524	.9196	.9200	.9204	.9186
71	BSPEFC (G/KWHR)	313.3	317.4	323.7	334.5	305.5
72	AIRFLO (G/SEC)	21.65	21.93	21.88	21.80	21.01
73	VOL EFF (%)	73.95	74.90	74.87	74.44	71.77
74	EXH A/F (:1)	22.73	23.85	23.78	23.68	22.88
75	COMB EFF (%)	96.34	94.04	93.41	92.28	96.29
76	BSPEHC (g/kWh)	8.569	15.26	17.47	21.57	8.464
77	BSPECO (g/kWh)	5.170	7.959	8.832	10.32	5.188
78	BSPENOX (g/kWh)	4.009	1.019	.7023	.5190	3.616
79	Sx ()	16.51	17.99	18.07	18.20	16.65
80	CEXH A/F (:1)	22.45	23.15	22.97	22.69	22.61
81	OEXH A/F (:1)	21.92	22.40	22.16	21.74	22.06
82	FFCC (mg/cyl/cyc)	7.610	7.347	7.350	7.352	7.342
83	AIRCC (mg/cyl/cyc)	173.0	175.2	174.8	174.1	168.0
84	MASS A/F (:1)					

	1	2	3	4	5
	E1H1.1	E1H2.1	E1H3.1	E1H4.1	E1H5.1
85 MASS_HC (g/sec)	.2605E-01	.4422E-01	.4965E-01	.5937E-01	.2545E-01
86 MASS_CO (g/sec)	.1572E-01	.2306E-01	.2510E-01	.2839E-01	.1560E-01
87 MASS_NOX (g/sec)	.1219E-01	.2952E-02	.1996E-02	.1428E-02	.1088E-01
88 AIR_DEN (G/L)					
89 SWEPT_VOL (CCS)	1195	1195	1195	1195	1195
90 DRY_HOTHC (ppmC)					
91 DRY_HOTNOX (ppm)					
92 MASS_HOTHC (g/sec)					
93 MASS_HOTNOX (g/sec)					
94 BSPEHOTHC (g/kWh)					
95 BSPEHOTNOX (g/kWh)					

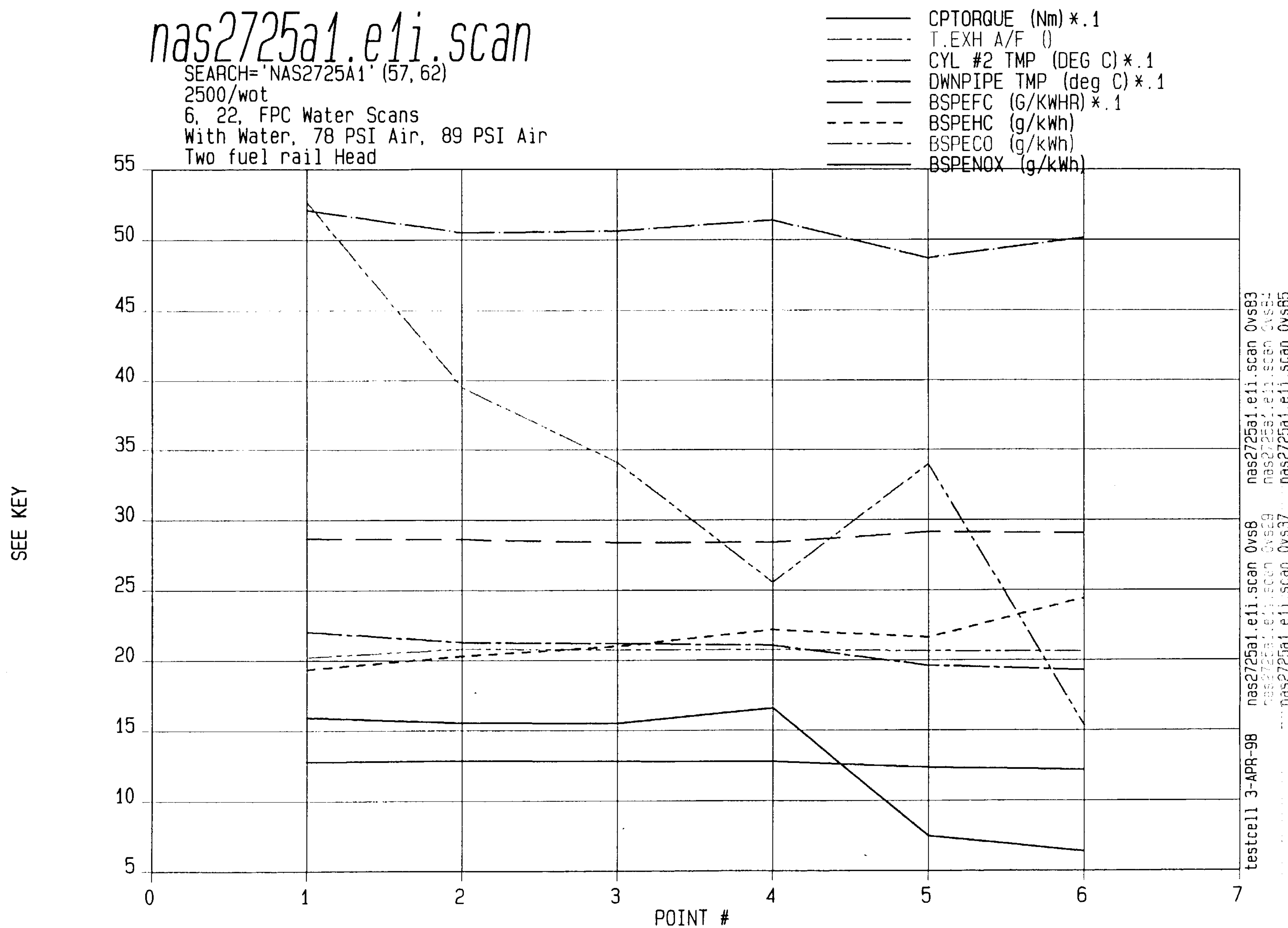


nas2725a1.e1h.scan
SEARCH='NAS2725A1' (52, 56)
2500/7.31 FPC Fuel
1.8, 2.5, 2.5, FPC Water
WITH AIR AND WATER
Two fuel rail Head
TORQUE (NM)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPENOX (g/kWh)
SEE KEY
POINT #
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
nas2725a1.e1h.scan Ovs76
nas2725a1.e1h.scan Ovs78
nas2725a1.e1h.scan Ovs11
testcell 3-APR-98

SEARCH="NAS2725A1"(57,62)
2500/wot
6, 22, FPC Water Scans
With Water, 78 PSI Air, 89 PSI Air
Two fuel rail Head

		1	2	3	4	5	6
		E1I1.1	E1I2.1	E1I3.1	E1I4.1	E1I5.1	E1I6.1
1							
2	Search BLK	57.00	58.00	59.00	60.00	61.00	62.00
3	Exp. Ref.	E1I1.1	E1I2.1	E1I3.1	E1I4.1	E1I5.1	E1I6.1
4	Date Logged	27/01/98	27/01/98	27/01/98	27/01/98	27/01/98	27/01/98
5	Time Logged	13:49:11	13:55:03	14:01:51	14:08:52	14:15:10	14:20:34
6	SPEED (rpm)	2504	2503	2503	2503	2503	2502
7	TORQUE (NM)	127.5	128.3	127.8	127.5	123.4	121.5
8	CPTORQUE (Nm)	128.4	128.9	128.7	128.4	124.0	122.2
9							
10	POWER (KWATTS)	33.44	33.64	33.50	33.42	32.34	31.83
11	CPPOWER (kW)	33.67	33.80	33.73	33.65	32.51	32.03
12							
13	HC FID (PPM)	7139	7300	7630	8059	7687	8659
14	CO (%)	.9571	.7008	.6116	.4581	.5955	.2677
15	CO2 (%)	8.914	8.875	8.960	9.069	9.023	9.189
16	O2 (%)	7.785	8.072	8.024	7.986	7.946	7.823
17	NOX (PPM)	1768	1681	1696	1810	800.4	680.1
18							
19	AT PRESS (MM HG)	743.1	743.0	742.9	742.9	742.9	742.8
20	FUEL TMP (DEG C)	16.48	16.43	16.57	16.51	16.30	16.19
21	WET TMP (deg c)	12.62	12.40	12.75	12.68	12.55	12.64
22	DRY TMP (DEG C)	21.95	21.42	21.99	21.79	21.35	21.49
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	23.69	22.54	23.48	23.32	22.55	22.90
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	266.5	267.5	264.4	263.8	261.8	256.9
27	T.CPTORQUE (NM)	128.4	128.9	128.7	128.4	124.0	122.2
28	T.PPC.FAC ()	1.007	1.005	1.007	1.007	1.005	1.006
29	T.EXH A/F ()	20.24	20.81	20.75	20.75	20.65	20.64
30	T.BSPEHC (G/KWHr)	19.47	20.17	20.98	22.11	21.39	24.55
31	T.BSPENOX (G/KWHr)	16.05	15.46	15.52	16.53	7.414	6.420
32	T.BSPECO (G/KWHr)	52.91	39.26	34.09	25.48	33.60	15.39
33	T.BSPEFC (G/KWHr)	288.4	284.5	283.9	283.2	288.4	291.9
34	T.AIRFLO (g/s)	54.20	55.33	54.81	54.58	53.50	53.26
35	T.REL HUM (Fraction)	.3203	.3314	.3270	.3315	.3439	.3430
36	T.FUELFLOW (g/s)	2.677	2.658	2.641	2.630	2.591	2.581
37	CYL #2 TMP (DEG C)	220.4	212.8	211.9	210.6	196.1	192.8
38	DWNPIPE TMP (deg C)	521.0	505.0	506.4	513.9	487.1	501.4
39	CAT TMP1 (deg c)	511.0	493.8	496.1	503.9	477.9	493.3
40	CAT TMP2 (deg C)	498.9	482.8	485.0	492.3	467.7	482.3
41	CAT TMP3 (deg C)	494.5	478.5	480.5	487.8	463.4	477.3
42	HD BOLT TMP (DEG C)	89.74	89.94	89.88	89.67	89.77	89.89
43	H2OIN TMP (DEG C)	83.62	84.17	84.21	83.96	85.35	85.59
44	H2OOUT TMP (DEG C)	89.53	89.72	89.70	89.47	89.66	89.78
45	H20 FLOW (l/min)	67.82	67.88	67.78	67.93	68.28	68.27
46	DYNO TMP (DEG C)	38.77	39.33	39.45	36.14	38.40	36.86
47	EX SYS PRES (kpa)	-1.621	-1.621	-1.636	-1.631	-1.623	-1.644
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	99.05	99.05	99.03	99.03	99.02	99.01
50	AIR PRESS (kPa)	538.0	537.9	537.6	537.7	537.7	537.6
51	F/A DIFF (kPa)	67.83	68.00	68.01	68.03	68.13	68.12
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00
54	PPC.FAC ()	1.007	1.005	1.007	1.007	1.005	1.006
55	DAT PRESS (kPa)	98.21	98.20	98.17	98.16	98.15	98.13
56	VAP PRESS (kPa)	.8439	.8452	.8638	.8650	.8733	.8786
57	NOX_HCF ()	.8499	.8501	.8529	.8531	.8544	.8552
58	CMASS_NOX (g/s)	.1260	.1236	.1233	.1313	.5752E-01	.4832E-01
59	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481
60	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000
61							
62	ECU FPC ()	21.10	21.10	21.10	21.10	20.42	20.42
63	ECU TEMP ()	91.00	91.00	91.00	91.00	91.00	91.00
64	ECU SA ()	13.00	13.00	13.00	13.00	13.00	13.00
65	ECU AST ()	163.0	163.0	163.0	163.0	163.0	163.0
66	ECU EOA ()	67.00	67.00	67.00	67.00	67.00	67.00
67	ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320
68	ECU FPW ()	8.610	8.610	8.610	8.610	8.610	8.610
69	ECU SAPC ()	385.0	385.0	385.0	385.0	385.0	385.0
70	ECU FBAPC ()	385.0	385.0	385.0	385.0	370.0	370.0
71	ECU A/F ()	18.10	18.10	18.10	18.10	18.10	18.10
72	ECU EV ()	53.00	53.00	53.00	53.00	53.00	53.00
73	ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0
74	ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0
75	ECU PPOT ()	848.0	848.0	848.0	848.0	848.0	848.0
76	ECU AFL ()	46.00	46.00	46.00	46.00	47.00	47.00
77							
78	FUELFLO (G/SEC)	2.665	2.675	2.644	2.638	2.618	2.569
79	AIRFLO (G/SEC)	53.94	55.67	54.87	54.75	54.07	53.02
80	EXH A/F (:1)	20.24	20.81	20.76	20.75	20.65	20.64
81							
82	BSPEFC (G/KWHR)	286.9	286.3	284.1	284.1	291.5	290.6
83	BSPEHC (g/kWh)	19.37	20.30	20.99	22.18	21.62	24.44
84	BSPECO (g/kWh)	52.63	39.50	34.12	25.55	33.96	15.31

	1	2	3	4	5	6
	E1I1.1	E1I2.1	E1I3.1	E1I4.1	E1I5.1	E1I6.1
85 BSPENOX (g/kWh)	15.96	15.56	15.54	16.58	7.495	6.390
86						
87 FFCC (mg/cyl/cyc)	21.29	21.38	21.12	21.08	20.92	20.54
88 AIRCC (mg/cyl/cyc)	430.9	444.8	438.4	437.5	432.1	423.8
89 MASS_HC (g/sec)	.1799	.1897	.1954	.2059	.1942	.2161
90 MASS_CO (g/sec)	.4888	.3691	.3175	.2373	.3050	.1354
91 MASS_NOX (g/sec)	.1483	.1454	.1446	.1539	.6732E-01	.5650E-01


nas2725a1.e1i.scan
SEARCH='NAS2725A1' (57,62)
2500/wot
6, 22, FPC Water Scans
With Water, 78 PSI Air, 89 PSI Air
Two fuel rail Head
CPTORQUE (Nm)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
SEE KEY
POINT #
55
50
45
40
35
30
25
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15
10
5
0
1
2
3
4
5
6
7
nas2725a1.e1i.scan Ovs83
nas2725a1.e1i.scan Ovs84
nas2725a1.e1i.scan Ovs85
nas2725a1.e1i.scan Ovs8
nas2725a1.e1i.scan Ovs29
nas2725a1.e1i.scan Ovs37
testcell 3-APR-98

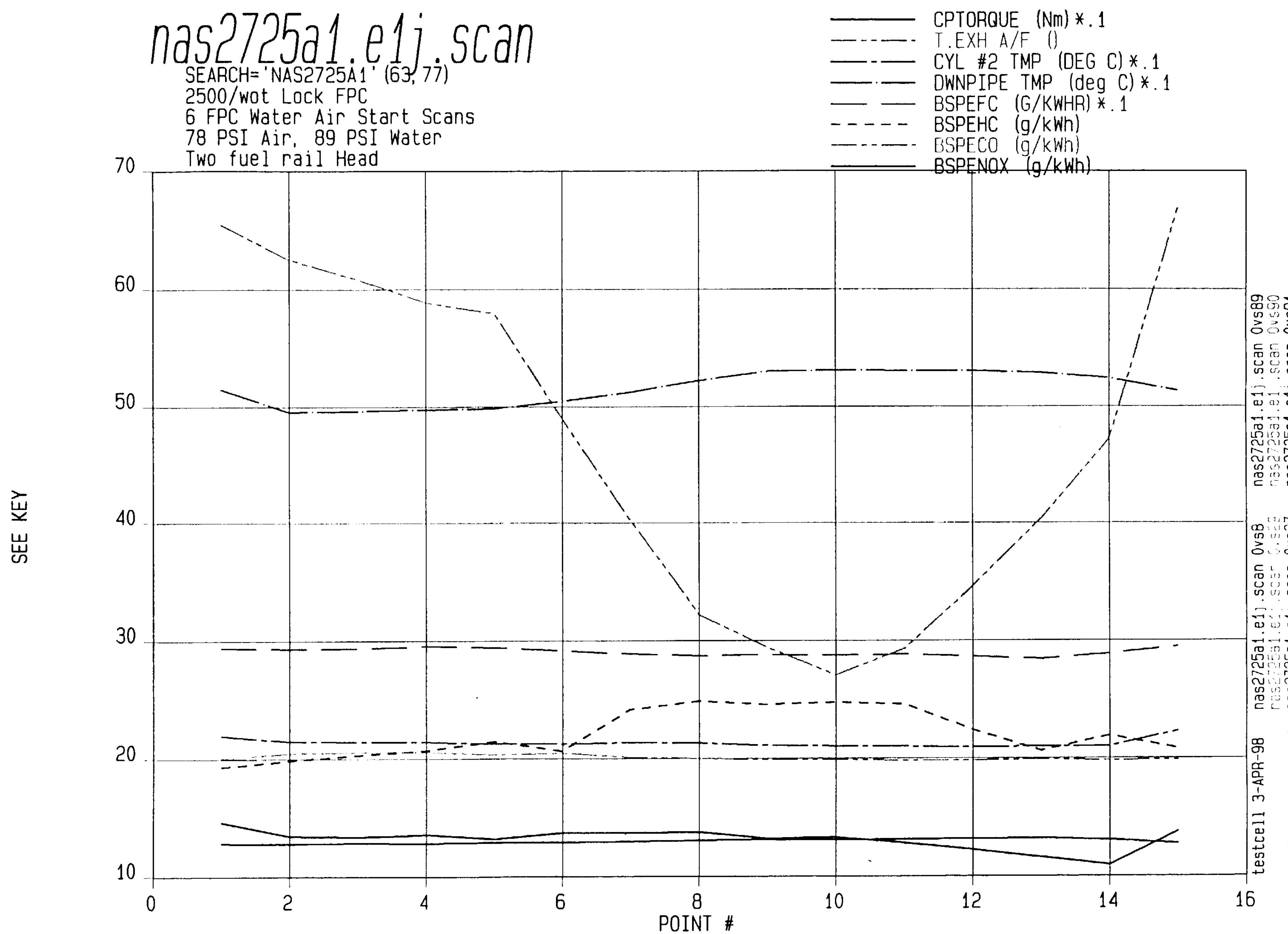
SEARCH="NAS2725A1"(63,77)
2500/wot Lock FPC
6 FPC Water Air Start Scans
78 PSI Air, 89 PSI Water
Two fuel rail Head

	1	2	3	4	5	6	7	8	9
	E1J1.1	E1J2.1	E1J3.1	E1J4.1	E1J5.1	E1J6.1	E1J7.1	E1J8.1	E1J9.1
1									
2 Search BLK	63.00	64.00	65.00	66.00	67.00	68.00	69.00	70.00	71.00
3 Exp. Ref.	E1J1.1	E1J2.1	E1J3.1	E1J4.1	E1J5.1	E1J6.1	E1J7.1	E1J8.1	E1J9.1
4 Date Logged	29/01/98	29/01/98	29/01/98	29/01/98	29/01/98	29/01/98	29/01/98	29/01/98	29/01/98
5 Time Logged	14:15:16	14:28:42	14:34:44	14:40:22	14:46:11	14:51:55	14:57:13	15:02:38	15:08:18
6 SPEED (rpm)	2503	2502	2503	2502	2503	2503	2503	2503	2503
7 TORQUE (NM)	125.6	125.7	125.9	126.1	126.5	126.8	127.4	128.3	128.9
8 CPTORQUE (Nm)	128.3	128.3	128.7	128.5	129.2	129.2	130.1	130.6	131.5
9									
10 POWER (KWATTS)	32.91	32.95	33.01	33.05	33.15	33.22	33.39	33.63	33.78
11 CPPOWER (kW)	33.64	33.61	33.73	33.69	33.87	33.85	34.10	34.24	34.46
12									
13 HC FID (PPM)	7035	7088	7203	7290	7605	7395	8892	9261	9143
14 CO (%)	1.173	1.099	1.064	1.022	1.013	.8642	.7293	.5914	.5395
15 CO2 (%)	8.818	8.669	8.640	8.661	8.669	8.853	9.028	9.191	9.274
16 O2 (%)	7.835	8.079	8.129	8.125	7.952	7.950	7.815	7.698	7.526
17 NOX (PPM)	1596	1439	1425	1436	1407	1475	1517	1541	1475
18									
19 AT PRESS (MM HG)	733.6	733.8	733.9	734.0	734.1	734.1	734.1	734.2	734.3
20 FUEL TMP (DEG C)	15.17	15.05	15.14	14.97	14.93	14.96	14.80	14.80	14.51
21 WET TMP (deg c)	12.49	12.30	12.42	12.18	12.52	12.08	12.37	12.05	12.33
22 DRY TMP (DEG C)	21.92	21.60	21.81	21.32	21.91	21.26	21.73	21.20	21.70
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	23.63	22.90	23.64	22.52	23.79	22.65	23.58	22.32	23.31
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	268.8	268.6	269.3	271.3	271.2	269.0	268.1	268.2	270.3
27 T.CPTORQUE (NM)	128.3	128.3	128.7	128.5	129.2	129.2	130.1	130.6	131.5
28 T.PPC.FAC ()	1.022	1.020	1.022	1.019	1.022	1.019	1.021	1.018	1.020
29 T.EXH A/F ()	20.11	20.50	20.58	20.60	20.38	20.49	20.14	20.03	19.90
30 T.BSPEHC (G/KWHr)	19.40	19.80	20.38	20.60	21.61	20.94	24.55	25.13	24.56
31 T.BSPENOX (G/KWHr)	14.66	13.38	13.42	13.51	13.30	13.90	13.95	13.92	13.19
32 T.BSPECO (G/KWHr)	65.60	62.24	61.01	58.55	58.32	49.60	40.81	32.53	29.37
33 T.BSPEFC (G/KWHr)	294.6	292.3	294.5	293.8	296.3	295.7	293.5	290.2	287.7
34 T.AIRFLO (g/s)	54.17	54.86	55.58	55.59	55.59	55.93	54.83	54.28	53.73
35 T.REL HUM (Fraction)	.3171	.3200	.3173	.3250	.3189	.3211	.3176	.3217	.3165
36 T.FUELFLOW (g/s)	2.693	2.676	2.701	2.698	2.728	2.730	2.723	2.711	2.700
37 CYL #2 TMP (DEG C)	219.8	215.1	214.4	214.4	213.0	212.7	213.7	213.2	211.3
38 DWNPIPE TMP (deg C)	515.0	495.5	496.2	497.4	498.4	504.8	512.3	522.0	529.9
39 CAT TMP1 (deg c)	506.2	483.8	484.2	485.7	487.2	494.7	502.9	512.4	519.3
40 CAT TMP2 (deg C)	493.7	472.9	473.5	474.9	476.4	483.5	491.2	500.2	507.0
41 CAT TMP3 (deg C)	489.2	469.2	469.7	471.2	472.7	479.1	486.6	495.2	501.8
42 HD BOLT TMP (DEG C)	89.90	89.67	89.70	89.85	89.64	89.78	89.78	89.76	89.90
43 H2OIN TMP (DEG C)	83.76	83.99	84.10	84.19	84.06	84.31	84.31	84.37	84.48
44 H2OOUT TMP (DEG C)	89.65	89.57	89.58	89.77	89.57	89.75	89.70	89.72	89.81
45 H20 FLOW (l/min)	68.02	68.16	68.19	68.05	68.18	68.18	68.15	68.22	68.14
46 DYNO TMP (DEG C)	37.03	38.62	35.98	38.77	36.26	37.85	36.26	37.55	36.36
47 EX SYS PRES (kpa)	-2.947	-2.951	-2.931	-2.914	-2.901	-2.911	-2.910	-2.885	-2.857
48 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
49 ATMOS (KPA)	97.79	97.82	97.83	97.84	97.85	97.85	97.86	97.87	97.88
50 AIR PRESS (kPa)	538.4	537.7	537.8	538.1	537.9	538.0	538.0	537.7	537.7
51 F/A DIFF (kPa)	68.70	69.09	69.08	69.10	69.07	69.12	69.20	69.29	69.28
52 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
53 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
54 WECU FPC ()	0.0	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
55 WECU AST ()	0.0	291.0	276.0	261.0	246.0	231.0	216.0	201.0	186.0
56 WECU EOA ()	0.0	206.0	192.0	176.0	162.0	147.0	132.0	117.0	102.0
57 WECU APW ()	0.0	5.600	5.600	5.600	5.600	5.600	5.600	5.600	5.600
58 WECU FPW ()	0.0	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400
59 WECU PPOT ()	0.0	843.0	843.0	843.0	843.0	843.0	843.0	843.0	843.0
60 PPC.FAC ()	1.022	1.020	1.022	1.019	1.022	1.019	1.021	1.018	1.020
61 DAT PRESS (kPa)	96.95	96.99	97.00	97.02	97.01	97.04	97.03	97.06	97.06
62 VAP PRESS (kPa)	.8338	.8249	.8287	.8238	.8382	.8112	.8256	.8098	.8214
63 NOX_HCF ()	.8500	.8486	.8491	.8484	.8506	.8464	.8486	.8462	.8479
64 CMASS_NOX (g/s)	.1136	.1044	.1042	.1058	.1036	.1070	.1091	.1088	.1050
65 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
66 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
67									
68 ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
69 ECU TEMP ()	91.00	91.00	91.00	91.00	91.00	91.00	91.00	91.00	91.00
70 ECU SA ()	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
71 ECU AST ()	161.0	161.0	161.0	161.0	161.0	161.0	161.0	161.0	161.0
72 ECU EOA ()	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00
73 ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320
74 ECU FPW ()	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610
75 ECU SAPC ()	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0
76 ECU FBAPC ()	377.0	377.0	379.0	377.0	375.0	374.0	370.0	370.0	368.0
77 ECU A/F ()	18.10	18.10	18.10	18.10	18.00	17.90	17.60	17.60	17.60
78 ECU EV ()	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00
79 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81 ECU PPOT ()	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0
82 ECU AFL ()	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00
83									
84 FUELFLO (G/SEC)	2.688	2.686	2.693	2.713	2.712	2.690	2.681	2.682	2.703

	10	11	12	13	14	15
	E1J10.1	E1J11.1	E1J12.1	E1J13.1	E1J14.1	E1J15.1
1						
2 Search BLK	72.00	73.00	74.00	75.00	76.00	77.00
3 Exp. Ref.	E1J10.1	E1J11.1	E1J12.1	E1J13.1	E1J14.1	E1J15.1
4 Date Logged	29/01/98	29/01/98	29/01/98	29/01/98	29/01/98	29/01/98
5 Time Logged	15:13:50	15:19:19	15:24:50	15:30:40	15:37:04	15:56:40
6 SPEED (rpm)	2503	2503	2503	2503	2503	2503
7 TORQUE (NM)	128.6	128.8	129.6	129.8	128.6	125.5
8 CPTORQUE (Nm)	131.0	131.4	131.9	132.2	130.8	127.9
9						
10 POWER (KWATTS)	33.71	33.77	33.96	34.03	33.70	32.89
11 CPPOWER (kW)	34.34	34.43	34.56	34.66	34.30	33.52
12						
13 HC FID (PPM)	9194	9140	8387	7816	8189	7543
14 CO (%)	.4957	.5369	.6385	.7532	.8695	1.192
15 CO2 (%)	9.280	9.274	9.250	9.244	9.120	8.726
16 O2 (%)	7.492	7.459	7.418	7.507	7.573	7.662
17 NOX (PPM)	1487	1435	1380	1318	1231	1498
18						
19 AT PRESS (MM HG)	734.4	734.6	734.6	734.7	734.8	734.9
20 FUEL TMP (DEG C)	14.65	14.54	14.65	14.27	14.55	14.28
21 WET TMP (deg c)	12.03	12.27	11.93	12.13	11.93	12.28
22 DRY TMP (DEG C)	21.31	21.71	21.26	21.53	21.33	22.12
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	22.80	23.32	22.44	23.02	22.72	23.48
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	269.3	270.5	270.1	268.8	270.4	269.3
27 T.CPTORQUE (NM)	131.0	131.4	131.9	132.2	130.8	127.9
28 T.PPC.FAC ()	1.019	1.020	1.018	1.019	1.018	1.019
29 T.EXH A/F ()	19.90	19.84	19.85	19.91	19.84	19.89
30 T.BSPEHC (G/KWHr)	24.92	24.66	22.44	20.77	21.91	20.96
31 T.BSPENOX (G/KWHr)	13.42	12.89	12.29	11.66	10.96	13.86
32 T.BSPECO (G/KWHr)	27.23	29.36	34.62	40.58	47.15	67.14
33 T.BSPEFC (G/KWHr)	289.5	288.9	286.5	286.1	288.6	296.2
34 T.AIRFLO (g/s)	53.97	53.79	53.64	53.81	53.61	53.82
35 T.REL HUM (Fraction)	.3158	.3122	.3117	.3120	.3089	.2952
36 T.FUELFLOW (g/s)	2.711	2.711	2.703	2.703	2.702	2.706
37 CYL #2 TMP (DEG C)	210.5	210.2	209.6	210.0	210.2	223.1
38 DWNPIPE TMP (deg C)	530.9	530.4	530.5	528.5	524.2	513.3
39 CAT TMP1 (deg c)	520.1	519.5	519.6	518.2	513.8	506.4
40 CAT TMP2 (deg C)	508.0	507.3	507.5	506.2	501.8	493.8
41 CAT TMP3 (deg C)	502.9	502.2	502.3	501.1	497.0	489.7
42 HD BOLT TMP (DEG C)	89.72	89.75	89.70	89.81	89.89	90.42
43 H2OIN TMP (DEG C)	84.39	84.32	84.30	84.34	84.40	84.34
44 H2OOUT TMP (DEG C)	89.69	89.65	89.69	89.73	89.75	90.20
45 H20 FLOW (l/min)	68.19	68.21	68.09	68.11	68.10	68.22
46 DYNO TMP (DEG C)	37.17	35.98	36.97	37.75	36.37	38.28
47 EX SYS PRES (kpa)	-2.846	-2.838	-2.847	-2.825	-2.814	-2.778
48 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00
49 ATMOS (KPA)	97.90	97.92	97.92	97.94	97.95	97.96
50 AIR PRESS (kPa)	537.7	537.9	537.8	537.5	537.6	538.0
51 F/A DIFF (kPa)	69.21	69.27	69.28	69.28	69.31	69.35
52 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0
53 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00
54 WECU FPC ()	6.000	6.000	6.000	6.000	6.000	0.0
55 WECU AST ()	171.0	156.0	141.0	126.0	106.0	0.0
56 WECU EOA ()	87.00	71.00	57.00	42.00	22.00	0.0
57 WECU APW ()	5.600	5.600	5.600	5.600	5.600	0.0
58 WECU FPW ()	2.400	2.400	2.400	2.400	2.400	0.0
59 WECU PPOT ()	843.0	843.0	843.0	843.0	843.0	0.0
60 PPC.FAC ()	1.019	1.020	1.018	1.019	1.018	1.019
61 DAT PRESS (kPa)	97.10	97.11	97.13	97.14	97.16	97.17
62 VAP PRESS (kPa)	.7999	.8105	.7873	.8012	.7832	.7858
63 NOX_HCF ()	.8447	.8462	.8427	.8443	.8421	.8424
64 CMASS_NOX (g/s)	.1054	.1021	.9761E-01	.9258E-01	.8645E-01	.1061
65 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481
66 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000
67						
68 ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00
69 ECU TEMP ()	91.00	91.00	91.00	91.00	91.00	91.00
70 ECU SA ()	13.00	13.00	13.00	13.00	13.00	13.00
71 ECU AST ()	161.0	161.0	161.0	161.0	161.0	161.0
72 ECU EOA ()	66.00	66.00	66.00	66.00	66.00	66.00
73 ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320
74 ECU FPW ()	8.610	8.610	8.610	8.610	8.610	8.610
75 ECU SAPC ()	386.0	386.0	386.0	386.0	386.0	386.0
76 ECU FBAPC ()	366.0	364.0	366.0	366.0	370.0	377.0
77 ECU A/F ()	17.40	17.40	17.40	17.50	17.70	18.10
78 ECU EV ()	53.00	53.00	53.00	53.00	53.00	53.00
79 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0
80 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0
81 ECU PPOT ()	850.0	850.0	850.0	850.0	850.0	850.0
82 ECU AFL ()	47.00	47.00	47.00	47.00	47.00	47.00
83						
84 FUELFLO (G/SEC)	2.693	2.705	2.701	2.688	2.704	2.693

	1	2	3	4	5	6	7	8	9
	E1J1.1	E1J2.1	E1J3.1	E1J4.1	E1J5.1	E1J6.1	E1J7.1	E1J8.1	E1J9.1
85 AIRFLO (G/SEC)	54.06	55.07	55.44	55.89	55.27	55.12	53.97	53.70	53.79
86 EXH A/F (:1)	20.11	20.50	20.58	20.60	20.38	20.49	20.13	20.02	19.90
87									
88 BSPEFC (G/KWHR)	294.0	293.5	293.7	295.5	294.5	291.6	289.0	287.1	288.0
89 BSPEHC (g/kWh)	19.36	19.89	20.32	20.72	21.48	20.65	24.17	24.86	24.58
90 BSPECO (g/kWh)	65.46	62.51	60.85	58.89	57.98	48.91	40.18	32.18	29.40
91 BSPENOX (g/kWh)	14.63	13.44	13.39	13.59	13.22	13.71	13.73	13.77	13.20
92									
93 FFCC (mg/cyl/cyc)	21.48	21.47	21.52	21.68	21.67	21.50	21.42	21.43	21.59
94 AIRCC (mg/cyl/cyc)	432.0	440.1	443.0	446.7	441.6	440.6	431.3	429.0	429.8
95 MASS_HC (g/sec)	.1770	.1820	.1864	.1902	.1978	.1905	.2242	.2322	.2307
96 MASS_CO (g/sec)	.5984	.5721	.5580	.5407	.5339	.4513	.3727	.3006	.2759
97 MASS_NOX (g/sec)	.1337	.1230	.1228	.1247	.1218	.1265	.1273	.1286	.1239

	10	11	12	13	14	15
	E1J10.1	E1J11.1	E1J12.1	E1J13.1	E1J14.1	E1J15.1
85 AIRFLO (G/SEC)	53.61	53.67	53.60	53.52	53.64	53.54
86 EXH A/F (:1)	19.90	19.84	19.84	19.91	19.84	19.88
87						
88 BSPEFC (G/KWHR)	287.6	288.3	286.3	284.4	288.8	294.8
89 BSPEHC (g/kWh)	24.75	24.60	22.42	20.65	21.92	20.86
90 BSPECO (g/kWh)	27.05	29.30	34.59	40.35	47.18	66.81
91 BSPENOX (g/kWh)	13.33	12.86	12.28	11.59	10.97	13.79
92						
93 FFCC (mg/cyl/cyc)	21.52	21.61	21.59	21.47	21.60	21.52
94 AIRCC (mg/cyl/cyc)	428.4	428.8	428.3	427.6	428.5	427.9
95 MASS_HC (g/sec)	.2318	.2308	.2115	.1952	.2052	.1906
96 MASS_CO (g/sec)	.2534	.2748	.3264	.3814	.4417	.6104
97 MASS_NOX (g/sec)	.1248	.1206	.1158	.1096	.1027	.1260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SEARCH='NAS2725A1' (63, 77)
2500/wot Lock FPC
6 FPC Water Air Start Scans
78 PSI Air, 89 PSI Water
Two fuel rail Head
CPTORQUE (Nm)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
SEE KEY
POINT #
70
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16
nas2725a1.e1j.scan Ovs8 nas2725a1.e1j.scan Ovs89
nas2725a1.e1j.scan Ovs37 nas2725a1.e1j.scan Ovs91
testcell 3-APR-98

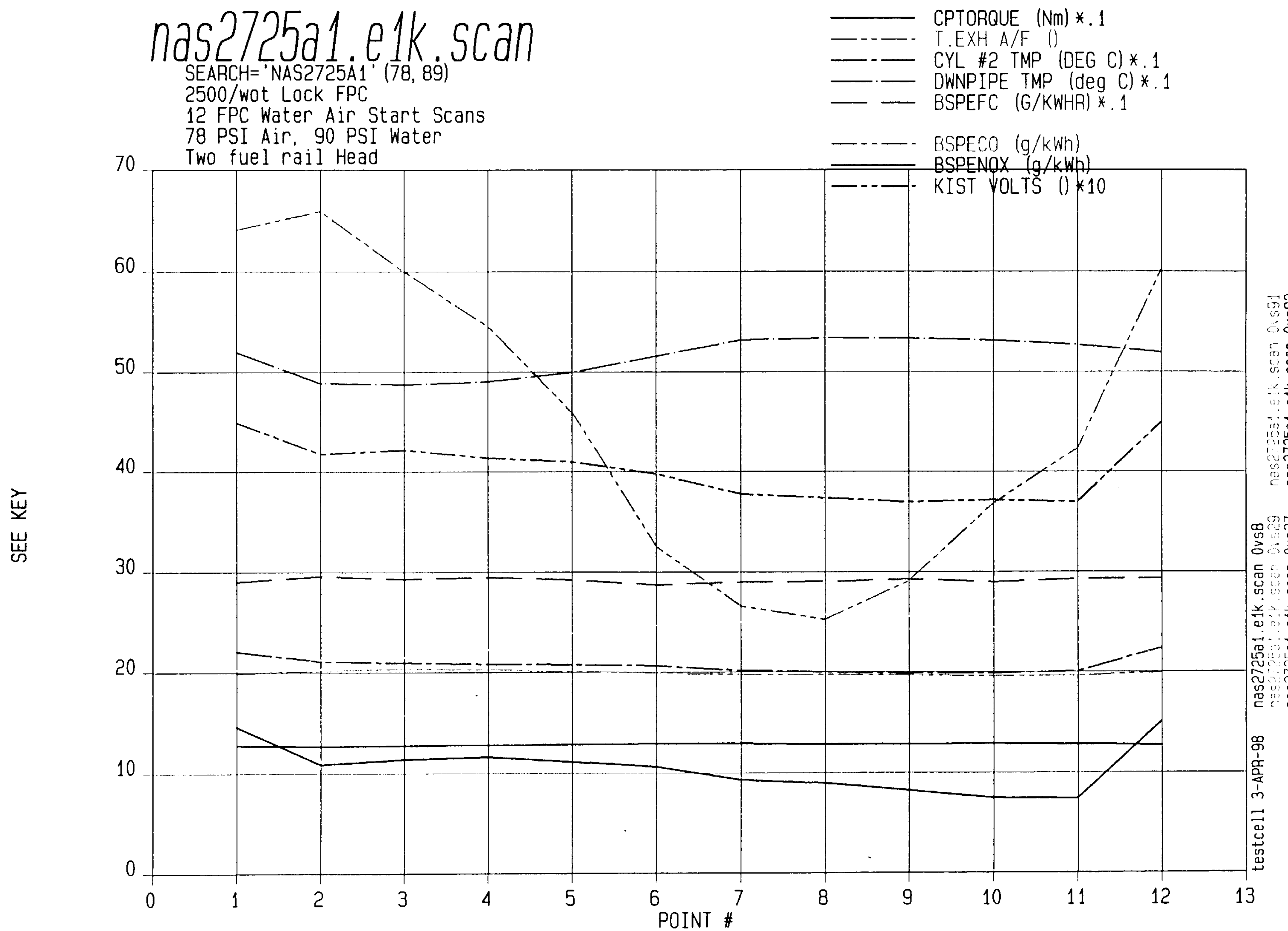
SEARCH="NAS2725A1"(78,89)
2500/wot Lock FPC
12 FPC Water Air Start Scans
78 PSI Air, 90 PSI Water
Two fuel rail Head

	1	2	3	4	5	6	7	8	9
	E1K1.1	E1K2.1	E1K3.1	E1K4.1	E1K5.1	E1K6.1	E1K7.1	E1K8.1	E1K9.1
1									
2 Search BLK	78.00	79.00	80.00	81.00	82.00	83.00	84.00	85.00	86.00
3 Exp. Ref.	E1K1.1	E1K2.1	E1K3.1	E1K4.1	E1K5.1	E1K6.1	E1K7.1	E1K8.1	E1K9.1
4 Date Logged	30/01/98	30/01/98	30/01/98	30/01/98	30/01/98	30/01/98	30/01/98	30/01/98	30/01/98
5 Time Logged	10:26:39	10:33:52	10:41:08	10:46:27	10:51:38	10:56:54	11:03:16	11:09:47	11:15:01
6 SPEED (rpm)	2503	2502	2503	2503	2503	2503	2503	2503	2503
7 TORQUE (NM)	126.5	125.9	126.6	127.2	127.9	128.5	128.6	127.9	127.9
8 CPTORQUE (Nm)	127.6	126.6	127.4	128.0	128.6	129.3	129.3	128.5	128.5
9									
10 POWER (KWATTS)	33.16	32.98	33.17	33.34	33.51	33.68	33.70	33.53	33.52
11 CPPOWER (kW)	33.45	33.18	33.39	33.57	33.70	33.88	33.88	33.69	33.67
12									
13 HC FID (PPM)	7479	7601	7677	7892	8682	9166	9258	9546	9386
14 CO (%)	1.168	1.162	1.053	.9537	.8221	.5962	.4856	.4609	.5275
15 CO2 (%)	8.817	8.662	8.635	8.729	8.931	9.180	9.346	9.345	9.322
16 O2 (%)	7.709	7.956	7.994	7.895	7.802	7.626	7.384	7.397	7.370
17 NOX (PPM)	1621	1167	1217	1235	1212	1184	1036	994.8	911.8
18									
19 AT PRESS (MM HG)	742.1	742.1	742.1	742.1	742.2	742.2	742.2	742.2	742.2
20 FUEL TMP (DEG C)	18.30	17.74	17.55	16.91	16.87	16.43	16.34	15.57	15.48
21 WET TMP (deg c)	11.78	11.33	11.64	11.63	11.40	11.41	11.43	11.27	11.19
22 DRY TMP (DEG C)	21.79	21.20	21.50	21.56	21.36	21.36	21.28	21.15	21.08
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	24.54	23.34	23.52	23.66	23.17	23.39	23.06	22.89	22.75
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	267.4	270.9	270.1	273.1	272.1	268.8	271.6	270.5	272.7
27 T.CPTORQUE (NM)	127.6	126.6	127.4	128.0	128.6	129.3	129.3	128.5	128.5
28 T.PPC.FAC ()	1.009	1.006	1.007	1.007	1.006	1.006	1.005	1.005	1.004
29 T.EXH A/F ()	19.92	20.22	20.38	20.30	20.11	19.98	19.77	19.76	19.70
30 T.BSPEHC (G/KWHr)	20.42	21.14	21.56	22.19	23.75	24.99	24.86	25.81	25.45
31 T.BSPENOX (G/KWHr)	14.73	10.81	11.38	11.56	11.04	10.74	9.265	8.956	8.230
32 T.BSPECO (G/KWHr)	64.61	65.50	59.95	54.35	45.59	32.94	26.43	25.26	28.99
33 T.BSPEFC (G/KWHr)	292.6	293.8	293.1	294.0	290.1	291.0	288.3	290.4	291.9
34 T.AIRFLO (g/s)	53.69	54.41	55.05	55.26	54.30	54.38	53.38	53.44	53.54
35 T.REL HUM (Fraction)	.2773	.2745	.2805	.2776	.2723	.2730	.2772	.2734	.2715
36 T.FUELFLOW (g/s)	2.695	2.691	2.702	2.722	2.701	2.722	2.700	2.704	2.718
37 CYL #2 TMP (DEG C)	221.1	210.8	209.8	208.3	207.7	206.4	201.8	200.2	198.8
38 DWNPIPE TMP (deg C)	520.0	489.2	487.7	490.6	499.8	515.8	532.0	533.9	533.4
39 CAT TMP1 (deg c)	511.3	479.4	477.7	481.2	491.5	507.6	522.1	523.1	522.3
40 CAT TMP2 (deg C)	498.9	468.9	467.4	470.7	480.2	495.6	509.8	511.1	510.4
41 CAT TMP3 (deg C)	494.9	465.6	464.1	467.3	476.1	490.8	504.5	505.9	505.5
42 HD BOLT TMP (DEG C)	90.05	91.87	90.09	89.79	89.94	89.86	90.13	90.16	90.00
43 H2OIN TMP (DEG C)	83.77	86.56	84.78	84.54	84.69	84.70	85.20	85.24	85.19
44 H2OOUT TMP (DEG C)	89.68	91.53	89.89	89.69	89.80	89.73	90.01	90.06	89.97
45 H20 FLOW (l/min)	68.37	68.70	68.48	68.52	68.42	68.48	68.56	68.51	68.65
46 DYNO TMP (DEG C)	36.97	38.58	36.06	36.62	36.26	36.56	36.21	38.92	36.23
47 EX SYS PRES (kpa)	-1.814	-1.830	-1.838	-1.852	-1.826	-1.829	-1.816	-1.826	-1.832
48 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
49 ATMOS (KPA)	98.93	98.91	98.92	98.92	98.93	98.93	98.94	98.94	98.94
50 AIR PRESS (kPa)	537.8	537.4	538.0	538.1	538.2	538.1	538.1	538.0	538.0
51 F/A DIFF (kPa)	69.82	69.96	69.80	69.88	69.79	69.83	69.80	69.75	69.75
52 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
53 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
54 WECU FPC ()	0.0	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
55 WECU AST ()	0.0	291.0	271.0	251.0	231.0	211.0	191.0	171.0	151.0
56 WECU EOA ()	0.0	207.0	187.0	167.0	147.0	127.0	107.0	87.00	67.00
57 WECU APW ()	0.0	5.600	5.600	5.600	5.600	5.600	5.600	5.600	5.600
58 WECU FPW ()	0.0	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800
59 WECU PPOT ()	0.0	844.0	844.0	844.0	844.0	844.0	844.0	844.0	844.0
60 KIST VOLTS ()	4.500	4.180	4.220	4.140	4.100	3.980	3.780	3.740	3.700
61 PPC.FAC ()	1.009	1.006	1.007	1.007	1.006	1.006	1.005	1.005	1.004
62 DAT PRESS (kPa)	98.20	98.22	98.20	98.21	98.24	98.24	98.24	98.25	98.26
63 VAP PRESS (kPa)	.7232	.6907	.7190	.7142	.6918	.6935	.7009	.6858	.6781
64 NOX_HCF ()	.8321	.8274	.8315	.8308	.8276	.8278	.8289	.8267	.8256
65 CMASS_NOX (g/s)	.1120	.8243E-01	.8720E-01	.8924E-01	.8568E-01	.8214E-01	.7233E-01	.6896E-01	.6348E-01
66 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
67 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
68									
69 ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
70 ECU TEMP ()	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00
71 ECU SA ()	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
72 ECU AST ()	161.0	161.0	161.0	161.0	161.0	161.0	161.0	161.0	161.0
73 ECU EOA ()	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00
74 ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320
75 ECU FPW ()	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610
76 ECU SAPC ()	385.0	385.0	385.0	385.0	385.0	385.0	385.0	385.0	385.0
77 ECU FBAPC ()	380.0	378.0	377.0	375.0	374.0	372.0	367.0	366.0	363.0
78 ECU A/F ()	18.20	18.10	18.00	17.90	17.80	17.70	17.60	17.40	17.30
79 ECU EV ()	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00
80 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82 ECU PPOT ()	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0
83 ECU AFL ()	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00
84									

