**MAC'S SERVICE SHOP**

# Philosophy of a Kit Manufacturer

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WHEN Barney entered the service department, still shivering a bit from the bleak, cold November morning, he found Mac, his employer, thumbing through the pages of a catalog.

"Hey, you've got a new Heathkit catalog!" the youth exclaimed. "How come I don't have mine?"

"Rank has its privileges," Mac replied with a teasing grin. "This came sort of special delivery when Gene, my old friend with the Heath Company, dropped in for a short visit last evening and left it."

"I suppose you two went at it hammer and tongs as usual," Barney said. "I can just hear you nit-picking the assembly instructions for the last kit you put together that didn't work perfectly the first time you turned it on, and I can hear Gene countering with scornful remarks about crusty old service technicians who never really learned how to make a decent solder joint and who stubbornly refuse to follow clear step-by-step instruction in the manual."

"You must have been listening," Mac chuckled reminiscently. "But then we settled down and Gene gave me a lot of information on the painstaking steps that are taken to see to it that a Heathkit is as error-free and fool-proof—both in design and in the instruction manual—as possible before it is put on the market. I think you, or anyone else who ever put a kit together, will find this interesting."

"I'm all ears," Barney invited, settling himself comfortably on the end of the service bench.

"Okay; after an engineering design has been frozen—I hate that barbarism 'finalized'—it is turned over to the Manual Department for publications treatment. The Manual Department gets six sets of parts and an operating prototype of the kit. Using these, the author of the manual evolves a general building procedure and step-by-step sequence. He strives to simplify wiring, to avoid redundancy of parts, to arrange complex wiring in proper layers, and to avoid more than four soldered connections to a single point. This last, of course, is to avoid rosin joints or the possibility bottom wires will stack up unsoldered because heat from the iron does not reach them. Working in collaboration with the design engineer, the author actually builds the kit, making careful handwritten notes of every procedure. After a preliminary check this written material is turned over to a typist for initial typing.

**Pre-proofing and Proof-Building.** "Next comes the pre-proof cycle. The design engineer and the author build the kit from the author's notes. This brings to light many obvious errors and spotlights a need for improvement in the sequence of several steps. After these corrections and modifications have been included in the written instructions, the kit is ready for the proof-building stage.

"The instructions are reproduced on a Xerox machine, and a proof-build program is scheduled involving 18 to 20 people, depending on the complexity of the kit. These proof-builders represent a cross-section of capable engineering people, marketing people, customer services people, production and office personnel, and always one or two novices. A novice is defined as someone who has never assembled a kit product before. By necessity these are always Heath employees, and they are issued kits on a Friday afternoon to take home and assemble from the Xerox-prepared instruc-

under the basic Model EC price of $34.95.

The theory behind the Serviset is simple. No matter how complex the apparatus under test, it can be broken down into discrete stages with each performing its own unique function. Each stage can also be broken down into various combinations of capacitors, resistors, inductors, and tube or transistor. If you work on the premise that there is an a-f or r-f input, then this signal can be traced from the input to the output. When you get to the stage that does not operate, the Model EC can be used as a substitute for the various components or be used to bypass this stage, thus helping to further isolate and localize the trouble.

As mentioned earlier, the Model EC uses only one test lead to perform its many functions. Using the instrument is as simple as inserting the test lead prod into one of the 13 receptacles in the upper end of the probe. Each receptacle is clearly identified according to function. The neon lamp high-voltage indicator is visible through a small hole in the probe shell; the low-resistance indicator lamp is readily visible through its hole at the upper end of the probe.

**Servicing a Radio.** We used the Serviset to check out an inoperative broadcast-band receiver. It was easy to follow the r-f signal from the antenna through the converter and to locate the problem in the i-f stage. Once the trouble was localized, plate voltage checks showed that all appeared to be okay in this area. However, going to the screen grid, we noted that there was no voltage. Further checks, using the Model EC as a substitute resistor, revealed that a resistor was open. Once the receiver was repaired, we again used the instrument as an audio and r-f signal tracer to check it out; the receiver worked fine. And we discovered, by using the Serviset as an electrolytic capacitor substitute, that the small amount of audible hum could be reduced to nil by beefing up the filtering.

Generally, we found that the Model EC Serviset is a handy troubleshooting tool to have around. It can be used in place of much more expensive and specialized equipment when first checking out a set to get a rough idea of why it does not work. On the other hand, the Serviset does not and cannot take the place of a VTVM or an oscilloscope when accuracy is required.

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tions. If the kit is fairly complex, they may be allowed two weekends with the due date on a Monday morning; but quite often the proof-builds are due back on the Monday following the Friday they were issued.

