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This project will improve the current methods of finishing metal and fiberglass hardware at Tracor, as well as increase production capability.

This project will improve masking methods, automate paint finishing, procure new chemical processing equipment and improve marking methods. A new layout will be designed to accomodate an automatic conveyor line that would allow hardware to be transported as it is primed, sanded, coated, and cured. Chemical processing equipment will be selected to fit the projected requirements of the finishing shop. Keywords: Manufacturing, Industrial production, Shops (work areas), Surface finishing. (SDW)

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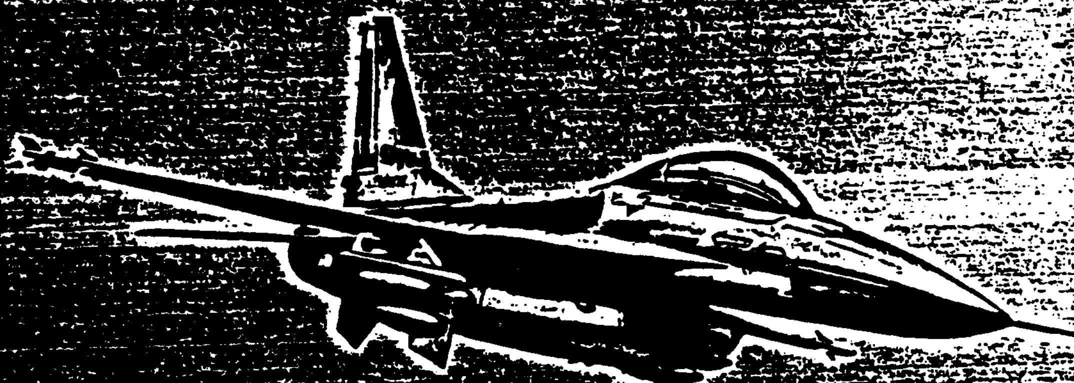

PHASE 3 PROPOSAL
CATEGORY 1 PROJECT
FINISHING SHOP IMPROVEMENTS

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INDUSTRIAL
TECHNOLOGY MODERNIZATION
PROGRAM

Tracor Aerospace
Aerospace Austin

PHASE III PROPOSAL
CATEGORY 1 PROJECT
FINISHING SHOP IMPROVEMENTS

TRACOR PROPOSAL 905-0162

SUBMITTED TO:

General Dynamics Corporation
Fort Worth Division
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May 30, 1986

Revision A

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FINISHING SHOP IMPROVEMENTS

1.0 INTRODUCTION

This Phase III proposal is the result of the successful completion of Phase II of the Finishing Shop Project. The objective of this project has been to design, develop, and implement a plan for improving all aspects of the Finishing Shop area. This project has reviewed, designed, and implemented improvements in equipment, new manufacturing methods, and product work flow through the facility. The proposal describes our present methods, followed by our proposed improvements, cost, and estimated savings. The initial ideas were outlined in Tracor's Phase I Industrial Technology Modernization Program and have been defined and developed in this project.

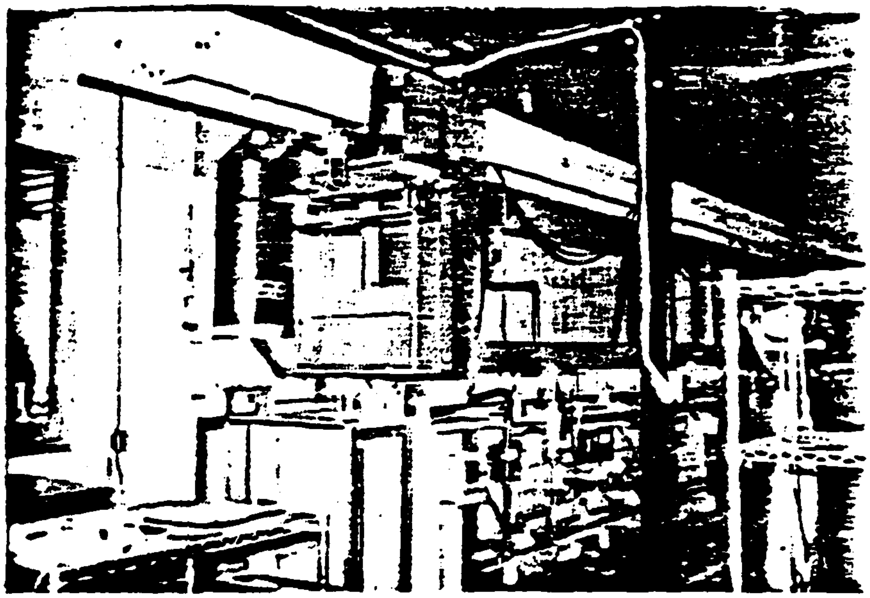


Figure 1-1. OVERHEAD PROGRAMMABLE HOIST
EXAMPLE OF EQUIPMENT TO BE INSTALLED IN FINISHING SHOP

1.1 Finishing Shop Location and Manning

The Finishing Shop is located in Building 2, which is shown on the map in Figure 1-2. The overall layout of Building 2 is shown in Figure 1-3.

The main portion of Building 2 was constructed in 1960 and underwent a complete renovation in 1984-1985, which included new electrical, HVAC, mechanical rooms, roofing, insulation, rest rooms, doors, lighting, etc., at a cost of over $1 million. The addition to Building 2 was constructed in 1968 to house the Finishing Shop and the Mold Press Shop. It also was completely renovated by Tracor during 1985 in conjunction with the installation of Tech Mod equipment.

The square footage of the addition to Building 2 is 6550 square feet, which compares to approximately 41,600 square feet in the main floor of Building 2.

The existing "AS-IS" layout of the Finishing Shop is shown in more detail in Figure 1-4. The manning of each of the areas is as follows:

AREA	DEPT.	MANNING	BID CODE
Chemical Finishing	548	2	M05
Painting	548	2	M05
Clean, Mask, Bondo, Sand	548	3	M05
Silkscreen, ID	548	3	M05
Touch-up	548	1	M05
Supervision	540	1	S08
Total		12	

