PRODUCTION LEAK TESTING

Presented By:

Mr. Alan Campbell
Uson L.P.
Houston, Texas
May 2000

Personal Background of Presenter

Mr. Alan Campbell is the Product Manager for Uson L.P., Houston, Texas, where he has been involved in a number of complex testing challenges presented to the company. Mr. Campbell has more than 23 years experience in production leak and flow testing of automotive, industrial, and medical components.

Background of Company

Uson L.P. has been in the forefront of leak testing industry for the past 37 years, providing leak testers primarily to the automotive industry, but also to the medical, industrial, and appliance industries.

Uson L.P. is a manufacturer of electronic test equipment, specializing in leak testing, flow testing, and multiple limit pressure testing. The Series 4000, Sprint 1100, and Model 1200 Leak Testers are our main product lines. These leak testers have the fastest testing speed and highest reliability of any leak tester.

Uson L.P. has been in business for 35 years, has 40 employees at the Houston location, utilizes the services of two independent electronic consulting firms and contracts over 20 sales representatives/Agents throughout the United States, Western Europe, and Asia Pacific.

Uson Groups consists of Uson L.P. – Houston, Texas, Uson Michigan – Troy, Michigan, Uson Salt Lake – Salt Lake City, Utah, Uson Europe – Suffolk, United Kingdom, and Uson Asia/Pacific – Singapore China.

Uson L.P. Customer Base

Uson L.P. has a diversified market area for its products. A general market area has been classified as follows:

Automotive
The automotive industry (automobile manufactures and their suppliers) is the largest user of the Uson test equipment. Uson supplies an estimated 85% of the total U.S.A. market within the automotive business.

General Motors Corporation is the largest single customer; although we do supply equipment to Ford, Chrysler, and other automobile manufacturers. Uson regularly supplies over 40 General Motors manufacturing plants.

Disposal Medical Products
This market area includes medical products such as artificial kidneys, blood filters and blood bags, complete administration blood tubing sets, fluid injection devices, and miscellaneous pumps, valves and flow devices.

Home Appliance and Military
This is a broad category and includes items such as gas control valves for furnaces, gas cocks, air conditioning valves, and components, water carrying valves, miscellaneous control valves, seal manufacturers, and many other items too numerous to list.

Military products include fuse assembly, projectiles, and casings.

Uson L.P. has customers with over 300 testers, which were purchased over a period of 5 - 12 years.

Over a 35 year history, collectively Uson has 18-20,000 testers worldwide, and growing.

Why Leak Test ?

Leak testing is a necessary and integral part of your manufacturing process. You can use different methods to check for leaks but, the most common and reliable is pressure testing. Everything leaks air!

One way to illustrate pressure testing is to blow up a balloon. Chances are you can tell if it has any leaks by watching the balloon. A very small leak might take several hours. Now if a pressure gauge were connected to the balloon, you could quickly tell if it had any leaks by watching the gauge. If the pressure began to drop, you'd know a leak was present. Even a very small leak would be detected right away.

In manufacturing, even very small leaks can cause big problems. That's why you need a fast, reliable method for detecting leaks in parts.

Leaks can be hazardous to your health and environment !

Leak testing is performed for two very crucial reasons – safety and quality assurance.

Certainly safety is your biggest concern for ensuring that parts don't leak. The consequences of leaking parts include fatal accidents, fires or explosions, and damage to people or surroundings.

Leak testing for quality assurance helps prevent product malfunction or deterioration, costly mistakes in manufacturing, and impaired customer relations.

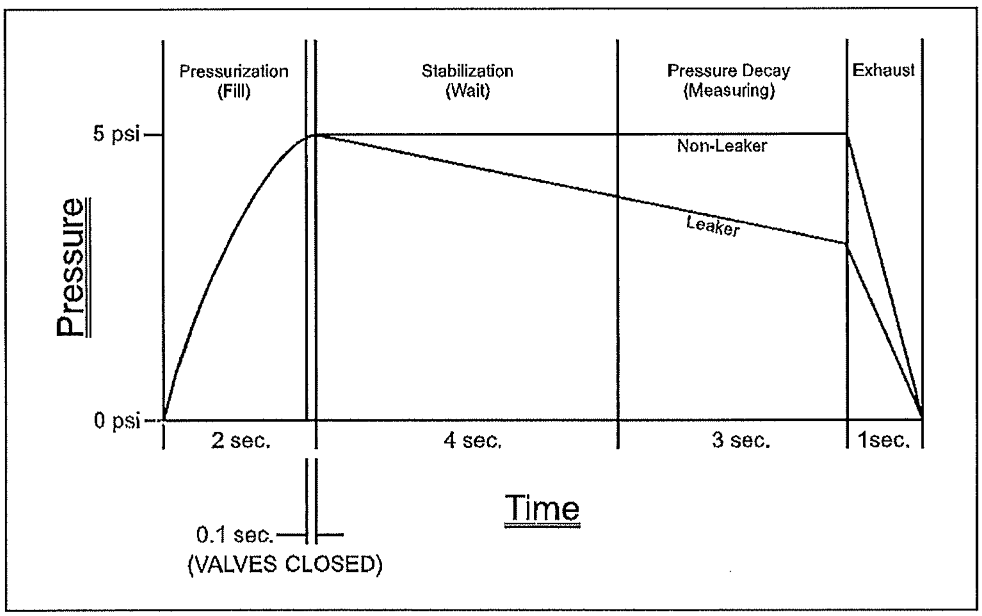
Testing an engine block for leaks in the casting is just as vital as ensuring that each and every blood bag manufactured does not leak. Many different parts – large or small, extremely rugged or very delicate, simple or complex – need to be checked for leaks.

What is Leak Testing ?

Modern leak testing uses air pressure, electronics, and pneumatics components to perform pressure testing. Electronic pressure testing involves filling a test part with air pressure, allowing it to stabilize, and then checking for leaks. These three major steps of modern leak testing are called FILL, STABILIZE, and LEAK.

The computer or electronics control the timing of each step and reads the air pressure of the test part. The pneumatic components control where the air pressure goes and convert the test part air pressure to an electrical signal.

The pneumatic component that converts air pressure to an electrical signal is called a Pressure Transducer. During the LEAK step, the computer reads the pressure transducer many times to create a graph of air pressure values over time. After the LEAK step, the computer compares the air pressure values to the values of a known non-leaking part. If the values are comparable, the tested part is good.



Leaking and Non-Leaking Test Part

Electronic Memory Pressure Decay type

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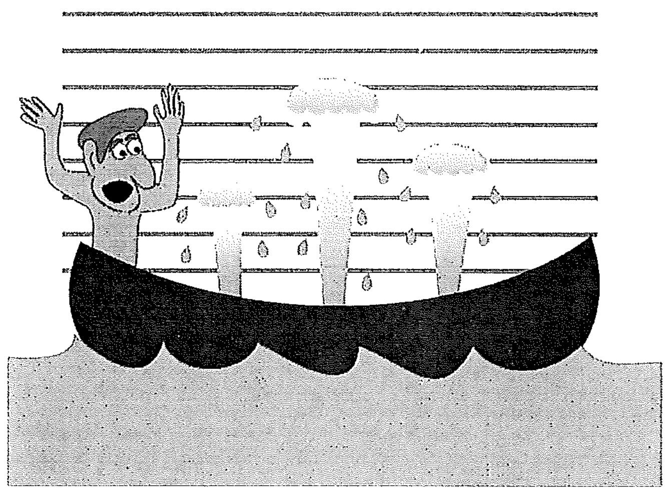
How to Leak Test

Several methods are available for you to check parts for leaks.

