How to Build
Championship Scale Vehicles

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Construction Considerations for Building Championship-Caliber Models

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Robert A. Wick

Championship Publishing, LLC

How to Build Championship Scale Vehicles

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This book is also available as a free downloadable PDF from the Museum's Web site at www.themodelcarmuseum.org/howto2.pdf

Please visit the Web page for the International Model Car Builders' Museum at www.TheModelCar Museum.org. At the Museum's site, you will find the latest information about the Museum's efforts to collect and preserve the history of our hobby, and to promote the future of the scale vehicle hobby. The Museum's Web page presents a lot of photographs, research databases and other useful information for model car hobbyists. E-mail messages to the Museum may be sent from the site.

You are also invited to the Web site for the GSL International Scale Vehicle Championship and Convention at www.GSLChampionship.org. This site contains the latest information and developments about the GSL Championship.

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Preface

Rather than offer just another "how-to" publication showing entry-level techniques for removing parting lines and avoiding the overuse of adhesives, the authors believe that it is time to take a fresh look at the process of conceptualizing, planning and building scale vehicles aimed at competing in championship-level contests. They want to suggest new ways to *think* about how to build championship models, and how to organize the creative spaces necessary for the design, fabrication and construction of high-quality scale vehicle miniatures. There are also chapters that describe specific model-building techniques to help builders develop necessary skills and knowledge, and on how contests are judged.

This book is the successor to two earlier editions of similarly-titled books (first published in 2000), but which were significantly smaller in scope and detail. The authors hope this updated and expanded edition will aid committed builders of scale vehicle miniatures in developing a new perspective and in learning to think carefully, and anew, about how to build the elements of their projects, and how to bring those projects to a successful conclusion.

To illustrate many of the topics and issues raised in the text, this book is filled with photographs of modeling projects originating in Mark S. Gustavson's shop. The machined parts featured herein have been created by Cody Grayland, and the artwork for the photoetched parts has been drawn by Bob Wick and produced by Fred Hultberg (Fotocut).

We hope the information in this edition is helpful, thought-provoking, and valuable in building championship-caliber scale vehicles for competition.

Acknowledgments

We express our great appreciation to Paul Anagnostopoulos, who composed this book and prepared it for publication. Many thanks to Jeremiah Gladstone who did the hard work of processing the many dozens of images for this book, including the project planning and management forms. Our thanks also to Bill Helm, who read the text and offered valuable commentary. We are grateful to Klaus Raddatz for his excellent article on paint booth design, and we also appreciate the courtesy extended by Kalmbach Publishing (Jim Haught, Editor, *Scale Auto*) for permitting us to reprint an article by author Gustavson. Finally, we also express our appreciation to Janet Gustavson who did most of the keyboarding on the text and served as linguistic guide (and scold) when we waxed obscure.

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April 2009

Introduction

Most modelers in our hobby at least occasionally think seriously about building a sophisticated, accurate, and credible scale model vehicle for display or competition. These thoughts are not of yet another "typical" model built to their current levels of skills and abilities, but are of a scale miniature that has that "winning edge" by pushing concept, details, craftsmanship and execution to new levels for the builder, and perhaps for the hobby.

When faced with the challenges of creating such a model, the builder should consider four very important aspects of the project that must be satisfied:

- The overall concept and scope of the model;
- How complex, detailed, and accurate the scale miniature will be;
- How to research, design, create and assemble the many components the finished model will be comprised of; and
- How to integrate all the elements into a complete, accurate and convincing scale vehicle.

Good scale automotive modeling is much more than carefully assembling the "right" parts and simply assuming that a realistic and satisfying model will be the natural result. Rather, successfully building a great scale automotive miniature is the amalgam of conceptualizing the project; defining and understanding the project scope and goals; systematically planning and organizing your work; gathering the research, parts, and tools needed; and adding the skills, fabrication and assembly techniques, craftsmanship, and artistry to bring that initial concept to life as a convincing, accurate, intriguing and exciting scale vehicle.

As judges at the GSL International Scale Vehicle Championship and Convention (GSL), we are often asked what we look for in the entries, how the judging is done, and what gives a certain model that extra element that places it above all its competition. These questions are typically a result of puzzlement as to why models that would appear to be top contenders don't place as high as expected, or don't even make the final cut for a Class or other award. As judges, we see details that others don't because of our close examination to each model during judging. We see less obvious problems, such as a lack of basic craftsmanship, inaccurate mechanical details, implausible ergonomics, and/or flawed or unrealistic paint and finish quality. We also look at a number of less tangible aspects, such as how well the builder integrated the many elements of the model, and for thematic consistency in the entry.

In discussing the philosophy and criteria used during judging among ourselves and with competitors at GSL, it has become apparent to us that a thoughtful and thorough discussion of how to approach model building from concept to completion for serious competition would benefit many modelers. We hope this publication does that, by discussing how to select the subject for a project and establish goals; how to research the subject matter; how to break the project into the necessary steps to accomplish the goal of creating an "ultimate" miniature; and how to develop the self-critical skills and attitudes to evaluate your project.

The ideas contained in this book come from our experiences in building and judging, and from talking with successful modelers about how they build winning scale vehicle miniatures. The steps outlined here are not the only ways to approach a project, and each builder will want to modify the suggestions discussed here to fit their styles and objectives, or will use some other approach they find works well for them. The steps and considerations presented here are intended to assist modelers in thinking about how to look at, evaluate and approach a project, the resources needed, how to plan the build, and then building the model and documenting the project for a successful presentation.

Because we want to create information that is as useful as possible, we welcome your comments, suggestions and/or questions, both on the content of this book, and in ways you think we can better present the information. Future editions will incorporate those ideas to make them more useful and helpful to more builders.

PART ONE

Thinking About Championship Modeling

CHAPTER 1

Conceptualizing the Competitive Model and Deciding What to Build

Every modeling project starts with an idea. It may be sparked by a newly-released kit, or inspired by a model seen in a magazine or at an event. It may be in response to a build "theme" for a contest, or a desire to replicate a favorite 1:1 vehicle. Or your new project may be stimulated by an interest in a particular event, point in time, or a specific kind or style of car.

Once the topic is selected, the next decision is: To what level of detail and accuracy will it be built? Will it be a "shelf model," just a fun build, or a serious build for serious competition?

This book is written for builders interested in the last category of build (although the information can be of value to any level of build), and we'll start out with two approaches to deciding what to build as a serious contender for serious competition. We will assume that the top contenders will all display similar craftsmanship, finishes, attention to detail, and documentation.

1.1 Selecting the Subject

The first approach is picking a personal favorite vehicle or style of 1:1 vehicle to build, then deciding how to build it in miniature. By selecting a subject of personal interest, you'll be working on a project you're enthusiastic about, and that goes a long way toward motivating the successful completion of the model. Moreover, familiarity with a subject can save a lot of time and research. It can also offer the opportunity to refine and perfect skills and techniques already learned and used on similar models in the past.

The second approach is to think about what design, mechanical, and technical details and features, what working parts, and what finishes will be needed for a Class, and Best-of-Show, win. Picking a subject that gives you the maximum opportunities to incorporate those elements, and to display your building skills, can be a smart way to create a competitive model.

In considering these two approaches, the question is this: Do you decide what to build from the perspective of "What is the best model I can build of my favorite style of vehicle to display my skills and expertise," or do you consider the decision from the perspective of "What subject offers the greatest opportunities to build a model that best displays my skills and expertise"?

If you take the first approach of building one of your favorite subjects, your evaluation of what to build might proceed along these lines, because carefully selecting your subject can permit you to use and display your abilities to the greatest effect.

- Let's look at hot rods as the first example. On one hand, a fenderless T-bucket offers the opportunity to exhibit detailing and working features, since relatively little mechanical detail is concealed. On the other hand, a 1940 Ford sedan delivery offers a canvas to display body, paint, graphics and interior detailing skills, but with somewhat fewer obvious mechanical details in immediate evidence.
- Or, let's say your favorite subject is NASCAR, and you've always wanted to build an ultra-detailed replica of Richard Petty's 1964 Plymouth. You might already possess many of the research materials you'll need, as well as having the vision and enthusiasm in place. But you'll need to consider one aspect carefully: Can the model contain enough detailing opportunities and complexity to compete against models of more recent NASCAR race cars displaying more equipment, more complexity, and more opportunity for detail? If so, then build it. If, however, you think that a later model vehicle would make a more competitive entry, then think carefully about your initial decision.

If you take the second approach, you'll likely look for subjects, regardless of Class, that offer you the most possibilities to show your skills and creativity. Let's say you've narrowed your choices down to three subjects that will be substantially scratch-built and ultra-detailed: a birdcage Maserati, a contemporary fire truck, or a diorama.

- Each subject has it advantages in showing your building skills and knowledge. The Maserati offers the challenge to replicate the frame, suspension, running gear, hand-crafted metal body panels, hand-laced wire wheels, and the opportunity to document the faithfulness of your replica. The fire truck presents a whole range of operating features and details: pumps, ladders, hoses, lighting, audio, and gear loaded into compartments in the body. The diorama offers a venue for the creative telling of a story and myriad opportunities for detailing, visual tricks and humor, and subtle nuance.

Which of these two approaches is best for you? The answer depends on your interests, the challenges you are looking for, and what talents, skills, and creative aspects of modeling you wish to showcase. By evaluating and comparing the opportunities inherent in each of several possibilities, and by analyzing which could be built as the outstanding entry in the competition, you can take full advantage of opportunities the subject matter presents.

1.2 Defining the Goals and Scope of the Project

To successfully build a persuasive miniature of the subject you've selected, you need to thoroughly analyze and understand what you want to build, and the elements the finished model must contain and feature to show and tell the judges or viewers what you've accomplished.

To meet those objectives effectively, you need to define and establish construction and detailing GOALS and how to reach them. By defining the goals for the model you are building, you can break down what you want to accomplish into specific steps that you can successfully complete as you work toward those goals. Once you decide what the goals are, write them down so you can refer to that list as your project progresses. (The goals will

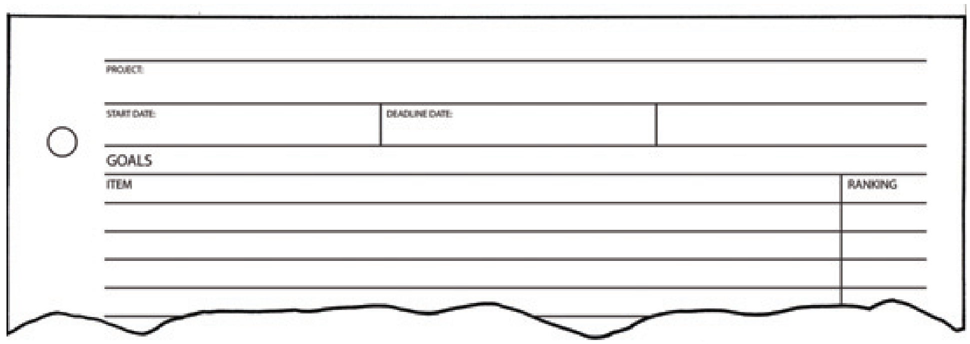

PROJECT:
START DATE: DEADLINE DATE:
GOALS
ITEM RANKING

Figure 1.1: This GOALS form, along with forms for PRIORITIES, RESEARCH, SCHEDULE, BUDGET, WORKING PARTS, FEATURES & DETAILS, and SKILLS DEVELOPMENT, can be downloaded from the version of this book available on CD. Examples of how each form can be filled out appear in the following chapters.

probably change, evolve, be modified, or expand during the building process, and that's fine. Just be sure to change your written list to reflect these new priorities.)

In all likelihood, you'll end up with both primary and secondary goals. The primary goal may be to create a faithful representation of a famous 1:1 vehicle; to present your own styling or engineering ideas to others; to create and tell a story with a diorama; or to beat another competitor. Secondary goals might include creating specific working details or features to best enhance your chosen subject matter; to showcase your expertise with specific materials or techniques; to improve and display the quality and authenticity of your painting and finishes; or to develop and demonstrate building skills. If you do establish primary and secondary goals, either write "P" of "S" next to each item, or use a separate GOALS form for each list. Either way will help you keep your goals prioritized.

1.3 Consistency and Theme

Once you've selected your subject and established your goals, you should consider the "theme" of the model. At the same time, you'll also have to think about how to maintain consistency within the model by integrating all of the elements that define what the model is about, along with historically-based or historically-accurate details (or plausible details for a non-historically-based model). Begin by thinking about, and visualizing, what features and details your model must contain to attract the attention of the judge or viewer, to involve them as they look at your miniature, and to convince them of the scale realism of your build.

If your model is a "period piece," do all the components accurately reflect what was done or available at the time? For instance, an accurate replica of the Jade Idol or a factory-stock 1960 Ford Starliner wouldn't have radial tires. Does the body style, chassis, and speed equipment on that mid-Fifties "digger"-style dragster accurately reflect what was available and used at that time? Do the finishes, sponsor decals and class designation represent the drag racing machines and rules of that era?

If you are creating a fictional "factory dream car" or styling study, does it make sense in the context of the way a manufacturer would have approached the project for the time period depicted? Why would your fictional concept car be built? To show what the future

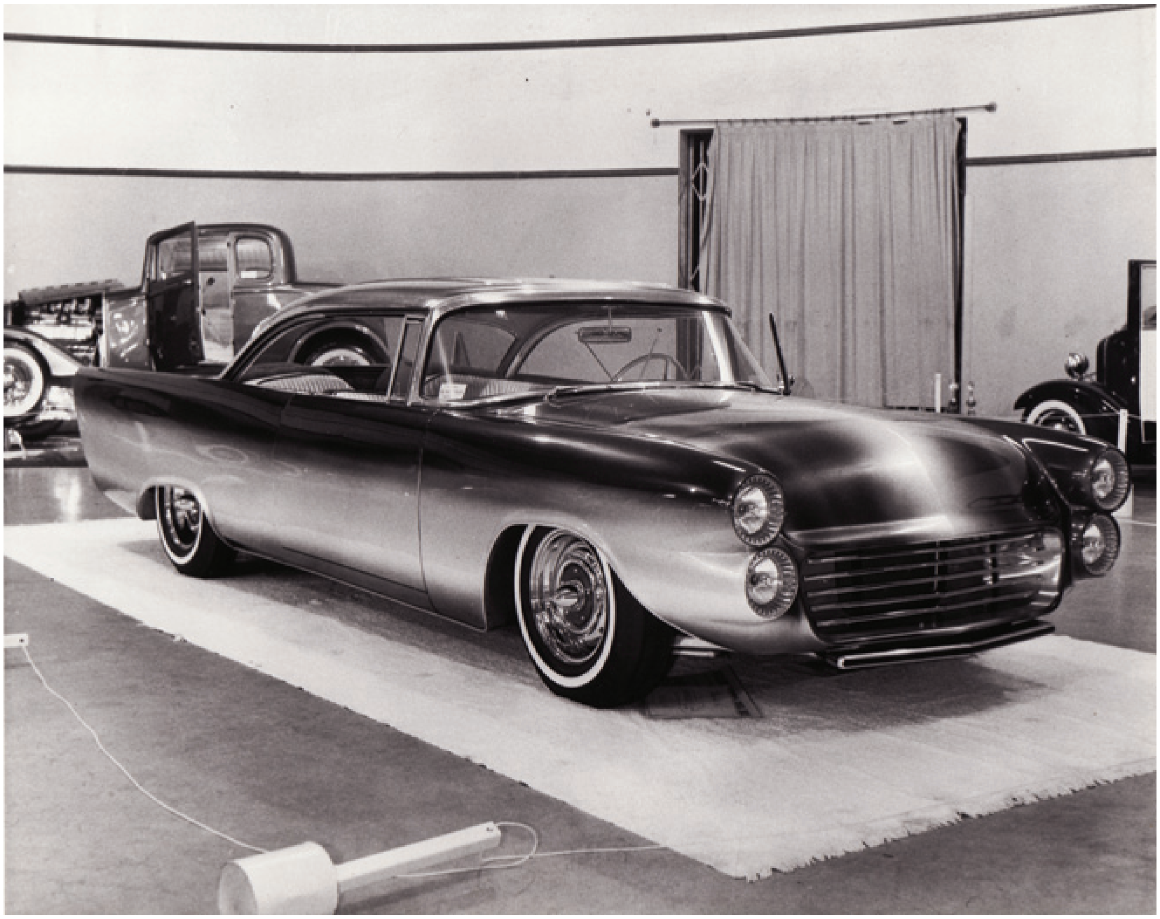


Figure 1.2: Cushenbery's famed Jade Idol is rooted in a particular point in time. A replica of this model would pay close attention to the many "period" details on this car. (Mark S. Gustavson photo archives)

holds, or speculate on how then-existing design elements could have been explored for later production vehicles? If so, what forward-thinking ideas would have been included in your concept car? If your model is a styling study of what a particular car could look like two years from the date its baseline vehicle was created, are the design and mechanical evolutions clearly evident, logical, and realistic?

A scale miniature of a piece of construction equipment, such as a backhoe, would need all the hydraulic lines present and correctly plumbed. Are the correct number of levers, switches and gauges in the cab? How would the equipment be used, and where would you see wear that reflects that use? What paint colors was the manufacturer using for that equipment at that time? If you're working from a kit, does it include the correct engine or optional equipment? If not, what do you need to know and do to correct these flaws? (Remember to document your research so you can show the judges and public what you did to correct the kit flaws.)

To begin thinking about all these aspects of your build, you'll need to be familiar with the vehicle's "history" and use. If the model will be a replica of a 1:1 vehicle, there will be an actual history to research and learn about. If the model will be based on an idea you

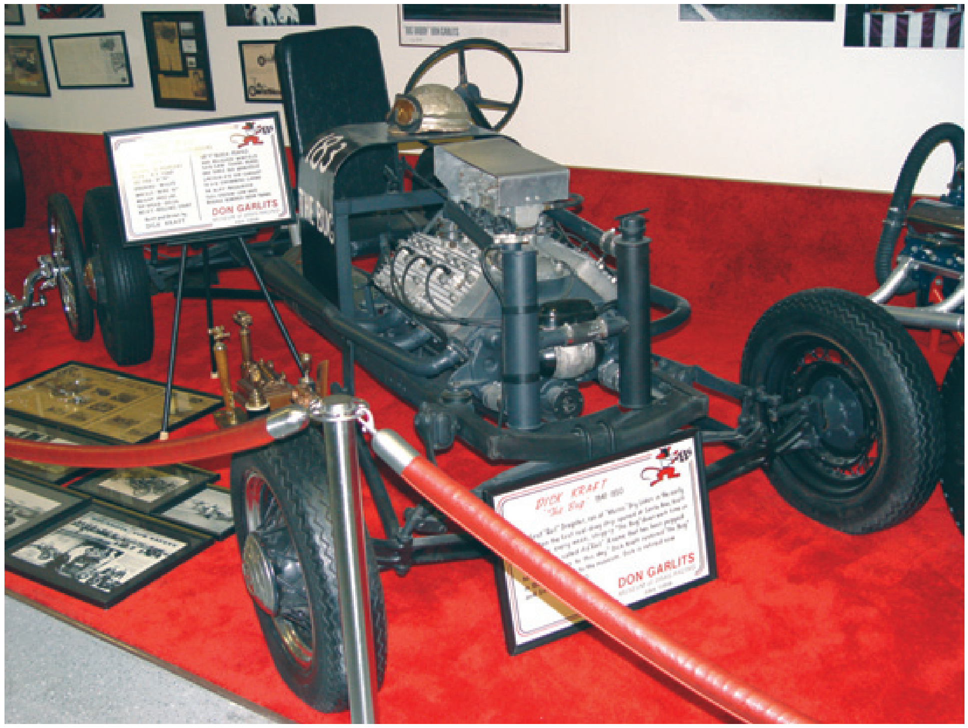


Figure 1.3: The famed "Bug"—the first-ever rail dragster—is a wealth of Forties' drag racing details. (Photo courtesy of Carl Molesworth).

have, you'll need to create a faux history—a "backstory"—that is a complete description of the model you'll be building, and how it came to be.

You should begin thinking about all these aspects before you start the actual build, so you can be very clear about what needs to be done in researching and defining the finished model, and what construction steps will be required to meet the goals and scope you've set for the project.

Assembling a complete "picture" of the model before you begin your build, whether it is a replica or a "fictional" vehicle, will help put you "in the moment" so you can have a better understanding of what you'll need to do to create and present a cohesive and convincing miniature. (It's also fun to research or create all that background information.) We'll cover this in more detail in Chapter 3.

CHAPTER 2

Contest Judging

This chapter includes three approaches used to judge contests. While there are additional formats and criteria used in some events, these will give you an idea of how different judging approaches can affect your model's chances in competition. It's a good idea to investigate how judging is conducted for the contest in which you'll be competing, as this will help you understand the criteria for evaluating your entry. We're not suggesting that you forego certain details or modeling standards, but it is to say that knowing the judging procedures and standards will allow you to place into competition an entry that meets or exceeds the criteria for a particular event.

The first approach we'll cover here is that employed by the judges at the GSL International Scale Vehicle Championship and Convention. After that, we'll take a look at the process for a more "typical" points-based judging system, and end with the new concept of a contest judged by the entrants.

2.1 GSL International Scale Vehicle Championship and Convention

The GSL Championship has a three-judge panel that, as a group, views and evaluates each entry in every Class. GSL judges are expressly prohibited from competing in any juried Class, and must consciously set aside personal preferences and preconceptions about every entry. The judging is conducted on Saturday night and into early Sunday morning, after the Contest Hall is closed to the public. This ensures privacy and the unrestricted ability of the judges to exchange their views openly and candidly. In this setting, each judge discusses and debates their individual perspectives about the relative strengths and weaknesses of each entry with the other judges. Additionally, a non-judging professional auto mechanic is on hand to answer technical questions that might arise about how realistic, authentic and practical specific mechanical details are on each model.

An overview of the GSL judging process for each model is described below. Please note that the following is presented only as a general description of how GSL judges proceed.

Initial Determination, Basic Craftsmanship. Entries in each Class are first evaluated by the judges for basic craftsmanship, with the top models identified for further judging. This initial evaluation can mean that sometimes well-detailed models are rejected from further consideration because of poor craftsmanship or poor basic assembly techniques. The GSL judging philosophy places a premium on basic model-building competence and craftsmanship, upon which sophisticated details can be added. Each model is examined critically for the neatness of the build, for how the parts are assembled, and with what level of fit and finish. Removal or repair of all manufacturing evidences or flaws, including molding and parting lines, sink marks, ejection pin marks and copyright notices are expected. Evidence of adhesive residue, complete and appropriate finishes on all visible surfaces, clean and accurate assembly, and how the model "sits" are all considered. In essence, have fundamental craftsmanship issues been addressed by the builder before more aggressive steps were undertaken?

Detailing. The next item to be evaluated is how mechanical and other details are handled. Is the detailing convincing, authentic, and realistic, given the definition of the Class in which the model is entered? Said another way, a high-gloss custom paint finish isn't appropriate for a factory-stock Fifties Ford, any more than chrome reverse rims are appropriate on a factory-stock Model A. What about ergonomics—can someone sit on the front seat and operate the controls, and is there enough headroom if the model was scaled up to 1:1? Is there enough room for all the parts to work? For instance, can the front wheels rotate, turn, and clear the fenders, inner panels, and suspension components? Are the chassis, body, interior, drivetrain, and suspension all persuasively presented? The judges also check to see if the mechanical, hydraulic and electrical lines, brackets, hoses, fittings and clamps are used realistically and consistently within accepted 1:1 mechanical standards. The judges also look for subtle detailing like "blueing" on chrome headers, and signs of weathering, wear or use where appropriate, and realistic details such as open grills and louvers. Are "glass surfaces" clean and polished where appropriate? Are factory overspray, assembly and code markings, and similar details present where appropriate to the Class? If relevant, are the parts used consistent with the time frame, era or theme that the model represents?

Scale Accuracy and Consistency. Are the sizes and scale of parts, major components, wiring and other elements in scale to the overall model? Are panel thicknesses realistic? Does everything "look right" on the model?

Working Features. Any functional elements are evaluated for proper, realistic and accurate operation. For example, do the doors open inward or outward on the hinges from the fenders or cowl, as they do on a full-size vehicle? Has the builder successfully created particularly difficult or unusual working features?

Fit and Finish. Do all body, chassis and other major components fit together properly? Do panels line up evenly with adjacent panels? Are there appropriate panel line gaps, whether or not those panels operate? Do bumpers, grilles, lights, trim and other details fit the bodywork as appropriate or do they sag, or fit unevenly side-to-side? Does the "glass" fit the opening authentically? Is it clean and polished, or realistically dirty if appropriate?

Are the finishes in scale or are the metallic particles too large for a factory finish and look like custom metalflake paint? Are the colors and levels of gloss appropriate and/or accurate? (A vintage factory paint job would be not clear coated.) Do metal finishes persuade the viewer that they represent the kind of materials portrayed? If appropriate to the model, are weathering, wear, and "patina" realistically represented, or is such evidence of use overdone? Are subtle details (like cowl vents and gas door reveals) clear and visible, or obscured with heavy coats of paint? Is the paint too thick or thin? Does the painted surface reveal consistently-applied paint (e.g., the absence of "tiger stripes," light and dark metallic splotches, or paint rubbed through to reveal the primer)? Is the paint heavily "orange-peeled," or does it show scratches or other imperfections? If two-toned, are paint separation lines sharp, and show no presence of bleed-through? If used, are decals appropriate and well applied (without silvering)?

Documentation. If required by the rules of that Class, is the documentation present and sufficient to inform the judges of the authenticity of the details portrayed on the entry? Regardless of whether the Class rules require documentation, is any research clearly presented, well-organized and easily accessible to the judges? If there are "in process" photos of the build, do these images and accompanying text adequately inform the judges of what the builder intended to accomplish, and reveal the steps taken to build his/her model? A portfolio assembled by the builder is of great value to that entrant because these materials will assist the judges when they are faced with a tough decision between two models. Such a documented narrative can also make the judges aware of the details and work undertaken on an entry that might not always be clear from simply viewing the model.

Additional Judging Considerations. The Best of Show Master Award is selected only from the Best of Class winners. When evaluating models for the other Master Awards, the GSL judges evaluate all models entered in the GSL Championship. In making the selections for the balance of the Master Awards, the judges evaluate only that relevant aspect of each entry (e.g., the finishes for Best Paint), and ignore all other aspects of the model. This is why a model that didn't win fourth through Best in Class might, for instance, win the Dave Shuklis Award for most/best working features. Finally, the GSL Popular Choice award is selected only by ballot distributed to both competitors and registered attendees at the event.

The GSL judging standard depends upon knowledgeable and thoughtful judges who enjoy the confidence and support of those entering the event. Similarly, the judges have a serious and solemn responsibility to completely disregard any personal preference or bias for styles of vehicle, favorite Classes, and the "gotcha factor" a model may exhibit. Rather, GSL Judges work to discipline themselves to the standards that reward the amalgam between the excellence of the final model and the work and chances the builder undertook to create that model.

2.2 Points-Based Judging

This approach to judging typically relies on a group of judges, working under the direction of an experienced Master Judge (who isn't a contestant and preferably who has a building resume). To evaluate each model, they fill out a pre-printed judging sheet, and award points for each designated aspect of the model (as opposed to a "negative" system where debits are made to the presumption of an initial perfect score). The judges may evaluate the models during the show, but preferably review the models when the contest hall is empty so they may openly discuss the models without the risk of revealing their deliberations or possibly offending contestants and attendees. The judges may individually, or as a group, then turn in their judging sheets to be tallied by an administrator.

Individual judges assigned to evaluate all models for a single aspect specified on the judging sheet (e.g., the paint and finish) offers the desirable advantage of a consistent application of criteria for all models entered in the contest (assuming enough qualified judges are present to evaluate each of the points categories). As an alternate approach, a judge (or judging team) may evaluate all criteria for each entry, but this works only where the same judge/set of judges evaluate all of the entries, so that consistency is achieved and biases are reduced or eliminated.

The first criteria to be evaluated is the overall craftsmanship of each entry (typically, about half the points are allocated to this primary standard), with the balances of the points allocated to specific aspects of the model. Judges' comments can sometimes be added to the bottom of the judging sheet so that the entrant can benefit from the observations of the judges (ideally, judging sheets are given to the entrant at the end of the contest, after the points are totaled and tallied).

Once all of the judging sheets have been completed and turned in to the contest adminstrator(s), the points total for each model is calculated and the winners for each Class are determined according to their total-points ranking. First Place is awarded to the model with the greatest number of points, and awards based on descending points totals are presented down through the number of "places" in that Class. Specialty Awards (typically called Master Awards, composed of Best of Show, Best Paint/Finish, Best Detail, Best Interior, etc.) are selected through another level of judging, typically based upon the points awarded on the judging sheets for those specific aspects of each entry. Ideally, the Master Judge will make the final decision when a tie needs to be broken, or when an Award needs to be made if there isn't a specific points-based criteria to decide that Award. Of course, a "Peoples/Popular Choice" award is selected by ballot, which can be distributed either to contestants only or to the all persons attending that contest.

(Samples of the successfully-used judging sheets from the Utah Miniature Automotive Guild are available in the "downloadable" section of the CD version of this book).

2.3 Peer Judging

The concept of a "peer judged" contest was created by The International Model Car Builders' Museum as an opportunity for very serious and highly-skilled competitors who build exceptionally detailed and accurate scale vehicles to go head-to-head in a no-holds-barred, single-class only, one-entry-per-builder event. All entries must be in the same scale since this is a single-class competition, but there are no limitations on type or style of vehicle, materials, technologies, techniques, or any other aspects of the build. There are additional requirements for oral presentation and visual documentation of the entry and the work accomplished.

The goal of this competition is to not only encourage, but to require, every competitor to push and expand their building skills and talents to create the most realistic and accurate scale vehicle they can build.

An additional twist is that the competitors are also the judges (peer judging), based on the premise that no one is in a better position to evaluate the efforts, skills, risk-taking, and talent put forth by each builder, and no one better understands the complexities and difficulties of design, fabrication and construction, and the overall results in each model.

This concept is designed for a limited number of entries, preferably ten to twelve, with an overall time frame for the event from announcement to judging of three to four years, giving each competitor enough time to plan and build their entry. The final presentations, judging, and awards ceremony are based on a two-day schedule to allow adequate time for presentations and to judge the entries thoroughly.

The contest would be overseen by a small group of administrators who would be responsible for setting up the event, distributing and collecting judging sheets, tallying the points totals, and announcing the winners.

PART TWO

How to Build a Championship Model

CHAPTER 3

Establishing Project Priorities

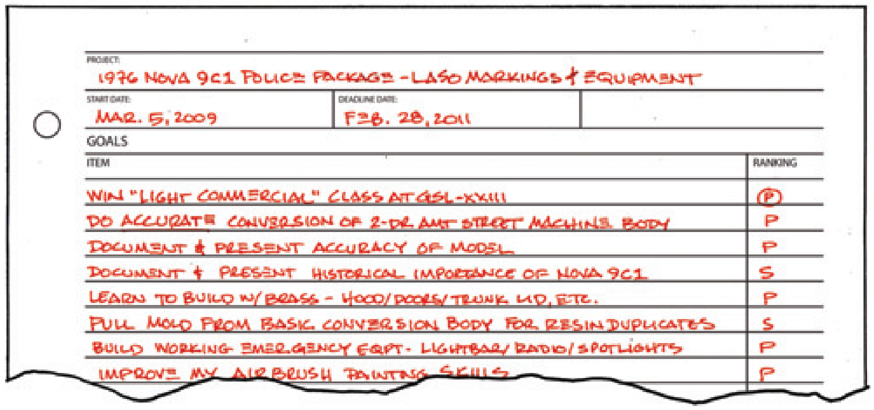
By the time you've decided on your subject matter, you're already developing a good idea of how you want your finished model to look: body configuration, exterior and interior colors and finishes, drivetrain and chassis details, what working parts and design features will be included, and all the other things that intrigue you about building this model. As part of this process, you should also be thinking about all the scratch-built details, machined and photo-etched components, graphics, and everything else you've decided that model needs to present a scale miniature of the subject matter.

Unfortunately, at some point, all these possibilities are enough to give you a headache . . . and a model you run the risk of not finishing. That's why it's important to organize your project, and to think about all that will be involved in bringing that model to a successful completion.

Begin taking stock of the scope of the entire project early on, establishing your priorities, and deciding on what static and operational details you'll actually incorporate into your model. It is also best to make a list of what topics you'll need to research, and skills you'll need to refine (or learn) to do the project. Here's one way to start:

First, write down everything you would like to do to the model if you could do it all on a list titled GOALS. Consider it your "Ultimate Wish List." (Note: All the forms suggested in this section are downloadable from the CD version of this book). Which design, mechanical and functional features would you incorporate to not only make your scale miniature as realistic as possible, but to intrigue and impress, or amaze, the judges and viewers? You may want to create your complete list over a period of time, so the new ideas that occur to you as you think about the project can be included. If you establish primary and secondary goals, either write "P" or "S" next to each item, or use a separate GOALS form for each list.

Your list could easily contain two or three dozen item, depending on how thoroughly you've thought about your project, and on just how far you want to push your skills and creativity. Next, use the PRIORITIES form to list the things you must have, do, learn and accomplish to build your model. This approach gives you the opportunity to decide what you really want to focus on, and will prove very valuable as you consider the true scope of your project, and all of the research and work you will need to do. You will also use it to help establish your SCHEDULE and BUDGET, both covered in Chapter 5. SCHEDULE is your best estimate of the time you'll need for the project (with the understanding that the project will inevitably take more time than you estimate), and will help you estimate how



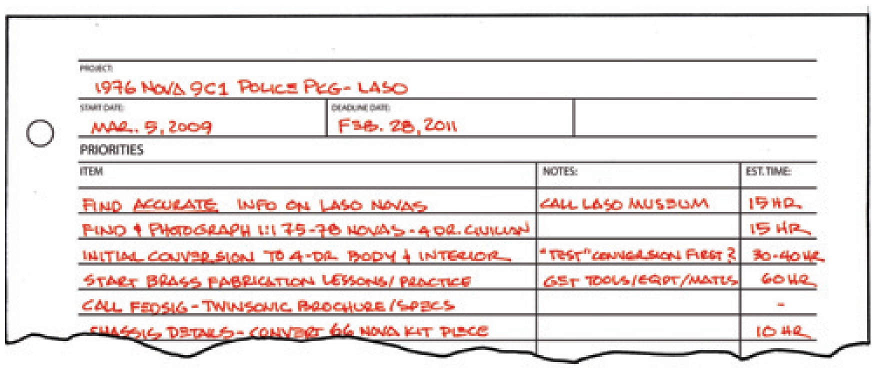
PROJECT: 1976 NOVA 9C1 POLICE PACKAGE - LASO MARKINGS & EQUIPMENT

START DATE: MAR. 5, 2009 DEADLINE DATE: FEB. 28, 2011

GOALS

ITEM	RANKING
WIN "LIGHT COMMERCIAL" CLASS AT GSL-XXIII	(P)
DO ACCURATE CONVERSION OF 2-DR AMT STREET MACHINE BODY	P
DOCUMENT & PRESENT ACCURACY OF MODEL	P
DOCUMENT & PRESENT HISTORICAL IMPORTANCE OF NOVA 9C1	S
LEARN TO BUILD W/ BRASS - HOOD/DOORS/TRUNK LID, ETC.	P
PULL MOLD FROM BASIC CONVERSION BODY FOR RESIN DUPLICATES	S
BUILD WORKING EMERGENCY EQPT - LIGHTBAR/RADIO/SPOTLIGHTS	P
IMPROVE MY AIRBRUSH PAINTING SKILLS	P

Figure 3.1: This GOALS list is for a model of a 1976 Chevrolet Nova 9C1 police package. Note the first goal is to win the Class at GSL-XXIII.



PROJECT: 1976 NOVA 9C1 POLICE PKG - LASO

START DATE: MAR. 5, 2009 DEADLINE DATE: FEB. 28, 2011

PRIORITIES

ITEM	NOTES:	EST. TIME:
FIND ACCURATE INFO ON LASO NOVAS	CALL LASO MUSEUM	15 HR
FIND & PHOTOGRAPH 1:1 75-78 NOVAS - 4 DR. CIVILIAN		15 HR
INITIAL CONVERSION TO 4-DR BODY & INTERIOR	"TEST" CONVERSION FIRST ?	30-40 HR
START BRASS FABRICATION LESSONS/PRACTICE	GET TOOLS/EQPT/MATLS	60 HR
CALL FEDSIG - TWINSONIC BROCHURE/SPECS		-
CHASSIS DETAILS - CONVERT 66 NOVA KIT PIECE		10 HR

Figure 3.2: Here is an example of PRIORITIES for the Nova project.

much time you'll need to allocate to your project each day or week. BUDGET will help you determine how much discretionary money you expect to allocate to buying kits, parts, tools, supplies, components, and commissioning parts, and at what key dates during the construction those monies will need to be spent.

CHAPTER 4

Research

You will need to starting filling out the RESEARCH form (contained on the CD version of this book) to keep track of information you'll need to find out about your model.

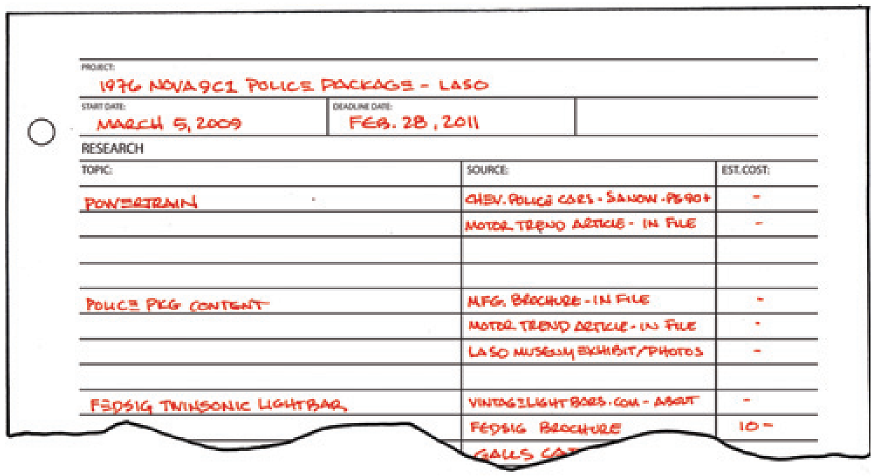
Some models (replicas of a specific vehicle, and of prototypical or Factory Stock vehicles in particular) already come with their own real history of how and why the 1:1 vehicle was created or evolved: What were the decisions made at the beginning of the project? What were the production and sales goals and how did those objectives affect the vehicle's design and mechanical features? Research will help you define and understand why and how things were done: What techniques and technologies existed at the "time" depicted by the model, and, for instance, what class, construction and equipment rules apply for the era depicted if a vintage competition vehicle is being built.

Also, use the RESEARCH form to list information such as the time spent searching through books and Web sites for information and the photos you need to authenticate your model or to see what "old time" hotrod or racing parts looked like, travel time to car shows, museums and swap meets, etc. Also consider the time spent testing new materials such as adhesives, finishes, and decals.

If you are designing and constructing a model based on your own vision of what the subject matter should be, creating a story about the "history" of the vehicle or diorama can be helpful, exciting, and add an additional creative element to your project. Your tale doesn't need to be elaborate or overly-detailed, but should include enough information to help you determine what your model will look like, and what mechanical and design elements your miniature could exhibit—all so you can be consistent and logical when making decisions about constructing the model. The story may be as elaborate as creating a fictional history within the context of actual 1:1 events, or a "what if" scenario about how a fictional vehicle or famous custom might have been built (but wasn't), to something as elementary as thinking about the environment in which an off-road Jeep would have competed and what damage, wear, and other evidence of a hard desert race would exist.

Once you've gotten a real sense of the model's "history," and how it will be presented in your scale miniature, you can begin doing more thorough research much more effectively, and you'll have a better idea of what you need to discover and document.

Regardless of subject matter, you'll need to look into the many elements of your project. You must become familiar with the history of the era that your model will depict; the mechanical features and equipment that need to be included; aesthetic elements; operating details; and other aspects. Additionally, doing research will help you focus on your subject, and increase your familiarity with it. Research can also make you aware of additional aspects of your subject you may want to incorporate in your model.


PROJECT: 1976 NOVA 9C1 POLICE PACKAGE - LASO

START DATE: MARCH 5, 2009 | DEADLINE DATE: FEB. 28, 2011

RESEARCH

TOPIC:	SOURCE:	EST. COST:
POWERTRAIN	CHEV. POLICE CARS - SANOW - PG 90+	-
	MOTOR TREND ARTICLE - IN FILE	-
POLICE PKG CONTENT	MFG. BROCHURE - IN FILE	-
	MOTOR TREND ARTICLE - IN FILE	-
	LASO MUSEUM EXHIBIT/PHOTOS	-
FEDSIG TWINSONIC LIGHTBAR	VINTAGELIGHTBARS.COM - ABOUT	-
	FEDSIG BROCHURE	10 -
	GALLS CA	

Figure 4.1: This is the start of the RESEARCH materials list and sources for the Nova.

Figure 4.2: If you're building a 1950s vintage police car, what emergency equipment, radio and signage were actually used during that era? (Carl Rees model/Mark S. Gustavson photo)

Consider these examples:

- If you're building a "typical" old-time hot rod, dragster, or motorcycle, what would be period-correct equipment, and styling and design elements? Be sure to avoid mixing eras if you intend to depict a specific period of time (60-series tires, for instance, wouldn't have appeared on a Factory-Stock 1963 Corvette.
- If your subject is a prototypical factory car (as opposed to a replica of a specific vehicle), what was actually available from the manufacturer? Watch out for dealer-installed equipment that might not have been either authorized by the factory, or that never appeared on an order form.

Figure 4.3: The first finish-painted version of the Murray *Dream Truck* reveals a number of interesting details not found in the second and third pre-1958 accident iterations. Note the side exhaust and the paint scheme, as well as the fact that Bob Metz had not yet added the finned rear bed in this early 1957 photos.

Figure 4.4: The last pre-accident version of the *Dream Truck* exhibited a number of obvious and subtle changes from the previous versions. For instance, the leading edge of the finned bed was straightened downward, the three Buick portholes-to-a-side were eliminated, and the paint scheme changed.

- If you're modeling Spencer Murray's *Dream Truck,* be sure to research and select one of the several versions that were constructed, and think about what research materials you'll want to use and present to document the accuracy of your miniature scale vehicle.

There are many, many sources for your research to authenticate and create a convincing and intriguing miniature, and for the documentation you will present to make sure the viewers and judges fully appreciate the accuracy of your build. Any or all of the following sources can be very helpful.