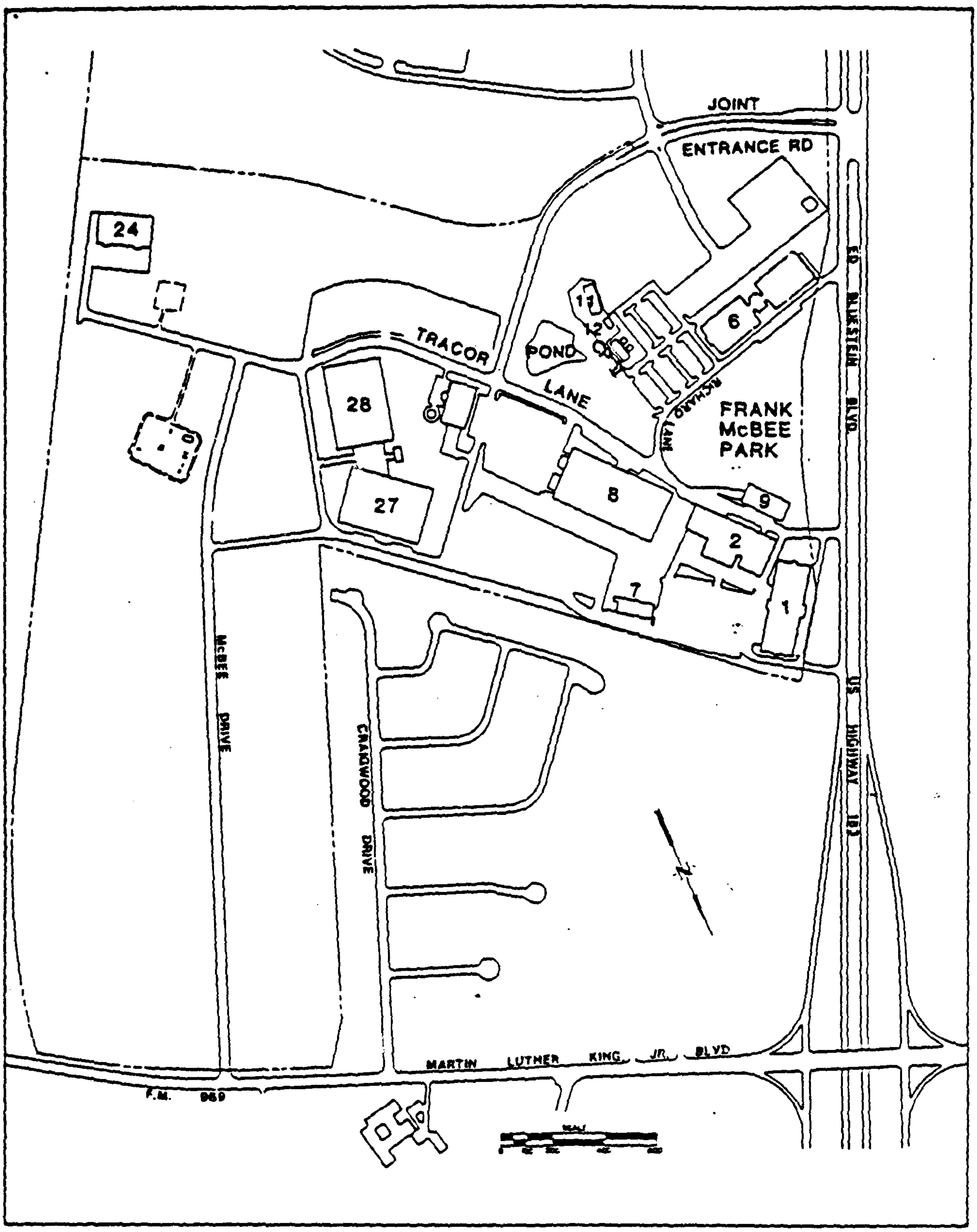


Figure 1-2 MAP OF TRACOR AREA

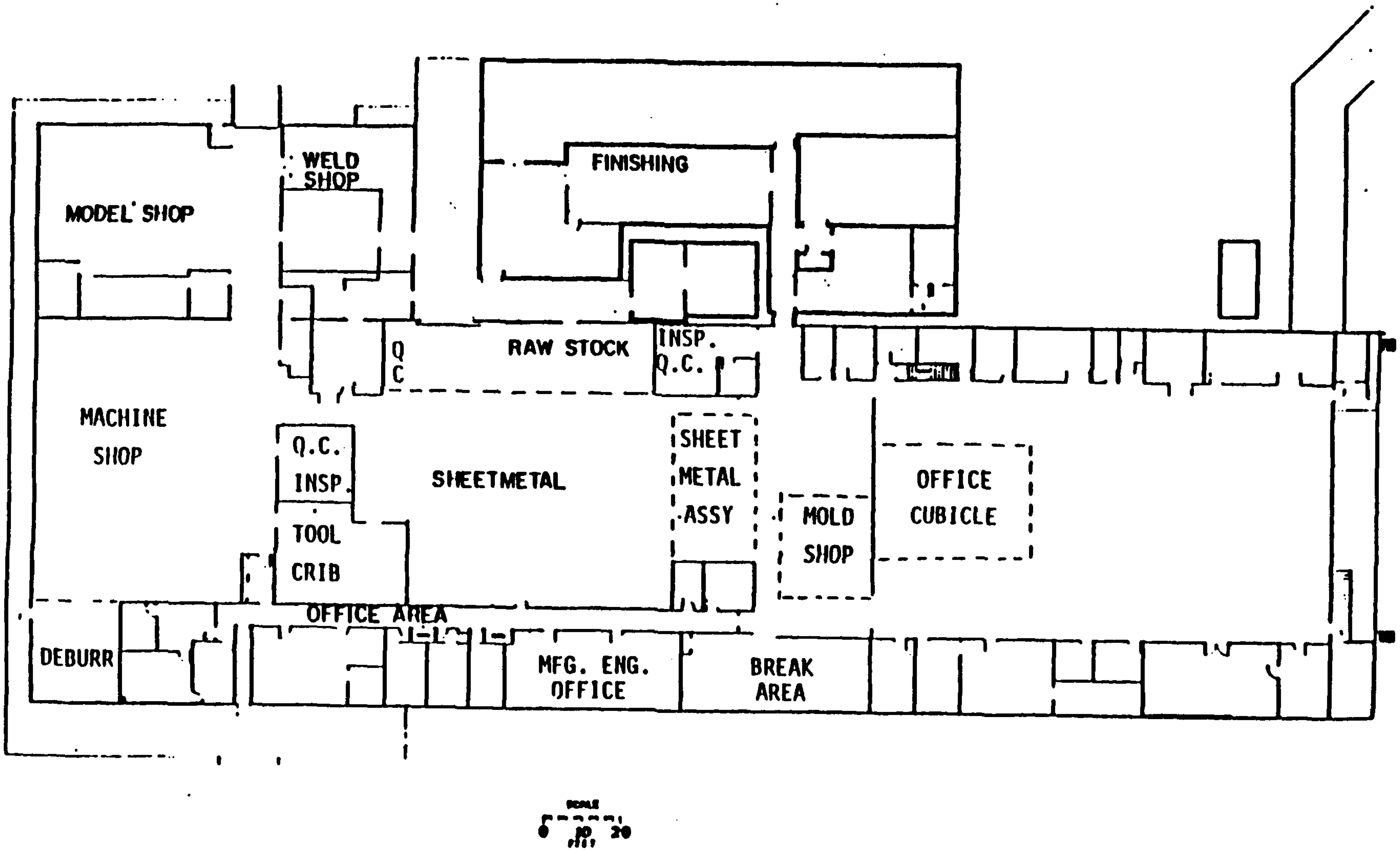


Figure 1-3. BUILDING 2 LAYOUT

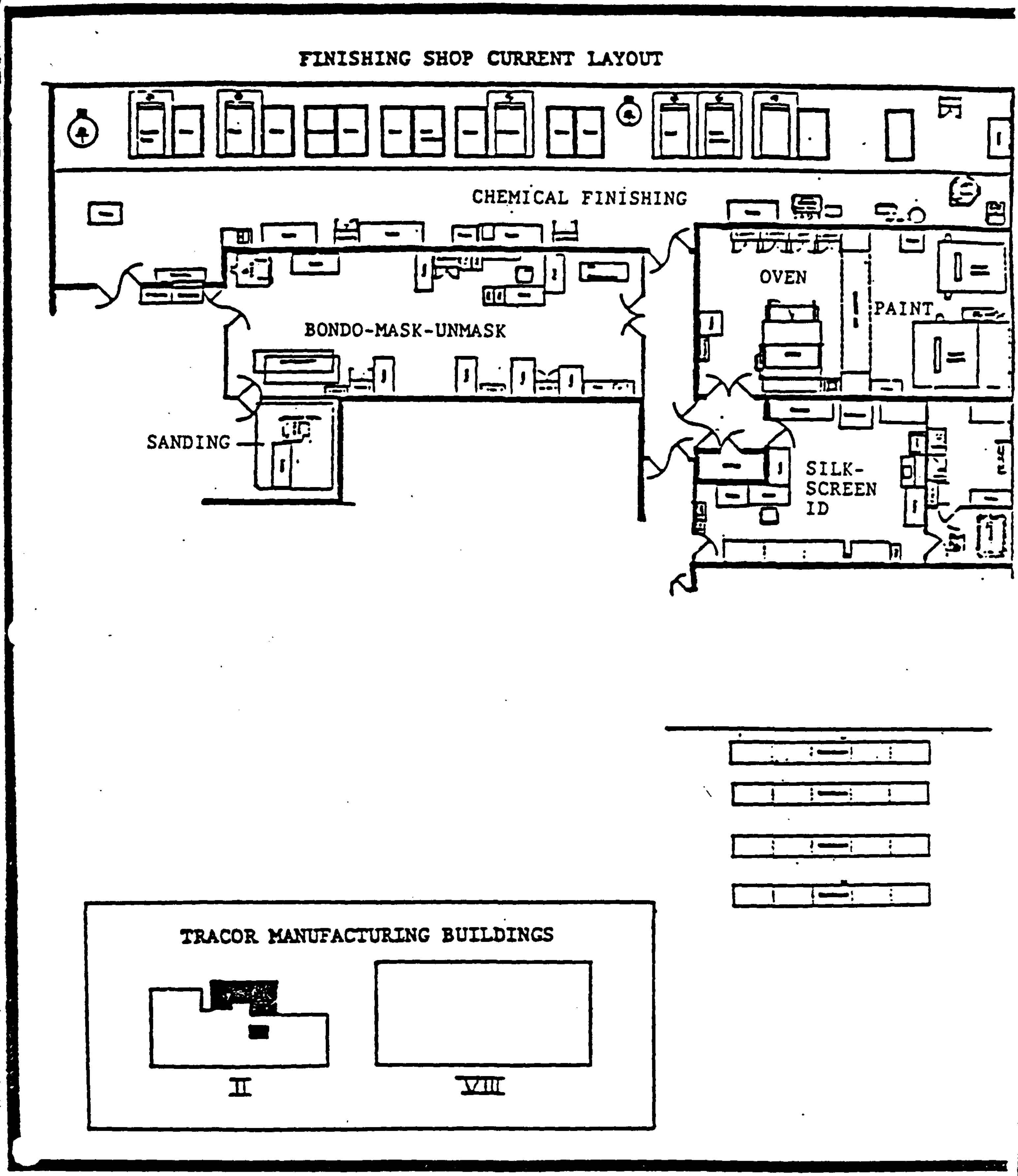


Figure 1-4. FINISHING SHOP CURRENT LAYOUT

As can be seen by the layout, the 6550 square feet of area in the Finishing shop is subdivided by cinder block walls which were originally intended to isolate the various operations for cleanliness, but seriously impede product flow.

1.2 Finishing Shop Description

The Finishing Shop performs chemical finishing, painting, silkscreening, and identification of parts fabricated by Tracor Aerospace per engineering drawings, military standards, and shop process specifications.

The 1665 individual part numbers that are currently on the books in the Finishing Shop are used in all of Tracor Aerospace Austin's product lines including teletypewriters, communications terminals, countermeasures, countermeasures test sets, avionics, and digital systems. Of 243 Line Replaceable Units (LRU's) spares, minor orders, etc. currently in production, 133 LRU's contain at least one part that goes through the Finishing Shop, and most contain numerous parts. The TRTT (Tactical Record Traffic Teletypewriter), for example, contains 169 different parts that go through the shop. A typical F-16 Countermeasures System contains 75.

Forty part numbers are sent out for finishing. These parts require processes that would be expensive to provide "in-house" in comparison to the number of parts requiring the process (e.g., Type III Hard Anodize), or possess processes which involve special chemicals or by-products that are difficult to treat in order to meet EPA wastewater requirements (e.g., cadmium plating, nickel plating, etc.). Figure 1-5 shows the number of parts sent out for various types of finishes that cannot be done in-house.