		10	11	12
		E1K10.1	E1K11.1	E1K12.1
1				
2	Search BLK	87.00	88.00	89.00
3	Exp. Ref.	E1K10.1	E1K11.1	E1K12.1
4	Date Logged	30/01/98	30/01/98	30/01/98
5	Time Logged	11:20:13	11:25:06	11:35:22
6	SPEED (rpm)	2502	2503	2503
7	TORQUE (NM)	128.1	127.4	126.5
8	CPTORQUE (Nm)	128.7	128.0	127.1
9				
10	POWER (KWATTS)	33.58	33.39	33.17
11	CPPOWER (kW)	33.71	33.54	33.32
12				
13	HC FID (PPM)	9169	9091	7814
14	CO (%)	.6802	.7752	1.079
15	CO2 (%)	9.280	9.217	8.793
16	O2 (%)	7.399	7.486	7.696
17	NOX (PPM)	839.5	825.4	1643
18				
19	AT PRESS (MM HG)	742.2	742.2	742.3
20	FUEL TMP (DEG C)	15.14	15.36	15.12
21	WET TMP (deg c)	11.14	11.16	11.36
22	DRY TMP (DEG C)	20.98	21.06	21.43
23	DEPRESS (MM H2O)	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	22.61	22.84	22.84
25	FUEL TIME (SECS)	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	270.4	271.8	270.3
27	T.CPTORQUE (NM)	128.7	128.0	127.1
28	T.PPC.FAC ()	1.004	1.005	1.005
29	T.EXH A/F ()	19.63	19.65	19.96
30	T.BSPEHC (G/KWHr)	24.61	24.44	21.62
31	T.BSPENOX (G/KWHr)	7.502	7.387	15.14
32	T.BSPECO (G/KWHr)	37.01	42.24	60.52
33	T.BSPEFC (G/KWHr)	291.2	292.4	294.5
34	T.AIRFLO (g/s)	53.31	53.28	54.13
35	T.REL HUM (Fraction)	.2722	.2704	.2668
36	T.FUELFLOW (g/s)	2.716	2.712	2.713
37	CYL #2 TMP (DEG C)	199.0	200.6	224.0
38	DWNPIPE TMP (deg C)	531.6	527.1	519.6
39	CAT TMP1 (deg c)	521.0	516.7	511.0
40	CAT TMP2 (deg C)	509.1	505.0	498.8
41	CAT TMP3 (deg C)	504.2	500.5	495.3
42	HD BOLT TMP (DEG C)	89.47	89.57	90.37
43	H2OIN TMP (DEG C)	84.67	84.88	84.38
44	H2OOUT TMP (DEG C)	89.44	89.56	90.26
45	H20 FLOW (l/min)	68.49	68.61	68.16
46	DYNO TMP (DEG C)	38.70	35.93	38.51
47	EX SYS PRES (kpa)	-1.793	-1.828	-1.820
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00
49	ATMOS (KPA)	98.94	98.94	98.94
50	AIR PRESS (kPa)	538.0	538.0	538.4
51	F/A DIFF (kPa)	69.87	69.70	69.82
52	TESTCELL # (101_103)	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00
54	WECU FPC ()	12.00	12.00	0.0
55	WECU AST ()	131.0	111.0	0.0
56	WECU EOA ()	47.00	27.00	0.0
57	WECU APW ()	5.600	5.600	0.0
58	WECU FPW ()	4.800	4.800	0.0
59	WECU PPOT ()	844.0	844.0	0.0
60	KIST VOLTS ()	3.720	3.700	4.500
61	PPC.FAC ()	1.004	1.005	1.005
62	DAT PRESS (kPa)	98.26	98.26	98.26
63	VAP PRESS (kPa)	.6758	.6747	.6806
64	NOX_HCF ()	.8252	.8251	.8259
65	CMASS_NOX (g/s)	.5746E-01	.5665E-01	.1148
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000
68				
69	ECU FPC ()	21.00	21.00	21.00
70	ECU TEMP ()	92.00	92.00	92.00
71	ECU SA ()	13.00	13.00	13.00
72	ECU AST ()	161.0	161.0	161.0
73	ECU EOA ()	66.00	66.00	66.00
74	ECU APW ()	6.320	6.320	6.320
75	ECU FPW ()	8.610	8.610	8.610
76	ECU SAPC ()	385.0	385.0	385.0
77	ECU FBAPC ()	362.0	364.0	378.0
78	ECU A/F ()	17.30	17.30	18.00
79	ECU EV ()	53.00	53.00	53.00
80	ECU EGR ()	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0
82	ECU PPOT ()	851.0	851.0	851.0
83	ECU AFL ()	47.00	47.00	47.00
84				

	1	2	3	4	5	6	7	8	9
	E1K1.1	E1K2.1	E1K3.1	E1K4.1	E1K5.1	E1K6.1	E1K7.1	E1K8.1	E1K9.1
85 FUELFLO (G/SEC)	2.674	2.709	2.701	2.731	2.721	2.688	2.716	2.705	2.727
86 AIRFLO (G/SEC)	53.25	54.75	55.05	55.46	54.72	53.69	53.69	53.44	53.72
87 EXH A/F (:1)	19.92	20.21	20.38	20.31	20.11	19.98	19.77	19.76	19.70
88									
89 BSPEFC (G/KWHR)	290.2	295.7	293.2	294.9	292.3	287.3	290.1	290.4	292.9
90 BSPEHC (g/kWh)	20.25	21.27	21.56	22.26	23.94	24.67	25.01	25.81	25.53
91 BSPECO (g/kWh)	64.08	65.92	59.96	54.53	45.94	32.53	26.60	25.26	29.09
92 BSPENOX (g/kWh)	14.61	10.88	11.38	11.60	11.12	10.61	9.321	8.955	8.258
93									
94 FFCC (mg/cyl/cyc)	21.36	21.65	21.59	21.82	21.75	21.48	21.70	21.61	21.79
95 AIRCC (mg/cyl/cyc)	425.5	437.6	439.9	443.1	437.2	429.0	429.1	426.9	429.3
96 MASS_HC (g/sec)	.1865	.1949	.1987	.2062	.2228	.2308	.2342	.2404	.2377
97 MASS_CO (g/sec)	.5903	.6038	.5525	.5050	.4277	.3043	.2490	.2353	.2709
98 MASS_NOX (g/sec)	.1345	.9962E-01	.1049	.1074	.1035	.9923E-01	.8727E-01	.8341E-01	.7689E-01

	10	11	12
	E1K10.1	E1K11.1	E1K12.1
85 FUELFLO (G/SEC)	2.704	2.718	2.703
86 AIRFLO (G/SEC)	53.05	53.40	53.94
87 EXH A/F (:1)	19.62	19.65	19.95
88			
89 BSPEFC (G/KWHR)	289.9	293.0	293.4
90 BSPEHC (g/kWh)	24.49	24.49	21.54
91 BSPECO (g/kWh)	36.83	42.33	60.29
92 BSPENOX (g/kWh)	7.465	7.402	15.06
93			
94 FFCC (mg/cyl/cyc)	21.61	21.72	21.59
95 AIRCC (mg/cyl/cyc)	424.1	426.7	430.9
96 MASS_HC (g/sec)	.2284	.2272	.1985
97 MASS_CO (g/sec)	.3435	.3927	.5555
98 MASS_NOX (g/sec)	.6962E-01	.6866E-01	.1390


nas2725a1.e1k.scan
SEARCH='NAS2725A1' (78, 89)
2500/wot Lock FPC
12 FPC Water Air Start Scans
78 PSI Air, 90 PSI Water
Two fuel rail Head
CPTORQUE (Nm) *.1
T.EXH A/F ()
CYL #2 TMP (DEG C) *.1
DWNPIPE TMP (deg C) *.1
BSPEFC (G/KWHR) *.1
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS () *10
SEE KEY
POINT #
0
1
2
3
4
5
6
7
8
9
10
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0
testcell 3-APR-98
nas2725a1.e1k.scan 0vs8
nas2725a1.e1k.scan 0vs37
nas2725a1.e1k.scan 0vs91
nas2725a1.e1k.scan 0vs92

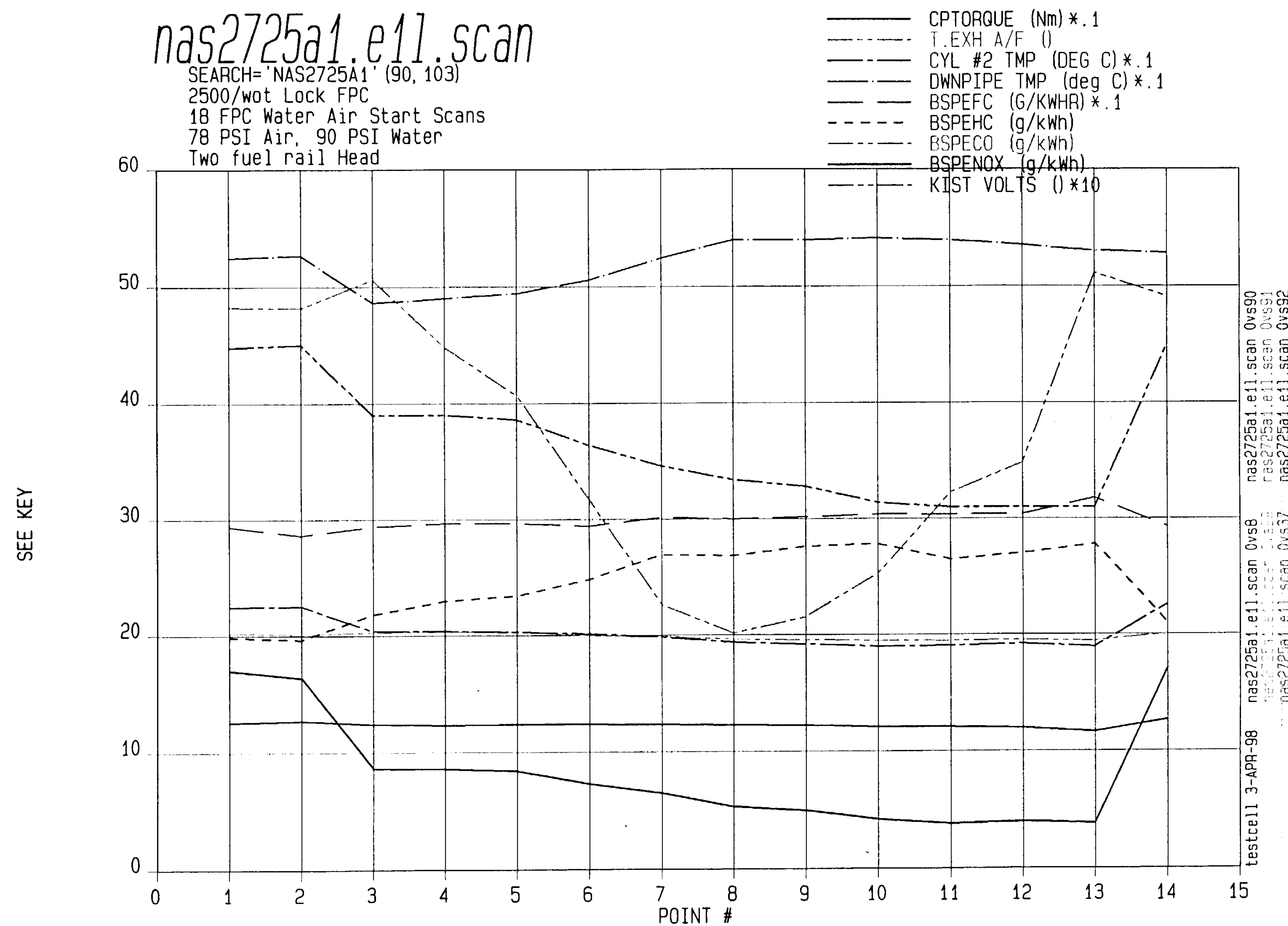
SEARCH="NAS2725A1"(90,103)
2500/wot Lock FPC
18 FPC Water Air Start Scans
78 PSI Air, 90 PSI Water
Two fuel rail Head

	1 E1L1.1	2 E1L2.1	3 E1L3.1	4 E1L4.1	5 E1L5.1	6 E1L6.1	7 E1L7.1	8 E1L8.1	9 E1L9.1
1									
2 Search BLK	90.00	91.00	92.00	93.00	94.00	95.00	96.00	97.00	98.00
3 Exp. Ref.	E1L1.1	E1L2.1	E1L3.1	E1L4.1	E1L5.1	E1L6.1	E1L7.1	E1L8.1	E1L9.1
4 Date Logged	03/02/98	03/02/98	03/02/98	03/02/98	03/02/98	03/02/98	03/02/98	03/02/98	03/02/98
5 Time Logged	08:18:35	08:38:36	08:45:26	08:50:27	08:55:41	09:02:02	09:07:26	09:12:57	09:18:11
6 SPEED (rpm)	2500	2500	2501	2501	2500	2500	2500	2502	2500
7 TORQUE (NM)	126.6	127.6	124.6	123.9	124.6	124.5	124.2	123.5	123.2
8 CPTORQUE (Nm)	125.8	127.0	124.1	123.3	123.8	123.9	123.4	122.6	122.5
9									
10 POWER (KWATTS)	33.14	33.41	32.64	32.44	32.62	32.60	32.51	32.36	32.25
11 CPPOWER (kW)	32.93	33.25	32.50	32.28	32.41	32.43	32.31	32.14	32.06
12									
13 HC FID (PPM)	7292	7431	7968	8213	8445	9107	9748	9835	.1006E+05
14 CO (%)	.8742	.8986	.9126	.7915	.7242	.5738	.4039	.3639	.3866
15 CO2 (%)	9.200	9.196	9.061	9.039	9.167	9.342	9.575	9.679	9.635
16 O2 (%)	7.863	7.842	8.025	7.970	7.988	7.699	7.630	7.351	7.354
17 NOX (PPM)	1875	1863	953.2	928.2	917.4	807.2	708.0	585.1	547.6
18									
19 AT PRESS (MM HG)	750.0	749.7	749.6	749.4	749.3	749.3	749.4	749.3	749.2
20 FUEL TMP (DEG C)	18.59	20.00	19.23	18.28	17.34	17.13	16.52	16.40	16.16
21 WET TMP (deg c)	11.67	11.34	11.44	11.51	11.26	11.40	11.34	11.10	11.22
22 DRY TMP (DEG C)	21.00	21.63	21.57	21.62	21.23	21.51	21.38	21.05	21.24
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	23.20	24.17	24.23	23.77	22.88	23.73	23.17	22.76	23.34
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	270.5	265.7	266.7	267.4	268.8	266.4	272.5	269.8	270.5
27 T.CPTORQUE (NM)	125.8	127.0	124.1	123.3	123.8	123.9	123.4	122.6	122.5
28 T.PPC.FAC ()	.9938	.9952	.9957	.9950	.9933	.9950	.9938	.9930	.9943
29 T.EXH A/F ()	20.22	20.15	20.28	20.33	20.31	20.00	19.88	19.61	19.56
30 T.BSPEHC (G/KWHr)	19.77	19.99	21.88	23.17	23.51	25.24	26.78	26.88	27.81
31 T.BSPENOX (G/KWHr)	16.92	16.68	8.714	8.718	8.501	7.447	6.474	5.324	5.038
32 T.BSPECO (G/KWHr)	48.05	49.00	50.80	45.27	40.86	32.23	22.49	20.16	21.66
33 T.BSPEFC (G/KWHr)	292.7	291.3	295.2	299.9	298.2	299.3	300.1	300.5	303.9
34 T.AIRFLO (g/s)	54.50	54.48	54.26	54.95	54.90	54.19	53.88	52.92	53.26
35 T.REL HUM (Fraction)	.3018	.2545	.2629	.2648	.2666	.2629	.2647	.2643	.2633
36 T.FUELFLOW (g/s)	2.695	2.703	2.676	2.703	2.703	2.710	2.710	2.699	2.722
37 CYL #2 TMP (DEG C)	224.4	225.1	204.0	203.8	202.8	201.2	198.5	193.6	192.0
38 DWNPIPE TMP (deg C)	524.8	526.6	486.3	490.0	494.3	505.9	524.3	539.8	539.6
39 CAT TMP1 (deg c)	514.9	517.2	477.1	480.3	484.8	497.1	515.1	528.6	527.8
40 CAT TMP2 (deg C)	502.5	504.8	466.9	469.9	474.1	485.2	502.3	515.9	515.6
41 CAT TMP3 (deg C)	498.5	500.9	463.6	466.3	470.4	480.8	497.1	510.7	510.9
42 HD BOLT TMP (DEG C)	91.10	90.66	90.12	89.38	89.80	89.86	90.13	89.86	89.78
43 H2OIN TMP (DEG C)	84.76	84.47	85.43	84.61	85.20	85.35	85.75	85.51	85.48
44 H2OOUT TMP (DEG C)	90.53	90.33	89.91	89.18	89.73	89.80	90.03	89.74	89.65
45 H20 FLOW (l/min)	69.11	68.58	69.31	69.12	69.16	69.21	69.17	69.13	69.20
46 DYNO TMP (DEG C)	32.95	37.38	38.35	36.56	38.29	36.23	38.47	35.99	38.19
47 EX SYS PRES (kpa)	-.8370	-.8592	-.8683	-.8769	-.8894	-.8821	-.8702	-.8920	-.8790
48 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
49 ATMOS (KPA)	99.98	99.93	99.91	99.90	99.88	99.89	99.89	99.87	99.87
50 AIR PRESS (kPa)	537.8	538.2	537.9	538.1	538.2	538.1	538.0	538.4	538.1
51 F/A DIFF (kPa)	68.40	68.68	68.73	68.74	68.73	68.86	68.92	68.60	68.78
52 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
53 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
54 WECU FPC ()	0.0	0.0	18.00	18.00	18.00	18.00	18.00	18.00	18.00
55 WECU AST ()	0.0	0.0	291.0	271.0	251.0	231.0	211.0	191.0	171.0
56 WECU EOA ()	0.0	0.0	207.0	187.0	167.0	147.0	127.0	106.0	87.00
57 WECU APW ()	0.0	0.0	5.600	5.600	5.600	5.600	5.600	5.600	5.600
58 WECU FPW ()	0.0	0.0	7.200	7.200	7.200	7.200	7.200	7.200	7.200
59 WECU PPOT ()	0.0	0.0	844.0	844.0	844.0	844.0	844.0	844.0	844.0
60 KIST VOLTS ()	4.480	4.500	3.900	3.900	3.860	3.640	3.460	3.340	3.280
61 PPC.FAC ()	.9937	.9952	.9957	.9950	.9933	.9950	.9938	.9930	.9943
62 DAT PRESS (kPa)	99.23	99.27	99.24	99.21	99.21	99.21	99.21	99.22	99.20
63 VAP PRESS (kPa)	.7503	.6573	.6769	.6839	.6723	.6743	.6736	.6590	.6642
64 NOX_HCF ()	.8349	.8217	.8245	.8255	.8238	.8241	.8240	.8220	.8227
65 CMASS_NOX (g/s)	.1306	.1250	.6491E-01	.6416E-01	.6314E-01	.5461E-01	.4844E-01	.3929E-01	.3688E-01
66 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
67 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
68									
69 ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
70 ECU TEMP ()	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00
71 ECU SA ()	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
72 ECU AST ()	161.0	161.0	161.0	161.0	161.0	161.0	161.0	161.0	161.0
73 ECU EOA ()	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00	66.00
74 ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320
75 ECU FPW ()	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610
76 ECU SAPC ()	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0
77 ECU FBAPC ()	380.0	380.0	376.0	375.0	372.0	370.0	366.0	360.0	357.0
78 ECU A/F ()	18.10	18.10	17.80	17.70	17.70	17.60	17.30	17.20	17.10
79 ECU EV ()	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.00
80 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82 ECU PPOT ()	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0
83 ECU AFL ()	48.00	48.00	47.00	47.00	47.00	47.00	47.00	46.00	46.00
84									

		10	11	12	13	14
		E1L10.1	E1L11.1	E1L12.1	E1L13.1	E1L14.1
1						
2	Search BLK	99.00	100.0	101.0	102.0	103.0
3	Exp. Ref.	E1L10.1	E1L11.1	E1L12.1	E1L13.1	E1L14.1
4	Date Logged	03/02/98	03/02/98	03/02/98	03/02/98	03/02/98
5	Time Logged	09:23:59	09:30:13	09:35:21	09:41:21	09:54:50
6	SPEED (rpm)	2500	2500	2500	2500	2501
7	TORQUE (NM)	122.0	121.4	120.8	117.4	127.8
8	CPTORQUE (Nm)	121.1	120.7	119.8	116.5	126.9
9						
10	POWER (KWATTS)	31.95	31.79	31.64	30.73	33.46
11	CPPOWER (kW)	31.72	31.61	31.38	30.50	33.23
12						
13	HC FID (PPM)	.1015E+05	9709	9848	9673	7753
14	CO (%)	.4538	.5832	.6258	.8776	.8960
15	CO2 (%)	9.641	9.618	9.509	9.240	9.183
16	O2 (%)	7.362	7.385	7.479	7.531	7.772
17	NOX (PPM)	462.6	420.0	440.5	402.4	1900
18						
19	AT PRESS (MM HG)	749.2	749.3	749.4	749.5	749.6
20	FUEL TMP (DEG C)	16.29	16.17	16.29	16.10	16.08
21	WET TMP (deg c)	11.15	11.34	10.94	11.22	11.29
22	DRY TMP (DEG C)	21.08	21.38	20.81	21.21	21.54
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	22.63	23.34	22.31	22.56	23.12
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	269.7	268.2	267.3	271.2	272.5
27	T.CPTORQUE (NM)	121.1	120.7	119.8	116.5	126.9
28	T.PPC.FAC ()	.9929	.9943	.9918	.9923	.9931
29	T.EXH A/F ()	19.48	19.46	19.52	19.47	20.04
30	T.BSPEHC (G/KWHr)	27.86	26.81	27.40	27.88	20.65
31	T.BSPENOX (G/KWHr)	4.226	3.861	4.079	3.861	16.85
32	T.BSPECO (G/KWHr)	25.24	32.64	35.29	51.28	48.38
33	T.BSPEFC (G/KWHr)	304.0	307.6	308.5	318.5	288.9
34	T.AIRFLO (g/s)	52.55	52.87	52.92	52.95	53.82
35	T.REL HUM (Fraction)	.2663	.2646	.2646	.2648	.2551
36	T.FUELFLOW (g/s)	2.697	2.717	2.711	2.720	2.686
37	CYL #2 TMP (DEG C)	189.8	190.4	191.9	189.5	225.6
38	DWNPIPE TMP (deg C)	541.1	539.5	535.2	530.4	528.3
39	CAT TMP1 (deg c)	529.4	528.3	524.0	519.8	519.6
40	CAT TMP2 (deg C)	517.4	516.4	512.2	508.0	507.0
41	CAT TMP3 (deg C)	512.8	511.8	507.6	503.7	503.3
42	HD BOLT TMP (DEG C)	89.48	89.77	89.24	89.17	89.94
43	H2OIN TMP (DEG C)	85.29	85.51	85.13	84.81	83.96
44	H2OOUT TMP (DEG C)	89.39	89.68	89.25	89.16	89.85
45	H20 FLOW (l/min)	69.13	69.06	69.18	69.06	68.45
46	DYNO TMP (DEG C)	36.01	38.31	35.97	37.95	37.80
47	EX SYS PRES (kpa)	-.8946	-.8941	-.8756	-.8427	-.8303
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	99.87	99.88	99.89	99.91	99.92
50	AIR PRESS (kPa)	538.1	537.9	538.2	538.2	538.5
51	F/A DIFF (kPa)	68.79	68.89	68.65	68.76	68.83
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00
54	WECU FPC ()	18.00	18.00	18.00	18.00	0.0
55	WECU AST ()	151.0	131.0	111.0	91.00	0.0
56	WECU EOA ()	67.00	47.00	27.00	6.000	0.0
57	WECU APW ()	5.600	5.600	5.600	5.600	0.0
58	WECU FPW ()	7.200	7.200	7.200	7.200	0.0
59	WECU PPOT ()	844.0	844.0	844.0	844.0	0.0
60	KIST VOLTS ()	3.140	3.100	3.100	3.100	4.500
61	PPC.FAC ()	.9929	.9943	.9918	.9923	.9931
62	DAT PRESS (kPa)	99.21	99.20	99.24	99.24	99.26
63	VAP PRESS (kPa)	.6651	.6734	.6502	.6667	.6551
64	NOX_HCF ()	.8228	.8240	.8207	.8230	.8214
65	CMASS_NOX (g/s)	.3085E-01	.2774E-01	.2902E-01	.2706E-01	.1305
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000
68						
69	ECU FPC ()	21.00	21.00	21.00	21.00	21.00
70	ECU TEMP ()	92.00	92.00	92.00	92.00	92.00
71	ECU SA ()	13.00	13.00	13.00	13.00	13.00
72	ECU AST ()	161.0	161.0	161.0	161.0	161.0
73	ECU EOA ()	66.00	66.00	66.00	66.00	66.00
74	ECU APW ()	6.320	6.320	6.320	6.320	6.320
75	ECU FPW ()	8.610	8.610	8.610	8.610	8.610
76	ECU SAPC ()	386.0	386.0	386.0	386.0	386.0
77	ECU FBAPC ()	355.0	355.0	355.0	360.0	380.0
78	ECU A/F ()	16.80	16.80	16.80	17.20	18.10
79	ECU EV ()	53.00	53.00	53.00	53.00	53.00
80	ECU EGR ()	0.0	0.0	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0	0.0	0.0
82	ECU PPOT ()	851.0	851.0	851.0	851.0	851.0
83	ECU AFL ()	46.00	46.00	46.00	46.00	47.00
84						

	1	2	3	4	5	6	7	8	9
	E1L1.1	E1L2.1	E1L3.1	E1L4.1	E1L5.1	E1L6.1	E1L7.1	E1L8.1	E1L9.1
85 FUELFLO (G/SEC)	2.705	2.657	2.667	2.674	2.688	2.664	2.725	2.698	2.705
86 AIRFLO (G/SEC)	54.71	53.55	54.08	54.36	54.60	53.26	54.19	52.90	52.92
87 EXH A/F (:1)	20.22	20.15	20.28	20.33	20.31	20.00	19.88	19.60	19.56
88									
89 BSPEFC (G/KWHR)	293.8	286.3	294.1	296.7	296.7	294.2	301.8	300.2	301.9
90 BSPEHC (g/kWh)	19.85	19.64	21.81	22.93	23.39	24.80	26.93	26.84	27.63
91 BSPECO (g/kWh)	48.24	48.16	50.62	44.79	40.65	31.68	22.61	20.14	21.52
92 BSPENOX (g/kWh)	16.99	16.40	8.683	8.625	8.457	7.318	6.511	5.317	5.004
93									
94 FFCC (mg/cyl/cyc)	21.64	21.25	21.33	21.39	21.51	21.31	21.80	21.57	21.64
95 AIRCC (mg/cyl/cyc)	437.6	428.3	432.5	434.8	436.9	426.2	433.5	422.8	423.3
96 MASS_HC (g/sec)	.1827	.1823	.1977	.2066	.2119	.2246	.2431	.2413	.2475
97 MASS_CO (g/sec)	.4441	.4469	.4591	.4036	.3684	.2868	.2042	.1810	.1927
98 MASS_NOX (g/sec)	.1564	.1521	.7874E-01	.7773E-01	.7664E-01	.6627E-01	.5879E-01	.4780E-01	.4483E-01

	10	11	12	13	14
	E1L10.1	E1L11.1	E1L12.1	E1L13.1	E1L14.1
85 FUELFLO (G/SEC)	2.697	2.682	2.673	2.712	2.725
86 AIRFLO (G/SEC)	52.55	52.20	52.20	52.80	54.60
87 EXH A/F (:1)	19.48	19.46	19.53	19.47	20.04
88					
89 BSPEFC (G/KWHR)	303.9	303.8	304.2	317.7	293.1
90 BSPEHC (g/kWh)	27.85	26.47	27.02	27.81	20.95
91 BSPECO (g/kWh)	25.24	32.23	34.80	51.14	49.09
92 BSPENOX (g/kWh)	4.225	3.812	4.023	3.850	17.09
93					
94 FFCC (mg/cyl/cyc)	21.57	21.46	21.38	21.70	21.79
95 AIRCC (mg/cyl/cyc)	420.3	417.6	417.6	422.4	436.7
96 MASS_HC (g/sec)	.2472	.2338	.2374	.2374	.1948
97 MASS_CO (g/sec)	.2240	.2847	.3059	.4366	.4563
98 MASS_NOX (g/sec)	.3749E-01	.3366E-01	.3535E-01	.3287E-01	.1589


nas2725a1.e11.scan
SEARCH='NAS2725A1' (90, 103)
2500/wot Lock FPC
18 FPC Water Air Start Scans
78 PSI Air, 90 PSI Water
Two fuel rail Head
CPTORQUE (Nm)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS ()*10
SEE KEY
POINT #
0
10
20
30
40
50
60
1
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4
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11
12
13
14
15
nas2725a1.e11.scan Ovs90
nas2725a1.e11.scan Ovs91
nas2725a1.e11.scan Ovs92
nas2725a1.e11.scan Ovs8
nas2725a1.e11.scan Ovs37
testcell 3-APR-98

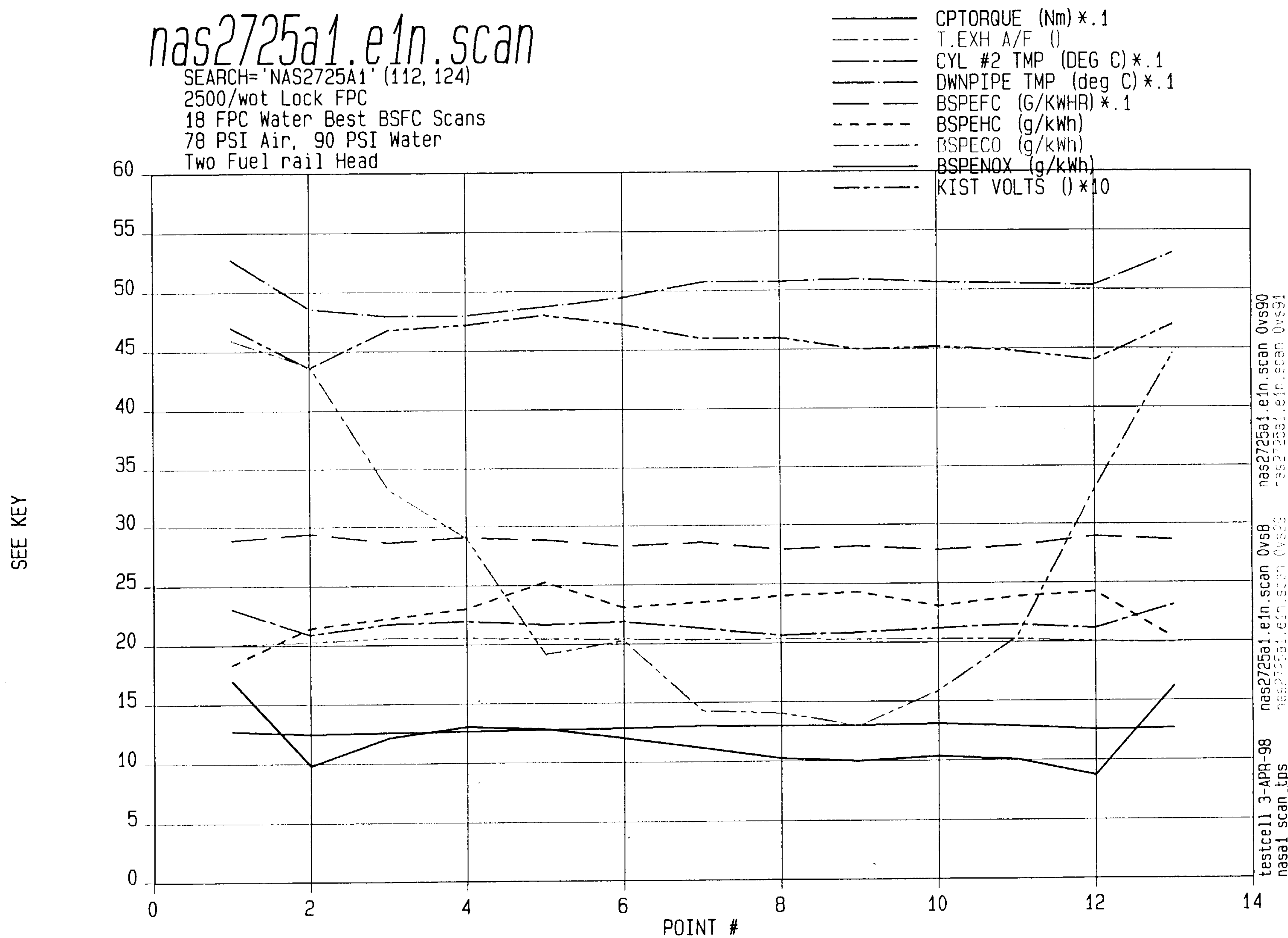
SEARCH="NAS2725A1"(112,124)
2500/wot Lock FPC
18 FPC Water Best BSFC Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head

	1	2	3	4	5	6	7	8	9
	E1N1.1	E1N2.1	E1N3.1	E1N4.1	E1N5.1	E1N6.1	E1N7.1	E1N8.1	E1N9.1
1									
2 Search BLK	112.0	113.0	114.0	115.0	116.0	117.0	118.0	119.0	120.0
3 Exp. Ref.	E1N1.1	E1N2.1	E1N3.1	E1N4.1	E1N5.1	E1N6.1	E1N7.1	E1N8.1	E1N9.1
4 Date Logged	04/02/98	04/02/98	04/02/98	04/02/98	04/02/98	04/02/98	04/02/98	04/02/98	04/02/98
5 Time Logged	08:21:42	08:29:34	08:36:06	08:43:43	08:51:16	08:59:03	09:06:13	09:13:03	09:19:43
6 SPEED (rpm)	2500	2500	2501	2501	2500	2501	2500	2501	2501
7 TORQUE (NM)	127.5	124.8	126.0	127.0	127.7	129.0	130.2	130.1	130.2
8 CPTORQUE (Nm)	127.4	124.8	126.0	126.8	127.6	128.9	130.3	129.9	130.1
9									
10 POWER (KWATTS)	33.37	32.67	33.00	33.25	33.44	33.77	34.08	34.06	34.10
11 CPPOWER (kW)	33.35	32.68	32.98	33.20	33.42	33.75	34.11	34.01	34.07
12									
13 HC FID (PPM)	6869	7807	8185	8290	9264	8600	8723	9150	9165
14 CO (%)	.8488	.7852	.6026	.5141	.3459	.3725	.2616	.2644	.2412
15 CO2 (%)	9.284	9.154	9.130	9.124	9.302	9.321	9.480	9.491	9.490
16 O2 (%)	7.619	7.886	8.071	7.953	7.949	7.798	7.666	7.797	7.692
17 NOX (PPM)	1908	1075	1344	1413	1416	1348	1247	1175	1135
18									
19 AT PRESS (MM HG)	745.6	745.3	745.4	745.4	745.3	745.2	745.2	745.3	745.4
20 FUEL TMP (DEG C)	17.01	17.23	17.61	17.85	19.70	19.31	18.08	17.54	16.86
21 WET TMP (deg c)	10.86	10.95	10.77	10.69	10.90	10.85	10.87	10.64	10.83
22 DRY TMP (DEG C)	21.55	21.73	21.53	21.33	21.66	21.66	21.75	21.37	21.67
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	23.49	23.64	23.45	22.89	23.29	23.20	23.86	22.88	23.23
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	267.6	266.8	262.8	268.6	267.8	265.6	270.5	264.4	266.9
27 T.CPTORQUE (NM)	127.4	124.8	126.0	126.8	127.6	128.9	130.3	129.9	130.1
28 T.PPC.FAC ()	.9995	1.000	.9996	.9984	.9995	.9995	1.001	.9985	.9991
29 T.EXH A/F ()	20.06	20.27	20.60	20.58	20.48	20.42	20.32	20.34	20.27
30 T.BSPEHC (G/KWHr)	18.47	21.27	22.51	22.55	24.56	23.11	23.54	24.67	24.27
31 T.BSPENOX (G/KWHr)	17.07	9.751	12.30	12.80	12.50	12.06	11.21	10.54	10.01
32 T.BSPECO (G/KWHr)	46.26	43.36	33.59	28.35	18.59	20.29	14.31	14.45	12.95
33 T.BSPEFC (G/KWHr)	290.7	291.5	289.7	284.4	280.0	283.2	285.9	287.2	281.5
34 T.AIRFLO (g/s)	54.06	53.63	54.70	54.05	53.27	54.24	54.98	55.29	54.03
35 T.REL HUM (Fraction)	.2306	.2285	.2261	.2287	.2283	.2256	.2234	.2243	.2244
36 T.FUELFLOW (g/s)	2.694	2.645	2.655	2.627	2.601	2.656	2.706	2.718	2.665
37 CYL #2 TMP (DEG C)	230.8	209.1	217.7	220.0	216.7	219.2	212.9	206.6	208.8
38 DWNPIPE TMP (deg C)	527.4	486.2	479.8	480.0	487.3	494.6	507.4	507.7	509.4
39 CAT TMP1 (deg c)	519.5	477.8	470.8	471.2	480.6	487.0	498.1	498.4	499.5
40 CAT TMP2 (deg C)	506.5	467.0	459.8	459.5	468.8	474.2	484.5	485.1	486.0
41 CAT TMP3 (deg C)	502.4	463.8	457.3	457.1	465.7	471.0	480.7	481.7	482.6
42 HD BOLT TMP (DEG C)	91.06	90.20	90.47	91.47	92.00	91.57	91.25	88.00	90.63
43 H2OIN TMP (DEG C)	84.77	85.31	85.54	86.40	87.19	87.03	86.92	83.55	86.16
44 H2OOUT TMP (DEG C)	90.66	89.87	90.26	91.20	91.71	91.32	91.02	88.02	90.48
45 H20 FLOW (l/min)	68.85	69.04	68.76	68.59	68.83	69.04	69.12	69.17	68.87
46 DYNO TMP (DEG C)	33.08	37.13	37.80	38.73	36.71	38.05	38.55	36.44	39.07
47 EX SYS PRES (kpa)	-1.365	-1.442	-1.418	-1.422	-1.421	-1.441	-1.422	-1.433	-1.411
48 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26:00	26.00	26.00	26.00
49 ATMOS (KPA)	99.38	99.35	99.36	99.36	99.35	99.33	99.34	99.34	99.36
50 AIR PRESS (kPa)	537.9	537.9	538.2	538.1	538.0	538.4	538.2	538.7	537.6
51 F/A DIFF (kPa)	68.00	67.92	67.81	68.04	67.99	68.11	68.15	67.75	68.19
52 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
53 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
54 WECU FPC ()	0.0	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
55 WECU AST ()	0.0	291.0	271.0	251.0	231.0	211.0	191.0	171.0	151.0
56 WECU EOA ()	0.0	207.0	207.0	167.0	147.0	127.0	107.0	87.00	67.00
57 WECU APW ()	0.0	5.600	5.600	5.600	5.600	5.600	5.600	5.600	5.600
58 WECU FPW ()	0.0	7.200	7.200	7.200	7.200	7.200	7.200	7.200	7.200
59 WECU PPOT ()	0.0	847.0	847.0	847.0	847.0	847.0	847.0	847.0	847.0
60 KIST VOLTS ()	4.700	4.360	4.680	4.720	4.800	4.720	4.600	4.600	4.500
61 PPC.FAC ()	.9995	1.000	.9996	.9984	.9995	.9995	1.001	.9985	.9991
62 DAT PRESS (kPa)	98.79	98.76	98.77	98.78	98.76	98.75	98.76	98.77	98.78
63 VAP PRESS (kPa)	.5929	.5938	.5805	.5804	.5909	.5841	.5815	.5705	.5810
64 NOX_HCF ()	.8132	.8134	.8115	.8115	.8130	.8121	.8117	.8102	.8116
65 CMASS_NOX (g/s)	.1278	.7260E-01	.9056E-01	.9811E-01	.9722E-01	.9183E-01	.8606E-01	.7865E-01	.7703E-01
66 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
67 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
68									
69 ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
70 ECU TEMP ()	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00
71 ECU SA ()	15.00	16.00	20.00	21.00	21.00	23.00	23.00	23.00	23.00
72 ECU AST ()	161.0	161.0	163.0	163.0	163.0	152.0	155.0	155.0	161.0
73 ECU EOA ()	66.00	66.00	69.00	69.00	69.00	57.00	61.00	61.00	66.00
74 ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320
75 ECU FPW ()	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610
76 ECU SAPC ()	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0
77 ECU FBAPC ()	375.0	375.0	374.0	374.0	374.0	374.0	372.0	370.0	370.0
78 ECU A/F ()	17.80	17.80	17.80	17.80	17.80	17.80	17.70	17.50	17.50
79 ECU EV ()	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00
80 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82 ECU PPOT ()	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0
83 ECU AFL ()	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00	47.00
84									

		10 E1N10.1	11 E1N11.1	12 E1N12.1	13 E1N13.1
1					
2	Search BLK	121.0	122.0	123.0	124.0
3	Exp. Ref.	E1N10.1	E1N11.1	E1N12.1	E1N13.1
4	Date Logged	04/02/98	04/02/98	04/02/98	04/02/98
5	Time Logged	09:26:11	09:33:00	09:39:12	09:45:51
6	SPEED (rpm)	2500	2501	2500	2501
7	TORQUE (NM)	131.1	129.3	125.8	126.5
8	CPTORQUE (Nm)	131.0	129.0	125.8	126.6
9					
10	POWER (KWATTS)	34.32	33.86	32.94	33.14
11	CPPOWER (kW)	34.30	33.79	32.95	33.16
12					
13	HC FID (PPM)	8863	9035	8978	7704
14	CO (%)	.3007	.3803	.6037	.8345
15	CO2 (%)	9.528	9.401	9.244	9.282
16	O2 (%)	7.756	7.759	7.710	7.611
17	NOX (PPM)	1197	1147	973.0	1848
18					
19	AT PRESS (MM HG)	745.3	745.1	745.1	744.9
20	FUEL TMP (DEG C)	16.28	15.96	15.51	15.60
21	WET TMP (deg c)	10.73	10.59	10.96	10.77
22	DRY TMP (DEG C)	21.53	21.35	21.79	21.78
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	23.29	22.50	23.59	23.77
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	265.6	265.0	265.0	263.7
27	T.CPTORQUE (NM)	131.0	129.0	125.8	126.6
28	T.PPC.FAC ()	.9993	.9979	1.000	1.001
29	T.EXH A/F ()	20.30	20.25	20.05	19.92
30	T.BSPEHC (G/KWHr)	23.14	23.79	24.66	20.59
31	T.BSPENOX (G/KWHr)	10.41	10.06	8.896	16.44
32	T.BSPECO (G/KWHr)	15.92	20.30	33.61	45.21
33	T.BSPEFC (G/KWHr)	279.2	280.8	294.5	290.7
34	T.AIRFLO (g/s)	54.07	53.49	54.02	53.29
35	T.REL HUM (Fraction)	.2235	.2225	.2269	.2163
36	T.FUELFLOW (g/s)	2.663	2.641	2.695	2.675
37	CYL #2 TMP (DEG C)	212.0	214.9	211.5	231.5
38	DWNPIPE TMP (deg C)	506.4	505.2	503.5	530.4
39	CAT TMP1 (deg c)	496.8	495.5	494.3	522.7
40	CAT TMP2 (deg C)	482.8	481.5	479.6	508.1
41	CAT TMP3 (deg C)	479.9	478.8	477.3	503.8
42	HD BOLT TMP (DEG C)	88.55	89.13	90.27	89.79
43	H2OIN TMP (DEG C)	84.24	84.72	85.70	83.83
44	H2OOUT TMP (DEG C)	88.58	89.15	90.18	89.69
45	H20 FLOW (l/min)	69.22	68.71	68.64	68.23
46	DYNO TMP (DEG C)	37.52	37.11	38.01	36.21
47	EX SYS PRES (kpa)	-1.433	-1.424	-1.448	-1.472
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	99.35	99.33	99.32	99.30
50	AIR PRESS (kPa)	538.0	537.8	537.6	538.4
51	F/A DIFF (kPa)	67.89	68.04	68.13	68.12
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00
54	WECU FPC ()	18.00	18.00	18.00	0.0
55	WECU AST ()	131.0	111.0	91.00	0.0
56	WECU EOA ()	47.00	27.00	7.000	0.0
57	WECU APW ()	5.600	5.600	5.600	0.0
58	WECU FPW ()	7.200	7.200	7.200	0.0
59	WECU PPOT ()	847.0	847.0	847.0	0.0
60	KIST VOLTS ()	4.520	4.480	4.400	4.700
61	PPC.FAC ()	.9993	.9979	1.000	1.001
62	DAT PRESS (kPa)	98.78	98.76	98.73	98.74
63	VAP PRESS (kPa)	.5738	.5650	.5919	.5637
64	NOX_HCF ()	.8106	.8094	.8131	.8093
65	CMASS_NOX (g/s)	.8024E-01	.7681E-01	.6509E-01	.1207
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000
68					
69	ECU FPC ()	21.00	21.00	21.00	21.00
70	ECU TEMP ()	92.00	92.00	92.00	92.00
71	ECU SA ()	24.00	24.00	24.00	15.00
72	ECU AST ()	161.0	161.0	161.0	161.0
73	ECU EOA ()	66.00	66.00	66.00	66.00
74	ECU APW ()	6.320	6.320	6.320	6.320
75	ECU FPW ()	8.610	8.610	8.610	8.610
76	ECU SAPC ()	386.0	386.0	386.0	386.0
77	ECU FBAPC ()	370.0	370.0	370.0	374.0
78	ECU A/F ()	17.50	17.60	17.60	17.80
79	ECU EV ()	55.00	55.00	55.00	55.00
80	ECU EGR ()	0.0	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0	0.0
82	ECU PPOT ()	851.0	851.0	851.0	851.0
83	ECU AFL ()	47.00	47.00	47.00	47.00
84					

	1	2	3	4	5	6	7	8	9
	E1N1.1	E1N2.1	E1N3.1	E1N4.1	E1N5.1	E1N6.1	E1N7.1	E1N8.1	E1N9.1
85 FUELFLO (G/SEC)	2.676	2.668	2.628	2.686	2.678	2.656	2.705	2.644	2.669
86 AIRFLO (G/SEC)	53.69	54.09	54.13	55.27	54.85	54.24	54.95	53.80	54.10
87 EXH A/F (:1)	20.06	20.27	20.60	20.58	20.48	20.42	20.31	20.34	20.27
88									
89 BSPEFC (G/KWHR)	288.7	294.0	286.7	290.8	288.3	283.1	285.7	279.5	281.8
90 BSPEHC (g/kWh)	18.34	21.45	22.27	23.07	25.30	23.10	23.52	24.01	24.30
91 BSPECO (g/kWh)	45.95	43.74	33.24	29.00	19.15	20.28	14.30	14.06	12.96
92 BSPENOX (g/kWh)	16.96	9.836	12.17	13.09	12.87	12.05	11.20	10.26	10.02
93									
94 FFCC (mg/cyl/cyc)	21.41	21.35	21.02	21.48	21.42	21.24	21.64	21.15	21.34
95 AIRCC (mg/cyl/cyc)	429.5	432.8	433.0	442.1	438.7	433.8	439.6	430.3	432.7
96 MASS_HC (g/sec)	.1700	.1947	.2042	.2130	.2350	.2167	.2227	.2272	.2302
97 MASS_CO (g/sec)	.4260	.3969	.3047	.2678	.1778	.1903	.1354	.1331	.1228
98 MASS_NOX (g/sec)	.1572	.8926E-01	.1116	.1209	.1196	.1131	.1060	.9708E-01	.9492E-01