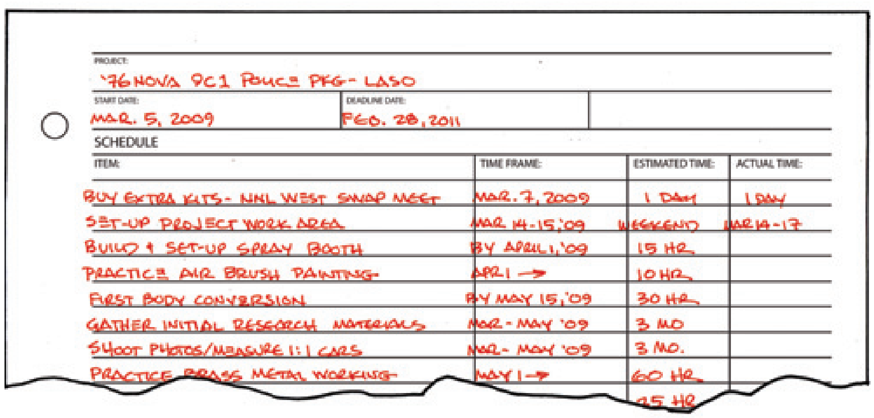
- Check the catalogs from major publishers for books on your subject. One great source is Motorbooks International/MBI, which offers books on almost any automotive marque and genre, as well as trucks, farm and construction equipment, motorcycles, and other related subjects.
- Catalogs from companies specializing in selling NOS or reproduction parts for the restoration of older vehicles can contain exploded views, parts details, and paint and upholstery information. Original catalogs from both vintage and contemporary speed equipment and aftermarket customizing manufacturers can help establish era-correct details.
- Vendors listed in Hemmings Motor News and other publications and magazines, online sources, and vendors at 1:1 vehicle shows and swap meets can be invaluable sources for vintage magazines, dealer brochures, and other printed materials that will help your research. Even an advertisement for a new pick-up truck can show detailed photos of the chassis and running gear. Dozens of magazines can supply myriad information for contemporary and vintage vehicles.
- Dealer brochures, factory photos and press kits can also be a great source of information, but be aware that manufacturers' brochures and press kits occasionally have some incorrect details in photos, illustrations, and even mechanical specifications, because they are typically created before all the production vehicle details are finalized. Remember, too, that photos, especially in the 1950s and 1960s, were shot to make the cars appear longer/lower/wider, or distorted in other ways. Artistic illustrations are typically a poor source for details, but can help you get a sense of the era the vehicle is from. Technical illustrations, however, can be a great source of how something was built, details, and what goes where. Look for additional photos and information from other sources whenever possible.
- Owners' clubs, and VIN/data plate decoding sources can be helpful in documenting correct OEM equipment and trim.
- Visiting museums, swap meets, car shows, restoration shops, and even friends who collect old car parts can yield new and useful information.
- Look at 1:1 scale vehicles to check on factory features and to see how various parts and components are designed, assembled and integrated into the whole vehicle. Visiting new car dealers will reveal what finishes, upholstery and trim actually look like in 1:1 scale. Visiting junkyards (especially self-service types) will help you better understand how vehicles are assembled, see how parts wear, deteriorate, leak and discolor, and learn how colors, finishes and upholstery fade and show wear and weathering.
- Videos, not only of racing and cars at concours and other events, but also of old movies and TV shows featuring hotrods and race cars, and even promotional or industry films that show commercial, construction or agricultural equipment, are also potential sources of information.

CHAPTER 5

Scheduling and Budgeting

To build your project to the levels of details you've chosen, you'll need to create practical and reasonable SCHEDULES and BUDGETS to get the project done on time (the forms referenced in this chapter are available on the CD version of this book).

One approach is shown here using the SCHEDULE form.



PROJECT: '76 NOVA 9C1 POLICE PKG - LASO

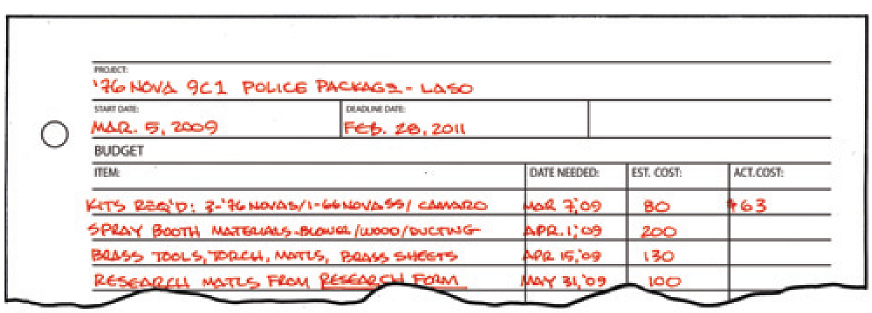
START DATE: MAR. 5, 2009 | DEADLINE DATE: FEB. 28, 2011

SCHEDULE

ITEM:	TIME FRAME:	ESTIMATED TIME:	ACTUAL TIME:
BUY EXTRA KITS - NNL WEST SWAP MEET	MAR. 7, 2009	1 DAY	1 DAY
SET-UP PROJECT WORK AREA	MAR 14-15,'09	WEEKEND	MAR 14-17
BUILD & SET-UP SPRAY BOOTH	BY APRIL 1,'09	15 HR	
PRACTICE AIR BRUSH PAINTING	APR 1 →	10 HR	
FIRST BODY CONVERSION	BY MAY 15,'09	30 HR	
GATHER INITIAL RESEARCH MATERIALS	MAR - MAY '09	3 MO	
SHOOT PHOTOS/MEASURE 1:1 CARS	MAR - MAY '09	3 MO.	
PRACTICE BRASS METAL WORKING	MAY 1 →	60 HR	
		25 HR	

Figure 5.1: This will give you an idea of what your SCHEDULE form might look like as you add information to it.

Print out a BUDGET form to track your estimated and actual expenses, and to know when you'll need to spend the money.



PROJECT: '76 NOVA 9C1 POLICE PACKAGE - LASO

START DATE: MAR. 5, 2009 | DEADLINE DATE: FEB. 28, 2011

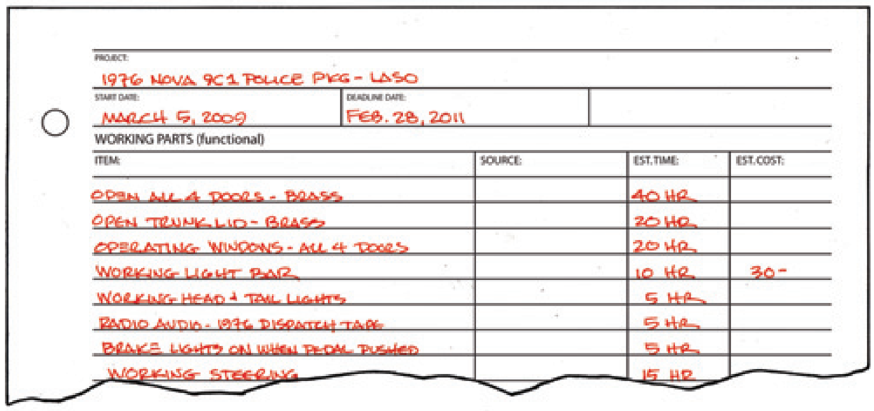
BUDGET

ITEM:	DATE NEEDED:	EST. COST:	ACT. COST:
KITS REQ'D: 3-'76 NOVAS/1-66 NOVA SS/ CAMARO	MAR 7,'09	80	$63
SPRAY BOOTH MATERIALS-BLOWER/WOOD/DUCTING	APR. 1,'09	200	
BRASS TOOLS, TORCH, MATLS, BRASS SHEETS	APR 15,'09	130	
RESEARCH MATLS FROM RESEARCH FORM	MAY 31,'09	100	

Figure 5.2: The BUDGET form will help you plan for your expenses and when you'll need the money as your project progresses.

Use the form titled WORKING PARTS to list the items you want on your model. Estimate as realistically as possible how much time each item will take to research, build, test and install. Write the hours in the ESTIMATED TIME column next to each part.

Be sure to allow time for the attempts that don't work the first (or second) time, and for the other setbacks and delays that inevitably crop up on any complex project. Add in time for outsourcing parts and services, such as chrome plating. Transfer these time estimates to your SCHEDULE form.


PROJECT: 1976 NOVA 9C1 POLICE PKG - LASO

START DATE: MARCH 5, 2009 | DEADLINE DATE: FEB. 28, 2011

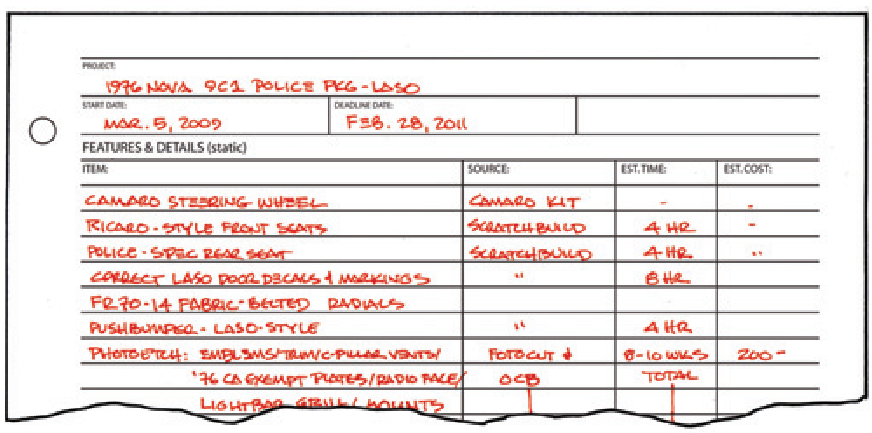
WORKING PARTS (functional)

ITEM:	SOURCE:	EST. TIME:	EST. COST:
OPEN ALL 4 DOORS - BRASS		40 HR	
OPEN TRUNK LID - BRASS		20 HR	
OPERATING WINDOWS - ALL 4 DOORS		20 HR	
WORKING LIGHT BAR		10 HR	30-
WORKING HEAD & TAIL LIGHTS		5 HR	
RADIO AUDIO - 1976 DISPATCH TAPE		5 HR	
BRAKE LIGHTS ON WHEN PEDAL PUSHED		5 HR	
WORKING STEERING		15 HR	

Figure 5.3: Here are some of the working parts planned for the Chevrolet Nova.

In the ESTIMATED COST column write down any estimated expenses you expect for each item. There may not be many entries in this column, but if money for your project is a factor, it's good to have even a preliminary budget to help you plan your expenses. Will you have to purchase parts or kits you don't have? What other parts or equipment you will have to out-source or have made? As you list costs, also add them to your BUDGET form.

Do the same on your FEATURES & DETAILS form. In addition to the features and details, your list might also include information such as how long it takes finishes to dry, the length of time (including shipping) parts will be at the platers, or lead times to have outsourced machined parts made, and so forth. Transfer any "costs" to your budget sheet as well.


PROJECT: 1976 NOVA 9C1 POLICE PKG - LASO

START DATE: MAR. 5, 2009 | DEADLINE DATE: FEB. 28, 2011

FEATURES & DETAILS (static)

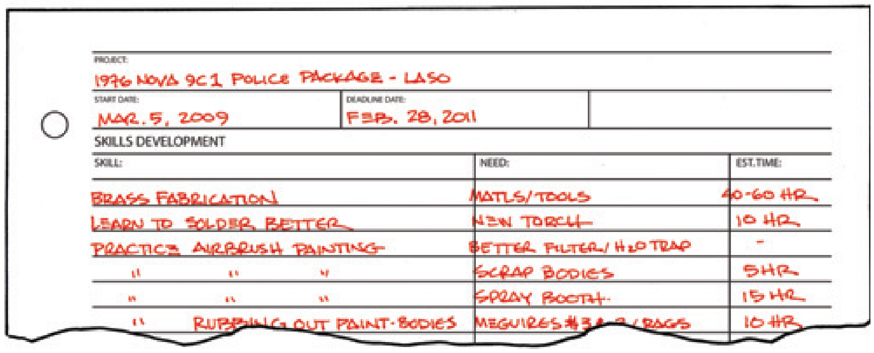
ITEM:	SOURCE:	EST. TIME:	EST. COST:
CAMARO STEERING WHEEL	CAMARO KIT	-	-
RICARO - STYLE FRONT SEATS	SCRATCHBUILD	4 HR	-
POLICE - SPEC REAR SEAT	SCRATCHBUILD	4 HR	"
CORRECT LASO DOOR DECALS & MARKINGS	"	8 HR	
FR70-14 FABRIC-BELTED RADIALS			
PUSHBUMPER - LASO-STYLE	"	4 HR	
PHOTOETCH: EMBLEMS/TRIM/C-PILLAR VENTS/	FOTOCUT &	8-10 WKS	200-
'76 CA EXEMPT PLATES/RADIO FACE/	OCB	TOTAL	
LIGHTBAR GRILL/ MOUNTS			

Figure 5.4: The start of the FEATURES & DETAILS list for the Nova is shown here.

Start a SKILLS DEVELOPMENT form to list the skills you'll need to learn or improve to build the model you envision. "Skills" may include time spent practicing airbrush techniques to get the appearance of finishes you want, developing your metal-finishing or soldering skills, or anything else you need to improve or learn.

Do you need to clean-up, rearrange or set-up your hobby area to accommodate your project? All these things take time, and are parts of scheduling and budgeting for your model.

Also realize your lists of goals and priorities will probably change or evolve as you research your subject and learn more important information. These will also change your schedules and budgets.


PROJECT:
1976 NOVA 9C1 POLICE PACKAGE - LASO

START DATE:	DEADLINE DATE:	
MAR. 5, 2009	FEB. 28, 2011	

SKILLS DEVELOPMENT

SKILL:	NEED:	EST. TIME:
BRASS FABRICATION	MATLS/TOOLS	40-60 HR
LEARN TO SOLDER BETTER	NEW TORCH	10 HR
PRACTICE AIRBRUSH PAINTING	BETTER FILTER/ H2O TRAP	-
" " "	SCRAP BODIES	5HR
" " "	SPRAY BOOTH	15 HR
" RUBBING OUT PAINT·BODIES	MEGUIRES #3 [illegible] / RAGS	10 HR

Figure 5.5: It's important to inventory and evaluate not only the skills you already have (and may need to improve), but also any new skills you'll need to learn and develop for your project.

Add up all the time you expect the project to take, add to it a factor of 20–30% (or whatever you consider reasonable), and you'll have a starting point for calculating how much time you'll need to allocate to the build.

Now, figure how many hours a week you can devote to your project. If you have a job, family and other responsibilities, allow for those important obligations. If you're retired, you might treat this as a 40-hour per week "profession," as at least two of the GSL Best of Show winners have done. In any case, divide the total hours calculated by the number of hours per week you can allocate, and you'll get the number of weeks you'll theoretically need to complete your project.

Look at your deadline: when is the event in which you want to compete? Do you think you'll have the time you need to actually complete your project as you've outlined it? Will you have to move it to the following (or another) contest date? As an alternative, can you put in enough additional time each week to meet your deadline?

Whatever your figures, you now have a pretty good idea of how you'll have to schedule your time.

One additional item may help. Consider creating a time line for the project, with projected "completed by" dates for different elements or steps of your project. This can make it easier to gauge your progress against your sequential deadlines, and make your build easier by having a series of smaller "due dates," rather than a single "finished by" date.

Now, three-hole punch these sheets and place them in a binder to keep them organized and handy. This binder will also give you a place to keep your notes, research materials, ideas, and photos as the build progresses. If you create a spreadsheet on your computer, be sure that it can be easily modified as needed, and print out a copy to use and amend on your hobby workbench.

CHAPTER 6

Set Up and Organize Your Workspace

We all work within the confines and limitations of our workspace. If space permits, we have a relatively dedicated area to set up and work in; otherwise, we work where we can. Maybe your work space is on a small workbench or table in a spare bedroom, a corner of the basement or garage, or whatever other arrangements you can find. Some modelers build dedicated spaces where they can set up their equipment and supplies for ready access.

Building scale miniatures for serious competition requires a serious look at the "production area" for these projects. While "casual" building allows for flexible space, including putting the pieces away at the end of each modeling session, building for serious competition really requires a dedicated space for the project. And, although the sizes of the spaces will be determined to a large degree by the room you can allocate as a "full-time" modeling area, what you do with, and within, those spaces will have a great effect on what you can accomplish, on how enthusiastic you stay during the build, and how much frustration you will experience.

When thinking about how to organize or arrange your work areas, consider dividing things into two categories: "dirty areas" and "clean areas."

Dirty areas need to be far enough away from the clean areas to avoid contaminating them with dust, overspray, chemicals, metal shavings, and so forth.

Bodywork and preparation. Try to set up a dedicated area where you can work on the preparation of parts: filing, trimming, cutting, sanding, spraying, media blasting, and all the other steps involved in those initial phases.

Soldering. If you're working with brass or other metals, and are using a soldering irons, allow adequate space to jig, clamp, and assemble the pieces you're working on, and room to use and set down the hot iron.

Adhesives. Adequate space needs to be provided for mixing adhesives, as well as for jigging, clamping and gluing, and setting assemblies aside to dry. Adhesives should be kept to the side and imported to the work in small quantities to avoid contaminating the model.

Figure 6.1: Media blasting is necessary to clean up a surface, or impart a texture, and can produce dust and particulate matter. Sequester such tasks away from your painting and final assembly area. (Mark Gustavson's shop/photo)

Figure 6.2: Set up your soldering workspace in a single work area and be certain to use a soldering base at all times. See Chapter 10 for soldering and fabricating techniques. (Mark Gustavson's shop/photo)

6.1 Clean Assembly Area

Make your final assembly area surgically clean. Wear cotton gloves. Consider placing a piece of glass over a white or light gray background on your work surface so you can easily see paint, glue or other contaminants. Keep the adhesives "off site" and import small amounts of adhesive for assembly as needed. Never work above your assemblies with any tool, adhesive, sandpaper, or any heavy or threatening object that will cause damage if it falls, is dropped, or is dripped on the assembly or a component.

Clean areas need to be free of machining, overspray and adhesive residues, and other contaminants.

Figure 6.3: A clutter-free work area is essential. Functions should be grouped. (Brian Radford's shop/photo)

Figure 6.4: A great work area doesn't need to be large in size. Organization is the key. (Dave McGaughey's shop/photo)

Painting areas. (Although they produce contaminants, we're considering them clean areas because they need to produce clean results.) Spraying, whether by can or airbrush, needs to be done in a well-lit, well-ventilated area, preferably in a booth, to avoid getting overspray on surrounding surfaces, and to isolate the model from "outside" particulates. Remember to wear eye and breathing protection when spraying! There also needs to be enough room to safely store freshly-painted parts while they dry. (An excellent article on spray booth design and construction can be found in Appendix A.)

Figure 6.5: Paint and supplies can be neatly stored in drawers under the working surface if space is at a premium. (Mark Gustavson's shop/photo)

Figure 6.6: Keep unbuilt kits and parts boxes away from your immediate work area. (Anthony Hazelaar's shop/photo)

A well-organized and well-appointed workbench is essential to the success of a project. Organize similar items together, and try to avoid clutter which can obscure delicate parts you've made. Your working surface should also be hard and smooth so that your work can be precise. Think about installing beveled safety glass inserts into a counter top: glass is hard to scratch, and can be easily cleaned of adhesives, paint and putty.

Brush painting needs to be done in an area where colors won't accidentally be transferred to other parts, and where thinners, brush cleaners, and other chemicals won't contact parts if they splash or spill. Consider placing several small parts to be painted similar colors on a turntable so you can leave the parts in place to dry while you work on the next one. The same concept can be applied to gluing and assembly.

Spaces needed for component, sub-assemblies, and final assembly should be "surgically" clean and uncluttered.

Consider setting up a "staging area" next to your assembly area, to keep parts out of the way until you're ready to install them.

If you're using shelving or racks to store your parts and components when you're not working on them, try to place them in an area removed from contaminate-producing sources. Be sure that the path from the storage area to your workbench is clear of obstacles so you don't run into, or trip over, something while carrying the trays, materials and supplies back and forth.

In both dirty and clean areas, be prepared for the occasional disaster. Keep handiwipes, cloths, and solutions to neutralize chemical spills handy. Download and print the materials data safety sheets from the manufacturers' Web sites and keep that information in your binder.

Whether you are thinking about setting up a new work space or rearranging your existing area, think about how you can make it more comfortable, inviting, and suited to building. Some basics to consider include:

Walls. If you can repaint, a light, semi-gloss or eggshell finish will help reflect lighting evenly. You can use walls to multiply storage space by installing sturdy shelving for resource materials, kits, and so forth. Magnetic strips and racks give you great ways to store tools, paints and adhesives where they will be handy yet out of the way.

Lighting. Even, daylight-value ambient lighting is critical to the building you'll be doing. It shows you true colors, and reduces eyestrain. Small fluorescent under-cabinet units (using daylight bulbs only) can be mounted on the bottom of low shelving, and flood the work surface with light. Localized lighting, such as swing-arm lamps, give you an adjustable light source you can direct where you need it. Set up the lighting so you aren't working in your own shadow. Consider getting a spot lamp with a built-in magnifier if you need it.

Flooring If your floor is concrete and you're not going to tile or carpet it, use a light-colored epoxy coating system to cover the floor to make dropped parts easier to find, and spills easier to clean up. If you are laying down a tile or linoleum surface, try to keep it a light color with little or no pattern. And, if you use carpeting to reduce noise and to insulate, go for a very short pile and minimal pattern.

Movable work surfaces. To keep construction clutter to a minimum and to reduce the risk of damage to parts and sub-assemblies, consider working on 16" × 16" or 18" × 18" plexi panels you can lift off the workbench and store on shelves or a rack. That way your work can be organized by subassemblies, and be left in place while drying or until you are ready to work on them again.

Figure 6.7: Non-glare, medium-intensity light is key. Over-the-shoulder and task lighting will greatly aid the builder. (Chris Batson's shop/photo)

Figure 6.8: Coating your floor with an epoxy finish may seem like an extravagance, but it's a great idea. (Brian Dees' shop/photo)

Counters/horizontal surfaces. A solid white or light neutral color surface to work on makes modeling life much easier. Check out the local home-improvement centers for pre-made counter tops with laminate surfaces. They can be a real bargain, and they're ready to use. When allocating and arranging workspace and counter areas, try to leave enough room that you can back away and look at the model from a distance to give yourself another perspective to view the progress from. Try placing your model on a turntable so you can rotate the model and view it from different angles as you review your work.

Figure 6.9: If you're pressed for space, consider mounting infrequently used equipment onto a movable cart. (Brian Dees' shop/photo)

Additional storage. Filing cabinets can hold volumes of organized information and materials. These, as well as kitchen below-counter cabinets with drawers and slide-out shelves, serve double-duty as storage for tools and equipment, as well as providing bases for your workbench top.

Seating. Find a comfortable, adjustable chair if you don't already have one. A swivel chair on rollers makes building a lot easier and less tiring. Make sure there is adequate padding and that the chair is ergonomically comfortable.

Hand tools. If they're not already organized, or if you're not satisfied with their current arrangement, try setting up your hand tools by type of tool, frequency of use, or other criteria that makes sense to you. Keep the tools stored to one side of the actual work surface when possible, so you don't have to reach over the area where you're working, reducing the possibility of dropping a tool on your model. Magnetic tool holder strips can be mounted on a vertical or horizontal surface to keep metal tools out of your way when not in use. Rotating tool trays keep brushes handy and organized.

Most modelers have a fairly extensive collection of spare parts gathered over many years. Organize those parts by type and vintage, and keep them in some sort of storage bins. Keep track of the hundreds or thousands of parts by preparing an inventory list listing the parts bin number. If the list is kept on your computer, it can be easily amended as new parts arrive.

6.2 Organizing and Storing Reference Materials

You'll need space to store books and manuals, to file brochures and magazines, a way to keep your notes organized, and a place to post sketches, drawings, and photos for reference as you work.

Book shelves. These make effective use of wall space for storing books and manuals. Magazines, catalogs and brochures can be stored in magazine file boxes, available at office supply stores, and placed on the bookshelves. Mount the shelves on a wall away from your primary area so you aren't leaning over your work to get the materials and running the risk of dropping them on your project. Photos can be placed in file folders and stored in a filing cabinet.

Three-ring binders. Binders with sheet protectors or pockets can hold a substantial amount of material, with the added advantage of being set up by categories, such as chassis, drivetrain, interior, body, working features, and so forth. It may also be helpful to date your notes, and to make cross-references to related information in materials you have stored in other areas.

Typist's copyboard. The vertical "clipboard" used to hold pages being read while typing, can hold your notes, a photo, or other page material in viewing range while you work.

Figure 6.10: Store research materials, catalogued by type and year or other criterion, in inexpensive file folders available at any office supply store. It's also wise to write an index to your research so you can quickly find what you need. (Mark Gustavson's shop/photo)

Figure 6.11: Light-colored walls and a contrasting workbench top work well to brighten the work area. (Greg Nichols' shop/photo)

Two-drawer or four-drawer file cabinets. Inexpensive cabinets can fit under (or support) your workbench, and hold files of reference materials, organized and out of the way.

Open wall space. Your walls can display photos and drawings of your subject, both as reference and as a reminder of what your build goal is.

Figure 6.12: Mills, lathes, saws, belt sanders, and similar tools should be set up in their own separate area where they can be mounted solidly and so the dust, shavings, and other debris they produce won't end up in your assembly area. If space is limited and they'll be mounted on your main workbench, consider placing a vertical barrier of clear plexi between them and your assembly area. (Greg Nichols' shop/photo)

Figure 6.13: Keep all key supplies and small tools handy even if they're not used in every operation. (Mark Gustavson's shop/photo)

Figure 6.14: Inexpensive "parts bins" found at any home improvement center can be labeled with numbers that correspond to your written list. (Mark Gustavson's shop/photo)

CHAPTER 7

Your Project Is a Miniature Vehicle: Build it Like One!

7.1 Building Models Like "Real" Automobiles Are Built

Auto manufacturers build their cars as they do for ease of assembly and to address quality-control issues. As a scale vehicle miniaturist, your objectives are almost identical: you want to be able to assemble your model in the best possible way to maximize the quality of the final result by minimizing assembly-tolerance and finish risks to the model during final assembly. Think about the model as a series of subassemblies making up major assemblies which are, in turn, integrated with other major assemblies to finally create a complete scale miniature automobile. Said another way, if your goals are realism and a relatively trouble-free assembly experience, think about ways to build your model as if it was in 1:1 scale.

The parts and projects shown in this chapter are either part of Mark Gustavson's *Dream Truck*[2], his scale models of the Lincoln-Mercury Lynx prototypes, his *New Age Mercury,* or a vintage-styled '50 Ford coupe.

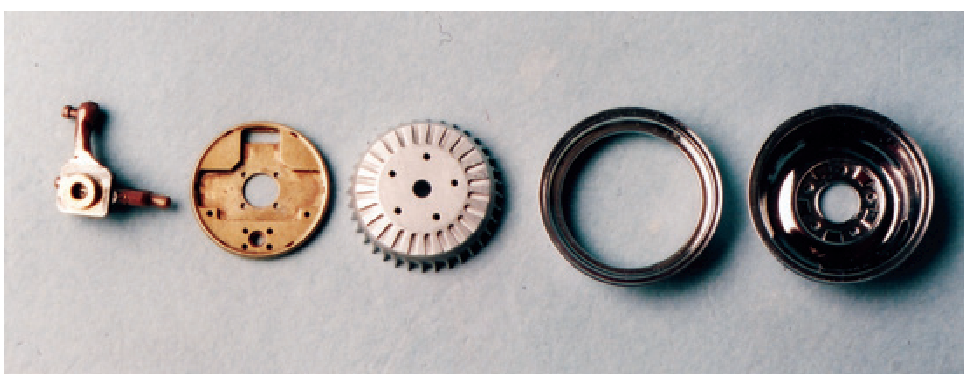


Figure 7.1: Though the work is labor-intensive during fabrication, the best way to build a realistic model is to build it in a way that most closely resembles how 1:1 parts are assembled. In this view, from left to right: A spindle was scratch-built, cast in brass, and then machined to interface with . . . the machined Bendix brake backing plate. Note the four holes around the central hole that index to four corresponding holes drilled in the fascia of the spindle. The brake backing plate . . . fits inside the reverse side of this vintage Buick finned brake drum. This drum as been machined in aluminum and will not be painted or plated. Note that the five central holes for the lugs index to the wheel. The rim is in two parts; not a 1:1 approach, but an acceptable compromise for ease of assembly.

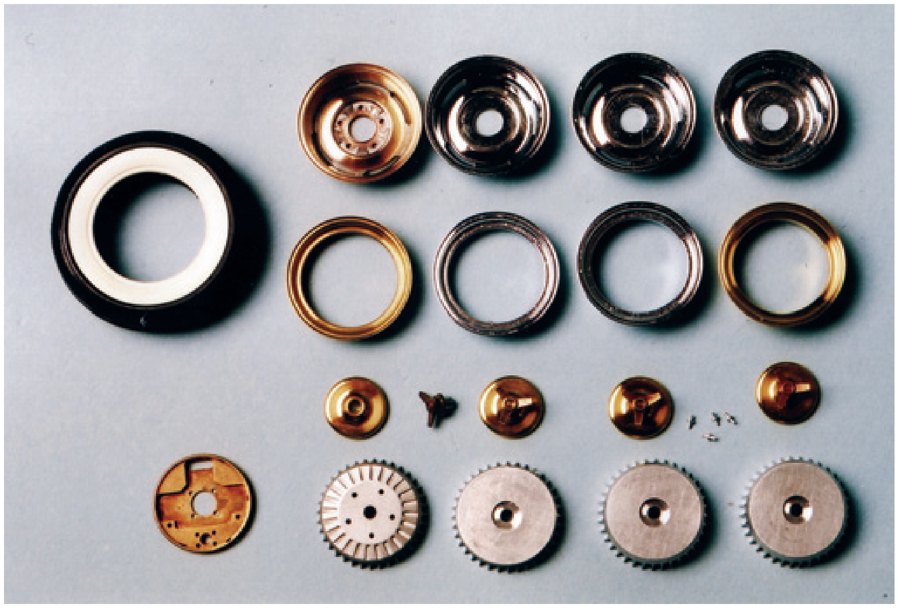


Figure 7.2: The rim was machined from brass to fit a specific tire. Threaded shafts (0000-160 in diameter, and available from The Morris Company) will be fitted to the five holes in the brake drum so that the rim can be mounted with scale hex nuts and removed for display. The three-ear spinners fit into the wheel cone that, in turn, fits inside the center of the wheel.

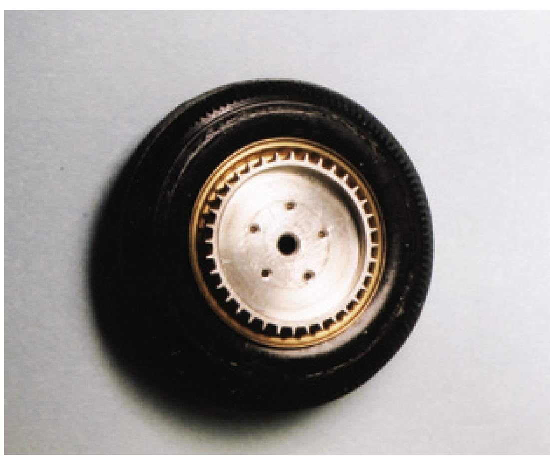


Figure 7.3: From the backside, note the carefully-managed tolerances between the outside diameter of the Buick brake drum and the inside diameter of the rim. There is a sleeve on the fascia of the spindle that indexes into the back of the brake drum.

Figure 7.4: The cast and machined spindle is index-drilled to exactly match the Bendix brake backing plate that fits closely into the drum brake which, in turn, matches the bolt pattern of the rim. The taper on the OD of the brake backing plate matches the taper on the ID of the Buick brake drum to insure a fool-proof, same-every-time fit. Compare this photo to Figure 7.3.

Figure 7.5: Flipped over, the rim (complete with the center cone and spinner) fits tightly into the Modelhaus tire. Compare this image to Figure 7.2.

7.2 Does Your Model Use Body-On-Frame or Unibody Construction?

Determine the body structure of your model. Is the subject vehicle body-on-frame construction, or is it a unibody model?

Body-On-Frame. If the subject employs body-on-frame construction, construct a floorboard and a separate frame (if the kit isn't already configured in this way). If the kit's frame and floorboards are molded as one piece, cut the kit's flooring away from the frame and scratch-build a new floorboard from raw materials (plastic or brass), using the kit part as a rough guide. This new floorboard will be attached to the body shell during construction, rather than to the frame. The plastic frame can then be used (after clean-up), you can scratchbuild a frame (see Chapter 10), or you can take the modified plastic frame to a jeweler and have it cast in brass. In any case, you have simplified your final construction tasks, and created a fresh canvas for your undercar and interior detailing tricks.

The frame should have small pins affixed to the top side (in hidden areas) that will index to correctly-located holes in the floor pan, or you could actually bolt the frame to the body through the typical "outriggers" using the micro-miniature bolts now available; all so you can a test-fit that frame to the same place on your body repeatedly as you check out the fit and integration of the many parts of your model as you develop them. Also, (assuming you're not building a convertible or roadster), cut open your doors, trunk and hood and fit the hinges before you attach the floorboard to the body shell. You'll have to assemble the model through the openings in the body, but if all the major components have been previously (and positively) located, this is not the difficult task that it seems. The goal here is to do the preparatory work to permit you to have a problem-free final assembly where the many assemblies go together easily.

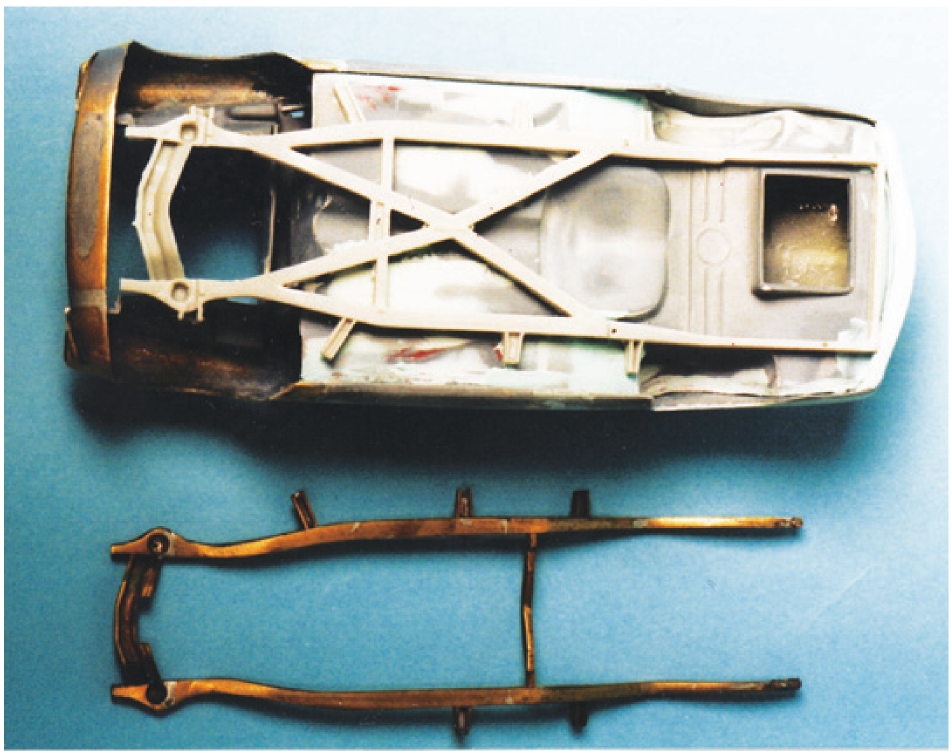


Figure 7.6: One way to create a body-on-frame model is to cut the frame away from a kit floorboard, and then cut the floorboard away from a frame on a duplicate part. Careful work will be required, and there will inevitably be work required to get everything to fit together. Here, an AMT '50 Ford frame has been cut in this manner, with work now going on to fit the floorboard to the body. The plastic frame can also be cast in brass for a more substantial element to the model.

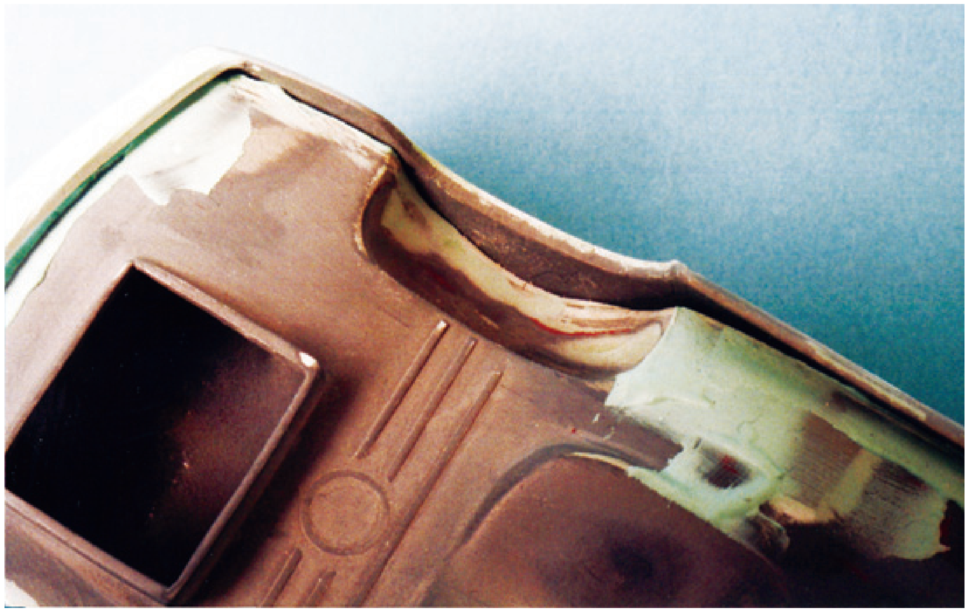


Figure 7.7: One task is to get the floorboard to mate up tightly against the body panel. Once everything fits, and the doors are cut out, and the floorboard can be correctly installed into the main body. Here, this process is in an early stage, with strip styrene being applied around the rear wheelhouses so that there is almost no gap between the body and floorboard. Be careful to correctly locate the floorboard, since it will also locate the frame, and you want to be certain the axles are correctly placed on the model. Take your time here.

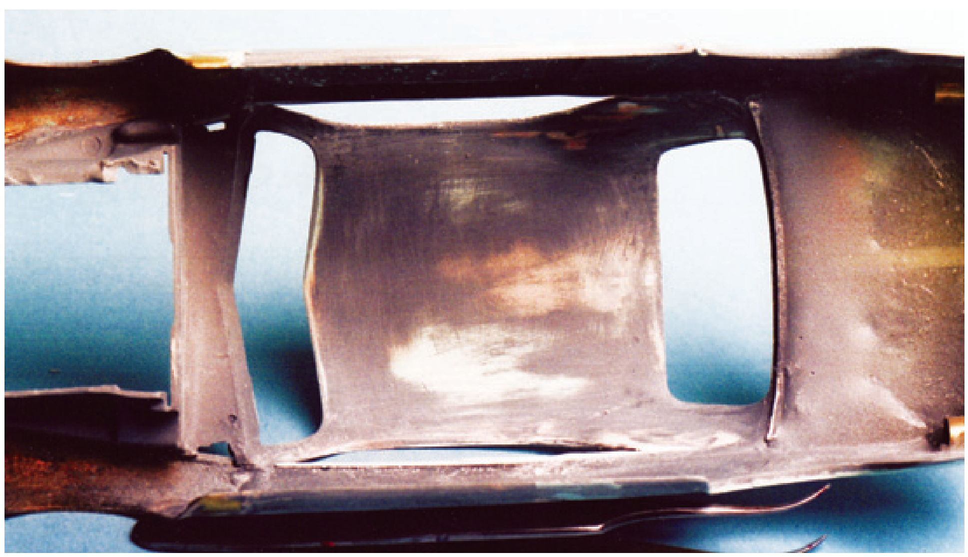


Figure 7.8: In this shoebox Ford, the roof has been pieced together from several parts, requiring bodywork on the inside of the roof. After making sure that the parts are securely attached to each other, use standard bodywork techniques to smooth out the inside of the roof. This model is still in the early stages of this work.

Figure 7.9: The other way to create a realistic body-on-frame model, when you don't want to open the doors, is to mate the interior tub to the floorboard to the bottom of which the frame will be placed. On the *New Age Merc,* this technique was tried successfully but note that the frame still had to be cut loose from the kit floorboard to achieve this method of construction.

Figure 7.10: It's obviously important to be certain that you've located the interior components on the floorboard so that it fits accurately into the body. Here, a narrowed '58 Thunderbird dash, and front and back seats, were mated to lengthened '60 Starliner door and rear quarter inner panels.

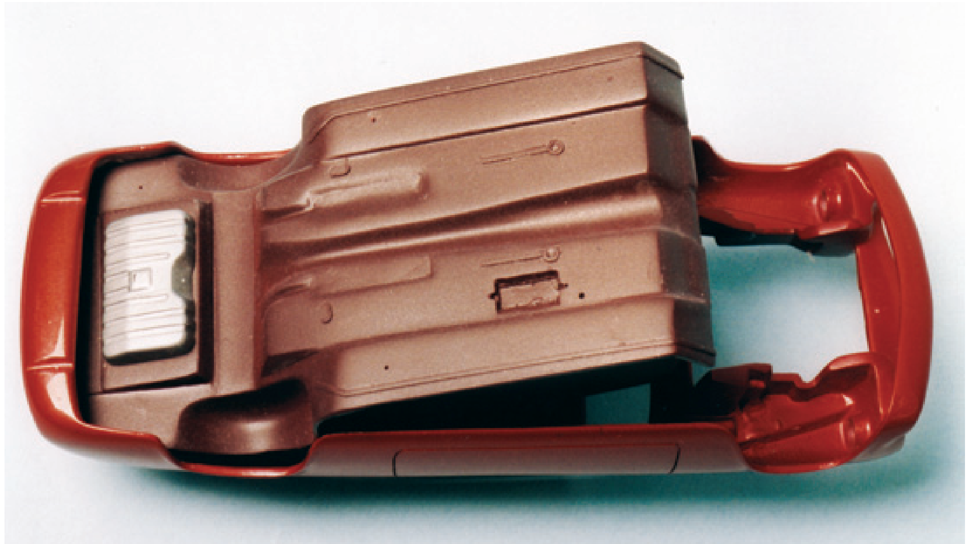


Figure 7.11: You have to develop a scheme to get the combo floorboard/interior tub into the body without damaging the bodywork and paint. A lot of work went into engineering this approach on the *New Age Merc*. Note how the interior/floorboard assembly angles into the body as shown, and then drops straight “down” . . .