Finish	Part Numbers
Cad Plating	11
Plating	2
Engraving	3
Black Oxide	3
Nickel Plating	2
Teflon Coated Hard Anodize	3
Anti-reflection Coating	1
Tin Plating	4
Hard Anodize	10
Heat Treat	1
TOTAL	40

Figure 1-5. PART NUMBERS SENT OUT FOR FINISHING

Most parts processed in the Finishing Shop are aluminum parts produced in the Sheet Metal Shop. These parts receive a variety of chemical finishing, painting, silkscreening, and identification finishing operations. A secondary part category and steady workload consists of fiberglass "blocks" used in Tracor's dispenser magazines. The "blocks" are produced in Building 8 and are transported to the Finishing Shop for sanding, painting, and silkscreening operations.

Finishing Shop parts vary in size and shape from a small guide pin (dime size) to the TRTT carrying case (20" x 18" x 12"). However, the average size part would fit the palm of a hand and be within an envelope size of one cubic foot.

1.3 Shop Scheduling

Scheduling work in the Finishing Shop is accomplished by Production Control using a single sheet document called a Production Work Order (PWO). The PWO for a given part number shows the part sequence, lot number, and schedule. The length of time in the shop for a given PWO ranges from 1 to 10 days. In addition to the PWO, Tracor has a Non-Production Work Order (NPWO) document which is issued by Production Control for controlling and monitoring engineering prototype or experimental work. The document is similar to a PWO in that it provides the shop with a sequence of operations, quantity to be produced, and schedule.