	10	11	12	13
	E1N10.1	E1N11.1	E1N12.1	E1N13.1
85 FUELFLO (G/SEC)	2.656	2.650	2.650	2.637
86 AIRFLO (G/SEC)	53.92	53.66	53.13	52.52
87 EXH A/F (:1)	20.30	20.25	20.05	19.92
88				
89 BSPEFC (G/KWHR)	278.6	281.7	289.7	286.5
90 BSPEHC (g/kWh)	23.08	23.87	24.25	20.29
91 BSPECO (g/kWh)	15.88	20.36	33.06	44.55
92 BSPENOX (g/kWh)	10.38	10.09	8.749	16.20
93				
94 FFCC (mg/cyl/cyc)	21.25	21.19	21.20	21.09
95 AIRCC (mg/cyl/cyc)	431.3	429.2	424.9	420.1
96 MASS_HC (g/sec)	.2201	.2245	.2219	.1866
97 MASS_CO (g/sec)	.1514	.1916	.3024	.4201
98 MASS_NOX (g/sec)	.9898E-01	.9490E-01	.8005E-01	.1492



nas2725a1.e1n.scan
SEARCH='NAS2725A1' (112, 124)
2500/wot Lock FPC
18 FPC Water Best BSFC Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head
CPTORQUE (Nm) *.1
T.EXH A/F ()
CYL #2 TMP (DEG C) *.1
DWNPIPE TMP (deg C) *.1
BSPEFC (G/KWHR) *.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS () *10
SEE KEY
POINT #
0
5
10
15
20
25
30
35
40
45
50
55
60
0
2
4
6
8
10
12
14
nas2725a1.e1n.scan Ovs90
nas2725a1.e1n.scan Ovs91
nas2725a1.e1n.scan Ovs92
nas2725a1.e1n.scan Ovs8
nas2725a1.e1n.scan Ovs37
testcell 3-APR-98
nasa1_scan_tps

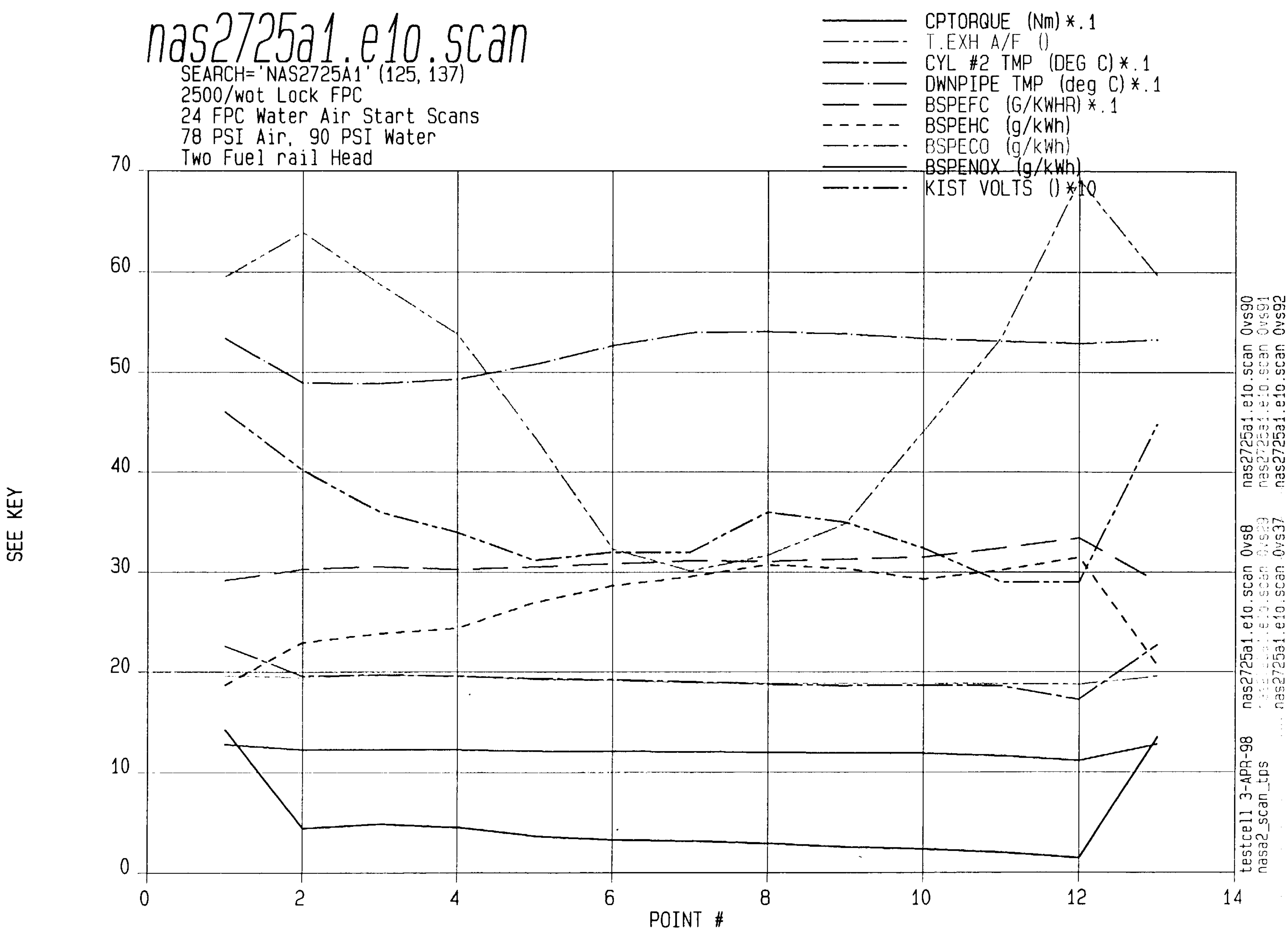
SEARCH="NAS2725A1"(125,137)
2500/wot Lock FPC
24 FPC Water Air Start Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head

	1	2	3	4	5	6	7	8	9
	E101.1	E102.1	E103.1	E104.1	E105.1	E106.1	E107.1	E108.1	E109.1
1									
2 Search BLK	125.0	126.0	127.0	128.0	129.0	130.0	131.0	132.0	133.0
3 Exp. Ref.	E101.1	E102.1	E103.1	E104.1	E105.1	E106.1	E107.1	E108.1	E109.1
4 Date Logged	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98
5 Time Logged	09:18:28	09:26:31	09:31:42	09:37:57	09:42:57	09:48:30	09:53:31	09:59:05	10:03:51
6 SPEED (rpm)	2501	2500	2501	2500	2499	2499	2500	2500	2501
7 TORQUE (NM)	127.5	121.8	121.9	121.8	120.4	120.2	119.7	118.8	118.6
8 CPTORQUE (Nm)	128.1	122.5	122.4	122.5	121.1	120.8	120.2	119.3	119.1
9									
10 POWER (KWATTS)	33.40	31.90	31.91	31.90	31.51	31.46	31.33	31.10	31.05
11 CPPOWER (kW)	33.56	32.07	32.06	32.08	31.70	31.61	31.45	31.23	31.18
12									
13 HC FID (PPM)	7028	8409	8555	8883	9845	.1046E+05	.1076E+05	.1127E+05	.1096E+05
14 CO (%)	1.105	1.154	1.039	.9658	.7812	.5820	.5411	.5731	.6209
15 CO2 (%)	9.193	9.126	9.090	9.197	9.406	9.663	9.756	9.734	9.625
16 O2 (%)	7.438	7.555	7.690	7.609	7.337	7.209	7.010	7.069	7.015
17 NOX (PPM)	1606	488.3	520.5	493.8	399.9	359.0	344.5	319.7	278.7
18									
19 AT PRESS (MM HG)	741.9	741.8	741.7	741.7	741.7	741.7	741.7	741.6	741.6
20 FUEL TMP (DEG C)	17.95	18.21	18.64	18.63	19.62	20.09	19.59	18.42	17.86
21 WET TMP (deg c)	10.73	10.73	10.65	10.68	10.73	10.59	10.47	10.42	10.42
22 DRY TMP (DEG C)	21.40	21.60	21.52	21.63	21.70	21.49	21.33	21.24	21.25
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	23.18	23.51	23.03	23.68	23.78	23.25	22.86	22.83	22.91
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	270.6	268.3	271.0	268.3	267.5	269.7	271.1	268.7	270.2
27 T.CPTORQUE (NM)	128.1	122.5	122.4	122.5	121.1	120.8	120.2	119.3	119.1
28 T.PPC.FAC ()	1.005	1.005	1.004	1.006	1.006	1.005	1.004	1.004	1.004
29 T.EXH A/F ()	19.63	19.48	19.71	19.61	19.29	19.16	18.93	18.88	18.88
30 T.BSPEHC (G/KWHr)	18.58	23.11	23.70	24.72	27.31	28.71	29.31	30.91	30.45
31 T.BSPENOX (G/KWHr)	14.13	4.468	4.799	4.575	3.693	3.282	3.124	2.919	2.578
32 T.BSPECO (G/KWHr)	59.22	64.32	58.31	54.48	43.93	32.39	29.88	31.85	34.97
33 T.BSPEFC (G/KWHr)	290.5	304.8	303.4	306.7	309.0	309.1	308.9	312.5	314.1
34 T.AIRFLO (g/s)	52.93	52.60	53.01	53.27	52.18	51.75	50.89	50.98	51.16
35 T.REL HUM (Fraction)	.2300	.2220	.2208	.2182	.2182	.2180	.2176	.2181	.2175
36 T.FUELFLOW (g/s)	2.696	2.701	2.689	2.717	2.706	2.701	2.688	2.700	2.710
37 CYL #2 TMP (DEG C)	226.2	195.9	197.3	196.0	193.5	192.5	190.3	187.7	186.3
38 DWNPIPE TMP (deg C)	534.1	489.5	489.0	492.9	507.9	526.6	539.6	540.7	538.5
39 CAT TMP1 (deg c)	526.7	482.4	481.3	485.6	500.9	519.2	530.1	530.6	528.6
40 CAT TMP2 (deg C)	512.4	470.5	468.9	472.8	487.7	505.6	516.0	516.6	514.8
41 CAT TMP3 (deg C)	508.2	467.7	466.7	470.3	483.8	500.8	511.3	512.2	510.4
42 HD BOLT TMP (DEG C)	90.30	89.83	90.00	89.82	90.23	90.10	90.31	90.07	89.96
43 H2OIN TMP (DEG C)	83.81	85.55	85.71	85.62	86.07	86.08	86.52	86.36	86.33
44 H2OOUT TMP (DEG C)	89.82	89.51	89.75	89.63	89.99	89.87	90.16	89.96	89.89
45 H20 FLOW (l/min)	68.50	69.18	69.04	69.02	69.01	69.10	69.19	69.27	69.11
46 DYNO TMP (DEG C)	33.85	37.82	37.49	37.99	37.63	37.34	38.52	36.74	38.37
47 EX SYS PRES (kpa)	-1.875	-1.920	-1.900	-1.904	-1.896	-1.909	-1.928	-1.927	-1.926
48 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26:00	26.00	26.00	26.00
49 ATMOS (KPA)	98.89	98.88	98.87	98.87	98.87	98.87	98.86	98.86	98.86
50 AIR PRESS (kPa)	537.3	537.6	537.8	538.1	538.2	538.0	537.9	537.7	537.7
51 F/A DIFF (kPa)	69.49	69.46	69.40	69.32	69.35	69.34	69.27	69.31	69.34
52 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
53 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
54 WECU FPC ()	0.0	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
55 WECU AST ()	0.0	291.0	271.0	251.0	231.0	211.0	191.0	171.0	151.0
56 WECU EOA ()	0.0	207.0	187.0	267.0	147.0	127.0	107.0	87.00	67.00
57 WECU APW ()	0.0	5.600	5.600	5.600	5.600	5.600	5.600	5.600	5.600
58 WECU FPW ()	0.0	9.600	9.600	9.600	9.600	9.600	9.600	9.600	9.600
59 WECU PPOT ()	0.0	843.0	843.0	843.0	843.0	843.0	843.0	843.0	843.0
60 KIST VOLTS ()	4.600	4.020	3.600	3.400	3.120	3.200	3.200	3.600	3.500
61 PPC.FAC ()	1.005	1.005	1.004	1.006	1.006	1.005	1.004	1.004	1.004
62 DAT PRESS (kPa)	98.31	98.30	98.30	98.31	98.30	98.31	98.31	98.31	98.31
63 VAP PRESS (kPa)	.5862	.5724	.5665	.5636	.5663	.5584	.5517	.5499	.5490
64 NOX_HCF ()	.8127	.8108	.8100	.8096	.8100	.8089	.8080	.8077	.8076
65 CMASS_NOX (g/s)	.1070	.3188E-01	.3472E-01	.3240E-01	.2589E-01	.2316E-01	.2215E-01	.2026E-01	.1791E-01
66 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
67 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
68									
69 ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
70 ECU TEMP ()	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00
71 ECU SA ()	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
72 ECU AST ()	161.0	161.0	161.0	161.0	161.0	161.0	161.0	161.0	161.0
73 ECU EOA ()	67.00	67.00	67.00	67.00	67.00	67.00	67.00	67.00	67.00
74 ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320
75 ECU FPW ()	8.210	8.210	8.210	8.210	8.210	8.210	8.210	8.210	8.210
76 ECU SAPC ()	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0
77 ECU FBAPC ()	370.0	356.0	356.0	356.0	355.0	350.0	347.0	340.0	340.0
78 ECU A/F ()	17.70	17.00	17.10	17.10	16.80	16.60	16.40	16.30	16.30
79 ECU EV ()	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00
80 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82 ECU PPOT ()	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0
83 ECU AFL ()	47.00	45.00	45.00	45.00	44.00	43.00	42.00	41.00	42.00
84									

		10	11	12	13
		E1010.1	E1011.1	E1012.1	E1013.1
1					
2	Search BLK	134.0	135.0	136.0	137.0
3	Exp. Ref.	E1010.1	E1011.1	E1012.1	E1013.1
4	Date Logged	05/02/98	05/02/98	05/02/98	05/02/98
5	Time Logged	10:09:59	10:15:49	10:21:21	10:29:05
6	SPEED (rpm)	2500	2500	2500	2501
7	TORQUE (NM)	118.5	115.5	111.0	126.8
8	CPTORQUE (Nm)	119.1	116.2	111.4	127.3
9					
10	POWER (KWATTS)	31.02	30.24	29.06	33.21
11	CPPOWER (kW)	31.16	30.42	29.16	33.34
12					
13	HC FID (PPM)	.1059E+05	.1059E+05	.1078E+05	7809
14	CO (%)	.7853	.9247	1.167	1.113
15	CO2 (%)	9.583	9.419	9.234	9.113
16	O2 (%)	7.099	7.135	7.296	7.488
17	NOX (PPM)	255.4	210.2	149.4	1534
18					
19	AT PRESS (MM HG)	741.6	741.6	741.6	741.6
20	FUEL TMP (DEG C)	17.51	17.22	17.19	17.10
21	WET TMP (deg c)	10.62	10.62	10.39	10.28
22	DRY TMP (DEG C)	21.54	21.57	21.16	21.32
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	23.04	23.72	22.45	22.91
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	271.7	272.4	269.9	267.8
27	T.CPTORQUE (NM)	119.1	116.2	111.4	127.3
28	T.PPC.FAC ()	1.004	1.006	1.003	1.004
29	T.EXH A/F ()	18.88	18.84	18.79	19.57
30	T.BSPEHC (G/KWHr)	29.12	30.37	31.36	20.62
31	T.BSPENOX (G/KWHr)	2.338	2.007	1.448	13.49
32	T.BSPECO (G/KWHr)	43.78	53.77	68.85	59.58
33	T.BSPEFC (G/KWHr)	313.3	326.0	333.0	290.2
34	T.AIRFLO (g/s)	50.96	51.60	50.48	52.40
35	T.REL HUM (Fraction)	.2179	.2169	.2192	.2069
36	T.FUELFLOW (g/s)	2.700	2.739	2.685	2.678
37	CYL #2 TMP (DEG C)	186.7	186.1	172.6	227.0
38	DWNPIPE TMP (deg C)	534.1	531.1	529.0	532.8
39	CAT TMP1 (deg c)	525.1	522.4	520.9	525.7
40	CAT TMP2 (deg C)	511.8	509.1	507.6	511.5
41	CAT TMP3 (deg C)	507.7	505.4	504.1	508.6
42	HD BOLT TMP (DEG C)	90.02	90.24	89.60	90.05
43	H2OIN TMP (DEG C)	86.32	86.57	85.98	84.13
44	H2OOUT TMP (DEG C)	89.93	90.08	89.54	89.96
45	H20 FLOW (l/min)	69.16	69.11	69.24	67.99
46	DYNO TMP (DEG C)	36.18	38.32	35.74	38.60
47	EX SYS PRES (kpa)	-1.901	-1.924	-1.902	-1.900
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	98.86	98.85	98.85	98.85
50	AIR PRESS (kPa)	537.7	537.8	538.1	538.4
51	F/A DIFF (kPa)	69.45	69.30	69.39	69.29
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00
54	WECU FPC ()	24.00	24.00	24.00	0.0
55	WECU AST ()	131.0	111.0	91.00	0.0
56	WECU EOA ()	47.00	27.00	7.000	0.0
57	WECU APW ()	5.600	5.600	5.600	0.0
58	WECU FPW ()	9.600	9.600	9.600	0.0
59	WECU PPOT ()	843.0	843.0	843.0	0.0
60	KIST VOLTS ()	3.240	2.900	2.900	4.480
61	PPC.FAC ()	1.004	1.006	1.003	1.004
62	DAT PRESS (kPa)	98.30	98.29	98.30	98.33
63	VAP PRESS (kPa)	.5598	.5583	.5505	.5243
64	NOX_HCF ()	.8091	.8089	.8078	.8043
65	CMASS_NOX (g/s)	.1641E-01	.1357E-01	.9479E-02	.1001
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000
68					
69	ECU FPC ()	21.00	21.00	21.00	21.00
70	ECU TEMP ()	92.00	92.00	92.00	92.00
71	ECU SA ()	13.00	13.00	13.00	13.00
72	ECU AST ()	161.0	161.0	161.0	161.0
73	ECU EOA ()	67.00	67.00	67.00	67.00
74	ECU APW ()	6.320	6.320	6.320	6.320
75	ECU FPW ()	8.210	8.210	8.210	8.210
76	ECU SAPC ()	386.0	386.0	386.0	386.0
77	ECU FBAPC ()	339.0	342.0	344.0	370.0
78	ECU A/F ()	16.20	16.60	16.50	17.60
79	ECU EV ()	55.00	55.00	55.00	55.00
80	ECU EGR ()	0.0	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0	0.0
82	ECU PPOT ()	851.0	851.0	851.0	851.0
83	ECU AFL ()	41.00	42.00	43.00	47.00
84					

	1	2	3	4	5	6	7	8	9
	E101.1	E102.1	E103.1	E104.1	E105.1	E106.1	E107.1	E108.1	E109.1
85 FUELFLO (G/SEC)	2.706	2.683	2.710	2.683	2.675	2.697	2.711	2.687	2.702
86 AIRFLO (G/SEC)	53.14	52.25	53.41	52.60	51.58	51.66	51.33	50.72	51.02
87 EXH A/F (:1)	19.64	19.48	19.71	19.60	19.29	19.16	18.93	18.88	18.88
88									
89 BSPEFC (G/KWHR)	291.7	302.8	305.7	302.8	305.5	308.6	311.6	311.0	313.3
90 BSPEHC (g/kWh)	18.66	22.96	23.87	24.41	27.00	28.66	29.56	30.75	30.37
91 BSPECO (g/kWh)	59.47	63.90	58.75	53.80	43.44	32.34	30.14	31.69	34.88
92 BSPENOX (g/kWh)	14.19	4.438	4.835	4.517	3.652	3.276	3.151	2.903	2.571
93									
94 FFCC (mg/cyl/cyc)	21.64	21.46	21.67	21.46	21.40	21.58	21.69	21.49	21.61
95 AIRCC (mg/cyl/cyc)	425.0	418.0	427.1	420.8	412.8	413.4	410.7	405.7	408.1
96 MASS_HC (g/sec)	.1731	.2034	.2116	.2163	.2364	.2505	.2573	.2657	.2619
97 MASS_CO (g/sec)	.5518	.5662	.5208	.4766	.3802	.2826	.2623	.2738	.3008
98 MASS_NOX (g/sec)	.1317	.3932E-01	.4286E-01	.4002E-01	.3197E-01	.2863E-01	.2742E-01	.2509E-01	.2218E-01

	10	11	12	13
	E1010.1	E1011.1	E1012.1	E1013.1
85 FUELFLO (G/SEC)	2.717	2.724	2.699	2.678
86 AIRFLO (G/SEC)	51.28	51.32	50.71	52.42
87 EXH A/F (:1)	18.88	18.84	18.79	19.57
88				
89 BSPEFC (G/KWHR)	315.3	324.3	334.3	290.3
90 BSPEHC (g/kWh)	29.30	30.21	31.49	20.62
91 BSPECO (g/kWh)	44.06	53.48	69.14	59.59
92 BSPENOX (g/kWh)	2.353	1.996	1.454	13.49
93				
94 FFCC (mg/cyl/cyc)	21.74	21.79	21.59	21.42
95 AIRCC (mg/cyl/cyc)	410.3	410.6	405.6	419.2
96 MASS_HC (g/sec)	.2525	.2538	.2542	.1903
97 MASS_CO (g/sec)	.3797	.4493	.5581	.5498
98 MASS_NOX (g/sec)	.2028E-01	.1677E-01	.1173E-01	.1244


nas2725a1.e1o.scan
SEARCH='NAS2725A1' (125, 137)
2500/wot Lock FPC
24 FPC Water Air Start Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head
CPTORQUE (Nm)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS ()*10
SEE KEY
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
POINT #
testcell 3-APR-98
nasa2_scan_tps
nas2725a1.e1o.scan 0vs8
nas2725a1.e1o.scan 0vs37
nas2725a1.e1o.scan 0vs90
nas2725a1.e1o.scan 0vs91
nas2725a1.e1o.scan 0vs92

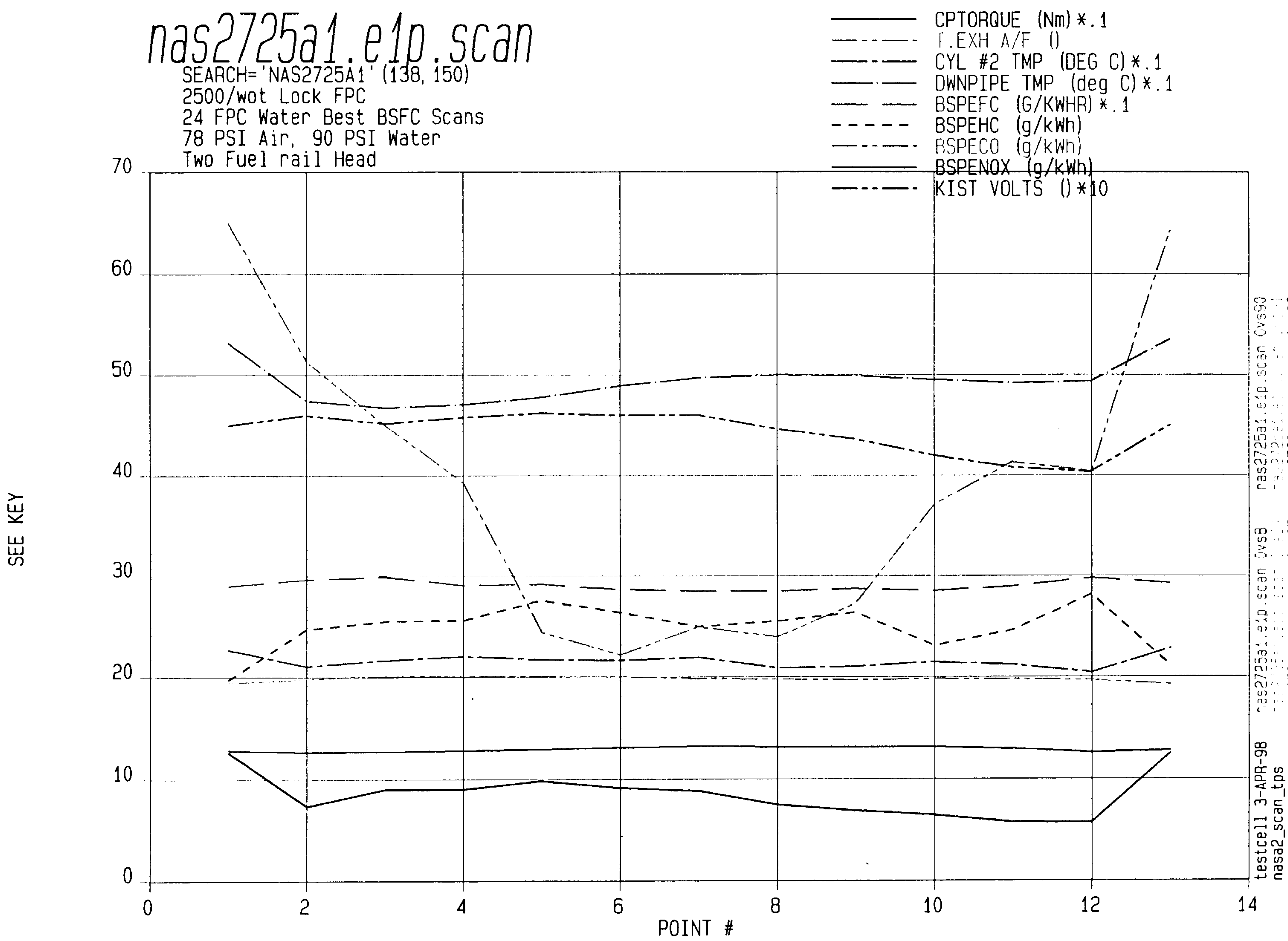
SEARCH="NAS2725A1"(138,150)
2500/wot Lock FPC
24 FPC Water Best BSFC Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head

	1 E1P1.1	2 E1P2.1	3 E1P3.1	4 E1P4.1	5 E1P5.1	6 E1P6.1	7 E1P7.1	8 E1P8.1	9 E1P9.1
1									
2 Search BLK	138.0	139.0	140.0	141.0	142.0	143.0	144.0	145.0	146.0
3 Exp. Ref.	E1P1.1	E1P2.1	E1P3.1	E1P4.1	E1P5.1	E1P6.1	E1P7.1	E1P8.1	E1P9.1
4 Date Logged	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98	05/02/98
5 Time Logged	13:00:06	13:07:53	13:13:33	13:19:04	13:24:57	13:30:15	13:35:28	13:40:52	13:46:26
6 SPEED (rpm)	2500	2500	2501	2500	2500	2500	2500	2500	2500
7 TORQUE (NM)	127.5	125.6	126.3	127.3	128.6	130.3	131.2	130.5	130.4
8 CPTORQUE (Nm)	128.3	126.5	127.1	127.9	129.3	131.1	132.0	131.4	131.2
9									
10 POWER (KWATTS)	33.37	32.89	33.09	33.33	33.66	34.13	34.34	34.18	34.14
11 CPPOWER (kW)	33.60	33.11	33.29	33.50	33.85	34.31	34.55	34.41	34.36
12									
13 HC FID (PPM)	7532	9109	9152	9469	.1008E+05	9913	9518	9689	.1001E+05
14 CO (%)	1.225	.9326	.7956	.7162	.4403	.4112	.4689	.4483	.5102
15 CO2 (%)	9.115	9.087	9.008	9.099	9.225	9.379	9.456	9.401	9.414
16 O2 (%)	7.444	7.769	7.993	7.901	7.767	7.743	7.574	7.475	7.565
17 NOX (PPM)	1443	814.3	968.9	999.7	1075	1031	1012	850.6	781.3
18									
19 AT PRESS (MM HG)	741.4	741.2	741.2	741.1	741.0	741.0	741.0	741.0	740.9
20 FUEL TMP (DEG C)	16.25	16.43	16.14	16.17	15.74	15.80	15.50	15.29	15.21
21 WET TMP (deg c)	10.72	10.74	10.84	10.63	10.68	10.68	10.82	10.88	10.84
22 DRY TMP (DEG C)	22.11	21.98	21.94	21.71	21.79	21.77	21.90	21.98	21.91
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	24.12	23.89	23.43	23.02	23.16	23.07	23.31	23.64	23.34
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	268.6	270.5	274.5	269.2	272.8	271.9	272.1	270.5	272.8
27 T.CPTORQUE (NM)	128.3	126.5	127.1	127.9	129.3	131.1	132.0	131.4	131.2
28 T.PPC.FAC ()	1.007	1.007	1.006	1.005	1.006	1.006	1.006	1.007	1.006
29 T.EXH A/F ()	19.46	19.80	20.19	20.08	20.08	20.04	19.86	19.79	19.74
30 T.BSPEHC (G/KWHr)	19.88	24.87	25.18	26.46	27.80	26.37	25.34	25.73	26.37
31 T.BSPENOX (G/KWHr)	12.68	7.400	8.875	9.300	9.868	9.132	8.965	7.521	6.853
32 T.BSPECO (G/KWHr)	65.56	51.61	44.37	40.57	24.61	22.17	25.31	24.14	27.25
33 T.BSPEFC (G/KWHr)	292.4	297.7	294.3	300.1	293.8	286.2	289.0	286.7	287.2
34 T.AIRFLO (g/s)	52.77	53.85	54.60	55.78	55.16	54.38	54.75	53.86	53.76
35 T.REL HUM (Fraction)	.2024	.2085	.2153	.2126	.2125	.2130	.2160	.2164	.2170
36 T.FUELFLOW (g/s)	2.711	2.720	2.705	2.778	2.747	2.713	2.756	2.722	2.724
37 CYL #2 TMP (DEG C)	227.1	210.8	216.7	220.6	217.4	216.5	219.6	208.9	210.4
38 DWNPIPE TMP (deg C)	531.9	474.3	467.7	470.8	477.8	489.2	497.0	499.9	499.2
39 CAT TMP1 (deg c)	525.3	467.7	460.3	463.5	471.0	483.3	489.0	491.2	491.5
40 CAT TMP2 (deg C)	511.6	455.9	448.9	451.3	457.8	471.4	477.1	478.9	479.2
41 CAT TMP3 (deg C)	508.5	454.8	448.0	450.5	456.5	468.8	474.4	476.3	476.5
42 HD BOLT TMP (DEG C)	90.74	90.80	89.90	92.10	89.08	89.18	91.29	87.93	90.41
43 H2OIN TMP (DEG C)	84.48	86.49	85.34	87.77	84.97	84.91	87.31	83.85	86.16
44 H2OOUT TMP (DEG C)	90.30	90.49	89.66	91.82	88.95	89.09	91.08	87.87	90.25
45 H20 FLOW (l/min)	68.37	69.01	68.65	68.72	69.05	68.67	69.06	68.99	68.65
46 DYNO TMP (DEG C)	35.93	38.03	37.37	38.30	37.58	38.43	37.33	38.94	36.76
47 EX SYS PRES (kpa)	-1.933	-1.953	-1.945	-1.969	-1.989	-1.996	-1.970	-1.993	-2.000
48 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
49 ATMOS (KPA)	98.82	98.80	98.80	98.79	98.78	98.78	98.77	98.77	98.77
50 AIR PRESS (kPa)	538.0	538.0	538.1	538.2	536.1	538.0	538.3	538.4	538.3
51 F/A DIFF (kPa)	70.11	70.08	70.20	70.16	70.16	70.28	70.28	70.15	70.11
52 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
53 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
54 WECU FPC ()	0.0	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
55 WECU AST ()	0.0	291.0	271.0	251.0	231.0	211.0	191.0	171.0	151.0
56 WECU EOA ()	0.0	207.0	187.0	167.0	147.0	127.0	107.0	87.00	67.00
57 WECU APW ()	0.0	5.600	5.600	5.600	5.600	5.600	5.600	5.600	5.600
58 WECU FPW ()	0.0	9.600	9.600	9.600	9.600	9.600	9.600	9.600	9.600
59 WECU PPOT ()	0.0	843.0	843.0	843.0	843.0	843.0	843.0	843.0	843.0
60 KIST VOLTS ()	4.500	4.600	4.520	4.580	4.620	4.600	4.600	4.460	4.360
61 PPC.FAC ()	1.007	1.007	1.006	1.005	1.006	1.006	1.006	1.007	1.006
62 DAT PRESS (kPa)	98.29	98.25	98.23	98.24	98.23	98.22	98.20	98.20	98.20
63 VAP PRESS (kPa)	.5384	.5501	.5670	.5518	.5543	.5552	.5673	.5712	.5704
64 NOX_HCF ()	.8062	.8078	.8101	.8080	.8084	.8085	.8102	.8107	.8106
65 CMASS_NOX (g/s)	.9392E-01	.5431E-01	.6706E-01	.6740E-01	.7408E-01	.7014E-01	.6840E-01	.5753E-01	.5277E-01
66 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
67 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
68									
69 ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
70 ECU TEMP ()	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00
71 ECU SA ()	13.00	19.00	21.00	23.00	25.00	25.00	27.00	24.00	24.00
72 ECU AST ()	161.0	166.0	166.0	166.0	166.0	161.0	156.0	156.0	156.0
73 ECU EOA ()	67.00	71.00	71.00	71.00	71.00	67.00	61.00	61.00	61.00
74 ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320
75 ECU FPW ()	8.210	8.210	8.210	8.210	8.210	8.210	8.210	8.210	8.210
76 ECU SAPC ()	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0
77 ECU FBAPC ()	369.0	368.0	369.0	370.0	369.0	370.0	370.0	366.0	362.0
78 ECU A/F ()	17.50	17.40	17.50	17.70	17.60	17.70	17.60	17.20	17.20
79 ECU EV ()	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00
80 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82 ECU PPOT ()	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0
83 ECU AFL ()	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00
84									

		10	11	12	13
		E1P10.1	E1P11.1	E1P12.1	E1P13.1
1					
2	Search BLK	147.0	148.0	149.0	150.0
3	Exp. Ref.	E1P10.1	E1P11.1	E1P12.1	E1P13.1
4	Date Logged	05/02/98	05/02/98	05/02/98	05/02/98
5	Time Logged	13:52:22	13:57:42	14:03:13	14:10:35
6	SPEED (rpm)	2500	2500	2501	2500
7	TORQUE (NM)	130.8	128.9	125.1	127.1
8	CPTORQUE (Nm)	131.5	129.6	125.9	127.8
9					
10	POWER (KWATTS)	34.24	33.76	32.76	33.27
11	CPPOWER (kW)	34.44	33.92	32.97	33.47
12					
13	HC FID (PPM)	8798	9254	.1028E+05	8046
14	CO (%)	.6964	.7650	.7273	1.206
15	CO2 (%)	9.313	9.212	9.129	9.137
16	O2 (%)	7.575	7.664	7.671	7.356
17	NOX (PPM)	738.6	648.5	624.8	1424
18					
19	AT PRESS (MM HG)	741.0	740.9	740.9	740.9
20	FUEL TMP (DEG C)	14.87	14.81	14.76	14.77
21	WET TMP (deg c)	10.74	10.61	10.70	10.56
22	DRY TMP (DEG C)	21.78	21.68	21.80	21.79
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	23.13	22.75	23.47	23.27
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	271.7	271.7	271.0	270.6
27	T.CPTORQUE (NM)	131.5	129.6	125.9	127.8
28	T.PPC.FAC ()	1.006	1.005	1.006	1.006
29	T.EXH A/F ()	19.82	19.80	19.70	19.30
30	T.BSPEHC (G/KWHr)	23.09	24.91	28.51	20.96
31	T.BSPENOX (G/KWHr)	6.454	5.812	5.770	12.35
32	T.BSPECO (G/KWHr)	37.05	41.74	40.90	63.67
33	T.BSPEFC (G/KWHr)	285.1	292.7	301.1	290.0
34	T.AIRFLO (g/s)	53.75	54.30	53.97	51.74
35	T.REL HUM (Fraction)	.2162	.2120	.2132	.2051
36	T.FUELFLOW (g/s)	2.712	2.743	2.740	2.681
37	CYL #2 TMP (DEG C)	215.0	212.3	204.4	228.4
38	DWNPIPE TMP (deg C)	495.2	492.0	493.7	535.2
39	CAT TMP1 (deg c)	487.2	483.5	485.1	528.9
40	CAT TMP2 (deg C)	474.2	470.2	471.1	514.5
41	CAT TMP3 (deg C)	472.5	469.1	470.7	510.8
42	HD BOLT TMP (DEG C)	92.24	88.20	89.86	89.84
43	H2OIN TMP (DEG C)	88.22	84.51	85.68	83.83
44	H2OOUT TMP (DEG C)	92.00	88.24	89.75	89.65
45	H20 FLOW (l/min)	68.71	68.96	68.47	68.10
46	DYNO TMP (DEG C)	38.91	36.86	38.66	37.60
47	EX SYS PRES (kpa)	-2.002	-2.013	-2.008	-2.010
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	98.77	98.77	98.76	98.76
50	AIR PRESS (kPa)	538.2	538.3	537.9	538.2
51	F/A DIFF (kPa)	70.25	70.15	69.99	70.15
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00
54	WECU FPC ()	24.00	24.00	24.00	0.0
55	WECU AST ()	131.0	111.0	91.00	0.0
56	WECU EOA ()	47.00	27.00	7.000	0.0
57	WECU APW ()	5.600	5.600	5.600	0.0
58	WECU FPW ()	9.600	9.600	9.600	0.0
59	WECU PPOT ()	843.0	843.0	843.0	0.0
60	KIST VOLTS ()	4.200	4.080	4.040	4.500
61	PPC.FAC ()	1.006	1.005	1.006	1.006
62	DAT PRESS (kPa)	98.20	98.22	98.21	98.22
63	VAP PRESS (kPa)	.5636	.5494	.5566	.5351
64	NOX_HCF ()	.8097	.8077	.8087	.8058
65	CMASS_NOX (g/s)	.4980E-01	.4355E-01	.4199E-01	.9287E-01
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000
68					
69	ECU FPC ()	21.00	21.00	21.00	21.00
70	ECU TEMP ()	92.00	92.00	92.00	92.00
71	ECU SA ()	24.00	24.00	25.00	13.00
72	ECU AST ()	156.0	156.0	166.0	161.0
73	ECU EOA ()	61.00	61.00	72.00	66.00
74	ECU APW ()	6.320	6.320	6.320	6.320
75	ECU FPW ()	8.210	8.210	8.210	8.210
76	ECU SAPC ()	386.0	386.0	386.0	386.0
77	ECU FBAPC ()	364.0	366.0	368.0	368.0
78	ECU A/F ()	17.30	17.30	17.50	17.50
79	ECU EV ()	55.00	55.00	55.00	55.00
80	ECU EGR ()	0.0	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0	0.0
82	ECU PPOT ()	851.0	851.0	851.0	851.0
83	ECU AFL ()	46.00	46.00	46.00	46.00
84					

	1	2	3	4	5	6	7	8	9
	E1P1.1	E1P2.1	E1P3.1	E1P4.1	E1P5.1	E1P6.1	E1P7.1	E1P8.1	E1P9.1
85 FUELFLO (G/SEC)	2.686	2.705	2.745	2.692	2.728	2.719	2.721	2.705	2.728
86 AIRFLO (G/SEC)	52.28	53.55	55.42	54.06	54.79	54.50	54.05	53.52	53.85
87 EXH A/F (:1)	19.46	19.80	20.19	20.08	20.08	20.05	19.86	19.79	19.74
88									
89 BSPEFC (G/KWHR)	289.8	296.1	298.7	290.8	291.7	286.8	285.3	284.9	287.6
90 BSPEHC (g/kWh)	19.70	24.73	25.56	25.64	27.61	26.42	25.02	25.57	26.42
91 BSPECO (g/kWh)	64.97	51.33	45.04	39.31	24.44	22.22	24.99	23.99	27.29
92 BSPENOX (g/kWh)	12.57	7.359	9.007	9.011	9.801	9.151	8.852	7.474	6.864
93									
94 FFCC (mg/cyl/cyc)	21.49	21.64	21.96	21.53	21.82	21.75	21.77	21.64	21.82
95 AIRCC (mg/cyl/cyc)	418.2	428.4	443.2	432.4	438.3	436.0	432.4	428.1	430.7
96 MASS_HC (g/sec)	.1826	.2260	.2349	.2373	.2582	.2505	.2386	.2428	.2505
97 MASS_CO (g/sec)	.6022	.4689	.4139	.3639	.2286	.2106	.2383	.2277	.2588
98 MASS_NOX (g/sec)	.1165	.6724E-01	.8278E-01	.8341E-01	.9164E-01	.8675E-01	.8443E-01	.7096E-01	.6509E-01

	10	11	12	13
	E1P10.1	E1P11.1	E1P12.1	E1P13.1
85 FUELFLO (G/SEC)	2.717	2.717	2.710	2.706
86 AIRFLO (G/SEC)	53.86	53.79	53.37	52.24
87 EXH A/F (:1)	19.82	19.79	19.70	19.30
88				
89 BSPEFC (G/KWHR)	285.7	289.8	297.8	292.8
90 BSPEHC (g/kWh)	23.14	24.66	28.19	21.16
91 BSPECO (g/kWh)	37.13	41.32	40.44	64.28
92 BSPENOX (g/kWh)	6.467	5.753	5.705	12.47
93				
94 FFCC (mg/cyl/cyc)	21.74	21.73	21.67	21.65
95 AIRCC (mg/cyl/cyc)	430.8	430.2	426.9	417.9
96 MASS_HC (g/sec)	.2201	.2312	.2565	.1956
97 MASS_CO (g/sec)	.3531	.3875	.3680	.5941
98 MASS_NOX (g/sec)	.6150E-01	.5395E-01	.5192E-01	.1152



nas2725a1.e1p.scan
SEARCH='NAS2725A1' (138, 150)
2500/wot Lock FPC
24 FPC Water Best BSFC Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head
CPTORQUE (Nm) *.1
T.EXH A/F ()
CYL #2 TMP (DEG C) *.1
DWNPIPE TMP (deg C) *.1
BSPEFC (G/KWHR) *.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS () *10
SEE KEY
POINT #
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
testcell 3-APR-98
nasa2_scan_tps
nas2725a1.e1p.scan Ovs8
nas2725a1.e1p.scan Ovs90

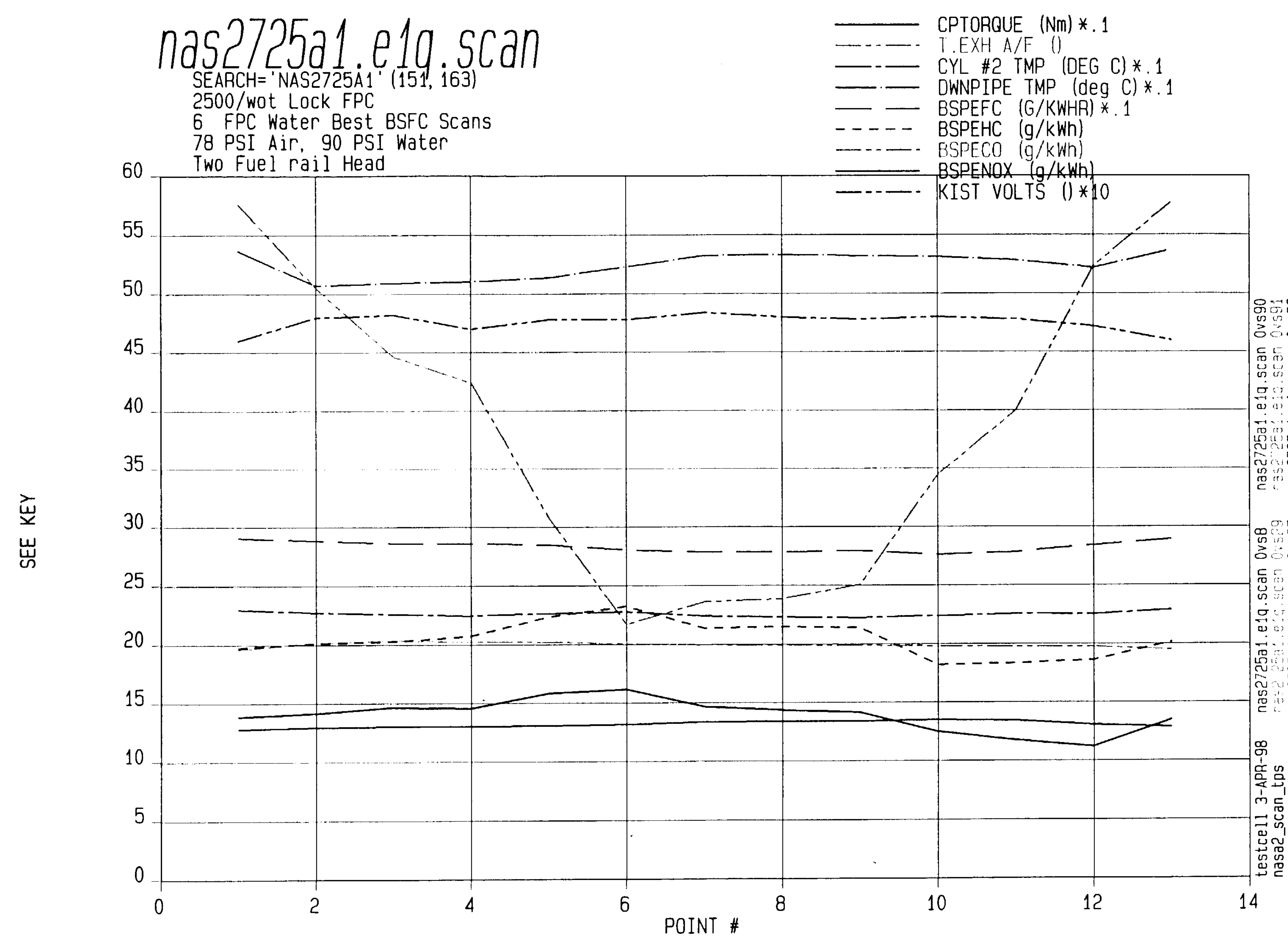
SEARCH="NAS2725A1"(151,163)
2500/wot Lock FPC
6 FPC Water Best BSFC Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head