One method involves filling the part with air and then watching, listening, or feeling for leaks. Another method is submerging the air-filled part in water and watching for air bubbles.



Another way is connecting the part to a pressure gauge and watching the gauge for a drop in pressure. All of these methods involve a considerable amount of time and are not practical for most leak testing applications. A more practical method is electronic leak testing.

With electronic leak testing, you connect a computer to a pneumatic system and let the computer control the testing process. The tester open valves to fill a test part with air and then close the valves to isolate the test part. After the system has stabilized, the pressure decay over time is measured, and the part is exhausted. This method is called Electronic Pressure Decay Leak Testing. After the pressure decay characteristics of a test part have been obtained, they are compared to the characteristics of a known good, or non-leaking part. Often, this part is called the Master Part, because its characteristics illustrate what a good part should look like.

Basically, the electronic tester fills a Master Part with air, and then records the pressure change of the part over time. Once these pressure readings are memorized by the computer, production parts can be checked for leaks by comparing their pressure characteristics to the Master Part.

Leaks can be a deflating experience !

WHAT IS REALLY BEING MEASURED – "PRESSURE CHANGE"

What Causes Pressure Change ?

All electronic leak test methods require a pressure change to measure a leak. Once you understand how your part is affected by pressure, you are well on your way to becoming a leak detection expert!

An electronic tester measures pressure change inside a part to detect leaks. If a leaking part were the only thing that causes a pressure change, our jobs – and that of the tester – would be easy. However, other things can cause pressure changes. The task is to know what are the possible causes of a pressure change and how much pressure change is tolerable before we can safely say, "This is a good part!"

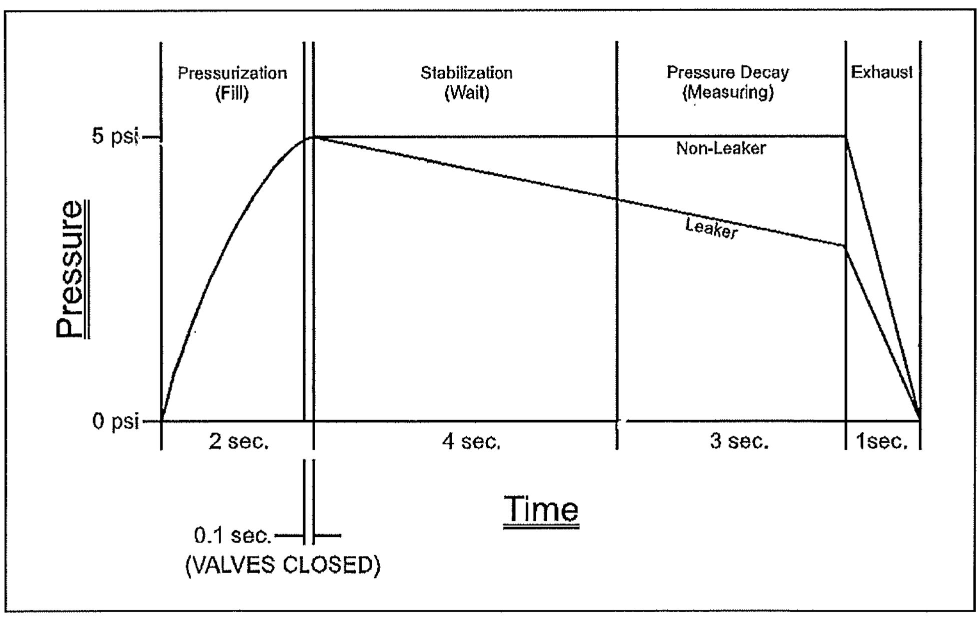
Basically, there are four things that can cause a pressure change in a part:

- A leak in the part, fixture, or test system
- Test part changes
- Test fixture changes
- Accuracy and repeatability of pneumatic components

Each of these is discussed briefly in the following sections.

Leak in the Part, Test System, or Fixture

During a basic leak test, an electrically operated valve opens to fill the test part to the test air pressure. Once the test part is pressurized, the valve closes and the test part is allowed to stabilize. After stabilization, the pressure is measured over time. A leak in the test part causes the pressure to drop or decay, as shown by the following graph:



Leaking and Non-Leaking Test Part

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It is imperative that all components of the pneumatic system be as air (bubble) tight as possible. Leaks in the pressurizing system can prevent the test part from reaching the full test pressure. Dirty or damaged seals in the test fixture can cause a good test part to appear defective.

Leak and Flow Test Methods

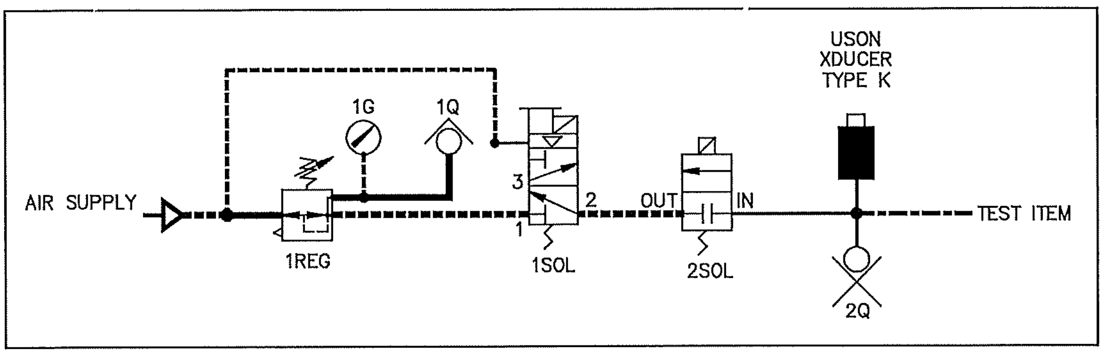
Electronic testers may perform six test types to give you maximum flexibility in your testing process:

- Pressure Decay Leak Test
- Differential Pressure Decay Leak Test
- Mass Flow Sensor Flow Test
- Back Pressure Flow Test
- Pressure Change Test
- Pressure/Vacuum Chamber Measurement Test

This section describes each of the above tests.