When the PWO arrives at the Finishing Shop with the quantity of parts in the lot, the shop foreman logs the PWO into the Work-in-Process Logbook (see Figure 1-6), entering the information called for. This includes date received, part number, description, account number, run, PWO number, quantity, due date, comments, standard time, actual hours, and completion date. For additional information, the shop foreman refers to a "tollgate" file which contains a complete manufacturing package on the part number. This manufacturing package includes the instruction sheets, engineering drawings, and more detailed notes and specifications relative to finishes, locations to be masked, paint colors, etc. The foreman assigns the work to the various finishing work centers, usually on a first-in first-out basis. Should backlogs develop in a work center, the foreman will reestablish priorities to balance the work load. When a PWO is completed, the foreman reviews the work and records the completion in the logbook.

Figure 1-6. LOGGING WORK INTO THE SHOP

1.4 Finishing Shop Processes

The shop performs 10 different finishing operations and Figure 1-7, page 11, shows a graphic representation of workload distribution in the shop.

- o Chem Film
- o Anodizing
- o Passivation

- Block Preparation
- Masking
- Painting
- Silkscreening
- Identification
- Assembly
- Other (wrap, touch-up, etc.)

1.5 Finishing Shop Equipment

Major items of production equipment include 2 paint spray booths, 2 sets of paint spray guns, a walk-in oven, 16 chemical process tanks, and silkscreen equipment. With the exception of the silkscreen equipment, all items are in fair to poor condition. Figure 1-8 provides further details.

1.6 Finishing Shop Process Specs

The Shop Process Specifications that apply to the Finishing Shop are shown in Figure 1-9.

1.7 Finishing Shop MIL-STDS and MIL-SPECS

Some of the Mil-Standards/Mil Specs that apply to the Finishing Shop are shown in Figure 1-10.

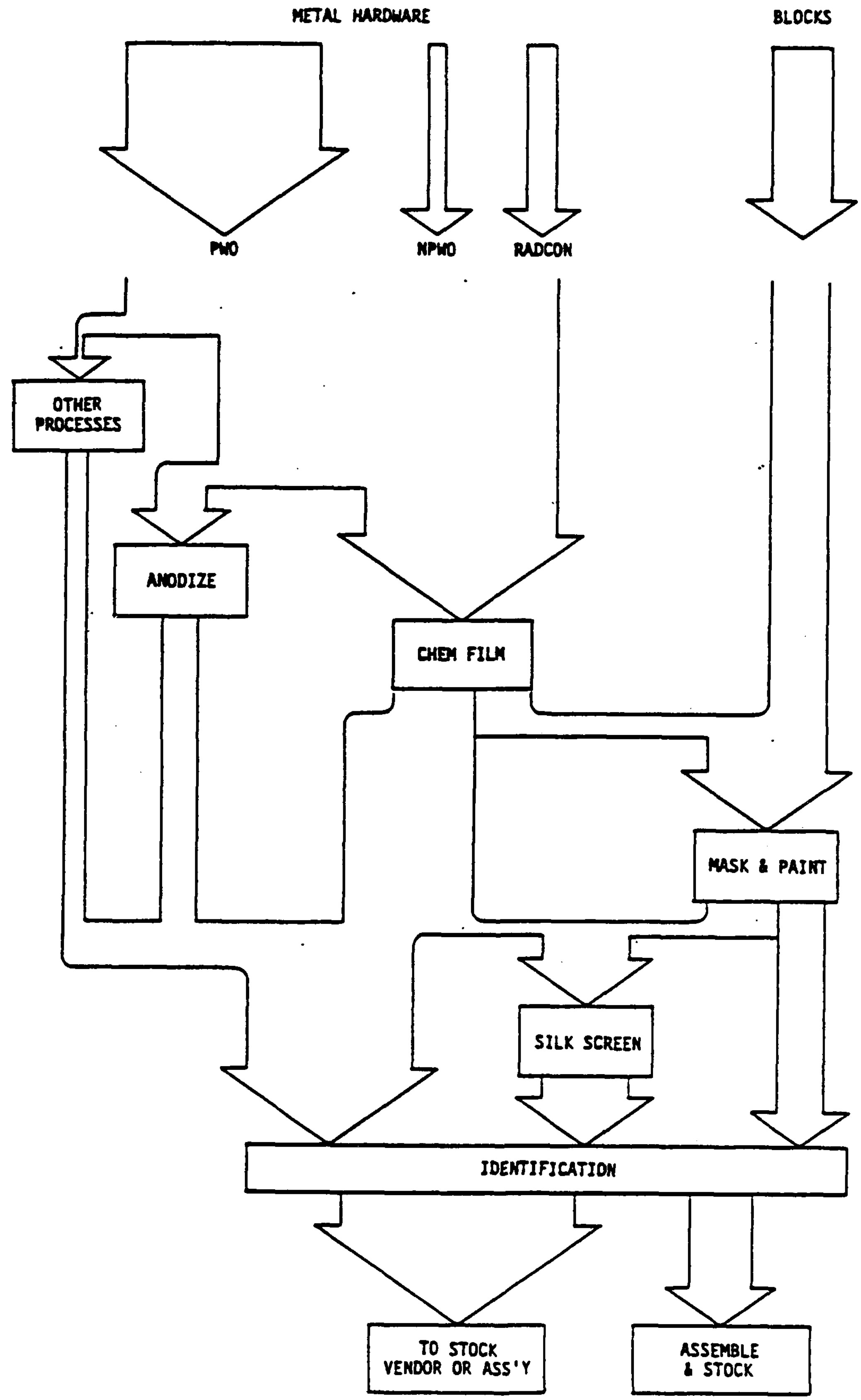


Figure 1-7 GRAPHIC PORTRAYAL OF WORKLOAD DISTRIBUTION

EQUIPMENT	QTY	DESCRIPTION	TRACOR ASSET TAG NO.	YEAR OF PURCHASE	CONDITION
Zero Bead Blaster	1	Model B-300-F	56424	1974	Poor
Bead Blast Filter	1		56425	1974	Fair
Nobatron Rectifier	1	0-150 Amps	59583	1975	Fair
Udylite Rectifier	1	0-1000 Amps	---	1975	Fair
Chemical Process Tanks	13	Steel, 526 gal.	---	1969	Poor
Chemical Process Tanks	3	Steel, 526 gal.	---	1971	Poor
Fume Scrubber	2	Lincoln Multiguard	---	1969	Poor
Paint Booth	1	Binks, 8 ft. x 7 ft.	53515	1969	Poor
Paint Booth	1	Binks, 7 ft. x 7 ft.	53516	1969	Poor
Pressure Pot	1	2 gal.	53517	1969	Poor
Pressure Pot	1	2 gal.	55236	1962	Poor
Electrostatic Gun	1	Ransburg #034402	59455	1974	Poor
Electrostatic Panel	1	Ransburg	59455	1974	Poor
Paint Spray Gun	2	DeVilbiss	---	1970	Fair
Walk-in Oven	1	Protector HC, 0-350°F	55211	1969	Poor
Blue M Oven	1	Model ESP-400BC-4	56911	1974	Good
Arc Lamp	1	Model H35-1MT	55860	1970	Good
Polycop Exposing Unit	1	Model 39X52	55875	1970	Good
Photo Plate Machine	1	Model 14-4	---	1970	Good
Sanding Booth	1			1970	Good
Ventilation Hood	1	Bondo Area		1970	Good
Paint Stg Cabinets	3	Justrite, 45 gal.		1971	Good
Monorail w/ Hoist	1	Chemical Finishing		1969	Fair
Squeegee Sharpener	1	Sharpee Model X-100	61124	1975	Good
Kroy Type Machine	1	Block Letters for Silkscreen	---	1980	Good
Deionized Water Unit	1	Culligan	59725	1970	Poor
Boiler	1	Williams & Davis	53520	1969	Poor
Degreaser	1	Tronic	59481	1970	Poor
Air-Makeup	1	Eclipse	53519	1970	Poor
Paint Recycling Unit	1	Stand-alone	---	1975	Fair