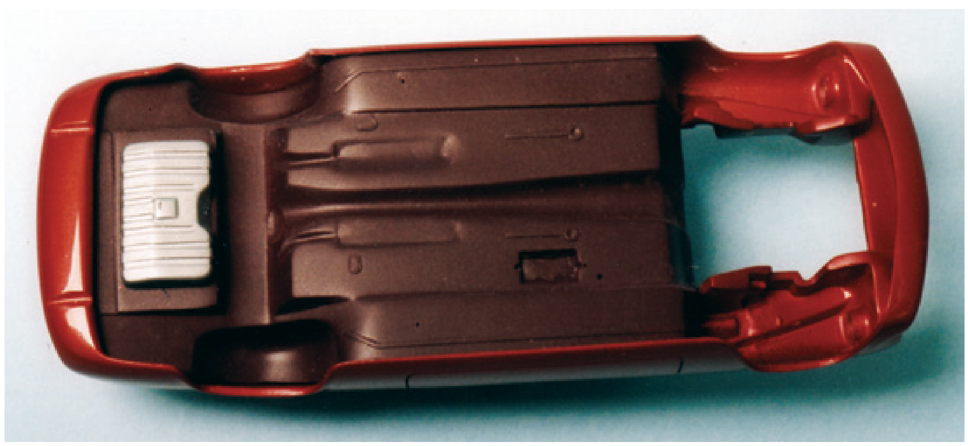


Figure 7.12: . . . into its final position in the body. More work could have been done to widen the rear wheelwells to fit more tightly into the inside of the rear quarter panels. Now, the modified kit frame attaches to the underbody.

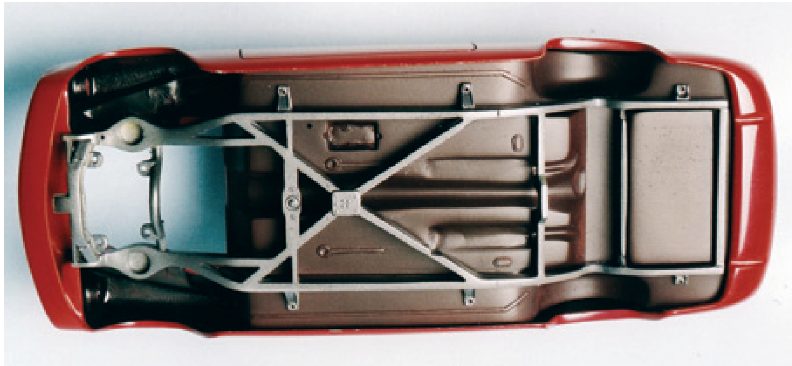


Figure 7.13: A ’60 Starliner front frame clip was fitted to the AMT ’49 Merc frame to display a more up-to-date suspension set-up on the *New Age Merc*. The frame here needs additional parts installed, as well as brake and fuel lines. This approach to creating a body-on-frame model produces a good result, but you need to be careful to measure *many* times as each major component is prepared.

You can use the kit frame when your project is essentially based upon an existing kit. Otherwise, you’ll need to scratchbuild a frame from plastic or, preferably, from brass, which will provide a stronger and more stable platform onto which to install all of the suspension components. See Chapter 10 for a photo essay on how the *Dream Truck*^{2} brass frame was built.

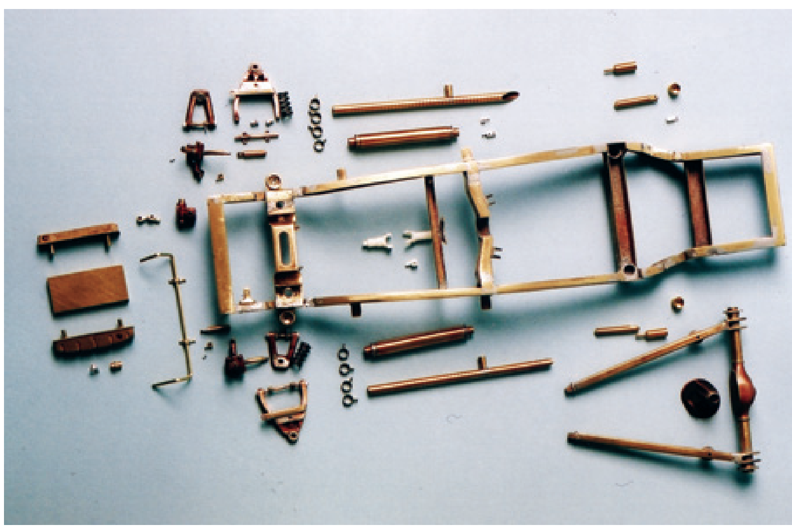


Figure 7.14: Here is the soldered brass frame (and most of the related parts) for the redesigned *Dream Truck*^{2} project. Once assembled, the complete frame will attach to the underbody of the model with small, specially-machined 000-160 hex bolts that will go through the prototypical holes in the frame outriggers and then into the bottom of the cab. These will be capped by bolts in the floor of the cab where each bolt head fits inside a recessed “cone.” Small photo-etched “rubber” biscuits will fit over the bolts atop the frame. This bolt-mount assembly approach is both achievable with some work, and authentically realistic. The rear axle assembly is built from 12 separate parts, all silver-soldered together. The gear set attaches to the axle housing with 0000-160 bolts. The leading brackets on the rear axle trailing arm attach—with small bolts—to the brackets on the frame crossmember. At the front of the frame, the brackets to pick up the upper and lower A-arms have also been fashioned and soldered to the frame and crossmember.

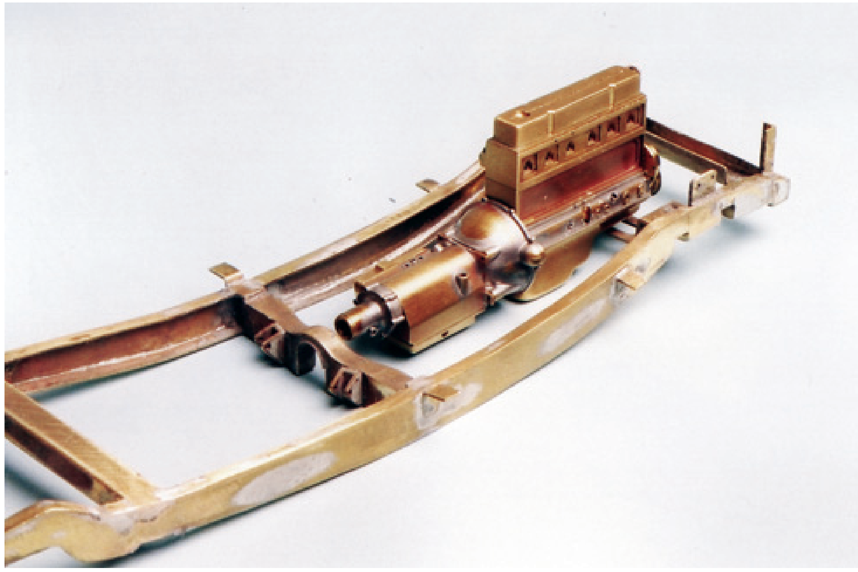


Figure 7.15: The brass frame is dimensionally stable and displays near-accurate scale thickness. The importance of this fact is measured by the reliability and predictability of the frame's dimensions and shapes when it comes time to fit other components to the frame, and the relative ease of final assembly when all the parts and subassemblies come together. The front crossmember features brackets for the upper and lower control arms, which provide a stable platform for further mechanical detailing. The basic engine and transmission are laid in the inside of the frame at their approximate locations. Their locations will be finalized after placing the frame into the body and deciding where the engine can fit to clear the firewall. Note that the frame-to-body outriggers have been soldered to the frame but not yet drilled for the body-mounting bolts.

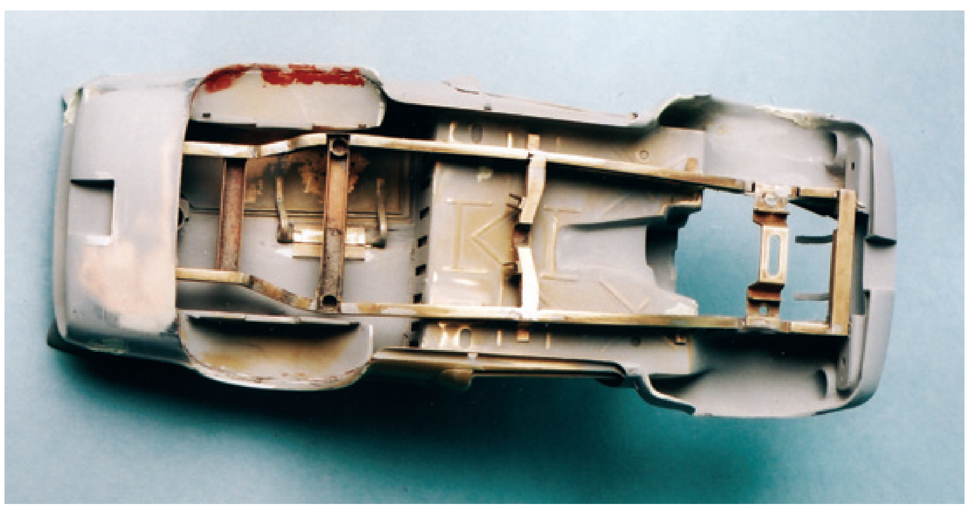


Figure 7.16: Because all of the brass parts are dimensionally stable, the frame fits into the body of the *Dream Truck*[2] the same way every time. This way, the interface between the parts can be repeatedly checked against the background of major components—whose interface with each other is also dimensionally stable—so that otherwise undetectable parts-interface/interference problems can be solved before painting and final assembly occurs. This is a way to achieve realism and avoid difficulties. Ultimately, the frame will positively locate to the body with bolts that will pass through the outriggers into matching holes on the underside of the cab floor and the bed floor still to be fashioned.

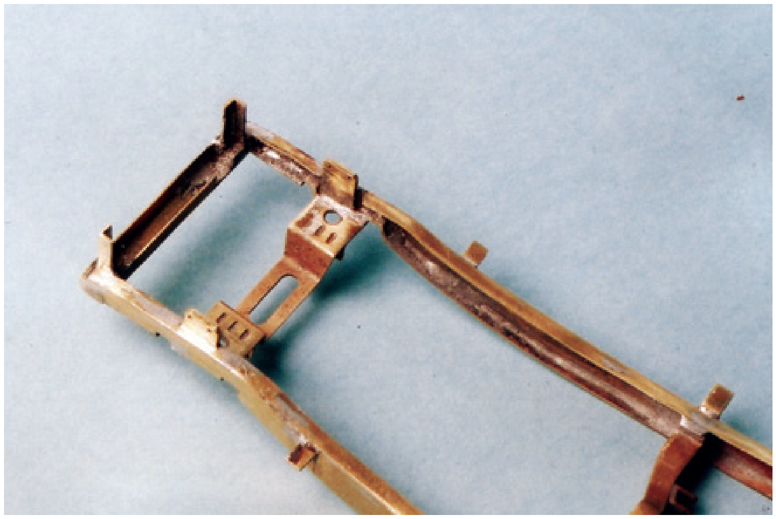


Figure 7.17: The L-shaped vertical brackets at the front of the frame make up part of the radiator support and those shapes index into the body, helping to reliably locate the body to the frame. The upper A-arms bolt to the upright shape just inside the frame rails, and the longer lower A-arms bolt to the bottom of the front crossmember before it angles downward to clear the oil pan.

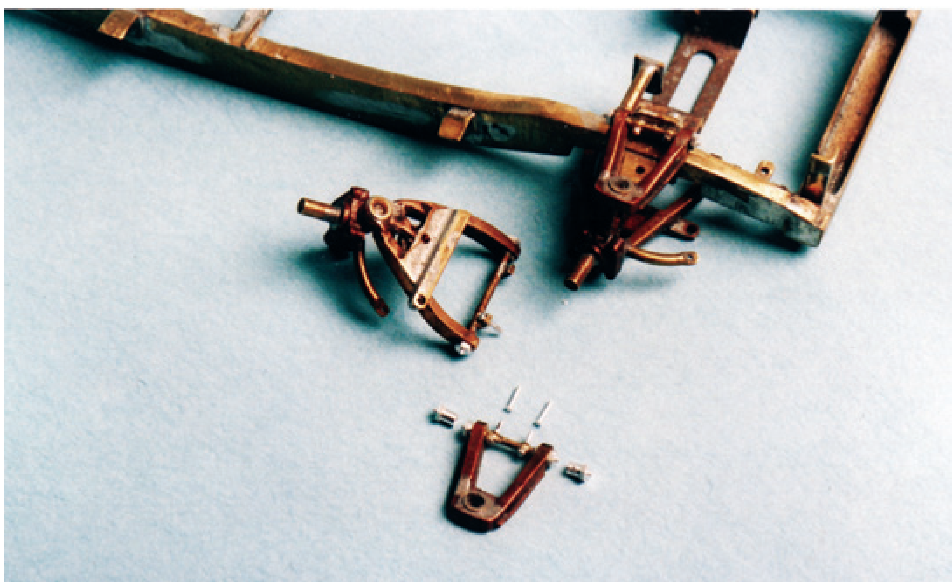


Figure 7.18: Cody Grayland machined the upper and lower control arms (complete with the bosses through which the mounting bolts are run) and the bolts that locate the control arm in the upper A-frame. The control arms are attached almost exactly as if they were 1:1 parts: the bushing slips over the shafts, which have been placed within the concentric “holes” through the pivot points in the upper and lower arms. The upper control arm bushing setup is comprised of five parts, as are the lower control arms.

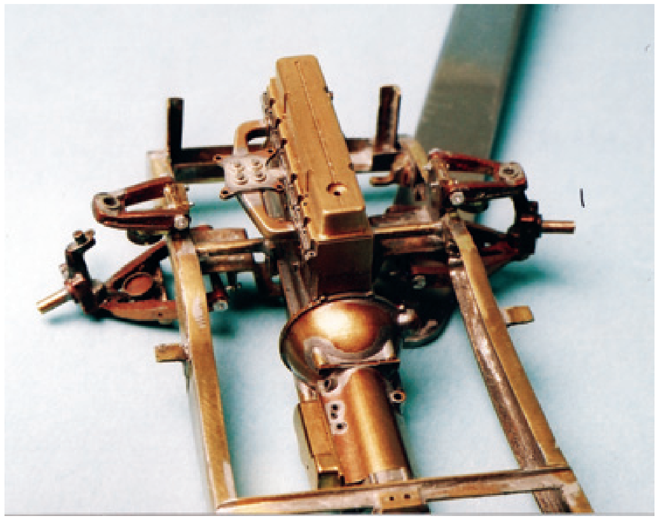


Figure 7.19: In this view, the upper and lower control arms are starting to be assembled, and the motor mounts are in place, which "locates" the Chevy inline engine in the chassis. With the basic front suspension parts in place, details like locating the steering box, tie rods, sway bar and other elements can be reliably placed and then fitted to the bodywork. If interferences (whether direct conflicts or those created by the compounding effects of parts as they are assembled) are discovered, the body can be modified while still in the primer stage. The centerline of the front spindles has been exhaustively checked to make sure that it plants the center of the wheel in the center of the front wheelwell opening.

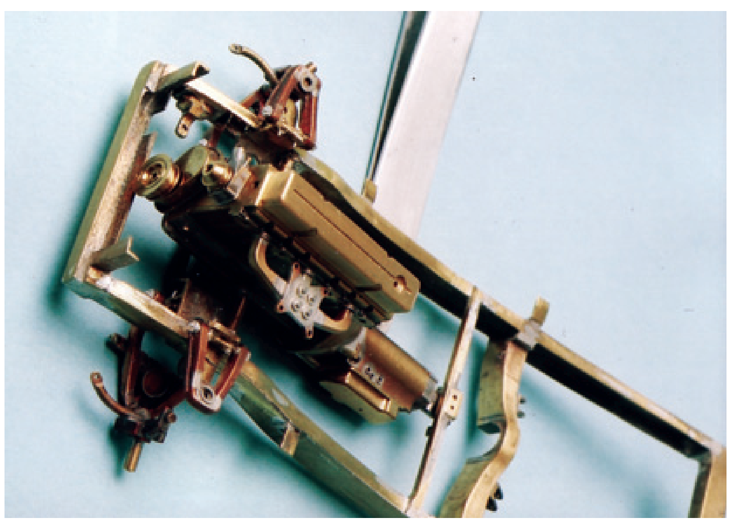


Figure 7.20: More detail on the front of the engine can now be added so that the radiator placement can be finalized. With each step, the increasingly complicated assembly is reconciled with the bodywork to make sure everything fits. With this much in place, aftermarket working ball joints can now be considered. Note the small round sleeves already soldered into the apex of the upper and lower control arms. As this progressive assembly procedure goes forward, it's time to install the backing plate/wheel/tire assembly which will, in turn, be checked for fit with the bodywork. A vintage airbag setup has yet to be fashioned.

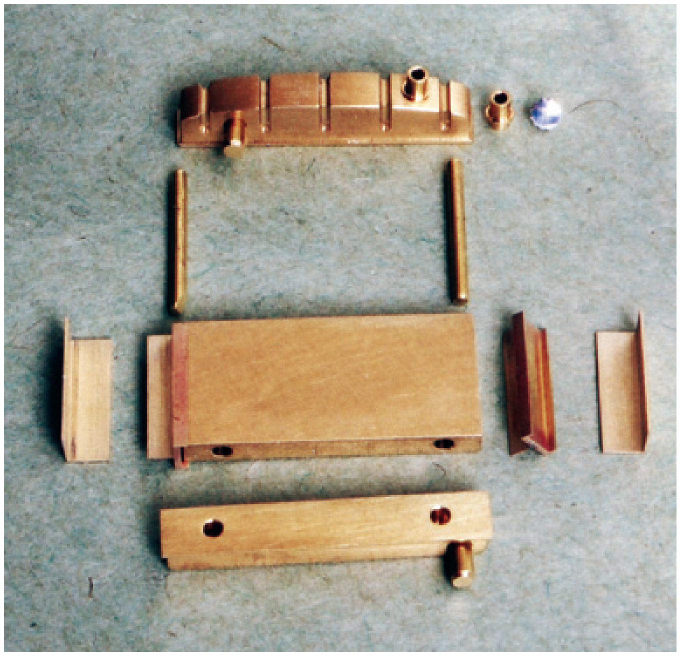


Figure 7.21: The multi-piece radiator assembles easily and the same way every time. The blank center section is used only to determine the overall size of the assembly for creating and checking the overall fit of this assembly to the body and other mechanical components; the center section will be replaced with a properly-detailed radiator at a later time.

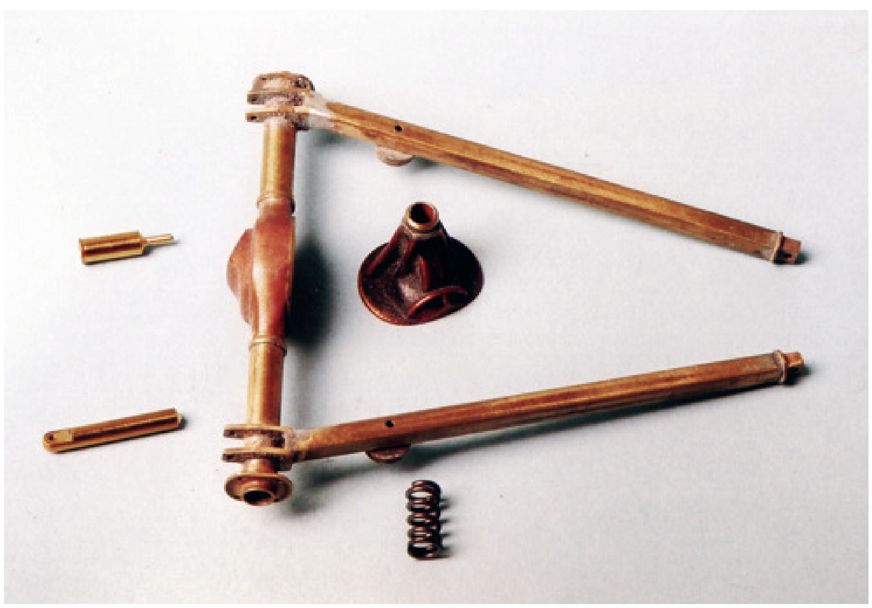


Figure 7.22: The rear axle of the *Dream Truck*[2] is a typical lower trailing arm design located by a Panhard bar, upper control arms, coil springs and shock absorbers. The upper control arms, Panhard bar, and a four-corner airbag setup, based on the rare '58 Ford option, are yet to be built. The center section and gear set are brass cast from plastic masters. Once again, this complete assembly will bolt to the frame, permitting adjustment to the rear axle assembly to align with the rear wheelwell openings and inner bodywork of the bed.

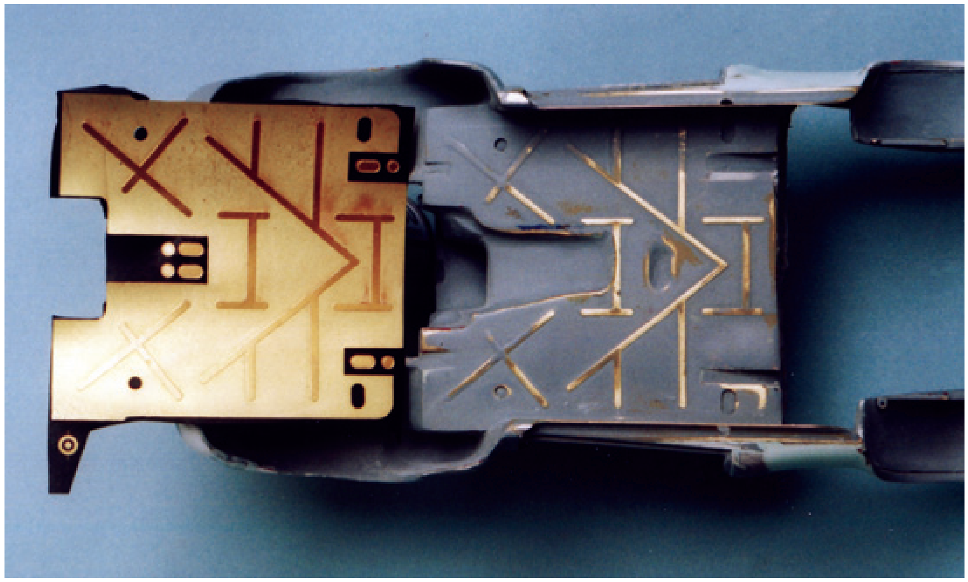


Figure 7.23: Note the structural detail underneath the cab of the *Dream Truck*[2]*;* this comes from a photoetch sheet created by Bob Wick and Fotocut (Fred Hultberg). The gas tank will be dropped in place between the rear frame rails through the top of the bed (before the double-hinged bed cover is installed) because the body design won't permit the gas tank to bolt in place from underneath. This is one of the issues to be considered when building your model: How are you going to assemble it? Develop and write down an "assembly manual" to guide the final construction of your scale miniature!

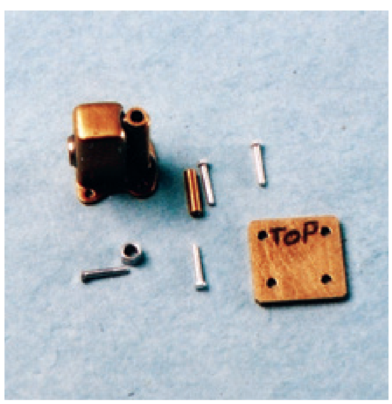


Figure 7.24: The brake system is approached the same way. The master cylinder will bolt to a dimensionally-stable "platform" that will be placed in the firewall (the square piece here labeled "top"). With this mounting plate made a part of the firewall prior to painting (thereby finalizing the location of the master cylinder), the brake lines can be bent from steel wire, attached to machined fittings, and placed and test-fitted, permitting any interference problems to be resolved before final color is applied to the model.

Unibody Car. If your subject matter features an integrated body and stressed/structural floorboard, construct the underbody platform (either by modifying the kit piece or by scratch-building one), but do not attach that platform to the body until you have finished all of the work that requires full access to the inside of the body. For instance, open and hinge the doors, hood and trunk, modify the inside of the body and the inside of the roof to remove ejection pin marks, etc., and to smooth out any bodywork that might have been done *before* you bond the unibody platform to the body. Make whatever changes are necessary to the platform, including suspension pick-up points, before proceeding. Then, *and only then,* mate the platform to the body shell. This body/platform assembling procedure allows you to stabilize a body that has been weakened if you have opened the doors, hood and trunk. Of course, you will assemble your model through the panel openings, but that isn't much of a problem if you work out the integration of components at each step in construction: each subassembly must fit with other subassemblies which, in turn, fit into larger assemblies of components. This assembly scheme also allows you to add details to the front and rear sub-frames and the components attached to them, before they are installed on the model.

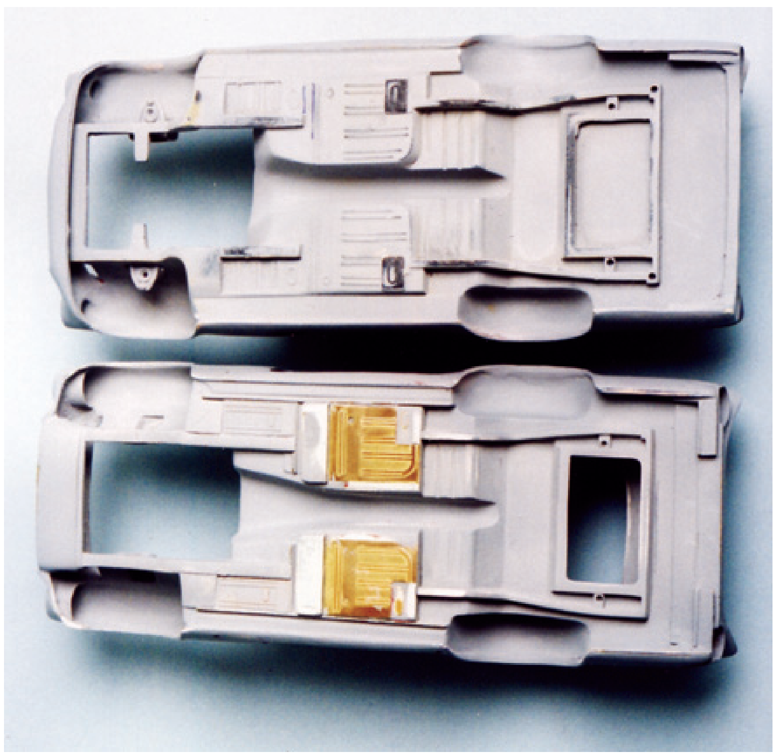


Figure 7.25: A unibody model presents some special issues for the builder. Create the underbody and bond it to the body once the doors have been removed, and the inside of the body has been finished. The brass panels with the structural detail shown here are photoetched. All suspension and drivetrain components will attach to the underbody structure. These two models will be replicas of two of the four "lost" Lincoln-Mercury Lynx dream cars from 1964.

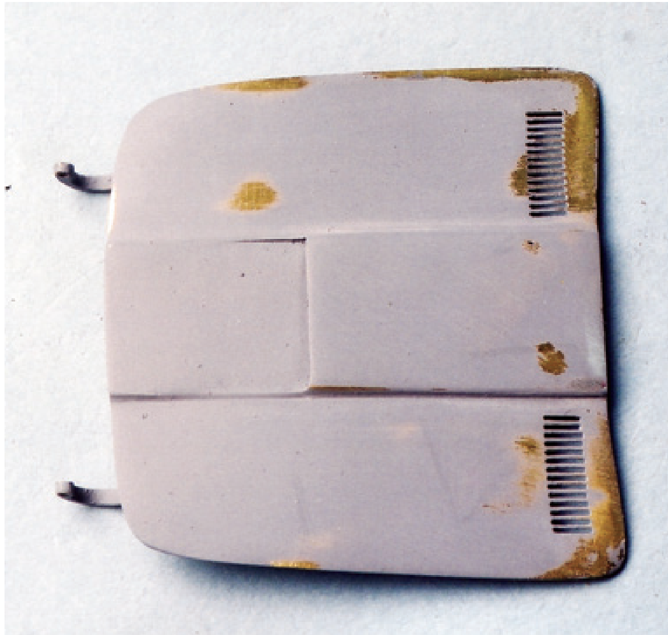


Figure 7.26: The hood for the second Lynx prototype has been hammered from brass and fitted with photoetched vent panels soldered to the hood before the hood opening shape in the body is finalized so that the final shapes of the hood and the hood opening can be matched for an exact fit. Note the formed hinges at the front of the hood (made from rectangular brass rod) that will bolt to a "receiver" up under the upper panel of the body between the headlights and just forward of the hood. Any fitment and interface issues—for instance, making sure that the hood will close over the engine and fit flush with the adjoining body panels—can be solved before the model is painted and assembled.

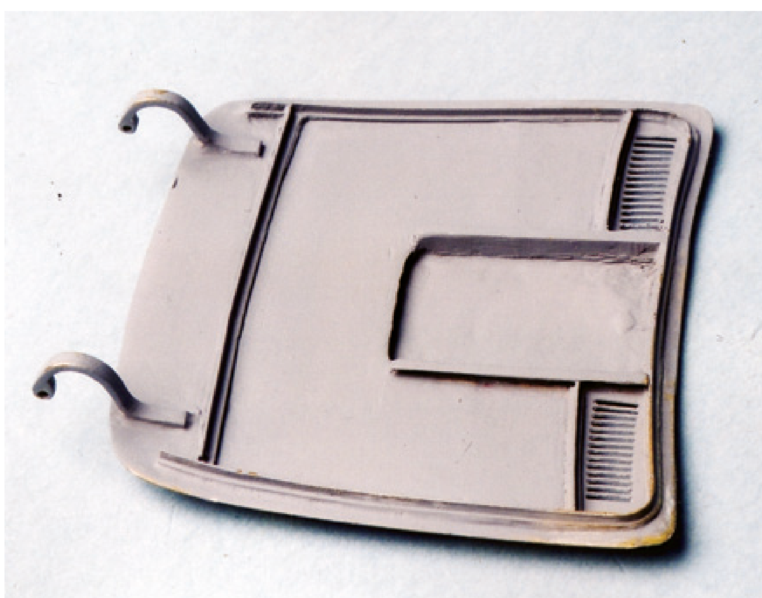


Figure 7.27: The underside of the brass hood has been fitted with soldered-on structural supports and solid brass rectangular rod to represent the hood-hinge arms.

7.3 Building Subassemblies and Components

Use a "locating pin" approach to install most components. Since the subassemblies on your model must be test-fitted repeatedly before completion to be certain that the parts fit together in the same place every time, you need to develop a way to positively locate one part to another assembly. One excellent way of doing this is to install small metal pins in pieces that will match up with holes in the mating surfaces, to positively locate the various minor and major components.

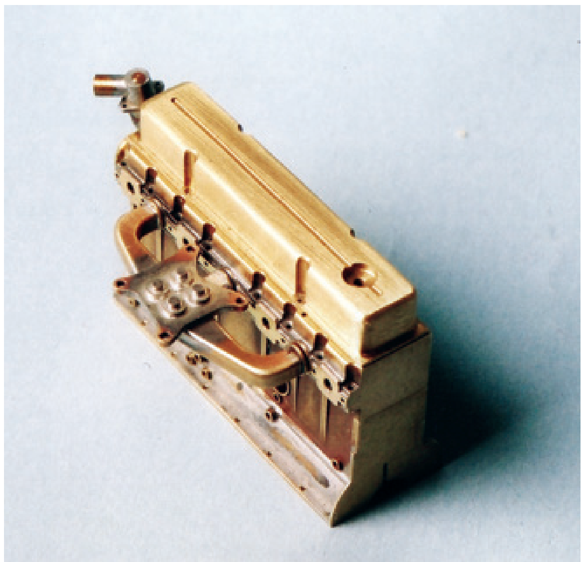


Figure 7.28: The DT^2 engine can only be assembled authentically if it uses pins to positively locate the many parts. The machined intake manifold will attach to the machined intake ports on the engine block. Small shafts are inserted into the intake manifold. The outside diameter of the pin is the inside diameter of the "receivers" in the engine block and in the intake manifold. When finished, the individual exhaust manifold flanges will attach to the exhaust ports so that the dimensions of each part and their relationship to other engine and adjacent parts are "set" to insure repeatability and accuracy of fit. Mounted into a machined receiver on the engine block (with the intake ports alternating with the exhaust ports), the intake manifold fits in the same place every time. The valve cover features an incut line to mimic a similar design on the hood and bed cover. With the engine bolted to the engine mounts, parts fitment and related construction issues can be addressed throughout construction so final assembly will go smoothly.

Is the Vehicle Comprised of a Series of Convincing Subassemblies? Once you have defined your goals and determined the nature and range of your basic mechanical and styling details, the next step is to visualize the completed, "whole" model by figuring out the sets of subassemblies that will comprise your project. In doing so, the entire scope of the model becomes more manageable and less daunting, especially when complex models are being built. This procedure will also help to create an accurate miniature that will go a long way in convincing the judges and viewers of the realism of your entry. Make *each* part, and *each* subassembly, a masterpiece model *in itself*. It is important to fashion each element of the model as if it could be entered in a contest without being combined with other parts. By treating each part, then each subassembly composed of those individual parts, as authentic masterpieces of details, the final subassembly of parts will be very convincing. In turn, larger assemblies of subassemblies, treated as if they alone would determine the character and quality of the entire scale vehicle, will result in a miniature with superior fit, finish, and realistic appearance that are consistent and convincing throughout.

This "subassembly-to-subassembly" construction approach can apply to a wide array of parts. Consider the following.

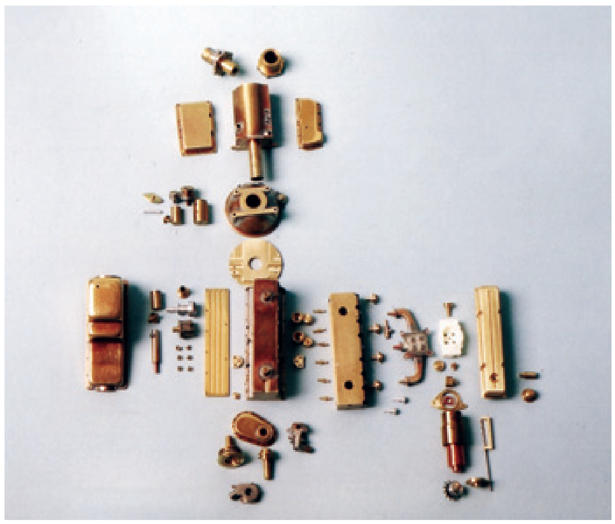


Figure 7.29: The engine for *Dream Truck*[2] is a vintage Chevy inline six mated to a vintage Hydramatic four-speed auto transmission. In this overhead view, most of the parts for the engine and transmission can be seen. All of these parts pin or bolt together which, once again, permits these parts to be reliably assembled to one another, and to be "dry assembled" for placement in the frame, which will allow any interference or assembly issues to be resolved as the bodywork is ongoing and before the paint is applied. One thing to think about is how to assemble a difficult set of parts *predictably and reliably*. You need to develop an assembly sequence and then write it down so you don't forget!

Figure 7.30: The Chevy starter is multi-piece and bolts to the bellhousing. This component approach allows repeated assembly, prior to painting and detailing, to check how these parts fit to the engine block, and how the entire assembly interfaces with the frame and other components.

Figure 7.31: Similarly, the generator (*Dream Truck*[2] is built to 1961 mechanical standards) is a multi-part assembly, and everything goes together easily. The armature was turned from copper to simulate the armature windings when it is seen through the small "windows" in the generator housing.

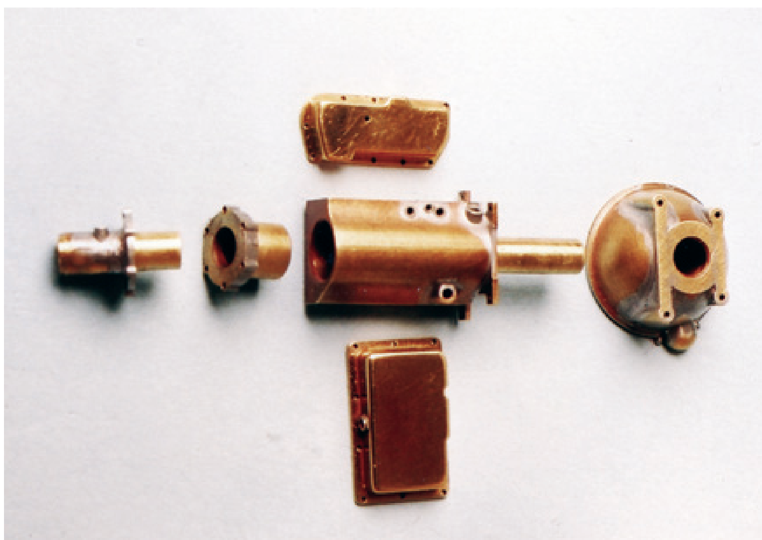


Figure 7.32: The GM Hydramatic was machined based on vintage dimensioned drawings. Note that this Hydramatic is an early version, without the much-later cooling lines, an interesting historically-correct detail. The bottom and side pans (both of which will be chrome plated) will bolt to the transmission housing, and the two-piece tailshaft interfaces with the U-joint machined to fit.

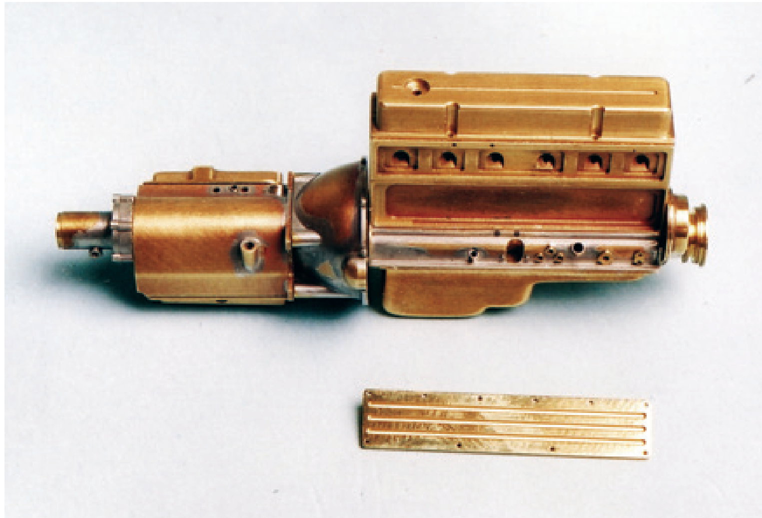


Figure 7.33: The passenger side of the engine shows the meticulous detail, as well as the Hydramatic transmission fully-assembled and in place. The side cover is machined, will be polished and chrome plated (along with the valve cover and oil pan), and will be attached to the side of the block with look-alike hex "bolts" (but without threads). Note that the oval front cover and lower pulley are in place here.

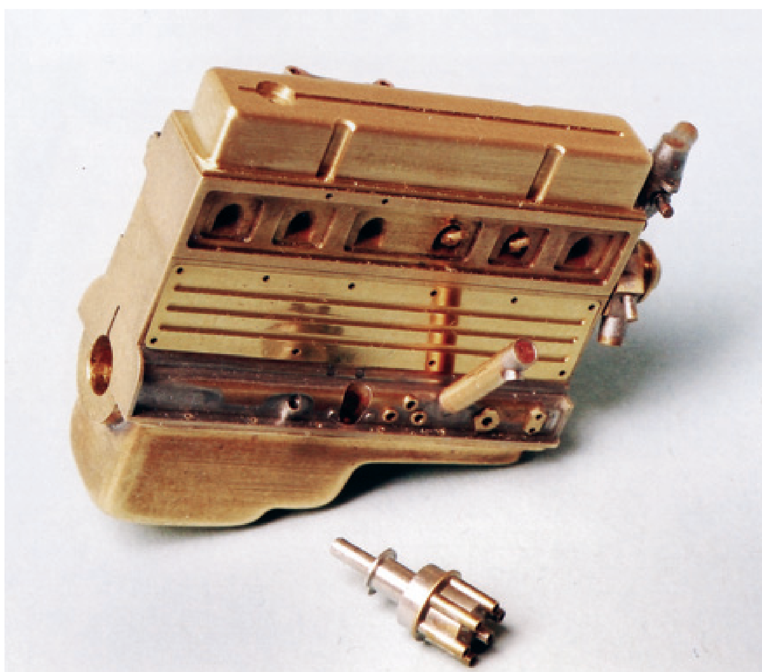


Figure 7.34: With more components in place, further detail on the right side of the block can be seen. The upper and lower radiator hose fittings are placed here to check on fit. Note the machined 6-cylinder distributor.

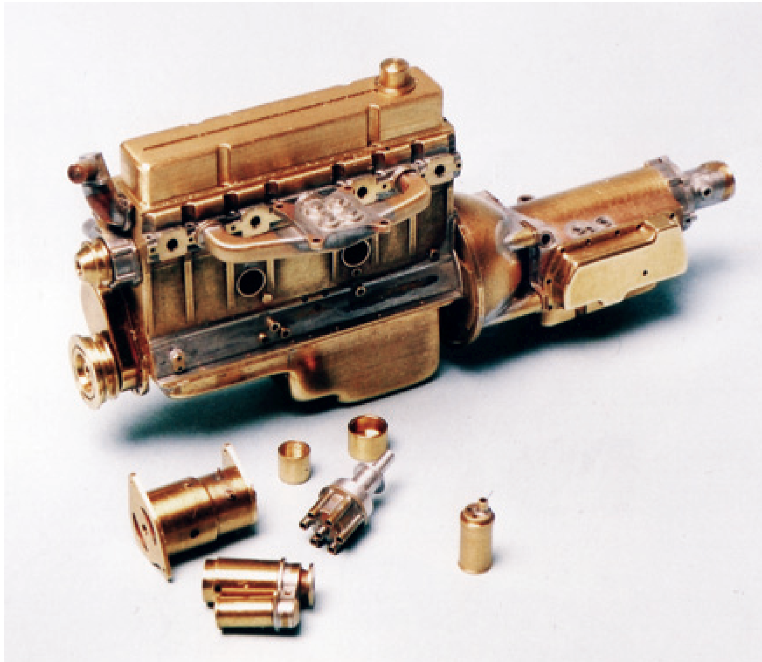


Figure 7.35: With most of the engine components seen here, the length of the fan belt can be determined once the assembled generator is located. The entire engine—composed of a series of sub-components—will become a major assembly that will be integrated with the frame assembly and that, in turn, integrate with the bodywork assembly. The goal is that the final construction will be uneventful and won't require any unplanned last-minute changes to the model that typically damage components and compromise quality. Refer to Figure 7.20 to see how the engine fits to the frame.