"As these people assemble their kits, they keep track of their time and are encouraged to write their comments directly in the 'manual' at the appropriate place where difficulty was encountered or an error detected. If the kit does not perform correctly when completed, the proof-builder is encouraged to try to locate and correct the trouble himself if he can; but working or not, the proof-builds must be turned over to an evaluation engineering group on the due date. This group is entirely separate from the engineering design group, and their function is to see how well the completed kits perform—if they perform at all—and to determine what is wrong if they will not work. Is the failure due to a defective component? To incorrect assembly or wiring? To a manual error?

"Finally the proof-builders meet with the engineering evaluation group, and individual experiences and suggestions are gone over in great detail to determine what changes, if any, are needed. Sometimes a different value of component is recommended, or a supplier is required to tighten up his quality control, or holes in the chassis must be changed, or instructions need to be clarified. Out of all this information comes the data that formulates the final pack, parts count, and final manual. Occasionally, however, when the proof-build corrections and changes are excessive, the company may elect to hold a 'post-proof-build.' This is a second proofing stage beyond the proof-build to verify that all the changes and corrections have been caught in the final printing. This post-proof build usually involves only one or two builds."

"Man, they ought to have all the bugs out by that time!" Barney exclaimed.

"They still don't take that for granted. As a final check, the tenth pack of the first production run for the product is pulled off the line by quality control and built again to make sure nothing has happened during the interim between engineering sign-off and the initial production run. And the first production run is not shipped until completion and verification of the production proof by quality control. Formal reports are required at each stage."

"Well, that explains why I am so often frustrated when I'm building a kit and think I've finally caught them leaving out an essential part or shorting me on hardware or making a goof in the manual. Invariably the missing item shows up tucked away in some obscure corner of the carton or in one of the sacks I've discarded as empty; and the glaring mistake in the manual turns out to be a mistake in my careless reading of it."

"Know what you mean," Mac nodded. "It's sort of like the bitter-sweet feeling you have when your checkbook won't agree with the bank statement and you're practically *sure* the bank has finally made an error; but then, on the tenth review, you discover a subtraction error in your checkbook."

"I'll bet you gave Gene a lot of Why Dontcha's," Barney hazarded.

**Kit Philosophy of the Company.** "Naturally," Mac said with a grin. "But he knocked them down as fast as I tossed them up. Out of my suggestions and his patient explanations of why the ideas were not practical, I think I acquired some insight into the 'kit philosophy' of the company. I believe the same philosophy applies to any other kit instrument manufacturer who puts out quality products.

"First is the idea nothing should be done for the builder that he can do well for himself. Doing so increases the cost of the kit and deprives the builder of much of the pride he has in the finished product. If wires are cut to length, sub-assemblies are all put together, and instructions are obiously written for a seven-year-old, the labor involved in doing all this will add very materially to the cost of the kit, since labor is a major item in the cost of any product these days. At the same time, the builder will be made to feel the manufacturer is holding his wrists at every step of the assembly, and this will subtract materially from any feeling of personal accomplishment. Money saved by allowing the builder to furnish as much labor as possible and by assuming he is an intelligent human being can be spent to improve the quality of the kit instrument while still keeping its price below that of an inferior assembled unit."

"Makes sense," Barney agreed. "Sometimes I gripe and growl when I encounter a tedious procedure in a kit assembly (pre-

paring lengths of coaxial cable, for instance) but I get the job done; and I certainly would not want to pay some high-priced worker to do it for me. After all, the average kit builder is very likely a special breed who really enjoys putting kits together. He doesn't buy a kit instrument just because it costs less than a comparable assembled unit. He savors every moment of the assembly from the time he opens the carton, sniffs that indescribable aroma of new insulation and lacquer, and catches his first peek at the exciting colors and shapes of still-unrecognized items, until he proudly peels the backing from the little blue model label and presses it against the chassis. He has watched something grow entirely under his own hands from a jumbled mess of parts to an attractive, reliable device."

"Spoken like a real *afficionado!*" Mac said. "But whether or not a person assembles or uses kit instruments, I strongly feel he and the entire electronic industry owe a debt to kit manufacturers. They have made it possible for many service technicians, experimenters, and radio amateurs to purchase and become familiar with equipment they could not otherwise afford. Many a small shop opens for business with a service bench full of Heathkit or other manufacturers' kit-type instruments. Then as the business prospers and the technician's time becomes more valuable, he tends to purchase assembled replacement instruments. I'll bet if you could get the figures, you'd find kit instrument manufacturers really have helped the sale of all instrument manufacturers."

"Yeah," Barney agreed. "Many a person enters the electronics field by the act of putting together a simple kit. Once he learns he can wire a bunch of parts together and make an instrument that really works, he is hooked for life. 'Who says electronics is black magic?' he asks himself as he signs up for a correspondence course in electronics or heads for an engineering course in college."

"Speaking of education," Mac concluded, "I've always admired the kit manufacturers' efforts in this area. They try to tell the builder not only *how* to assemble the instrument but also *why* it works as it does. Every manual has a 'Circuit Description' section. Heath's color-TV receiver manuals include what is actually an excellent short course in color-TV theory and practice. I consider this most commendable." ◈