Figure 1- 8. FINISHING SHOP EQUIPMENT

SHOP PROCESS #	TITLE
59	Prime and Paint OMEGA Antenna
60	Epoxy Polyamide Paint Application
62	Anodize Process for P/N 131566-0001 Pulley-Idler
63	Metal Photo Process
77	Zinc Chromate Primer Application
101	Tanks 1 & 16 Alkaline Cleaning
103	Tank 3
105	Tank 5 Dioxidize
107	Tank 7
108	Tank 8 (Alodine 1200S) Iridescent Conversion Coat
109	Desmutting Process for Aluminum Castings
110	Anodizing Tank 10
114 & 118	Deionized Water Sealing Iron Phosphate Coating Tank No. 18
119	Cleaning Process for Dip Brazed Parts
121	Chemical Conversion Coating Line
122	Anodizing Line
130	Black Dyed Anodization Tank 15
135	CRES Passivation
140	Silkscreening
141	Identification of Component Parts and Fabricated Assemblies by Rubber Stamping per MIL-STD-130
147	Dry Blast Glass Peening
148	Spray Painting
149	Acrylic Lacquer Topcoat Application

Figure 1-9. FINISHING SHOP PROCESS SPECS

MIL-STD-171D	Finishing of Metal and Wood Surfaces
MIL-C-5541C	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-A-8625C	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-F-14072B(EL)	Finishes for Ground Electronic Equipment
MIL-C-22750D	Coating, Epoxy-Polyamide
MIL-P-23377D	Primer Coatings: Epoxy-Polyamide, Chemical and Solvent Resistant
MIL-C-83286B	Coating, Urethane, Aliphatic Isocyanate, for Aerospace Applications
MIL-C-81706	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys
MIL-T-817772	Thinner, Aliphatic, Polyurethane Coating

Figure 1-10. MIL-STD'S AND MIL-SPECS

2.0 "AS-IS" ASSESSMENT

2.1 Introduction

There are two predominant features in the Finishing Shop that strike an observer initially and dominate all activity. One, the area is subdivided physically by cinder block walls which limit flexibility, hamper material handling, and restrict communication and control. The other feature is that almost everything is done manually. Except for the paint shaker and the paint spray guns in the paint shop, which are used every day, and the overhead monorail crane loop in the chemical finishing room, which is only used for heavy loads, all work functions are carried out manually. This includes:

- Masking parts prior to painting when called for on the drawings.
- Unmasking parts.
- Applying a Bondo mixture to the surface of fiberglass "blocks" to fill voids.
- Sanding the blocks with a belt sander.
- Hanging parts in the paint booth for painting, and then taking them down and returning them to their previous position on a cart.
- Silkscreening.
- Identification and marking of parts.
- Dipping parts in any of the 16 process or rinse tanks for chemical finishing.
- Loading parts on and off carts and transporting them manually from one process to the next.

The initial approach to the project involved the following objectives:

- o Rearrangment of the shop to eliminate zig-zag work flows and reduce travel times.
- o Install a conveyor to carry parts through preparation, mask, paint, dry, and silkscreen.
- o Replace aging, corroded chemical tanks.
- o Replace marginal ventilation system over the tanks.
- o Replace the walk-in oven with a tunnel oven.
- o Investigate the use of electrostatic paint spray guns to reduce paint usage and improve the quality of finished parts.
- o Investigate the use of an overhead programmable hoist over the chemical finishing line.
- o Install automatic or pass-thru doors.
- o Develop new masking techniques involving fewer labor hours.
- o Investigate the use of decals and labels to eliminate the time-consuming silkscreening operation.

The following subsections describe further details of the shop operation, discuss potential improvements, and assess the impact on productivity.

2.2 Chemical Finishing

2.2.1 Method - The parts requiring chemical finishing are logged in and then transported by hand or by material handling cart from the staging area through a set of double doors to the chemical finishing area. Two regular operators are assigned to the chemical finishing area. A third operator is available when the workload demands.

Approximately eighty percent of the 1665 part numbers entering the Finishing Shop require chemical finishing of some type, with annual production running in excess of 300,000 total parts. However, the different part numbers do not require chemical finishing alone. Other processing is required. Some of the more common routings are shown in Figure 2-1.

*ROUTING PATTERN #	OPERATIONS REQUIRED	NO. OF PART NUMBERS
36	Passivate/ID	119
42	Passivate	11
43	Anodize/ID	83
55	Chem Film/ID	685
59	Chem Film/Silkscreen/ID	23
64	Chem Film/Paint/ID	45
65	Chem Film/Paint/Silkscreen/ID	13
79	Chem Film/Mask/Paint/Unmask/ID	51
82	Chem Film/Mask/Paint/Unmask/Silkscreen/ID	26
94	Chem Film only	42

*Routing patterns, or parts families, are explained later in Section 3.2, page 50.

Figure 2-1. COMMON ROUTINGS

The primary chemical finishing operation is called "chem-film", which is the term commonly used for chromate conversion coating. There are two versions of chem-film: gold (or iridescent) and clear. The overwhelming majority of chem-film work done at Tracor is gold.

The shop actually performs five different chemical finishing operations using 16 process and rinse tanks, each of which contains 525 gallons of liquid and measures 72" long, 44" wide, and 48" deep. All operations are done manually except for the heavier loads which are assisted by an overhead monorail loop with electrical hoist. The five chemical finishing operations performed in the area are:

- o Chem-Film - Clear
- o Chem-Film - Gold
- o Anodize - Clear
- o Anodize - Black
- o Passivation (steel/stainless steel parts)

Figure 2-2 shows the sequence of operation for the various chemical processes and what chemicals the tanks contain. The various processes and controls on each tank, both concentrations and temperatures, are carefully spelled out in the Shop Process Specs shown earlier in Figure 1-9, page 13. Concentrations of all tanks are checked at five-day intervals using special test equipment (see Figure 2-3). Qualification testing is performed by Quality Control on a monthly basis using 14 aluminum test panels measuring 1/32" x 3" x 10". Dumping of tanks and preparation of fresh solutions is required annually.