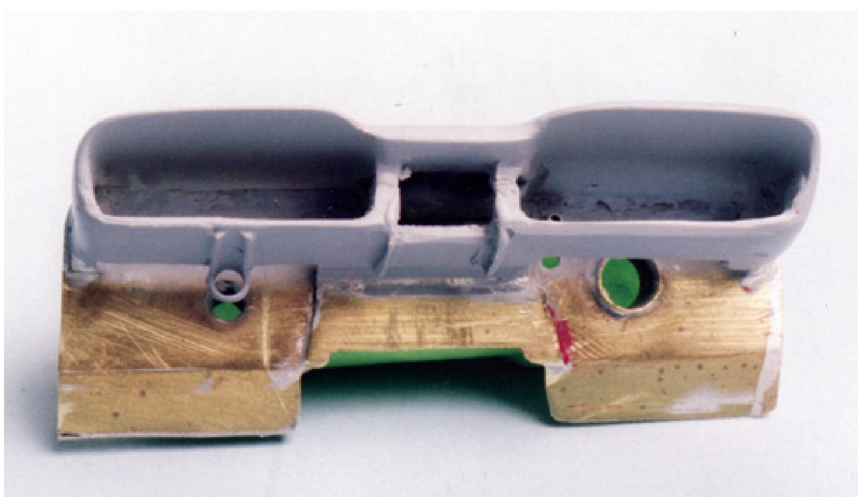


Figure 7.36: The dashboard of the Lynx is a composite of styrene and brass. This entire subassembly has been fitted to the unibody, and will be fully detailed (machined instruments, photoetch instrument faces, operating dash/radio/glove box lights) before placement in the painted model. Note the receiver for the steering column (the brass half-sleeve mounted in the correct position under the dash, and tubing on the brass firewall). The machined steering column will also be fitted and double-checked before any final finishing or assembly.

Figure 7.37: The Lynx dashboard is located to the body using positive mounting points to assure stability and predictability of how parts fit in two ways: a brass sleeve for the heater motor that fits into a sleeve placed in the firewall, and the console (not shown here) that fits up under the center part of the dash which, in turn, pins to the transmission tunnel. Note that defroster vents, the cut-out for the speaker, and the line that will define the painted and padded parts of the dash top.

Figure 7.38: The plastic dash is permanently affixed to a brass structure that not only provides a stable and secure mounting surface for the dash, but also creates a smooth toeboard for the cabin. This view also shows the console in place.

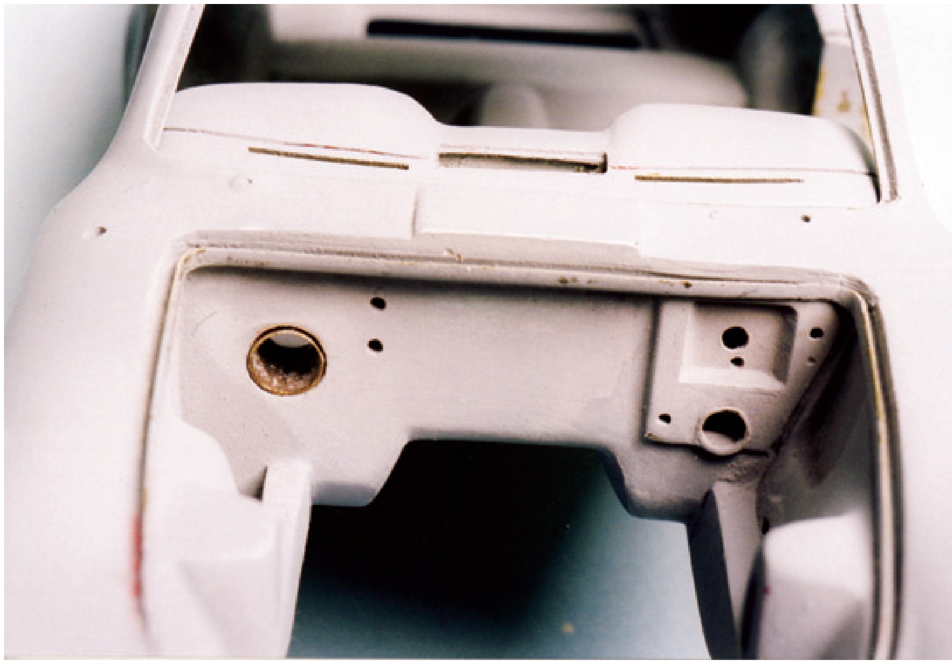


Figure 7.39: With the dashboard temporarily in place against the firewall of Lynx prototype #2, the through-the-firewall heater core (on the left) and the steering column locator tube (on the right) assure accurate and predictable placement. The two holes by the heater motor hole are for the heater hoses, and the openings to the outside of the steering column hole are for wiring harnesses and the master cylinder. Note the brass receiver channel for the windshield; a multi-part separate photoetch "chrome" surround will fit just inside the inner radius of this opening, sandwiching the glass between this panel and the photoetch parts.

Think About How the Parts Interface. When your project requires many parts to fit together, the combined physical intervals between those parts can compound to the point that a seemingly insignificant misfit in each area results in a significant misfit of parts or entire subassemblies to either an adjacent subassembly or to the space the subassembly itself will fit into. It is virtually impossible to think about the shape and size of every part, and how those parts fit with all other parts on the final vehicle without fitting parts together during construction. So, early in the planning stages, you should think seriously about the overall dimensions of major subassemblies and their components, and how each subassembly will fit into the allotted space in the model. By establishing the outer parameters of each subassembly and how that subassembly integrates with other subassemblies in the early stages of construction, you can work within the confines of those parameters and ensure the correct fit of every subassembly into the overall model. By building subassemblies, dimensional errors (or "tolerance drift") can be contained within each subassembly, and not compounded throughout the entire model.

Think about ways to reduce these errors so they are contained within each subassembly. That is, the compounding of panel thickness, the fit between parts, and structural requirements of subassemblies can be compensated for by using techniques that permit some parts to overlap the mating surfaces between the various subassemblies. For example, the extended leading edge of a dashboard (as it fits under the inside of the cowl of a model) could cover up the natural "gap" between the leading edge of the dashboard and the cowl. In that way, you don't need to spend many hours absolutely mating up the dash to the inside of the cowl, which you would have to do if they were to join together surface-to-surface. Try to "cheat" parts so that they appear to be the correct size, or that the entire part appears to be present, even if one end of it is cut short to fit into the available space.

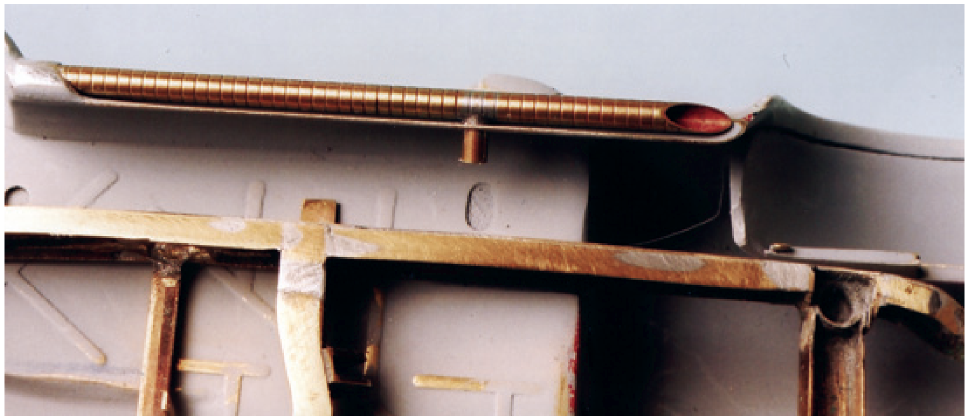


Figure 7.40: On the *Dream Truck*[2], the side exhaust fits into a half-open brass reveal that has been fitted into (rather than merely attached to) the bodywork at the bottom of the cab: The inside diameter of the half-open brass tube is the outside diameter of the lake pipe. Though the length of the lake pipe might suggest that the inlet pipe is at the front, in fact, the exhaust enters the rocker panel side exhaust from the side (note the right angle inlet tube). The placement of this exhaust pipe in a receiver eliminates any uncertainty about how and where the exhaust system mounts to the model.

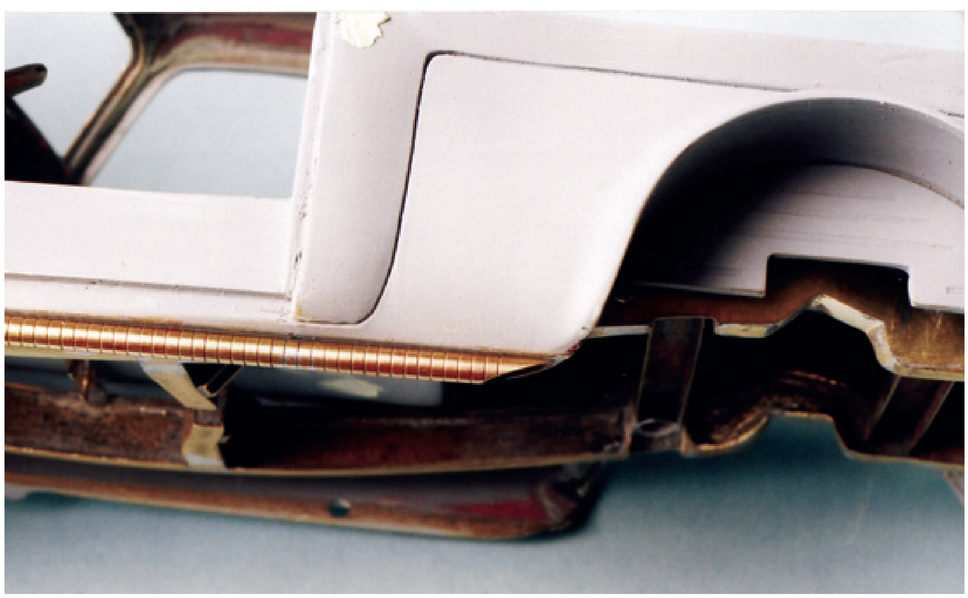


Figure 7.41: Note the concentric rings on the exhaust pipe that match the rings on the front and rear grille work, and note how the curvature at the end of the pipe matches the sweep of the rear wheelwell flare. Think about the interface between styling and function. With the frame in place, the exact relationship between the parts can be identified early, meaning that the final assembly of the exhaust system will go smoothly.

Figure 7.42: The tubular mufflers will mount inside the frame rails and will "hang" on the small machined/soldered brass "hangers." Those clamps will be attached to photoetched hangars insulted by "rubber" straps "bonded" to a bracket that will be bolted to the frame. Of course, the diameters of the inlet and outside muffler clamps, as well as the hangers, match commercially-available brass tubing. Since DT^2 will be built as a "show truck," all chassis-mounted exhaust parts will be nickel plated, and the lake pipes will be chrome plated.

Assemble Major Subassemblies; Each Part a Modeling Masterpiece. If you construct your scale model as the factory does, you'll be able to control size and detailing issues for each component within each subassembly. This also means you will control and limit the impact of each subassembly upon other elements of the model by integrating that subassembly with other subassemblies, then integrating those larger assemblies into the "whole" model. For example, assemble the rear axle as a unit, then fit it to the springs, add the wheels and tires, and then test-install that complete axle assembly on the frame or unibody. If you doubt an assembly will survive much handling, glue together a matching "mule" (at least with respect to exterior dimension and mounting points) and use it as a fitting guide.

Test-fit Every Part Repeatedly During the Design and Construction Process. Think about how that part interfaces with other components. Test-fit everything repeatedly. As you continue to create layers of detail, you will always be amazed at how many glitches will show up as you check and recheck the fit of the pieces that you have crafted. This process can be frustrating, but is much easier to deal with in the early stages of construction and design than it is during final assembly. The goal is to reduce the chances of parts not fitting together when final assembly occurs. Keep in mind the possibility of using one subassembly to determine and locate another subassembly in your model. Also remember to test-fit body parts to check for paint interference.

Figure 7.43: The steering column and Corvette steering wheel for DT^2 generally mimic the steering wheel from the pre-accident version of Spencer Murray's *Dream Truck*. The length of the column and its diameter, as well as the dimensions of the steering wheel and the spoke detail, were all taken from 1:1 scale parts.

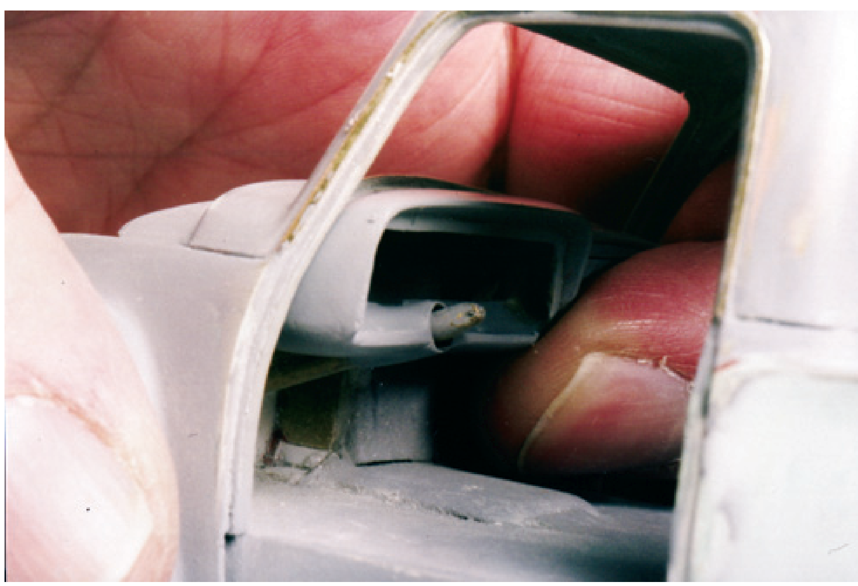


Figure 7.44: The length of the steering column, as it goes through a tube on the dash and over a solid brass rod mounted to the firewall, principally locates the dash in the model. In this way, one assembly becomes an integral part of another assembly, and minimizes the risk of spilled adhesives and other final-assembly tasks that might damage or compromise the quality of the final model. Another positive method of locating the DT^2 dash will be a console that fits tightly to the floorboard and under the dash. Compare Figures 7.38 and 7.52.

Figure 7.45: Because the cab and floor are one assembly, it's essential to create an "insert" that will serve as the molded headliner and adjoining "upholstered" panel. To do that, a part comprised of the headliner, a panel around the rear window, and pieces that fit down inside the B pillars and will serve double-duty as the "receivers" for the seat inserts is created from multiple pieces of .040 sheet styrene. The center of the headliner will receive a pleated insert.

Figure 7.46: The process of readying this part for final painting requires a lot of shaping, putty, sanding, more catalyzed putty, primer and more sanding, all while constantly checking the fit of this part to the inside of the cab roof. As this work progresses, this part is repeatedly placed into the cab to check for fit. Note that small protuberances have been added at the outside corners of the front of the headliner insert, and will eventually locate the upholstered panels that fit inside the A pillars.

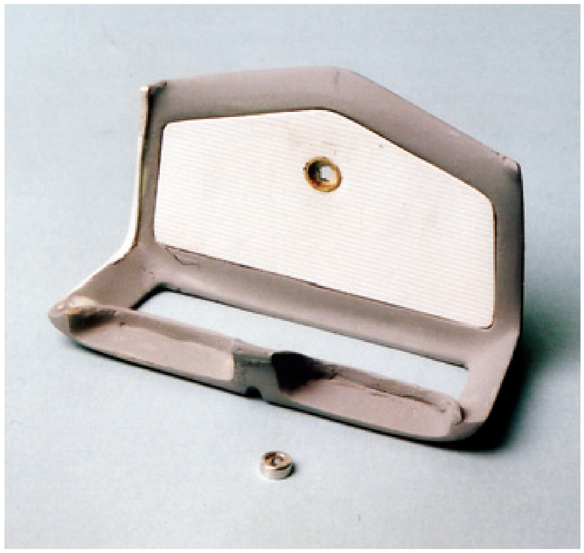


Figure 7.47: Here, the insert is starting to take shape. With the basic configuration determined at this point, the upholstered headliner insert is cut to shape (using a template) and then repeatedly fitted to the headliner so that only the most minimal gap exists between the two parts, to accommodate the anticipated thickness of the paint. Note the short length of brass tubing placed in the upholstery headliner insert. This will be the "receiver" for the machined and chromeed courtesy light bezel seen here in the foreground (a bulb will be placed into the bezel, over which a clear lens will be placed; this is one of the lighting elements of the model). This is another way of stabilizing not only the bezel-to-headliner location but also the placement of the clear lens.

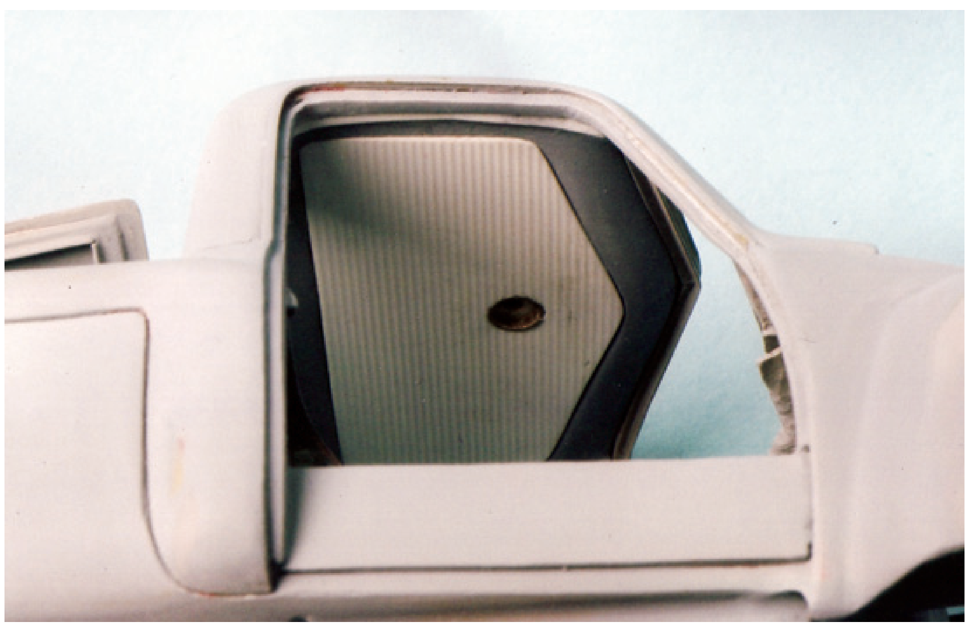


Figure 7.48: This part now fits tightly into the top of the cab. It is almost a friction fit. Here, a little more work will be necessary to make the gaps between the outside perimeter of the headliner and the inside of the roof uniform. The leading edge of the headliner still needs to be modified to mount the sun visors that will pivot and swing sideways. Incuts will be made into the "upholstered" headliner so that the sun visors can come close to being coplanar with the headliner.

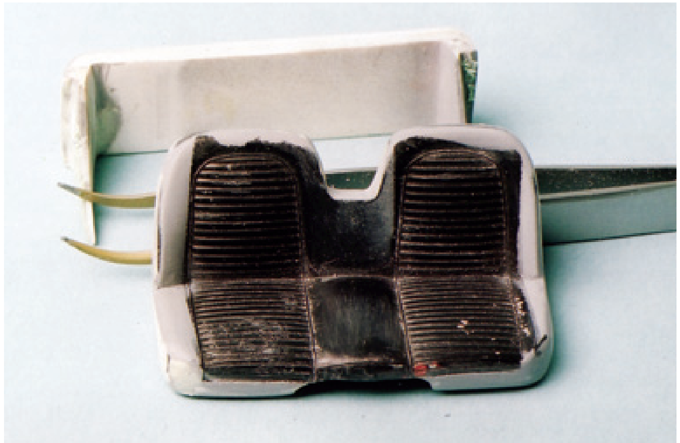


Figure 7.49: The front seat will be a one-piece shaped/bucket seat design, using a section of the rear seat from the Monogram 1958 Thunderbird. Side bolsters have been added (rather than splitting the seat and widening it) to make sure that the driver would sit squarely in front of the steering wheel. The very roughed-in part behind the seat assembly is a "surround" that will be placed inside the cab, into which the seat will fit. This part will be modified so that the passenger seat back will fold forward to give access to a panel that will open to the bed, where the Delco battery will be located.

Figure 7.50: The seat surround, shown in its early stage, is placed inside the cab and beneath the headliner/rear window insert. Note how the shape of the upper seat receiver will sweep up and around and follow the side of the seat. Eliminating or minimizing the part-mating line between these two parts will be a challenge; either a piece of trim to cover the interface or a very tight line will be necessary. Again, prepare an assembly manual to govern construction; there is *only one* sequence that allows the interior of the DT^2 to go together.

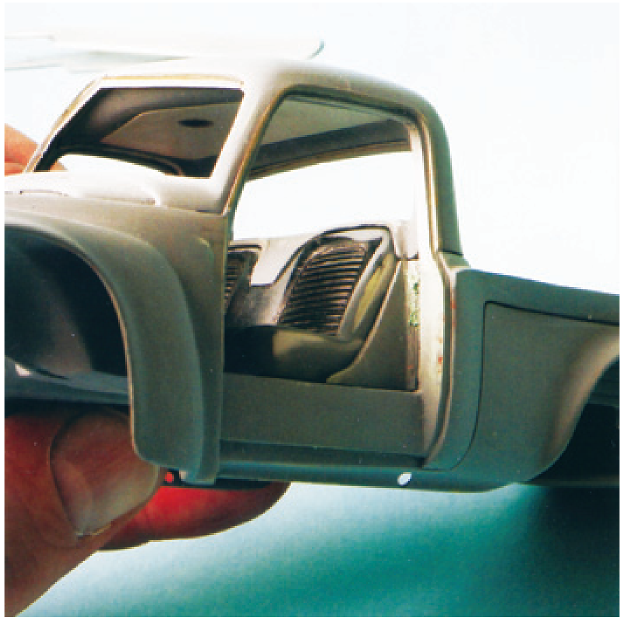


Figure 7.51: With the roughed-in seat in place to check the basic fit of the parts, the question of how these parts will integrate can be fully explored. The seat will slide on tracks, so a bit of the bottom of the seat will have to be removed because the seat can't move upward without reshaping the upper upholstered panel. The shape of the side panel will be changed to sweep more gracefully at its downward angle.

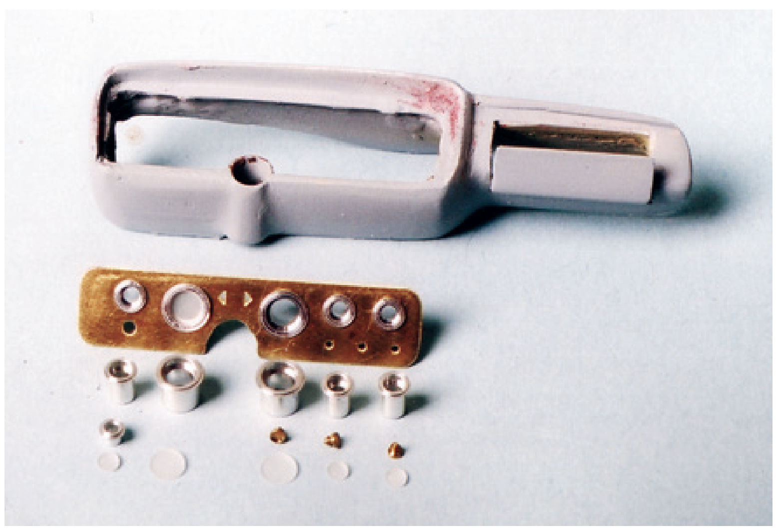
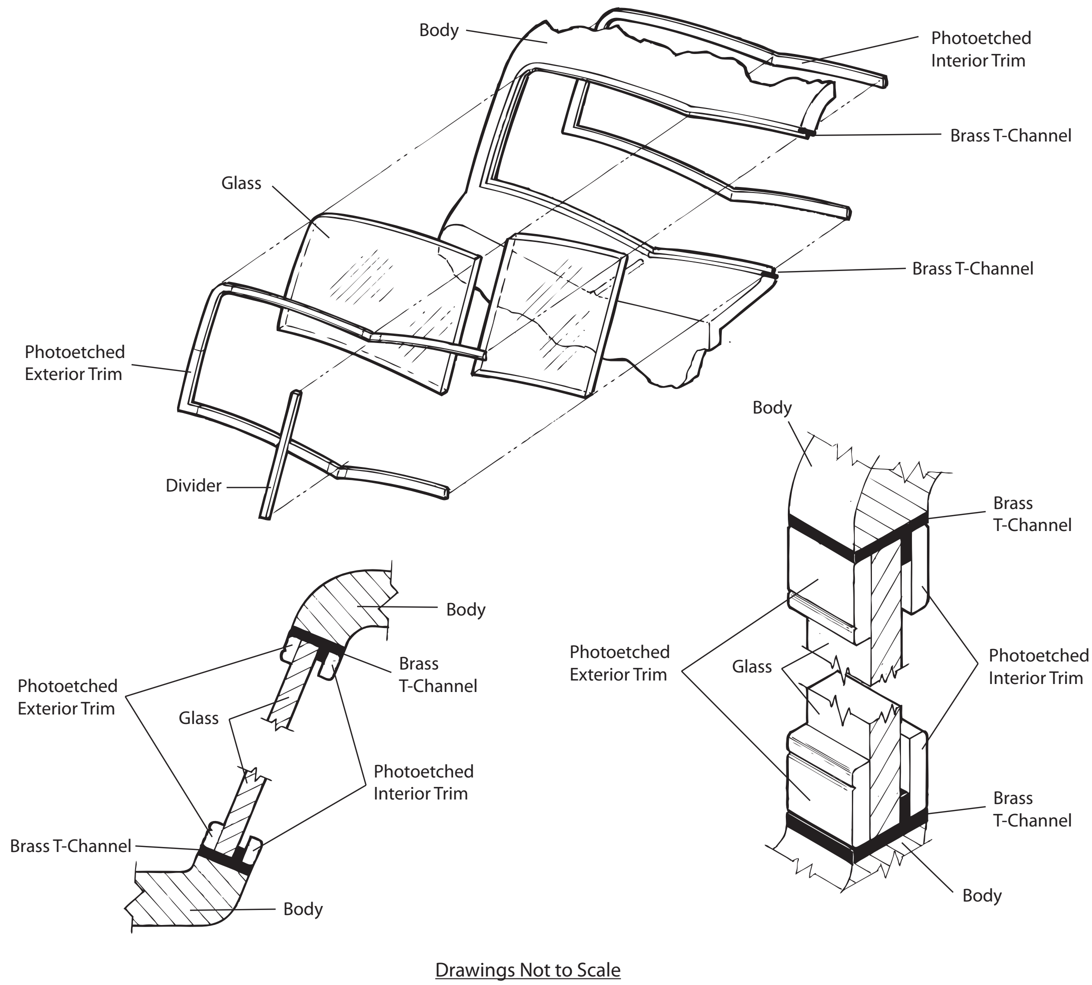


Figure 7.52: The DT^2 dashboard is also a model composed of subassemblies which, in turn, must fit properly into the cab. The dash fascia here is photoetched, the bezels are machined with clear lenses installed, (to the inside of which will be fitted the instrument decals). The steering "tube" will receive the steering column.

Painting the Body; Prepare Your "Chrome" Trim. It's a good practice to concentrate on the body cleanup and modifications as early as possible in the assembly process, to allow plenty of time for your bodywork to stabilize before painting, and permitting you the time to find and fix any flaws. Before you apply your final coats of paint, test-fit the major exterior body pieces (doors, trunk, and hood) and allow for paint thickness along panel edges which can foul up the best plans at final assembly. If necessary, lightly sand the facing surfaces of interfacing panels (e.g., the opening door to fender interface) on the edge to reduce the width or height of the painted panel before applying the final coat of paint. While the body paint is drying, you can concentrate on building and finishing the subassemblies that fit into the body and chassis so that everything is ready to go together within a relatively short time-frame. This reduces the risks of damage to your model because the longer it is left out waiting for the next parts to be finished and installed, the greater the risks of something being damaged, broken or lost. Check out Chapter 11 for tips on how to paint a championship model.

One of the key issues that must be addressed before painting is how to integrate your exterior trim to make sure that you achieve a realistic appearance and not chip the paint or have the parts not fit. One way to do this is to create stand-alone trim that fits inside a defined shape, the final dimensions of which can be determined before painting. (Remember that the interface between the painted panel and the exterior perimeter of the part must be anticipated).

Figure 7.53: The first thing to do is to create a "ledge" against which the real glass, and the inside and outside trim, can be placed. The ledge here was created from "T"-shaped brass available from Special Shapes. Care must be taken to place this ledge, with respect to the windshield opening, so that inner and outer photoetched trim can fit without protruding beyond the dimensions of the surrounding body. See Figures 7.54 through 7.56.



- This glass and trim assembly scheme requires a "T" channel which is "deeper" on the outside of the body than on the inside (to accommodate the thickness of the glass);
- The photoetched trim fits tightly inside the "T"-channel fixture in the body, thereby covering any small gap between the outside perimeter of the glass and the inside of the "T"-channel;
- "T"-channel is built and installed AFTER the photoetched trim is on hand because it isn't possible to precisely determine the dimensions of photoetched parts at the art-creation stage;
- After nickel plating, paint the "incut" reveal line in the exterior photoetched trim matte black.
- The "T" channel fits around the entire radius of the window opening;
- Installation sequence: After the body is painted, the inside of the "T" channel on the inside of the channel is painted matte black to simulate the rubber seal; the glass is secured with small drops of Krystal Kleer or similar product; photoetched trim is then installed with small drops of Krystal Kleer applied to the extreme perimeter of the glass;
- Install the inside photoetched trim in the same way (except, of course, that no glass is installed on the inside of the "T"-channel).

Figure 7.54: The best way to do trim (for the windshield and backlight) is to either replicate the 1:1 setup, or come close. These illustrations show how the glass fits into a channel from the outside, over which the photoetched trim fits. This trim will not only bridge any gap between the exterior dimension of the glass and the inside of the brass surround, but also provide a realistic appearance. Note the details on how the inner and outer "chrome" trim, and the glass, will be installed on DT[2] In many cases, 1:1 construction and design details and procedures can be successfully transferred to your chosen scale. (Bob Wick illustrations)

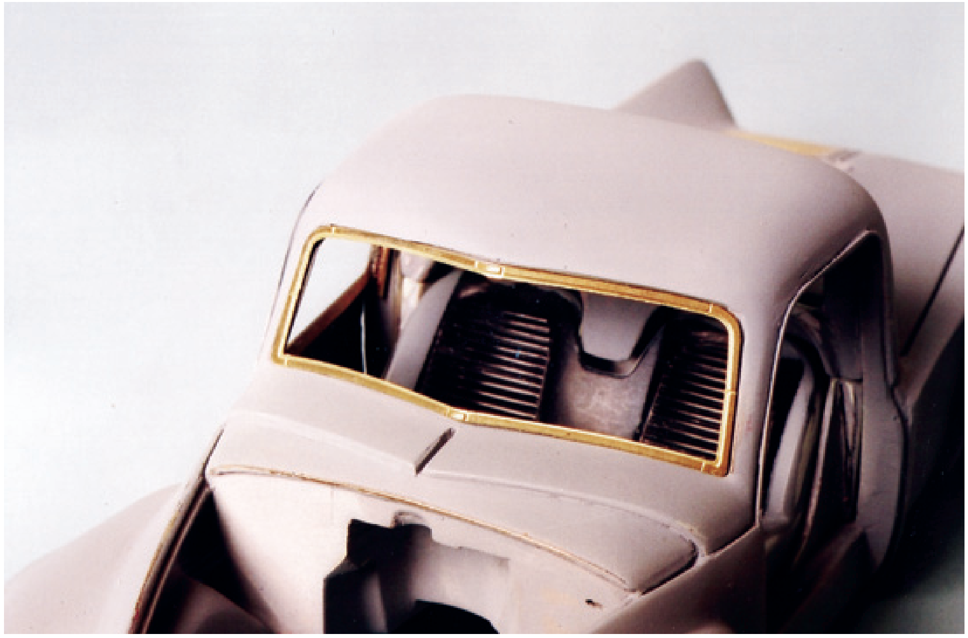


Figure 7.55: The exterior trim was photoetched, with double-cut lines placed in the trim to simulate the likely length of each piece of the multi-piece assembly that comprises windshield trim.

Figure 7.56: Mirror-image photoetched trim parts were drawn by Bob Wick and photocut by Fred Hultberg. Note the "cut lines" which delineate where the several parts that make up a trim set would exist in this application. Note also here the ultra-small Phillips-head screw relief cuts because inside trim is most usually secured by screws. When polished, this trim will be nickel plated (because none of this trim, as anodized aluminum or polished stainless in 1:1 scale, would have a "blue"-chrome appearance.

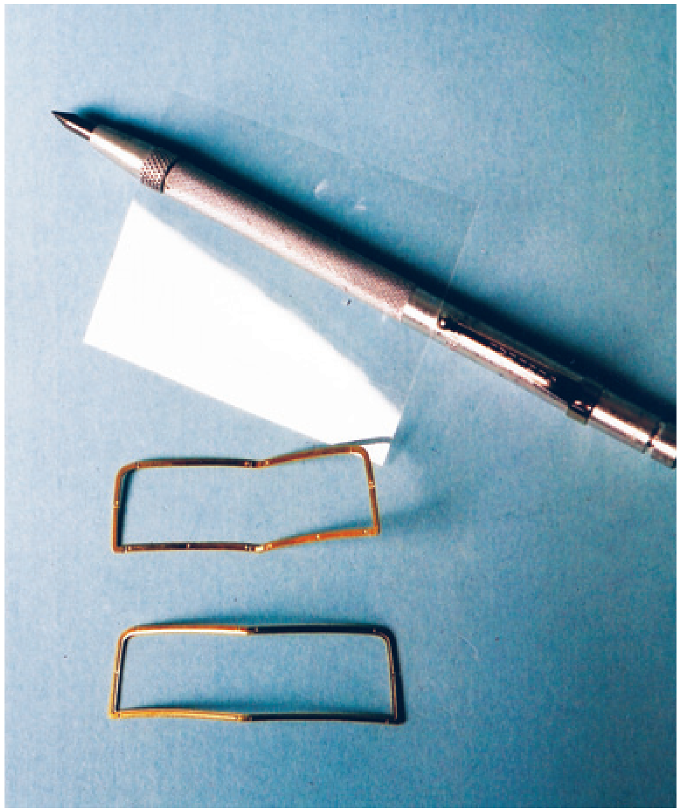


Figure 7.57: Real, scale glass (slide glass, .010 thick) will be mounted. Using the outer trim part (lower) as the template, glass will be cut and placed inside the channel illustrated in Figure 7.54. Nothing "reads" like glass except glass, but using real glass is limited to applications where the shape is flat because custom-made curved real glass is incredibly expensive.

7.4 Take Your Time

A great enemy to quality building is impatience and its companion, the belief that spending a lot of time on a single model is inconsistent with enjoying the hobby. That is one reason scheduling is so important. Excellence in building has a price and, if you pay it, you will be richly rewarded with a work of miniature automotive art. On the other hand, not every model you build needs to be at the highest level . . . Keep it fun, and vary your projects and goals.

CHAPTER **8**

Evaluate Your Work and the Work of Other Builders

One crucial aspect of building authentic scale vehicles is the ability to look at your skills and the work you do critically, both as your model evolves during construction, and once it's finished. This kind of critical evaluation also includes looking at other builders' work, and seeing what does and doesn't make their models successful.

These evaluations will, at various times, be revealing, discouraging, frustrating, encouraging, disheartening, invigorating and occasionally inspiring. Nonetheless, these reviews are vital to reaching the goals you've set, and to creating the best scale models you can possibly build, now and in the future. Through these self-appraisals, you'll learn to measure what you're doing against what you want to achieve. The discouraging aspect will be when you realize something you've spent many hours doing isn't good enough, didn't work out the way you thought it would, that you need to further refine your skills, that you'll need even more research to get something correct, or when you see that someone else has done what you did, only better. The encouragement and inspiration will occur when you realize that you've accomplished a particular task as you had intended it, when you've successfully applied new or improved skills and knowledge to that task, and when you've learned how make your next project even more realistic.

Critical evaluations of models begin when you can look at your projects, and the models of others, with a "judges's eye," divorced from your involvement as the builder and apart from your preferences and biases, and can say "that works" or "that's not realistic." But remember: There is a second part to that critical evaluation. You'll need to figure out *why* some element of your model does, or doesn't, convince the viewer that this is a scale miniature of the intended subject. Figuring *that* out and applying that information to what you build will allow, and encourage, you to improve your work.

When evaluating your work or the models of others, here are some things to consider.

Basic Craftsmanship. This topic appears throughout this book because it is the cornerstone upon which every element of every models rests, and it sets the tone, philosophy and attitude that carries throughout the process of building that model from beginning to end. Craftsmanship isn't just making sure that the mold and parting lines, ejection pin marks and copyright notices are all removed. Rather, craftsmanship can be determined by how each part fits with other parts and, in turn, how that grouping of parts fits into a larger subassembly; in how each subassembly appears as a completed unit (a "model in a model"); in the delicacy and detail of surface finishes, in the smooth and proper operation of all working parts and features; in the fit of major components (e.g., the interior into the body); and how the finished body integrates with the interior, chassis, and all mechanical components; and in every other aspect of the completed model.

Detailing. Once basic craftsmanship is addressed, detailing is evaluated. Judges look to see if the detailing is convincing. Is the detailing authentic and realistic? Don't make the mistake of "burying" the model in irrelevant and inaccurate details by randomly attaching wires, brackets and clamps everywhere. Route mechanical, electrical and hydraulic elements in the way they appear in a 1:1 vehicle. Check out research materials, brochures and ads, review factory or aftermarket repair manuals, visit car showrooms and old car shows, and go to junkyards, which can provide an incredible array of examples and information on how "real" cars are wired, plumbed, and assembled.

Scale Are all of the components and individual pieces in a scale appropriate to the overall model? Be aware of the dangers of "mixing scales" and inaccurately sized components. For instance, don't automatically assume that every part in a kit is accurately scaled, or that all of the parts in a kit are consistently scaled. Develop a critical eye and make an independent determination of whether all of the parts look right with respect to other parts. The real test is: Does that part "look right" in relation to the rest of the model? Remember those radio antennas in kits from the Sixties? If you scaled those parts up to 1:1, the antenna shafts would the one-half inch or greater in diameter; clearly, you'd never use that part of your latest project. What about the big-rig kit exterior rear view mirror arms and braces? If scaled up, they'd be more than an inch in diameter; hardly a realistic representation. Think about hood, doors, fenders and and trunk thickness. How thick do you think those panels would be if scaled up?

These scale considerations invoke a deeper question: If you can't build a stable, strong part in correct scale dimensions from plastic, then choose another material like brass, aluminum wire or whatever would be appropriate for the application. There is an interchange here between successfully completing a model that will survive the construction process and, at the same time, a model that portrays a realistically-scaled miniature. Don't be reluctant to modify, replace, or scratch-build parts for proper scale. All of these scale details add up to a more realistic and credible model.

Acceptable Compromise. Begin thinking about this early on. Every model has compromises, most often because of scale vs. materials limitations. What details can (or should) you make as complete and realistic as possible because they'll be in plain view, which should you simplify, and which could or should you leave out? If the engine compartment is a little too short or narrow, what can you "cheat" so it looks right? Would a slightly smaller scale engine "look better"? Should you create thinner inner fenders from brass, and "push" them outward a few scale inches to get more space and create a more realistic setting for the engine and other mechanical components? Can you thin down the radiator core, or shorten the water pump to create more space and still look correct? Sometimes these are just too many wires jammed into an engine compartment to look realistic, a problem that is usually the result of not using correctly-sized wires and fittings. How about reducing the physical size of some elements, such as wire or hose diameters? Within the bounds of what might be required in terms of accurate placement (as in the case of replicating a factory car, or any other specific vehicle), can you re-route some lines and wires to create a better look for the engine compartment? Consider, too, where intricate and thorough detailing will be seen, and where you might be able to "imply" details without actually making them. Would careful selection and application of paint, upholstery, or panels suggest to the viewer that more detail is present than actually exists? Think about creating shadows to suggest parts not actually there, or even painting lines to mimic wires or hard lines (and shadow painting the same to suggest depth).

Grabbing the Viewer. Will the model you've created involve the viewer both aesthetically and emotionally? Can you intrigue the viewer and invite a closer look at your work? When you look at someone else's model, what captures your interest? How can you apply that technique or approach to you model? If you're looking at a diorama, can you picture yourself in the scene? Is it realistic and well-thought-out enough to tell a persuasive story? Are you intrigued with the story, delighted by the little visual details, and do you find yourself trying to peer around corners or through doors as your eye is led from detail to detail?

If you're building a birdcage Maserati, will your viewer want to look through and around all the chassis tubes to see intriguing details on the engine, the interior appointments, and the suspension? Think about creating little "surprises" for the viewer that they may not notice at first, but that, once they are seen, will make your audience want to look closer and for more details.

Finishes. Do the surface and component finishes look real? Are the gloss, satin, flat, metallic, chrome and fabric finishes appropriate to the model and convincing to the eye? Is the weathering or signs of use subtle or overdone? Are the tires too shiny or too black? Does some detail just "look wrong"? Even if you can't figure out why to begin with, if you acknowledge the existence of that shortcoming you'll eventually realize what bothers you about it, and how you can fix it. Whenever possible, look at 1:1 vehicles similar to what you're building, and see how various finishes on a particular part actually look, and then compare your effort to what you observed on a full-scale vehicle.

Is the quality of the body paint consistent and authentic in appearance? Are there scratches, orange peel, sanding marks and other evidences of flawed bodywork and paint? Is the paint thin over broad panels, showing hints of the primer or sealer? On the other side of the coin, does heavy paint cover up delicate details like cowl vents or emblems? Consider how to fix such problems *before* final assembly occurs. Evaluating and solving potential problems will prevent the problems from occurring in the first place.