Pressure Decay Leak Test

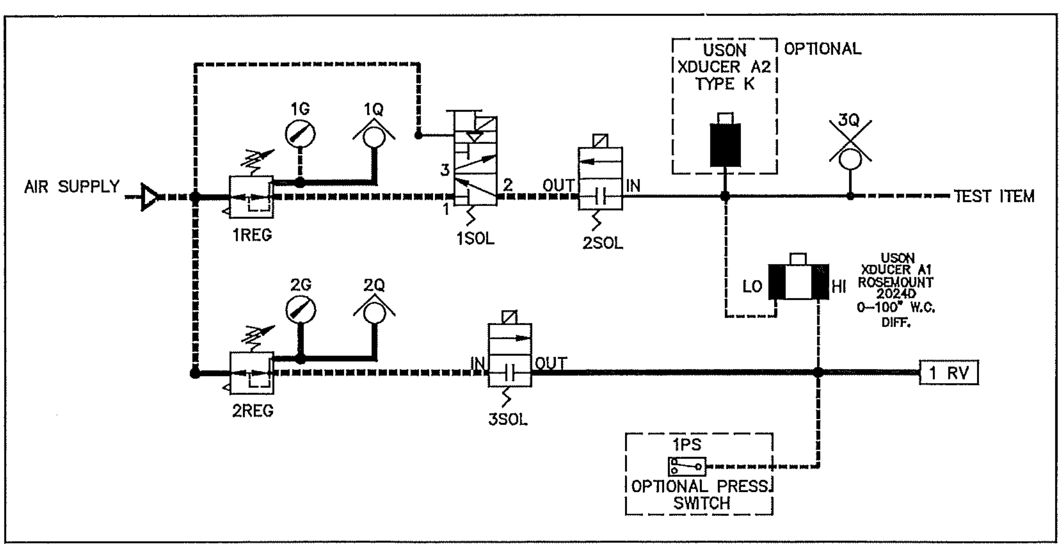
This is the most popular leak test because of its simplicity. A Uson pressure transducer monitors the air pressure during the Fill and Stabilization step of the test. Pressure loss characteristics for a non-leaking part (Master Part) are memorized during the Leak step and then compared to production parts. This test is used for many leak test applications.



Pressure Decay Leak Test

Differential Pressure Decay Leak Test

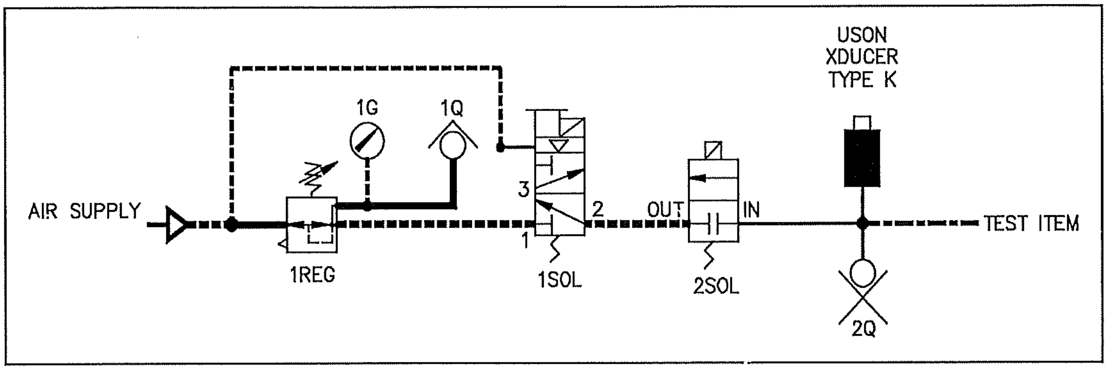
This leak test uses a differential pressure transducer and therefore, needs a reference pressure chamber. Pressure change characteristics between the reference chamber and the Master Part are memorized and then compared to production parts.



Differential Pressure Decay Leak Test

Pressure Change Test

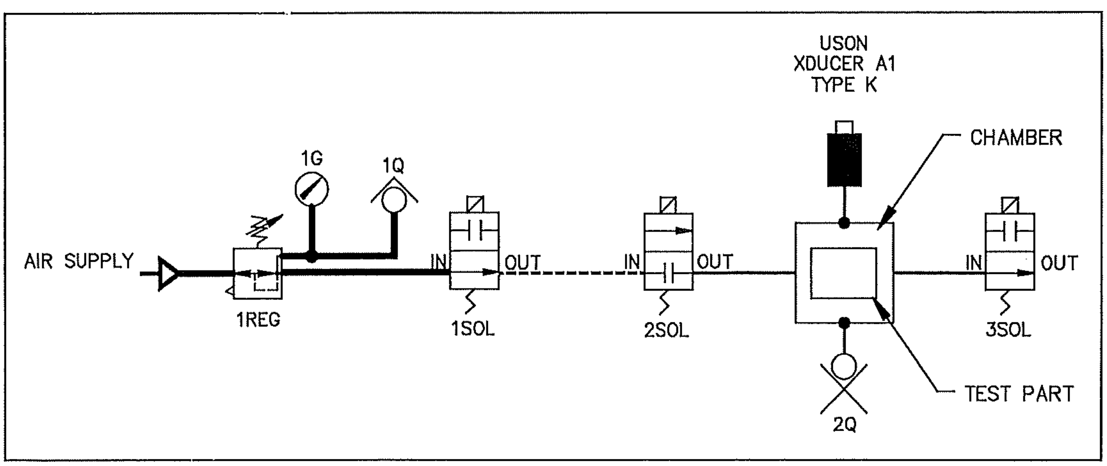
This test displays a leak in terms of a pressure change. Calibration is not needed because the pressure change is not converted into a leak rate. This test uses the same principle as the Gauge Pressure Decay leak test except the final result does not convert to leak rate units.



Pressure Change Test

Pressure/Vacuum Chamber Measurement Test

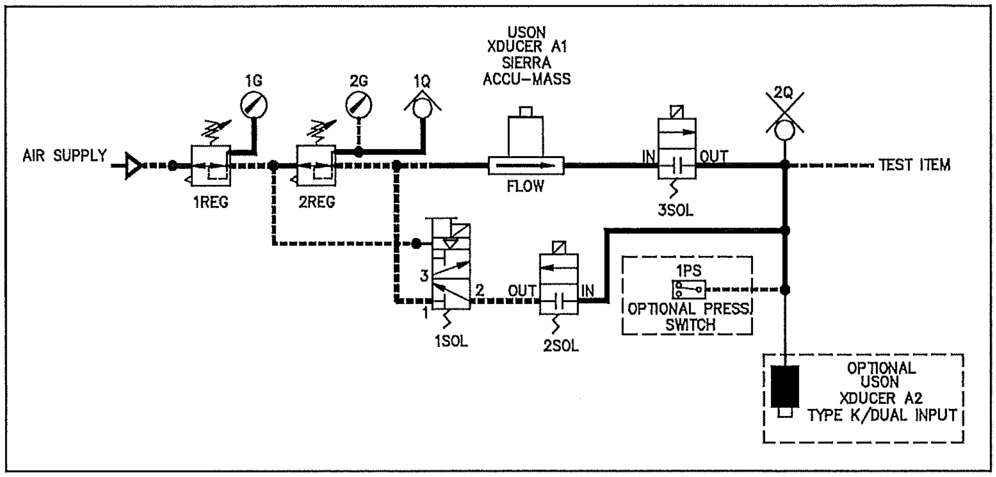
This test requires a leak tight chamber to completely enclose the part under test. A pressure transducer is installed to measure the pressure in the chamber. The part, or the chamber, is then pressurized. The system looks for a change in pressure in the chamber. The test air supply is always a known metered quantity of air. This technique is particularly useful for hermetically sealed parts as it is not possible to directly pressurize or vent the part.