Figure 2-4 shows the chemical finishing area. In Figure 2-5 an operator is using the monorail overhead hoist at the anodizing tank. In Figure 2-6 the operator is checking the finish on an anodized part. For most operations the operators are required to wear safety glasses and protective clothing.

The various processes in chemical finishing are all carried out manually. The operators can refer to the applicable process spec for details on the process to be run.

	TANK NO.	CHEM FILM CLEAR	CHEM FILM GOLD	CLEAR ANODIZE	BLACK ANODIZE	PASSIVA-TION
Alkaline Cleaner	1	X	X	X	X	X
Rinse (Hot)	2	X	X	X	X	X
Deoxidizer (Acid)	5	X	X	X	X	
Rinse (Hot)	6	X	X	X	X	
Alkaline Etch	3	X	X	X	X	
Rinse (Hot)	4	X	X	X	X	
Deoxidizer (Acid)	5	X	X	X	X	
Rinse (Hot)	6	X	X	X	X	
Acid Diversey(CF-clear)	7	X				
Acid Alodine (CF-gold)	8		X			
Rinse (Warm)	9	X	X			
Sulfuric Acid (Anodize)	10			X	X	
Rinse	11			X	X	
Rinse	12			X	X	
Removed	13					
Deionizer (Seal)	14			X		
Alkaline Dye	15				X	
Desmutt (Alk)	16					
Rinse	12				X	
Deionizer (Seal)	14				X	
Passivation Tank						X
Rinse (Hot)	2					X
Dichromate Bath						X
Rinse (Hot)	2					X
Air Dry		X	X	X	X	X

Figure 2-2. SEQUENCE OF OPERATIONS IN CHEMICAL FINISHING

Figure 2-3. OPERATOR CHECKING CHEMICAL CONCENTRATIONS

Due to their experience, however, both operators can recite from memory the tanks to be used and the duration of time required for each tank. The parts are either attached to racks or placed in baskets, depending on their size and shape. The parts are then taken to the first tank and submerged for the required time, then lifted out for drip-dry and taken to the next tank. This is continued until the process is completed, and then the parts are taken to a bench fixture for drying with compressed air. The makeshift fixture shown in Figure 2-7 involves wedging the carrier bar into a drawer which holds the parts rigidly enough for drying.