		1	2	3	4	5	6	7	8	9
		E1Q1.1	E1Q2.1	E1Q3.1	E1Q4.1	E1Q5.1	E1Q6.1	E1Q7.1	E1Q8.1	E1Q9.1
1										
2	Search BLK	151.0	152.0	153.0	154.0	155.0	156.0	157.0	158.0	159.0
3	Exp. Ref.	E1Q1.1	E1Q2.1	E1Q3.1	E1Q4.1	E1Q5.1	E1Q6.1	E1Q7.1	E1Q8.1	E1Q9.1
4	Date Logged	06/02/98	06/02/98	06/02/98	06/02/98	06/02/98	06/02/98	06/02/98	06/02/98	06/02/98
5	Time Logged	12:53:18	12:59:57	13:05:45	13:11:28	13:16:52	13:22:48	13:29:42	13:35:59	13:41:50
6	SPEED (rpm)	2500	2500	2501	2501	2500	2500	2501	2500	2500
7	TORQUE (NM)	128.0	129.2	130.0	130.1	130.5	131.4	133.1	133.6	133.6
8	CPTORQUE (Nm)	128.3	129.7	130.2	130.5	130.7	131.9	133.6	133.9	134.1
9										
10	POWER (KWATTS)	33.50	33.83	34.03	34.06	34.17	34.39	34.87	34.99	34.97
11	CPPOWER (kW)	33.59	33.96	34.10	34.19	34.22	34.53	34.99	35.05	35.11
12										
13	HC FID (PPM)	7448	7443	7495	7645	8284	8798	8196	8294	8257
14	CO (%)	1.070	.9215	.8133	.7709	.5620	.4053	.4465	.4547	.4773
15	CO2 (%)	9.167	9.031	9.026	9.031	9.174	9.345	9.433	9.485	9.508
16	O2 (%)	7.450	7.793	7.888	7.725	7.670	7.534	7.359	7.385	7.381
17	NOX (PPM)	1572	1575	1628	1614	1764	1835	1689	1666	1641
18										
19	AT PRESS (MM HG)	743.7	743.8	743.7	743.7	743.6	743.6	743.5	743.5	743.4
20	FUEL TMP (DEG C)	19.48	18.85	17.97	17.35	17.22	16.76	16.48	16.38	16.23
21	WET TMP (deg c)	11.31	11.42	11.07	11.36	11.05	11.25	11.18	10.96	11.21
22	DRY TMP (DEG C)	21.93	22.05	21.52	21.94	21.45	21.90	21.70	21.41	21.82
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	23.36	23.98	23.03	23.75	22.63	23.86	23.63	22.80	23.83
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	270.8	271.4	270.6	270.9	270.6	268.2	270.2	271.0	271.8
27	T.CPTORQUE (NM)	128.3	129.7	130.2	130.5	130.7	131.9	133.6	133.9	134.1
28	T.PPC.FAC ()	1.003	1.004	1.002	1.004	1.001	1.004	1.004	1.002	1.004
29	T.EXH A/F ()	19.62	20.17	20.38	20.24	20.22	20.08	19.95	19.91	19.88
30	T.BSPEHC (G/KWHr)	19.89	20.03	20.39	20.81	22.32	23.61	21.35	21.44	21.28
31	T.BSPENOX (G/KWHr)	13.97	14.11	14.75	14.62	15.82	16.40	14.65	14.34	14.08
32	T.BSPECO (G/KWHr)	57.93	50.27	44.85	42.54	30.69	22.05	23.58	23.82	24.94
33	T.BSPEFC (G/KWHr)	292.9	287.5	287.7	287.3	284.3	285.1	278.4	278.1	278.4
34	T.AIRFLO (g/s)	53.48	54.48	55.42	55.01	54.58	54.70	53.78	53.83	53.75
35	T.REL HUM (Fraction)	.2424	.2443	.2449	.2453	.2463	.2403	.2442	.2427	.2413
36	T.FUELFLOW (g/s)	2.726	2.701	2.720	2.718	2.699	2.724	2.697	2.703	2.704
37	CYL #2 TMP (DEG C)	230.0	227.7	226.1	224.8	226.7	228.0	224.3	223.2	222.6
38	DWNPIPE TMP (deg C)	536.3	507.1	509.2	510.7	514.0	523.1	532.3	533.1	532.1
39	CAT TMP1 (deg c)	530.8	498.8	500.7	502.8	507.1	517.0	525.6	525.9	525.2
40	CAT TMP2 (deg C)	517.0	486.1	487.8	489.7	494.3	504.0	512.5	513.1	512.3
41	CAT TMP3 (deg C)	513.6	484.0	485.8	487.6	491.6	500.5	508.8	509.4	508.7
42	HD BOLT TMP (DEG C)	90.36	90.06	89.31	89.39	89.63	89.83	89.89	89.61	89.53
43	H2OIN TMP (DEG C)	84.53	84.30	83.71	83.77	84.09	84.12	84.44	84.00	83.98
44	H2OOUT TMP (DEG C)	90.29	89.96	89.31	89.35	89.64	89.73	89.84	89.55	89.43
45	H20 FLOW (l/min)	68.52	68.53	68.42	68.61	68.67	68.27	68.53	68.50	68.47
46	DYNO TMP (DEG C)	37.71	38.11	37.09	38.36	36.93	38.56	36.51	38.88	37.20
47	EX SYS PRES (kpa)	-1.606	-1.600	-1.626	-1.629	-1.658	-1.684	-1.663	-1.670	-1.693
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	99.14	99.14	99.13	99.13	99.12	99.12	99.11	99.10	99.10
50	AIR PRESS (kPa)	538.2	538.2	538.0	538.2	538.2	538.3	538.4	538.4	538.4
51	F/A DIFF (kPa)	70.12	69.99	70.15	70.13	70.18	70.05	70.04	70.08	70.06
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
54	WECU FPC ()	0.0	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
55	WECU AST ()	0.0	291.0	271.0	251.0	231.0	211.0	191.0	171.0	151.0
56	WECU EOA ()	0.0	207.0	187.0	167.0	147.0	127.0	107.0	87.00	67.00
57	WECU APW ()	0.0	5.600	5.600	5.600	5.600	5.600	5.600	5.600	5.600
58	WECU FPW ()	0.0	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400
59	WECU PPOT ()	0.0	842.0	842.0	842.0	842.0	842.0	842.0	842.0	842.0
60	KIST VOLTS ()	4.600	4.800	4.820	4.700	4.780	4.780	4.840	4.800	4.780
61	PPC.FAC ()	1.003	1.004	1.002	1.004	1.001	1.004	1.004	1.002	1.004
62	DAT PRESS (kPa)	98.50	98.49	98.50	98.48	98.50	98.49	98.48	98.49	98.46
63	VAP PRESS (kPa)	.6379	.6474	.6281	.6459	.6292	.6310	.6334	.6185	.6306
64	NOX_HCF ()	.8197	.8210	.8183	.8208	.8185	.8187	.8191	.8170	.8187
65	CMASS_NOX (g/s)	.1059	.1094	.1135	.1232	.1232	.1263	.1164	.1141	.1126
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
68										
69	ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
70	ECU TEMP ()	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00
71	ECU SA ()	13.00	16.00	16.00	16.00	18.00	18.00	18.00	18.00	18.00
72	ECU AST ()	161.0	161.0	161.0	161.0	161.0	161.0	156.0	153.0	153.0
73	ECU EOA ()	66.00	66.00	66.00	66.00	66.00	66.00	107.0	58.00	58.00
74	ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320
75	ECU FPW ()	8.210	8.210	8.210	8.210	8.210	8.210	8.210	8.210	8.210
76	ECU SAPC ()	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0
77	ECU FBAPC ()	370.0	372.0	372.0	373.0	373.0	372.0	371.0	368.0	366.0
78	ECU A/F ()	17.70	17.70	17.80	17.80	17.80	17.80	17.70	17.50	17.40
79	ECU EV ()	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00
80	ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	ECU PPOT ()	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0	851.0
83	ECU AFL ()	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00
84										

		10	11	12	13
		E1Q10.1	E1Q11.1	E1Q12.1	E1Q13.1
1					
2	Search BLK	160.0	161.0	162.0	163.0
3	Exp. Ref.	E1Q10.1	E1Q11.1	E1Q12.1	E1Q13.1
4	Date Logged	06/02/98	06/02/98	06/02/98	06/02/98
5	Time Logged	13:47:51	13:53:53	13:59:23	14:05:54
6	SPEED (rpm)	2500	2501	2500	2501
7	TORQUE (NM)	134.8	133.8	130.5	128.6
8	CPTORQUE (Nm)	135.0	134.2	130.8	129.0
9					
10	POWER (KWATTS)	35.28	35.04	34.16	33.69
11	CPPOWER (kW)	35.35	35.15	34.26	33.77
12					
13	HC FID (PPM)	7088	7092	7053	7650
14	CO (%)	.6610	.7610	.9776	1.080
15	CO2 (%)	9.401	9.319	9.110	9.155
16	O2 (%)	7.242	7.269	7.385	7.380
17	NOX (PPM)	1458	1367	1277	1538
18					
19	AT PRESS (MM HG)	743.4	743.4	743.3	743.2
20	FUEL TMP (DEG C)	16.27	15.86	15.96	15.53
21	WET TMP (deg c)	10.92	11.17	11.09	11.13
22	DRY TMP (DEG C)	21.37	21.75	21.59	21.69
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	22.81	23.34	23.15	22.92
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	271.0	271.2	270.0	271.0
27	T.CPTORQUE (NM)	135.0	134.2	130.8	129.0
28	T.PPC.FAC ()	1.002	1.003	1.003	1.003
29	T.EXH A/F ()	19.82	19.78	19.76	19.52
30	T.BSPEHC (G/KWHr)	18.19	18.39	18.68	20.06
31	T.BSPENOX (G/KWHr)	12.46	11.80	11.26	13.43
32	T.BSPECO (G/KWHr)	34.39	40.01	52.48	57.40
33	T.BSPEFC (G/KWHr)	276.1	279.4	285.3	288.0
34	T.AIRFLO (g/s)	53.65	53.78	53.51	52.59
35	T.REL HUM (Fraction)	.2421	.2415	.2435	.2421
36	T.FUELFLOW (g/s)	2.707	2.719	2.708	2.694
37	CYL #2 TMP (DEG C)	224.1	225.8	225.3	229.1
38	DWNPIPE TMP (deg C)	531.3	528.4	521.9	536.9
39	CAT TMP1 (deg c)	524.3	521.5	515.8	531.0
40	CAT TMP2 (deg C)	511.3	508.7	502.7	517.6
41	CAT TMP3 (deg C)	507.7	505.3	500.1	514.2
42	HD BOLT TMP (DEG C)	89.40	90.13	89.20	89.92
43	H2OIN TMP (DEG C)	83.82	84.58	83.72	84.09
44	H2OOUT TMP (DEG C)	89.41	90.05	89.20	89.86
45	H20 FLOW (l/min)	68.44	68.58	68.42	68.30
46	DYNO TMP (DEG C)	38.01	38.01	37.23	39.28
47	EX SYS PRES (kpa)	-1.670	-1.692	-1.684	-1.716
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	99.09	99.09	99.08	99.07
50	AIR PRESS (kPa)	538.5	538.2	538.3	537.9
51	F/A DIFF (kPa)	70.10	70.08	69.94	70.09
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00
54	WECU FPC ()	6.000	6.000	6.000	0.0
55	WECU AST ()	131.0	111.0	91.00	0.0
56	WECU EOA ()	47.00	27.00	7.000	0.0
57	WECU APW ()	5.600	5.600	5.600	0.0
58	WECU FPW ()	2.400	2.400	2.400	0.0
59	WECU PPOT ()	842.0	842.0	842.0	0.0
60	KIST VOLTS ()	4.800	4.780	4.720	4.600
61	PPC.FAC ()	1.002	1.003	1.003	1.003
62	DAT PRESS (kPa)	98.47	98.46	98.45	98.45
63	VAP PRESS (kPa)	.6157	.6285	.6276	.6275
64	NOX_HCF ()	.8166	.8184	.8183	.8183
65	CMASS_NOX (g/s)	.9989E-01	.9375E-01	.8717E-01	.1034
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000
68					
69	ECU FPC ()	21.00	21.00	21.00	21.00
70	ECU TEMP ()	92.00	92.00	92.00	92.00
71	ECU SA ()	18.00	18.00	18.00	18.00
72	ECU AST ()	152.0	156.0	156.0	161.0
73	ECU EOA ()	57.00	62.00	62.00	66.00
74	ECU APW ()	6.320	6.320	6.320	6.320
75	ECU FPW ()	8.210	8.210	8.210	8.210
76	ECU SAPC ()	386.0	386.0	386.0	386.0
77	ECU FBAPC ()	366.0	367.0	370.0	371.0
78	ECU A/F ()	17.40	17.50	17.70	17.70
79	ECU EV ()	55.00	55.00	55.00	55.00
80	ECU EGR ()	0.0	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0	0.0
82	ECU PPOT ()	851.0	851.0	851.0	851.0
83	ECU AFL ()	46.00	46.00	46.00	46.00
84					

	1	2	3	4	5	6	7	8	9
	E1Q1.1	E1Q2.1	E1Q3.1	E1Q4.1	E1Q5.1	E1Q6.1	E1Q7.1	E1Q8.1	E1Q9.1
85 FUELFLO (G/SEC)	2.708	2.714	2.706	2.709	2.706	2.682	2.702	2.710	2.718
86 AIRFLO (G/SEC)	53.12	54.74	55.13	54.83	54.73	53.88	53.89	53.96	54.04
87 EXH A/F (:1)	19.62	20.17	20.37	20.24	20.23	20.09	19.94	19.91	19.88
88									
89 BSPEFC (G/KWHR)	291.0	288.9	286.2	286.3	285.1	280.8	279.0	278.8	279.8
90 BSPEHC (g/kWh)	19.76	20.12	20.28	20.74	22.37	23.26	21.39	21.49	21.40
91 BSPECO (g/kWh)	57.55	50.51	44.62	42.40	30.77	21.72	23.62	23.88	25.07
92 BSPENOX (g/kWh)	13.88	14.18	14.67	14.57	15.86	16.15	14.67	14.37	14.16
93									
94 FFCC (mg/cyl/cyc)	21.66	21.71	21.64	21.67	21.65	21.45	21.61	21.67	21.75
95 AIRCC (mg/cyl/cyc)	425.0	437.8	440.9	438.5	437.8	430.9	430.9	431.6	432.3
96 MASS_HC (g/sec)	.1839	.1891	.1917	.1962	.2124	.2222	.2072	.2089	.2078
97 MASS_CO (g/sec)	.5355	.4746	.4218	.4011	.2921	.2075	.2288	.2322	.2435
98 MASS_NOX (g/sec)	.1291	.1332	.1387	.1379	.1505	.1543	.1421	.1397	.1375

	10	11	12	13
	E1Q10.1	E1Q11.1	E1Q12.1	E1Q13.1
85 FUELFLO (G/SEC)	2.710	2.712	2.700	2.710
86 AIRFLO (G/SEC)	53.72	53.64	53.34	52.88
87 EXH A/F (:1)	19.82	19.78	19.76	19.52
88				
89 BSPEFC (G/KWHR)	276.5	278.6	284.5	289.5
90 BSPEHC (g/kWh)	18.22	18.34	18.62	20.16
91 BSPECO (g/kWh)	34.44	39.90	52.32	57.70
92 BSPENOX (g/kWh)	12.48	11.77	11.23	13.50
93				
94 FFCC (mg/cyl/cyc)	21.68	21.69	21.59	21.67
95 AIRCC (mg/cyl/cyc)	429.7	429.0	426.7	422.9
96 MASS_HC (g/sec)	.1786	.1785	.1767	.1887
97 MASS_CO (g/sec)	.3376	.3884	.4965	.5400
98 MASS_NOX (g/sec)	.1223	.1146	.1065	.1263



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SEARCH='NAS2725A1' (151, 163)
2500/wot Lock FPC
6 FPC Water Best BSFC Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head
CPTORQUE (Nm) * .1
T.EXH A/F ()
CYL #2 TMP (DEG C) * .1
DWNPIPE TMP (deg C) * .1
BSPEFC (G/KWHR) * .1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS () * 10
SEE KEY
60
55
50
45
40
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
POINT #
nas2725a1.e1q.scan 0vs90
nas2725a1.e1q.scan 0vs91
nas2725a1.e1q.scan 0vs92
nas2725a1.e1q.scan 0vs8
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testcell 3-APR-98
nasa2_scan_tps

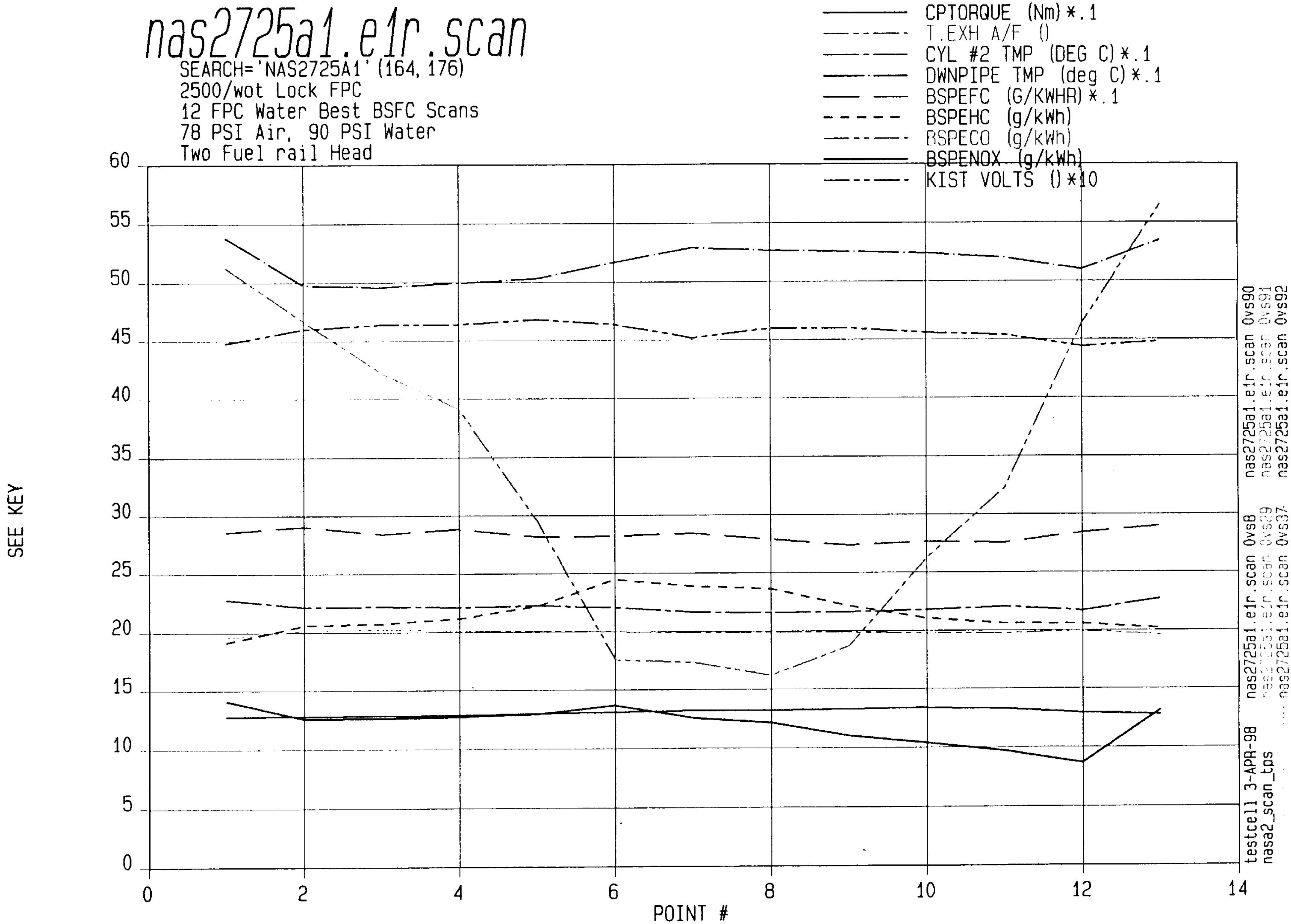
SEARCH="NAS2725A1"(164,176)
2500/wot Lock FPC
12 FPC Water Best BSFC Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head

	1	2	3	4	5	6	7	8	9
	E1R1.1	E1R2.1	E1R3.1	E1R4.1	E1R5.1	E1R6.1	E1R7.1	E1R8.1	E1R9.1
1									
2 Search BLK	164.0	165.0	166.0	167.0	168.0	169.0	170.0	171.0	172.0
3 Exp. Ref.	E1R1.1	E1R2.1	E1R3.1	E1R4.1	E1R5.1	E1R6.1	E1R7.1	E1R8.1	E1R9.1
4 Date Logged	09/02/98	09/02/98	09/02/98	09/02/98	09/02/98	09/02/98	09/02/98	09/02/98	09/02/98
5 Time Logged	08:21:36	08:30:43	08:36:20	08:43:46	08:49:30	08:55:10	09:01:35	09:07:53	09:13:12
6 SPEED (rpm)	2499	2500	2500	2500	2500	2500	2500	2500	2500
7 TORQUE (NM)	127.5	128.2	128.6	129.1	129.7	131.0	132.5	132.2	132.8
8 CPTORQUE (Nm)	127.8	128.1	128.8	129.1	130.0	131.0	132.4	132.4	132.8
9									
10 POWER (KWATTS)	33.38	33.56	33.66	33.81	33.96	34.30	34.70	34.61	34.76
11 CPPOWER (kW)	33.45	33.53	33.72	33.80	34.04	34.30	34.67	34.66	34.77
12									
13 HC FID (PPM)	7341	7550	7737	7773	8364	9252	9062	9075	8673
14 CO (%)	.9685	.8445	.7772	.7084	.5485	.3276	.3239	.3067	.3604
15 CO2 (%)	9.260	9.077	9.068	9.115	9.242	9.416	9.575	9.517	9.503
16 O2 (%)	7.342	7.731	7.796	7.620	7.554	7.506	7.391	7.352	7.316
17 NOX (PPM)	1624	1387	1417	1406	1468	1556	1434	1404	1299
18									
19 AT PRESS (MM HG)	745.3	745.4	745.4	745.3	745.2	745.1	745.1	745.0	745.0
20 FUEL TMP (DEG C)	21.73	21.86	21.99	22.22	20.66	18.98	18.22	17.47	17.17
21 WET TMP (deg c)	11.30	11.04	11.33	11.18	11.48	11.07	11.07	11.45	11.22
22 DRY TMP (DEG C)	21.69	21.37	21.77	21.53	22.01	21.30	21.24	21.77	21.34
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	24.28	22.88	24.15	23.14	24.25	23.02	22.53	23.55	22.97
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	265.0	271.1	265.7	270.7	265.9	268.8	274.2	268.3	264.4
27 T.CPTORQUE (NM)	127.8	128.1	128.8	129.1	130.0	131.0	132.4	132.4	132.8
28 T.PPC.FAC ()	1.002	.9991	1.002	.9999	1.002	.9999	.9990	1.001	1.000
29 T.EXH A/F ()	19.61	20.15	20.26	20.14	20.08	20.02	19.87	19.88	19.87
30 T.BSPEHC (G/KWHr)	19.54	20.32	21.22	20.81	23.01	24.98	23.02	23.64	22.82
31 T.BSPENOX (G/KWHr)	14.39	12.43	12.93	12.53	13.45	13.99	12.13	12.18	11.37
32 T.BSPECO (G/KWHr)	52.25	46.06	43.20	38.45	30.58	17.93	16.68	16.20	19.22
33 T.BSPEFC (G/KWHr)	291.4	286.9	290.8	283.4	291.9	287.7	274.1	279.2	281.9
34 T.AIRFLO (g/s)	52.99	53.90	55.09	53.60	55.29	54.90	52.50	53.36	54.10
35 T.REL HUM (Fraction)	.2513	.2482	.2493	.2505	.2486	.2537	.2561	.2569	.2608
36 T.FUELFLOW (g/s)	2.703	2.675	2.719	2.661	2.754	2.742	2.642	2.684	2.722
37 CYL #2 TMP (DEG C)	228.3	221.6	222.0	221.3	222.7	220.8	216.7	216.1	216.2
38 DWNPIPE TMP (deg C)	537.9	497.8	496.1	499.6	503.2	516.9	529.0	526.5	525.5
39 CAT TMP1 (deg c)	532.7	490.3	488.5	492.8	497.5	511.4	522.0	519.0	518.0
40 CAT TMP2 (deg C)	518.8	478.0	475.8	479.8	484.8	498.9	509.3	506.6	505.5
41 CAT TMP3 (deg C)	515.4	476.5	474.8	478.4	482.5	495.6	505.4	503.1	502.2
42 HD BOLT TMP (DEG C)	90.83	89.76	89.80	89.94	89.83	89.81	89.89	89.66	89.93
43 H2OIN TMP (DEG C)	84.74	84.55	84.51	84.69	84.62	84.75	84.98	84.69	85.03
44 H2OOUT TMP (DEG C)	90.45	89.66	89.60	89.84	89.71	89.71	89.84	89.57	89.89
45 H20 FLOW (l/min)	69.30	69.11	69.17	69.17	69.15	69.02	69.12	69.36	69.19
46 DYNO TMP (DEG C)	35.68	38.25	37.37	38.71	36.68	39.03	37.11	37.81	37.79
47 EX SYS PRES (kpa)	-1.437	-1.429	-1.425	-1.423	-1.439	-1.476	-1.459	-1.463	-1.461
48 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
49 ATMOS (KPA)	99.35	99.35	99.36	99.34	99.33	99.32	99.31	99.31	99.31
50 AIR PRESS (kPa)	537.6	537.9	537.7	537.9	538.0	537.8	538.2	537.9	538.3
51 F/A DIFF (kPa)	69.44	69.39	69.66	69.66	69.49	69.35	69.47	69.70	69.32
52 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0
53 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
54 WECU FPC ()	0.0	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
55 WECU AST ()	0.0	291.0	271.0	251.0	231.0	211.0	191.0	171.0	151.0
56 WECU EOA ()	0.0	207.0	187.0	167.0	147.0	127.0	107.0	87.00	67.00
57 WECU APW ()	0.0	5.600	5.600	5.600	5.600	5.600	5.600	5.600	5.600
58 WECU FPW ()	0.0	4.800	4.800	4.800	4.800	4.800	4.800	4.800	4.800
59 WECU PPOT ()	0.0	843.0	843.0	843.0	843.0	843.0	843.0	843.0	843.0
60 KIST VOLTS ()	4.480	4.600	4.640	4.640	4.680	4.640	4.520	4.600	4.600
61 PPC.FAC ()	1.002	.9991	1.002	.9999	1.002	.9999	.9990	1.001	1.000
62 DAT PRESS (kPa)	98.70	98.72	98.71	98.70	98.67	98.68	98.67	98.64	98.65
63 VAP PRESS (kPa)	.6514	.6313	.6497	.6432	.6574	.6422	.6459	.6692	.6618
64 NOX_HCF ()	.8214	.8186	.8212	.8203	.8223	.8201	.8207	.8240	.8229
65 CMASS_NOX (g/s)	.1074	.9612E-01	.9704E-01	.9816E-01	.1007	.1072	.9960E-01	.9644E-01	.8779E-01
66 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481	.7481
67 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
68									
69 ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
70 ECU TEMP ()	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00
71 ECU SA ()	13.00	17.00	17.00	17.00	19.00	19.00	19.00	20.00	20.00
72 ECU AST ()	161.0	161.0	161.0	161.0	161.0	161.0	158.0	158.0	158.0
73 ECU EOA ()	66.00	66.00	66.00	66.00	66.00	66.00	63.00	63.00	63.00
74 ECU APW ()	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320	6.320
75 ECU FPW ()	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610	8.610
76 ECU SAPC ()	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0	386.0
77 ECU FBAPC ()	371.0	371.0	372.0	372.0	370.0	370.0	368.0	368.0	367.0
78 ECU A/F ()	17.70	17.70	17.90	17.80	17.60	17.60	17.50	17.60	17.50
79 ECU EV ()	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00
80 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82 ECU PPOT ()	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0
83 ECU AFL ()	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00
84									

		10	11	12	13
		E1R10.1	E1R11.1	E1R12.1	E1R13.1
1					
2	Search BLK	173.0	174.0	175.0	176.0
3	Exp. Ref.	E1R10.1	E1R11.1	E1R12.1	E1R13.1
4	Date Logged	09/02/98	09/02/98	09/02/98	09/02/98
5	Time Logged	09:18:54	09:24:47	09:31:02	09:38:35
6	SPEED (rpm)	2501	2500	2500	2500
7	TORQUE (NM)	133.9	132.6	129.3	127.7
8	CPTORQUE (Nm)	134.0	132.8	129.2	127.7
9					
10	POWER (KWATTS)	35.05	34.70	33.84	33.43
11	CPPOWER (kW)	35.08	34.77	33.82	33.42
12					
13	HC FID (PPM)	8196	8082	7783	7622
14	CO (%)	.5042	.6235	.8657	1.052
15	CO2 (%)	9.461	9.402	9.134	9.144
16	O2 (%)	7.256	7.333	7.640	7.434
17	NOX (PPM)	1216	1144	989.5	1494
18					
19	AT PRESS (MM HG)	745.0	745.0	745.1	745.2
20	FUEL TMP (DEG C)	17.09	16.81	16.61	15.99
21	WET TMP (deg c)	11.39	11.53	11.28	11.27
22	DRY TMP (DEG C)	21.55	21.80	21.27	21.37
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	23.17	23.77	22.56	22.85
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	269.5	265.9	267.3	269.1
27	T.CPTORQUE (NM)	134.0	132.8	129.2	127.7
28	T.PPC.FAC ()	1.001	1.002	.9994	.9998
29	T.EXH A/F ()	19.77	19.76	19.97	19.61
30	T.BSPEHC (G/KWHr)	21.19	21.23	20.74	19.92
31	T.BSPENOX (G/KWHr)	10.46	10.01	8.777	13.00
32	T.BSPECO (G/KWHr)	26.42	33.20	46.76	55.74
33	T.BSPEFC (G/KWHr)	278.3	284.1	286.6	286.1
34	T.AIRFLO (g/s)	53.57	54.12	53.80	52.10
35	T.REL HUM (Fraction)	.2627	.2602	.2679	.2631
36	T.FUELFLOW (g/s)	2.710	2.738	2.694	2.658
37	CYL #2 TMP (DEG C)	218.0	220.6	217.2	227.3
38	DWNPIPE TMP (deg C)	524.0	520.0	509.9	534.6
39	CAT TMP1 (deg c)	516.8	513.2	502.8	528.4
40	CAT TMP2 (deg C)	504.3	500.5	490.6	515.2
41	CAT TMP3 (deg C)	501.0	497.8	488.4	512.0
42	HD BOLT TMP (DEG C)	89.53	90.01	89.11	89.17
43	H2OIN TMP (DEG C)	84.53	85.13	84.26	83.52
44	H2OOUT TMP (DEG C)	89.43	89.94	89.16	89.16
45	H20 FLOW (l/min)	69.33	69.29	69.24	69.01
46	DYNO TMP (DEG C)	37.84	38.04	36.86	38.92
47	EX SYS PRES (kpa)	-1.476	-1.479	-1.469	-1.438
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	99.31	99.31	99.32	99.33
50	AIR PRESS (kPa)	537.8	538.5	538.2	538.4
51	F/A DIFF (kPa)	69.91	69.11	69.43	69.20
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00
54	WECU FPC ()	12.00	12.00	12.00	0.0
55	WECU AST ()	131.0	111.0	91.00	0.0
56	WECU EOA ()	47.00	27.00	7.000	0.0
57	WECU APW ()	5.600	5.600	5.600	0.0
58	WECU FPW ()	4.800	4.800	4.800	0.0
59	WECU PPOT ()	843.0	843.0	843.0	0.0
60	KIST VOLTS ()	4.560	4.540	4.440	4.480
61	PPC.FAC ()	1.001	1.002	.9994	.9998
62	DAT PRESS (kPa)	98.63	98.63	98.64	98.66
63	VAP PRESS (kPa)	.6752	.6793	.6767	.6687
64	NOX_HCF ()	.8248	.8254	.8250	.8239
65	CMASS_NOX (g/s)	.8355E-01	.7733E-01	.6754E-01	.1007
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000
68					
69	ECU FPC ()	21.00	21.00	21.00	21.00
70	ECU TEMP ()	92.00	92.00	92.00	92.00
71	ECU SA ()	20.00	20.00	20.00	13.00
72	ECU AST ()	158.0	158.0	158.0	161.0
73	ECU EOA ()	63.00	63.00	63.00	66.00
74	ECU APW ()	6.320	6.320	6.320	6.320
75	ECU FPW ()	8.610	8.610	8.610	8.610
76	ECU SAPC ()	386.0	386.0	386.0	386.0
77	ECU FBAPC ()	368.0	366.0	371.0	372.0
78	ECU A/F ()	17.40	17.40	17.70	17.70
79	ECU EV ()	55.00	55.00	55.00	55.00
80	ECU EGR ()	0.0	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0	0.0
82	ECU PPOT ()	850.0	850.0	850.0	850.0
83	ECU AFL ()	46.00	46.00	46.00	46.00
84					

	1	2	3	4	5	6	7	8	9
	E1R1.1	E1R2.1	E1R3.1	E1R4.1	E1R5.1	E1R6.1	E1R7.1	E1R8.1	E1R9.1
85 FUELFLO (G/SEC)	2.650	2.711	2.657	2.707	2.658	2.688	2.742	2.683	2.644
86 AIRFLO (G/SEC)	51.95	54.63	53.83	54.51	53.38	53.83	54.50	53.35	52.54
87 EXH A/F (:1)	19.60	20.15	20.26	20.14	20.08	20.02	19.87	19.88	19.87
88									
89 BSPEFC (G/KWHR)	285.8	290.7	284.2	288.2	281.8	282.2	284.5	279.1	273.8
90 BSPEHC (g/kWh)	19.16	20.59	20.74	21.17	22.21	24.50	23.89	23.63	22.16
91 BSPECO (g/kWh)	51.24	46.69	42.23	39.10	29.53	17.59	17.31	16.19	18.67
92 BSPENOX (g/kWh)	14.11	12.59	12.64	12.74	12.98	13.72	12.59	12.18	11.05
93									
94 FFCC (mg/cyl/cyc)	21.20	21.69	21.26	21.65	21.27	21.51	21.94	21.46	21.15
95 AIRCC (mg/cyl/cyc)	415.7	437.0	430.6	436.0	427.0	430.6	436.0	426.7	420.3
96 MASS_HC (g/sec)	.1776	.1920	.1939	.1988	.2095	.2334	.2303	.2272	.2140
97 MASS_CO (g/sec)	.4751	.4353	.3948	.3672	.2785	.1676	.1669	.1557	.1803
98 MASS_NOX (g/sec)	.1308	.1174	.1182	.1197	.1225	.1307	.1214	.1170	.1067

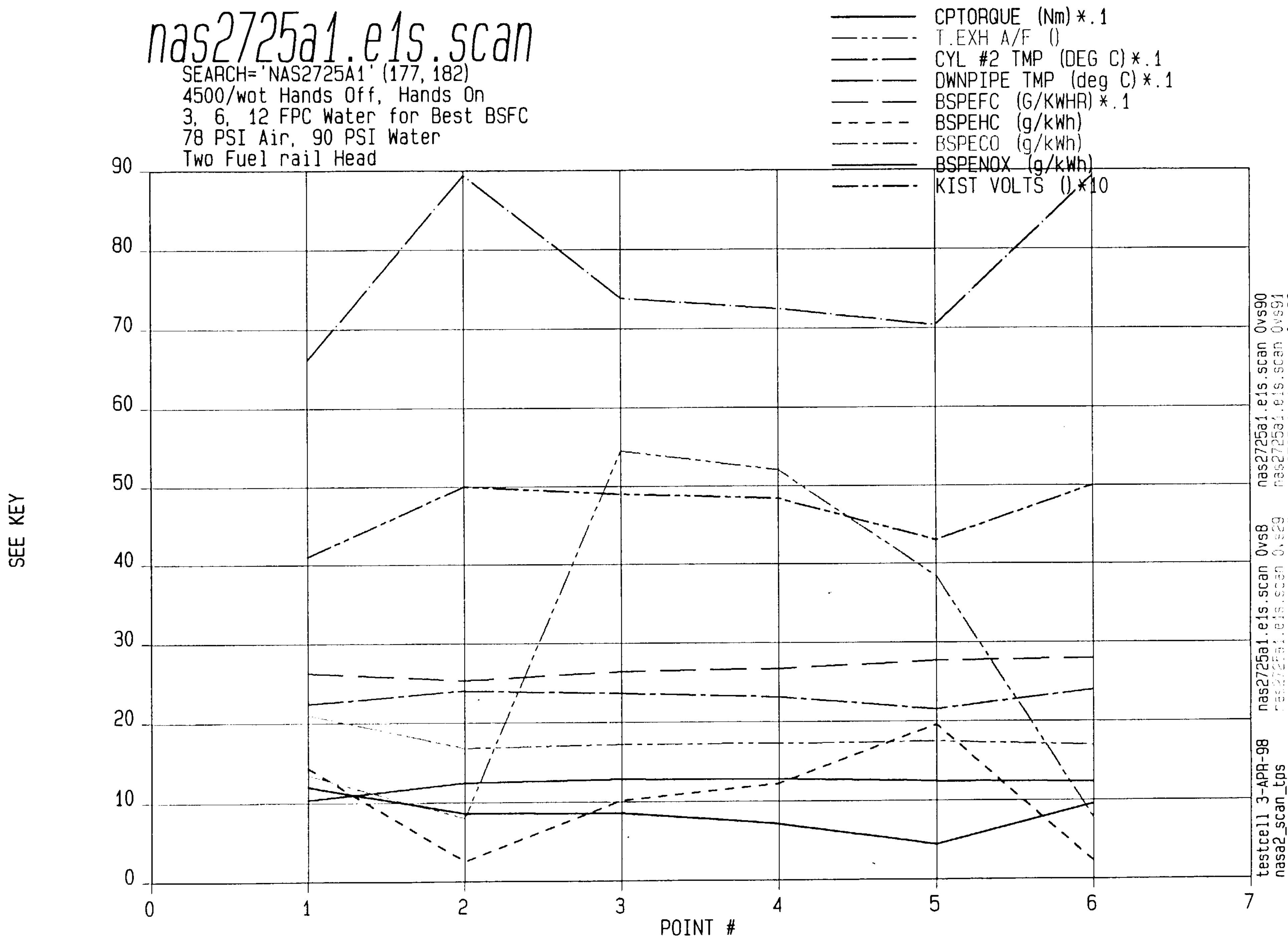
	10	11	12	13
	E1R10.1	E1R11.1	E1R12.1	E1R13.1
85 FUELFLO (G/SEC)	2.695	2.659	2.673	2.691
86 AIRFLO (G/SEC)	53.27	52.55	53.38	52.76
87 EXH A/F (:1)	19.77	19.76	19.97	19.60
88				
89 BSPEFC (G/KWHR)	276.7	275.8	284.3	289.8
90 BSPEHC (g/kWh)	21.07	20.61	20.57	20.18
91 BSPECO (g/kWh)	26.27	32.24	46.39	56.46
92 BSPENOX (g/kWh)	10.40	9.718	8.708	13.17
93				
94 FFCC (mg/cyl/cyc)	21.55	21.27	21.38	21.53
95 AIRCC (mg/cyl/cyc)	426.0	420.4	427.1	422.1
96 MASS_HC (g/sec)	.2051	.1987	.1934	.1874
97 MASS_CO (g/sec)	.2558	.3108	.4361	.5243
98 MASS_NOX (g/sec)	.1013	.9369E-01	.8186E-01	.1223


nas2725a1.e1r.scan
SEARCH='NAS2725A1' (164, 176)
2500/wot Lock FPC
12 FPC Water Best BSFC Scans
78 PSI Air, 90 PSI Water
Two Fuel rail Head
CPTORQUE (Nm)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS ()*10
SEE KEY
POINT #
nas2725a1.e1r.scan 0vs90
nas2725a1.e1r.scan 0vs91
nas2725a1.e1r.scan 0vs92
nas2725a1.e1r.scan 0vs8
nas2725a1.e1r.scan 0vs29
nas2725a1.e1r.scan 0vs37
testcell 3-APR-98
nasa2_scan_tps

SEARCH="NAS2725A1"(177,182)
4500/wot Hands Off, Hands On
3, 6, 12 FPC Water for Best BSFC
78 PSI Air, 90 PSI Water
Two Fuel rail Head

		1	2	3	4	5	6
		E1S1.1	E1S2.1	E1S5.1	E1S3.1	E1S4.1	E1S6.1
1							
2	Search BLK	177.0	178.0	181.0	179.0	180.0	182.0
3	Exp. Ref.	E1S1.1	E1S2.1	E1S5.1	E1S3.1	E1S4.1	E1S6.1
4	Date Logged	09/02/98	09/02/98	09/02/98	09/02/98	09/02/98	09/02/98
5	Time Logged	13:10:58	13:21:38	13:45:19	13:30:20	13:38:42	13:52:54
6	SPEED (rpm)	4501	4501	4501	4501	4501	4501
7	TORQUE (NM)	104.8	125.1	129.2	128.8	125.0	124.2
8	CPTORQUE (Nm)	104.0	124.5	128.5	128.1	124.4	123.7
9							
10	POWER (KWATTS)	49.40	58.99	60.87	60.69	58.93	58.56
11	CPPOWER (kW)	49.02	58.70	60.55	60.38	58.65	58.28
12							
13	HC FID (PPM)	5574	1338	4859	5719	8768	1062
14	CO (%)	.2586	.2059	1.284	1.199	.8484	.1754
15	CO2 (%)	9.447	12.85	10.86	10.73	10.72	12.72
16	O2 (%)	7.765	3.404	5.012	5.090	5.539	3.528
17	NOX (PPM)	1409	1349	1228	1001	596.6	1328
18							
19	AT PRESS (MM HG)	745.1	745.4	745.6	745.6	745.6	745.6
20	FUEL TMP (DEG C)	14.84	16.57	16.39	16.30	15.86	16.42
21	WET TMP (deg c)	9.168	9.428	9.520	9.650	9.834	9.515
22	DRY TMP (DEG C)	18.73	19.11	18.95	19.23	19.36	19.00
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	19.93	21.47	21.27	21.42	21.46	21.59
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	360.5	415.1	446.5	450.3	453.1	455.3
27	T.CPTORQUE (NM)	104.0	124.5	128.5	128.1	124.4	123.7
28	T.PPC.FAC ()	.9924	.9951	.9947	.9950	.9953	.9953
29	T.EXH A/F ()	21.06	16.78	17.21	17.24	17.44	16.95
30	T.BSPEHC (G/KWHr)	14.28	2.579	10.17	11.31	19.67	2.345
31	T.BSPENOX (G/KWHr)	12.01	8.654	8.555	6.592	4.455	9.762
32	T.BSPECO (G/KWHr)	13.43	8.045	54.45	48.05	38.58	7.851
33	T.BSPEFC (G/KWHr)	262.4	253.9	263.8	246.8	278.4	286.7
34	T.AIRFLO (g/s)	75.81	69.80	76.76	71.74	79.46	79.03
35	T.REL HUM (Fraction)	.2445	.2445	.2577	.2535	.2598	.2554
36	T.FUELFLOW (g/s)	3.600	4.160	4.461	4.161	4.556	4.662
37	CYL #2 TMP (DEG C)	223.8	240.3	236.5	231.2	215.2	240.0
38	DWNPIPE TMP (deg C)	661.6	894.1	739.0	725.1	704.2	892.1
39	CAT TMP1 (deg c)	649.6	863.5	745.1	717.9	685.3	860.2
40	CAT TMP2 (deg C)	644.7	852.8	748.4	715.2	680.1	849.6
41	CAT TMP3 (deg C)	645.7	843.8	754.3	714.1	675.0	839.1
42	HD BOLT TMP (DEG C)	89.39	89.36	89.49	90.73	90.06	90.27
43	H2OIN TMP (DEG C)	85.91	85.04	85.30	86.68	86.61	85.76
44	H2OOUT TMP (DEG C)	89.68	89.42	89.47	90.59	89.89	90.12
45	H20 FLOW (l/min)	123.6	123.5	123.6	123.4	123.6	123.3
46	DYNO TMP (DEG C)	36.48	41.01	40.58	42.52	41.46	41.29
47	EX SYS PRES (kpa)	-1.471	-1.488	-1.482	-1.467	-1.453	-1.499
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	99.32	99.36	99.39	99.39	99.39	99.39
50	AIR PRESS (kPa)	542.7	543.3	543.5	543.2	542.4	543.8
51	F/A DIFF (kPa)	69.71	69.82	68.65	69.17	69.33	69.03
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00
54	WECU FPC ()	0.0	0.0	3.000	6.000	12.00	0.0
55	WECU AST ()	0.0	0.0	166.0	181.0	171.0	0.0
56	WECU EOA ()	0.0	0.0	50.00	65.00	56.00	0.0
57	WECU APW ()	0.0	0.0	4.300	4.300	4.300	0.0
58	WECU FPW ()	0.0	0.0	1.200	2.400	4.800	0.0
59	WECU PPOT ()	0.0	0.0	843.0	843.0	843.0	0.0
60	KIST VOLTS ()	4.100	5.000	4.900	4.840	4.300	5.000
61	PPC.FAC ()	.9924	.9951	.9947	.9950	.9953	.9953
62	DAT PRESS (kPa)	98.79	98.82	98.82	98.82	98.80	98.83
63	VAP PRESS (kPa)	.5279	.5406	.5643	.5647	.5834	.5606
64	NOX_HCF ()	.8044	.8061	.8093	.8094	.8119	.8088
65	CMASS_NOX (g/s)	.1327	.1140	.1172	.9737E-01	.5887E-01	.1254
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000
68							
69	ECU FPC ()	17.00	21.00	21.00	21.00	21.00	21.00
70	ECU TEMP ()	91.00	91.00	91.00	91.00	91.00	91.00
71	ECU SA ()	12.00	12.00	20.00	21.00	22.00	12.00
72	ECU AST ()	177.0	182.0	184.0	184.0	189.0	182.0
73	ECU EOA ()	30.00	26.00	28.00	28.00	37.00	26.00
74	ECU APW ()	5.380	5.770	5.770	5.770	5.770	5.770
75	ECU FPW ()	6.900	8.610	8.610	8.610	8.610	8.610
76	ECU SAPC ()	377.0	377.0	377.0	377.0	377.0	377.0
77	ECU FBAPC ()	326.0	335.0	327.0	325.0	327.0	333.0
78	ECU A/F ()	19.20	16.00	15.70	15.60	15.80	15.80
79	ECU EV ()	84.00	100.0	100.0	100.0	100.0	100.0
80	ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0
82	ECU PPOT ()	851.0	851.0	851.0	851.0	851.0	851.0
83	ECU AFL ()	74.00	74.00	74.00	74.00	74.00	74.00
84							