Pressure/Vacuum Chamber Measurement Test

Mass Flow Sensor Flow Test

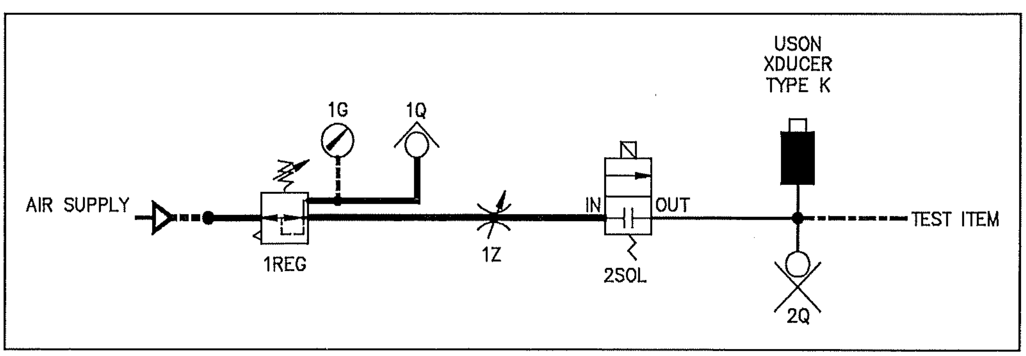
This test measures post stabilization flow to a test part caused by a leak by electronically measuring the heat loss of air passing over a heated element. This test is not normally used for parts that have leak rates below 8.3 cc/sec. (500 cc/min.)



Mass Flow Sensor Flow Test

Back Pressure Flow Test

This flow test uses a pressure transducer to measure the back pressure caused by restrictions within the test part. The transducer is connected to the flow port going to the part. All of the flow components must be larger than the possible restrictions in the part. A variable flow restrictor is sometimes used to increase the tester resolution by limiting the flow capacity of the pressure regulator.



Back Pressure Flow Test

Applications

When deciding whether a part is a candidate for air leak testing, it is necessary to consider the type of liquid or gas used in service, as well as the operating pressure of this liquid or gas. Components that operate with liquid are excellent candidates for air leak testing. The primary advantage of using air over liquid is the speed at which the test can be performed; however, it is necessary to keep in mind that air will pass through some leaks that will not pass liquid. Because of this, a maximum allowable air leakage rate should be specified.

Guidelines

Automotive components which generally receive a leak test in the various phases of manufacturing and assembly are summarized by functional area of the automobile.

A. Liquid Containing Components –

The major components which will contain a liquid in service, but are typically tested with air are:

- Engine cooling and oil systems
- Brake Components – cylinders & calipers
- Fuel Systems – fuel sender, fuel pumps, fuel rails w/injectors (assy)
- Power Train – transmission, transaxles, internal components of transmissions & axles.
- Cooling Components – radiator, heater core, oil coolers, & hoses
- Power Steering – pump & gear

B. Gas Containing Components –

- Exhaust Gas – exhaust gas manifold, mufflers, catalytic converter, exhaust piping, & oxygen sensor
- Air Conditioning – compressor, evaporator, condenser, condensing valve, accumulator, & hoses

C. Vacuum Components –

- Actuators – brake booster, climate control vacuum motors, intake manifolds
- Emission Control Devices – EGR valve, thermal vacuum switches, filters, canisters, purge valves, & restrictors

Air vs. Liquid Leak Testing

Since many automotive components operate with liquid, the question arises, why don't they use a liquid for the leak testing. In our earlier discussion, we did mention the use of liquid leak testing, with the only particular advantage being for extremely high pressure.

Let us consider the relative merits and disadvantages of using air and liquid for leak testing media. You must consider that air is a compressible media with a relative low viscosity, compared to common liquids. This means that the air travels through the leak at approximately 100-400 times faster than liquids.

Air has essentially no surface tension. This allow it to escape much more easily that the liquid through a small leak.

However, it is very important to consider that the air does go through leaks that will not leak liquid. This is one of the reasons for requiring a specified maximum allowable air leakage rate.

The primary advantage of using air as a test fluid is speed in leak testing.

The No-Leak Syndrome

The easy escape route for a specifying design engineer is to say "**No Leak**". However, this is the same as specifying no dimensional tolerance .... "**No Tolerance!**"

For Example: 1.0 inch ± zero = 1.000000000..

This is no such thing as "**No Leak**". As a common example, consider that cigarettes are packaged in cellophane. Cellophane is a highly permeable material and has extremely low air leakage. You don't see cigarettes packaged in polyethylene plastics. The reason is polyethylene plastic is relatively porous compared to cellophane. And paper is relatively porous to polyethylene plastic.

Everything leaks. It is only relative to the situation.

Each individual automotive component has some amount of air leakage. When we say no leakage of a specific liquid, that is a start to approaching leak rate specification. However, since we test most of the components with air to prevent this liquid leakage, you can not specify "No Leak" of air or other gas.

Maximum allowable leak rates are typically specified as so many cc/min. at a specified test pressure.

Determining Actual Leaking by Specification & Can I Trust My Eyes "Can't Find"

Electronic Testing with a Defined Reject Limit

Let us review this by means of an example:

An operator has tested several hours of production parts, and selectively upon completion of testing, sorted the "Acceptable" into one bin, and the "Rejected" parts into another bin.

The rejected parts are taken to a water dunk tank for visual bubble monitoring to determine location of leakage as air is re-introduced into the part.

As expected, the majority of parts collected display a visual stream of bubbles to the operator under water submersion. Then however, a collection of products rejected at the tester do not display any visual bubble formation to the operator. Are these parts truly "Rejected", or was the tester in error or mis-calibrated.

The parts have been given the classification over the years as "Can't Find".

Remember previously, the tester monitors the accumulative pressure change (loss) which occurs in a product over a given time and compared to a pressure loss (leak rate) limit. The "Can't Find" parts truly did leak in excess of the reject limit of the tester due to perhaps more points of leakage (locations), but with porosity (hole size) too small for the eye to see.

For example, a single point of leakage 10 cc/min. at 10 psig, would be very easy to see under water. But, 20 points of leakage, each 0.5 cc/min. would not be visible, yet the product would be rejected by the electronic tester due to accumulative pressure loss and tester sensitivity and resolution.

Setting New Specifications

The first attempt at setting the specifications should utilize the actual test pressure (for pressures under 200 psig) as the normal pressure encountered. This pressure selected is the typical operating pressure of the part under service conditions. However, this pressure may be adjusted lower for practical reasons, such as available air supply pressure, safety, and test fixture design.

Let us assume that you are looking for a no liquid leak. First, you must specify the liquid. Let us take two examples, gasoline and engine oil.

