Learning to Learn

By Jorge Menchu

Developing a solid learning approach can become the most powerful tool in your diagnostic arsenal.

A car you've never worked on before is brought in. The customer complains of a slight intermittent misfire. Tentatively, you open the hood and find yourself staring into a maze of aluminum, wiring and steel. You're immediately overwhelmed, and ask yourself, *Where do I begin? What do I do?*

The challenges techs face today are extreme. More sophistication is constantly being introduced into the systems, technologies and tools we use, making diagnosis even more complex. The idea of repairs done based on go/no-go techniques is quickly fading.

Some technicians have found the secret to success—learning how to learn. Think of it like this: Every time we open a hood we learn something about a problem. Every time we buy new test equipment, or whenever a new system comes out, we try to learn something new. Our ability to find, absorb and use new information is the foundation for our success.

For many, the idea of being able to master all technologies is overwhelming. But by developing a solid approach for learning, we can better our chances for success.

Learning Structure

A good learning structure allows you to deal with a complex subject by putting it into manageable bits. It's similar to the process engineers use: They start with a concept, define the major parts and then complete the details as they go along. It's a step-by-step process. This same technique can be applied to diagnostic endeavors if we follow a few general rules:

Step 1. Develop an overall picture. This provides a goal and helps us understand how things interrelate. Investigate and learn as much as you can about a subject with the intention of developing a good overall understanding of it. Learn to ask yourself questions.

Step 2. Divide the subject matter into functional building blocks. Once you have a general understanding of what you're trying to learn, divide it into logical building blocks. This is a useful way to deal with complex subjects. It also allows us to deal with as little information as needed to achieve our goal. For example, the logical building blocks of a screwdriver are the handle, the shaft and the blade. If we were looking to design the perfect handle, we'd focus on the details of the handle and not the shaft or blade.

Step 3. Learn what to know. There are certain things that are better committed to memory. Things that we should "know" include those that relate to our everyday chores as technicians. These "foundation technologies" don't change readily. Once you learn them, you know them. Your lab scope does not grow new buttons and controls overnight. The principles of physics and electricity are the same today as they were when first discovered. The sooner you tackle these foundation technologies, the more you can focus on the problem you're trying to solve!

Step 4. Learn how much you should know. Many things are too complex to try to commit to memory. For example, the basic strategies of engine control systems are things we should understand. The specifics, however, change model-to-model and year-to-year. It would be crazy to try to master them all.

Step 5. Learn the right thing first. Learning the right thing first leads to an understanding of the next thing. As your understanding develops, you begin to see how one thing relates or builds on another. Understanding the relationship of volts to resistance to current found in Ohm's law, for instance, leads to an understanding of how circuit components shape a waveform.

Information and Info Tools

We are hammered with huge amounts of information—from waveforms, manuals and TSBs, from our scanners, from classes we attend, even from our customers. Throw in the need to learn about the latest electronic or emissions system and we can get pretty bogged down.

There are a number of techniques we can develop to help improve our chances of success in dealing with—using—this information. We have to develop the ability to find, access and organize the information we need.

Following is a list of some of the resources and information tools and techniques we have at our disposal:

Test equipment. Our test equipment allows us to speak the language of the computer system. But if we don't understand this language, the information does us no good! So, to be masters of our tools we need to understand how to use them, when to use them and what they tell us. Our goal as professionals is to be able to do more than just compare results to specifications in a manual. It is to be able to make decisions based on what we find.

Fig. 1 is a good example of the information available in a waveform. The multitrace lab scope allows us to see the relationship of different signals such as the crank position and injector signals shown here. In this example, both signals have an obvious problem. If we understand the relationship (flow of information) between these two signals, we can determine cause and effect. Since we know the crank sensor is the heart of the system, and that almost every output is dependent on the integrity of its signal, we can conclude that the bad injector signal is the effect and the crank sensor signal is the cause.