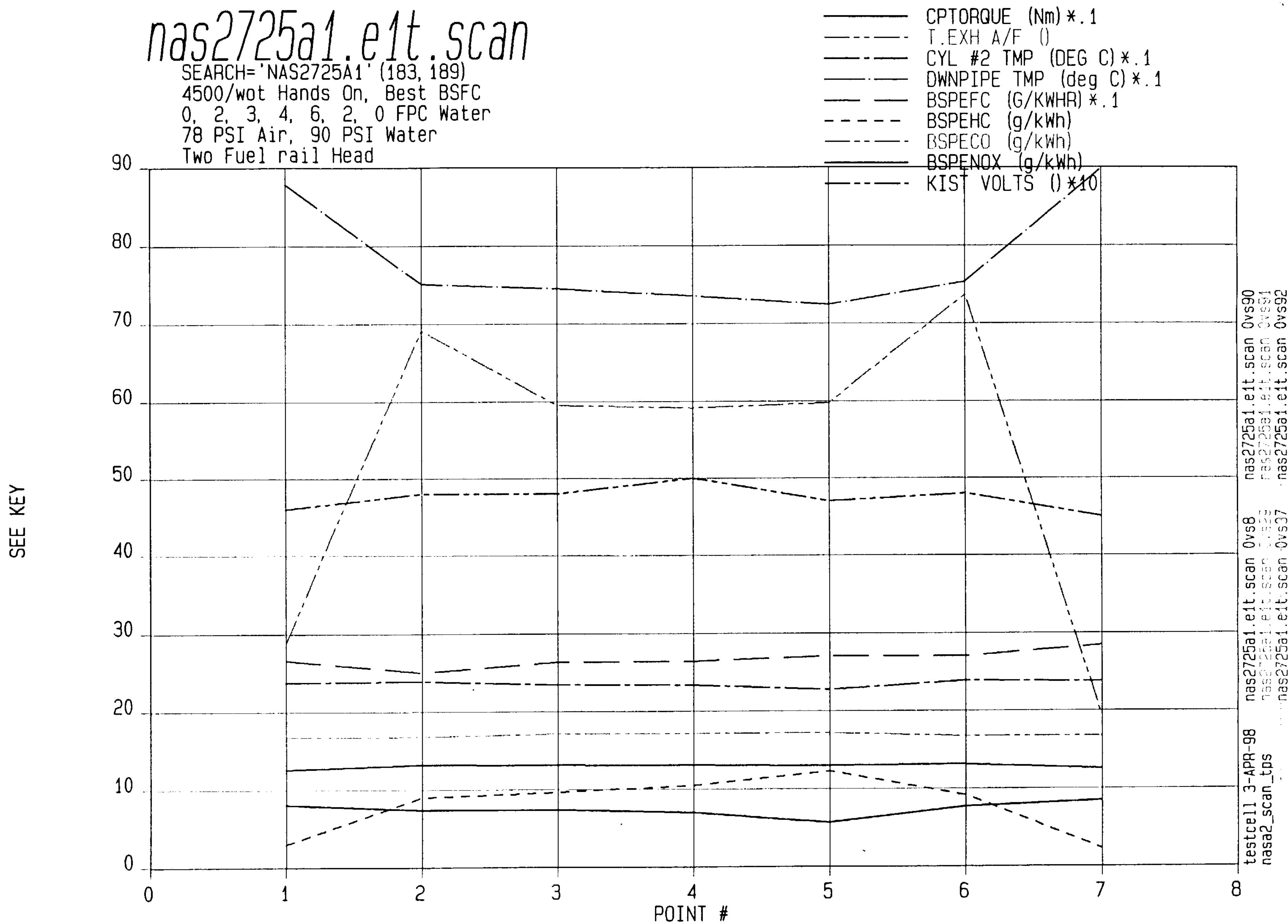
	1	2	3	4	5	6
	E1S1.1	E1S2.1	E1S5.1	E1S3.1	E1S4.1	E1S6.1
85 FUELFLO (G/SEC)	3.605	4.151	4.465	4.503	4.531	4.553
86 AIRFLO (G/SEC)	75.90	69.65	76.83	77.65	79.03	77.19
87 EXH A/F (:1)	21.06	16.78	17.21	17.24	17.44	16.95
88						
89 BSPEFC (G/KWHR)	262.7	253.3	264.0	267.1	276.8	279.9
90 BSPEHC (g/kWh)	14.29	2.573	10.18	12.25	19.55	2.289
91 BSPECO (g/kWh)	13.44	8.027	54.51	52.02	38.36	7.664
92 BSPENOX (g/kWh)	12.03	8.635	8.563	7.137	4.430	9.533
93						
94 FFCC (mg/cyl/cyc)	16.02	18.44	19.84	20.01	20.13	20.23
95 AIRCC (mg/cyl/cyc)	337.3	309.5	341.4	345.1	351.1	343.0
96 MASS_HC (g/sec)	.1961	.4216E-01	.1721	.2064	.3201	.3724E-01
97 MASS_CO (g/sec)	.1844	.1315	.9216	.8770	.6279	.1247
98 MASS_NOX (g/sec)	.1650	.1415	.1448	.1203	.7251E-01	.1551


nas2725a1.e1s.scan
SEARCH='NAS2725A1' (177, 182)
4500/wot Hands Off, Hands On
3, 6, 12 FPC Water for Best BSFC
78 PSI Air, 90 PSI Water
Two Fuel rail Head
CPTORQUE (Nm)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS ()*10
SEE KEY
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
POINT #
nas2725a1.e1s.scan 0vs90
nas2725a1.e1s.scan 0vs91
nas2725a1.e1s.scan 0vs92
nas2725a1.e1s.scan 0vs8
nas2725a1.e1s.scan 0vs29
nas2725a1.e1s.scan 0vs37
testcell 3-APR-98
nasa2_scan_tps

SEARCH="NAS2725A1"(183,189)
4500/wot Hands On, Best BSFC
0, 2, 3, 4, 6, 2, 0 FPC Water
78 PSI Air, 90 PSI Water
Two Fuel rail Head

	1	2	3	4	5	6	7
	E1T1.1	E1T2.1	E1T3.1	E1T4.1	E1T5.1	E1T6.1	E1T7.1
1							
2 Search BLK	183.0	184.0	185.0	186.0	187.0	188.0	189.0
3 Exp. Ref.	E1T1.1	E1T2.1	E1T3.1	E1T4.1	E1T5.1	E1T6.1	E1T7.1
4 Date Logged	11/02/98	11/02/98	11/02/98	11/02/98	11/02/98	11/02/98	11/02/98
5 Time Logged	13:48:57	14:01:36	14:14:17	14:23:19	14:33:18	14:40:54	14:46:31
6 SPEED (rpm)	4501	4503	4500	4501	4501	4501	4502
7 TORQUE (NM)	122.8	128.3	127.7	127.6	126.5	128.0	121.9
8 CPTORQUE (Nm)	126.4	132.2	131.5	131.3	129.9	131.9	125.8
9							
10 POWER (KWATTS)	57.86	60.51	60.16	60.14	59.64	60.33	57.49
11 CPPOWER (kW)	59.58	62.34	61.95	61.88	61.24	62.15	59.32
12							
13 HC FID (PPM)	1441	4584	4574	4921	5632	4305	1044
14 CO (%)	.6868	1.742	1.391	1.369	1.349	1.707	.4284
15 CO2 (%)	12.02	10.59	10.65	10.56	10.48	10.57	12.28
16 O2 (%)	3.626	4.802	4.903	4.969	5.095	4.685	3.378
17 NOX (PPM)	1172	1130	1052	983.7	784.7	1089	1147
18							
19 AT PRESS (MM HG)	733.7	734.0	733.6	734.0	733.8	733.9	733.9
20 FUEL TMP (DEG C)	18.60	18.57	18.33	17.45	17.14	17.57	17.12
21 WET TMP (deg c)	12.57	11.98	11.99	11.86	12.08	11.63	11.66
22 DRY TMP (DEG C)	19.66	18.15	18.04	17.97	18.40	17.56	17.56
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	26.46	27.00	26.32	26.33	25.17	26.99	27.72
25 FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26 FUEL MASS (GRAMS)	427.2	420.4	439.7	441.1	447.5	452.9	454.0
27 T.CPTORQUE (NM)	126.4	132.2	131.5	131.3	129.9	131.9	125.8
28 T.PPC.FAC ()	1.030	1.030	1.030	1.029	1.027	1.030	1.032
29 T.EXH A/F ()	16.77	16.81	17.13	17.17	17.20	16.78	16.75
30 T.BSPEHC (G/KWHr)	3.002	8.925	9.094	10.35	12.01	8.913	2.328
31 T.BSPENOX (G/KWHr)	8.130	7.322	6.960	6.890	5.571	7.505	8.511
32 T.BSPECO (G/KWHr)	29.02	68.73	56.08	58.39	58.31	71.63	19.36
33 T.BSPEFC (G/KWHr)	267.4	248.5	248.0	260.8	263.6	262.6	285.2
34 T.AIRFLO (g/s)	72.04	70.15	71.00	74.78	75.14	73.84	76.27
35 T.REL HUM (Fraction)	.4346	.4789	.4869	.4816	.4717	.4896	.4918
36 T.FUELFLOW (g/s)	4.296	4.174	4.145	4.356	4.367	4.400	4.553
37 CYL #2 TMP (DEG C)	237.5	238.9	234.2	233.4	227.1	238.9	237.5
38 DWNPIPE TMP (deg C)	878.7	751.6	745.4	736.1	724.6	753.9	897.5
39 CAT TMP1 (deg c)	873.2	772.0	753.2	739.6	716.6	773.9	878.0
40 CAT TMP2 (deg C)	873.9	788.1	760.3	742.5	714.8	791.5	872.0
41 CAT TMP3 (deg C)	866.0	805.8	766.2	744.3	712.2	808.8	861.1
42 HD BOLT TMP (DEG C)	89.78	90.28	89.08	89.49	90.15	89.51	89.49
43 H2OIN TMP (DEG C)	85.62	86.04	85.06	85.38	86.12	85.22	85.08
44 H2OOUT TMP (DEG C)	89.93	90.37	89.19	89.44	89.95	89.44	89.39
45 H20 FLOW (l/min)	123.1	123.0	123.3	123.3	123.2	123.5	123.3
46 DYNO TMP (DEG C)	41.93	42.33	41.66	41.57	41.19	40.04	41.53
47 EX SYS PRES (kpa)	-2.977	-3.007	-3.110	-3.054	-3.142	-3.114	-3.144
48 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00
49 ATMOS (KPA)	97.80	97.85	97.79	97.84	97.82	97.83	97.83
50 AIR PRESS (kPa)	543.2	543.1	543.0	542.9	543.6	543.2	543.1
51 F/A DIFF (kPa)	69.06	68.91	68.95	69.17	68.22	68.68	68.86
52 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0
53 TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00	11.00
54 WECU FPC ()	0.0	2.000	3.000	4.000	6.000	2.000	0.0
55 WECU AST ()	0.0	151.0	151.0	161.0	156.0	151.0	0.0
56 WECU EOA ()	0.0	35.00	35.00	46.00	41.00	35.00	0.0
57 WECU APW ()	0.0	4.300	4.300	4.300	4.300	4.300	0.0
58 WECU FPW ()	0.0	.8000	1.200	1.600	2.400	.8000	0.0
59 WECU PPOT ()	0.0	843.0	843.0	843.0	843.0	843.0	0.0
60 KIST VOLTS ()	4.600	4.800	4.800	5.000	4.700	4.800	4.500
61 PPC.FAC ()	1.030	1.030	1.030	1.029	1.027	1.030	1.032
62 DAT PRESS (kPa)	96.81	96.85	96.78	96.85	96.82	96.85	96.84
63 VAP PRESS (kPa)	.9943	.9972	1.007	.9913	.9976	.9822	.9865
64 NOX_HCF ()	.8754	.8758	.8775	.8749	.8759	.8734	.8741
65 CMASS_NOX (g/s)	.1137	.1085	.1083	.1019	.8283E-01	.1130	.1184
66 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481
67 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000
68							
69 ECU FPC ()	21.00	21.48	21.00	21.00	21.00	21.48	21.48
70 ECU TEMP ()	92.00	92.00	92.00	92.00	92.00	92.00	92.00
71 ECU SA ()	12.00	19.00	19.00	20.00	21.00	19.00	12.00
72 ECU AST ()	186.0	186.0	186.0	186.0	186.0	186.0	186.0
73 ECU EOA ()	31.00	31.00	31.00	31.00	31.00	31.00	31.00
74 ECU APW ()	5.770	5.770	5.770	5.770	5.770	5.770	5.770
75 ECU FPW ()	8.610	8.800	8.610	8.610	8.610	8.800	8.800
76 ECU SAPC ()	377.0	377.0	377.0	377.0	377.0	377.0	377.0
77 ECU FBAPC ()	340.0	333.0	333.0	333.0	333.0	333.0	340.0
78 ECU A/F ()	16.10	15.50	15.80	16.00	15.80	15.60	16.30
79 ECU EV ()	100.0	100.0	100.0	100.0	100.0	100.0	100.0
80 ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81 ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82 ECU PPOT ()	853.0	853.0	853.0	853.0	853.0	853.0	853.0
83 ECU AFL ()	77.00	77.00	77.00	77.00	77.00	77.00	77.00
84							

	1	2	3	4	5	6	7
	E1T1.1	E1T2.1	E1T3.1	E1T4.1	E1T5.1	E1T6.1	E1T7.1
85 FUELFLO (G/SEC)	4.272	4.204	4.397	4.411	4.475	4.529	4.540
86 AIRFLO (G/SEC)	71.63	70.67	75.31	75.73	76.99	76.02	76.06
87 EXH A/F (:1)	16.77	16.81	17.13	17.17	17.20	16.78	16.75
88							
89 BSPEFC (G/KWHR)	265.8	250.1	263.1	264.0	270.1	270.3	284.3
90 BSPEHC (g/kWh)	2.985	8.983	9.648	10.48	12.31	9.173	2.321
91 BSPECO (g/kWh)	28.85	69.18	59.50	59.13	59.76	73.73	19.30
92 BSPENOX (g/kWh)	8.082	7.370	7.384	6.976	5.708	7.723	8.485
93							
94 FFCC (mg/cyl/cyc)	18.98	18.67	19.54	19.60	19.88	20.13	20.17
95 AIRCC (mg/cyl/cyc)	318.3	313.9	334.7	336.5	342.1	337.8	337.9
96 MASS_HC (g/sec)	.4798E-01	.1510	.1612	.1751	.2039	.1537	.3706E-01
97 MASS_CO (g/sec)	.4637	1.163	.9943	.9877	.9899	1.236	.3082
98 MASS_NOX (g/sec)	.1299	.1239	.1234	.1165	.9456E-01	.1294	.1355

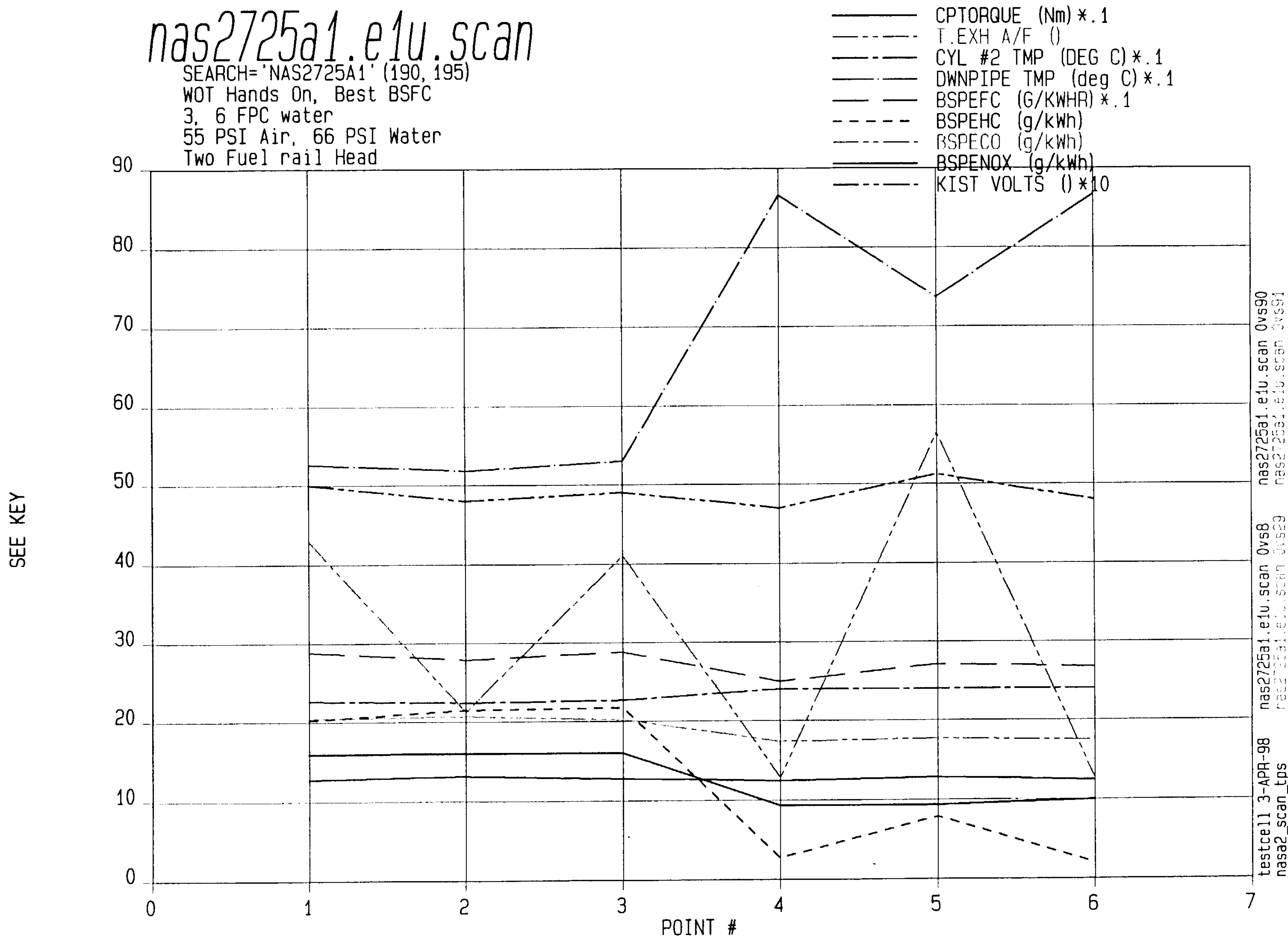


nas2725a1.e1t.scan
SEARCH='NAS2725A1' (183, 189)
4500/wot Hands On, Best BSFC
0, 2, 3, 4, 6, 2, 0 FPC Water
78 PSI Air, 90 PSI Water
Two Fuel rail Head
CPTORQUE (Nm)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS ()*10
SEE KEY
POINT #
0
10
20
30
40
50
60
70
80
90
1
2
3
4
5
6
7
8
testcell 3-APR-98
nasa2_scan_tps
nas2725a1.e1t.scan 0vs8
nas2725a1.e1t.scan 0vs90
nas2725a1.e1t.scan 0vs37
nas2725a1.e1t.scan 0vs92

SEARCH="NAS2725A1"(190,195)
WOT Hands On, Best BSFC
3, 6 FPC water
55 PSI Air, 66 PSI Water
Two Fuel rail Head

		1	2	3	4	5	6
		E1U1.1	E1U2.1	E1U3.1	E1U4.1	E1U5.1	E1U6.1
1							
2	Search BLK	190.0	191.0	192.0	193.0	194.0	195.0
3	Exp. Ref.	E1U1.1	E1U2.1	E1U3.1	E1U4.1	E1U5.1	E1U6.1
4	Date Logged	16/02/98	16/02/98	16/02/98	16/02/98	16/02/98	16/02/98
5	Time Logged	09:44:36	09:55:15	10:01:03	10:13:32	10:24:51	10:31:53
6	SPEED (rpm)	2503	2502	2503	4499	4500	4502
7	TORQUE (NM)	126.6	130.5	126.8	123.9	128.2	123.9
8	CPTORQUE (Nm)	127.6	131.5	127.7	124.5	128.6	124.4
9							
10	POWER (KWATTS)	33.18	34.19	33.24	58.40	60.41	58.40
11	CPPOWER (kW)	33.44	34.47	33.46	58.65	60.60	58.65
12							
13	HC FID (PPM)	7452	8086	8075	1375	3541	948.4
14	CO (%)	.7783	.3943	.7524	.3136	1.250	.2885
15	CO2 (%)	9.103	9.301	9.160	11.98	10.59	12.07
16	O2 (%)	7.934	7.980	7.842	4.068	5.274	4.116
17	NOX (PPM)	1762	1811	1787	1393	1258	1397
18							
19	AT PRESS (MM HG)	745.9	745.9	746.0	746.3	746.7	746.8
20	FUEL TMP (DEG C)	20.67	18.40	17.70	18.04	16.40	16.30
21	WET TMP (deg c)	11.74	11.68	11.56	10.52	10.41	10.24
22	DRY TMP (DEG C)	21.59	21.40	21.20	18.43	18.00	17.74
23	DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0
24	AIRIN TMP (DEG C)	27.16	27.29	26.57	25.64	25.28	25.97
25	FUEL TIME (SECS)	100.0	100.0	100.0	100.0	100.0	100.0
26	FUEL MASS (GRAMS)	265.8	264.7	266.0	404.9	455.1	434.7
27	T.CPTORQUE (NM)	127.6	131.5	127.7	124.5	128.6	124.4
28	T.PPC.FAC ()	1.008	1.008	1.007	1.004	1.003	1.004
29	T.EXH A/F ()	20.42	20.68	20.22	17.40	17.69	17.49
30	T.BSPEHC (G/KWHr)	20.23	21.50	21.68	2.782	7.336	2.032
31	T.BSPENOX (G/KWHr)	15.92	16.03	15.97	9.381	8.674	9.961
32	T.BSPECO (G/KWHr)	42.84	21.25	40.94	12.86	52.50	12.53
33	T.BSPEFC (G/KWHr)	288.3	279.0	287.5	251.1	252.3	266.4
34	T.AIRFLO (g/s)	54.24	54.80	53.67	70.87	74.92	75.55
35	T.REL HUM (Fraction)	.2815	.2867	.2875	.3525	.3672	.3695
36	T.FUELFLOW (g/s)	2.656	2.650	2.655	4.073	4.234	4.320
37	CYL #2 TMP (DEG C)	226.0	224.1	226.4	240.0	239.9	239.9
38	DWNPIPE TMP (deg C)	526.1	518.0	529.7	866.1	737.4	866.5
39	CAT TMP1 (deg c)	514.9	505.9	518.2	839.0	739.7	838.5
40	CAT TMP2 (deg C)	503.4	495.0	506.7	834.2	746.1	832.8
41	CAT TMP3 (deg C)	497.4	489.3	500.8	824.9	750.8	822.6
42	HD BOLT TMP (DEG C)	89.64	89.70	89.50	89.87	89.69	89.25
43	H2OIN TMP (DEG C)	83.56	84.17	83.51	85.74	85.68	85.03
44	H2OOUT TMP (DEG C)	89.37	89.53	89.32	89.97	89.70	89.26
45	H20 FLOW (l/min)	69.03	69.04	69.05	123.6	124.6	124.6
46	DYNO TMP (DEG C)	39.62	39.01	36.40	41.54	42.35	40.42
47	EX SYS PRES (kpa)	-1.292	-1.308	-1.292	-1.310	-1.007	-1.040
48	AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00
49	ATMOS (KPA)	99.43	99.43	99.44	99.49	99.53	99.55
50	AIR PRESS (kPa)	378.3	378.5	378.3	383.9	384.2	384.7
51	F/A DIFF (kPa)	67.11	67.08	67.34	67.14	67.21	67.17
52	TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0
53	TECHNICIAN (CLOCK#)	11.00	11.00	11.00	11.00	11.00	11.00
54	WECU FPC ()	0.0	6.000	0.0	0.0	3.000	0.0
55	WECU AST ()	0.0	126.0	0.0	0.0	156.0	0.0
56	WECU EOA ()	0.0	42.00	0.0	0.0	40.00	0.0
57	WECU APW ()	0.0	5.600	0.0	0.0	4.300	0.0
58	WECU FPW ()	0.0	2.400	0.0	0.0	1.200	0.0
59	WECU PPOT ()	0.0	843.0	0.0	0.0	843.0	0.0
60	KIST VOLTS ()	5.000	4.800	4.900	4.700	5.120	4.800
61	PPC.FAC ()	1.008	1.008	1.007	1.004	1.003	1.004
62	DAT PRESS (kPa)	98.71	98.70	98.71	98.74	98.77	98.80
63	VAP PRESS (kPa)	.7257	.7301	.7234	.7472	.7578	.7497
64	NOX_HCF ()	.8319	.8326	.8316	.8350	.8365	.8353
65	CMASS_NOX (g/s)	.1222	.1266	.1229	.1263	.1309	.1358
66	FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481
67	FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000
68							
69	ECU FPC ()	21.00	21.00	21.00	21.00	21.00	21.00
70	ECU TEMP ()	92.00	92.00	92.00	92.00	92.00	92.00
71	ECU SA ()	13.00	19.00	13.00	12.00	19.00	12.00
72	ECU AST ()	161.0	161.0	161.0	186.0	186.0	186.0
73	ECU EOA ()	66.00	66.00	66.00	30.00	30.00	30.00
74	ECU APW ()	6.320	6.320	6.320	5.770	5.770	5.770
75	ECU FPW ()	8.610	8.610	8.610	8.610	8.610	8.610
76	ECU SAPC ()	386.0	386.0	386.0	377.0	377.0	377.0
77	ECU FBAPC ()	388.0	388.0	388.0	345.0	340.0	344.0
78	ECU A/F ()	18.60	18.60	18.60	16.60	16.10	16.60
79	ECU EV ()	55.00	55.00	55.00	100.0	100.0	100.0
80	ECU EGR ()	0.0	0.0	0.0	0.0	0.0	0.0
81	ECU DAR ()	0.0	0.0	0.0	0.0	0.0	0.0
82	ECU PPOT ()	851.0	851.0	851.0	853.0	853.0	853.0
83	ECU AFL ()	47.00	47.00	47.00	78.00	76.00	78.00
84							

	1	2	3	4	5	6
	E1U1.1	E1U2.1	E1U3.1	E1U4.1	E1U5.1	E1U6.1
85 FUELFLO (G/SEC)	2.658	2.647	2.660	4.049	4.551	4.347
86 AIRFLO (G/SEC)	54.28	54.75	53.78	70.44	80.52	76.04
87 EXH A/F (:1)	20.42	20.68	20.22	17.40	17.69	17.49
88						
89 BSPEFC (G/KWHR)	288.4	278.7	288.1	249.6	271.2	268.0
90 BSPEHC (g/kWh)	20.24	21.48	21.72	2.766	7.886	2.044
91 BSPECO (g/kWh)	42.86	21.23	41.03	12.79	56.43	12.60
92 BSPENOX (g/kWh)	15.93	16.01	16.00	9.326	9.324	10.02
93						
94 FFCC (mg/cyl/cyc)	21.24	21.16	21.26	18.00	20.22	19.31
95 AIRCC (mg/cyl/cyc)	433.8	437.6	429.8	313.1	357.9	337.8
96 MASS_HC (g/sec)	.1866	.2040	.2006	.4486E-01	.1323	.3316E-01
97 MASS_CO (g/sec)	.3950	.2016	.3789	.2074	.9470	.2045
98 MASS_NOX (g/sec)	.1468	.1521	.1477	.1513	.1565	.1626



nas2725a1.e1u.scan
SEARCH='NAS2725A1' (190, 195)
WOT Hands On, Best BSFC
3, 6 FPC water
55 PSI Air, 66 PSI Water
Two Fuel rail Head
CPTORQUE (Nm)*.1
T.EXH A/F ()
CYL #2 TMP (DEG C)*.1
DWNPIPE TMP (deg C)*.1
BSPEFC (G/KWHR)*.1
BSPEHC (g/kWh)
BSPECO (g/kWh)
BSPENOX (g/kWh)
KIST VOLTS ()*10
SEE KEY
POINT #
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
nas2725a1.e1u.scan Ovs90
nas2725a1.e1u.scan Ovs91
nas2725a1.e1u.scan Ovs92
nas2725a1.e1u.scan Ovs8
nas2725a1.e1u.scan Ovs29
nas2725a1.e1u.scan Ovs37
testcell 3-APR-98
nasa2_scan_tps

SEARCH="NAS2725B1"(48,54)
With three haed gaskets
Compression ratio 4.86:1

	1 E1F1.1	2 E1F2.1	3 E2A1.1	4 E2A2.1	5 E2A3.1	6 E2A4.1	7 E2A5.1
1							
2 Search BLK	48.00	49.00	50.00	51.00	52.00	53.00	54.00
3 Exp. Ref.	E1F1.1	E1F2.1	E2A1.1	E2A2.1	E2A3.1	E2A4.1	E2A5.1
4 Date Logged	24/03/98	24/03/98	25/03/98	25/03/98	25/03/98	26/03/98	26/03/98
5 Time Logged	16:03:19	16:10:32	14:17:52	16:14:02	16:16:51	09:04:40	09:25:27
6 SPEED (rpm)	2502	2502		2504	2503	2502	2504
7 TORQUE (NM)	149.6	162.9	184.6	196.8	200.9	222.6	250.1
8 CPTORQUE (Nm)	147.6	160.7	184.9	195.6	199.7	224.9	253.5
9							
10 POWER (KWATTS)	39.19	42.69		51.60	52.67	58.32	65.58
11 CPPOWER (kW)	38.66	42.12		51.28	52.36	58.95	66.46
12							
13 HC FID (PPM)	.1126E+05	.1407E+05	.1775E+05	.1741E+05	.1591E+05	.1683E+05	9793
14 CO (%)	.2920	.1134	2.087	1.682	1.176	2.348	.6483
15 CO2 (%)	9.655	6.900	8.016	8.873	9.155	7.373	8.306
16 O2 (%)	7.225	11.31	8.035	7.397	7.387	8.569	8.878
17 NOX (PPM)	882.4	390.3	862.1	800.9	925.8	773.1	1319
18							
19 AT PRESS (MM HG)	748.7	748.8	746.5	745.8	745.8	741.7	741.5
20 FUEL TMP (DEG C)	15.53	15.54	16.84	17.37	17.49	20.06	20.11
21 WET TMP (deg c)	10.70	10.64	13.30	12.45	12.54	15.58	16.02
22 DRY TMP (DEG C)	19.98	19.97	22.91	20.82	20.91	21.69	22.60
23 DEPRESS (MM H2O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 AIRIN TMP (DEG C)	18.89	19.18	23.45	19.06	19.14	21.30	22.42
25 LFE DIFF (mm H2O)	43.82	112.7	71.27	68.68	76.85	116.6	186.7
26 LFE TMP (DEG C)	18.89	19.18	23.45	19.06	19.14	21.30	22.42
27 FUEL TIME ()	100.0	100.0	50.00	50.00	50.00	50.00	50.00
28 FUEL MASS ()	3.610	0.0	253.8	238.2	238.4	268.8	282.1
29 T.CPTORQUE (NM)	147.6	160.7	184.9	195.6	199.7	224.9	253.5
30 T.PPC.FAC ()	.9863	.9866	1.002	.9939	.9941	1.011	1.013
31 T.EXH A/F ()	19.32	25.34	17.91	17.53	18.08	18.48	21.56
32 T.BSPEHC (G/KWHr)	32.63	56.68	55.78	47.73	43.68	51.12	30.79
33 T.BSPENOX (G/KWHr)	8.514	5.227	9.017	7.307	8.462	7.817	13.78
34 T.BSPECO (G/KWHr)	17.16	9.262	133.0	93.47	65.46	144.5	41.27
35 T.BSPEFC (G/KWHr)	320.4	338.8	372.4	336.3	326.6	345.4	311.2
36 T.AIRFLO (g/s)	67.34	101.8	89.28	84.49	86.35	103.4	122.2
37 LFE DIF (inches H2O)	1.725	4.438	2.806	2.704	3.026	4.590	7.351
38 PRESO PRES1 (PSIA)	102.3	95.09	105.7	106.0	104.8	100.9	97.08
39 PRESO QA (SCFM)	120.8	186.9	156.7	154.0	162.0	195.8	243.0
40 PRESOAIRFLO (G/S)	67.65	104.5	86.02	85.75	90.20	107.4	132.8
41 PRESO TMP (deg F)	68.00	68.00	68.00	68.00	68.00	68.00	68.00
42 NASA AIRDEN (G/L)	2.660	2.573	2.622	2.169	2.422	2.910	3.531
43 NASA PRESS (kPa)	239.7	237.6	222.0	244.7	259.6	245.6	297.9
44 NASA TMP (deg C)	40.08	47.87	20.99	119.1	99.46	19.98	19.93
45 NASA AIRFLO (SCFM)	53.89	86.10	69.50	83.79	78.92	78.22	79.68
46 T.AIR DENS (G/L)	1.186	1.185	1.163	1.180	1.180	1.162	1.158
47 T.VAP PRESS (kPa)	.6693	.6608	.8903	.8903	.8982	1.367	1.387
48 T.VISCC ()	1.006	1.005	.9939	1.005	1.005	.9995	.9966
49 T.REL HUM (Fraction)	.2868	.2832	.3188	.3621	.3634	.5271	.5064
50 T.FUELFLOW (g/s)	3.485	4.019	4.984	4.820	4.777	5.596	5.669
51 CYL #2 TMP (DEG C)	206.5	182.5	229.5	236.5	227.5	236.3	217.4
52 EXH CYL 2 (Degree C)	611.5	509.2	546.7	585.8	614.9	549.6	593.9
53 DWNPIPE TMP (deg C)	577.0	503.4	525.6	572.4	610.6	562.4	681.6
54 CAT TMP1 (deg c)	536.9	466.2	490.7	532.8	570.4	531.8	641.8
55 CAT TMP3 (deg C)	510.9	457.8	482.2	518.0	555.0	525.3	638.3
56 HD BOLT TMP (DEG C)	82.81	80.64	90.87	87.92	87.74	88.83	88.18
57 H2OIN TMP (DEG C)	74.80	75.13	81.57	78.88	78.34	79.32	79.21
58 H2OOUT TMP (DEG C)	83.05	81.26	90.55	88.11	87.82	88.50	88.11
59 H20 FLOW (l/min)	69.01	70.45	68.85	69.01	69.13	69.06	69.43
60 DYNO TMP (DEG C)	39.24	36.56	35.37	40.75	40.55	37.35	42.52
61 EX SYS PRES (kpa)	-.8563	-.9149	-.9256	-1.034	-1.019	-1.839	-1.818
62 AL CELLTMP1 (DEG C)	26.00	26.00	26.00	26.00	26.00	26.00	26.00
63 ATMOS (KPA)	99.80	99.82	99.50	99.41	99.41	98.87	98.85
64 AIR PRESS (kPa)	547.4	548.1	552.6	548.3	548.5	553.4	550.8
65 F/A DIFF (kPa)	66.62	66.49	66.05	66.54	66.49	62.45	65.84
66 CRANKPRESS (kPa)	139.9	137.8	122.5	145.3	160.2		
67 EXHPRESS (kPa)	111.9	91.09	58.06	99.43	111.7		
68 TESTCELL # (101_103)	101.0	101.0	101.0	101.0	101.0	101.0	101.0
69 TECHNICIAN ()	11.00	11.00	11.00	11.00	11.00	11.00	11.00
70 WECU FPC ()	3.000	3.000	0.0	10.00	10.00	0.0	0.0
71 WECU AST ()	116.0	116.0	0.0	126.0	126.0	0.0	0.0
72 WECU EOA ()	32.00	32.00	0.0	42.00	42.00	0.0	0.0
73 WECU APW ()	5.600	5.600	0.0	5.600	5.600	0.0	0.0
74 WECU FPW ()	1.200	1.200	0.0	4.100	4.100	0.0	0.0
75 WECU PPOT ()	966.0	966.0	0.0	967.0	967.0		
76 KIST VOLTS ()	4.000	4.000	4.560	4.600	4.600	5.200	4.000
77 T.CPPOWER (KW)				51.29	52.34	58.95	66.46
78 CRANK PRESS (kPa)						146.8	199.0
79 EXH PRESS (kPa)						81.88	137.5
80 PPC.FAC ()	.9863	.9866	1.002	.9939	.9941	1.011	1.013
81 DAT PRESS (kPa)	99.13	99.16	98.61	98.52	98.51	97.50	97.46
82 VAP PRESS (kPa)	.6693	.6608	.8901	.8903	.8982	1.367	1.387
83 NOX_HCF ()	.8235	.8223	.8563	.8565	.8577	.9384	.9423
84 CMASS_NOX (g/s)	.7904E-03		.1052	.8867E-01	.1060	.1141	.2354

	1	2	3	4	5	6	7
	E1F1.1	E1F2.1	E2A1.1	E2A2.1	E2A3.1	E2A4.1	E2A5.1
85 FUEL DEN (G/CC @ 15+	.7481	.7481	.7481	.7481	.7481	.7481	.7481
86 FUEL TYPE (1-6)	3.000	3.000	3.000	3.000	3.000	3.000	3.000
87							
88 ECU FPC ()	28.00	32.00	40.00	40.00	40.00	52.00	51.00
89 ECU TEMP ()	85.00	85.00	94.00	90.00	90.00	91.00	91.00
90 ECU SA ()	18.00	18.00	13.00	17.00	13.00	13.00	13.00
91 ECU AST ()	158.0	158.0	158.0	158.0	158.0	158.0	158.0
92 ECU EOA ()	62.00	62.00	64.00	64.00	64.00	63.00	63.00
93 ECU APW ()	6.320	6.320	6.380	6.320	6.320	6.320	6.320
94 ECU FPW ()	1.480	1.480	16.39	16.39	16.39	19.69	19.69
95 ECU SAPC ()	0.0	0.0					
96 ECU FBAPC ()	0.0	0.0					
97 ECU A/F ()	0.0	0.0					
98 ECU EV ()	0.0	0.0	31.00	41.00	41.00	41.00	50.00
99 ECU EGR ()	0.0	0.0					
100 ECU DAR ()	0.0	0.0					
101 ECU PPOT ()	965.0	965.0	965.0	964.0	964.0		
102 ECU AFL ()	0.0	0.0					
103							
104 FUELFLO (G/SEC)	.3610E-01		5.075	4.764	4.769	5.376	5.643
105 AIRFLO (G/SEC)	.6976		90.88	83.51	86.21	99.33	121.5
106 EXH A/F (:1)	19.33	25.35	17.91	17.53	18.08	18.48	21.53
107							
108 BSPEFC (G/KWHR)				332.4	326.0	331.9	309.8
109 BSPEHC (g/kWh)	.3378			47.18	43.60	49.09	30.59
110 BSPECO (g/kWh)	.1777			92.40	65.33	138.8	41.04
111 BSPENOX (g/kWh)	.8817E-01			7.223	8.445	7.506	13.71
112							
113 FFCC (mg/cyl/cyc)	.2886			38.06	38.10	42.97	45.07
114 AIRCC (mg/cyl/cyc)	5.578			667.1	688.8	793.9	970.5
115 MASS_HC (g/sec)	.3678E-02		.7599	.6762	.6378	.7953	.5572
116 MASS_CO (g/sec)	.1934E-02		1.811	1.324	.9558	2.249	.7477
117 MASS_NOX (g/sec)	.9598E-03		.1229	.1035	.1236	.1216	.2498

SEARCH="NAS2725C1"(1,3)
With two head gasket + 9.5 thick plate
Compression ratio 3.17:1

		1	2
		E1A1.1	E1A2.1
1			
2	Search BLK	1.000	2.000
3	Exp. Ref.	E1A1.1	E1A2.1
4	Date Logged	27/03/98	27/03/98
5	Time Logged	14:50:47	15:13:22
6	SPEED (rpm)	2504	3002
7	TORQUE (NM)	185.0	100.2
8	CPTORQUE (Nm)		
9			
10	POWER (KWATTS)	48.52	31.51
11	CPPOWER (kW)		
12			
13	HC FID (PPM)	2182	.1298E+05
14	CO (%)	.3092	2.628
15	CO2 (%)	10.50	10.76
16	O2 (%)	6.275	3.690
17	NOX (PPM)	1454	993.3
18			
19	AT PRESS (MM HG)	738.6	738.4
20	FUEL TMP (DEG C)	19.05	17.64
21	WET TMP (deg c)	17.59	17.27
22	DRY TMP (DEG C)	27.26	26.92
23	AIRIN TMP (DEG C)	28.45	27.61
24	LFE DIFF (mm H2O)	123.5	29.91
25	LFE TMP (DEG C)	28.45	27.61
26	FUEL TIME ()	50.00	50.00
27	FUEL MASS ()	231.2	192.9
28	T.CPTORQUE (NM)	190.6	103.1
29	T.CPPOWER (KW)	49.93	32.43
30	T.PPC.FAC ()	1.030	1.029
31	T.EXH A/F ()	19.66	14.52
32	T.BSPEHC (G/KWHr)	6.734	39.90
33	T.BSPENOX (G/KWHr)	14.93	10.17
34	T.BSPECO (G/KWHr)	19.35	163.7
35	T.BSPEFC (G/KWHr)	339.7	450.6
36	T.AIRFLO (g/s)	89.88	57.31
37	LFE DIF (inches H2O)	4.863	1.178
38	PRESO PRES1 (PSIA)	97.84	110.4
39	PRESO QA (SCFM)	198.4	103.7
40	PRESOAIRFLO (G/S)	105.8	55.47
41	PRESO TMP (deg F)	68.00	68.00
42	NASA AIRDEN (G/L)	3.322	1.542
43	NASA PRESS (kPa)	282.1	131.4
44	NASA TMP (deg C)	21.81	22.34
45	NASA AIRFLO (SCFM)	67.51	76.23
46	T.AIR DENS (G/L)	1.130	1.133
47	T.VAP PRESS (kPa)	1.376	1.338
48	T.VISCC ()	.9812	.9833
49	T.REL HUM (Fraction)	.3802	.3772
50	T.FUELFLOW (g/s)	4.573	3.946
51	CYL #2 TMP (DEG C)	224.7	215.0
52	EXH CYL 2 (Degree C)	714.7	703.9
53	DWNPIPE TMP (deg C)	878.6	751.4
54	CAT TMP1 (deg c)	831.2	783.8
55	CAT TMP3 (deg C)	811.3	803.0
56	HD BOLT TMP (DEG C)	88.41	89.16
57	H2OIN TMP (DEG C)	78.28	82.93
58	H2OOUT TMP (DEG C)	87.65	88.78
59	H20 FLOW (l/min)	69.85	85.71
60	DYNO TMP (DEG C)	40.14	36.14
61	AL CELLTMP1 (DEG C)	26.00	26.00
62	ATMOS (KPA)	98.45	98.42
63	AIR PRESS (kPa)	548.5	541.8
64	F/A DIFF (kPa)	67.36	66.73
65	CRANK PRESS (kPa)	183.6	33.00
66	EXH PRESS (kPa)	146.0	8.590
67	TESTCELL # (101_103)	101.0	101.0
68	TECHNICIAN ()	137.5	137.5
69	WECU FPC ()	0.0	0.0
70	WECU AST ()	0.0	0.0
71	WECU EOA ()	0.0	0.0
72	WECU APW ()	0.0	0.0
73	WECU FPW ()	0.0	0.0
74	KIST VOLTS ()	0.0	0.0
75	PPC.FAC ()		
76	DAT PRESS (kPa)		
77	VAP PRESS (kPa)		
78	NOX_HCF ()		
79	CMASS_NOX (g/s)		
80	FUEL DEN (G/CC @ 15+	.7481	.7481
81	FUEL TYPE (1-6)	3.000	3.000
82			
83	ECU FPC ()	42.00	26.00
84	ECU TEMP ()	90.00	91.00

	1	2
	E1A1.1	E1A2.1
85 ECU SA ()	10.00	10.00
86 ECU AST ()	163.0	182.0
87 ECU EOA ()	68.00	69.00
88 ECU APW ()	6.320	6.320
89 ECU FPW ()	17.22	10.66
90 ECU EV ()	71.00	78.00
91		
92 FUELFLO (G/SEC)	4.623	3.858
93 AIRFLO (G/SEC)	90.93	56.05
94 EXH A/F (:1)	19.67	14.53
95		
96 BSPEFC (G/KWHR)	343.1	440.8
97 BSPEHC (g/kWh)	6.801	39.05
98 BSPECO (g/kWh)	19.54	160.2
99 BSPENOX (g/kWh)	15.09	9.945
100		
101 FFCC (mg/cyl/cyc)	36.92	25.70
102 AIRCC (mg/cyl/cyc)	726.2	373.4
103 MASS_HC (g/sec)	.9166E-01	.3418
104 MASS_CO (g/sec)	.2633	1.402
105 MASS_NOX (g/sec)	.2033	.8705E-01

Appendix B

Key to Test Data Forms

PARAMETER	UNITS	DESCRIPTION
SPEED	RPM	Engine crankshaft rotational speed.
TORQUE	Nm	Engine Brake Torque at the dynamometer.
T.CPTORQUE	Nm	Engine Torque corrected to standard intake conditions. Only relevant to Wide Open Throttle Torques.
T.CPPOWER	Kilowatts	Engine Power corrected to standard intake conditions. Only relevant to Wide Open Throttle Torques.
T.PPC.FAC	Fraction	A correction factor to correct for non standard ambient conditions. Used on TORQUE and POWER, and only relevant if at Wide Open Throttle conditions. Standards as per reference, (SAE J1349 Dec 80 + Jun 85). 85% mechanical efficiency assumed.
HC FID	PPMC	Hydrocarbon exhaust emissions as measured by an FID (Flame Ionization Detector) Analyzer. The units are ppm-carbon.
CO	%	Carbon Monoxide exhaust emission as measured by a NDIR (Non Dispersive Infrared) analyzers % by volume.
CO2	%	Carbon dioxide exhaust emissions as measured by a NDIR(non-dispersive infrared) analyzer as % by volume.
O2	%	Oxygen exhaust emissions as measured by a Polarographic analyzer as % by volume.
NOX	PPM	Oxides of Nitrogen (NO + NO2) as measured by a chemiluminescent analyzer as PPM.
T.EXH A/F	RATIO	The engine's running air fuel ratio (air flow/fuel flow) as calculated from the exhaust gas analysis. The calculation is as developed by OEC, and is the A/F ordinarily used.
T.BSPEHC	Grams/Kilowatts/Hour	Hydrocarbon emissions expressed as grams of HC per kilowatt hour of Energy produced at the driveshaft.
T.BSPENOX	Grams/Kilowatts/Hour	Oxides Nitrogen emissions expressed as grams of NOx per kilowatt hour of Energy produced at the driveshaft.
T.BSPECO	Grams/Kilowatts/Hour	Carbon Monoxide emissions expressed as grams of CO per kilowatt hour of Energy produced at the driveshaft.
T.BSPEFC	Grams/Kilowatts/Hour	The amount of fuel consumed by the engine for every kilowatt hour of energy produced at the driveshaft.
T.AIRFLO	RATIO	This parameter is a calculated from the emissions bench T.EXH A/F and the fuel used from the Ono Sokki (fuel flow meter).
LFE DIF	Inches of Water	Pressure differential across the LFE (Laminar Flow Element). The units are inches of Water.
LFE DIFF	Millimeter of Water	Pressure differential across the LFE (Laminar Flow Element). The units are mm of Water.
LFE TMP	Degree C	Air temperature of the intake to the LFE (Laminar Flow Element).
PRESO PRES1	PSIA	This parameter is a calculation used for the Preso air meter.
PRESO QA	SCFM	This is a Square root of PRESO PRES1 to give the SCFM.
PRESOAIRFLO	Grams/Second	This converts the PRESO QA parameter to Grams/Second.
PRESO TMP	Degree C	Temperature of the PRESO air meter used for the calculation.
NASA AIRDEN	Grams/Litier	Air density based on air inlet temperature and the crankcase pressure.
NASA PRESS	kPa	This is the absolute crankcase pressure.
NASA TMP	Degree C	The air inlet temperature.
NASA AIRFLO	SCFM	The SCFM after the NASA AIRDEN correction.
T.AIR DENS	Grams/Litier	Air density calculated at the ambient conditions AT THE LFE. N.B. air den is used by other parameters (eg vol eff) which may require the ambient conditions to be different (eg at airin tmp).
T.VAP PRESS	kPa	Partial pressure of water vapour.
T.VISCC		LFE viscosity correction factor.
AT PRESS	mm Hg	Absolute Atmospheric Pressure