> The general leakage range for gasoline is 1-5 cc/min. This maximum allowable air leakage range is sufficient to prevent leakage of gasoline.
>
> A leakage rate of approximately 12-15 cc/min. is sufficient to prevent leakage of tap water. As the viscosity and surface tension increases, the leak rate increases. An example is engine oil more tolerance is allowable, often to 30-500 cc/min.

Wall thickness of the part also has some influence on the specification. Thicker parts can have larger maximum allowable air leak rates. Very thin parts must have low leak rates.

Effect of Test Pressure on Allowable Leak Rate

Let us assume that you set a 20 psig test pressure which is based on the application pressure. The maximum air allowable leak rate (air) was 20 cc/min.

Further, let us assume that there is a justified reason for reducing the pressure to 10 psig, such as the large opening to seal the part and requiring high clamping force. However, since this is lower than the actual application pressure, you must adjust your maximum air leakage rate correspondingly about 10 cc/min.

This is really an approximation, but works linearly with gauge pressure in practice on test pressure under 100 psig. When the test pressures get considerably higher than that, the reduction in the maximum allowable air leakage rate does not have reduced linearity.

Verify this by testing leakage at various pressures on actual parts. The leakage from these parts must be in the general maximum allowable leak rate range.

Correlation Testing

The real test of any specification, is to use actual parts with pre-measured air leakage rate from a conventional manufacturing process. Then put these parts in a service test condition.

By testing various samples, with pre-measured leak rates, the sample tests determines where the maximum allowable air leakage is detrimental to the parts operation, e.g., external leakage or other causes. There is a point that you must consider, that air does leak and that liquid does not leak.

You should consider the difference in the maximum allowable air leakage rate with more aluminum and less cast iron parts. More plastic parts have similar trends in set leak rate. The manufacturing process are different.

Aluminum has a natural tendency to be more porous and can stand more maximum allowable air leakage rates since it is normally multi-path leakage. This is not normally true in cast iron parts. Cast aluminum, lost foam aluminum, and cast iron all test differently.

Historical Specifications

You must realize that with the advent of new parts and materials, the change of specifications is worthy of investigation. You must also consider the economic trade-off's in the cost of testing.

However, you must respect the historical testing specifications, particularly for automatic leak testing in your evaluation. Certainly you have information available on a warranty problem associated with leakage.

Sometimes a specification on a new part is a copy from the old part, and the old part specification were copies from an older part. The specification on the older part was copies from an unrelated part.

The modification of historical specifications is not improper. In many cases they are too conservative and have been unnecessarily costly in reworking rejected parts.

If the specifications say "No Leak" and they are discussing air leakage, remember this is not a valid or realistic specification. "No Leak" liquid, is a valid specification, but must be realistically clarified for air pressure decay, water immersion, or gas detection methods.

Test Considerations

Leak Test Time Cycle

Before you set the final maximum allowable air leakage rate and test pressure, you must consider the impact on the overall production cycle and testing equipment cost. The following information is required for evaluation of the leak test time cycle.

1) Maximum allowable air leak rate
2) Test pressure
3) Internal test volume
4) Production rate
5) Part material

In the overall time cycle evaluation, you must include the other considerations as well.

1) Clamp/unclamp time
2) Part transfer, either automatic or manual
3) Adiabatic heating effect

All of these items will then determine the entire total time cycle.

The impact of different maximum allowable leak rates on the production cycle and testing equipment is shown in one example. Each individual application requires its own individual analysis.

The example is the water coolant section of an automotive engine block. Typically, an engine block is 200 cu.in. in test volume. The internal volume is reduced to 100 cu.in. by individually testing the separate halves of the V-8 engine.

The nominal test pressure is 20 psig. Let us consider the impact of different maximum allowable air leakage rates on the total cycle time.

The individual segments of the leak test and the total test time cycle are as follows for various maximum allowable air leakage rates.

	2 cc/min.	**5 cc/min.**	**10 cc/min.**	**15 cc/min.**	**20 cc/min.**
Pressurization	5 sec.	5 sec.	5 sec.	5 sec.	5 sec.
Stabilization	60 sec.	25 sec.	15 sec.	8 sec.	5 sec.
Memory Setting	1 sec.	1 sec.	1 sec.	1 sec.	1 sec.
Decay Period	60 sec.	25 sec.	15 sec.	8 sec.	5 sec.
Total Test Time	126 sec.	56 sec.	36 sec.	22 sec.	16 sec.

In these examples, you will note that we have arbitrarily selected a stabilization time equal to the decay period. This is a conservative approach.

Let us further consider that one part must be manufactured each 30 seconds. This would leave 20 seconds dwell time in a single station for the leak test.

By examining the specifications for the maximum allowable leak rate, you can see the impact. At 10 cc/min., you would require two stations. At 5 cc/min., you would require four stations, and at 2 cc/min., possibly eight stations.

But a leak rate at 15 cc/min., and 20 cc/min., there is a possibility of doing this in one station.

As you can see, setting the specification arbitrarily could be very expensive. By some practical adjustment of the specification, you can save as much as $100,000. in the testing stations.

Arbitrary setting of specifications, without realistic evaluation and proper correlation testing, can be expensive.

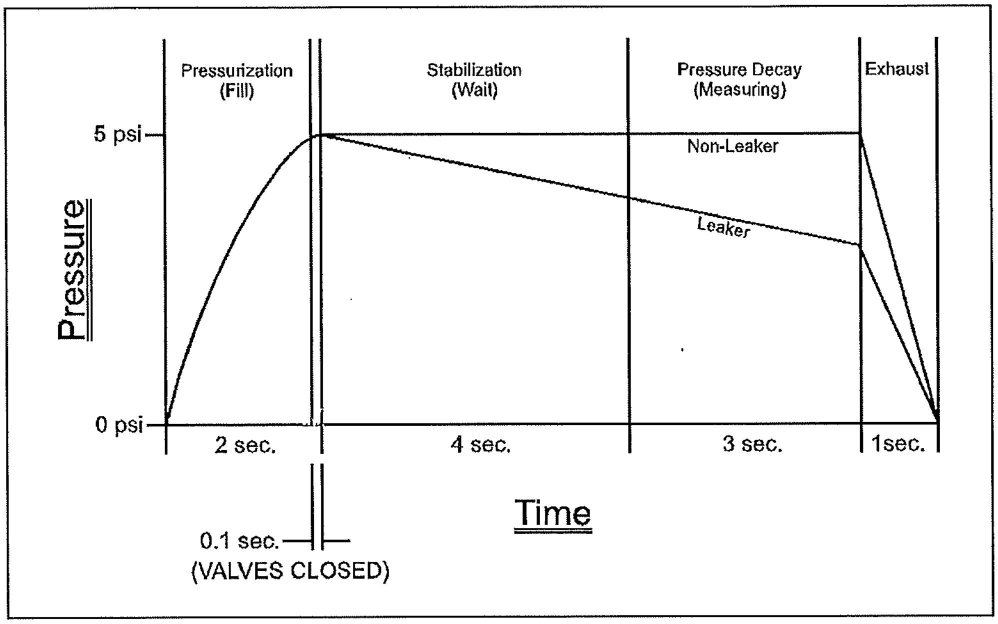
Adiabatic Effect and Elastic Creep

In most leak testing applications, you must be aware of the timing considerations associated with adiabatic heating and/or elastic creep of the part. Adiabatic heating and elastic creep are described below:

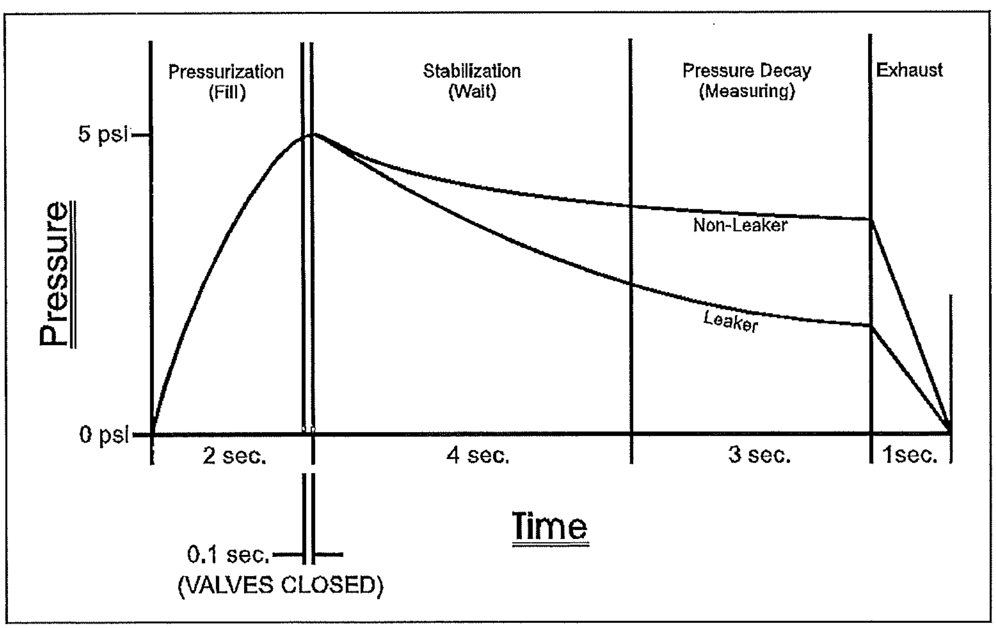
Adiabatic Heating

As the test part initially fills with air, the air is compressed and causes the air temperature to rise. The test part, acting as a heat sink, absorbs heat and causes the air temperature and pressure to drop. Generally, the larger the volume of the test part, the larger the adiabatic heating effect. In some cases, you can add volume reducers to the test parts to reduce the adiabatic heating effect. Most test programs incorporate a STABILIZE step to eliminate the effects of adiabatic heating.

The following two graphs show a leak test without adiabatic heating and a leak test with adiabatic heating.



Leak Test without Adiabatic Heating



Leak Test with Adiabatic Heating

An analogy of adiabatic heating is the way car tire pressure increases after driving. The friction of the road against the tires causes heat and the increase in pressure.

Test Fixture Design

Associated with most leak tests is a test fixture. A few simple parts only require a manual connection.

Most parts require sealing at more than one single point. Intricate parts, such as fuel rails with injectors assembled, require very small seals in small drilled holes. Other parts, such as an engine block, require sealing of large areas under relatively high clamping pressure.

The design of a leak test fixture requires adequate clamping pressures for seals. For a part, a water pump for example, that has 100 sq.in. opening, a test pressure of 20 psig, you must have proper sealing force.

Sealing force would be 20 psig x 100 sq.in. = 2000 lbs. clamping force. However, you should have available about 50% - 100% additional clamping force. This additional clamping force is required to deform the seal to the part. On this example the total clamping force available would be 3000 lbs.

On the water pump, consider a test pressure increase to 50 psig. Clamping force increases from 3000 to 7500 psig on the main opening. It will require the weight of a Lincoln Town Sedan to hold the fixture closed instead of a Mustang.

The selection of the test pressure on some parts is resolved in the fixture design itself.

Do not overlook vacuum testing on parts which have an extremely large opening. The vacuum reduces all the clamping force and provides the clamping force itself. When you are considering testing aluminum diecast parts, such as transmission cases, water pump castings, you should consider vacuum on the testing only.

It may not be advisable to use vacuum on most items which are elastomeric or other use of rubber seals.

Parts Transfer

Depending on your production rate, cost of product, and desired productivity, you should consider both automatic transfer of the material and manual unload/reload. With higher production items, it is much more common to use automatic transfer, both synchronous, and non-synchronous. On lower production items, it is normal for manual handling of the part.

Automatic assembly machines typically integrate automatic leak testing station(s).

When the part is handled manually, often two stations are handled by one operator. This allows the operator to unload/reload one station, while the second station is under test. Then the operator unloads the part from the finished test in the other station, and reloads a new part while the opposite station is undergoing a test.

Selection of Special Machinery Suppliers

Most parts require some sort of sealing and clamping fixture. This fixture can range from very simple to very elaborate and complex, depending on the part to be tested.

On the simple parts, you often build your own leak testing fixture. On the more complex part, suppliers with capability to this area are utilized.

The capability of these special machinery suppliers must be comparable with the complexity of the project. The complexity may range from simple manual clamping to fixture to completely automatic assembly, incorporating automatic leak testing.

Mechanical design, manufacture, and assembly leak testing fixtures and special machinery requires specialization and emphasis in that area. Since this is the more costly portion of the total leak testing project, the emphasis is also applied in this area.

While these suppliers do have instrumentation capability, it is basically the capability applied to packaged instrumentation for the total projects, leak testing or other. These companies do not have the specific capability or emphasis for providing current technology and instrumentation in leak testing.

Selection of the manufacturer of leak testing equipment, who can supply the personnel training, calibration procedures, spare parts, and responsive service after the equipment is installed in your plant is very important.

Seal Design and Materials

Each application requires its own evaluation on the type of seal material that is utilized in the test fixture. The selection of the seal material is important in each application. The softness of the material and its abrasive resistance must be considered.

Common seal materials utilized, there relative advantages and disadvantages, are as follows:

	Material	Raw Material Available	Advantages	Dis-advantages
1.	Neoprene	Durometers 40 – 100	Commonly available, i.e., o'rings, pads, oil resistance	Extremely soft materials not available. It is not highly abrasive resistant.
2.	Gum Rubber	Durometers	Soft-grade, more durable than neoprene. Conforms with irregular surfaces	Difficult to cut in irregular shapes. Deteriorates quickly with oil contact.
3.	Polyurethane	Durometers 50 – 80	High abrasion resistance, high surface cutting resistance, long life & durability	Must be molded or machined in frozen state. Expensive.
4.	Silicon Rubber	Durometers 40 – 100	Available in softer compounds than Neoprene. More durable	Expensive. Not generally available in sheet form.