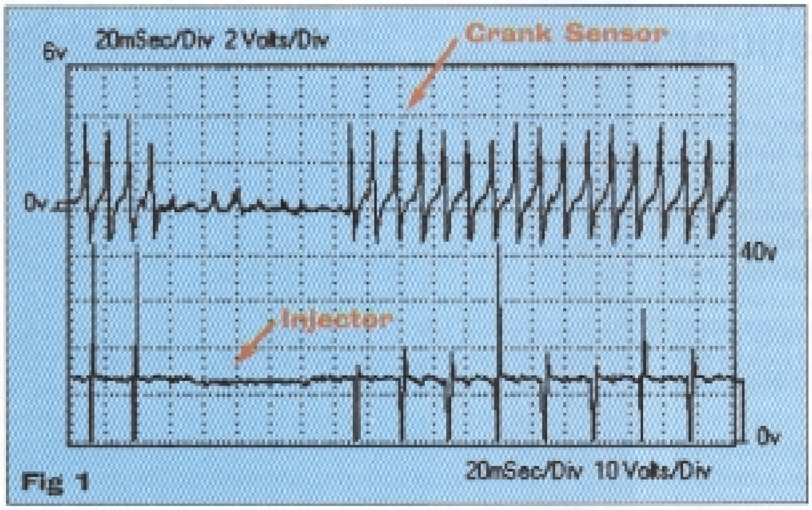

Fig 1

Repair manuals. Most manuals follow the basic structure we just mentioned for learning—they start with a general description of the system, then divide the system into the main components (building blocks).

Many technicians cuss the diagnostic procedures in manuals. But these often hold the clues (albeit sometimes cryptically) to all that's involved in the operation of a circuit or system.

It's important to familiarize yourself with the manuals your shop uses. Taking a little time for this task can save lots of time in the heat of battle!

Wiring diagrams. Wiring diagrams are the roadmaps to the systems that visually tell us what's involved in a system and, to some extent, how one thing relates to another. From them alone we can often determine what test equipment is needed, how it needs to be adjusted and what type of result to expect!

Trade publications. Free to professionals in the field, trade publications are full of tips, techniques and other valuable information. Shop owners and technicians would be foolish not to take advantage of this.

Training classes. We all know the value of training classes. But sometimes it becomes necessary to pick and choose carefully. An ideal strategy is to take notes from a class and store them in a computer database for later review. Classes are also a great place to network with other techs.

Colleagues. Interact and network with other technicians. When experience talks, the smart ones listen!

Computers. The computer allows us to store and easily retrieve massive amounts of data, which makes it the ideal information management tool. As an example, my AES Waveform & Analysis database program allows technicians to capture a waveform, enter diagnostic information and save it for later recall. This so-called information library optimizes and maximizes diagnostic time. The next time a tech comes across a similar problem, he can simply call it up from the database, then read and apply it.

Computers have also given us immediate access to technicians and information. Services such as CompuServe and the Internet have libraries of waveforms and other technical data. But even more important, this technology allows us to carry on conversations with other techs across the country.

Identifying Your Weaknesses

When we begin building our personal training plan, it's important that we have a good idea of how our knowledge and skills stack up so we can recognize our weaknesses. Following are some key ideas to help you identify your weak points:

Analyze your diagnoses. After each diagnosis, analyze what you did and what you could have done better. What did you not understand and what were you weak in? Always try to learn from your mistakes.

Training class miscues. Many of us go to training classes to learn something new. But what about the things we don't understand? Take special "weak-point notes" about the topics that throw you so you can focus on them. And don't forget to ask questions. If you're not getting something out of a class and you ask no questions, it's a waste of time and money.

Increase your vocabulary. Pay close attention to the special words and phrases used in the industry. What was that word in last night's seminar? Get used to using a dictionary.

Discipline and motivation. The best made plan is useless unless we're motivated and have the discipline to execute it. It's your future. You're the one fixing the car. *Get motivated and do it!*

Identifying Patterns

Patterns in technology refers to the way one thing relates to another. For example, to create combustion, we must first introduce air and fuel, compress them, then add a spark.

Earlier I mentioned the value of learning the right thing first and how it leads to an understanding of the next thing. This is a pattern.

Many technicians are faced with the challenge of understanding wave-

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forms. Let's apply some of the learning techniques I mentioned to understanding waveforms in general.

During testing, most of us look at a waveform to determine if a circuit is delivering the proper information. For instance, is the injector on for the right amount of time? Is the engine at the correct temperature? This is information the computer system uses to operate properly.