PARAMETER	UNITS	DESCRIPTION
SPEED	RPM	Engine crankshaft rotational speed.
TORQUE	Nm	Engine Brake Torque at the dynamometer.
T.CPTORQUE	Nm	Engine Torque corrected to standard intake conditions. Only relevant to Wide Open Throttle Torques.
T.CPPOWER	Kilowatts	Engine Power corrected to standard intake conditions. Only relevant to Wide Open Throttle Torques.
T.PPC.FAC	Fraction	A correction factor to correct for non standard ambient conditions. Used on TORQUE and POWER, and only relevant if at Wide Open Throttle conditions. Standards as per reference, (SAE J1349 Dec 80 + Jun 85). 85% mechanical efficiency assumed.
HC FID	PPMC	Hydrocarbon exhaust emissions as measured by an FID (Flame Ionization Detector) Analyzer. The units are ppm-carbon.
CO	%	Carbon Monoxide exhaust emission as measured by a NDIR (Non Dispersive Infrared) analyzers % by volume.
CO2	%	Carbon dioxide exhaust emissions as measured by a NDIR(non-dispersive infrared) analyzer as % by volume.
O2	%	Oxygen exhaust emissions as measured by a Polarographic analyzer as % by volume.
NOX	PPM	Oxides of Nitrogen (NO + NO2) as measured by a chemiluminescent analyzer as PPM.
T.EXH A/F	RATIO	The engine's running air fuel ratio (air flow/fuel flow) as calculated from the exhaust gas analysis. The calculation is as developed by OEC, and is the A/F ordinarily used.
T.BSPEHC	Grams/Kilowatts/Hour	Hydrocarbon emissions expressed as grams of HC per kilowatt hour of Energy produced at the driveshaft.
T.BSPENOX	Grams/Kilowatts/Hour	Oxides Nitrogen emissions expressed as grams of NOx per kilowatt hour of Energy produced at the driveshaft.
T.BSPECO	Grams/Kilowatts/Hour	Carbon Monoxide emissions expressed as grams of CO per kilowatt hour of Energy produced at the driveshaft.
T.BSPEFC	Grams/Kilowatts/Hour	The amount of fuel consumed by the engine for every kilowatt hour of energy produced at the driveshaft.
T.AIRFLO	RATIO	This parameter is a calculated from the emissions bench T.EXH A/F and the fuel used from the Ono Sokki (fuel flow meter).
LFE DIF	Inches of Water	Pressure differential across the LFE (Laminar Flow Element). The units are inches of Water.
LFE DIFF	Millimeter of Water	Pressure differential across the LFE (Laminar Flow Element). The units are mm of Water.
LFE TMP	Degree C	Air temperature of the intake to the LFE (Laminar Flow Element).
PRESO PRES1	PSIA	This parameter is a calculation used for the Preso air meter.
PRESO QA	SCFM	This is a Square root of PRESO PRES1 to give the SCFM.
PRESOAIRFLO	Grams/Second	This converts the PRESO QA parameter to Grams/Second.
PRESO TMP	Degree C	Temperature of the PRESO air meter used for the calculation.
NASA AIRDEN	Grams/Litier	Air density based on air inlet temperature and the crankcase pressure.
NASA PRESS	kPa	This is the absolute crankcase pressure.
NASA TMP	Degree C	The air inlet temperature.
NASA AIRFLO	SCFM	The SCFM after the NASA AIRDEN changes.
T.AIR DENS	Grams/Litier	Air density calculated at the ambient conditions AT THE LFE. N.B. air den is used by other parameters (eg vol eff) which may require the ambient conditions to be different (eg at airin tmp).
T.VAP PRESS	kPa	Partial pressure of water vapour.
T.VISCC		LFE viscosity correction factor.
AT PRESS	mm Hg	Absolute Atmospheric Pressure

DEPRESS	kPa	Gauge pressure of the engine air intake manifold before the throttle blade, but after any filters and airflow measuring instrument.
WET TMP	Degree C	Wet bulb temperature, as measured in test cell.
DRY TMP	Degree C	Used to calculate the relative humidity.
T.REL HUM	Fraction	Ambient Relative Humidity, as measured locally in the test cell.
AIRIN TMP	Degree C	Intake air temperature to the engine, before the throttle blade.
FUEL DEN	Kilograms/Liter	Fuel density at 15'C as measured periodically from our fuel tanks here at OEC.
T.FUELFLOW	Grams/second	Fuel flow rate to the engine calculated from different methods of measurement (Gravimetric or Volumetric). If more than one set of the Required Parameters for the above is logged, the order of priority is as shown.
CYL #2 TMP	Degree C	The temperature of combustion of cylinder # 2.
EXH CYL 2	Degree C	Temperature of cylinder # 2 exhaust.
DWNPIPE TMP	Degree C	Temperature of down pipe approx. 400 mm from engine.
CAT TMP1	Degree C	Catalyst temperature (NO catalyst used).
CAT TMP3	Degree C	Catalyst temperature (NO catalyst used).
HD BOLT TMP	Degree C	Head bolt temperature used for engine shut down (over heating).
H2OIN TMP	Degree C	Water inlet temperature.
H2OOUT TMP	Degree C	Water outlet temperature.
H20 FLOW	Litier/Minute	Water flow.
DYNO TMP	Degree C	Dyno temperature.
AL CELLTMP1	Degree C	Alarm temperature used for fire protection of testcell.
ATMOS	kPa	Atmospheric pressure in kPa.
FUEL TMP	Degree C	Fuel Temperature.
AIR PRESS	kPa	Air pressure of the fuel rail.
F/A DIFF	kPa	The differential between the fuel pressure and the air pressure.
CRANK PRESS	kPa	Crankcase pressure.
EXH PRESS	kPa	Exhaust back pressure.
TESTCELL #		Testcell number.
TECHNICIAN	Clock Number	Testcell operator.
ECU FPC	Milligrams/cylinder/cycle	The ECU fuel per cycle is the mass of fuel delivered to each cylinder of the engine per engine cycle. This figure is looked up in maps for crank, normal and WOT modes. Further corrections are made for idle and cold start modes.
ECU TEMP	Degree C	ECU engine water temperature.
ECU SA	Degree BTDC	The ECU spark advance is the crank angle indicating the position of ignition spark timing. This angle is determined from maps for crank, normal and WOT modes.
ECU AST	Degree BTDC	The ECU air injection start is the advance before TDC that the air injection pulse commences. This figure is looked up from maps for crank, normal and WOT modes. Often referred to as the mechanical start of air.
ECU EOA	Degree BTDC	The ECU end of air is the advance before TDC that the air injection pulse finishes. This figure is calculated according to the ECU fuel duration and the ECU air injection start. Often referred to as the mechanical end of air.
ECU APW	Milliseconds	The ECU air injection duration represents the time span for which the air injector remains open. This figure is looked up from maps for normal and WOT modes. Often referred to as the mechanical air duration.
ECU FPW	Milliseconds	The ECU fuel injection duration represents the time span for which the fuel injector remains open. To calculate this figure the ECU must consider the required total FPC and the fuel injector gain constant.

ECU SAPC	Milligrams/cylinder/cycle	The ECU setpoint APC is the desired mass air flow rate for each cylinder per cycle for a particular set of running conditions. Its this setpoint APC which is continually compared with the feedback APC to generate an error signal used as input to the DAR valve PID control loop.
ECU FBAPC	Milligrams/cylinder/cycle	The ECU feedback APC is a measure of the actual mass air flow rate for each cylinder per cycle for a particular set of running conditions. The feedback APC mass flow rate is determined by means of an air flow meter voltage vs speed lookup table.
ECU A/F	RATIO	The ECU air fuel ratio based on airflow and fuelflow.
ECU EV	%	The ECU exhaust valve position is a measure of the position of the variable exhaust port opening edge relative to the soft stops. The exhaust valve position is a function of RPM and censored FPC in normal mode, and RPM only in WOT mode.
ECU EGR	%	The ECU EGR is measure in percent of exhaust returning to engine.
ECU DAR	%	The ECU DARV position is a measure of the percentage drive being applied to the DAR valve electrical actuator. The DAR valve PID controller continually adjusts the airflow in an attempt to achieve a FBAPC equal to that of the SAPC.
ECU PPOT	1 to 1000	The ECU pedal potentiometer position is the feedback indicating the approximate position of the throttle blade. It's this feedback which is used to determine the ECU pedal map ordinate value which in conjunction with the engine speed determines the required engine fuelling level. Once the fuelling level has been determined, all other major ECU parameters are looked up as a function of fuelling and engine speed.
EUC AFL	Grams/Second	The ECU airflow is a measure of the air entering the engine as measured by the airmeter (hotwire) and displayed on the ERI. This figure is sampled once every millisecond and immediately converted from a voltage to mass air flow by means of a look up table.
FUEL TYPE		An integer to indicate the type of fuel being used.
WECU FPC	Milligrams/cylinder/cycle	Same as ECU FPC but with water.
WECU AST	Degree BTDC	Same as ECU AST but with water.
WECU EOA	Degree BTDC	Same as ECU EOA but with water.
WECU APW	Milliseconds	Same as ECU APW but with water.
WECU FPW	Milliseconds	Same as ECU FPW but with water.
KIST VOLTS	Volts	Measuring the combustion pressure.
FUEL TIME	Seconds	Time taken to use the mass of fuel as stored in FUEL MASS. Used to calculated fuel flow.
FUEL MASS	Grams	The mass of fuel consumed by the engine over the time period in FUEL TIME. Used to calculate fuel.

The "T." parameters designates a TSYS (TestSystem) calculated parameter.

Appendix C

Water Delivery Rates

Lateral Fuel Rail Injector Delivery Using Fixed Mechanical Duration

	Measured Mass of Water (grams)	Seconds	Water flow (Grams/Second)	Average Speed	ECU Delivery (MilliGrams/Cylinder/Cycle)	Water Delivery (MilliGrams/Cylinder/Cycle)	Average Actual Water Delivery	Percent Difference between ECU Delivery and Actaul Delivery
Test1	16.16	88.00	0.1836	2022.5	4.99	5.45		
Test2	20.21	93.00	0.2173	2023.6	4.99	6.44	5.75	13.17
Test3	15.17	84.00	0.1805	2024.6	4.99	5.35		
Test4	10.02	52.00	0.1926	2027.1	4.99	5.70		
Test5	6.95	39.00	0.1782	2028.0	4.99	5.27	5.41	7.74
Test6	9.76	55.00	0.1775	2027.0	4.99	5.25		
Test7	19.46	45.00	0.4324	2027.9	9.99	12.79		
Test8	13.38	33.00	0.4054	2029.6	9.99	11.98	11.88	15.94
Test9	11.40	31.00	0.3677	2029.0	9.99	10.87		
Test10	17.59	30.00	0.5862	2029.1	14.99	17.33		
Test11	22.54	41.00	0.5497	2030.0	14.99	16.25	16.61	9.77
Test12	19.81	36.00	0.5503	2030.6	14.99	16.26		
Test13	10.32	47.00	0.2196	803.1	14.99	16.41		
Test14	9.14	42.00	0.2176	803.5	14.99	16.25	16.37	8.41
Test15	12.11	55.00	0.2202	803.2	14.99	16.45		
Test16	17.36	47.00	0.3694	802.9	24.99	27.61		
Test17	13.28	36.00	0.3688	802.8	24.99	27.56	27.53	9.22
Test18	17.24	47.00	0.3668	802.6	24.99	27.42		

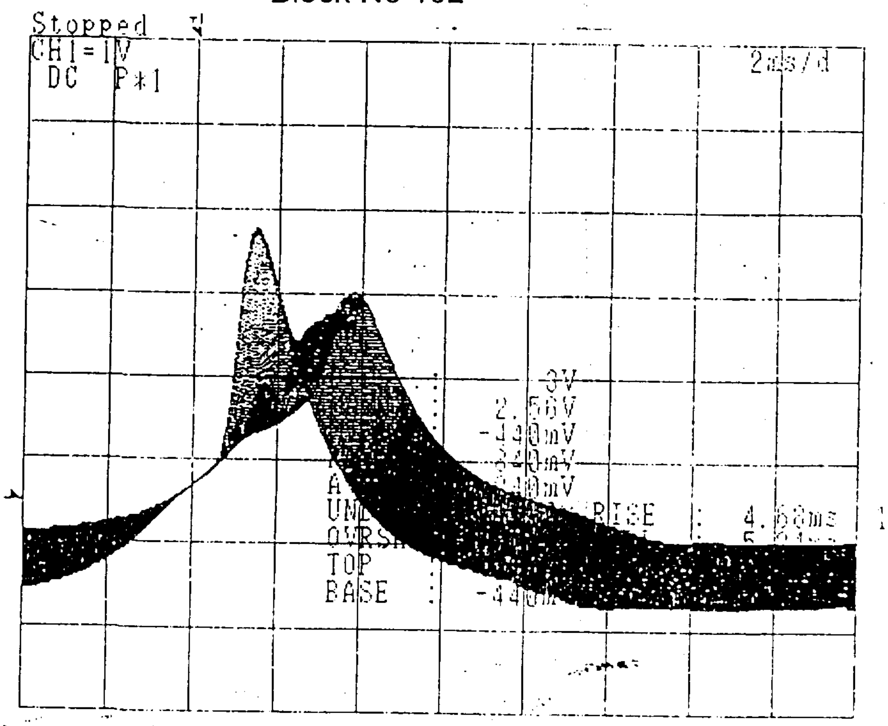
Current fuel density at test facility : 0.7481 Grams/Milliliter at 15 Degree C.

The ECU has a data logging facility. Logg any ECU parameter over time.

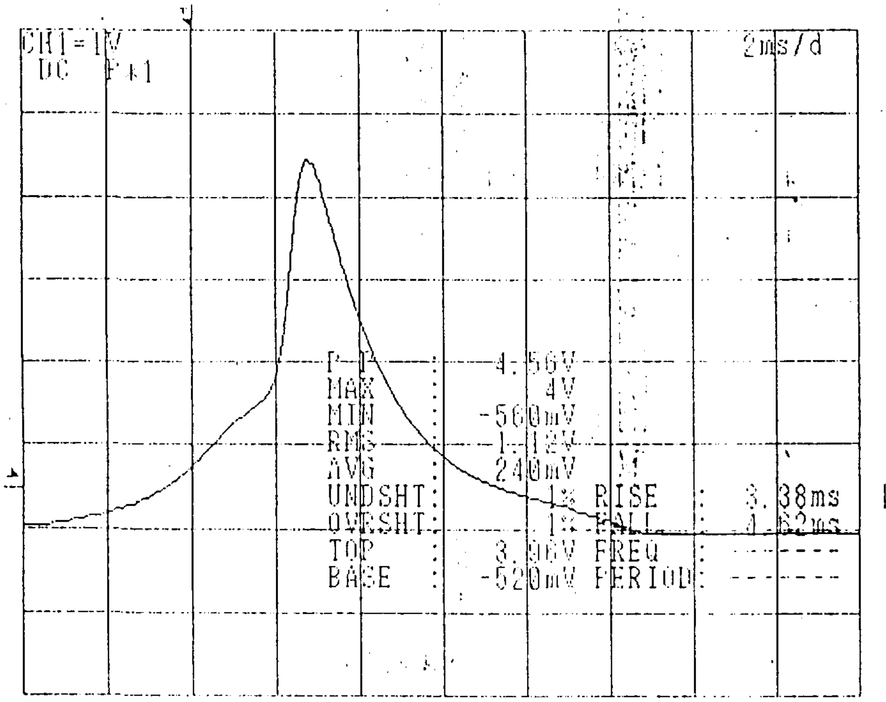
Appendix D

In-cylinder Pressure Trace as Output from Digital Oscilloscope

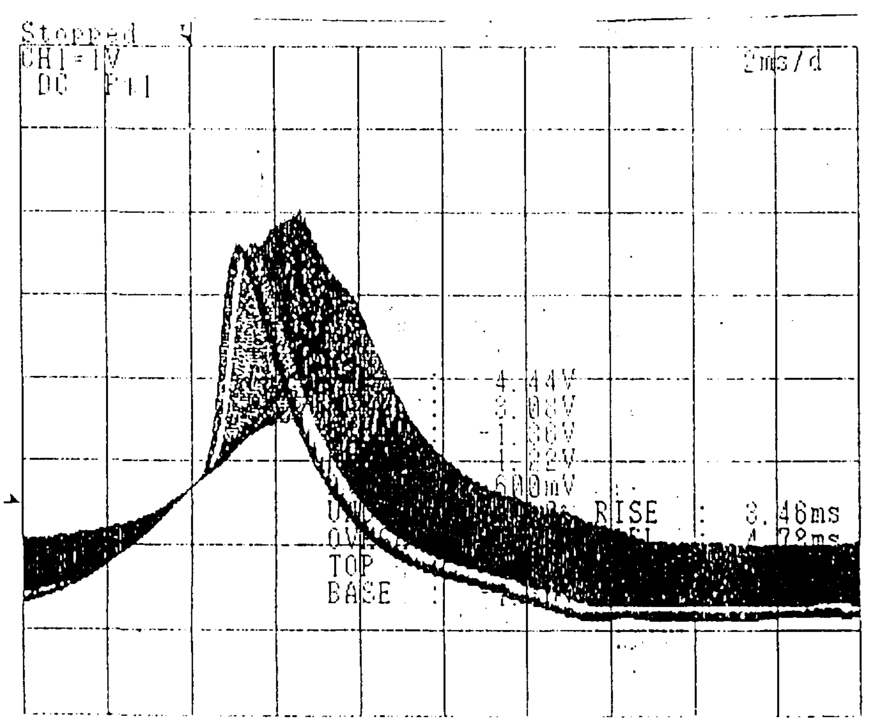
Engine speed = 2500/WOT
Turn water on   18 FPC water
91 degree airstart
Block No 102



18



Engine speed = 2500/WOT
Turn water off 18 FPC water
91 degree airstart
Block No 102



Appendix E

Preliminary Engine Tear-down Report (At 50 Hours Total Engine Run-time)

PRE-GEN & GENESIS ENGINE STRIP & ASSESSMENT REPORT

ENGINE# : NASA 2725	JOB # :
STRIP # : 1	DATE : Feb / 19 / 1998

REASON FOR STRIP : Inspect & remachine - seals

OPERATING SPEED / LOAD AT FAILURE : ________ (RPM) ________ (Nm)

HOURS RUN SINCE LAST BUILD : ________________

TOTAL HOURS RUN TO DATE : 50:20
(See last spec sheet and test cell log for relevant information).

IMPORTANT

A STRIP SHEET MUST BE COMPLETED AS ENGINE IS STRIPPED.

THE ENGINE MUST STAY IN OPERATING POSITION PRIOR TO STRIPPING TO MINIMIZE THE DISTURBANCE OF OIL DISTRIBUTION IN ENGINE.

ON REMOVAL PISTONS MUST BE MARKED WITH ENGINE No. AND CURRENT STRIP No.

INSTRUCTIONS RE THIS STRIP :

RECORD RUN TIMES OF ALL COMPONENTS
INFO IS AVAILABLE FOR.

RECORD GENERAL CONDITION OF ENGINE AS DELIVERED. PAY PARTICULAR ATTENTION TO THE CONDITION OF THE LOOM & ELECTRICAL CONNECTIONS & ALL HOSES. NOTE ANY SIGNS OF COOLANT LEAKAGE AND ANY COMPONENTS REMOVED OR NOT RETURNED WITH THE ENGINE:

- Rails removed
- Intake manifold loose
- Throttle body removed

NOTE : EACH OPERATION MUST BE SIGNED OFF ON COMPLETION

STRIP INSTRUCTIONS

STRIP REPORT TO BE SIGNED OFF ON COMPLETION OF STRIP OR END OF SHIFT OR END OF PART STRIP.		INITIALS
1	REMOVE ENGINE FROM TEST CELL FRAME COMPLETE WITH PLUMBING .	
2	ENGINE LEAK TEST. - WHEN APPLICABLE. MIN DECAY TIME 12 sec FROM 40 kPa TO 10 kPa. TIME ACHIEVED	
3	REMOVE FUEL/AIR RAIL AND INJECTORS.	
4	REMOVE CYLINDER HEAD AND COMPLETE PAGE 3 SECTION A.	GDK
5	REMOVE BALANCE SHAFT, PAGE 5A.	GDK
6	REMOVE PISTONS AND COMPLETE PAGE 5.	GDK
7	REMOVE ACCESSORY PACK & COMPLETE PAGE 4.	GDK
8	REMOVE FLYWHEEL AND FRONT PULLEY etc. COMPLETE PAGE 8 SECTION A .	GDK
9.	REMOVE OIL PUMP AND COMPLETE PAGE 3 SECTION C.	GDK
10	REMOVE CRANKSHAFT AND COMPLETE PAGE 8 SECTION B .	GDK
11	REMOVE INLET SYSTEM AND COMPLETE PAGE 3 SECTION B.	GDK
12	REMOVE BOTH FILLER RODS.	GDK
	[illegible] FRONT MOUNTING, ACTUATOR & PULLEYS. COMPLETE 4B & C.	
14	REMOVE EXHAUST VALVES IF NECESSARY AND COMPLETE PAGE 5 SECTION B.	GDK
15	MAKE COPY OF ENGINE FAILED COMPONENT REPORT.	
16	STRIP REPORT TO BE SIGNED OFF ON COMPLETION OF STRIP OR END OF SHIFT OR END OF PART STRIP. a) SHIFT LEADING HAND b) DEPARTMENT LEADER Signature : Date :	

2

General condition of CYLINDER HEAD ASSEMBLY
Injector holes - cracks etc., corrosion

Cyl head in good condition - no corrosion or cracks
Patterened areas clean right to metal - burn pattern or flow

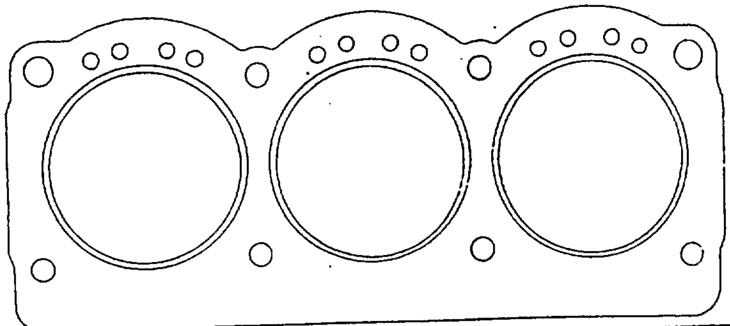
HEAD GASKET	Was there any leakage or other failure ? YES / (NO)

3

If yes, indicate on sketch areas of damage & comment in the space below :

Which way up was the gaskot ?

- Normal



SECTION B	INLET SYSTEM AS STRIPPED

General condition of Manifold including Throttle Mechanism & oil leaks

E.G.R VALVE : ser # 725 - Leak at block from machining
but EGR blocked w/plate

INTERMEDIATE PLATE : Good seal on both sides - ~~[illegible]~~
~~[illegible]~~ Blanking plate

Reed Pack Details : Indicate position of any failed petals or seals.

	1 OK	2 OK	3 OK
SERIAL #			
TOTAL RUN			

PETAL CONDITION Reeds are in good shape - petals alighn good with block - well oiled - no damage to reeds

LUBRICATION SYSTEM

OIL PUMP SERIAL # :	019701l 307
OIL LEAKS:	OK - none
'O' Ring Condition:	OK

FRONT DRIVE ASSEMBLY AS STRIPPED

A — EXHAUST VALVE ACTUATOR

Comment re condition of exhaust valve actuator and linkage :

Actuator & linkage OK

Actuator Serial # : 1453 TOTAL HOURS RUN TO DATE :

B — BALANCE SHAFT & ACC PACK PULLEY ASSEMBLIES

4

PULLEYS : OK

BELT : OK

TOTAL HOURS RUN TO DATE :

C — ACCESSORY DRIVE BELT AND PULLEYS

PULLEYS: OK

BELT: OK

AIR CON: —

P/S PUMP: /

TOTAL HOURS RUN TO DATE :

ACCESSORY PACK

GENERAL CONDITION ON REMOVAL FROM ENGINE:

No end play on shaft - no rock
No signs of heat damage
Oil passage & seal - diaphram OK no
material extra - no signs of water discoloration

TOTAL HOURS RUN TO DATE : ACC. PACK No.: BU001580

A

CONDITION OF CRANKCASE JOINING FACE

INSPECTION HOLE 'O' RINGS: OK

OIL LEAKS OR FRETTING: None

BEARINGS: all surfaces look good - no excess play
no unusual wear, small resistance to turn

WEIGHTS: OK - no chips or nicks or damage H_2O

INSIDE CASING: OK no damage from heat or H_2O

TOTAL HOURS RUN TO DATE:

4 5

B

EXHAUST VALVES

COMMENT ON CONDITION OF FOLLOWING WHEN STRIPPED

GASKET COVER TO BLOCK: OK still sealed all the way across

BUSHES: Good

VALVES: Good - No build up or damage from H_2O

LINE BORE: bearing surfaces are clean - no measurable wear - [redacted]

EXHAUST POCKETS I.E. CARBON DEPOSITS: nothing that is excess

IN CASES OF SEIZED EXHAUST VALVE

ENGINE HOURS AT TIME OF SEIZURE:		
TORQUE REQUIRED TO FREE VALVES:		

ANY OTHER COMMENTS:

PISTON DETAILS : As pistons are removed mark cylinder No. , Engine No and strip No. on each . Comment on pistons as stripped :-

CYL # 1 : ENO A1 CF-P 17541	PISTON # :
All pistons and rings well lubed	
CYL # 2 : ENO 17958 A1	PISTON # :
Piston skirts on all 3 - no scuffs or grooves	
CYL # 3 : ENO A1 17965 Small amount of blowby	PISTON # :
~~Small amount~~ of TOTAL HOURS RUN TO DATE :	

PISTON PINS - Comment on condition, oil presence & colour.

Mark front and rear of

CYL # 1 :	Did not remove - there is no evidence that shows adnormal wear, discoloration, or excess clearance
CYL # 2 :	"
	"
CYL # 3 :	"

TOTAL HOURS RUN TO DATE :

PISTON RINGS (Comment re condition & measure 'gap).

Clean and dry rings before weighing. (Weight required on all engines).

CYL # 1 : TOP	clean - no grooves - well oiled	Weight :
2nd	"	Weight :
CYL # 2 : TOP	"	Weight :
2nd	"	Weight :
CYL # 3 : TOP	Signs of blow-by between T & 2	Weight :
2nd	clean - no grooves - well oiled	Weight :
Operators signature :		Clock no. :

CONNECTING ROD BEARINGS

(Comment on oiling, discolouration, wear, cage damage related to orientation in engine). GRADE of ROD:-

CYL #1 BIG END :	All rods at top and bottom	ROD # : 5723
CYL # 1 SMALL END :	show normal wear - well oiled -	
CYL # 2 BIG END :	no build-up or metal shavings -	ROD # : 5997
CYL # 2 SMALL END :	all cages in good shape	
CYL # 3 BIG END :	color is even w/ no hot spots	ROD # : 5076
CYL # 3 SMALL END :		

TOTAL HOURS RUN TO DATE :

CONNECTING ROD EYES

CYL # 1 BIG END :	No.
CYL # 1 SMALL END :	
CYL # 2 BIG END :	No.
CYL # 2 SMALL END :	
CYL # 3 BIG END :	No.
CYL # 3 SMALL END :	

TOTAL HOURS RODS HAVE RUN TO DATE :

Operators signature :	Clock no. :

6

CRANKSHAFT AS STRIPPED

Section A	FLYWHEEL, ENCODER PICKUPS
FRONT PULLEY & FLYWHEEL . Comment on condition. OK	
ENCODER PICKUPS AND ELECTRICAL CONNECTIONS (comment). OK	
TOTAL HOURS RUN TO DATE :	
REAR SEALS: No leaks or weeping	
FRONT SEAL: " " " "	
Operators signature :	Clock No.:

7

DURABILITY ENGINES - NOTE ORIENTATION OF BEARINGS

Section B	CRANKSHAFT # :	
CONDITION OF :-	JOURNALS.	BEARINGS.
CYL #1 : BIG END	all show normal wear - no measurable grooves - no metal chips - do discoloration. all surfaces well oiled	
CYL #2 : BIG END		
CYL #3 : BIG END		
FRONT MAIN	were not removed from crankshaft - showed no signs of abnormal wear, no discoloration and no excess clearance - all well oiled	
No. 2 MAIN		
No. 3 MAIN		
REAR MAIN BEARING		

Was Loctite used on this Assembly? (YES) / no

No. 1 LABYRINTH SEAL :
No. 1 LABYRINTH GROOVE :
No. 2 LABYRINTH SEAL :
No. 2 LABYRINTH GROOVE :
TOTAL HOURS CRANK HAS RUN TO DATE :
Operators signature : / Clock No.:
ADDITIONAL COMMENTS :

8

BRG TUNNEL : Comment on condition of tunnel & oil content- BLOCK

Was Loctite used in this assembly? (YES) / NO.

BRG #1: all good	BRG #2 :
BRG #3:	BRG #4 :-

BRG TUNNEL :Comment on condition of tunnel & oil content-C.CASE

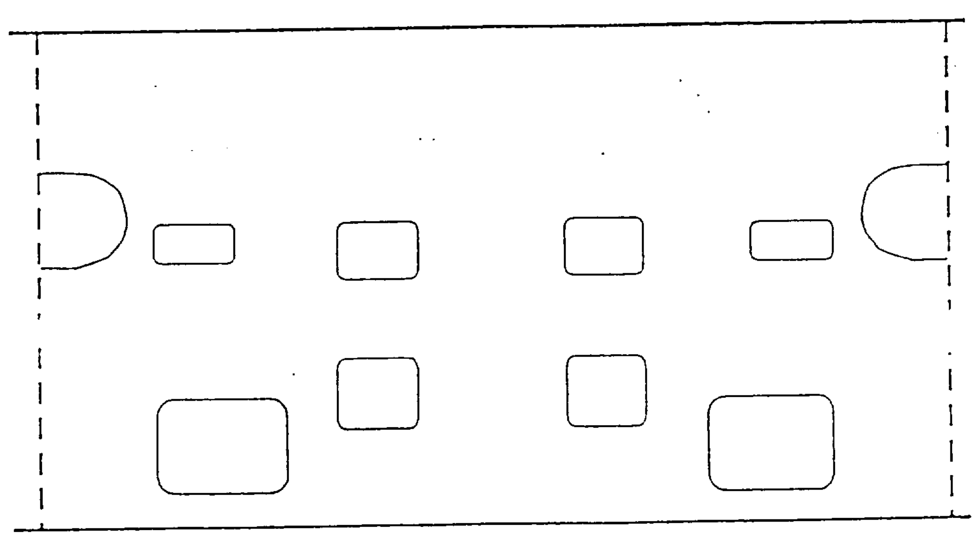
BRG #1: all good	BRG #2 :
BRG #3:	BRG #4 :

Cylinder Bores : Comment on condition of Cyl. Bores, oil content & deposits.

CYLINDER #1:	all bores are well oiled and show no grooves or scuffs. All the ports are well shaped and
CYLINDER #2:	the tops have no scuffs extending to top of cyl.
CYLINDER #3:	plating looks good - no discoloration - no missing chips - hone still looks good in all 3

DRAW SCORES & INDICATE DAMAGE AND / OR DEPOSITS ON CHART BELOW IF ANY. SEE FRONT OF ENGINE RECORD BOOK RE TORQUE PLATE REQUIREMENTS.

CYLINDERS HAVE SPECIFIC DAMAGE OR DEPOSITS



PORT CHAMFERS : Comment on condition of Port Chamfers.

HAD CHAMFERS BEEN POLISHED PRIOR TO BUILD?

CYLINDER #1:	No wear or mis-shapened ports - no wear grooves
CYLINDER #2:	above ports
CYLINDER #3:	

Operators signature :	Clock No.:

FAILED COMPONENTS

ENGINE :	PROJECT :
STRIP # :	JOB # :
DATE :	TEST CELL / VEHICLE # :

9

COMPONENT (S)	NO. FAILED	FAILURE DESCRIPTION

Appendix F

NASA PDFI-HPC Model

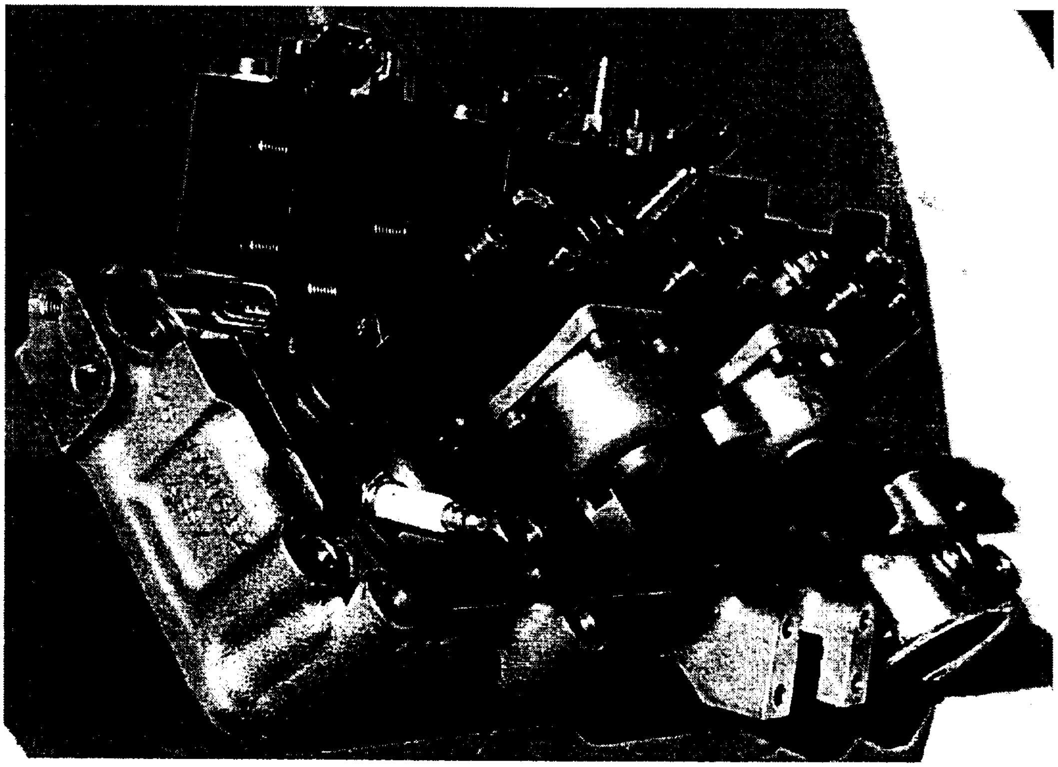
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**Internal Combustion Worksheet Developed by Mark D. Moore, NASA Ames Research Center - use and duplication only with authors consent)**															
2																
3	**Constants**															
4	Gas Constant of air	ft lbf / lbm deg R	Ro		53.3				V	73.27658802	1.614375		6.618819777	13.83333333		
5	Cv of air	btu / lbm deg R	Cv		0.171								11.01208459	5.282608696		
6	Work conversion factor	ft lbf / btu	J		777.9											
7	Pressure conversion psi to kPa		PSIToKPA		6.8948											
8	Fuel				gas	gas	gas	gas	gas	gas	gas	gas	gas	gas	gas	gas
9	Stochiometric Air-Fuel Ratio		1/Fc		14.9254	14.9254	14.9254	14.9254	14.9254	14.9254	14.9254	14.9254	14.9254	14.9254	14.9254	14.9254
10	Stoichiometric fuel-air ratio		Fprime		0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700	0.06700
11	Heat of Evaporation	kj/kg	Qv		250	250	250	250	250	250	250	250	250	250	250	250
12																
13	**Engine Cycle Characteristics**															
14	Name				OCP Baselin	Mod OCP 1/ C	OCP w/turbo	ModOCP w turb	OCP w/turbo 5%H2	ModOC w/turbo 5%H2	OCP w/turbo 5%H2O b	ModOC w/turbo 5%H2O a	OCP w/turbo 5%H2O b	ModOC w/turbo 5%H2O a	ModOC w/turbo 5%H2O a	ModOC w/turbo+in altitud
15	Number of cylinders		NOC	3.00	3	3	3	3	3	3	3	3	3	3	3	3
16	Bore	in	b	3.31	3.305	3.305	3.305	3.305	3.305	3.305	3.305	3.305	3.305	3.305	3.305	3.305
17	Stroke	in	S	2.84	2.835	2.835	2.835	2.835	2.835	2.835	2.835	2.835	2.835	2.835	2.835	2.835
18	Displacement	in^3	Vd	72.93	72.923	72.923	72.923	72.923	72.923	72.923	72.923	72.923	72.923	72.923	72.923	72.923
19		liters		1.20	1.195	1.195	1.195	1.195	1.195	1.195	1.195	1.195	1.195	1.195	1.195	1.195
20	Trapped Stroke to Swept Stroke Ratio		Rs		0.569	0.569	0.569	0.569	0.569	0.569	0.569	0.569	0.569	0.569	0.569	0.569
21	Effective Displacement	in^3	Vds	41.53	41.526	41.526	41.526	41.526	41.526	41.526	41.526	41.526	41.526	41.526	41.526	41.526
22		liters	0.56		0.681	0.681	0.681	0.681	0.681	0.681	0.681	0.681	0.681	0.681	0.681	0.681
23	Compression ratio (effective)		rc	0.93	6.27	2.20	6.27	2.20	6.27	2.20	6.27	2.20	6.27	2.20	2.20	2.20
24	Expansion ratio (effective)	56.5579513	rx		6.27	2.20	6.27	2.20	6.27	2.20	6.27	2.20	6.27	2.20	3.00	3.00
25	Fuel to air ratio	18.86363636	F		.0559	.0559	.0559	.0559	.0559	.0559	.0559	.0559	.0559	.0559	.0559	.0559
26	Equivalence ratio	2.99825284	Fr		.8343	.8343	.8343	.8343	.8343	.8343	.8343	.8343	.8343	.8343	.8343	.8343
27	Fuel heating value	btu/lbm	Qc		19000	19000	19000	19000	19000	19000	19000	19000	19000	19000	19000	19000
28																
29	RPM	rev/min	N	5000.00	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
30	Strokes per power stroke		Strokes	2.00	2	2	2	2	2	2	2	2	2	2	2	2
31	Reference intake pressure	psi	pi		14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	4.37
32	Reference intake temperature	deg R	Ti		519.00	519.00	519.00	519.00	519.00	519.00	519.00	519.00	519.00	519.00	519.00	412.00
33	Reference exhaust pressure	psi	pe		14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	4.37
34	Reference exhaust temperature	deg R	Te		519.00	519.00	519.00	519.00	519.00	519.00	519.00	519.00	519.00	519.00	519.00	412.00
35	Reference intake density	lbm/ft^3	RHOo		0.0765	0.0765	0.0765	0.0765	0.0765	0.0765	0.0765	0.0765	0.0765	0.0765	0.0765	0.0287
36																
37	**Calculated Parameters**															
38	[illegible]															
39	Gamma of air at 520 deg R		gamma_1		1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39
40	Turbocharger boost pressure ratio		p2p1		1.00	1.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	5.70
41	Turbocharger compressor efficiency		ADAc		0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
42	Pressure after Turbo compression	psi			14.70	14.70	88.20	88.20	88.20	88.20	88.20	88.20	88.20	88.20	88.20	24.91
43		MPa			0.10	0.10	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.17
44	Temperature after Turbo compression	deg R			519.00	519.00	971.03	971.03	971.03	971.03	971.03	971.03	971.03	971.03	971.03	757.86
45		deg K			288.33	288.33	539.46	539.46	539.46	539.46	539.46	539.46	539.46	539.46	539.46	421.03
46	Density after pre-compression	lbm/ft^3			0.0765	0.0765	0.2454	0.2454	0.2454	0.2454	0.2454	0.2454	0.2454	0.2454	0.2454	0.0888
47	*Supercharger - isentropic compression, crankshaft work out*															
48	Supercharger boost pressure ratio		p2p1s		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
49	Supercharger compressor efficiency		ADAs		0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
50	Pressure after Super compression	psi			14.70	14.70	88.20	88.20	88.20	88.20	88.20	88.20	88.20	88.20	88.20	24.91
51		MPa			0.10	0.10	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.17
52	Temperature after Super compression	deg R			519.00	519.00	971.03	971.03	971.03	971.03	971.03	971.03	971.03	971.03	971.03	757.86
53		deg K			288.33	288.33	539.46	539.46	539.46	539.46	539.46	539.46	539.46	539.46	539.46	421.03
54	Density after Super compression	lbm/ft^3			0.0765	0.0765	0.2454	0.2454	0.2454	0.2454	0.2454	0.2454	0.2454	0.2454	0.2454	0.0888
55	*Intercooler - pressure and temperature decrease*															
56	Intercooler delta temperature	deg R			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-300.00	-300.00	-300.00	-300.00
57	Intercooler delta pressure	psi			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-8.82	-8.82	-8.82	-2.49
58	Temperature after Intercooler	deg R			519.00	519.00	971.03	971.03	971.03	971.03	971.03	971.03	671.03	671.03	671.03	457.86
59		deg K			288.33	288.33	539.46	539.46	539.46	539.46	539.46	539.46	372.79	372.79	372.79	254.37
60		deg F			59.00	59.00	511.03	511.03	511.03	511.03	511.03	511.03	211.03	211.03	211.03	-2.14

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
61	Pressure after Intercooler	psi	198.00		14.70	14.70	88.20	88.20	88.20	88.20	88.20	88.20	79.38	79.38	79.38	22.42
62		MPa	132.8125		0.10	0.10	0.61	0.61	0.61	0.61	0.61	0.61	0.55	0.55	0.55	0.15
63	Density after Intercooler	lbm/ft^3			0.0765	0.0765	0.2454	0.2454	0.2454	0.2454	0.2454	0.2454	0.3196	0.3196	0.3196	0.1323
64																
65	Air consumption	ft^3/min			120.15	120.15	120.15	120.15	120.15	120.15	120.15	120.15	120.15	120.15	120.15	120.15
66		lbm/min	Mdota		9.19	9.19	29.49	29.49	29.49	29.49	29.49	29.49	38.40	38.40	38.40	15.89
67		lbm/hr			551.67	551.67	1769.15	1769.15	1769.15	1769.15	1769.15	1769.15	2304.09	2304.09	2304.09	953.66
68		g/s		68.00	69.51	69.51	222.91	222.91	222.91	222.91	222.91	222.91	290.31	290.31	290.31	120.16
69	Stoichiometric fuel flow	lbm/min	Mdotc		0.6160	0.6160	1.9756	1.9756	1.9756	1.9756	1.9756	1.9756	2.5729	2.5729	2.5729	1.0649
70	Fuel flow rate	lbm/min	Mdotf		0.5140	0.5140	1.6483	1.6483	1.6483	1.6483	1.6483	1.6483	2.1466	2.1466	2.1466	0.8885
71		g/s		3.80	3.89	3.89	12.46	12.46	12.46	12.46	12.46	12.46	16.23	16.23	16.23	6.72
72																
73	Gamma of air with 5% water mix				1.39	1.39	1.39	1.39	1.388	1.388	1.39	1.39	1.39	1.39	1.39	1.39
74	Cv of air with 5% water mix				0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182
75	H2O percent flow	%			0	0	0	0	5	5	0	0	0	0	0	0
76	H2O2 flow rate	lbm/min	Mdotw		0.00	0.00	0.00	0.00	1.47	1.47	0.00	0.00	0.00	0.00	0.00	0.00
77		g/s			0.00	0.00	0.00	0.00	11.15	11.15	0.00	0.00	0.00	0.00	0.00	0.00
78	Phase change energy rate to 760 deg F	btu/lbm			0.00	0.00	0.00	0.00	850.00	850.00	0.00	0.00	0.00	0.00	0.00	0.00
79	Phase change energy rate per 100 deg	btu/lbm			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	Temperature after H2O injection	deg R			519.00	519.00	971.03	971.03	737.51	737.51	971.03	971.03	671.03	671.03	671.03	457.86
81		deg K			288.33	288.33	539.46	539.46	409.73	409.73	539.46	539.46	372.79	372.79	372.79	254.37
82		deg F			59.00	59.00	511.03	511.03	277.51	277.51	511.03	511.03	211.03	211.03	211.03	-2.14
83	Pressure after H2O injection	psi			14.70	14.70	88.20	88.20	72.38	72.38	88.20	88.20	79.38	79.38	79.38	22.42
84		MPa			0.10	0.10	0.61	0.61	0.50	0.50	0.61	0.61	0.55	0.55	0.55	0.15
85	Density after H2O injection	lbm/ft^3			0.0765	0.0765	0.2454	0.2454	0.2577	0.2577	0.2454	0.2454	0.3196	0.3196	0.3196	0.1323
86	Effective mass flow rate	lbm/min	Mdot	9.20	9.71	9.71	31.13	31.13	32.61	32.61	31.13	31.13	40.55	40.55	40.55	16.78
87		g/s			73.39	73.39	235.37	235.37	246.52	246.52	235.37	235.37	306.54	306.54	306.54	126.88
88																
89	Gamma of air				1.39	1.39	1.39	1.39	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.39
90	Cp of air				0.245	0.245	0.245	0.245	0.271	0.271	0.271	0.271	0.271	0.271	0.271	0.245
91	Cv of air				0.176	0.176	0.176	0.176	0.201	0.201	0.201	0.201	0.201	0.201	0.201	0.176
92	Ideal temperature after compression	deg R			1061.94	705.85	1986.85	1320.61	1402.21	971.89	1846.18	1279.61	1275.80	884.28	884.28	622.70
93		deg F			601.94	245.85	1526.85	860.61	942.21	511.89	1386.18	819.61	815.80	424.28	424.28	162.70
94	Delta h of compression (Table 1 or 3)				132.00	44.00	376.00	198.00	279.00	164.00	338.00	188.00	187.00	88.00	88.00	88.00
95	Heat Transfer (hin)				38.00	33.21	46.73	40.83	41.65	36.90	45.61	40.41	40.37	35.77	35.77	31.86
96	Total enthalpy at compression				170.00	77.21	422.73	238.83	320.65	200.90	383.61	228.41	227.37	123.77	123.77	119.86
97	Temperature after compression	deg R			1210.28	835.48	2169.26	1480.02	1564.80	1115.95	2024.22	1437.37	1433.40	1023.92	1023.92	747.08
98		deg F			750.28	375.48	1709.26	1020.02	1104.80	655.95	1564.22	977.37	973.40	563.92	563.92	287.08
99		deg K			672.38	464.16	1205.14	822.23	869.33	619.97	1124.57	798.54	796.33	568.84	568.84	415.04
100	Pressure after compression	psi			188.59	43.98	1131.54	263.90	862.82	209.84	1051.43	255.70	946.29	230.13	230.13	67.08
101		MPa			1.30	0.30	7.80	1.82	5.95	1.45	7.25	1.76	6.53	1.59	1.59	0.46
102	Density after compression	lbm/ft^3			0.4210	0.1422	1.4093	0.4817	1.4897	0.5080	1.4033	0.4806	1.7836	0.6072	0.6072	0.2426
103																
104	Gamma of air with 5% water mix				1.39	1.39	1.367	1.367	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.39
105	Cv of air with 5% water mix		142.8571429		0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182
106	H2O percent flow	%			0	0	0	0	0	0	5	5	5	5	5	0
107	H2O2 flow rate	lbm/min	Mdotw		0.00	0.00	0.00	0.00	0.00	0.00	1.47	1.47	1.92	1.92	1.92	0.00
108		g/s			0.00	0.00	0.00	0.00	11.15	11.15	0.00	0.00	0.00	0.00	0.00	0.00
109	Phase change energy rate to 760 deg F	btu/lbm			0.00	0.00	0.00	0.00	0.00	0.00	1145.00	1020.00	960.00	890.00	890.00	0.00
110	Phase change energy rate per 100 deg	btu/lbm			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
111	Temperature after H2O injection	deg R			1210.28	835.48	2169.26	1480.02	1564.80	1115.95	1709.66	1157.15	1169.67	779.41	779.41	747.08
112		deg K			672.38	464.16	1205.14	822.23	869.33	619.97	949.81	642.86	649.81	433.01	433.01	415.04
113		deg F			750.28	375.48	1709.26	1020.02	1104.80	655.95	1249.66	697.15	709.67	319.41	319.41	287.08
114	Correction to compression work	btu/lbm			0.00	0.00	0.00	0.00	0.00	0.00	59.15	32.90	32.73	15.40	15.40	0.00
115	Pressure after H2O injection	psi			188.59	43.98	1131.54	263.90	862.82	209.84	921.78	217.23	801.69	185.00	185.00	67.08
116		MPa			1.30	0.30	7.80	1.82	5.95	1.45	6.36	1.50	5.53	1.28	1.28	0.46
117	Density after H2O injection	lbm/ft^3			0.4210	0.1422	1.4093	0.4817	1.4897	0.5080	1.4156	0.4929	1.7995	0.6232	0.6232	0.2426
118	Effective mass flow rate	lbm/min	Mdot	9.20	9.71	9.71	31.13	31.13	32.61	32.61	31.13	31.13	40.55	40.55	40.55	16.78
119		g/s			73.39	73.39	235.37	235.37	246.52	246.52	235.37	235.37	306.54	306.54	306.54	126.88
120																
121	Gamma of hot mixture				1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.251
122	Cp of hot mixture				0.3408	0.3408	0.3408	0.3408	0.3408	0.3408	0.3408	0.3408	0.3408	0.3408	0.3408	0.3408