Evaluate Your Strengths and Weaknesses. Be honest about where your skills excel, where they're weak, or need further development. Can you do killer interior work and upholstery, but aren't really comfortable when approaching mechanical detailing? Are you a great brass fabricator, but only an adequate painter? Can you replicate almost anything, but can't seem to get your original designs to turn out quite right? What skills do you expect to use on your project, and do you have them presently? How much practice and further skill development will be necessary for you to build your desired model? Do you need more or better tools? Most importantly, do you have the time, interest, commitment and "drive" to take on your next high-effort project?

The key element here is the willingness and ability to be intellectually and aesthetically honest about your skills and work. There is strength—and no downside—in the ability to critically evaluate your own work. The commitment to look, clear-eyed, at your work, to appreciate the strengths and weaknesses of your modeling, is the core of great building.

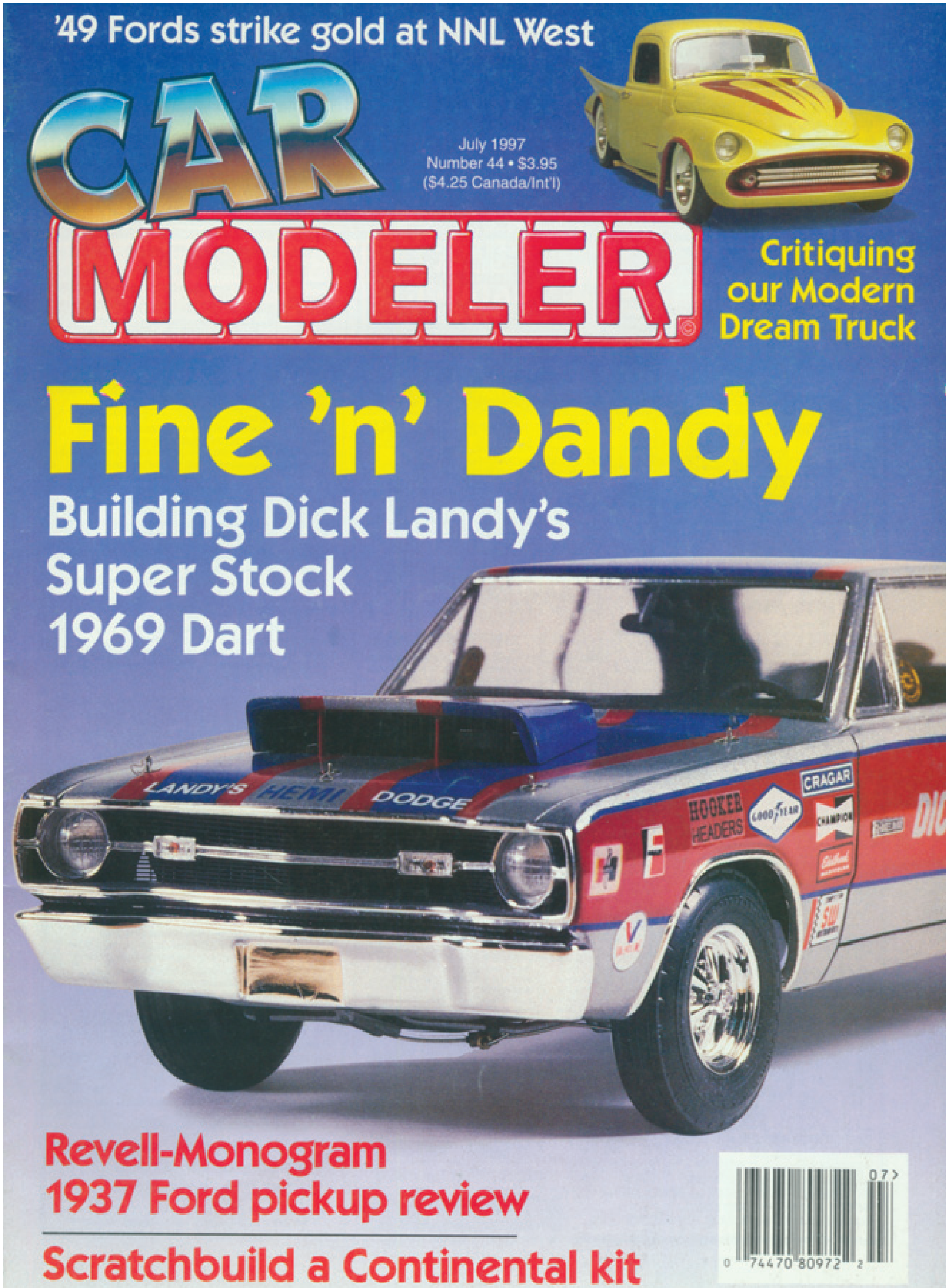


Figure 8.1: It's important to be critically aware of the flaws and strengths of your work. Mark S. Gustavson publically critiqued the first version of DT^2 in the July 1997 issue of *Car Modeler*. For the complete evaluation that led to the redesign and reconstruction of this model, please go to Appendix B. (Images here and in Appendix B courtesy of Kalmbach Publishing.)

Look at as many aspects of your project as you can objectively, and make a list of what you need to do (and what additional skill sets you need to develop) to successfully build your project. Prepare an inventory of your skills and think about how those skills can be matched to your next project. While you shouldn't shy away from a subject because parts of it fall outside your current skill levels, it may be wise to consider building a series of increasingly complex and complete models to develop and exhibit a sophisticated range of skills and knowledge. The truth is that a novice builder can seldom, if ever, build a Championship-level winning model.

Advice and Feedback from Other Builders. Scale vehicle modelers are generous in sharing their solutions to various building problems, including which materials and techniques work best. If you see something you like, ask how it was done. We all have fellow modelers whose opinions, artistic eye, or sense of detail we respect. Make use of those resources, and ask them to critique your model during construction and following completion. You may not agree with their comments entirely, but such comments will get you to think about what they see, and that's valuable information. If other builders' opinions are important enough to seek out, they're important enough for your serious attention.

Also ask other modelers if they have solved similar problems; where they sourced their materials, parts and supplies; and what techniques they've used or developed. Club meetings, display and competitive events, and magazines are all places to find a range of ideas in one place . . . use them! There are several excellent discussion boards readily available online that are great sources for such discussions, too, including:

- wwwboard.spotlighthobbies.com
- cs.scaleautomag.com/scacs/forums
- www.modelcarsmag.com/forums
- scalemotorcars.com/forum/index.php

Remember that it's a two-way street. When someone asks you for a critique, advice, or help on their project, extend them the same courtesy, time, and knowledge. Maybe you can teach someone a skill you have in exchange for them teaching you something that you need to learn, or improve upon. The exchange of information is a big help in better building, and is one of the most fun and enjoyable aspects of the hobby of scale vehicle construction. And, odds are great that both of you will learn something from each exchange.

CHAPTER 9

Championship Bodywork in Plastic

This chapter discusses basic through advanced bodywork and painting techniques. We'll work through surface preparation to avoid an uneven surface, apply a bullet-proof sealer to avoid the dreaded appearance of "ghost" images in the final paint job, and then move on to how a solid color can be applied and rubbed out to glass smoothness, eliminating the need for a clear coat (though metallic, pearl and candy color coats will always need clear coats).

Let's start by mastering some basic bodywork techniques, and then fully explore the relatively simple techniques of applying a solid-color acrylic lacquer finish to a mildly-customized 1966 Buick Riviera, based on the excellent AMT kit.

Note: All products shown here are available at autobody supply stores and are intended for professional use only, so you may have to persuade the proprietor that you are knowledgeable in the use of the products.

Figure 9.1: The polyester two-part putty marketed by Evercoat is the best catalyzed putty to use. Formulated for use with automotive paint, this is an excellent product that requires mixing the putty with a catalyst. Choose the "Metal Glaze" version from the Evercoat line; it is finely-grained and feather-edges beautifully. Remember to keep the lid on tightly; otherwise, you'll have a solid two-pound paperweight! Other brands are also available.

Figure 9.2: A great finish is no better than the surface preparation. You should acquire a range of the popular and ever-useful sanding sticks, some 150 dry autobody sandpaper (in the center), as well as some 3-M autobody 600 grit, 800 grit, 1200 grit and 2000 grit. Use only autobody products because we're doing just what the "big boys" do, and paint doesn't know a scale! If you're learning to do paint and bodywork, don't take a shortcut and substitute other products for the ones used here. If you're already experienced and have preferences for products you've found work well, use those.

Figure 9.3: In the lacquer system, there are no better products than these. Never skimp by buying cheap thinner, and always mix the primer and thinner according to instructions. See Figure 9.4 for a mixing chart.

LACQUER PAINT THINNING CHART

Recommended DuPont Lacquer Thinners
Fast Dry (no. 3608S)
Medium Dry (no. 3661S)
Fast Dry/High Gloss (no. 3602S)
General High Performance (no. 3696)

Standard Thinning *
Solid and Metallic colors: 125-150%
Clear: 150-200%
Candies: 150-200%

*Airbrushes are small and therefore require thinner paints. Always test spray to achieve a smooth flow of materials. The thinner the paint the smoother the flow. However, the "flow" characteristics of lacquer paints are inversely related to the "hiding" ability of the colors. The occurrence or runs and sags is directly related to the "thinness" of the paint. This is why it is important to fallow the recommended thinning formulas when mixing.

Thinning Chart
25% = 4 parts color to 1 part thinner
33% = 3 parts color to 1 part thinner
50% = 2 parts color to 1 part thinner
100% = 1 parts color to 1 part thinner
125% = 4 parts color to 5 part thinner
150% = 2 parts color to 3 part thinner
200% = 1 parts color to 2 part thinner
500% = 1 parts color to 5 part thinner

Figure 9.4: Carefully study this mixing chart with the understanding that is a guideline only since paint and primer viscosity differs between manufacturers, metallics and candies may need to be thinned a bit more, the humidity and ambient air temperature differs by location, and other factors. Always test the atomization of your spray pattern on a scrap or a manufacturer's paint test card.

Figure 9.5: You will need to seal your bodywork. Use VariPrime or its equivalent strictly according to manufacturer's instructions, always wear a two-cartridge filter, and always be sure there is adequate ventilation when spraying.

Figure 9.6: A professional dual-cartridge respirator is essential to your safety. Store your mask in a sealed plastic bag or container between uses: it's also a good idea to have a spare set of cartridges. Don't go cheap here; your safety and life are at stake!

Figure 9.7: To remove molded-on emblems and chrome trim, use a rotary power tool with a round cutter and lightly excavate the surface. Wash the body thoroughly in a good-quality liquid dishwashing soap that *does not* contain silicone, and use an old soft toothbrush to lightly scrub the surface and all recesses.

Figure 9.8: Mix the polyester putty carefully and completely. The more catalyst you use, the darker the mixed color becomes and the quicker it sets up. Experiment so that you create a mixture that cures in about three minutes.

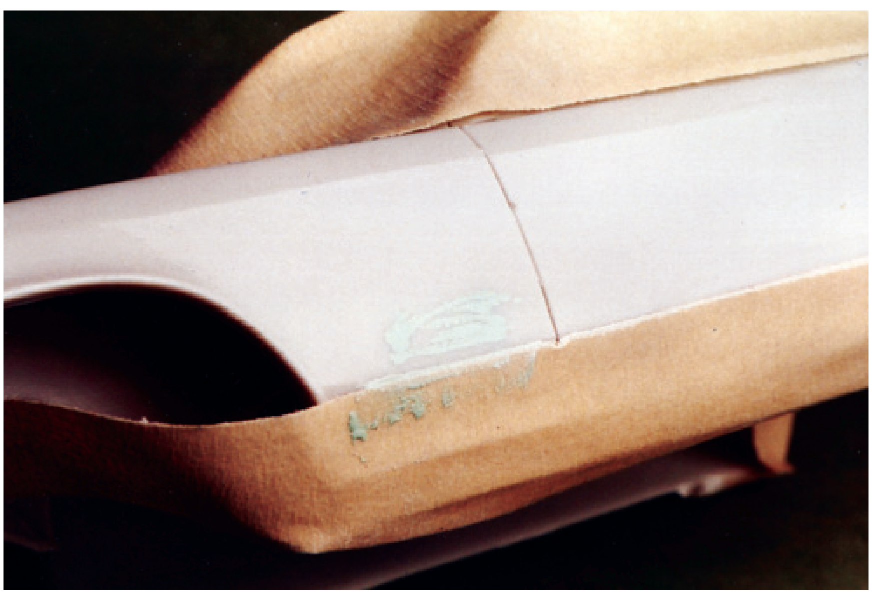


Figure 9.9: Tape off the area around the spot to protect the surrounding area from excess putty, greatly reducing your work. Mix a small amount of catalyzed putty and fill in the area, extending the putty just a bit beyond the excavated area.

Figure 9.10: Sometimes, a panel is marred because the under-hood engraving appears in a "shadow" pattern on the outside. Though a real annoyance, it presents us with an excellent opportunity to discuss the techniques to correct this problem. In this case, we'll also remove the over-scaled chrome molding on the hood. Grind out the shape, and then . . .

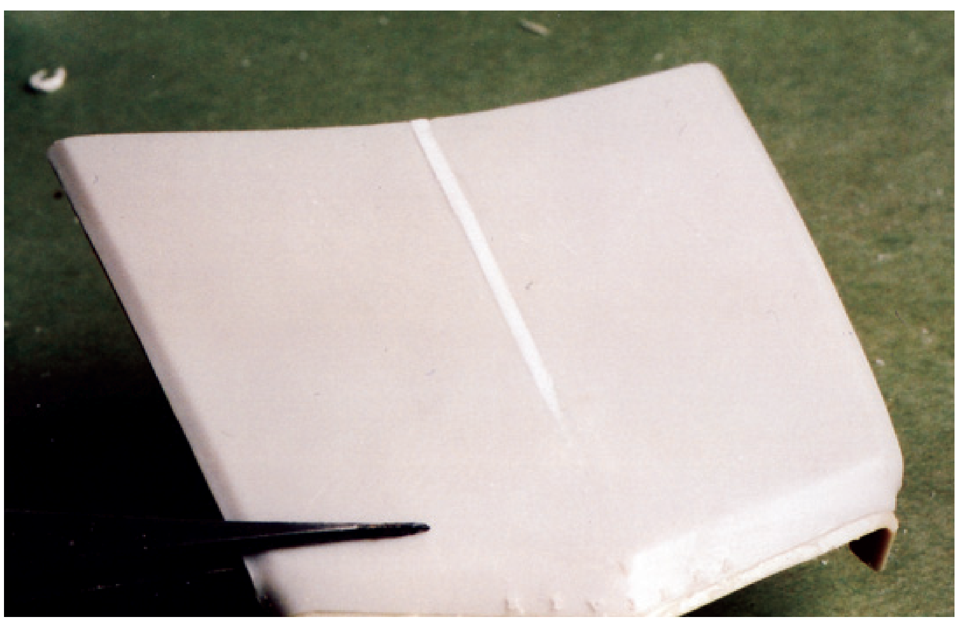


Figure 9.11: . . . fill in the depression with a strip of styrene, attached with instant adhesive (CA glue) aided by some accelerator. It is important to fill in the trough created by the grinding operation on a panel that will flex like this during bodywork, sanding and polishing. Do *not* use any solvent-based glue for this step.

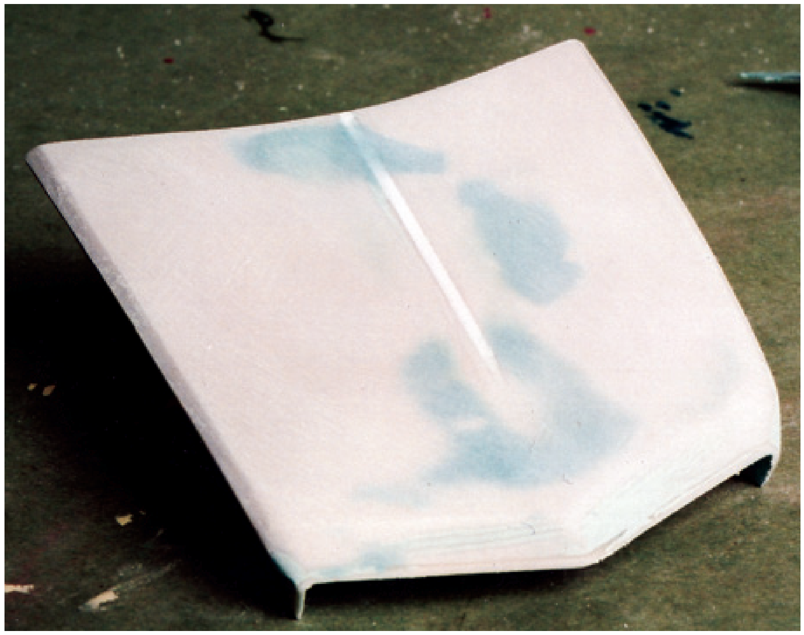


Figure 9.12: After the adhesive has cured, apply a thin coat of polyester putty over the entire area, including the area filled with strip styrene to fill in the gap created when the hood molding was removed. When cured, knock down the putty with a piece of 150 grit autobody paper, then finish by cross-sanding with a coarse sanding stick.

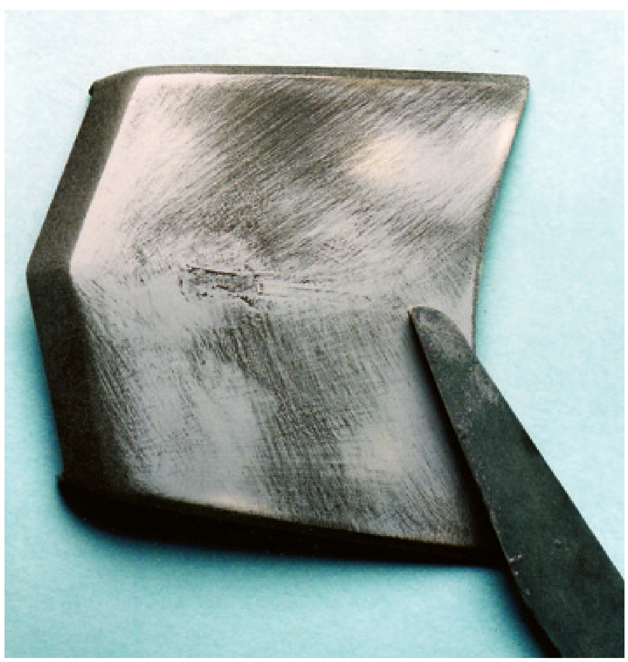


Figure 9.13: Lay down a light coat of grey lacquer primer, and then guide coat it with a light coat of contrasting black (or other dark) lacquer. After the two colors have dried for several hours in a dry and warm environment, cross-sand the panel with a coarse sanding stick. This will show a lot of sanding marks from the sanding stage. Don't be worried: Sand the surface until most of the black guide coat is removed, reprime and re-guide coat, then sand again starting with a medium sanding stick.

Figure 9.14: A similar approach is taken on the trunk. The peak was ground away and filled as in Figures 9.10 and 9.11; also, the vents were cut away and filled with a solid piece of strip styrene (you can't just fill in recesses—even with catalyzed putty—and expect to avoid "shadows" of those shapes later on). Here, the first coat of catalyzed putty has been applied, then rough-sanded to shape. More work will be necessary.

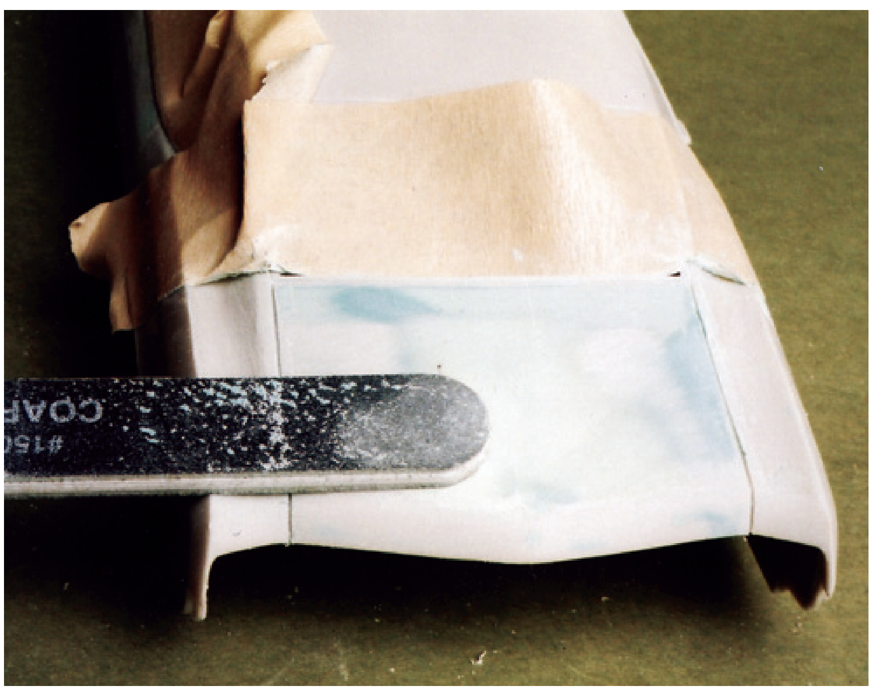


Figure 9.15: It was discovered that there were some pretty significant depressions on the left and right of the trunk, necessitating a second application of catalyzed polyester putty (mixed a little "hotter and darker" to call out the second coat), and then a third coat was applied to the center of the trunk to re-introduce the gentle curve to the trunk removed during the earlier sanding process.

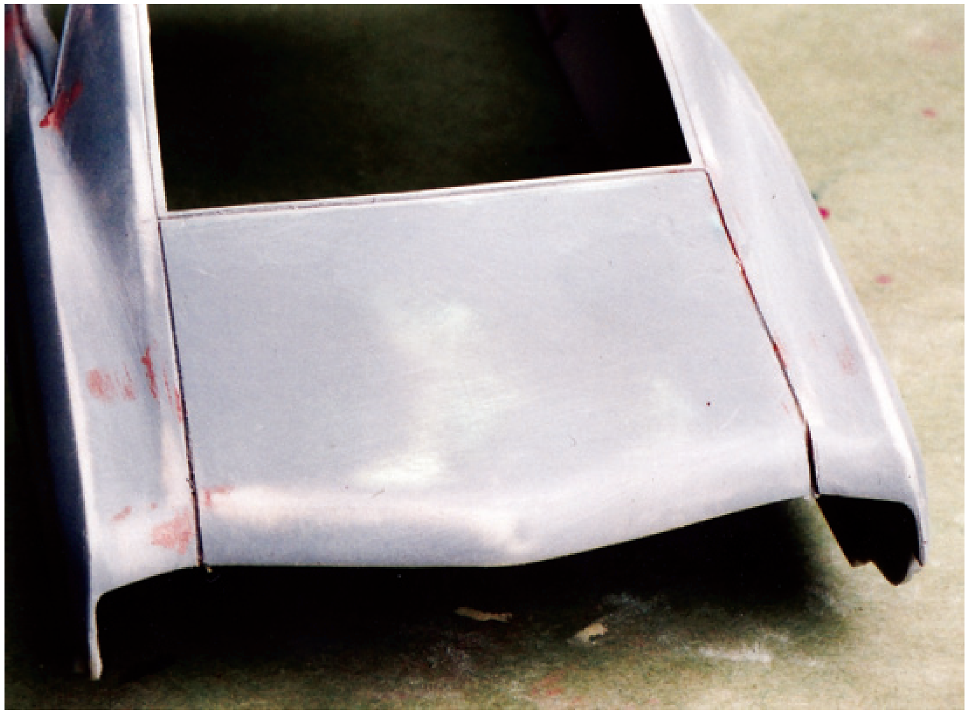


Figure 9.16: After this, a first coat of primer was applied and sanded to reveal surface irregularities. Note the very small bit of Acryl Red glazing putty used here to smooth out any deep sanding scratches. *Never* use this product to do bodywork or fill in depressions. At this point, apply a couple of light coats of lacquer primer to the reworked areas, being careful to mask off all unaffected areas that contain any surface detail at all (e.g., vents, emblems, and the like). When thoroughly dry, lightly "block sand" the areas you've been smoothing with a medium sanding stick. See Chapter 11 for a photo essay on how this Riviera was finish-painted.

CHAPTER 10

Soldering and Metal Forming

Soldering is a mystery to many model car builders: scary, complicated, and not a "proper material or technique" for plastic models. Alternatively viewed as too difficult or irrelevant to quality building, too many hobbyists overestimate the difficulty of attaching two pieces of nonferrous metal together, or suppose that metal working doesn't add anything to their model. In reality, soldering is a straightforward technique that can be easily mastered by almost everyone, and it can add levels of precision and strength that can't be achieved in any other way.

With just a few tools and a modest assemblage of sheet brass and related shapes, a motivated hobbyist can build parts that are stronger than plastic and resin. Brass parts also have the advantage of mimicking scale thicknesses. And, when coupled with brass panel fabrication and finishing procedures, soldering and metal forming can become another skill in the arsenal of the scale automobile miniaturist.

This chapter will address only entry-level soldering, using a traditional soldering iron and a basic hobby torch. Resistance soldering will not be covered here.

10.1 Basic Techniques

Figure 10.1: An adjustable-temperature soldering iron, with a safety holder, is best. Weller makes a good unit; this was purchased from MicroMark. The torch uses Butane and should always be filled outside to assure plenty of ventilation. This unit has a trigger to ignite the gas, and the flame width is adjusted by moving the red slide valve mounted on top of the torch.

Figure 10.2: There are several types of solder. Make sure that you use a silver-bearing solder for strength. Don't use rosin core (electronic) solder or, worse yet, acid-core solder. For introductory uses, I recommend the Stay Brite kit that comes with liquid flux that can be squeezed from the flexible dispenser. Other types of solder are also available, including a paste format. You must use flux, regardless of the composition of the solder.

Figure 10.3: You'll need a few more tools, too. A medium-grit sanding stick is used to clean the metal surfaces. Tweezers are used to place small balls of solder, and can also be used as a heat sink, which is necessary to thermally "insulate" prior work from the heat used in subsequent operations. The hobby knife is useful to cut solder. Small brass pins can help to locate an assembly of parts to

the soldering board (the white background item), which will insulate your workbench from damage from heat and possible fire.

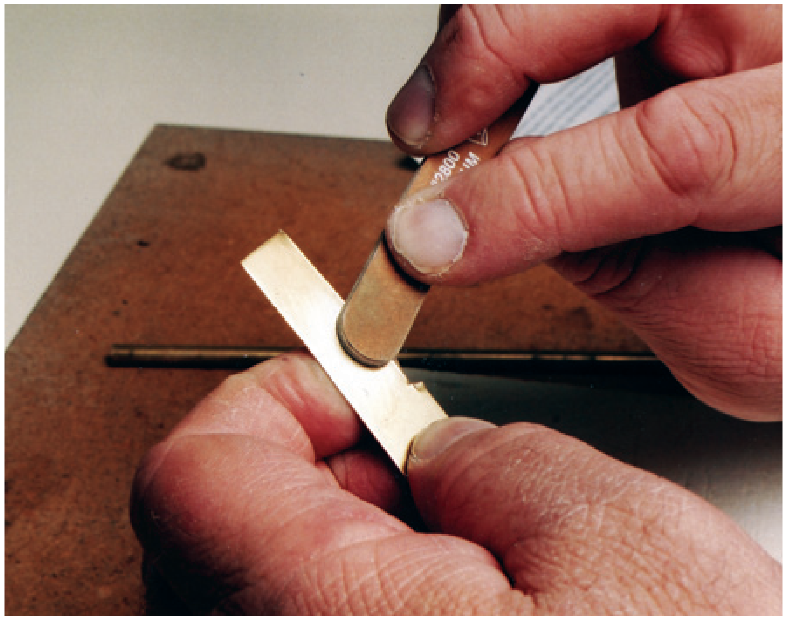


Figure 10.4: The first thing to understand about soldering is that you can ”weld” parts together only if both surfaces are free of dirt, corrosion and other surface contaminants. Always lightly rough-up the surfaces. In this case, the flat surface is a piece of .025 K&S brass.

Figure 10.5: We’ll be attaching a piece of tubing, so the base of the tubing is lightly sanded. Make sure that you clean up around the entire circumference of the part.

Figure 10.6: It is also important to keep the tip of your soldering iron clean. After each use, lightly wipe your hot iron across a wet sponge which will remove flux, excess solder and other contaminants. In this case, a small drop of liquid flux is being dropped onto the tip of the soldering iron as it is heating up. Remember, a soldering iron is hot, so be careful.

Figure 10.7: Apply a bit of flux to the two surfaces to be joined together. Rather than squeezing out a puddle of flux (as here), it would be best to use a glass eyedropper to avoid flooding the surface. Stay Clean-brand flux is an excellent product.

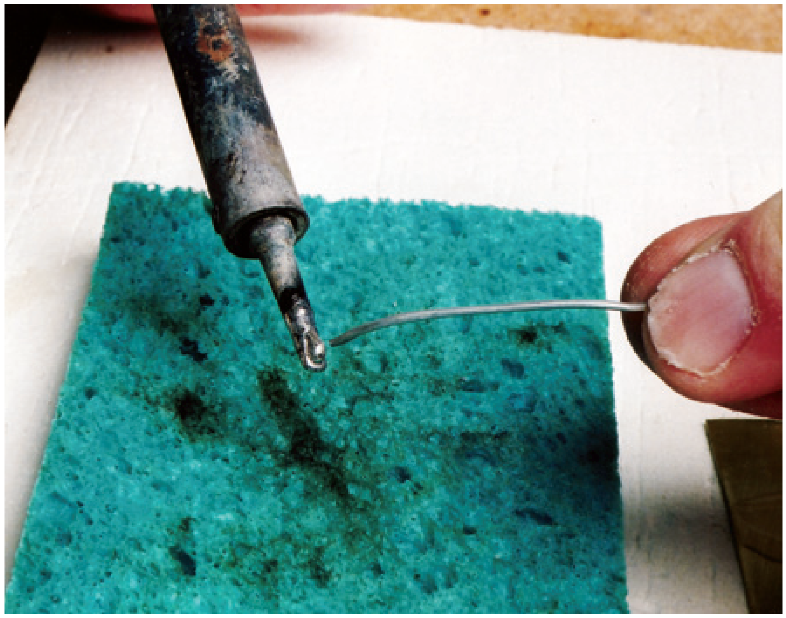


Figure 10.8: With the fluxed and completely heated soldering iron ready to go, press your silver-bearing solder to the tip and melt a bit onto the tip. You should melt only about 1/16" of a length of the solder.

Figure 10.9: Place the flat brass onto a fireproof surface. With the solder on the tip of the iron, place the iron onto the previously-fluxed surface and heat up the surface. This will take a few minutes and results . . .

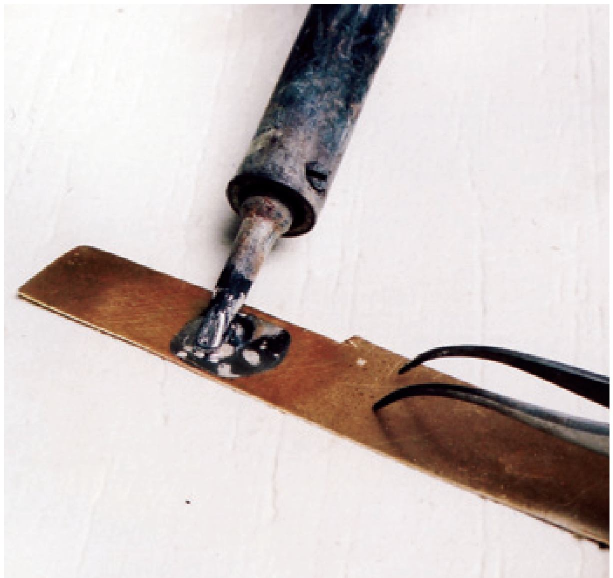


Figure 10.10: . . . in the deposition of the solder on the surface. Spread the solder around a bit, making sure that the solder flows out easily, and is shiny at the completion of this operation.

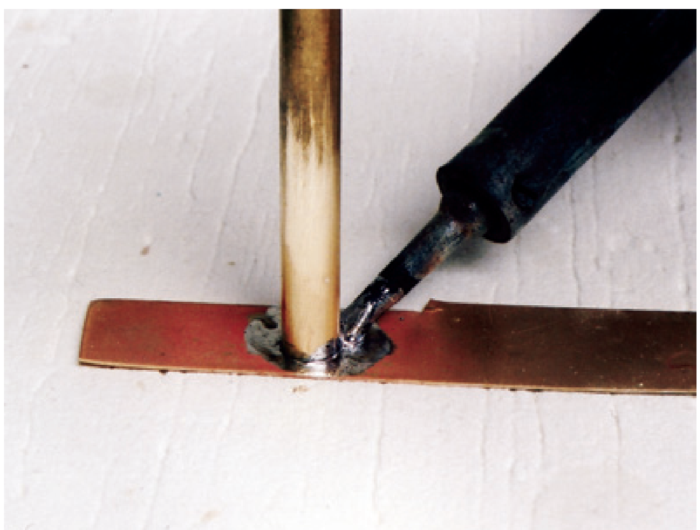


Figure 10.11: Place the second part (here, a piece of the fluxed tubing) atop the flat surface on the cooled solder puddle, and heat up that second part with the soldering iron. This will take a moment or two since you'll have to heat up the entire target area for the solder to melt. Now, place the iron on the solder puddle, and keep the iron on the area until it is obviously liquid again. Then, run the soldering iron around the perimeter of the tubing so that the hot solder will bridge the gap between the two parts. If the tubing is clean and fluxed, the solder should easily "climb" the very bottom of the tubing. Watch out for the heat. Use the wet sponge to quickly reduce the heat following the soldering operation. Always do this work atop a soldering pad.

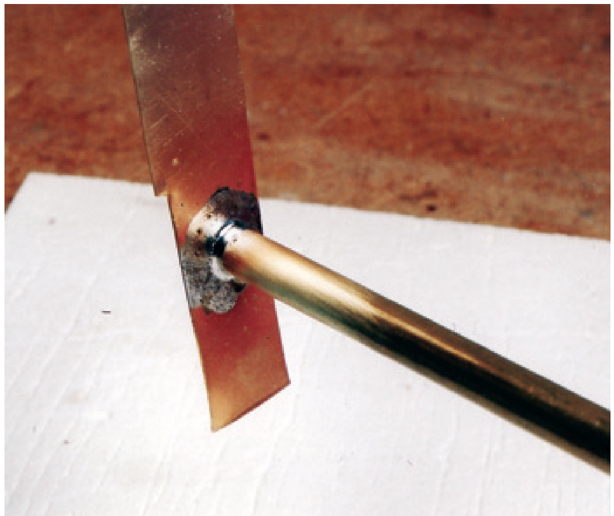


Figure 10.12: Once you see that the solder has bridged the gap, withdraw the soldering iron and permit everything to cool down. Be careful not to move the tubing around while the solder is cooling down! In this application, a bit too much solder was used (which is hard to avoid while using a soldering iron). Watch out for the heat after soldering. Let the part cool completely before handling the assembly.

Figure 10.13: The mating surface can be cleaned up by using a flat hobby file. Be careful not to gouge the two brass surfaces. After the excess solder has been removed, use a medium sanding stick to remove any fine file marks.

Figure 10.14: Careful work yields this tidy result. The surface can be further refined by using a fine sanding stick with water, followed by 1000-grit 3-M sandpaper. Before painting, it is recommended that you lightly scrub the soldered parts with a discarded toothbrush soaked in a 50-50 mixture of vinegar and water, and then rinse in plain water. This will remove any remaining flux that would interfere with paint adhesion. After rinsing and drying, you should use a professional etching primer like Dupont's VariPrime.

Figure 10.15: A butane-fueled torch is a handy investment. This setup works reasonably well: Get a unit with a base to keep it from tipping over. Its only drawback is that the flame is a bit too large for really fine work. A proper jeweler's torch would be better for the additional reason that the "pressure" of the flame won't move solder around.

Figure 10.16: There is another, more delicate way to apply solder to the surface about to be heated: cut the silver solder into small bits with your hobby knife. Cut about 6–8 small soldering balls for the average soldered joint. This solder is being cut on the soldering surface because the textured surface keeps the small solder balls from rolling away.

Figure 10.17: Lightly sand and flux both surfaces. After fluxing both parts, place the second piece atop the first, and then carefully place the small soldering balls equa-distant around the perimeter of the brass tubing to brass base interface.

Figure 10.18: Play the torch flame onto the joint. Keep the flame low and move it around the perimeter evenly. Go slowly, and watch out for the heat!

Figure 10.19: In this view, you can see how the heat has started to melt the solder balls.

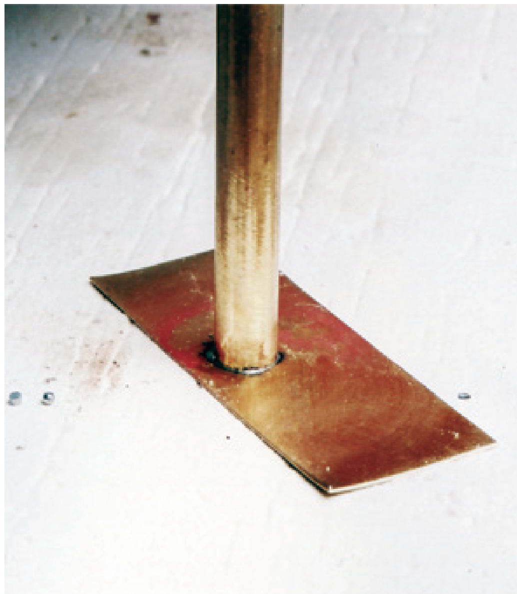


Figure 10.20: As the solder melts, it will naturally flow around the circumference of the joint and fill the gap. In fact, the solder "crawls" up the inside *and* the outside of the joint, thereby strengthening it.

Figure 10.21: Continue to heat the interface between the two parts so that all of the solder balls melt and flow around the circumference of the tubing. Now, can you think of parts that can be made this way? Think about all the ways you can use soldering your next project.

10.2 Build a Frame!

The basic soldering tasks learned above can be successfully adapted to build major components for your next project. Constructing a "U"-channel frame seems difficult but isn't if you follow the basic techniques taught below, which will allow the creation of a frame more realistic than one constructed from solid brass rectangular channel.

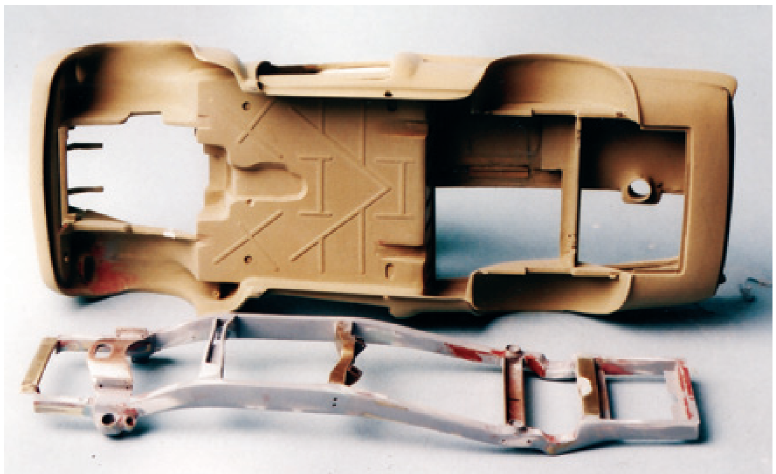


Figure 10.22: The original version of the *Dream Truck*[2] (originally named the *Modern Dream Truck*) was built in the Nineties for a series of articles in *Car Modeler* magazine. Dissatisfied with the finished model when it was completed, I tore it down with the goal of correcting the several design flaws, as well adding more detail. At one point in the rebuilding process, I realized the fresh plastic frame I built didn't measure up to the standards of the rest of the model. What to do? I decided to scratch-build a brass frame to match the basic dimensions of the plastic version that was already in the right shape with the correct suspension pick-up points. At this time, some of the brass crossmembers had already been built, and would be transferred to the new brass frame.

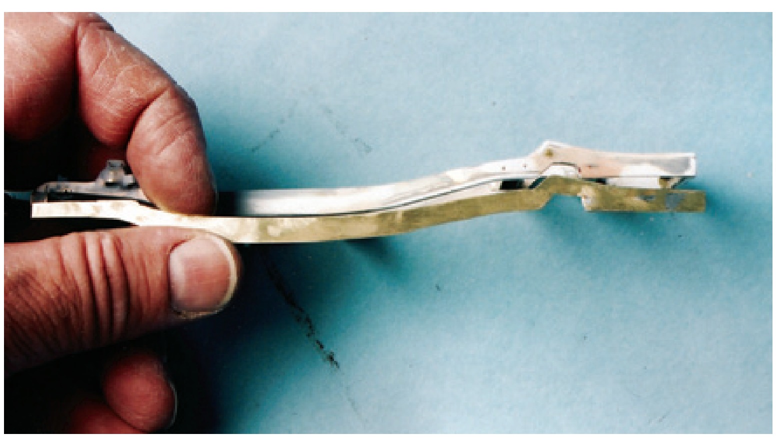


Figure 10.23: I traced one side of the plastic frame onto card stock, double-checked it for accuracy, and then traced around the card stock template onto a sheet of .025 brass. Because some material is inevitably lost when the frame rail sides are filed, it is important to start with frame rail material not less then .025 in thickness. Using a pair of carbon steel shears, cut out the pattern, then compare it to the plastic master frame; some correction was necessary.

Figure 10.24: With the corrected brass master frame rail in hand, I traced it onto another piece of brass sheet and cut out a second frame rail.

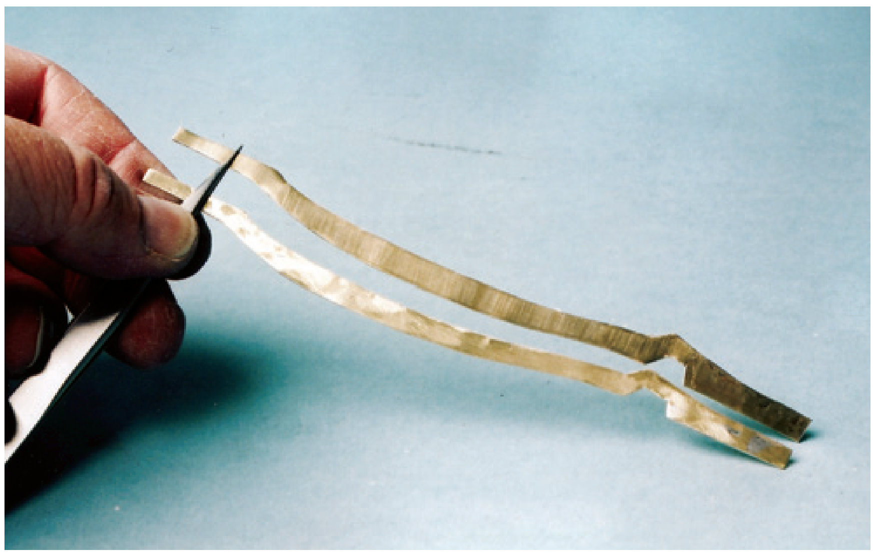


Figure 10.25: Even though there is a superficial resemblance between the two frame rails, the second one differs significantly from the first one. The critical part here is that both rails must match exactly. The way to reconcile the two parts is to spot solder them together.