Calibration Procedures and Documentation

In any quality control operation, it is necessary to have at least two levels of quality standards for testing measurement equipment. Leak testing equipment is not an exception.

Consider for example the dimensional micrometer. The machinist could utilize a poor micrometer for at least one day (or improper air gauge). This is the reason that you frequently check gauges to dimensional masters. You would not tolerate any inadequacies in your dimensional gauging operation.

The same rules apply to leak testing calibration masters. They are basically the following levels on leak testing masters:

1) "Challenge" Masters – This is a leak master which the quality control foreman, or an operator, can utilize to test the operation of the total leak test system. This "challenge" master often is installed in an existing part as a maximum allowable leak rate master. It is "tested" in the leak test system to assure that it rejects the part. Accept leak masters can also be utilized additionally.

2) There is also a Plug-in Leak Master. The verification standard is plugged into this leak testing system through a quick disconnect fitting. With this technique, you assume that all the parts are relatively good, and verify that the next five parts are rejected to assure that they would not have been accepted with the leak master installed in the system. The assumption is that you do not make five or six bad parts in a row.

3) In addition to On-line Master, you will need to have a back-up master. The leak standards are not totally reliable. They are mechanical devices. You must also have a calibration device, such as water immersion technique with water displacement, or with a soap film flow meter.

   The Soap Film Flow Meter is the most common device. Special calibration kits are available, that allow on-line calibration of the leak master. Devices allow on-line calibration. Soap film flow meters are available from as small as 1 cc displacement, to as large as 100 cc displacement.

   Continual verification of calibration masters is important.

   The use of Variable Area Flow Meters as a permanent calibration master is unreliable. Variable area flow meters are not to be trusted for long term operation.

   In the lower flow ranges, where leak testing is performed, the problems with contamination and damage to the floats makes them basically unreliable. They can provide a good visual indicator, but they can not be depended upon for a long-term operation for the precision of most leak testing systems.

   Calibration and procedures today are very important issues.

   Manufacturing competitiveness and quality standards desire ISO-9000 Certification, CE Mark Certification, etc.

Verify the Tester's Calibration

One of the features available with the Uson tester allows you to verify compensation and calibration without assigning new values to the tester. All test programs require a successful compensation and calibration before they will execute.

To verify calibration, install the non-leaking Master Part and follow these steps.

1) Select the desired test program and start the test. The Master Part is tested and receives a status of ACCEPT.

2) Allow the part to vent for two minutes and install the Leak Master ,or turn the manual valve (on the pneumatic front panel) ON.

3) Start the test again. The Master Part is tested and receives a status of REJECT

The fact that the 1st test received a status ACCEPT and the second test received a status of REJECT verifies the calibration.

When to Use

Verification of the tester should be done on a regular basis as per the quality requirements of your company. Verification assures you that the tester's accuracy accepts good parts and rejects bad parts. Verification with the non-leaking Master Part installed should be performed when all test parts are rejected. The test can help determine if the problem is with the fixture or the parts.

What is Needed

To verify calibration the following is needed.

- Non-leaking Master Part – must be identical and of the same material as production parts.
- Leak Master – Can be a fixed or variable orifice or flow meter set to the reject leak rate.

Futurc Trends and Developments

Lighter Weight Materials

To satisfy new Corporate Average Fue' Economy (C.A.F.E.) requirements, there will be continually increased use of aluminum, plastic, and other material in automotive components. Newer materials however, do not have the inherent leak tight integrity of cast iron and steel. Additionally, you will find thinner sections in the use with all materials, making them more susceptible to leakage.

With the increased susceptibility of leakage with these new materials and designs, the leak testing effort will be put into castings and sub-components of assemblies. For instance, not all cast iron parts were tested prior to assembly. With aluminum parts however, expect to have all castings 100% tested. Cast aluminum, lost foam aluminum, and cast iron all test differently due to unique material characteristics.

Faster Leak Test Time Cycles

Internal test volume of lighter weight components will generally be smaller. Using pressure decay leak testing methods, you obtain faster leak test time cycles.

With the advent of more plastic being utilized in smaller components, you must consider that additional stabilization, time in the leak testing cycle, may be required to obtain repeatable elastomeric creep.

Enhanced Tester Sensitivity

Production testing may consider:

- Test pressure ranges : Vacuum to 10,000 psi
- Resolution : 0.000003 psi
- Engineering Unit Display : Customer selectable
- Leak Rate Range : As low as 0.01 cc/min.

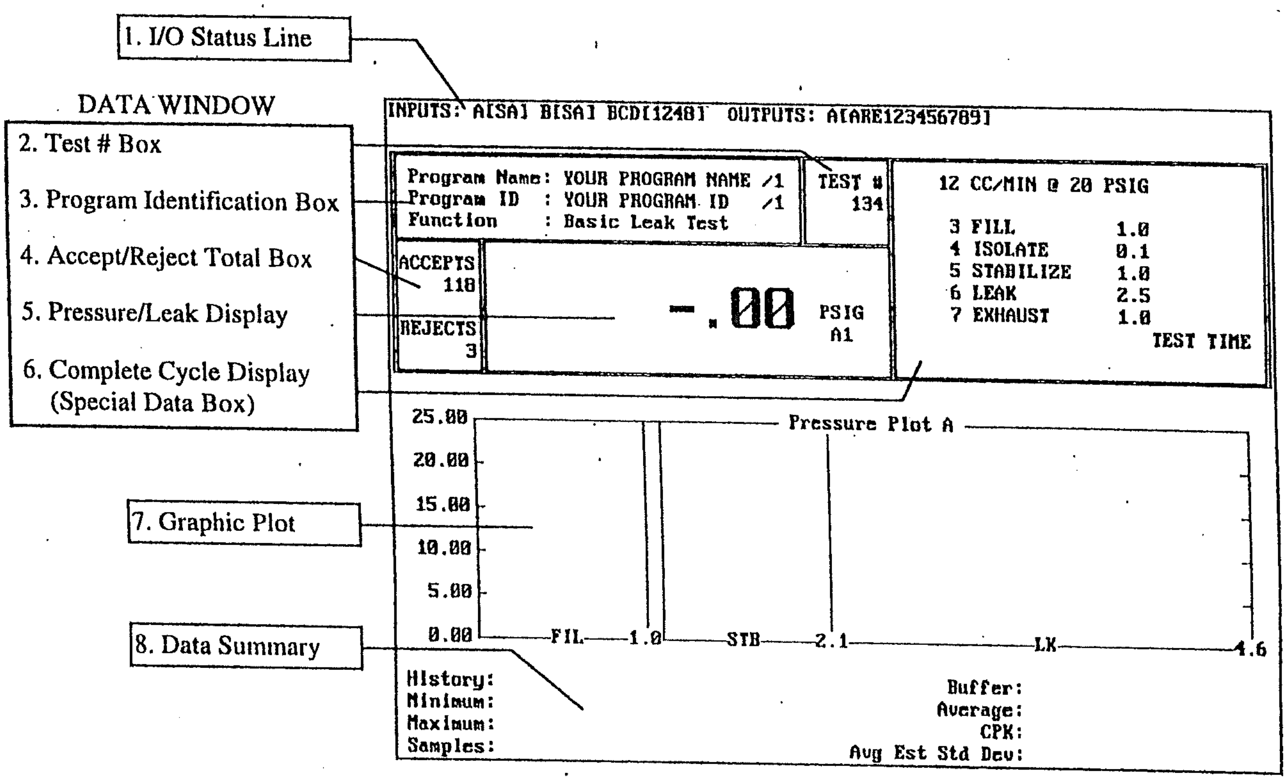
Leak Rate Specifications

There should not be any substantial changes in actual leak rate specifications. There is a need to have better defined maximum allowable air leakage rates on components and sub-components.