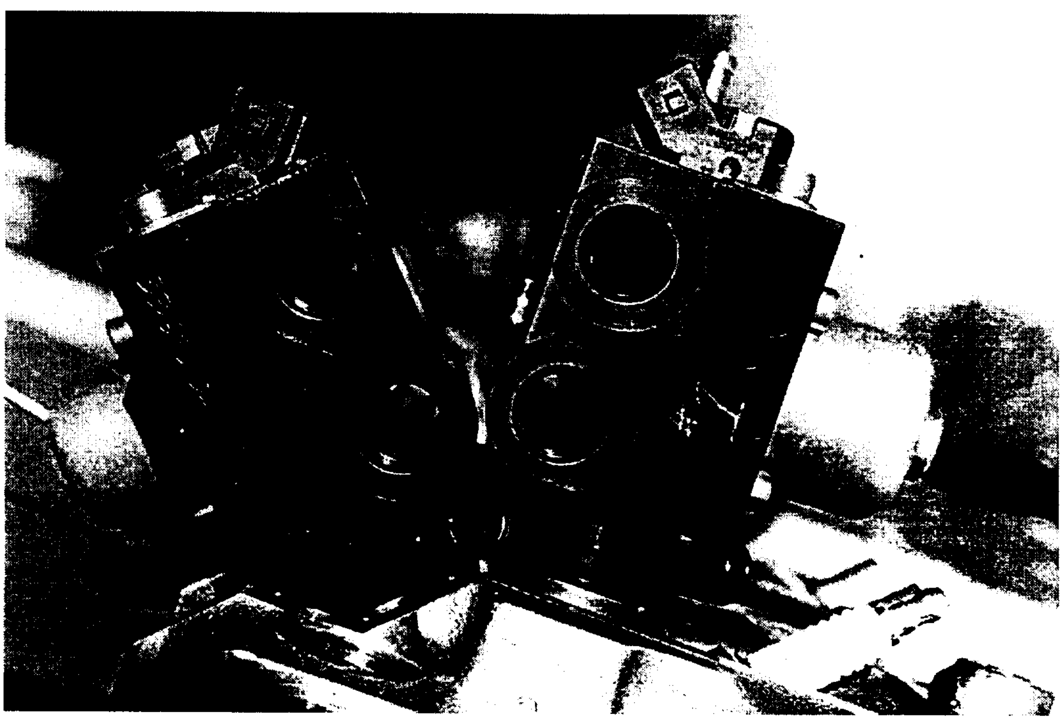
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
123	Cv				0.272422062	0.272422062	0.272422062	0.272422062	0.272422062	0.272422062	0.272422062	0.272422062	0.272422062	0.272422062	0.272422062	0.272422062
124	Heat addition	btu/lbm			1062.10	1062.10	1062.10	1062.10	1062.10	1062.10	1062.10	1062.10	1062.10	1062.10	1062.10	1062.10
125	Enthalpy at combustion	btu/lbm			1166.87	1078.99	1406.22	1232.06	1309.55	1196.14	1369.17	1222.19	1221.21	1123.09	1123.09	1119.39
126	Fraction of useful heat addition	(based on comb. enthalpy)			0.752	0.781	0.685	0.734	0.696	0.730	0.701	0.739	0.736	0.765	0.765	0.765
127	Effective heat addition	btu/lbm			798.17	829.50	727.54	779.58	739.22	775.33	744.53	784.89	781.71	812.51	812.51	812.51
128	Temperature after combustion	deg R			4140.18	3880.39	4839.89	4341.69	4278.31	3962.03	4442.67	4038.31	4039.13	3761.94	3761.94	3729.61
129		deg K		2300.00	2300.10	2155.77	2688.83	2412.05	2376.84	2201.13	2468.15	2243.51	2243.96	2089.97	2089.97	2072.00
130		deg F			3680.18	3420.39	4379.89	3881.69	3818.31	3502.03	3982.67	3578.31	3579.13	3301.94	3301.94	3269.61
131	Temperature after combustion (w/steam absorp	deg R			4140.18	3880.39	4839.89	4341.69	4278.31	3962.03	4442.67	4038.31	4039.13	3761.94	3761.94	3729.61
132		deg K			2300.10	2155.77	2688.83	2412.05	2376.84	2201.13	2468.15	2243.51	2243.96	2089.97	2089.97	2072.00
133	Pressure after combustion (w/steam absorption)	psi			681.20	215.70	2665.74	817.43	2608.87	823.89	2564.52	811.67	2976.33	960.01	960.01	353.58
134		MPa	0.00	4.50	4.70	1.49	18.39	5.64	17.99	5.68	17.69	5.60	20.53	6.62	6.62	2.44
135																
136	Density after combustion (w/steam absorption)	lbm/ft^3			0.421	0.142	1.409	0.482	1.490	0.508	1.416	0.493	1.800	0.623	0.623	0.243
137	[illegible]															
138	Gamma of air				1.262	1.262	1.262	1.262	1.262	1.262	1.262	1.262	1.262	1.262	1.262	1.262
139	Ideal temperature after expansion	deg R			2559.382	3156.173	2991.929	3531.374	2644.772	3222.571	2746.377	3284.618	2496.915	3059.830	2821.021	2796.772
140		deg K		1012.20	1421.879	1753.429	1662.183	1961.875	1469.318	1790.317	1525.765	1824.788	1387.175	1699.906	1567.234	1553.762
141		deg F			2099.382	2696.173	2531.929	3071.374	2184.772	2762.571	2286.377	2824.618	2036.915	2599.830	2361.021	2336.772
142	Enthalpy at expansion (Table 4)	btu/lbm			547.000	840.000	785.000	961.000	740.000	936.000	775.000	958.000	693.000	880.000	800.000	813.000
143	Pressure after expansion	psi			67.162	79.746	262.824	302.213	257.217	304.601	252.845	300.083	293.446	354.925	239.964	88.381
144		MPa			0.46	0.55	1.81	2.08	1.77	2.10	1.74	2.07	2.02	2.45	1.66	0.61
145	Density after expansion	lbm/ft^3			0.071	0.068	0.237	0.231	0.263	0.255	0.249	0.247	0.318	0.313	0.230	0.085
146	[illegible]															
147	Name				OCP Baselin	Mod OCP 1/C	OCP w/turbo	ModOCP w turb	OCP w/turbo 5%H2	ModOC w/turbo 5%H2	OCP w/turbo 5%H2O a	ModOC w/turbo 5%H2O a	OCP w/turbo 5%H2O a inte	ModOC w/turbo 5%H2O a inte	ModOC w/turbo 5%H2O a inter e	ModOC w/turbo+in altitud
148	[illegible]															
149	Work out due to expansion	btu/lbm	we		519.87	238.99	621.22	271.06	569.55	260.14	594.17	264.19	528.21	243.09	323.09	306.39
150	Work in due to compression	btu/lbm	wc		-170.00	-77.21	-422.73	-238.83	-320.65	-200.90	-324.46	-195.51	-194.65	-108.37	-108.37	-119.86
151	Energy rejection	btu/lbm			647.00	840.00	785.00	961.00	740.00	936.00	775.00	958.00	693.00	880.00	800.00	813.00
152	Net work (energy balance)	btu/lbm	wnet_energy		349.87	161.78	198.49	32.23	248.90	59.24	269.71	68.68	333.56	134.72	214.72	186.53
153																
154	Power =f(energy balance)	hp			80.05	37.02	145.64	23.65	191.27	45.52	197.90	50.39	318.74	128.74	205.18	73.77
155	Friction Power	hp			4.38	3.12	8.33	2.11	11.67	4.47	11.96	4.99	18.90	12.48	11.49	2.87
156	**Net Power**	hp		76.44	75.68	33.89	137.31	21.54	179.60	41.05	185.93	45.40	299.84	116.25	193.69	70.91
157	Power =f(mep, mass flow)	hp			84.48	60.15	160.45	40.58	224.90	86.15	230.52	96.18	364.24	240.53	221.41	69.60
158	Mean effective pres. =f(Wnet, rhos)	psi	mep		161.13	114.72	306.02	77.40	428.94	164.31	439.66	183.43	694.70	458.76	422.29	132.75
159	bsfc	lbm/hr-hp	bsfc		0.4303	0.9607	0.7605	4.8479	0.6090	2.6643	0.5616	2.3001	0.4536	1.1699	0.7021	0.7939
160																
161	[illegible]															
162	Work out due to expansion	btu/lbm	we		430.64	197.29	503.42	220.75	445.01	201.44	462.11	205.32	420.13	191.27	256.33	254.12
163	Work in due to compression	btu/lbm	wc		-95.70	-32.93	-179.05	-61.62	-133.43	-47.05	-175.68	-61.95	-121.40	-42.81	-42.81	-29.05
164	Energy rejection	btu/lbm			727.15	897.74	737.72	902.97	750.52	907.71	775.67	918.72	763.37	913.64	848.58	837.03
165	Net work (energy balance)	btu/lbm	wnet_energy		334.95	164.36	324.38	159.13	311.58	154.39	286.43	143.38	298.73	148.46	213.52	225.07
166																
167	Power =f(energy balance)	hp		76.44	76.63	37.60	238.00	116.76	239.44	118.65	210.16	105.20	285.46	141.87	204.04	89.02
168	Mean effective pres. =f(Wnet, rhos)	psi	mep		154.26	116.55	500.09	382.18	536.97	428.27	466.90	382.94	622.17	505.56	419.93	160.18
169	bsfc	lbm/hr-hp	bsfc		0.4249	0.8659	0.4387	0.8944	0.4568	0.9218	0.4969	0.9926	0.4764	0.9586	0.6665	0.6323
170																
171	Piston speed	ft/min	s		2362.20	2362.20	2362.20	2362.20	2362.20	2362.20	2362.20	2362.20	2362.20	2362.20	2362.20	2362.20
172	Ideal thermal efficiency				0.5113	0.2647	0.5113	0.2647	0.5113	0.2647	0.5113	0.2647	0.5113	0.2647	0.2647	0.2647
173	Turbocharger work available	btu/lbm			528.46	683.03	640.49	780.20	550.58	700.22	576.89	716.30	512.28	658.07	596.22	617.66
174	Turbocharger work required	btu/lbm			0.00	0.00	117.08	117.08	117.08	117.08	117.08	117.08	117.08	117.08	117.08	89.58

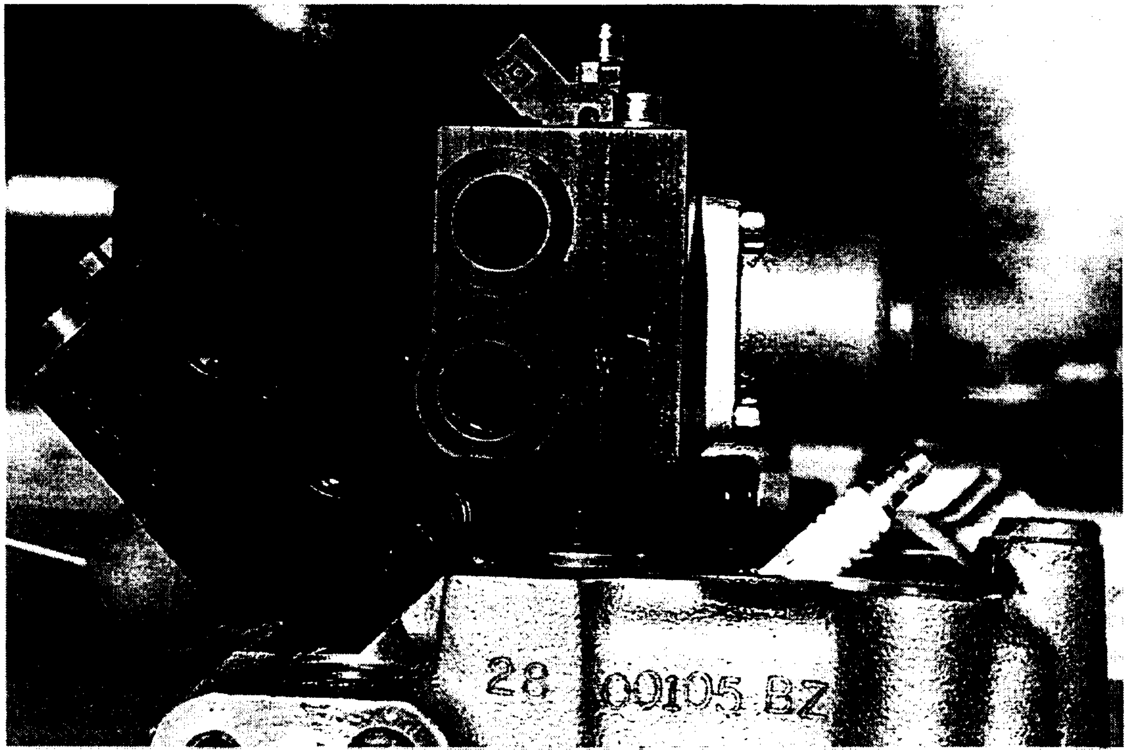
Appendix G

Pictures of the Engine and Test Cell Set-up

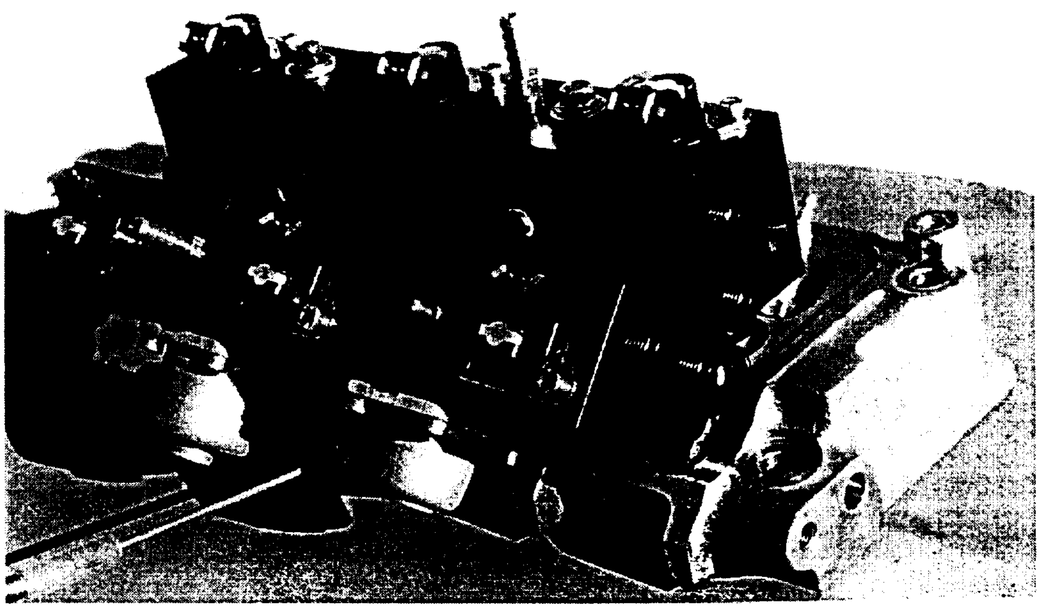


Cylinder Head Assembly (right side of engine)

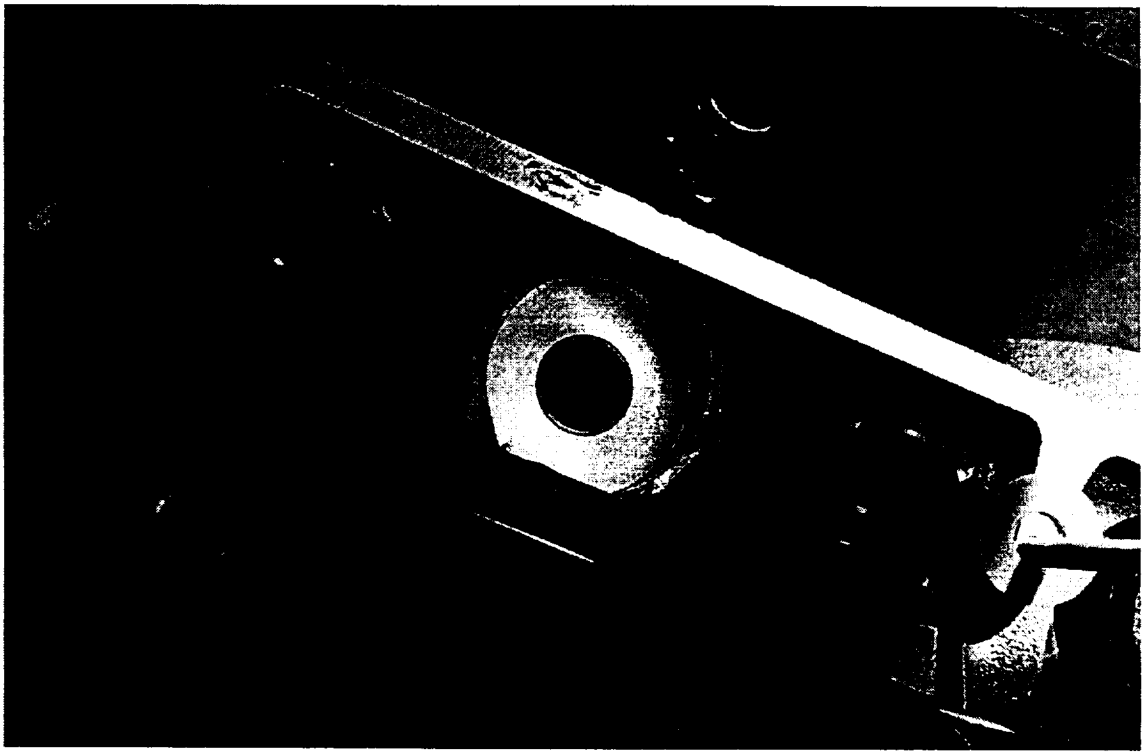




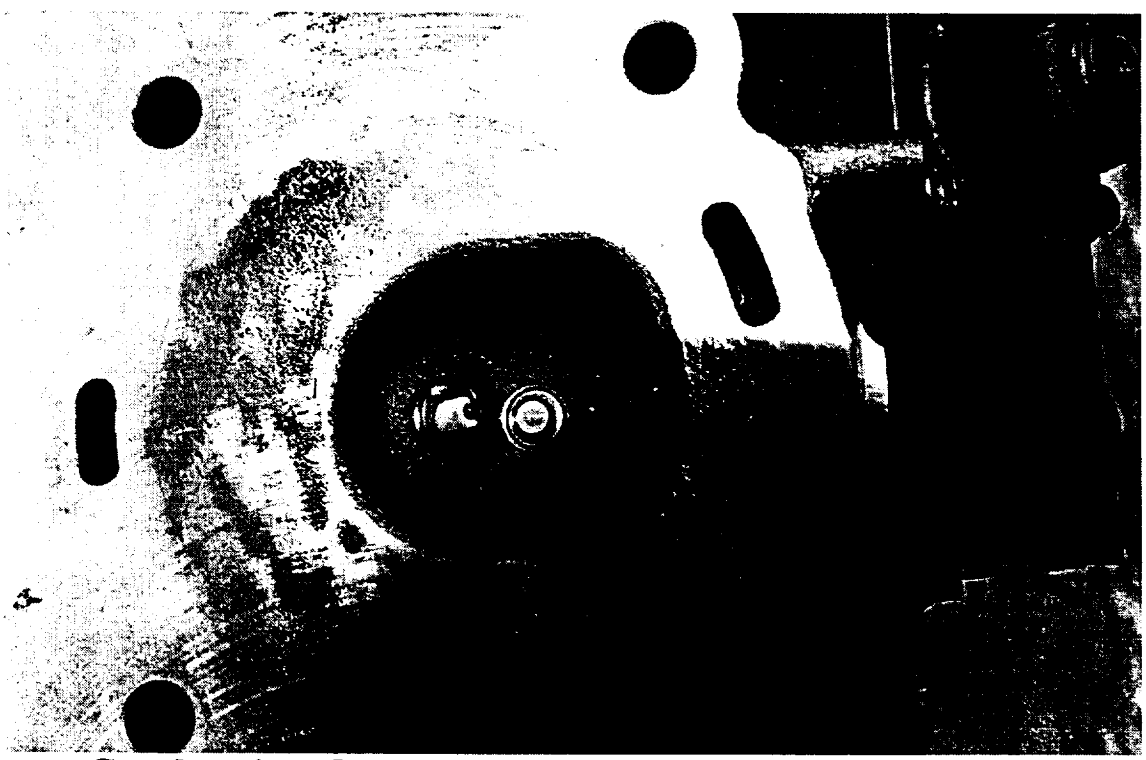
Front View – Cylinder Head Assembly



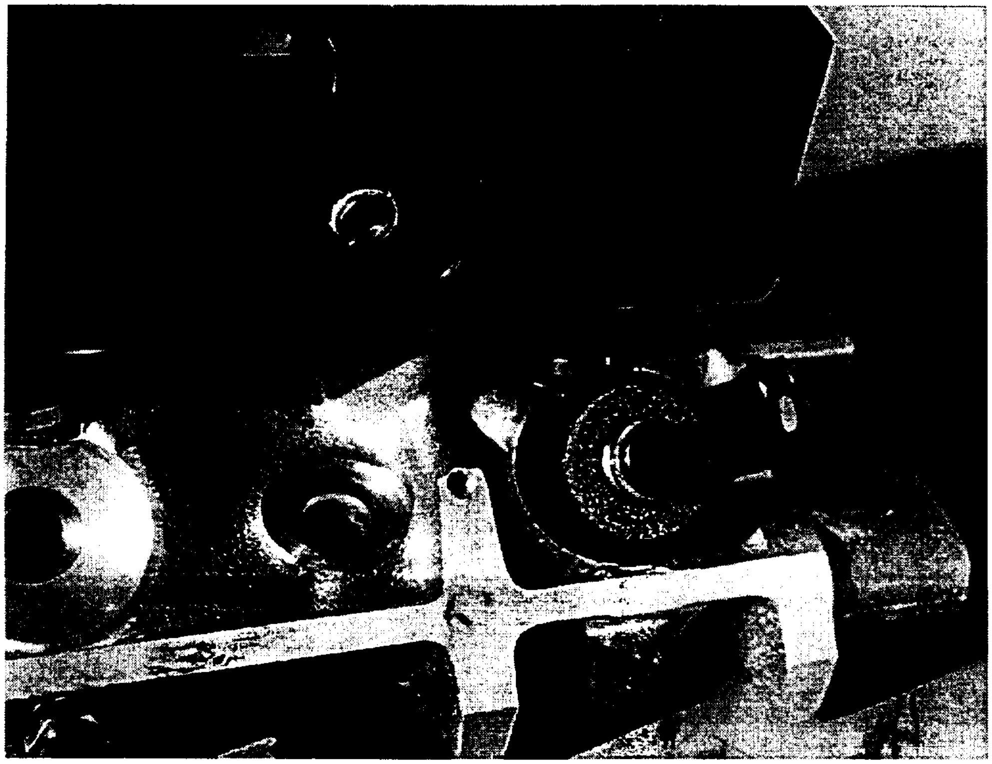
Cylinder Head Assembly



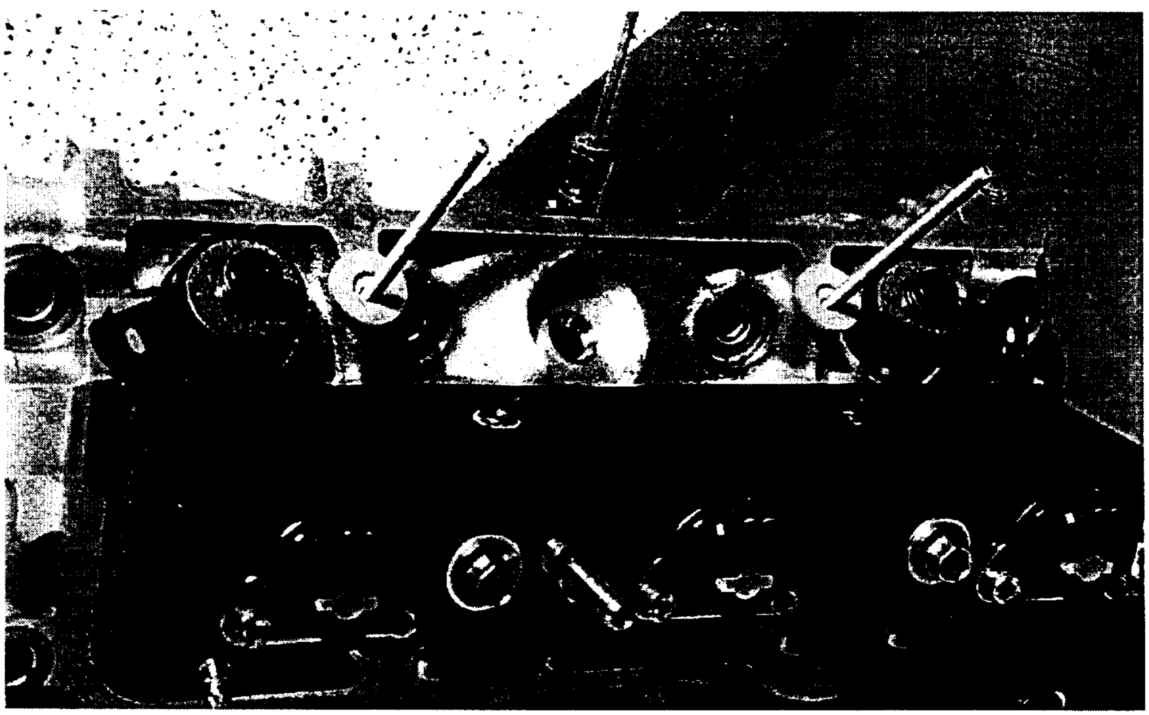
Water Direct Injector Mounting Surface Showing Combustion Chamber Temperature Probe



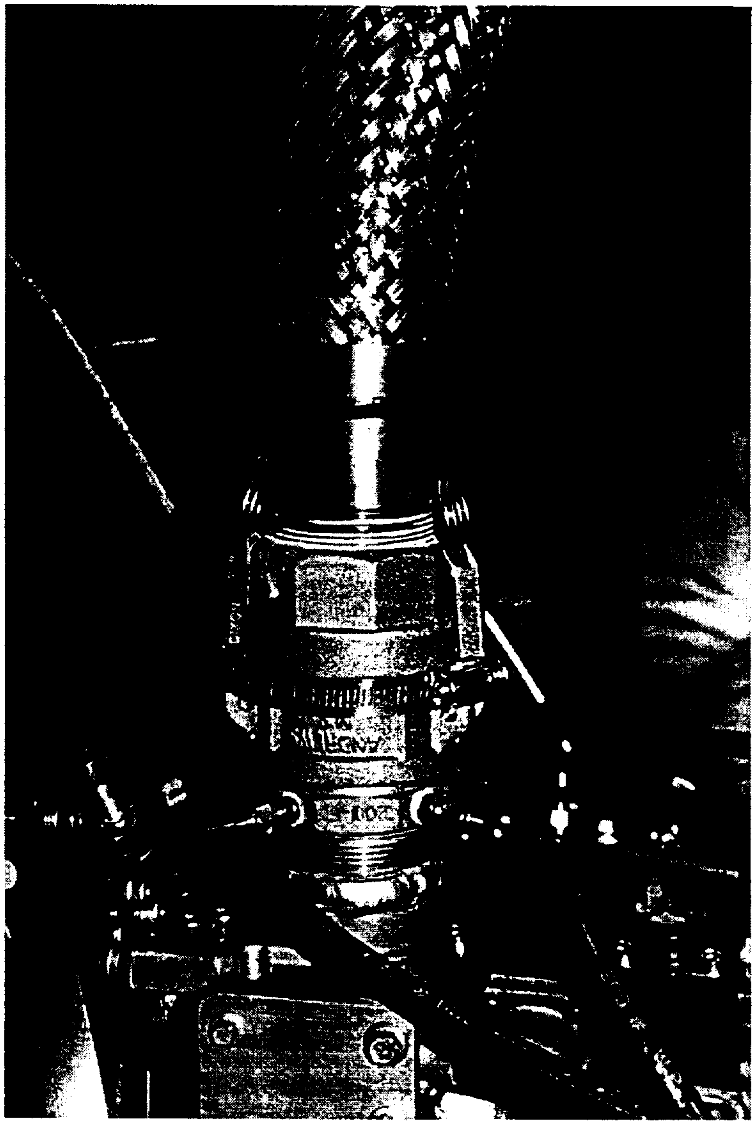
Combustion Chamber (Direct Fuel Injector in center, Direct Water Injector to the right)



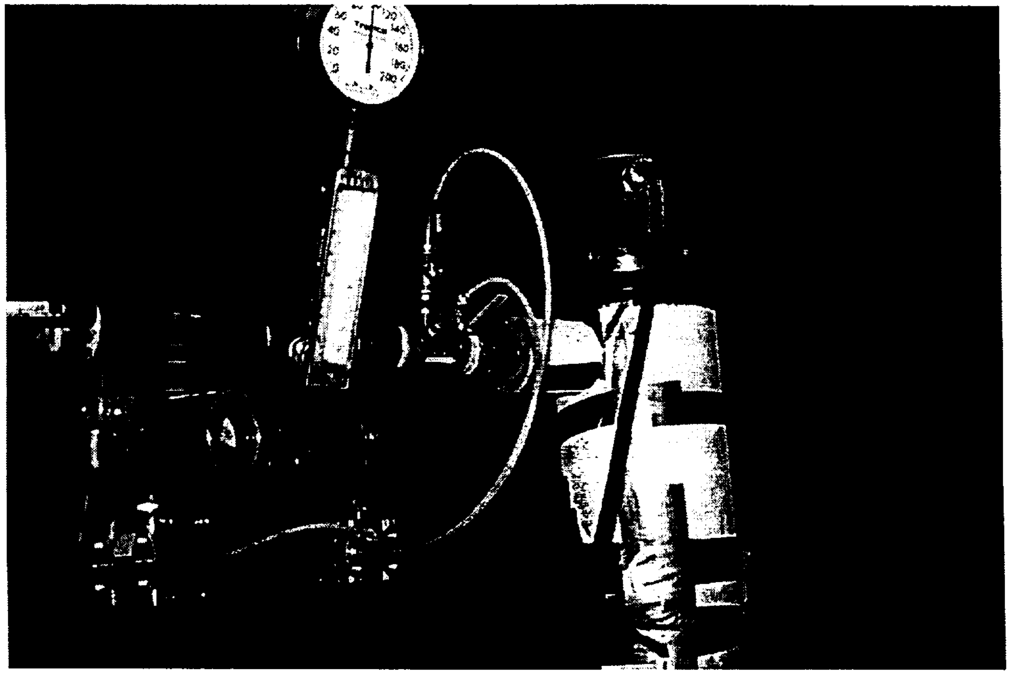
Direct Water Injector (shown mounted in seat)



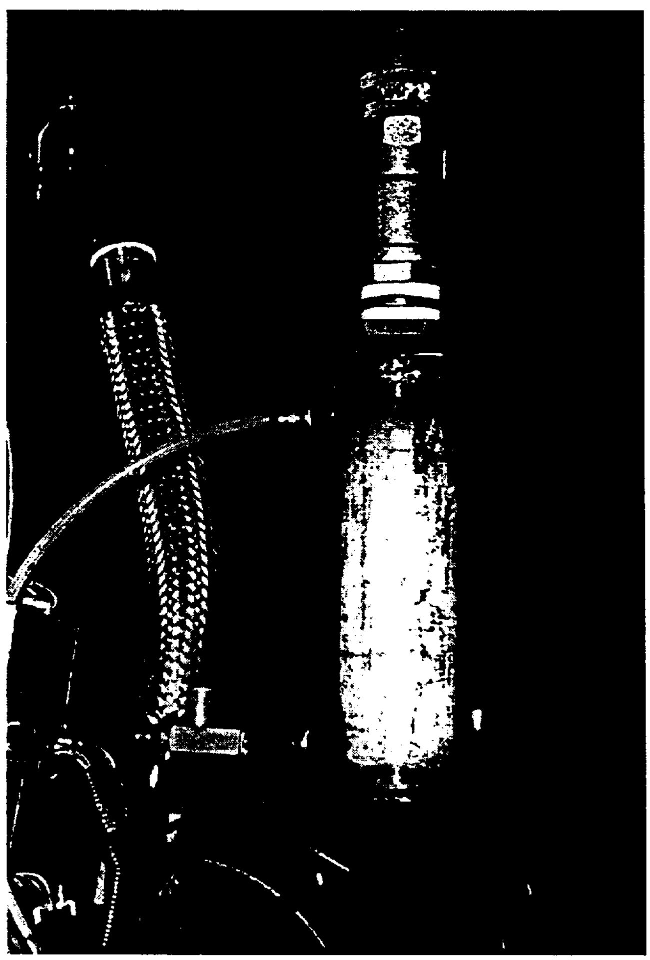
Water Rail Mounting Layout



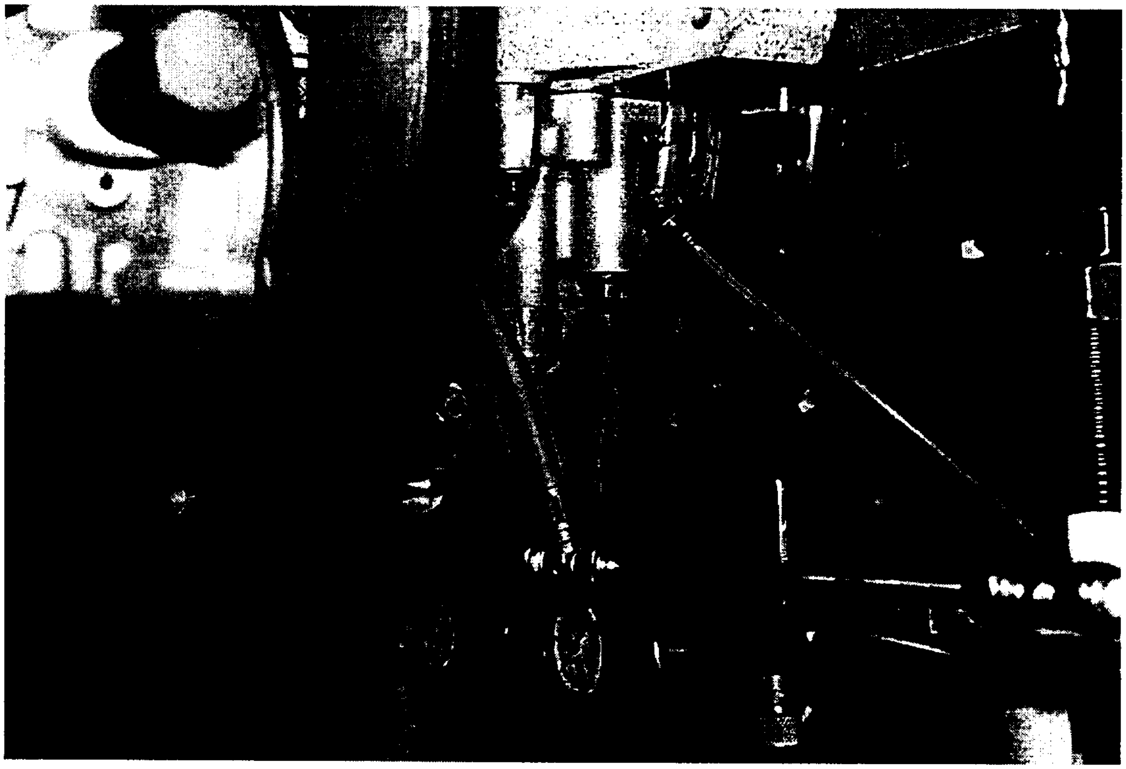
Engine Throttle Body (with flex hose connection and quick disconnect)



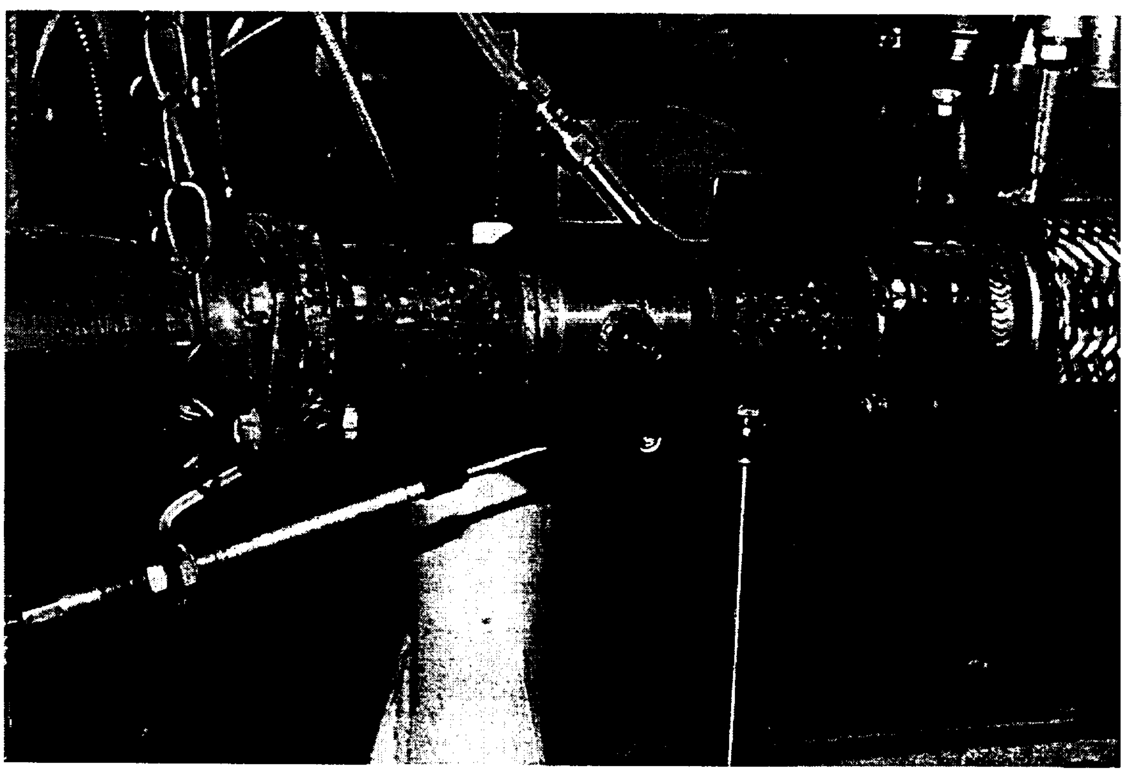
Engine Induction Air Heater (right) and Airflow Measurement Instrumentation



Pressurized Engine Oil Reservoir



Engine Exhaust with rear seal manifold (center bottom)



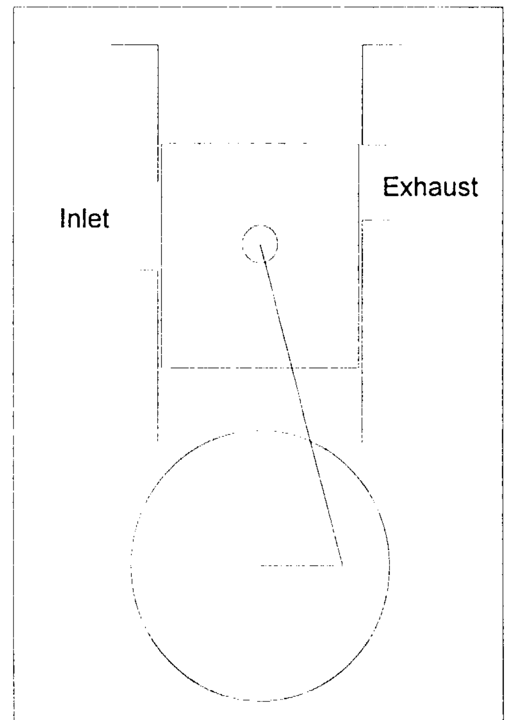
Exhaust Butterfly Valve for Backpressure Control

Appendix H

Compression Ratio Calculation Worksheet

ENGINE COMPRESSION RATIO WORKSHEET

Chamber Volume	cc	36.00	
Bore Diameter	mm	83.95	
Stroke Length	mm	40.00	
Gasket Thickness	mm	1.37	
Piston Protrusion	mm	0.35	
Squish	mm	1.02	
Unswept Volume	cc	41.79	
Swept Volume	cc	221.41	
Normal Compression Ratio : 1			6.30
2nd Gasket Volume		7.77	
Diameter of plate	mm	84.00	
Height of plate	mm	9.50	
Plate Volume		52.65	
Final Compression Ratio:1			3.17

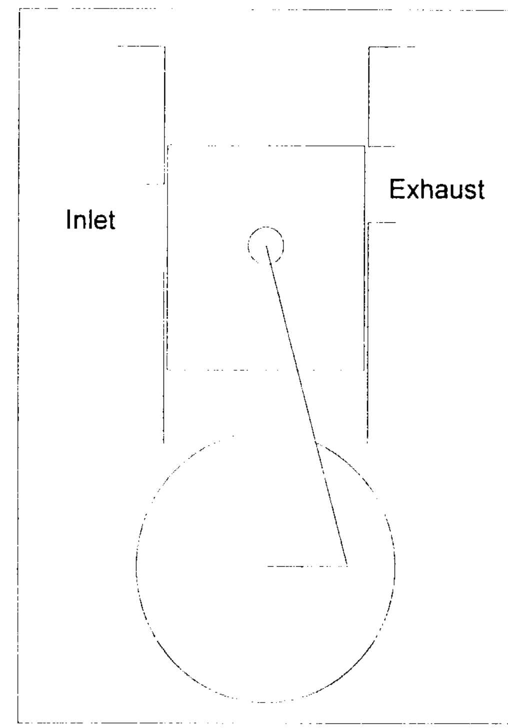


Compression Ratio = (Swept Volume + Unswept Volume) / Unswept Volume

The final Compression Ratio is with two head gaskets plus 9.5mm plate

ENGINE COMPRESSION RATIO WORKSHEET

Chamber Volume	cc	36.00	
Bore Diameter	mm	83.95	
Stroke Length	mm	40.00	
Gasket Thickness	mm	1.37	
Piston Protrusion	mm	0.35	
Squish	mm	1.02	
Unswept Volume	cc	41.79	
Swept Volume	cc	221.41	
Normal Compression Ratio : 1			**6.30**
2nd Gasket Volume		7.77	
Diameter of plate	mm	85.00	
Height of plate	mm	1.37	
Plate Volume		7.77	
Final Compression Ratio:1			**4.86**

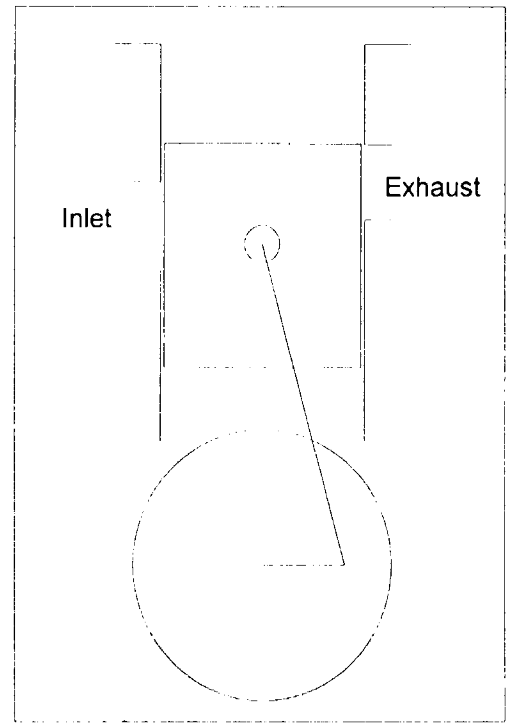


Compression Ratio = (Swept Volume + Unswept Volume) / Unswept Volume

The final Compression Ratio is with three head gaskets

ENGINE COMPRESSION RATIO WORKSHEET

Chamber Volume	cc	36.00	
Bore Diameter	mm	83.95	
Stroke Length	mm	40.00	
Gasket Thickness	mm	1.37	
Piston Protrusion	mm	0.35	
Squish	mm	1.02	
Unswept Volume	cc	41.79	
Swept Volume	cc	221.41	
Normal Compression Ratio : 1			**6.30**
2nd Gasket Volume		7.77	
Diameter of plate	mm	0.00	
Height of plate	mm	0.00	
Plate Volume		0.00	
Final Compression Ratio:1			**5.47**