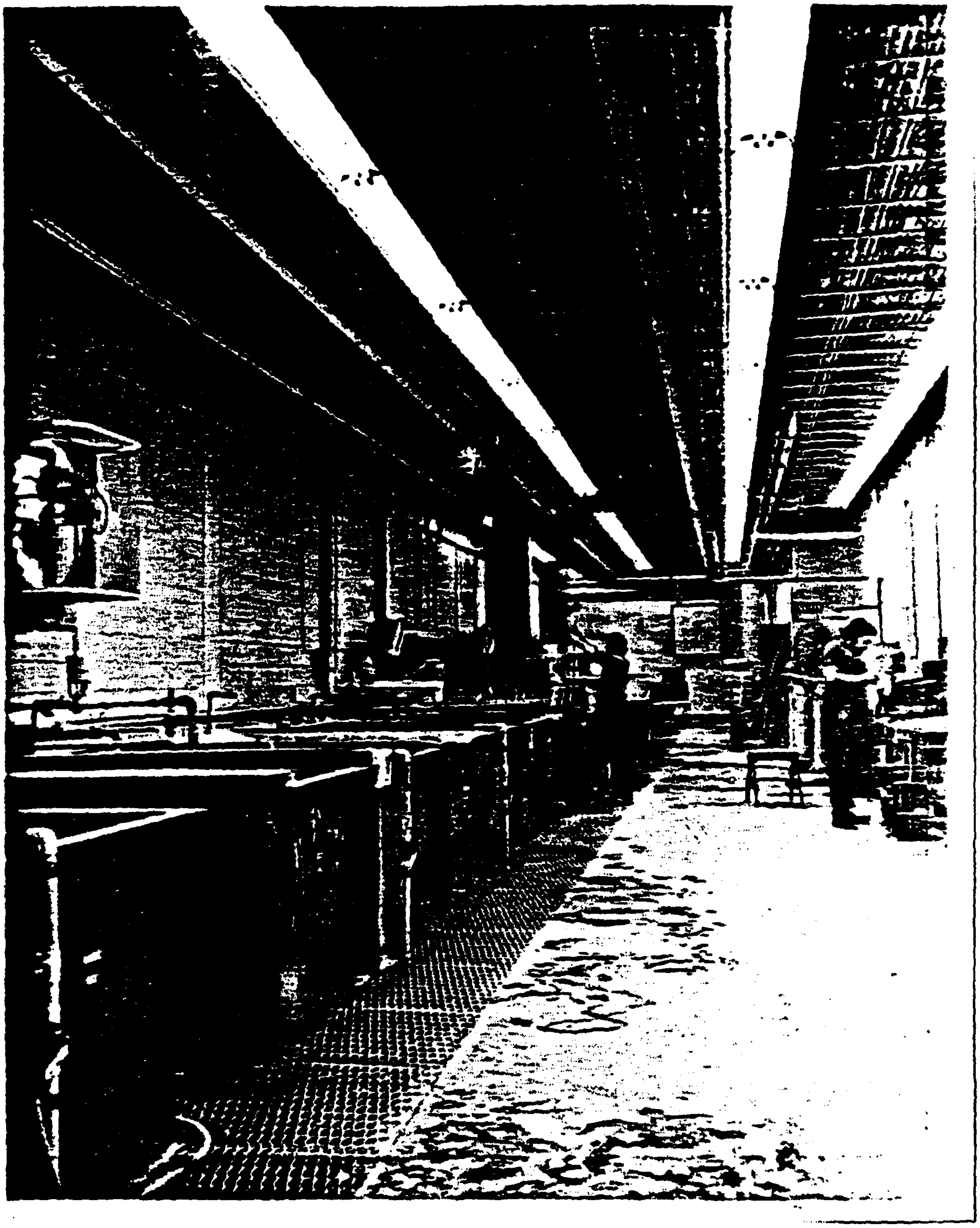


Figure 2-4. CHEMICAL FINISHING AREA

Figure 2-5. OPERATOR USING HOIST AT ANODIZING TANK

Figure 2-6. OPERATOR CHECKING FINISH ON ANODIZED PART

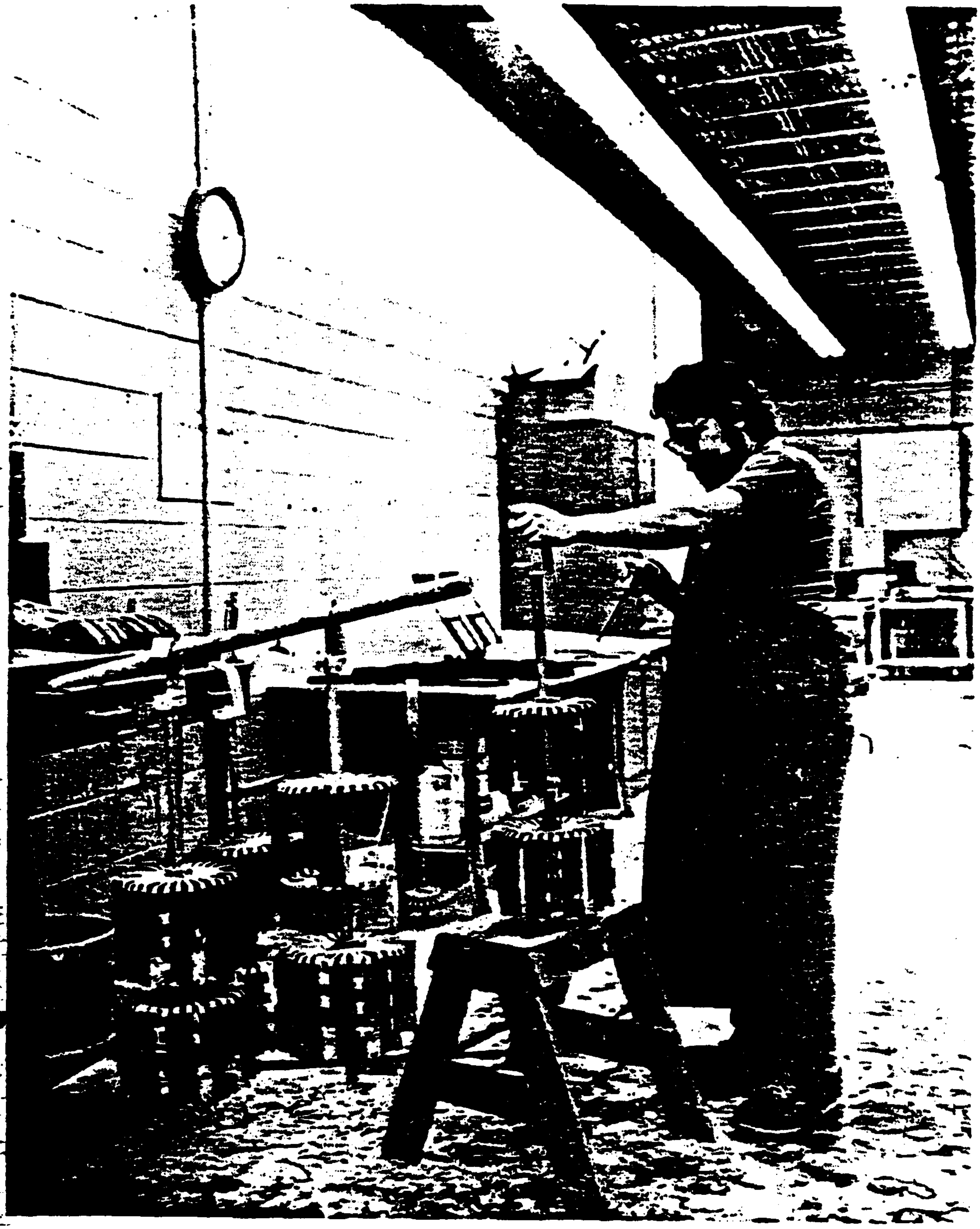


Figure 2-7. OPERATOR DRYING PARTS WITH COMPRESSED AIR

2.2.2 Potential Chemical Finishing Improvements

Tanks and Scrubber - The need to replace the 16 chemical tanks and the fume scrubber ventilation system was obvious from the beginning of the project. The 13-year-old steel tanks are badly corroded and leaking. The fume scrubber ventilation system has deteriorated through the years and is ineffective as a fume scrubber. Both these items are included in the project cost, even through they are both "repair" items and do not generate savings. The decision to include them was based on the fact that the project would not have been considered complete without them. They were an integral part of the chemical finishing "system".

Hoist - The present overhead conveyor and electrical hoist which services chemical finishing requires an individual to batch the parts for racking, dipping, timing, drying, etc. This method is very time-consuming and may not keep up with the expected increases in production requirements. An overhead programmable hoist would automatically lift the parts from a load/unload station and sequence them through process tanks and rinse tanks in the proper order and the exact duration, and bring them back to the load/unload station. The chemical finishing operator would be relieved of most tasks except racking and unracking the parts. Initial savings estimates for the programmable hoist placed the man-hour reduction at 40-50%, and with a volume of 300,000 parts per year, that would mean over 2000 hours saved annually.

Drying Tank - Currently an operator blow-dries all parts using compressed air and makeshift holding fixtures. A drying tank placed in the appropriate position with the other tanks would relieve the operator of this task. The drying tank would be the same size as all the other tanks (72" long, 44" wide, and 48" deep), and it would be constructed to use steam heat, with non-corrosive inner and outer jacket, equipped with recirculating motors, vents, and ducts. The cost of the drying tank was originally estimated at $5K, but bids ranged up to $25K. Once the requirements were better defined and a statement of work was written and sent to vendors, estimates were raised, and the two alternatives became a single-station drying tank for $10K or a double-station drying tank for $15K. The single-station drying tank was decided on, due to budget constraints and the proximity of the manufacturer (Houston), and the reliability of the consultant that assisted us. Savings, based on 5-10 minutes spent drying off a rack of 72 parts, and 300,000 such parts per year, would amount to $5,000 per year.

Hard Anodize - A thorough review was made of parts sent out for finishing with an eye toward bringing them into the plant. The finishes and part numbers sent out were previously shown in Figure 1-5. Hard anodize was the only candidate considered feasible for in-house processing. The other processes were eliminated because of low volume or high EPA requirements on the chemicals involved. However, an investment of over $38,000 in chillers and rectifiers would have been required to establish the hard anodize process. Presently, Tracor sends 2000 parts a year out for hard anodize at an average cost of $3.05 per part. The $38,000 investment compared to the $6,100 annual outlay made the idea seem impractical and the idea was dropped.

2.3 Painting

2.3.1 Method - The current painting method is conventional air spray with two sets of guns and two 13-year old booths. The booths are encrusted with years of overspray and are dissimilar in size. See Figures 2-8 and 2-9. Their built-in light fixtures have become dilapidated and their exhaust systems are corroded. The guns are also 13 years but are in good shape.