Radiator Testing Today (Final Assembly) Traditionally

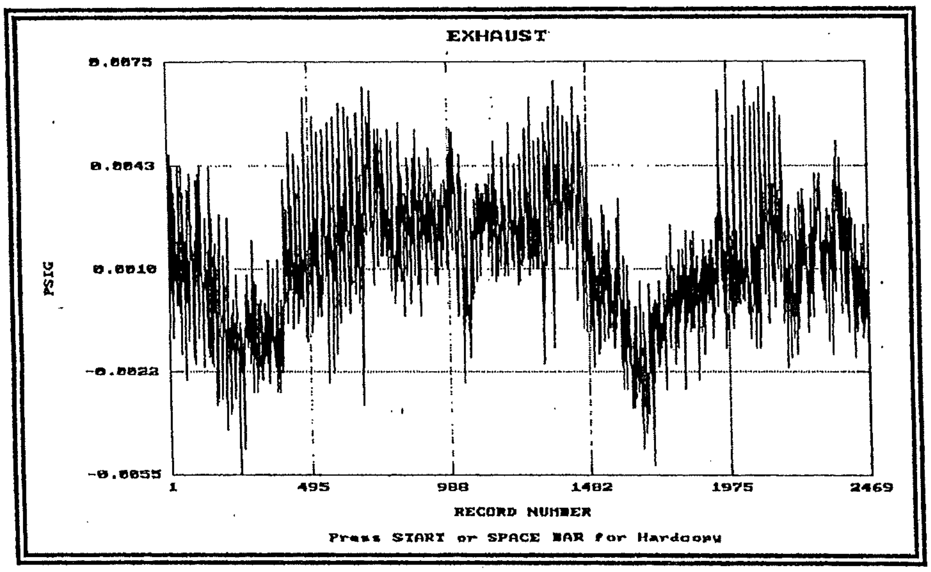
There is a need to eliminate ridiculous and redundant specifications. This is one area where quality control personnel can contribute.

Complete Tester Screen Display

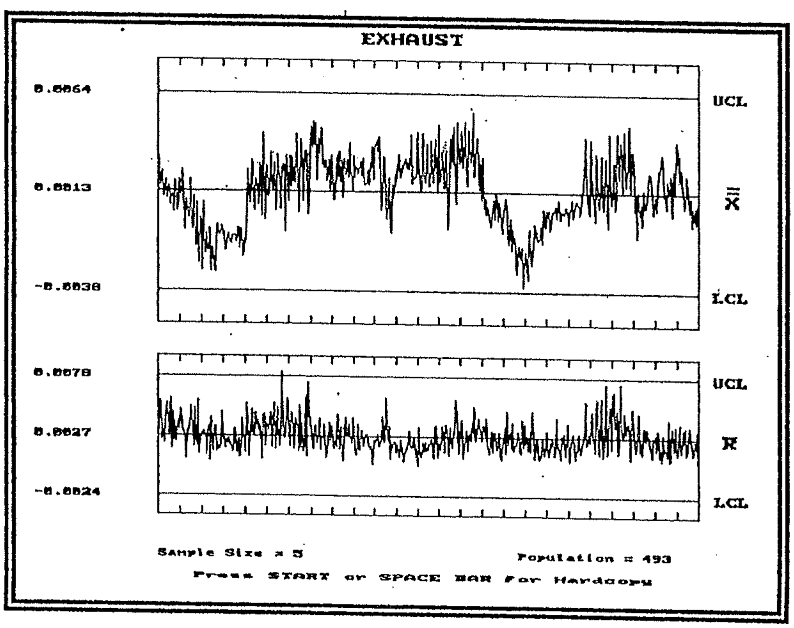


Active Statistics or Off-line

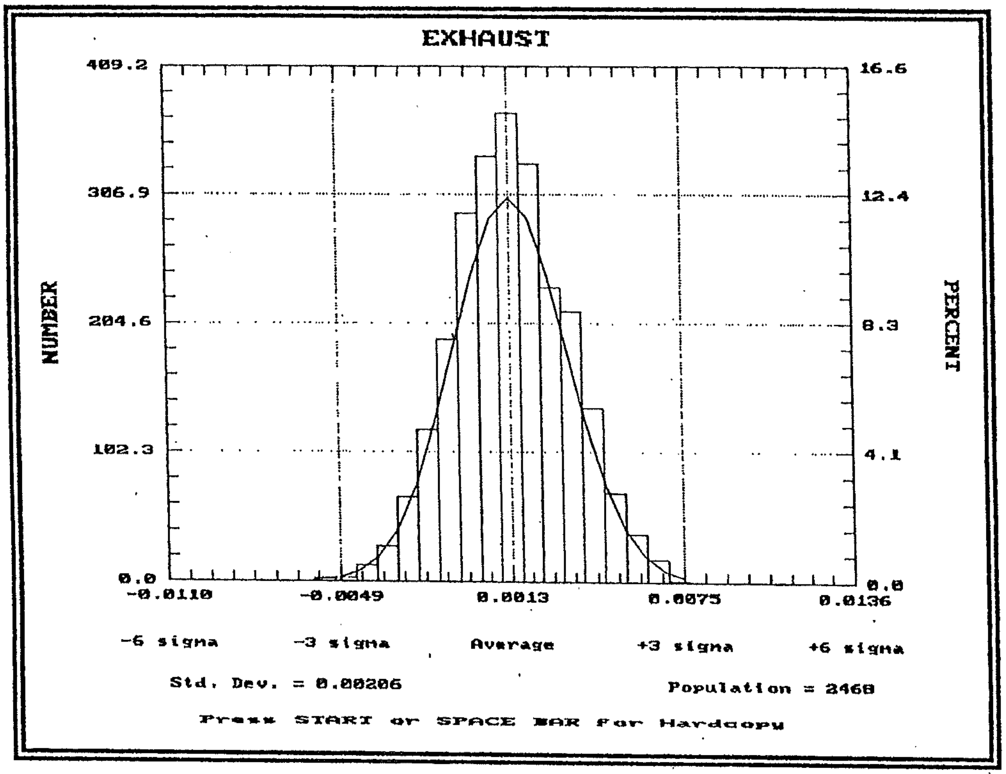
Sample vs. Time Plot



X-Bar & R Chart



Histogram



Alan Campbell
Houston, Texas - May 2000