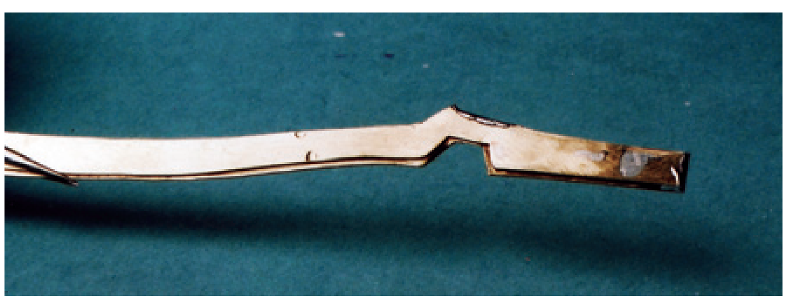


Figure 10.26: Choosing the closest matching dimensions, the soldering iron was used to solder the rails together by "spot soldering" the two parts in just a few key points. At this point, the larger (second) of the two frame rails was filed to match the smaller (first) frame rail. When both parts matched, the torch was used to heat up the several soldering spots and the two rails were pulled apart, and the solder points were carefully filed away. These frame rails could have been photoetched, too.

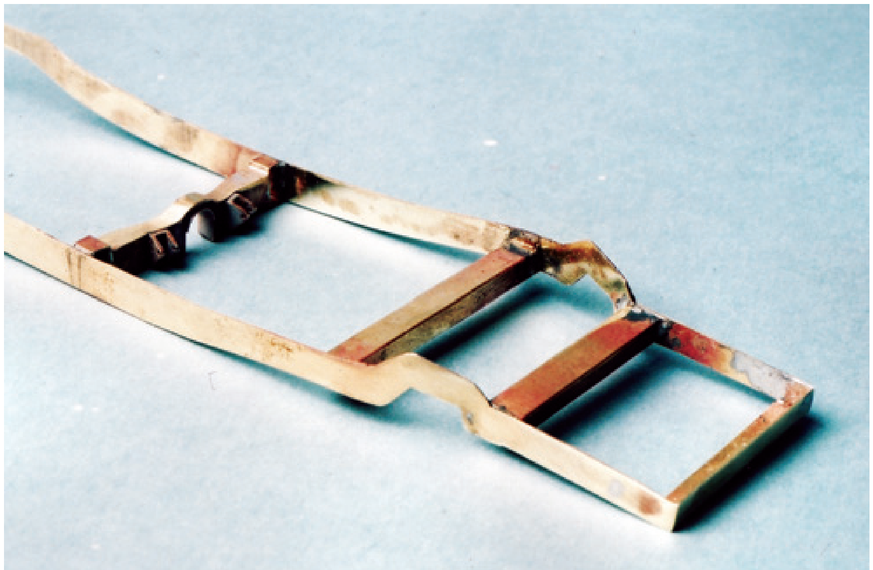


Figure 10.27: The locations of two of the crossmembers in the plastic original frame were determined and transferred to the new brass frame rails, including the crossmember to which the trailing arm assembly (for the rear axle) attaches. The other crossmembers were made from standard brass shapes.

Figure 10.28: With the basic shape of the frame determined, it was time to add the top and bottom pieces to the frame rails. Lengths of .100 × .020 brass strips were cut to length and soldered to the top and bottom of the frame rails. If a more precise jeweler's torch had been available, it would have been used with plenty of heat sinks. The problem with not having the solder hot enough is seen here at the back of the frame rail—too much cold solder has clumped up. I fixed it by clamping a heat sink at the point where the two most rearward frame cross-members met the frame rail and "pulled" molten solder until the solder ran the length of the strip brass.

Figure 10.29: After a few quick passes with a flat hobby file, check out the neat and authentic look of this partial boxed short length of the frame.

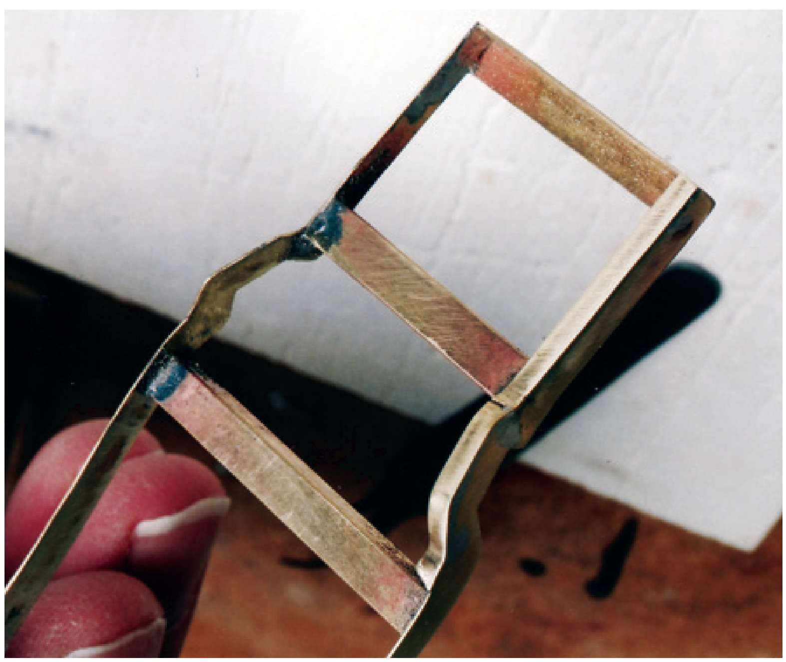


Figure 10.30: Initial partial boxing at the rear of the frame can be seen here. Proceed slowly and bend the flat brass strip to the shape of the side frame rail, and solder as you go along. Use heat sinks wherever possible to avoid "de-soldering" prior work.

Figure 10.31: Using the same .100 by .020 strip brass, continue to add the top and bottom brass strips to the side frame rails, and then do the same on the underside of that side of the frame. Then repeat the boxing operation on the other frame rail. Since the frame is pinched in a couple of places, the strip brass can be bent (using a torch first to soften the metal) to fit, and then soldered.

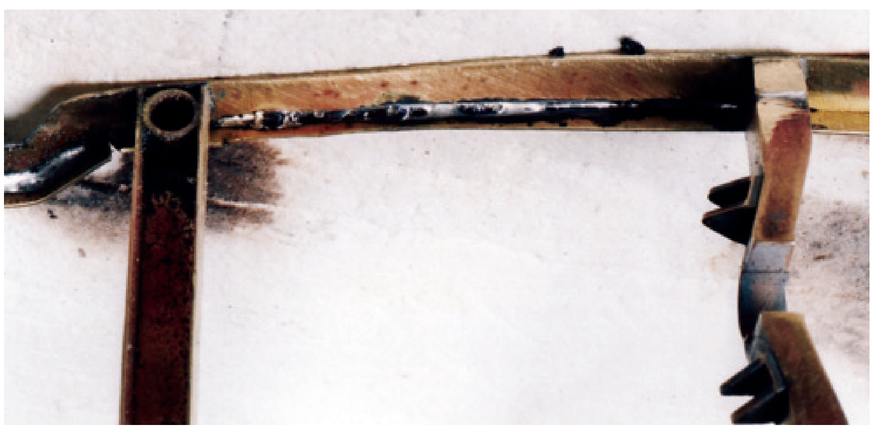


Figure 10.32: With the strip tacked in placed, run the soldering iron along the length of the strip. When there is a good bead along the surface that covers the top of the strip, lightly file the frame rail side and the top strip. One helpful trick, which would be easier and more precise with a more delicate flame, is to play a flame along the inside of the frame rail to smooth out the solder that inevitably penetrates the right-angle mounting surface. This ensures a good bead, but be careful to modulate the heat so that you don't end up de-soldering the boxed frame!

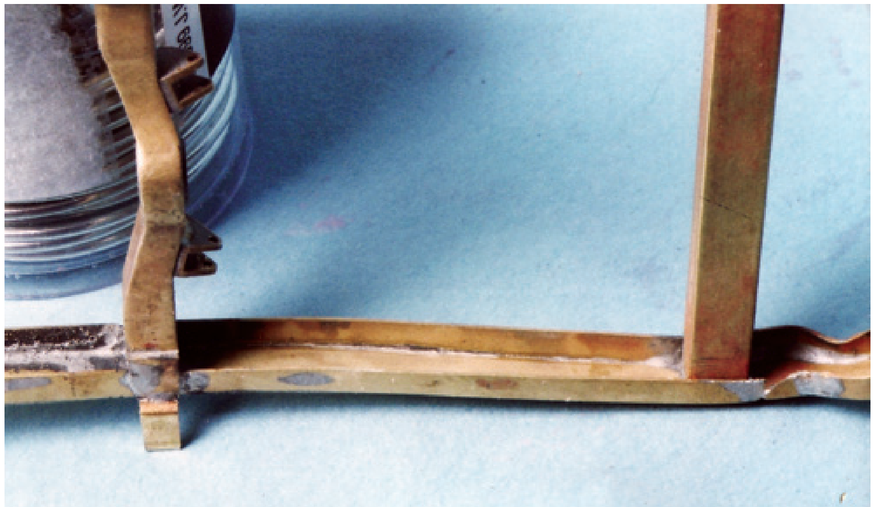


Figure 10.33: Cleaned up with a riffler file, the inside of the frame has a very neat appearance. Work carefully and deliberately.

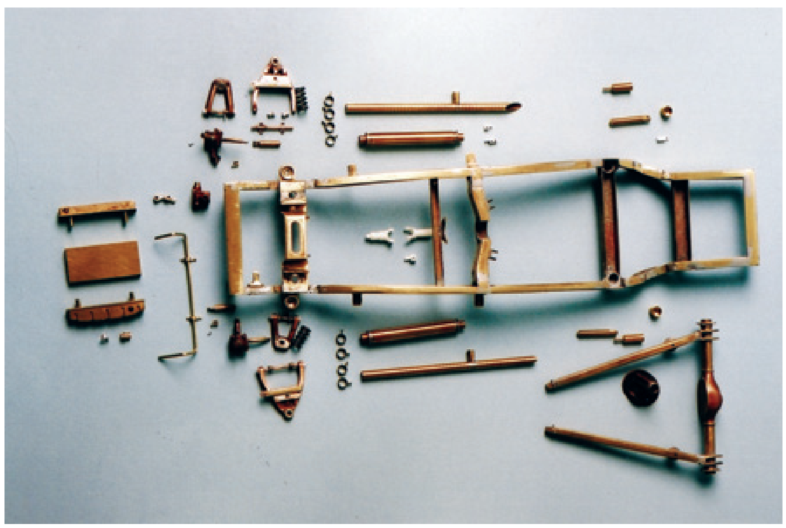


Figure 10.34: Here's where the practical advantages really emerge: brass is thin and won't warp with paint, and you have a dimensionally stable and strong item that can be reliably and predictably fitted to the underbody of the model and checked for fit before painting and final assembly ever starts, insuring a superior result.

10.3 Creating Brass Panels and Shapes

For the ultimate in scale realism and strength, the advanced hobbyist should consider constructing panels from brass. This material offers strength with relative scale thinness, and the opportunity to solder structures and hinges to brass panels make it an ideal medium for working panels. The advantages are clear: such a part is thinner, stronger, and can be detailed in ways that no plastic part can. Additionally, any paint can be used, and no paint type will warp any panel, as some will with scale-thin plastic panels.

But whatever the advantages, there is this pervasive fear that it is just too difficult. On top of that, there are some persistent biases against working in brass or other nonferrous metals that can't be explained rationally. In spite of the many advantages, for too many modelers facing the problem of replicating an existing shape or building a unique panel in brass is just too much. Still largely considered to be an exotic material that only the most dedicated or skilled modelers can tackle and master, it can really be successfully used with only modest training, matched to a willingness to take a chance.

Brass panel fabrication is an obstacle only until some basic techniques are understood and mastered. Of course, you'll need to purchase a few tools, too. You should pick up a flat, fine-tooth bastard file, a roll of 4" masking tape, an X-Acto hammer, some carbon-steel shears, soldering equipment, a good supply of coarse and medium sanding sticks, a light-duty hobby torch, and painting equipment and supplies. Of course, obtain some .020 brass sheet.

If you'll work through the following photos, you can build any panel from brass (or copper). Keep these basic principles in mind: First, shape a panel by hammering on the metal from the side *opposite* the outside of the panel. Second, start at the apex of the intended curve and work outward from that area to less curved areas. Third, hammering hardens the material and you're going to have to anneal (soften) the metal from time to time.

Figure 10.35: The equipment needed for forming your own brass panels is modest. A fine-tooth flat file, a pair of high carbon shears (available at any cutlery shop), a roll of tape, a hammer (from MicroMark), sanding sticks, and Evercoat catalyzed putty complete the items.

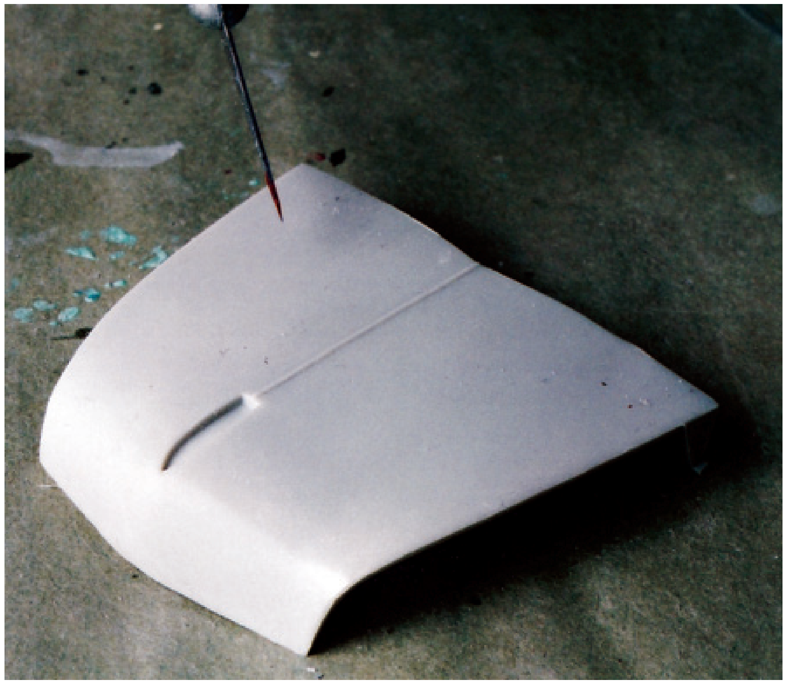


Figure 10.36: We're going to be replicating this '50 Ford hood. Its deeply-drawn front radius will allow us to learn how to hammer a moderately complicated panel.

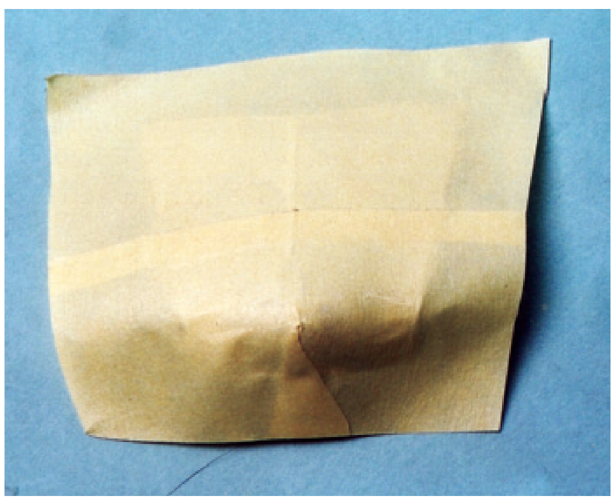


Figure 10.37: The first step is to use a roll of 4" masking tape. We need to make a pattern, so cover the hood with tape, using only two pieces laid out lengthwise. Try to pull the tape tight over the curved corners, but don't worry if the tape bunches up as it has here at the front of the hood.

Figure 10.38: Carefully trim the tape to the perimeter of your part with a fresh hobby knife blade. Your part should look like this now.

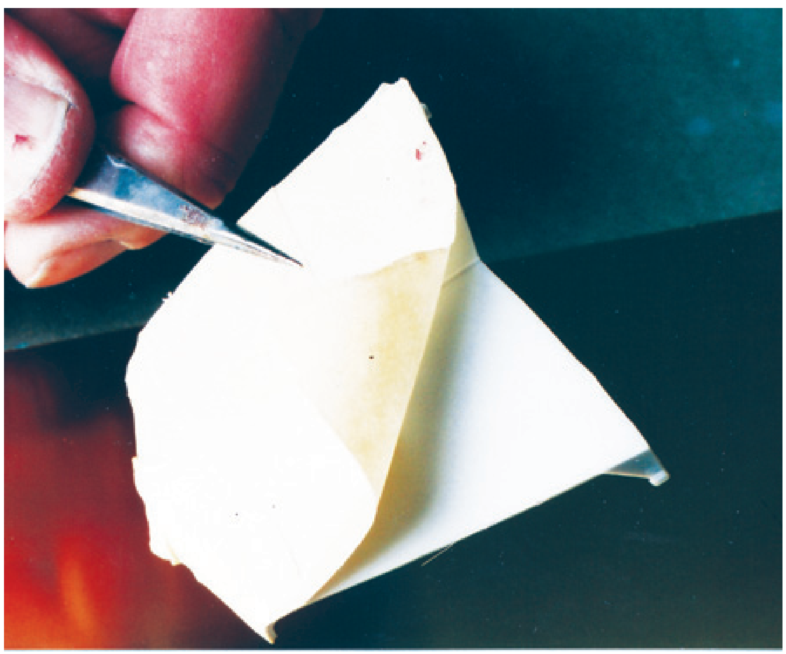


Figure 10.39: Carefully pull up the tape, being careful not to stretch the tape too much.

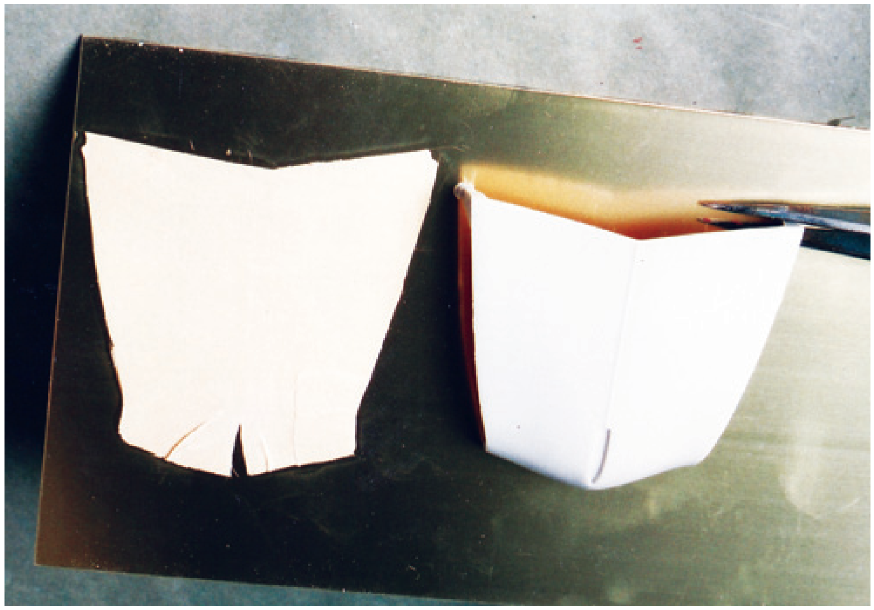


Figure 10.40: Lay the tape down onto a piece of .020 brass sheet, placing the tape near to an end of the sheet to minimize wasted material. Because the tape was applied to a curved shape, you need to make a cut in the center of the tape pattern so that you can layout a pattern of a curved part onto a flat surface. The tape pattern on the left is the shape on the right, laid out cartographically.

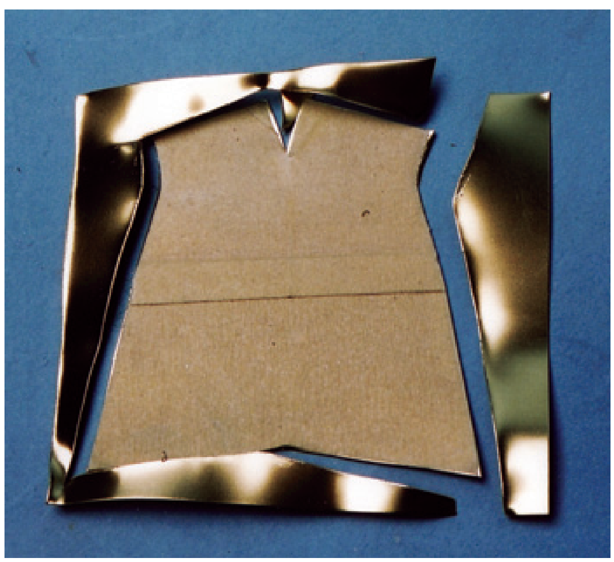


Figure 10.41: Use a pair of high-quality carbon steel shears and start to remove the excess material from around your tape pattern. Here is our part, with the pattern still attached, with the excess material. Note how the discarded material has been distorted by the shearing effort. Some of this warpage is in the part, too, but don't worry about it—by hammering and filing, we'll take care of this problem.

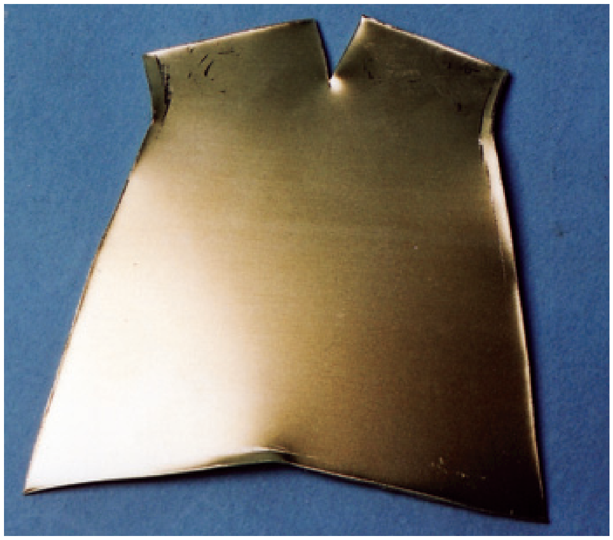


Figure 10.42: Trim the excess brass sheet fairly close to the pattern, but don't worry about small deviations since the hammering process will stretch the brass (this material is very malleable). The "V"-shaped cut in the front of the hood will permit the creation of the complex curves at the front.

Figure 10.43: Use a fine-tooth flat file to file down the raised edges around the perimeter of the part. This will also reduce the chance of cutting your hands—remember this is metal and it can be sharp!

Figure 10.44: Now, let's start hammering. Determine the location of the "deepest" part of the curve, and start to lightly tap the back side of the sheet brass in the area. Don't assume that you can quickly shape the panel—dozens and dozens of light taps are needed. Vary the location of the taps and radiate the taps away from the sharpest part of the curve. In this photo, the location of the taps show up as shiny areas on the brass.

Figure 10.45: Note here how the leading edge of the hood has already started to curl. At this point, 40–50 hammer taps have occurred. You should make sure that both sides of the hood, measured by the centerline, are shaped concurrently to better insure uniformity. Remember that you are stretching the metal when you shape it with the hammer. Note how the center cut made earlier Figure 10.43 has begun to close up.

Figure 10.46: Relief cuts need to be made on both sides of the hood, as shown. The vertical line at the front of the hood is the cut made initially in the tape pattern—note how shaping the panel has closed the gap. The uneven bottom edge on the front of the hood is not problem—this is the natural result of the hammering process. We'll trim it later.

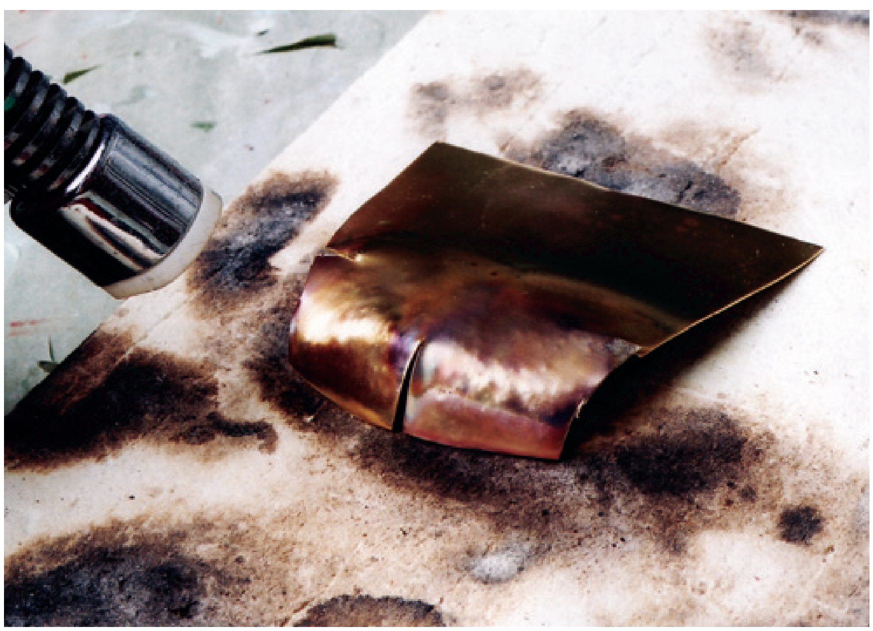


Figure 10.47: Before we solder the panel, we need to anneal the sheet brass. As you shape the panel by tapping on it, you are work-hardening the material and we need to reverse that process. You need to lightly play a flame across the panel once it has been placed on a fireproof material like this thermal panel—don't do this near any flammable material! You should not heat the panel to the point where it sags, just get it obviously hot and then let it cool down without quenching it in oil or water.

Figure 10.48: After fluxing the joint at the front of the hood, lightly heat up the panel and melt some silver-bearing solder into the joint. Don't use regular rosin-core or acid-core solder: neither are strong and both melt at too low a temperature. Once the solder has flowed into the joint, lightly play the flame over the area to help the solder flow along the joint. You'll need to experiment on this technique since you don't want the pressure of the flame to literally blow the solder out of the joint. Now, solder up the two cuts made at the side of the hood.

Figure 10.49: At this point, lay your hood on top of the original plastic panel. Note how the soldered area has buckled upward a bit. Gently tapping down on the outside of the part and then tapping up on the lower area will correct this minor difficulty. You'll encounter this sort of problem often, but it's easy to fix.

Figure 10.50: Okay, check this out. Though a lot of work remains to be done, look at what we've achieved. Constantly check your work by referring your new panel to the one you're trying to replicate. If you're building a custom piece, then repeatedly test-fit it to the rest of the parts.

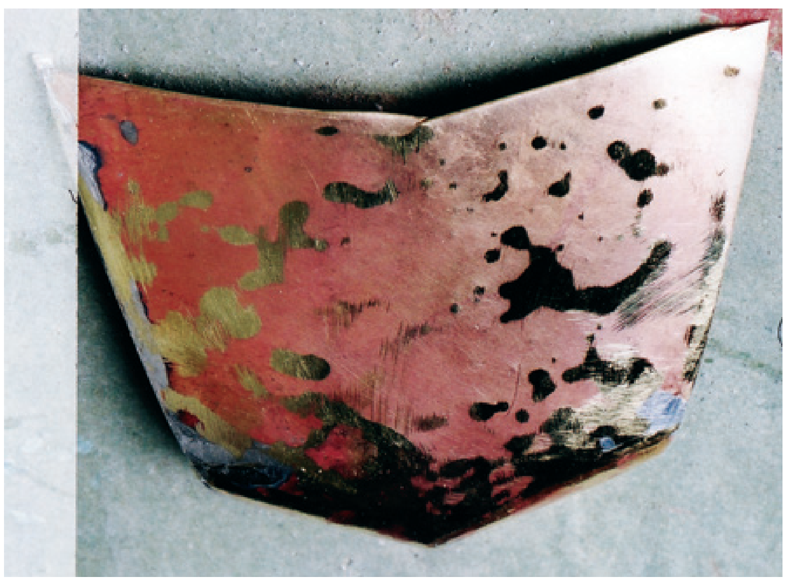


Figure 10.51: The task now before us is to very gently tap up the underside of the hood so that the panel is relatively even. Progress is checked by filing down the outside panel. Here, the unevenly spaced bright areas are those where the hood panel was "high" and has been smoothed with a fine-cut hobby file. Your filing should be kept to a minimum to avoid weakening the panel by thinning the brass too much. Just be patient and tap upward on the underside and check your progress with careful filing with a flat file. Because you'll be filing the part a lot to smooth it out, it's important to start with .020 brass sheet.

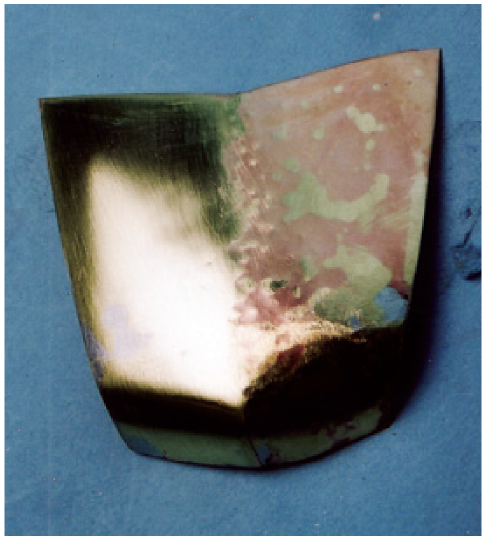


Figure 10.52: In this view, real progress has been made to the passenger side of the hood. Check out the filing marks; file at an angle to the length of the hood, which will assist in evening out the panel. Filing in a line parallel to the length of the hood will introduce a “trough” in the panel.

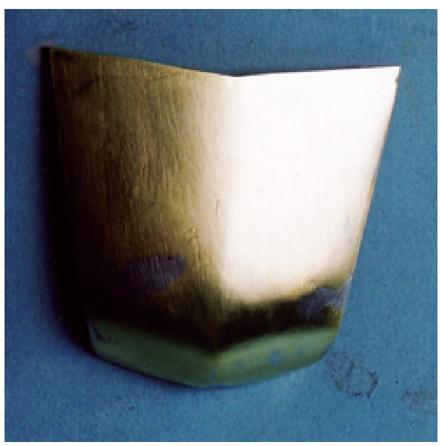


Figure 10.53: With both sides of the hood rough-finished, this is looking pretty good. A persistent depression on the right front of the passenger side (hard to see here) was filled with a little spot of low-temperature silver solder and then filed to shape: this mimics “leading” on full-size customs.

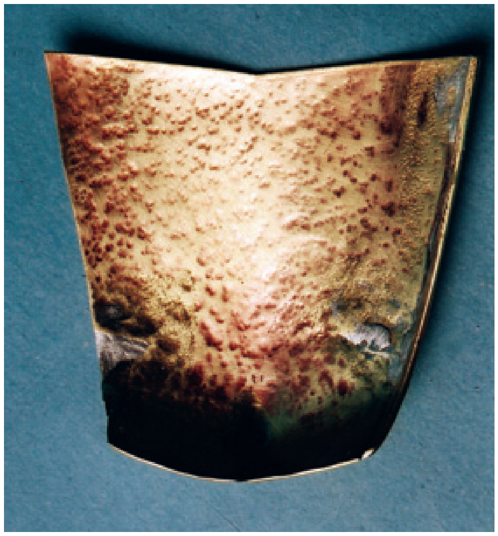


Figure 10.54: The underside of the hood shows the effect of literally hundreds of light taps from our metal-shaping hammer. These taps look really deep, but they are all only .0010 deep. Ideally, each of these little dimples (that have been filed flat on the top side in early steps) would be hammered out and flattened, but this brass is too soft and too thin for that technique. We'll take care of this later after applying the primer/sealer.

Figure 10.55: With the hood close to its finished shaped (it's shiny from being smoothed with a fine sanding stick), it's time to apply a good primer/sealer. Brass is an odd material, in a way, since it needs a coating that actually etches into the metal. I highly recommend Dupont's VariPrime because it "etches" the brass and can be applied directly over the filed brass panel. Mix the two parts 1:1. *Be sure to use a dual filter respirator! Don't spray without such a mask. A regular dust mask does not work!* Read the VariPrime Material Data Safety Sheet!

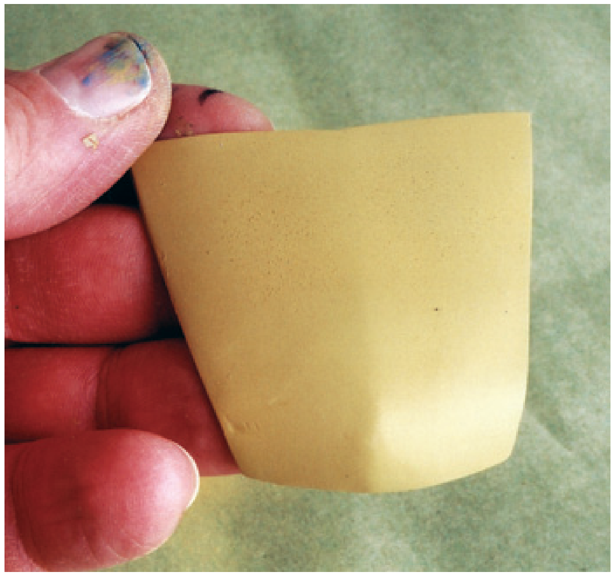


Figure 10.56: Following the product instructions, apply three light coats of the VariPrime Sealer and allow it to cure for about three hours. Though this part looks ready for color, it's not.

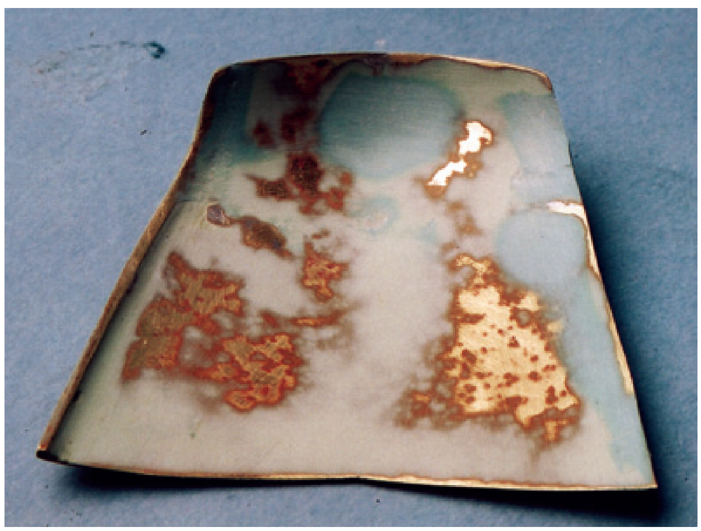


Figure 10.57: Flip the hood over an apply some catalyzed spot putty directly over the bare brass. Use Evercoat's Metal Glaze two-part automotive putty only. Sand the putty with 150 grade autobody paper to rough shape it. A second coat may be necessary. You can also apply this putty over the cured VariPrime.

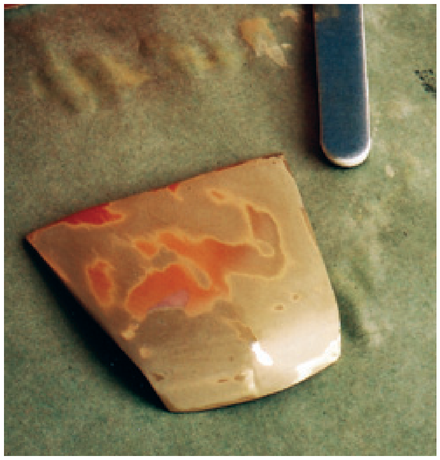


Figure 10.58: Lightly sand the hood once the Variprime has thoroughly cured (it sets up catalytically rather than "drying" in the traditional sense). Use a medium sanding stick and warm water. Check out the shiny areas which reveal high spots. Only by doing this kind of sanding will you ever get a perfect surface for painting. *Gently* tap down the peak of the high spot (this won't dislodge the putty underneath), resand, and apply more VariPrime. When cured, sand again.

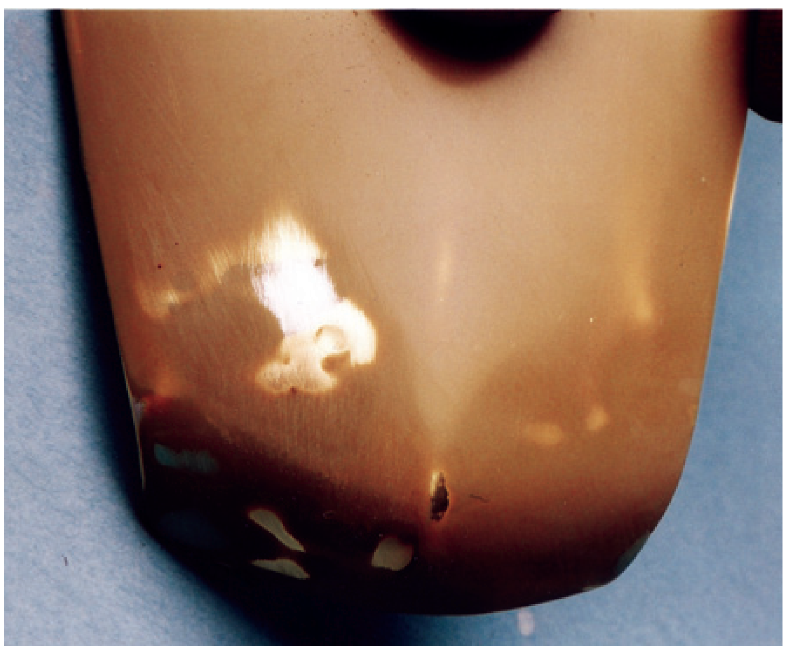


Figure 10.59: Apply more VariPrime, let it cure, and then use a coarse sanding stick to sand the surface again. In this view, there an obvious high spot that remains following the steps in Figure 10.58. Again, lightly tap around this high spot, but be careful not to work the spot too much or you'll have a low spot!

Figure 10.60: More sanding after the next coat of VariPrime will reveal still further slight surface irregularities, but things are getting better. Here the tip of the hobby knife points to a very slight high spot. Tap down that small area very gently. Note two small areas of sanded putty at the leading edge of the passenger side.

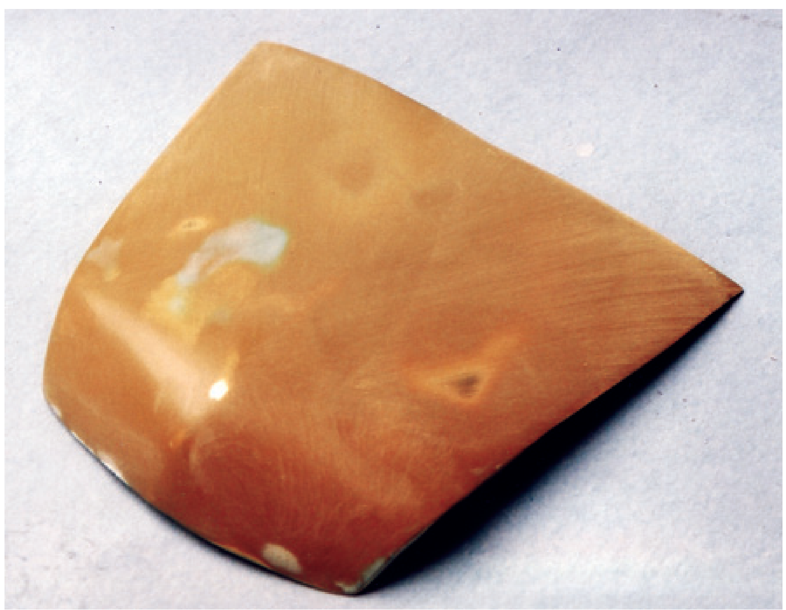


Figure 10.61: We're about done. More sanding revealed a slight low spot filled with a bit of catalyzed putty here. Use a medium sanding stick here and cross-sand the shape to show any slight surface irregularities.

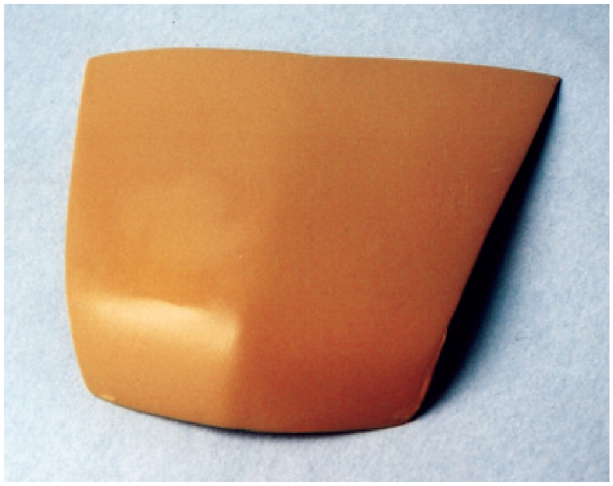


Figure 10.62: Use a coarse sanding stick and knock down the putty, then apply more VariPrime. At this point, lightly sand the primed hood with 800 grit paper, followed with 1200 grit autobody sandpaper, used wet, to prepare the surface for painting. Set aside to dry. This part is just about ready to go.

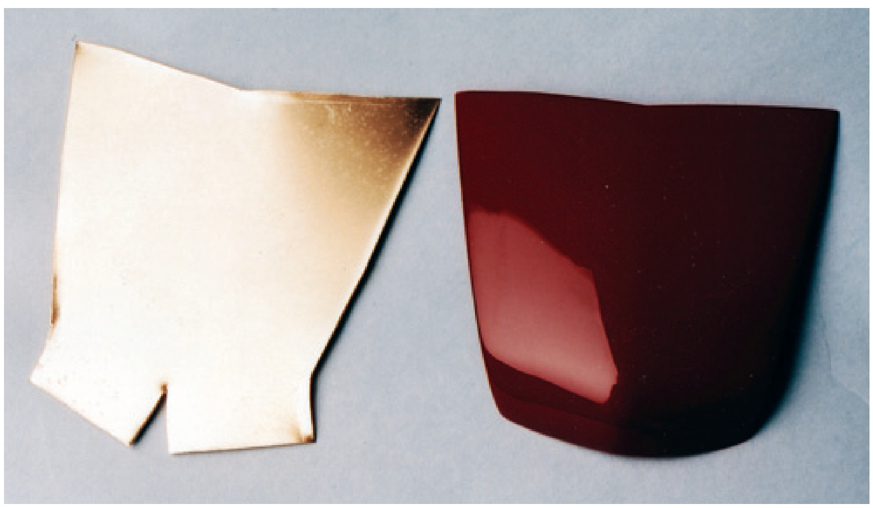


Figure 10.63: Apply your favorite color and stand back and enjoy the fruit of all your work. Check out Chapter Eleven for information on creating show-quality paint job. Isn't this contrast between the final painted panel and the raw brass sheet interesting?