We know that system information is based on the integrity of a circuit. For example, if a TPS is bad, it will misinform the computer.

System and circuit information is what a waveform offers us. Our next step is to examine how the waveform is created and shaped. Since the lab scope is a voltmeter, a waveform is a charting of voltage changes in a circuit. For there to be a change in a waveform, the voltage, current and/or resistance in the circuit must change.

Sound like Ohm's law? It is. The relationships Ohm's law describes is the foundation for understanding waveforms. This will lead to an understanding of the forces that cause these changes.

Start by examining wiring diagrams and manuals to make a list of components that comprise automotive circuits. Some obvious examples are switches, resistors and coils. Next, use your information tools to find out how these items change and create waveforms. For example, injector coils cause current to "build up" in a circuit, but they can also cause spikes and oscillations.

Information Flow

Now let's examine the flow of information in the automotive electrical system and how it relates to the engine controller. Let's say we're testing an EGR position sensor and it's intermittently bad. If the signal is bad, then the power and ground for that signal could also be bad. If that's the case, then it's possible that the power and ground to the computer are also bad all the way back to the alternator and battery. So we can say that the alternator and battery are the foundation for the automotive electrical system.

When you help someone with a diagnosis, you'll know right away if that person doesn't have a diagnostic plan. These people often don't know where they've been or why—or where they're going. If we divide an automotive system into its functional building blocks based on drivability problems, it greatly simplifies diagnosis.

Fig 2

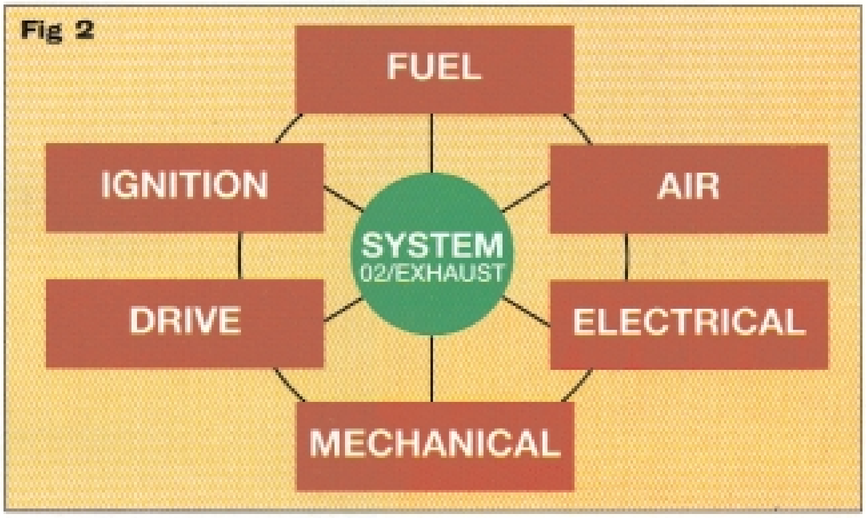

Fig. 2 shows possible causes of a drivability problem. Our goal is to deal with as little information as necessary to determine which block (or blocks) is the source of the problem. Once we identify the source, that block now becomes the main picture and we can divide it into its building blocks.

The best way to deal with blocks is to examine the final output that each represents. For the computer system it's the O_2 sensor and the exhaust, for the fuel system it's the injector, for the ignition system it's the secondary or primary patterns, etc. Often it's wise to monitor the computer system at the O_2 sensor, or exhaust, in conjunction with the others. For example, the injector could have a nice signal but still lack in fuel delivery. The O_2 signal or gas analysis would certainly point that out.

Let's say we've eliminated all of the blocks but ignition and our system signals (O_2 and gas analysis) confirm that we have a problem. Now, the ignition becomes the main concern and we can divide *it* into its building blocks—spark delivery, strength, timing.

The Bottom Line

Every time we diagnose a car we learn something. We might as well maximize our time and perfect our techniques by paying attention to what we do and how we do it. Building your own diagnostic approach is based on knowing yourself, your capabilities, how you deal with things and learning to ask yourself the right questions.

Right now we have a wonderful opportunity in our grasp. The need for us to master technology is increasing every day. Someone has to do it. Will it be you? Catch a wave!