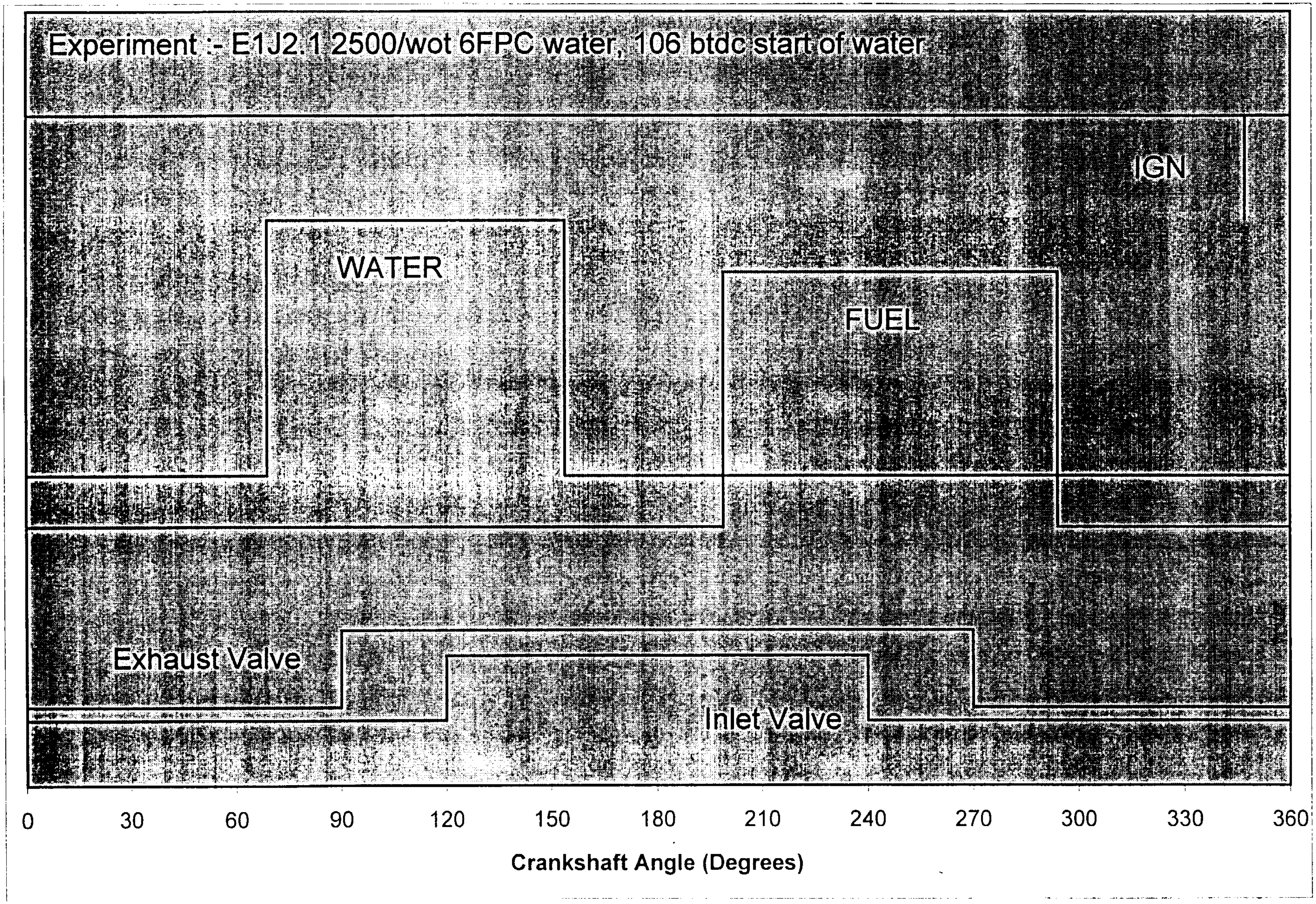


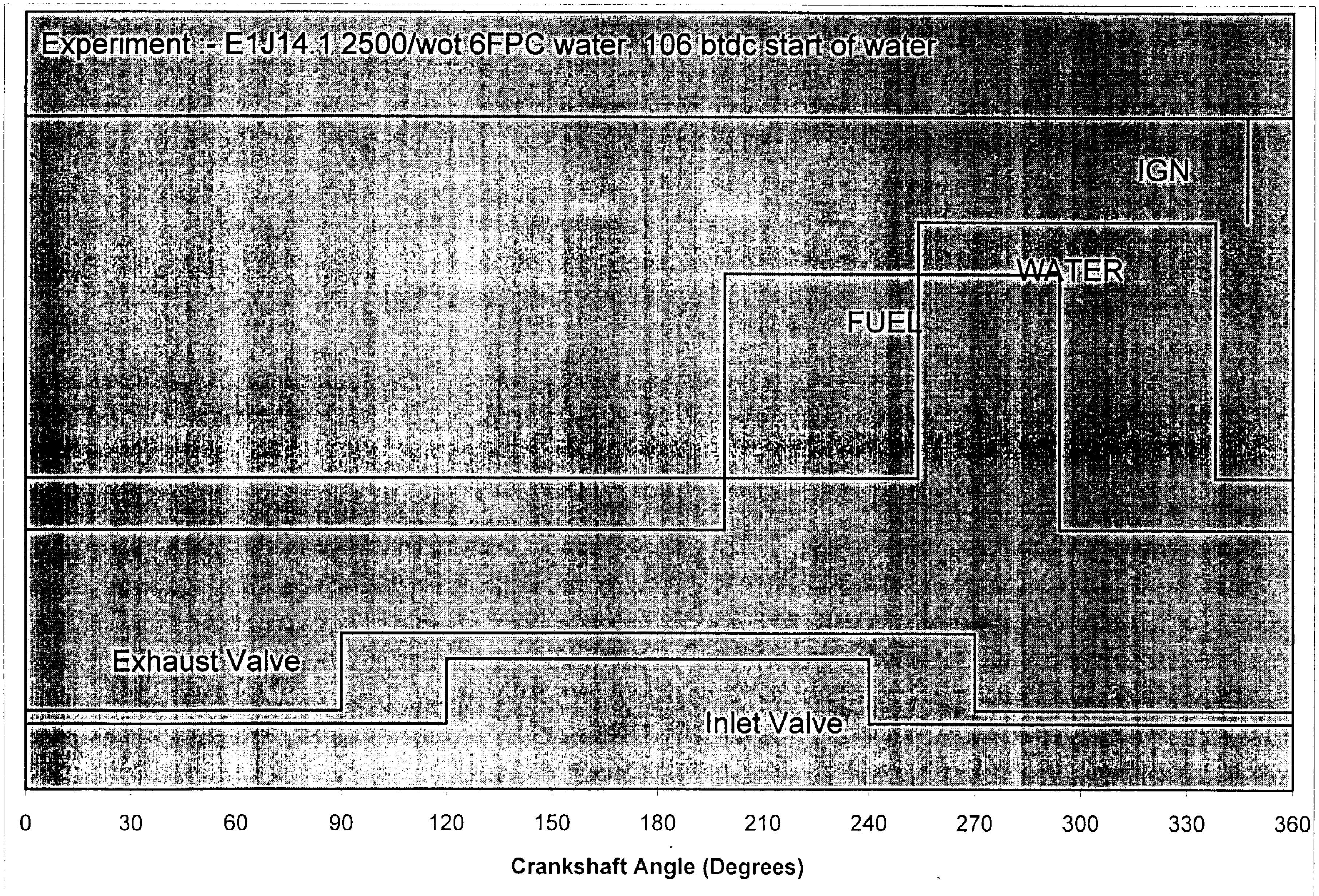
Compression Ratio = (Swept Volume + Unswept Volume) / Unswept Volume

The final Compression Ratio is with two head gaskets

Appendix I

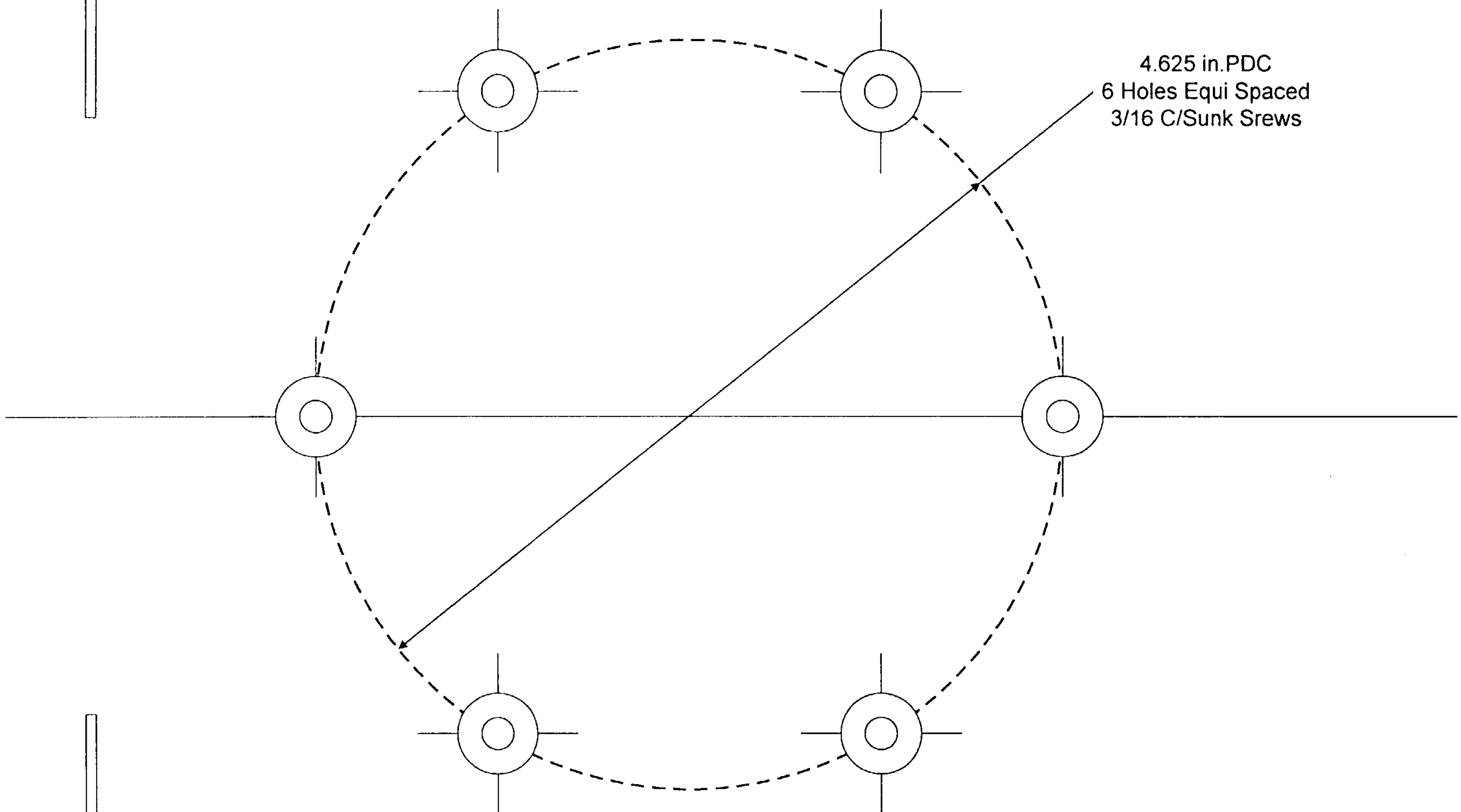
Graphical Representation of Cycle Showing Event Angles


Experiment :- E1J2.1 2500/wot 6FPC water, 106 btdc start of water
IGN
WATER
FUEL
Exhaust Valve
Inlet Valve
0
30
60
90
120
150
180
210
240
270
300
330
360
Crankshaft Angle (Degrees)


Experiment :- E1J14.1 2500/wot 6FPC water, 106 btdc start of water
IGN
WATER
FUEL
Exhaust Valve
Inlet Valve
0
30
60
90
120
150
180
210
240
270
300
330
360
Crankshaft Angle (Degrees)

Appendix J

Details of Engine Modifications

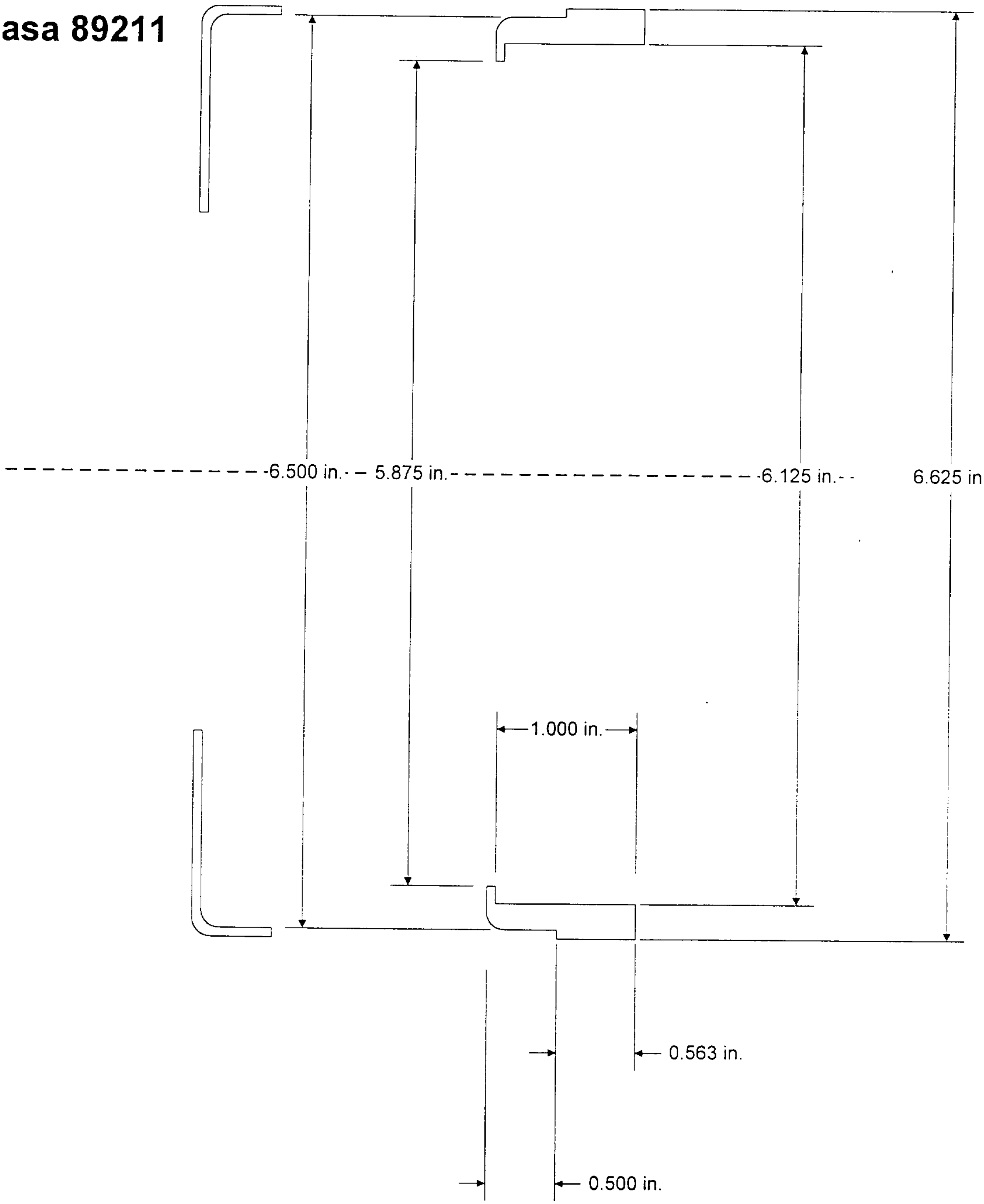


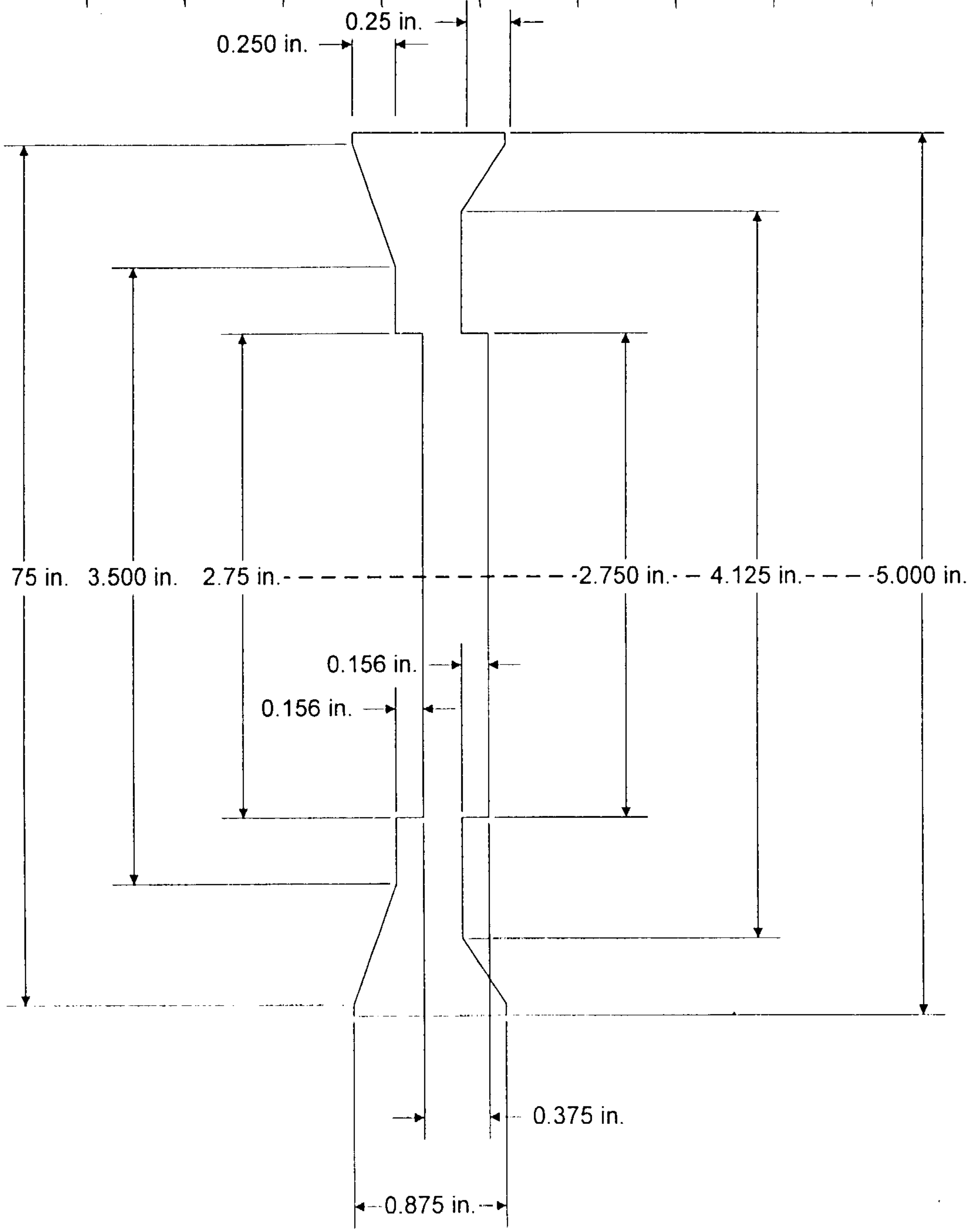
Hole Patern for Seal Housing

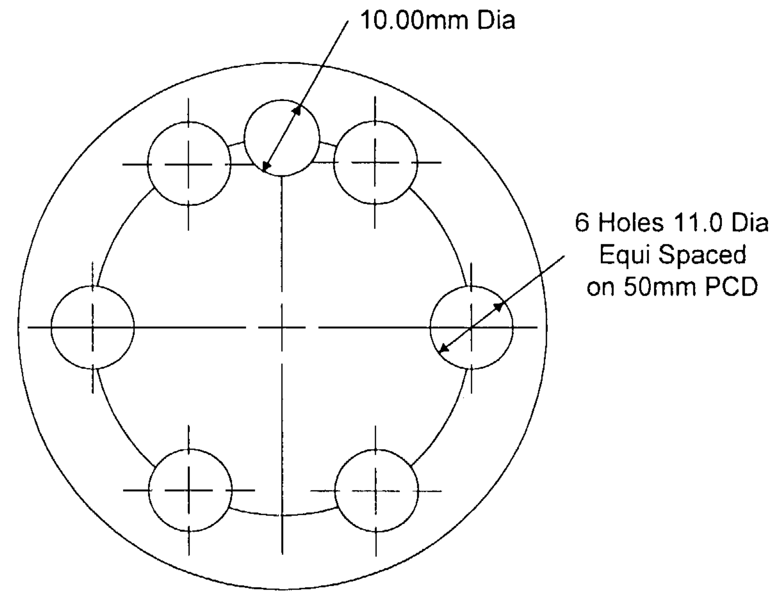
BEARING SEAL RING

Material - Steel

Nasa 89211



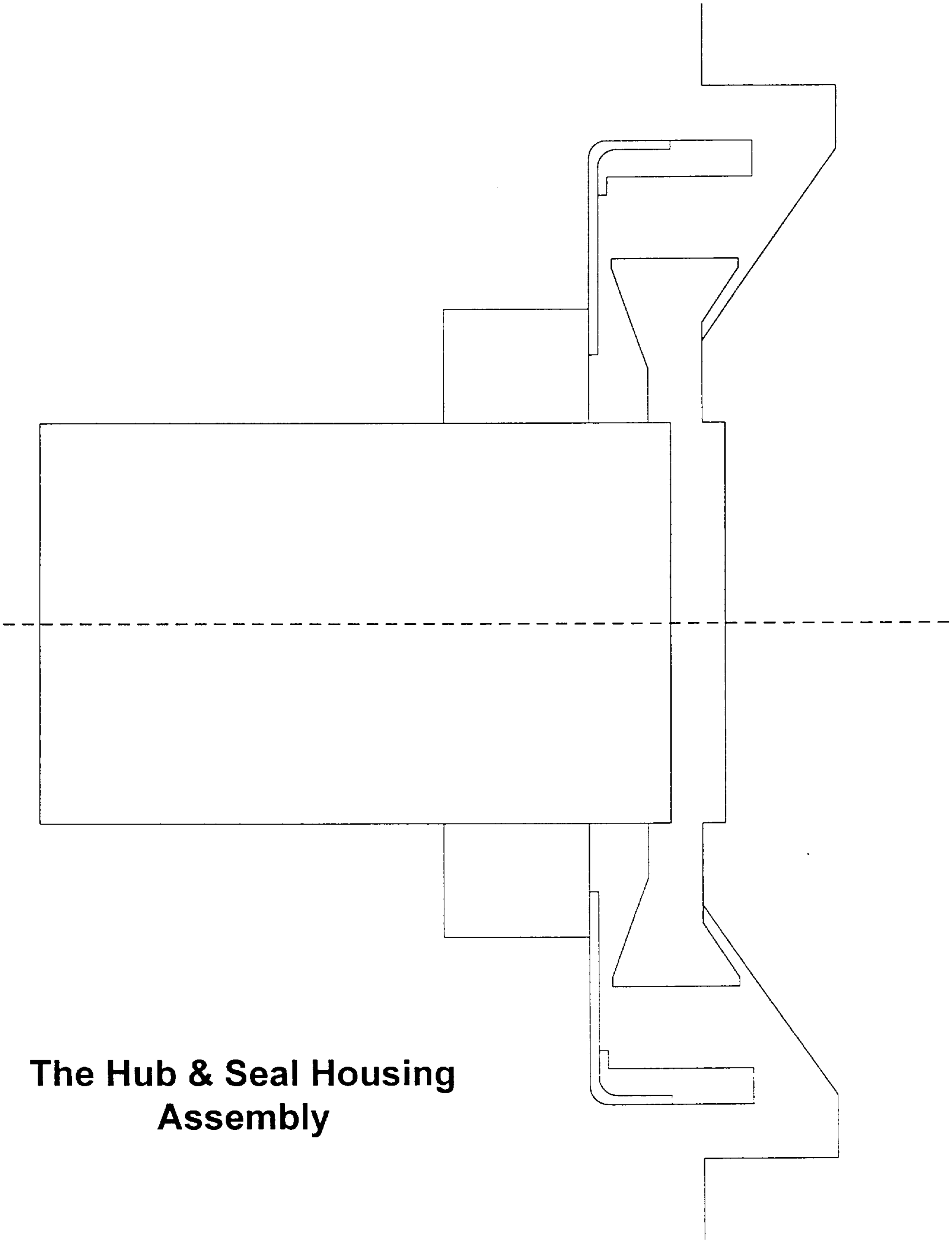




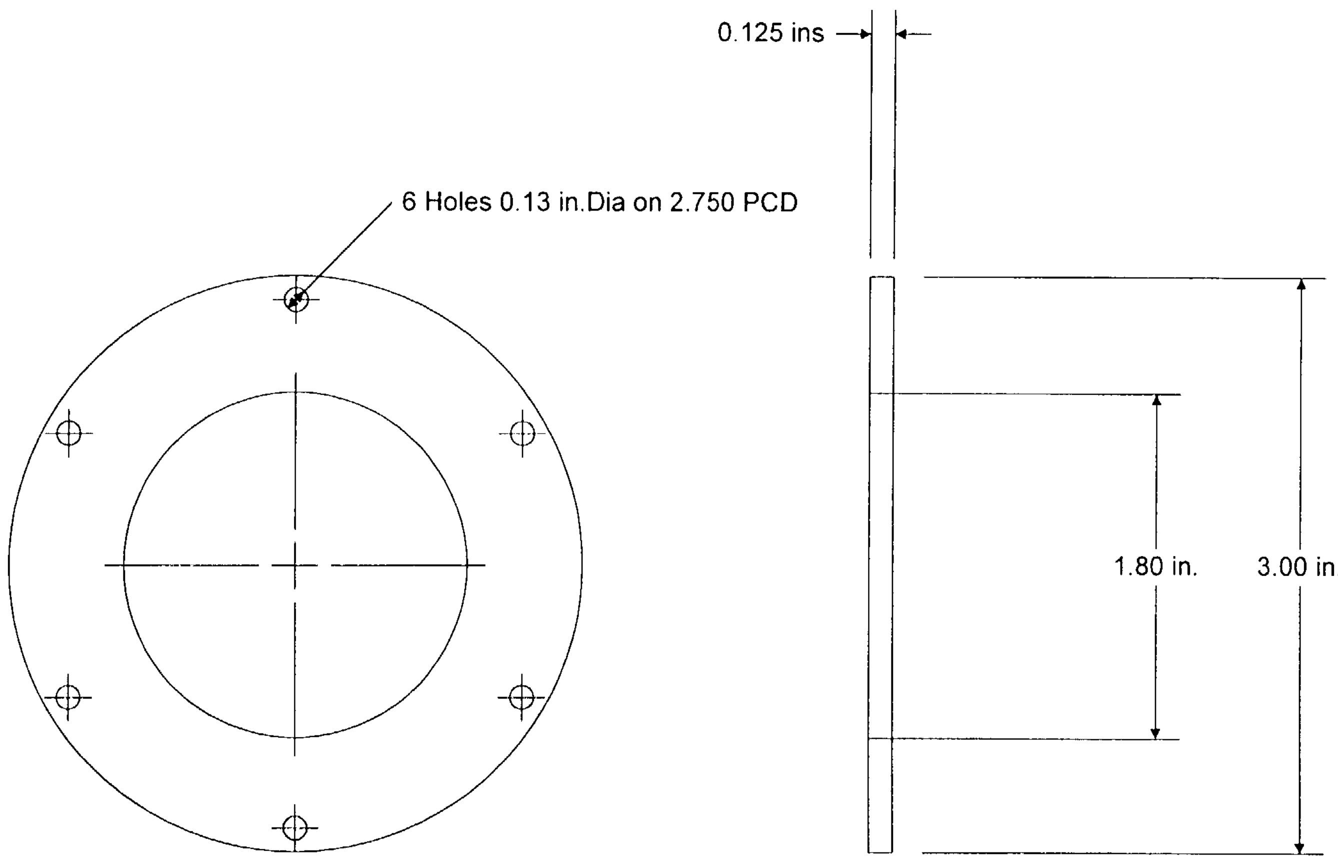
BEARING SEAL HUB

Material - Steel

Nasa 89211



The Hub & Seal Housing Assembly

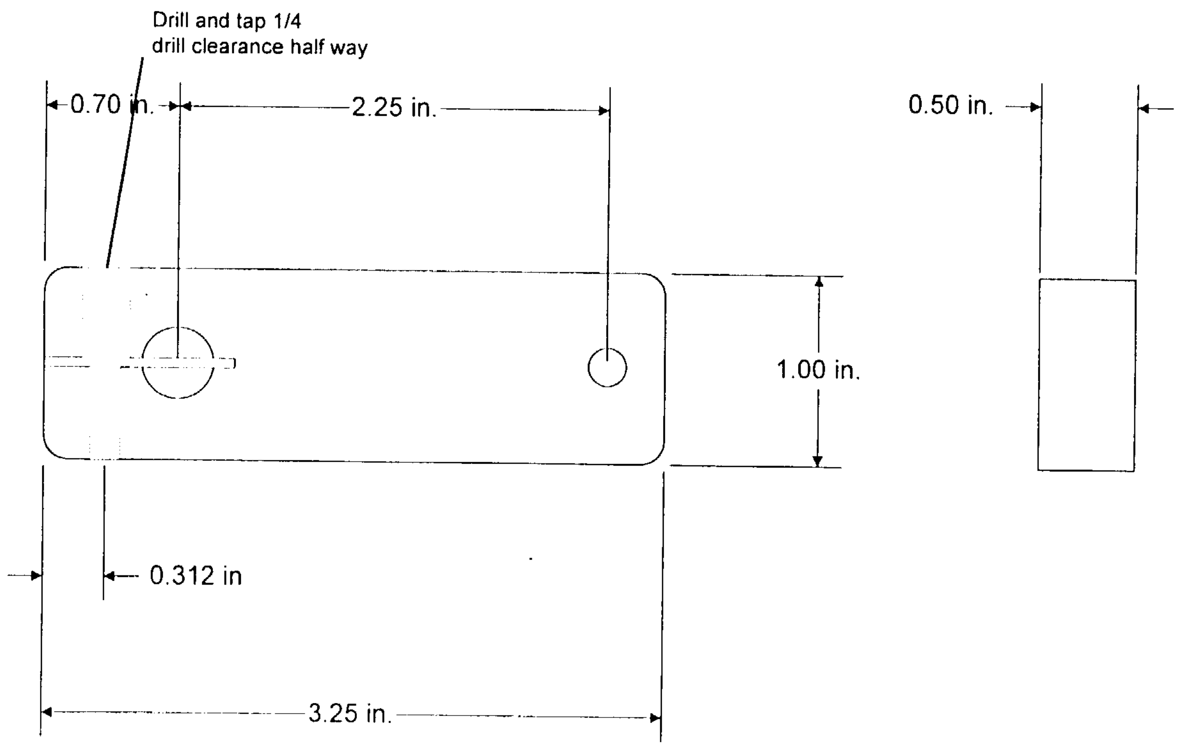


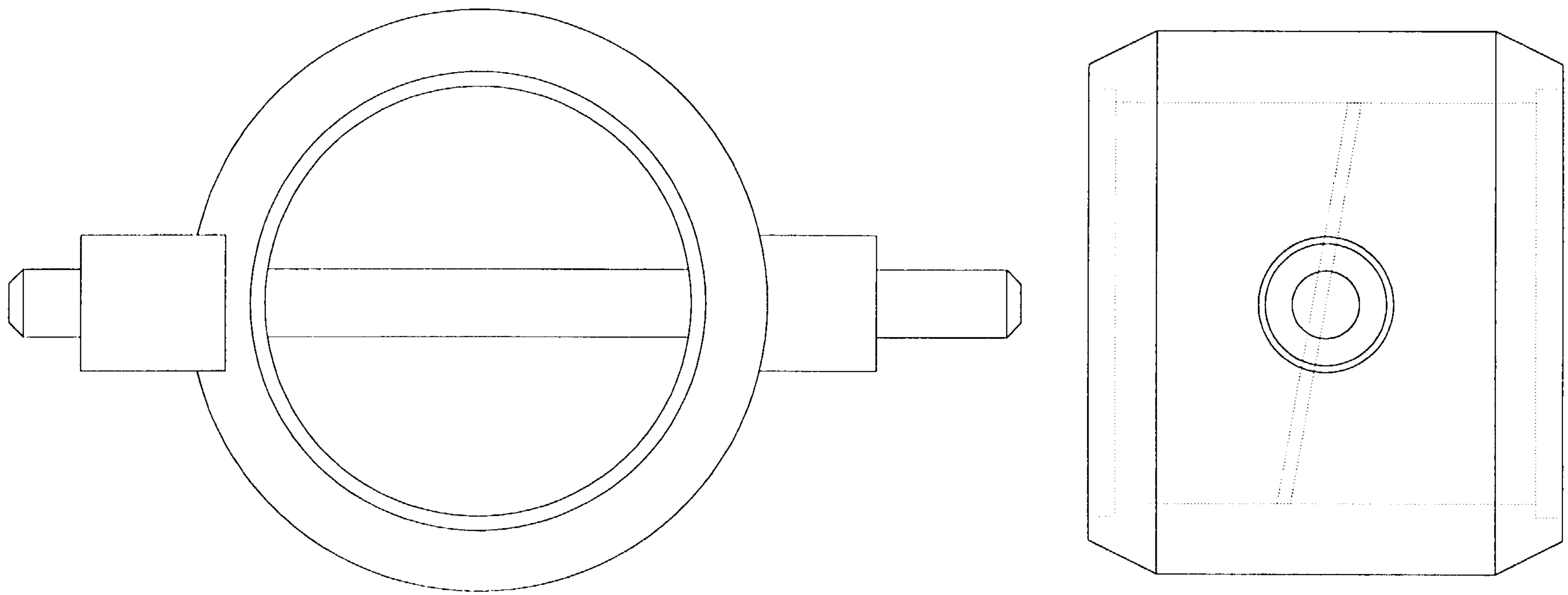
FRONT KEEPER PLATE

Material - Steel Plate

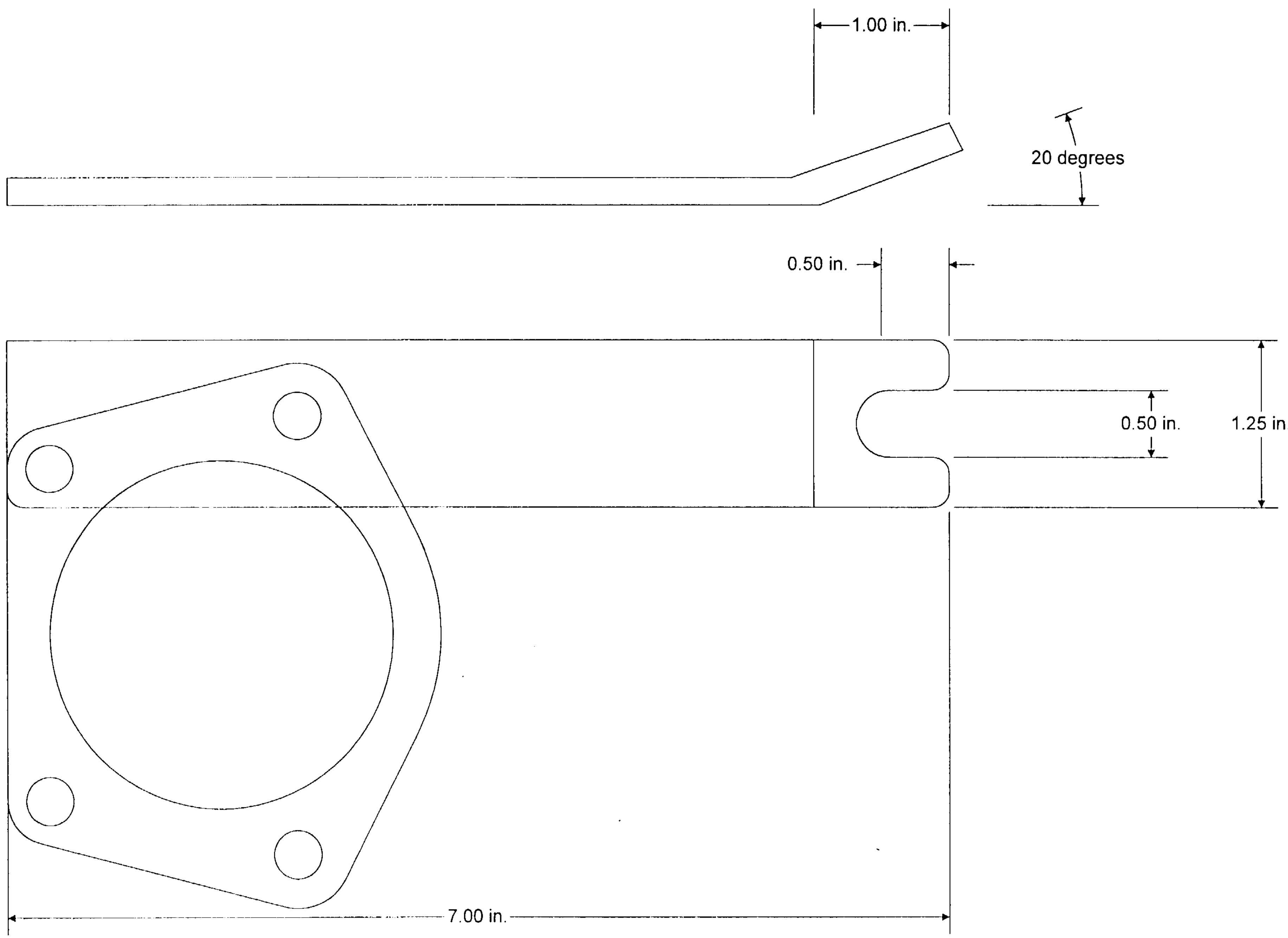
Nasa 89211

Exhaust Lever

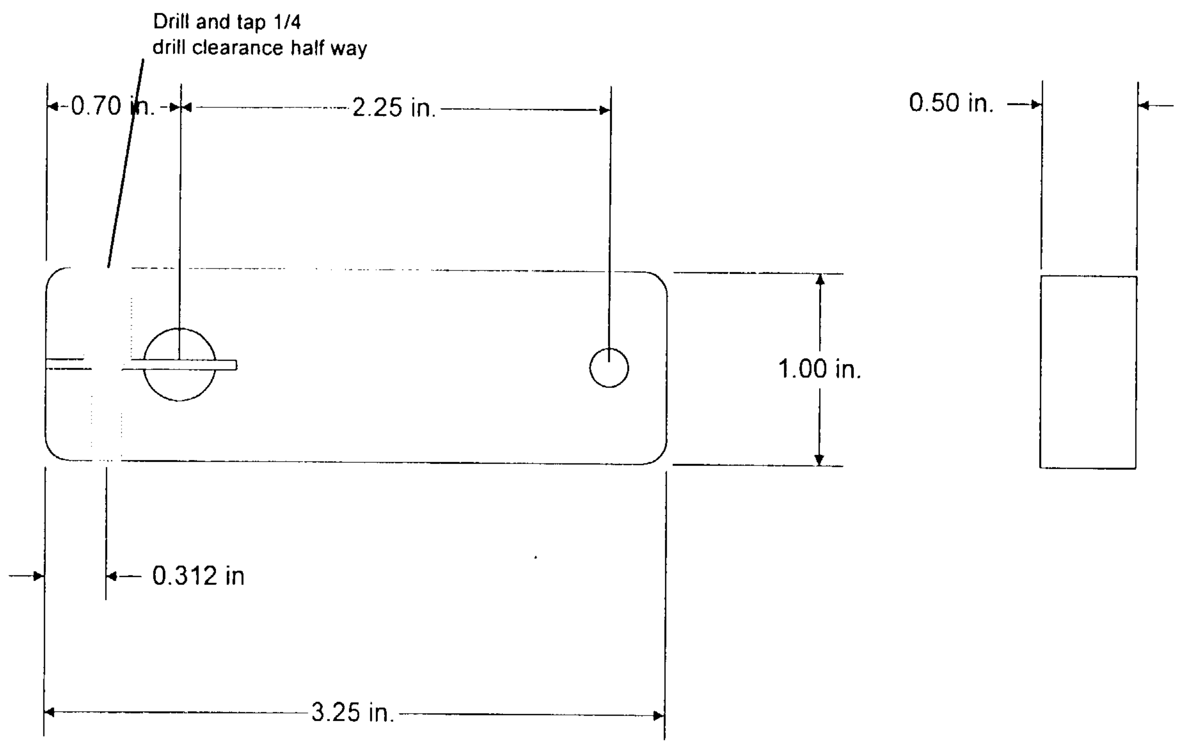


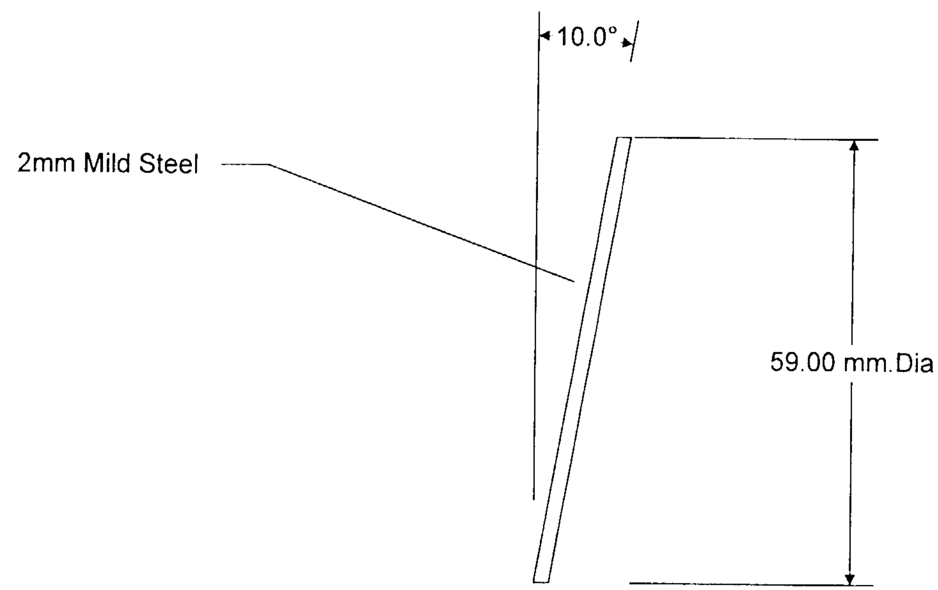


Exhaust Butterfly Valve Assembly


1.00 in.
20 degrees
0.50 in.
0.50 in.
1.25 in.
7.00 in.

Exhaust Lever

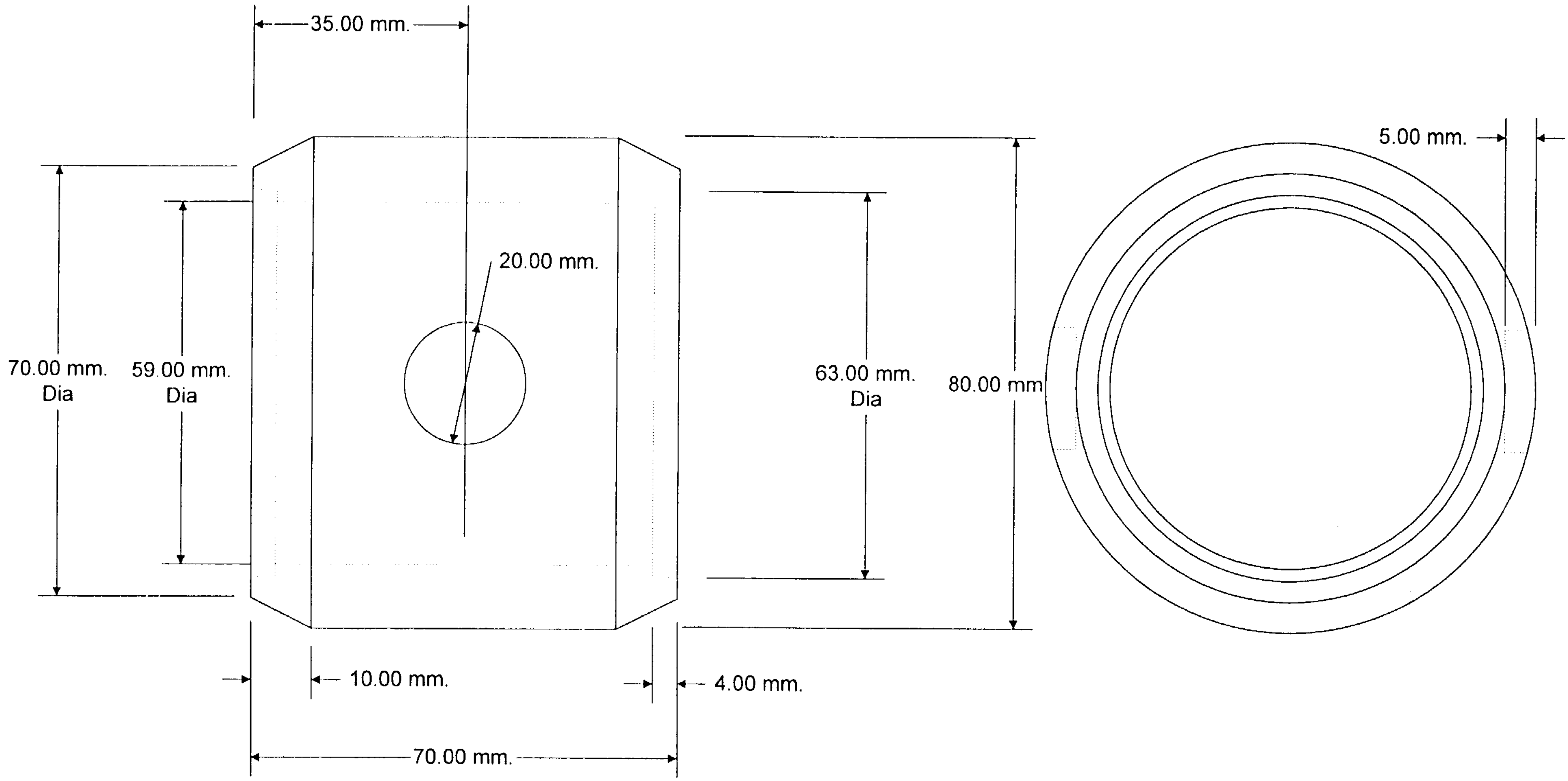




THOTTLE BLADE

Material: Mild Steel

Project No 89211 NASA



EXHAUST THROTTLE BODY

Material: Mild Steel

Project No 89211 NASA

LUGS & SHAFT

Material: Mild Steel

Project No 89211 NASA