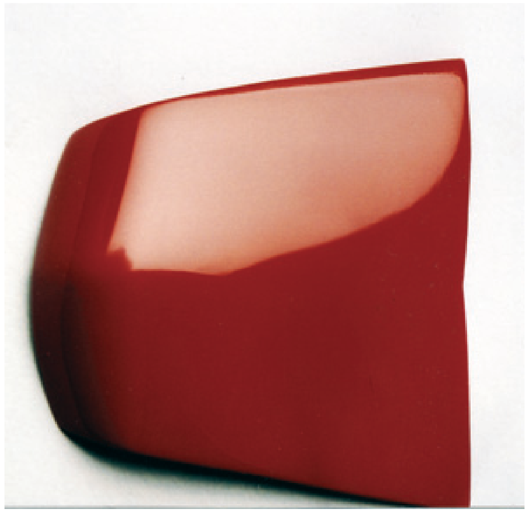


Figure 10.64: The hood was painted in automotive lacquer and rubbed out. Isn't this beautiful? Lose your fear and try working brass!

Figure 10.65: With a little practice, you can build many shapes, many depicting relatively sophisticated shapes. With the exception of the custom '50 Ford trunk on the upper left, the rest of these panels will be used on the *Dream Truck*[2]. The reason to use brass is that you can achieve near-scale thickness of the panels even when applying plastic-warping paint lacquer finishes. Besides, brass is strong, and you can be sure the shape will be accurate when it is assembled, after painting, with other individual components into a larger assembly.

CHAPTER 11

Championship Painting with Lacquer

Some modelers call it a "black art." Other hobbyists, almost reflexively, don't think lacquer can be applied over plastic to produce a mirror finish. The fact is that the seemingly arcane art of laying down a winning lacquer paint job is easily within the capabilities of any builder.

The advantages to lacquer painting are many, and not generally well understood. First, lacquer is very thin and preserves subtle detail on a model. If properly applied, a complete lacquer finish (from primer, through sealer and then to color) can be as thin as just two average coats of hobby enamel. Second, errors can be corrected quickly because this paint dries so rapidly. Though lacquer is no longer generally available from mainstream manufacturers like DuPont, specialty companies (e.g., House of Kolor and Metalflake) still offer acrylic lacquer. Also, most of the techniques shown in this chapter can be used regardless of paint type.

Of course, there is one drawback in particular: avoiding exposure to volatile organic compounds. But every kind of paint exposes the hobbyist to some health risk. Every potential risk can be easily solved by wearing a proper dual-filament respirator, and you still have the advantages of lacquer.

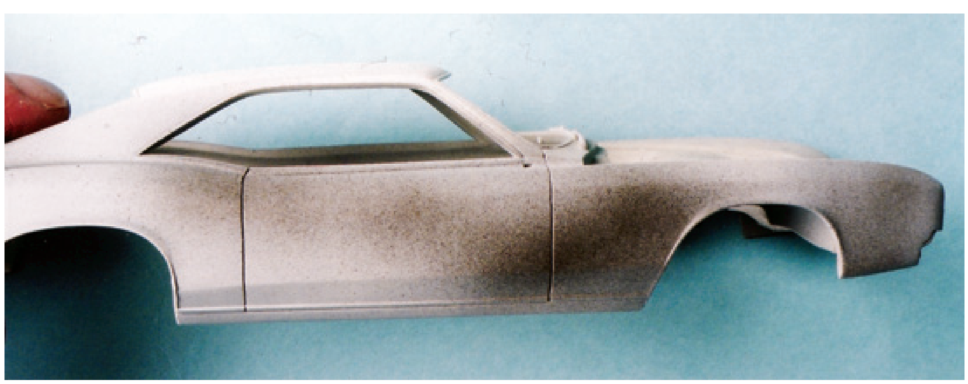


Figure 11.1: Once your basic bodywork is finished and primed, apply a light coat of very dark lacquer (preferably black) over the primed areas that cover your bodywork. The purpose of applying a guide coat is to detect high and low spots in your bodywork when the guide coat is sanded.

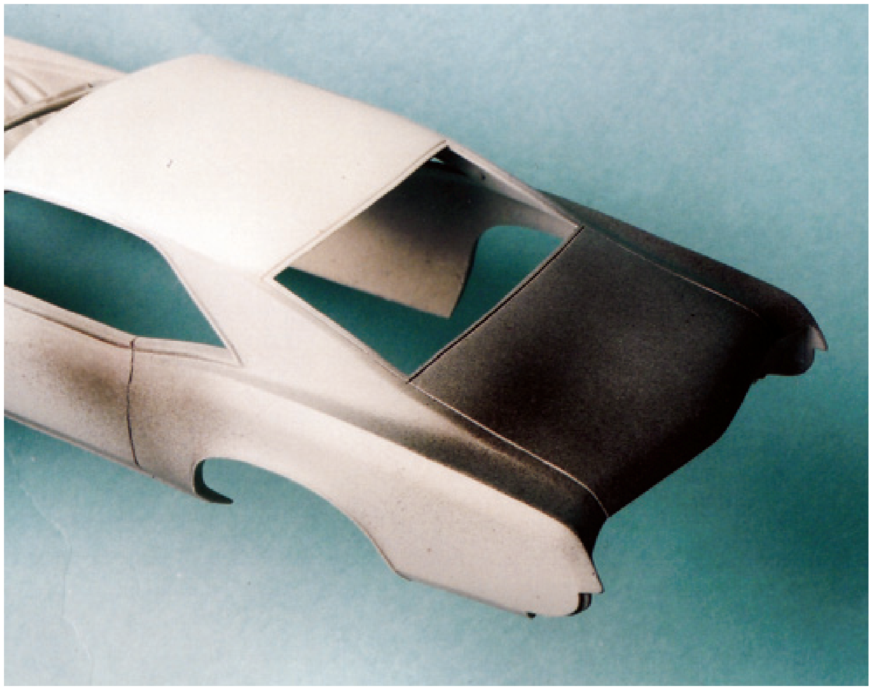


Figure 11.2: If the area to be checked involves substantial bodywork, you should lay down a heavier initial guide coat. Don't worry, you'll remove most of it. Wait until the black guide coat is thoroughly dry before sanding it, because a pigment color will sand differently from a primer, and will "fill up" your sanding stick too quickly if it isn't really dry.

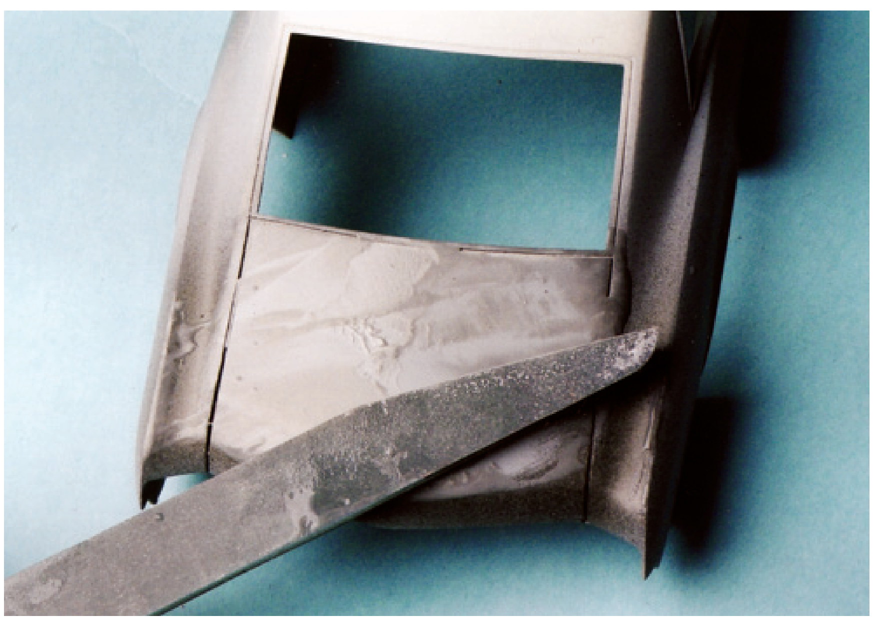


Figure 11.3: You should wet sand the guide-coated surfaces, using a medium sanding stick to prevent surface irregularities that might be created if you "finger sand." Sand at an angle to the panel rather than parallel to the panel's shape. Note the sanding sludge created here; just be sure to wash it all off periodically.

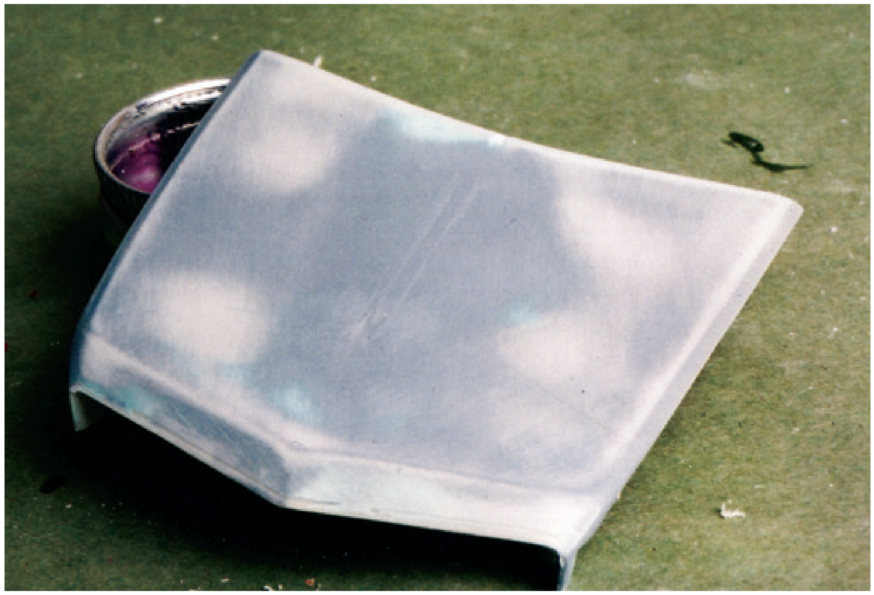


Figure 11.4: We've sanded the hood at several angles with a medium sanding stick and have revealed several surface irregularities: areas where the primer remains are "low," and reappearing putty or the original plastic reveal "high" areas. Since these problems appeared so easily and are so significant, we'll reprime this panel, apply a medium guide coat of dark grey or black lacquer and repeat the process until this surface presents only a uniform grey primer surface after sanding with 600 grit paper.

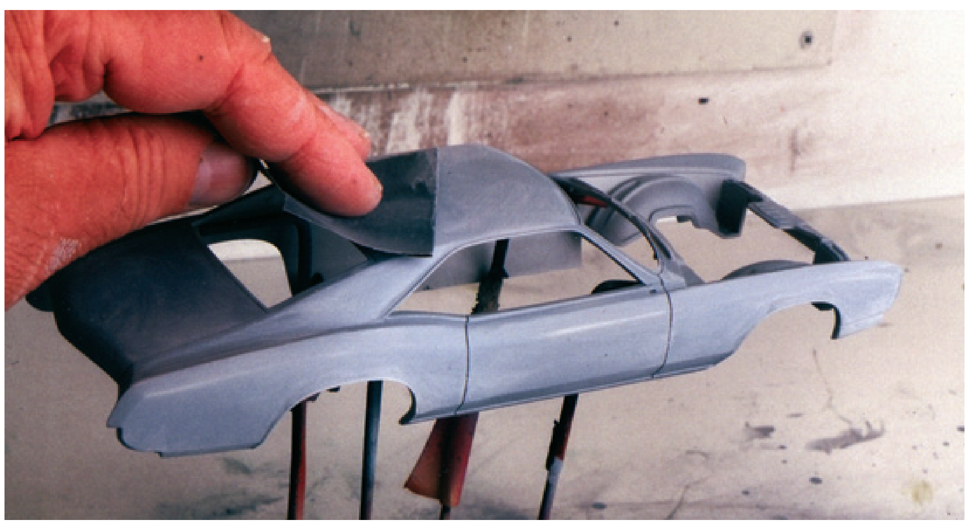


Figure 11.5: Thoroughly wash the whole model with warm water containing a few drop of non-silicone liquid soap, and lightly scrub out the panel lines and other recessed areas with a SOFT old toothbrush to remove sanding debris. Also, completely clean the inside of the body. Dry the model with a clean, lint-free rag free of oils and other contaminants, and set the model aside to dry for at least 30 minutes. Apply a light coat of primer over the entire model, and inspect the model for surface irregularities. Use a piece of 800-grit autobody paper and wet sand the entire model by hand and using water, after which you should wash and dry the model, and blow out any crevices with your airbrush.

Figure 11.6: Blow out the panel lines with your airbrush—running just air, of course—and then set the model aside. Now it's time to mix up your sealer, Dupont's VariPrime mixed 50-50 with the Activator. No further thinner is necessary. Shake the airbrush bottle for a few minutes to assure a good mix. The VariPrime mix has a pot life of about 48 hours, but always re-shake the bottle before each use.

Figure 11.7: Once the lacquer primer has thoroughly dried, apply a light coat of VariPrime. Start on the underside of the fenders, then move to the recessed areas, and then move to the broad flat surfaces. Don't be concerned if the sealer, when wet, appears to have a bit of an orange-peel surface; when curing, it flattens out considerably. In this photo, the roof has been left in primer to demonstrate the color difference. A uniform coat of the sealer should be allowed to cure for a few hours (the hood was also sealed at this time). Remember that the VariPrime actually "sets up" rather than dries since the Activator is a catalyst. This is a good time to remind you to be sure to use a two-cannister respirator: purchase a good one, use it, and keep it a sealed plastic container between uses. Replace the twin filters as recommended.

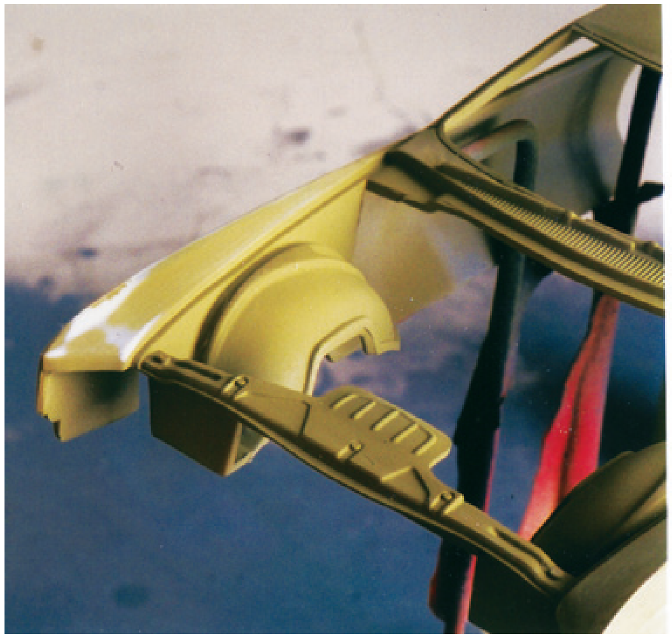


Figure 11.8: You may find that some surface flaws persist even though you were careful. In this case, a slight problem was missed on the left front fender. Once the sealer had thoroughly cured (about an hour), a fine-grit sanding stick, with water, was used to sand the offending area. After the model was washed again and dried, just this small area was re-sealed. You can apply the sealer directly over bare plastic.

Figure 11.9: Use a quality tack rag. Choose one of the so-called blue "clear coat" tack rags rather than the old mustard yellow beeswax versions. Gerson is one of several excellent brands.

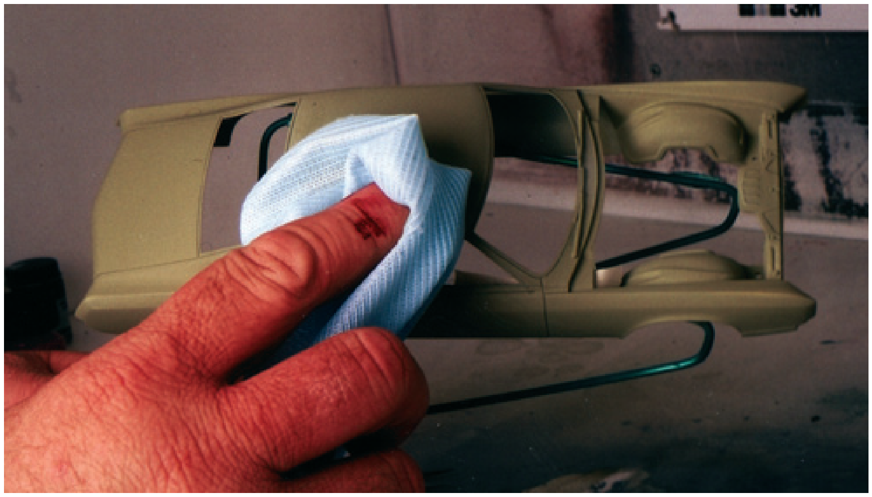


Figure 11.10: *Lightly* wipe down the model after first washing it again with liquid soap and water. Strict attention to cleanliness is essential to a show-winning finish.

Figure 11.11: As the primer cures, it is time to mix up the top coat. In this case, we're using a 1996 Hyundai color that is a rich wine red tone. Always strain the paint to remove debris. Pour the paint slowly and fill your bottle about 40% full, then add compatible thinner almost to the top of the bottle (leaving just a bit of space for proper agitating when shaking). Discard the strainer after each use. Dispose of all used thinner, lacquer-contaminated strainers and related materials in accordance with your local laws. Spray a test pattern to test for proper paint atomization. Remember, any mixing formula is just a guideline because the actual viscosity of each paint varies.

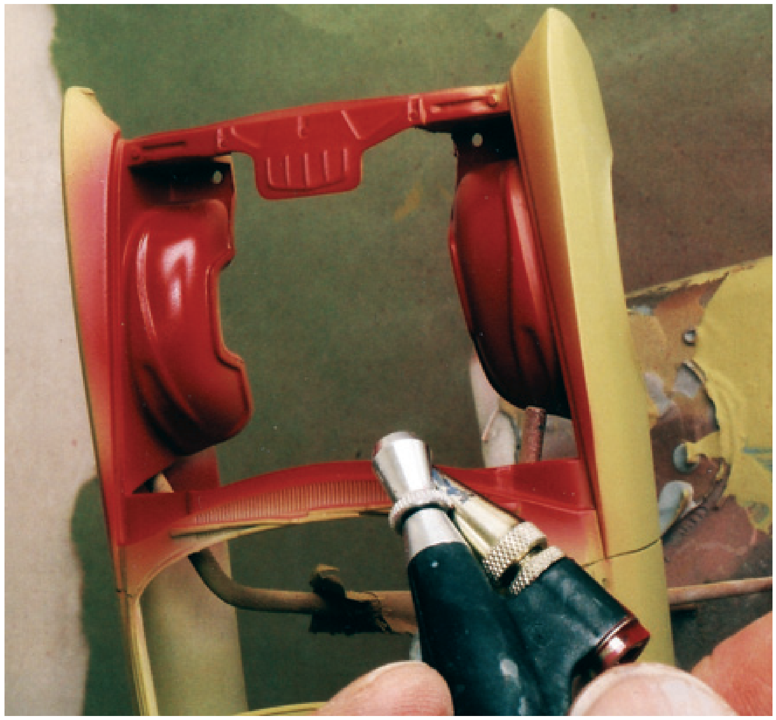


Figure 11.12: After blowing out the door reveals and other lines (away from your painting area), again gently wipe down the surface with the tack rag. Start by applying your color directly onto the sealer (our color is a "high-solid"and covers quickly). Your airbrush needs to be about 6–8 inches away from the surface and moved with moderate speed (use a test body to determine the best technique for each color). On this job, I used a Badger 350 with a fresh coarse nozzle and tip and the color was shot between 35–40 psi. Your first applications of color should be in recessed areas.

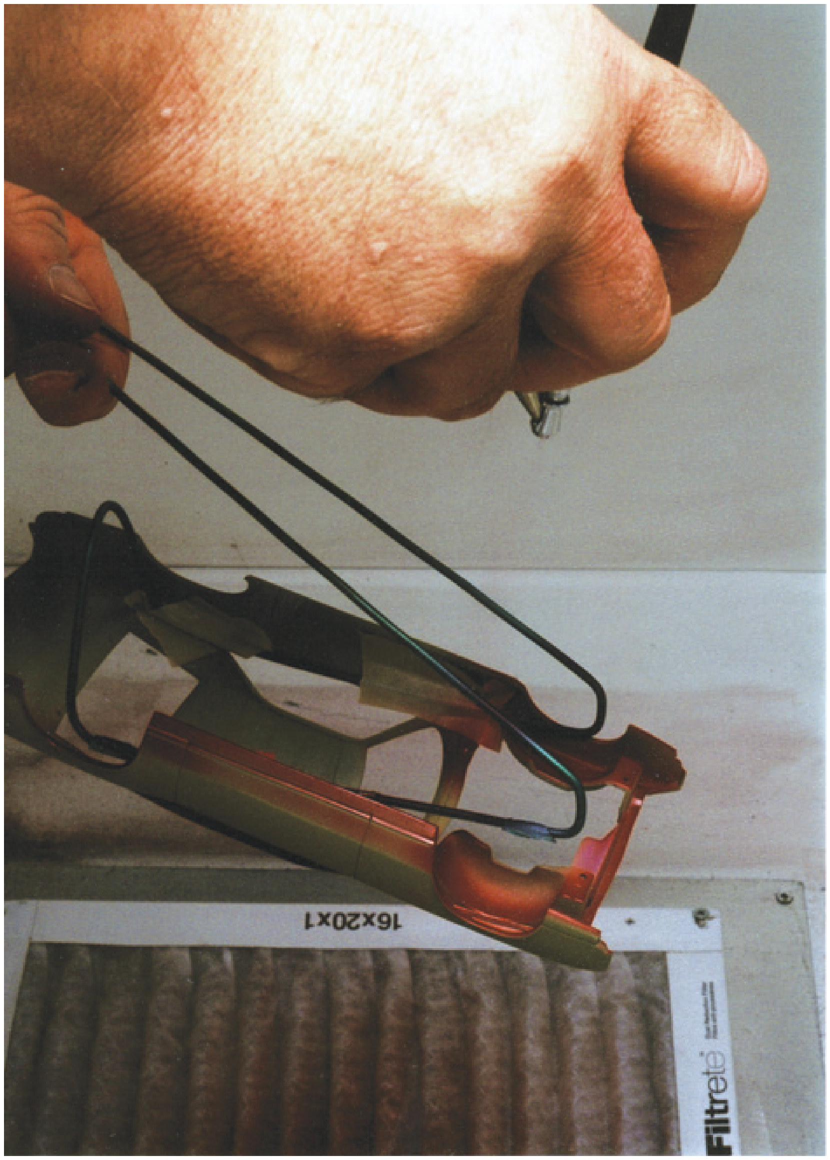


Figure 11.13: The next move is to apply color around the wheelwell openings, and then along the lower part of the model, moving the gun left to right, and then back again using a coarse nozzle. Repeat this step for both sides. Now, immediately move the gun "up" on the model and apply two medium coats of paint.

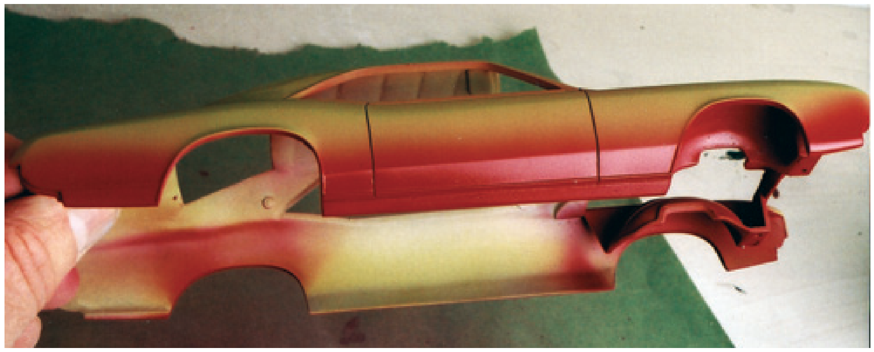


Figure 11.14: Before that paint has dried, rotate the device you're using to hold the model so that you can apply color along the bottom around the entire model. Since this is a solid color, the actual spray pattern isn't critical, though it is generally best to apply the paint in a line parallel with the longest measurement of the panel. It is important to start on the fogged edge of the color and move up and away from that surface rather than to start at the top of the fenders and paint down to meet the rocker panel. It is important to minimize rough overspray wherever possible.

Figure 11.15: Paint your hood (and other removable panels) next by first painting the underside and the panel edges before proceeding to the top of the panel to avoid unnecessary overspray. Unless you're spraying a metallic or other custom finish (e.g., candies and pearls), the spray pattern is relatively unimportant.

Figure 11.16: Go along the perimeter of the hood now, being sure to cover all of these vertical surfaces with a couple coats of color.

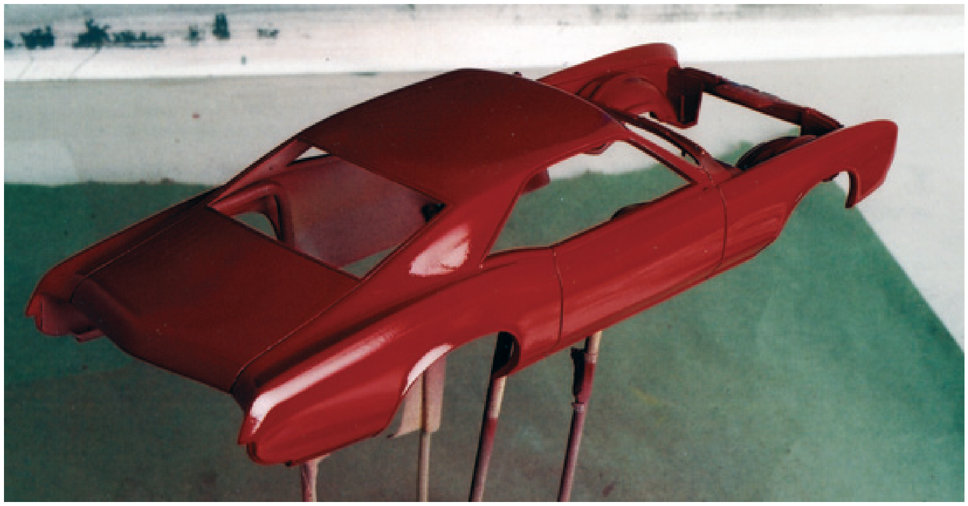


Figure 11.17: Thin out the color by 10 percent and lay down two more color coats. At this point, the paint on your model should look like this, but lacquer will "pucker" up a bit as it dries, necessitating polishing.

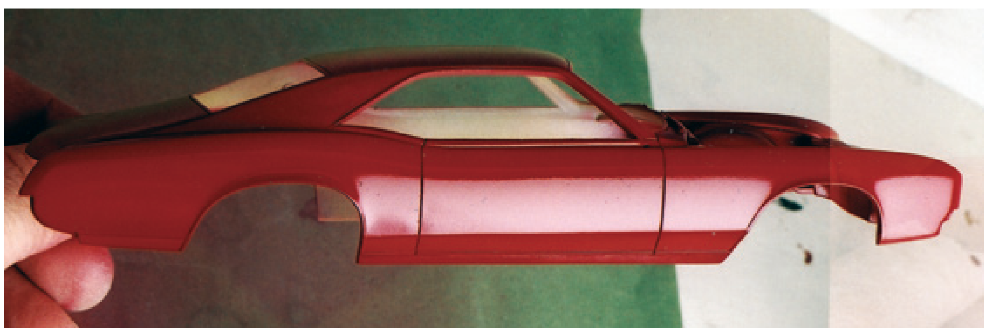


Figure 11.18: Wait for the initial coat of lacquer to completely dry, preferably for 2–3 days at an ambient temperature of 70° F. Then, lightly sand the surface with 1200 grit wet and dry sandpaper, being very careful not to hit raised areas or creases. Then wash the model completely, use that old toothbrush to scour out panel lines, and dry thoroughly. Apply three more coats of color at 5 minute intervals, each progressively thinned out just a bit, and then stand back and look at your work—look at the gloss! Allow the paint to dry completely. It is recommended that you set aside the model for at least 24 hours before handling it, since lacquer shrinks as it dries. If you're in a humid or cold area, allow more time.

Figure 11.19: Here's the roof after the lacquer color coats have dried for about 10 days. Note that there is a slight puckering on the surface (commonly called orange peel), and this is perfectly normal. Our chosen polish will smooth out this surface to mirror smoothness. Do *not* sand this surface at this point.

Figure 11.20: Now we're ready for polishing. You should visit your autobody jobber and acquire Meguiar's #3 and Meguiar's #7 paint polish or 3-M Finessee It! Don't *ever* use any silicone-based product—it will contaminate your work area (interfering with paint adhesion and preventing smooth paint application on other projects in the future), and will effectively prevent any paint repair to your model. Select genuine auto paint products and stick with them!

Figure 11.21: Pour out a small dollop of Meguiar's #3 or Finesse It onto a freshly laundered old soft cotton T-shirt or diaper. It is a good idea to get your rag damp with water so that the cloth doesn't merely soak up your polish.

Figure 11.22: Gently rub the polish into the surface, using a roughly circular motion. Any particular area may take four to six minutes to produce a mirror shine. Go gentle on the pressure, and always support the panel by placing your other hand underneath it. Watch to avoid rubbing too much on any sharp panel crease or other protrusion: You can rub right through the color to the sealer below.

Figure 11.23: In small areas adjacent to sharp panel lines, approach the area from opposite the crease, never over the top of the line. Gently rub along the length of the inside of the crease line. Think about what you're doing, and remember that polishing removes a bit of paint in the process.

Figure 11.24: The same process is used on the top of the fender. By placing your index finger inside the soft rag which is lightly soaked with either M-3 or Finesse-It, you can get a mirror finish along a recessed area like this one. Watch the progress of your work to avoid rubbing through on a sharp panel crease.

Figure 11.25: When you need to rub out paint around a wheelwell, rub the polish into the surface and then rotate your shrouded finger up and around the sharp crease. Note that this surface has not been sanded—even with 2000-grit paper—because of the care taken in the application stage, which consisted of the application of the last three coats of color over a carefully-sanded finish. Note the very slight orange peel just forward of the wheelwell, midway up the panel.

Figure 11.26: A long panel should first be rubbed with the polish along the length of the panel to cut down the orange peel. Once the finish is smooth—and don't be afraid to use the polish liberally—you should return to a series of small circular motions along the length of the panel.

Figure 11.27: The trunk, as with other roughly square panels like the hood, can be rubbed out by consistently applying the polish in a circular pattern. You should also polish the trim around the "glass" so that, when you apply your Bare Metal Foil, the underlying surface is mirror smooth.

Figure 11.28: After the last panel is polished with #3 or Finesse-It, wash the entire model in tepid water with a liquid hand soap, and then gently dry off the entire model. Grab a fresh polishing rag, and gently rub Meguiar's #7 into the surface of the entire model in a series of circular patterns. Wash the model again, apply your foil, "glass" and use a complimentary hue of The Detailer liquids in panel lines. This model has not been sanded with harsh sandpapers, and no clear lacquer was applied to enhance the final finish gloss. I never use wax.

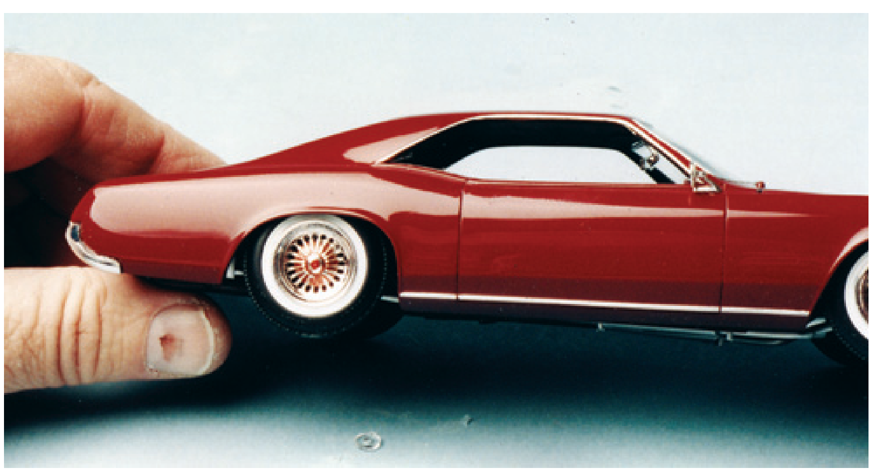


Figure 11.29: Check out this flawless surface. No clear was applied, and this paint looks "in scale."

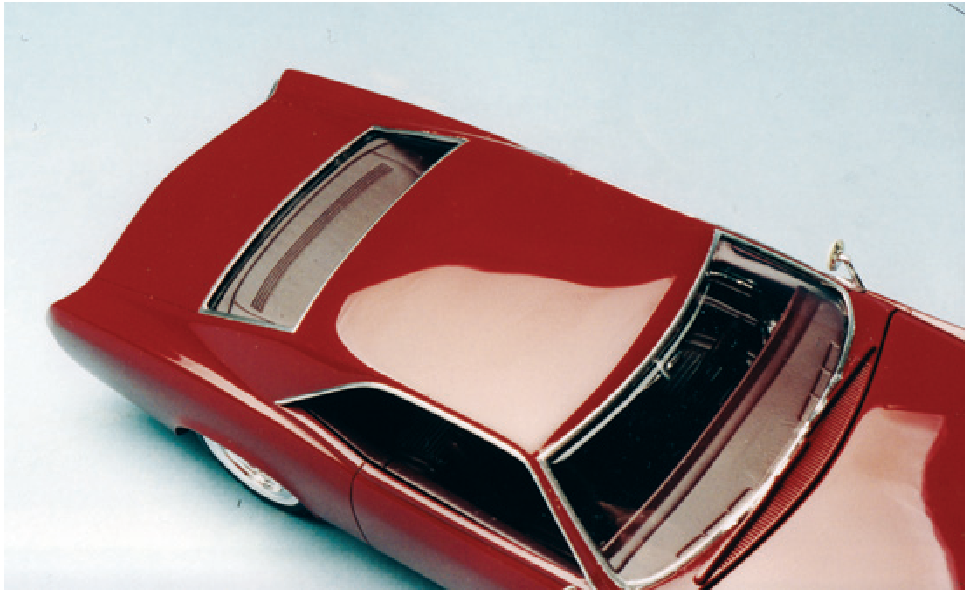


Figure 11.30: Here's where the beauty of lacquer paint (really, any well-applied product) really shines. This kind of finish is often the threshold element when a judge first reviews your model.

APPENDIX A

Getting Your Ducts in a Row: Spray Booth Design and Fan Selection

KLAUS RADDATZ

This is not intended to be the final word on spray booth design, fan selection, or a criticism of anyone's spray booth, but to share what I know about booth design, and provide a guide that takes some of the experimentation out of building your own spray booth. Also, please keep in mind that we're designing a *hobby* paint spray booth using some of the design principles of full sized booths. This should not be interpreted as a guide to building a full sized spray booth.

When it comes to fan selection, there are usually concerns about drawing too much air into the booth and contaminating your paint with dust/dirt. In determining the airflow through your booth keep in mind where your spray booth will be used, the type of spray equipment that you'll be using, and the ambient condition. While some compromises are possible, dusty environments should be addressed through means other than reduced airflow through the booth. The goal in building a spray booth is to create a healthier working environment by exhausting the paint fumes from your workshop. Until you've worked with a properly ventilated booth, you'll never realize the difference that the right fan can make

Several things to consider before selecting a fan for your spray booth are:

- Spray booth size
- Direction of draft
- Airflow requirements
- Duct diameter and length
- Static pressure

A.1 Spray Booth Size

Booth size and proportion are dependent upon need. Make sure the booth will accommodate your largest part and you can comfortably paint within those confines. If you're not sure about proportions, build a mock-up out of cardboard first and try it. Then transfer those dimensions to whatever material you're going to use to build your booth. Something to keep in mind when you're deciding on size: the larger the booth, the larger the fan you will need to exhaust it, and fan prices go up with CFM and SP ratings. Also, consider adding a plenum chamber between the fans and the filters. 1:1 spray booths use plenums to even out the airflow across the filters.

A.2 Direction of Draft

Most 1:1 spray booths are totally enclosed and designed with either a cross-draft or downdraft airflow. Cross-draft booths pull air horizontally across the booth from inlet filters typically located in the booth doors to exhaust filters located directly opposite the inlet filters. Downdraft booths pull air downward from inlet filters located in the ceiling, to exhaust filters located in the floor.

From a hobby perspective, it's not feasible to build a totally enclosed spray booth. Hobby spray booths are typically small, open-faced bench top units, drawing in unfiltered air for ventilation, as shown in Figure A.1. As such, problems can occur with dust and dirt settling in the paint. This is especially true in cross-draft booths, where all of the air entering the booth flows across the painted part. Dust contamination is somewhat reduced in downdraft booths due to lower air volumes required for ventilation, and because the air flows downward as it enters the booth. Adding an inlet filter to the top of the downdraft booth can further reduce the amount of unfiltered air drawn across the part.

As for venting to the top of the booth (updraft booth), in the real world it's just not done that way. This can have adverse affects on both booth performance and finish quality.

It's important to understand what happens when you vent to the top of the booth. First, you're working against gravity; that means you'll need higher airflow rates for proper ventilation. Secondly, the updraft pulls the atomized paint away from the part, requiring higher spraying pressures to compensate. The resulting finish problems created by high airflow rates and high spraying pressures are further compounded by the limited adjustments on airbrushes (versus conventional spray guns), and limited thinners and reducers available for hobby paints. Although automotive thinners and reducers have been used in hobby applications, their corrective properties may not be sufficient to overcome a poorly designed spray booth. Finally, when venting to the top of the booth, there is a good chance that overspray particles in the filter will fall down into the paint. It's not a good idea to hang dirt above the part you're painting.

My spray booth, shown in Figures A.2 through A.4, is a cross-draft booth that measures 17 1/4” tall, 24” wide, and 19” deep. The top of the booth is set back about 9” to provide clearance for overhead spraying, and I've added a 2” plenum chamber to even out the airflow across the filter. Another advantage of the plenum is that if I find I've installed too large of a fan, I can vent the plenum chamber to allow the fan to draw in outside air, thus reducing the airflow through the booth. I've also added a door so I can close the booth after the fans are turned off to prevent dust from settling in the paint.

A.3 Air Flow Requirements

Once the spray booth size and direction of draft are determined, we can calculate the fan requirements, starting with air movement through the booth. For cross draft booths, this is known as *face velocity* and for downdraft booths, it's known as *downward velocity*. Industry standards specify that the air velocity through a cross draft booth should be 100 feet/minute (FPM), empty, meaning no operator or parts are present. For downdraft booths the specification is 100 FPM past the operator, meaning the operator and part are present when airflow readings are taken. Some applications require more or less velocity

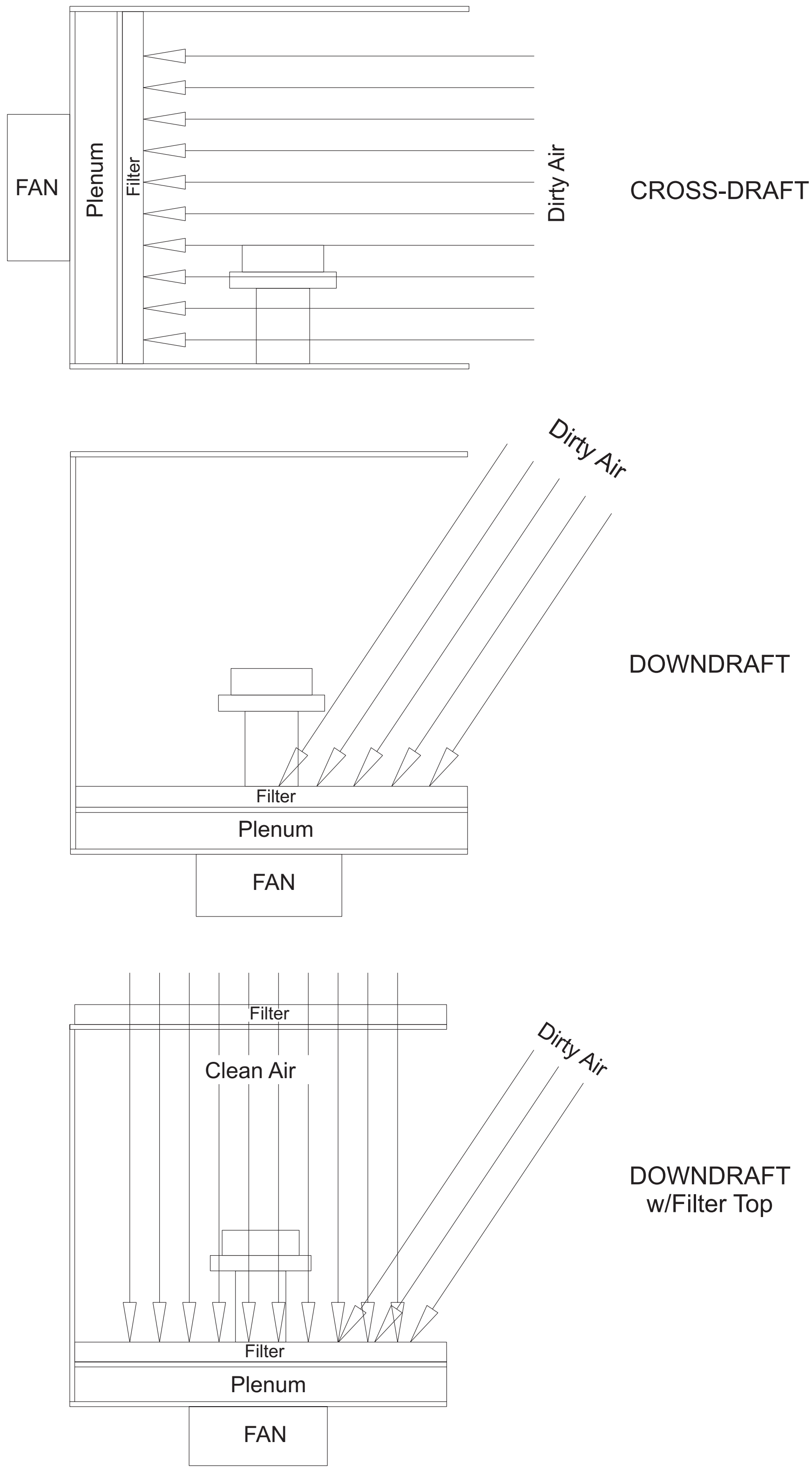


Figure A.1: Direction of draft. (Klaus Raddatz diagrams)

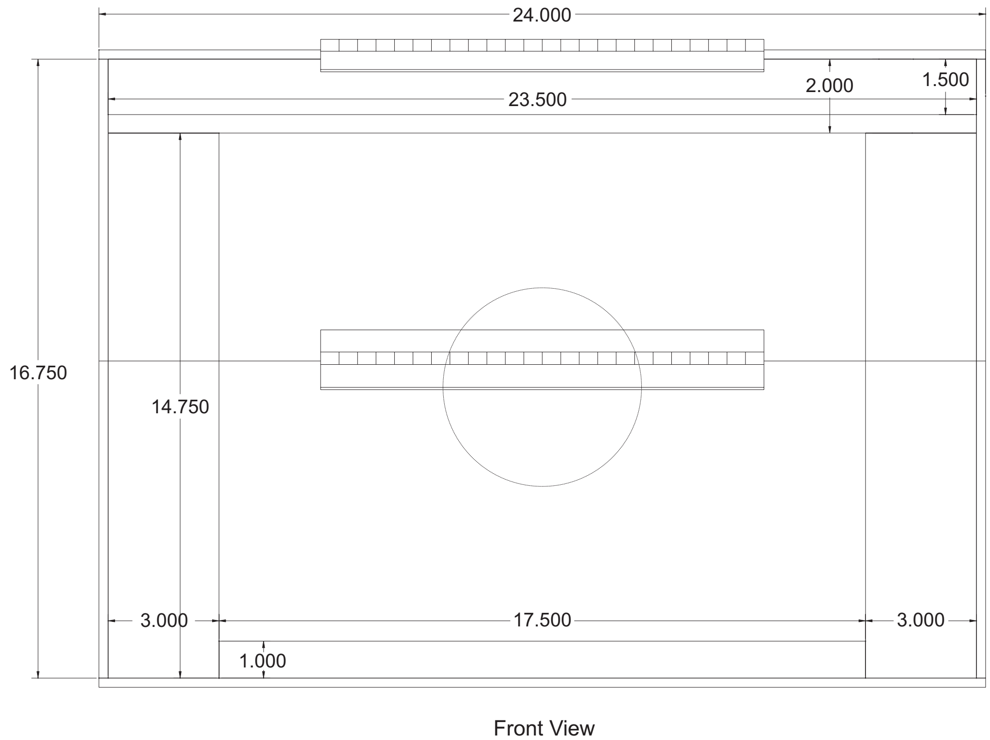


Figure A.2: Spray booth front view.

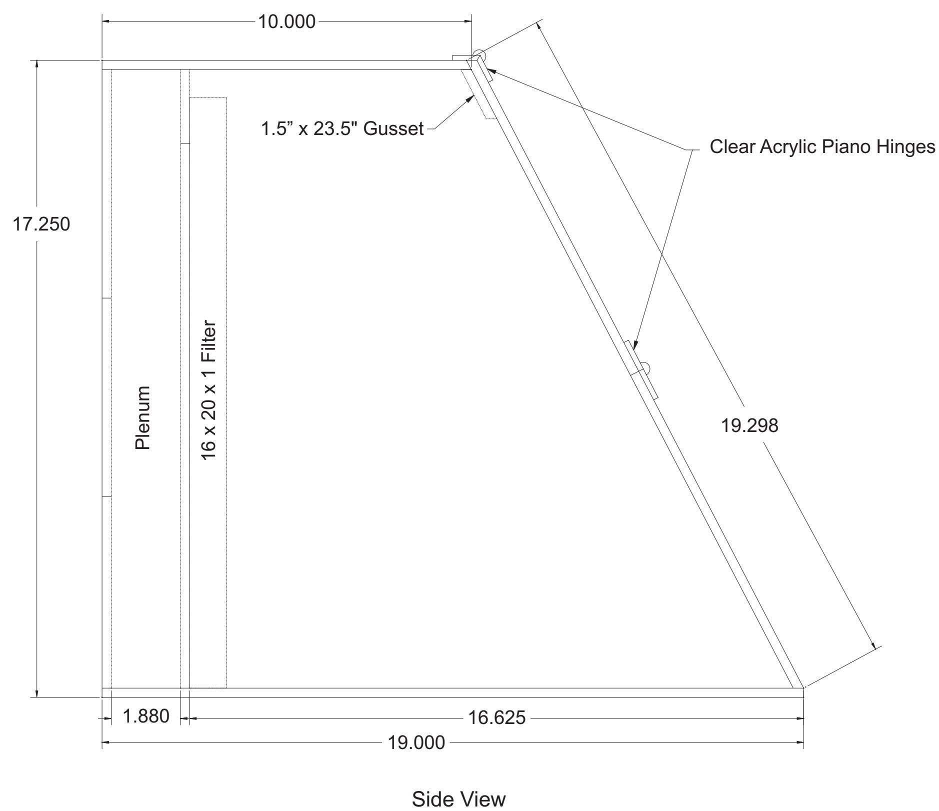
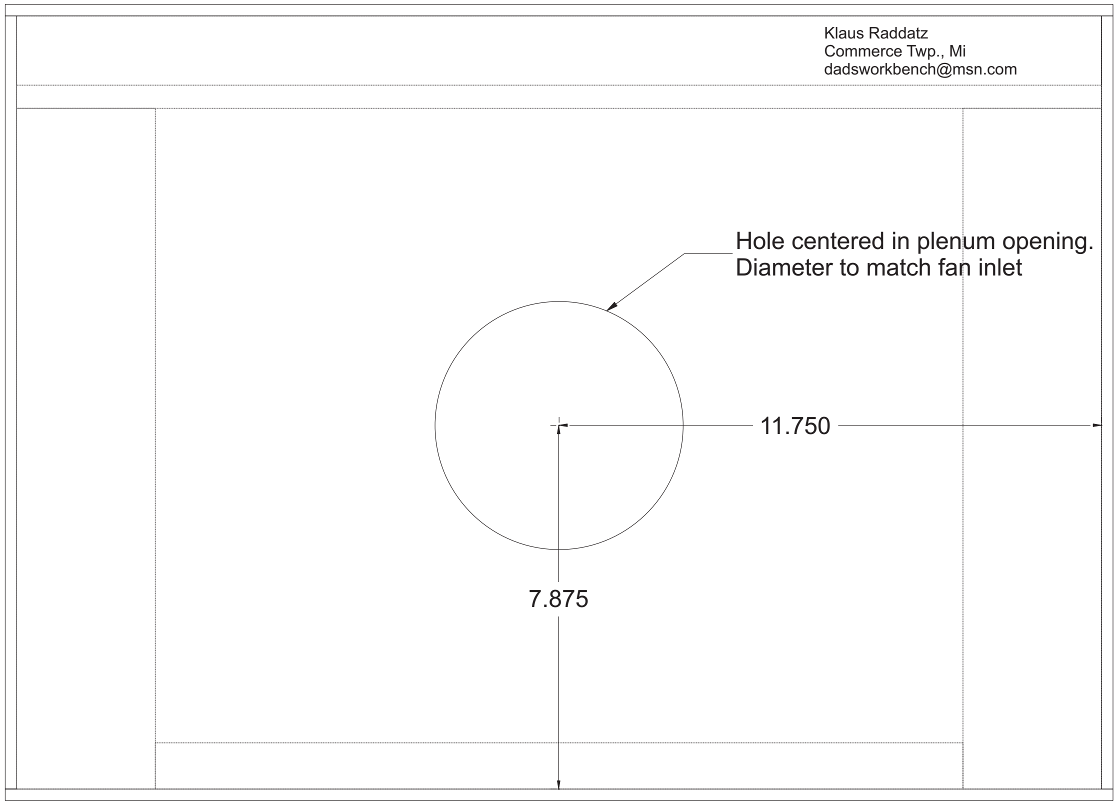


Figure A.3: Spray booth side view.



Rear View
Fan Location

<u>Materials:</u>
1/4" Clear Acrylic Plastic
1 3/4" x 12" Clear Acrylic Piano Hinge (qty. 2)

<u>Cement:</u>
44629 Solvent Cement (qty. 1, 5 oz tube)

<u>Supplier:</u>
United States Plastic Corp.
1-800-537-9724
www.usplastic.com

<u>Filter:</u>
16" x 20" x 1" Furnace Filter

<u>FilterRetainer:</u>
Electricians fish-tape 48" long

Figure A.4: Spray booth rear view and materials list.

depending on the type and quantity of material being sprayed, the applicator being used, and the direction of draft.

The rules of thumb: design cross draft booths with 100 FPM face velocity and downdraft booths with 50 FPM downward velocity. A lower velocity is used for downdraft booths, first, because of gravity's effect on overspray, and secondly, when a mass (part and operator) is added to the inside of the booth, the airflow velocity increases because the internal volume of the booth has decreased. It's like pushing the same volume of air through a smaller pipe.

For my cross-draft booth, I need a face velocity of 100 FPM. To reach that velocity, I'll need a fan capable of moving 300 cubic feet of air per minute (CFM) as shown by the following calculations:

CFM Calculations.

To calculate the CFM of air required to produce the desired face velocity in a cross draft booth or the downward velocity in a downdraft booth, use the following formulas:

Cross-draft CFM = inside height × inside width × desired face velocity
(depth is not a consideration)

Downdraft CFM = inside width × inside depth × desired downward velocity
(height is not a consideration)

For example, the inside height and width of my cross draft booth is approximately 18" × 24". To calculate for industry standards, multiply the height and width by 100 FPM:

1.5' × 2' × 100 FPM = 300 CFM

To meet industry standards, I need a fan capable of moving 300 CFM of air. But don't buy a fan yet, read on . . .

A.4 Duct Diameter and Length

Next step is duct diameter and routing. The goal at this point is to determine the total length of the ductwork. It's helpful here to calculate the length for a couple of different duct diameters. For example, if you plan on using 4" duct, also calculate the values for 5" duct, just in case the 4" duct is too small (meaning static pressure is too high) for the required air volume.

Also, if you're using flexible duct, multiply the actual length by 3. Flexible duct can be very restrictive depending on the length, corrugation, and number of bends. Minimize the use of flexible duct.

To determine total duct length, measure the straight duct sections and count the number of 90 and 45-degree elbows you'll be using, as shown in Figure A.5. Refer to Table A.1 to convert the elbows to straight duct, and then add up all the measurements to come up with a total length.

My booth uses 4' of 5" straight duct, one 5" 90-degree elbow, and one 5" 45-degree elbow, as shown below. The elbow to straight duct conversion for a 5" 90-degree elbow is 9', and a 5" 45-degree elbow is 4.5'. Add up the duct lengths, 4' + 9' + 4.5' = 17.5'. I find my booth uses the equivalent of 17.5' of straight 5" duct.

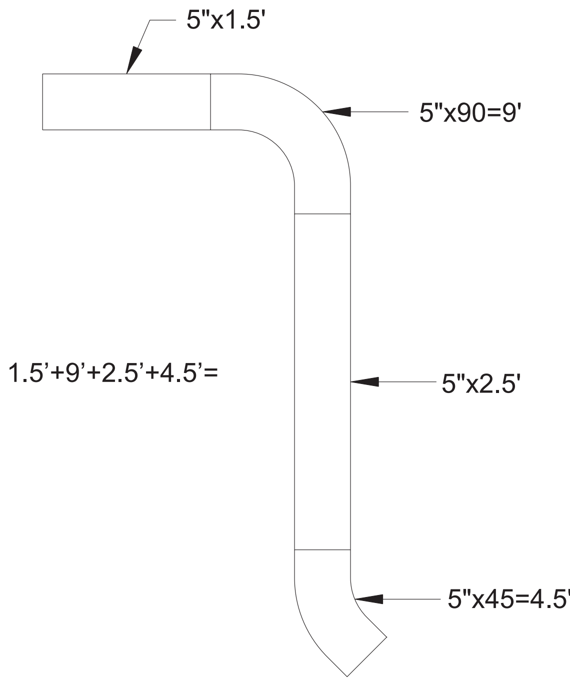


Figure A.5: Total duct length

Table A.1: Elbow to straight duct conversion

	Duct Diameter									
	3”		4”		5”		6”		7”	
Angle	45°	90°	45°	90°	45°	90°	45°	90°	45°	90°
Straight Duct Equivalent	2.5’	5’	3’	6’	4.5’	9’	6’	12’	6.5’	13’

If I were using 4” duct, the total length would be: 4’ + 6’ + 3’ = 13’. Although the calculated length is shorter, you’ll find in the next step, the SP values are much higher.

A.5 Static Pressure

Next, determine the static pressure in the ductwork. Static pressure (SP) is the resistance to air movement in the ducts, and is important in choosing a fan. The fan you choose must be able to deliver the required CFM at the static pressure level inherent to your ductwork.

Refer to Table A.2. The values shown are for 100’ of straight, smooth, aluminum duct. Find the duct diameter you’ll be using and the CFM closest to the face or downward velocity determined above. Note the SP value and proceed to Calculate the Static Pressure in the Ductwork. Static pressure values not given were determined to be too high for practical application with available fans or blowers.

Table A.2: Static pressure in 100’ of straight aluminum duct

	Static Pressure (inches H_2O) by Duct Diameter				
CFM	**3”**	**4”**	**5”**	**6”**	**7”**
100	2.27	0.56	—	—	—
125	3.44	0.84	—	—	—
150	4.77	1.17	—	—	—
175	6.39	1.56	—	—	—
200	8.14	1.98	—	—	—
225	—	2.45	—	—	—
250	—	2.98	—	—	—
275	—	3.56	—	—	—
300	—	4.19	1.39	—	—
325	—	4.87	1.62	—	—
350	—	5.57	1.86	—	—
375	—	6.35	2.11	—	—
400	—	—	2.37	—	—
425	—	—	2.67	—	—
450	—	—	2.96	—	—
475	—	—	3.28	—	—
500	—	—	3.58	1.47	—
525	—	—	3.94	1.61	—
550	—	—	4.28	1.75	—
575	—	—	4.69	1.90	—
600	—	—	—	2.06	—
625	—	—	—	2.21	—
650	—	—	—	2.38	—
675	—	—	—	2.56	—
700	—	—	—	2.73	1.28
725	—	—	—	2.91	1.36
750	—	—	—	3.12	1.46
775	—	—	—	3.31	1.55
800	—	—	—	3.51	1.64
825	—	—	—	—	1.74
850	—	—	—	—	1.84
875	—	—	—	—	1.94
900	—	—	—	—	2.05
925	—	—	—	—	2.15
950	—	—	—	—	2.25
975	—	—	—	—	2.37
1000	—	—	—	—	2.49

Calculate the Static Pressure in the Ductwork.

To calculate the static pressure of your ductwork, multiply 1/100 of your duct length by the static pressure value.

For example, to meet industry standards, I need to calculate the SP for 300 CFM airflow through 13' of 4" duct. Multiply 1/100 of the duct length (for my booth, 13' × 1/100 = 0.13) by the SP value for the duct diameter:

4" duct at 300 CFM = 4.19" SP	(static pressure value from Table A.2)
0.13 × 4.19 = 0.55" SP	(static pressure in the ductwork)

To meet industry standards using 4" duct, I need a fan capable of delivering 300 CFM at 0.55" SP. This SP value is very high and borders at a point that may make fan selection difficult. I would be better off using a 5" duct to reduce the SP and simplify fan selection.

Running the same calculations with 5" duct (the calculated length of 5" ducting was 17.5'):

5" duct at 300 CFM = 1.39" SP	(static pressure value from Table A.2)
0.175 × 1.39 = 0.24" SP	(static pressure in the ductwork)

An SP of 0.24" is very workable. Looking at the blowers available from Grainger, I find the 4C444 blower is capable of moving 350 CFM of air at 0.0" SP. At 0.24" it drops to approximately 322 CFM (40% of the difference between the 0.2" and 0.3" values), so this may be a good choice.

Run the calculation again using the maximum output of the blower you choose, in this case, 350 CFM:

5" duct at 350 CFM = 1.86" SP	(static pressure value from Table A.2)
0.175 × 1.86 = 0.33" SP	(static pressure in the ductwork)

At 0.33" SP, the CFM drops to approximately 307 CFM (30% of the difference between the 0.3" and 0.4" values), and although a bit higher than needed, the booth velocity increases only to 102 FPM, which won't be a problem.

To calculate for multiple duct diameters, simply calculate the SP for each diameter, individually, using the full rated CFM of the blower (0.0" SP), and add the resulting SP numbers together for each diameter. This becomes the total system SP as shown above.

I didn't include losses through the filters because it varies with filter media; however, furnace filters have minimal pressure loss when they're clean. I've measured this with a digital manometer and found that clean, doubled fiberglass filters increase the SP by 0.001" SP at the airflow calculated above.

So, how critical is the SP to fan selection? Here's an example from a catalog to give you an idea of how much the air volume is reduced as the static pressure increases. The free air (0.0" SP) rating of this particular fan is 320 CFM. At 0.5" SP that dropped to 50 CFM. In my booth that would produce a face velocity of about 17 FPM. Quite a bit less than the 100 FPM, I'm currently using, and a guarantee that my workshop will smell like paint. Not all fans will lose this much air volume, but without doing these calculations you'll never know (remember, we're trying to take some of the experimentation out of booth design). Also, keep in mind that many fans are rated only in free air (0.0" SP). If SP values aren't given, be careful. Contact the manufacturer to see if SP ratings are available. Some manufacturers have this information posted on their Web sites.

Motors, Fans, and Lights.

Now, what type of fan? Bathroom, kitchen, induction motor, inside the booth, outside the booth . . . ? First, you won't find an electric motor in the air stream of a 1:1 spray booth. 1:1 booths use externally mounted explosion proof motors. An explosion proof motor is certified as such by one of several industry-recognized certifying agencies. None of the previously mentioned fans is explosion proof. Kitchen and bathroom fans are probably the most critical because they typically have exposed stator windings. Paint solvents, unlike cooking oils and hair sprays, can deteriorate the varnish on these windings and cause the motor to short circuit. Exercise caution if you're using these types of fans.

Also, keep in mind that voltage and current levels inside a spray booth must be kept below non-sparking levels, unless the components are certified as explosion proof. Non-sparking voltage and current levels are, if I recall correctly, about 16 volts and 50 mA, way below the 120 volts and several amps that many small fans use. Ultimately, the best type of fan to use is one that keeps the motor out of the air stream.

There are booths available that use computer type axial fans. These have induction motors located in the air stream, and while they're not explosion proof, their design makes them a better choice than bathroom or kitchen fans. I've taken a few of these fans apart and found the stator windings embedded in epoxy. Since epoxy typically has a high resistance to solvents, I feel comfortable that the solvents won't migrate into the stator windings and deteriorate the insulation.

Another alternative would be a fan with an externally mounted motor, such as the Dayton shaded pole blowers shown in Table A.3, Grainger Blowers, available at Grainger.com. These blowers have been used successfully in spray booths, but please remember, they are also not explosion-proof.

To find complete specifications for these blowers, go to www.grainger.com and search for the blowers by stock number. Depending on the booth size and the airflow restriction of your ductwork, one of these blowers should work for you. When selecting a blower, it's better to go larger than necessary and vent the plenum rather than too small and have insufficient airflow.

Table A.3: Grainger blowers

	CFM at Static Pressure								
Grainger Stock No.	**0.0”**	**0.1”**	**0.2”**	**0.3”**	**0.4”**	**0.5”**	**0.6”**	**0.7”**	**0.8”**
4C444	350	340	328	312	296	274	240	202	158
4YJ31	382	349	335	319	300	279	248	204	145
1TDR7	485	475	448	425	398	375	325	275	215
4YJ32	488	470	450	430	406	377	336	282	217
4C445	495	476	458	437	416	387	360	312	265
1TDT2	549	538	510	500	480	450	435	390	360
1TDT4	805	770	730	685	645	605	562	485	—
2C946	815	767	716	663	604	537	460	280	—
1TDT5	965	950	910	850	820	750	710	—	—
4C054	980	940	890	843	788	730	655	—	—

When it comes to lights, florescent are preferred. They run cooler, use less energy, and tend to be more color correct than incandescent lights. Lights should be mounted outside of the booth for the same reasons that apply to motors: voltage and current. Cut a hole in the booth, install a piece a plexi-glass, and mount the light over the top of that.

If your booth is metal or plastic, make sure it has a proper electrical ground. I spent a number of years in robotic spray finishing, and I can tell you first hand that electricity, whether it's AC, DC, or static, doesn't mix well with paint, unless of course you're painting with electrostatic guns. But that's another story.

Make-Up Air.

Finally, using a spray booth in an enclosed space requires ventilation to replenish the exhausted air. Failure to provide a make-up air source will cause air to flow through gaps in windows, doors, etc., or existing vents such as furnace/water heater/fireplace flues, which introduces the possibility of carbon monoxide poisoning.

Additionally, without adequate make-up air, the spray booth can lose efficiency. This will become increasingly evident by the smell of paint fumes and overspray not clearing from the booth.

My workshop measures approximately 10' × 8' × 12', for a total volume of 960 cubic feet. Using a blower that moves air at a rate of 300 CFM, will in theory, attempt to replace the air in my shop every 3.2 minutes. To compensate, I simply open a window, and in the colder months, place a small electric heater in front of it to help warm the incoming air.

That's it. I hope you find this useful. If you have any questions or need information that is more specific, feel free to e-mail me at dadsworkbench@msn.com.

APPENDIX B

Dream Truck^2

After the completion of the first version of the *Modern Dream Truck,* Mark S. Gustavson was quite unhappy with the way it turned out. In fact, there were many features of the model, both mechanical and styling, that he found to be entirely unsatisfactory.

Subsequently, he wrote a strongly-worded critique of the model which was printed in the July 1997 issue of *Car Modeler* magazine. With the permission of Kalmbach Publishing, that entire article is reproduced here to demonstrate the kind of open-eyed evaluation of a completed model that ought to be done at the end of each project, so that future efforts can be better planned and executed.

As a result of this critique, he decided to entirely redesign, re-engineer, and rebuild the model. The work done to date on the revised model, now called the *Dream Truck*^{2}, is detailed in part in Chapter 7 of this book.

Custom Model Car Series

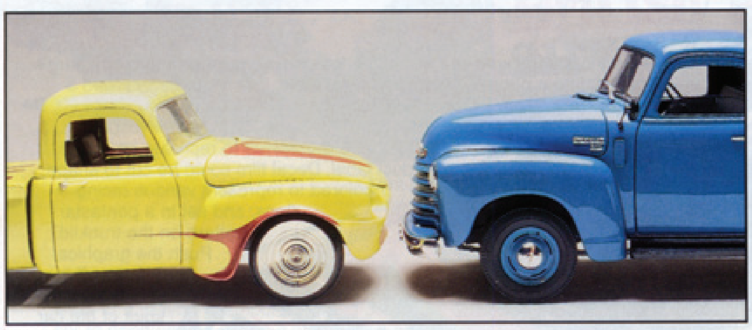
Making a Dream Truck, Part XIV: The final chapter?

This dramatic comparison between the Modern Dream Truck and Jeff Wolfe's factory stock version of the AMT/Ertl 1950 Chevy pickup points out how deep sectioning and channeling can substantially reduce the overall height of a model. Our Modern Dream Truck is not chopped. While the Modern Dream Truck appears to be a much lower vehicle, the principal difference is that the body has been reduced in height and dropped lower on the frame.

by MARK S. GUSTAVSON
photos by MIKE BARLOW and PAT COVERT

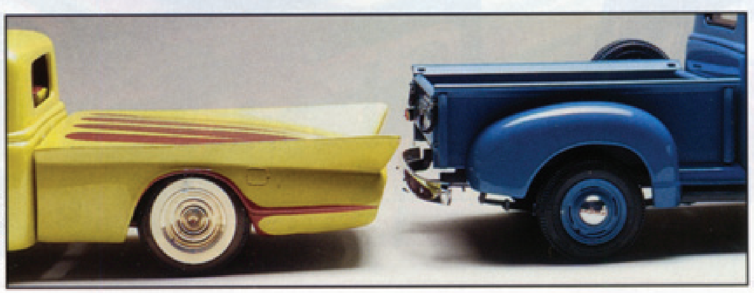
The making of our "Modern Dream Truck" has been an odyssey. Starting in the January 1995 issue of this magazine (*CM 29*), we have worked together to section the cab of the AMT/Ertl '50 Chevy pickup, narrow and reshape the front fenders, section and drop the hood, open and hinge the doors, create a finned "bed," cut up and adapt a '62 Chevy frame, and mimic an illustrated paint scheme using custom lacquer painting techniques.

Now let's take a brief look at the model to see where it has succeeded and failed. Frankly, there are a couple of significant styling glitches we must discuss (see sidebar). There are other elements, which, if you don't mind the indulgence, are pretty well done.



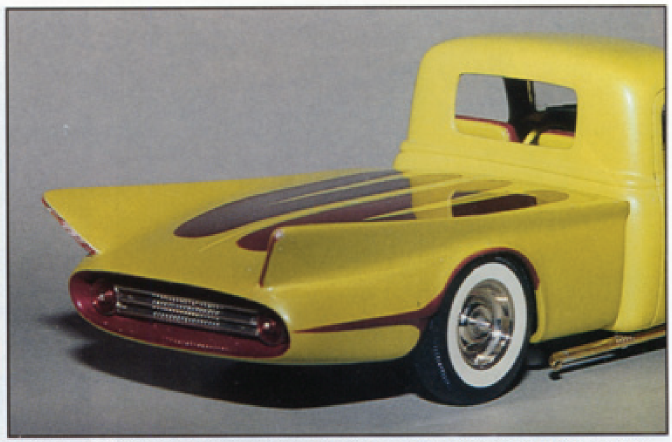
A nose-to-nose comparison of the two models presents a strong contrast. The sudden drop-off of our custom hood avoids the objectionable "dolphin-nose" look of the factory truck and streamlines the new design. Notice how the nearly vertical line through the grille area of our Modern Dream Truck reflects the factory design.

I would like to thank a few people who have contributed substantially to this effort. The first is Kirk Bell whose patience has been sorely tempted by this long-running project. I have appreciated his gritty good humor and encouragement. The next benefactor has been Jairus Watson whose illustrated vision of the Truck was instrumental in my completion of the model. Cody Grayland's machined parts are exemplary; his ability to translate into reality the many details of the project (e.g., the multipiece wheels, grillework front and rear, head- and taillight bezels and lake pipes) is without peer. A special thanks also to Byron Bowman of Superior Paint in Salt Lake City for his Herculean efforts to match lacquer paint to Jairus' illustration. Also, the following vendors and friends generously helped: The Modelhaus contributed the wonderfully authentic big 'n' little whitewall tires; Les Osborn of Cutting Edge Technology provided the breathtakingly realistic nickel-chrome door handles; Mike Barlow shot the many hundreds of slides; Owencraft supplied



This tail-to-tail comparison portrays how the strong horizontal and lateral movement of the fins buttress the sharply sloping bed. The top of the fins mimics the top of the stock truck's bed.

The oval front grille, with its Jairus Watson-designed turn signals, pays homage to the original **Rod & Custom** *Dream Truck. The burgundy paint draws the eye to the opening and gives the illusion of more depth than is actually present. The widely set headlights balance the strong grille opening. This is probably the most successful aspect of the model's design.*



The oval rear grille opening, as well as the bezels and grille bars, match the front of the model. The lack of a bed opening cleans up the rear of the model, but renders it useless (which is perfectly acceptable for a custom). Jairus Watson's graphics bring definition to the bed and minimize the "aircraft carrier" look.

the cast-bronze brake and clutch pedals; Model Car Garage provided the photoreduced gauges; Detail Master was the source for the perfectly colored fine-cut flocking used on the floor, inner cab and ceiling; and Replicas & Miniatures Co. of Maryland cast some of the parts for the truck (the custom grille/headlight combo is offered for sale to the public). My thanks also to Jeff Wolfe for lending me his stone stock Chevy pickup for the accompanying comparo shots, which were graciously taken by Pat Covert at the 1997 Birmingham Classic.

I am happy to note that I have just signed a deal with Kalmbach Publishing Company to write a book on custom model car building. Tentative plans for the content include a condensed version the Modern Dream Truck project, other projects from the "Custom Model Car Series," additional information on custom painting, and another, restyled version of our Modern Dream Truck, which should correct the problems in the version presented on these pages.

You can now request a free copy of the National Model Car Builders' Museum's *"How to Build Better Scale Model Vehicles: Model Construction Considerations When Building Championship Caliber Models"* by

The Good, the Bad, and the Merely Annoying

Critiquing the design of the Modern Dream Truck

by MARK GUSTAVSON

In any restyling project, there are hits and misses. The Modern Dream Truck is no different. Let's look at the design, then briefly review how the problems could be corrected.

THE FRONT FENDERS AND HOOD.

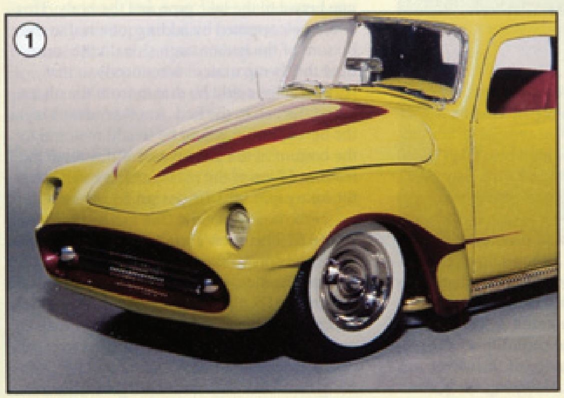
The Good. Perhaps the best features of our Modern Dream Truck are the front fenders and hood (see **Photo 1**). The dramatic narrowing of the fenders lends a well-groomed look to an essentially clunky factory design. The pie-shaped, tapered sectioning of the hood really resolves itself into the overall design and obliterates the annoying "dolphin-nose" look common to GM vehicles from 1947 through '54. I find the headlight openings particularly satisfying: Their integrated in-cut shape resolves neatly into the flare around each fender.

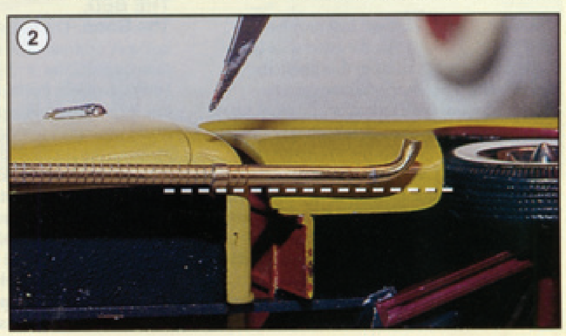
The Bad. The grille opening is too tall through the center, yielding a maw that lacks delicacy and subtlety. Also, the taper of the opening has too much of an angle. The in-cut character line on the hood, which mates with the belt molding on the body, should extend further forward; as it is, it seems like an afterthought. Note also how poorly the hood fits. Though it was carefully integrated into the cowl during the primer stage, too much paint on the body caused fit problems.

The Merely Annoying. The leading edge of the hood sits on top of the panel between the headlights, making the hood look as if it has simply been dropped there. The body should be built up so the front of the hood fits into, rather than on top of, the body. This would create a smoother transition.

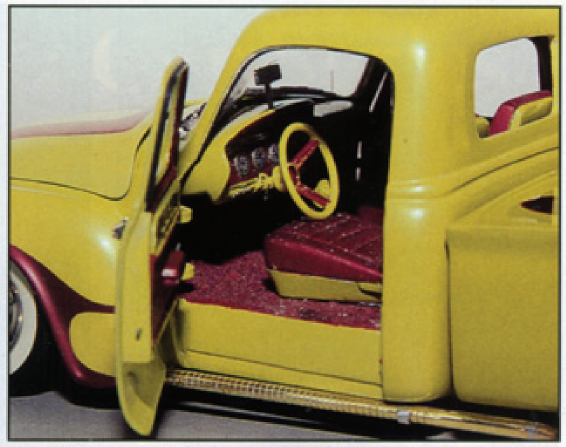
THE CAB.

The Good. Generally, I find the cab satisfac-





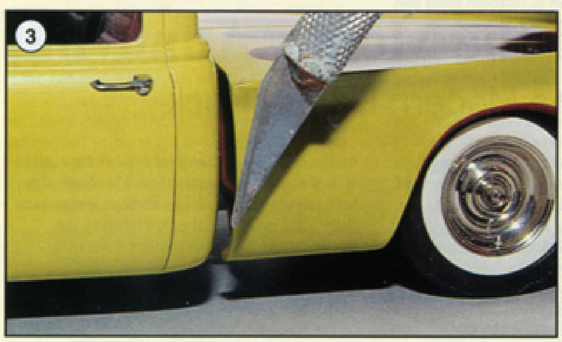
The AMT/Ertl 1962 Chevy 409 engine is a tight fit. The vastly narrowed engine compartment (reflecting the narrowed and tapered front fenders) just doesn't permit a big V-8 engine to be installed with normal operating items like an alternator in place. Additionally, you can't install the steering shaft! A long in-line motor needs to be installed. How about the inline GMC six cylinder from AMT's '51 Chevy Bel Air kit?

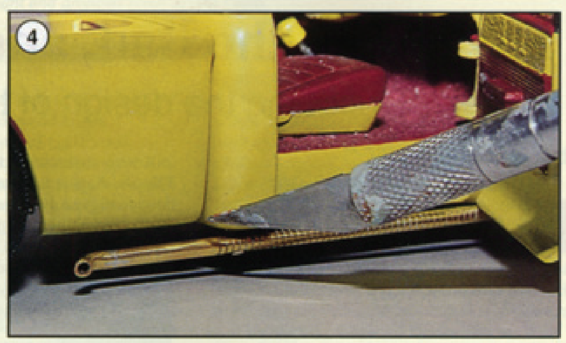


The interior components are painted to match the exterior. A low gloss clear has been applied over the 1962 Chevy bucket seats for a realistic vinyl look. The dash is poorly designed: The steering column is too low, dropping the small steering wheel almost to the seat. The gauge cluster needs to be raised to permit the steering column to be moved to a more realistic elevation.

sending two unattached $.32 stamps to the Museum at 353 East 400 South, Salt Lake City, Utah 84101. This eight-page pamphlet discusses some new approaches and techniques to achieve more realistic model vehicles.

Also remember to visit the Museum on its newly refurbished (with Russ Schwenkler graphics) website at: http://www.xmission.com/~msgsl/nmcbm. Though we had hoped to get the "Custom Clinic" web page in place by now, a heavy work schedule for webmaster Mark Benton and I will delay the launch until later this year. Then, custom builders on the Internet will be able to visit the "Custom Clinic" web page which will feature photos of Custom Clinic Custom Car Photo Contest winners, the work of other key hobbyists, historical photographs of customs with related data, a question and answer segment, and lots more fun! That effort will include a large database of references to famous customs and hot rods that I have assembled with the help of Bill





tory. Parts of it, such as the sectioned doors, represent vast improvements over the factory design. The sweep of the forward door lines (a change that was necessitated by the sectioned body) balances out the length of the cab. The taper of the body from the back of the cab through the cowl is a neat touch.

The Bad. There are some real problems here. **Photo 2** shows that the otherwise pleasant taper of the cab leads to this anomaly: straight lake pipes (necessary to trim the bottom edges of the cab and bed) cannot line up with the cab and bed. A few changes could eliminate much of this problem. Strips of material could be added to the inside of the body to create a line parallel to the lake pipes. This would widen the "undercut" under the doors. At the same time, cutting back the "wrap under" of the leading edge of the bed would make it line up with the reshaped bottom of the cab. These proposed fixes are represented by the dotted lines in Photo 2. The failure to discover and remedy this problem is a major glitch.

The Merely Annoying. The rear window should be wider. How about the wide 1955 Chevy Cameo pickup rear window?

THE BED.

The Good. The bed's design is neat, though not very original. The sweep of the fins is dramatic and the oval grille agreeably ties the bed to the front grille design. I also like the taillights that are integrated into the fins. But that's were my approval ends with a thud.

The Bad. There are a lot of problems here, some significant. **Photo 3** shows how poorly the leading edge of the bed has been matched to the shape of the cab. If this were the only problem, adding some material to the front of the bed on each side, then carefully shaping it to mate with the trailing edge of the cab would be relatively easy. However, the bed should also be wider to create a smoother transition between it and the cab. **Photo 4** points out that the bottom leading edges of the bed should be lower to avoid the unsightly gap between the lake pipe and the body. This could be corrected by adding material to the bottom of the bed on each side (at the same time the "wrap under" is reduced) so that parallel lines could be drawn from the undercut of the cab to the bed. Another idea: Maybe the best solution would be to add material to the bottom of the cab on each side and to the leading edges of the rear quarters to integrate the lake pipes into the design.

Now, how about the flaws evident in **Photo 5**? This view shows that the rear grille opening is probably placed too low (compare it to the Predicta model next to it). Also note that the bed is not square on the frame, which makes the driver's side slightly lower than the passenger's side. The discrepancy is a bit less than .005-inch and can be corrected by shimming the driver's side of the frame. However, Aitchison, Steve Catron and Joel Dirnberger.

Thanks for tagging along on this journey. Overall, it has been a great experience. In the next issue, we will take a look at how to chop a 1940 Ford coupe, and in the November issue, we plan to review the results of the fourth annual Custom Clinic Custom Car Photo Contest (remember to get those entries in by June 1). Please send any questions to the address in the box below. CM

If you have a question or comment about custom model car building, write to:

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Car Modeler magazine
P.O. Box 1612
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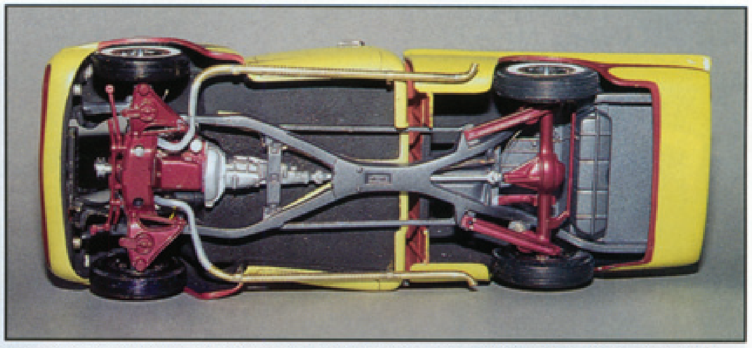
or E-mail: msgsl@xmission.com.



The underside of the truck features a much-modified 1962 Chevy frame. Note that the rear wheel track is narrower than the front track. I spotted this problem too late in the project to change it.

This overhead shot shows how all of the major body components work together. Note that the width of the front fenders is roughly equal to the width of the leading edge of the bed. An interesting, though inadvertent, aspect of this design is that the cab is dramatically wider at the rear than at the cowl. That tapered shape works nicely with the narrowed and peaked hood.

the elevation of the rear grille opening can't be remedied without redesigning the entire bed.

The Merely Annoying. The final problem with the bed design is shared with the original *Rod & Custom* Dream Truck: the bed sits lower than the bottom window line of the cab. There just doesn't seem to be any way to integrate the two designs. One way to minimize the design-integration problems would be to add a bit of horizontal shape to the entire bed. Alternatively, maybe the elevation and placement of the door handle does all that can be done by suggesting a continuation of the upper bed line.

THE PAINT JOB.

The Good. The colors suggest the color scheme of the original Dream Truck at the time of its accident in Kansas in 1958. The juxtaposition of the pearl lime-gold base with burgundy scallops is a nice contrast. Jairus Watson's scallop design looks good. However, sweeping the hood scallops back onto the cowl would tie the cab to the hood more cohesively.

The Bad. In the last article, I briefly discussed the problems with the paint. These problems forced me to paint the various body panels on three separate occasions which resulted in three distinctly different shades of the pearl lime-gold base color. Painting all of the panels at once would eliminate any problems with color-shifting.

The Grossly Annoying. I have never been so frustrated with any painting project in my entire modeling experience. A combination of rushing for magazine deadlines and the lack of careful attention explain my difficulties.

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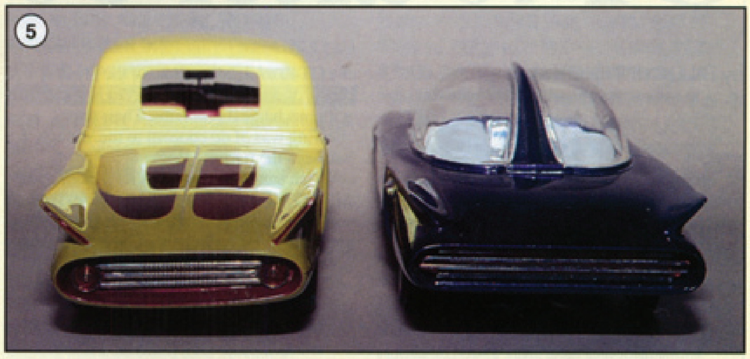

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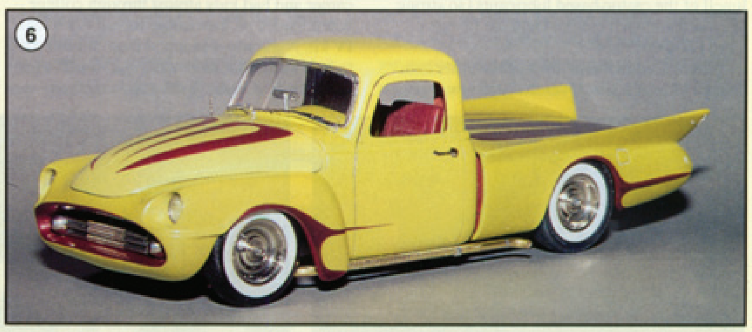

Like most custom vehicles, the Modern Dream Truck is a mixture of pleasing and clumsy design elements. While this has been a long project, I will disassemble and rebuild the model to remedy some, but not all, of the problems. Just as the original *Rod & Custom* Dream Truck was an ongoing project, the Modern Dream Truck may never actually be *finished*. CM