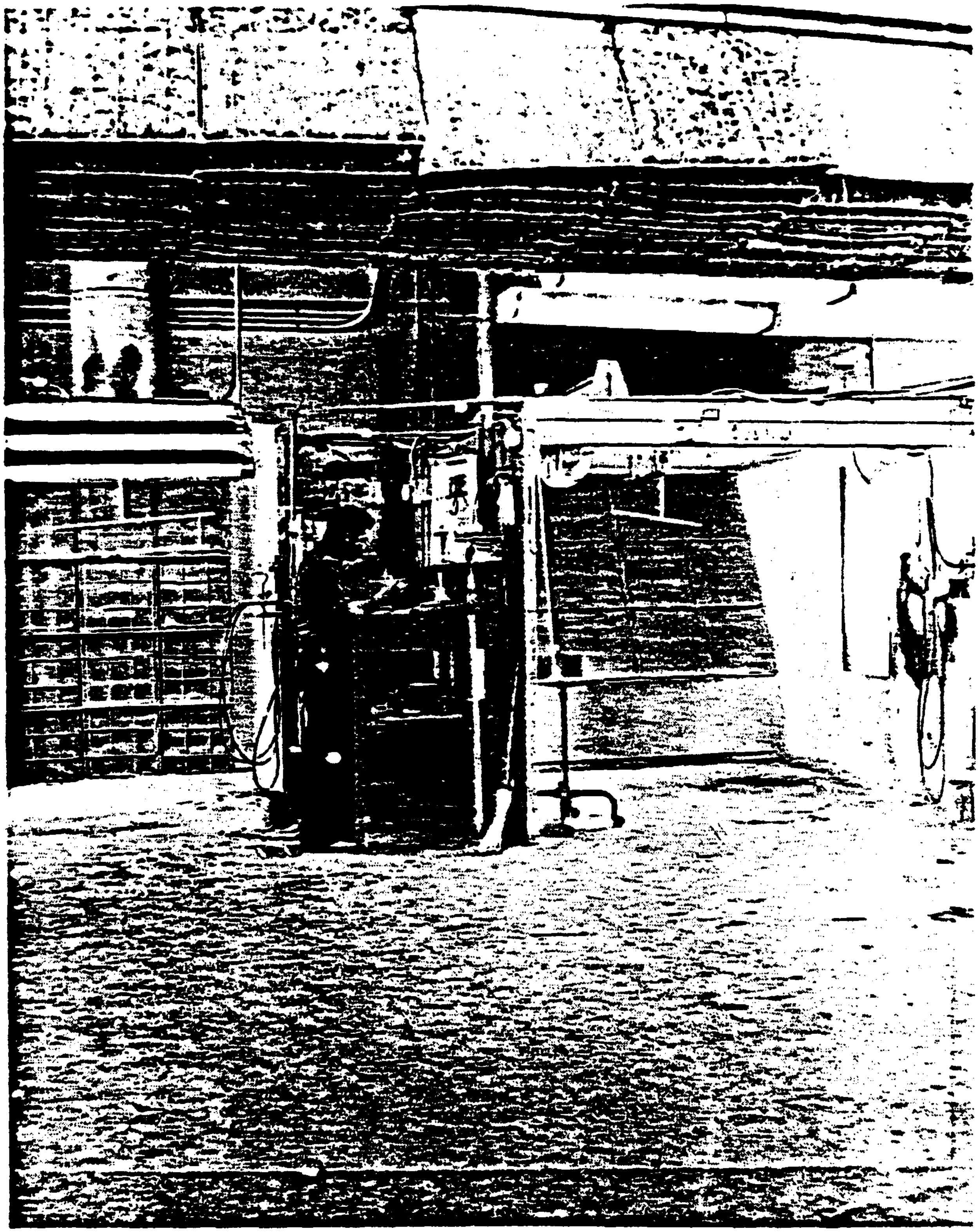


Figure 2-8. EXISTING PAINT SPRAY BOOTHS

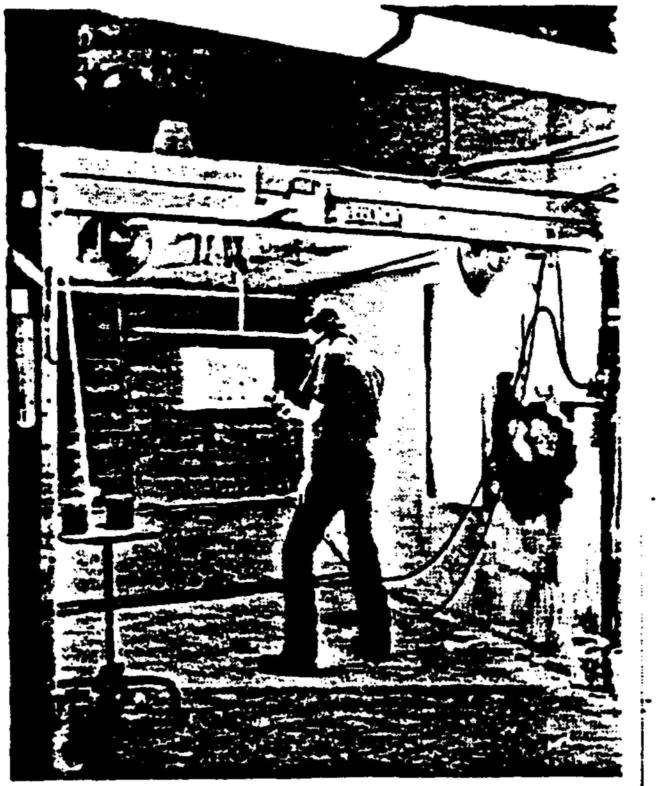


Figure 2-9. OPERATOR SPRAYING A PART

Paint and thinner supplies come in gallon cans and are stored in two places: bulk cans unopened are stored in the storage closet (Figure 2-10) and partially used cans are stored in three paint storage cabinets (Figure 2-11).

Approximately 289 different part numbers in various quantities are painted, with annual production running at 25,000 units. The parts vary in size and shape from 2 inches to 2 feet. Approximately 15 colors are applied to these parts under the specifications shown in Figure 2-12. Forty percent of the part numbers require masking prior to their arrival in the paint shop.

Figure 2-10. EXISTING PAINT STORAGE CLOSET

Figure 2-11. PAINT STORAGE CABINETS

Parts are wheeled into the painting room on carts and are manually suspended from a "T" bar in the booth with wire hangers, usually 2 or 3 at a time. The prime coat or "mist" coat is applied first. After completing the operation, the parts are returned to the cart for air dry. Meanwhile, 2 or 3 more parts are put on hangers and suspended in the booth and painted. This process continues until all parts are prime-coated. Usually enough time has elapsed so that the parts that were prime-coated first are ready for final coating. Once the final coat is applied, the parts are either air-dried in the paint room or placed in the walk-in oven (see Figure 2-13), depending on the requirements of that paint specification.

MILITARY SPEC	MIN AIR DRY	CURE MAX TEMP MIN TIME	TSN	NOMENCLATURE
TT-E-527	72 hr	300°F 30 min	24940-0001	Enamel Alkyd Lusterless
TT-E-529 Class A Comp Ct	72 hr	250°F 60 min	25179-0001	Enamel Alkyd
TT-P-1757	1 hr	250°F 15 min	23166-0002	Zinc Chromate Primer
MIL-L-19537	---	Room Temp 15 min	4431-0001	Nitrocellulose Acrylic Lacquer
MIL-C-22750	48 hr	250°F 30 min	4416-0003	Epoxy Polyamide Enamel
MIL-P-23377D	1 hr	250°F 20 min	---	Primer
MIL-C-83286B	1 hr	250°F 20-30 min	24846-0023	Polyurethane Pigmental Resin Base Coating

Figure 2-12. PAINT SPECIFICATIONS

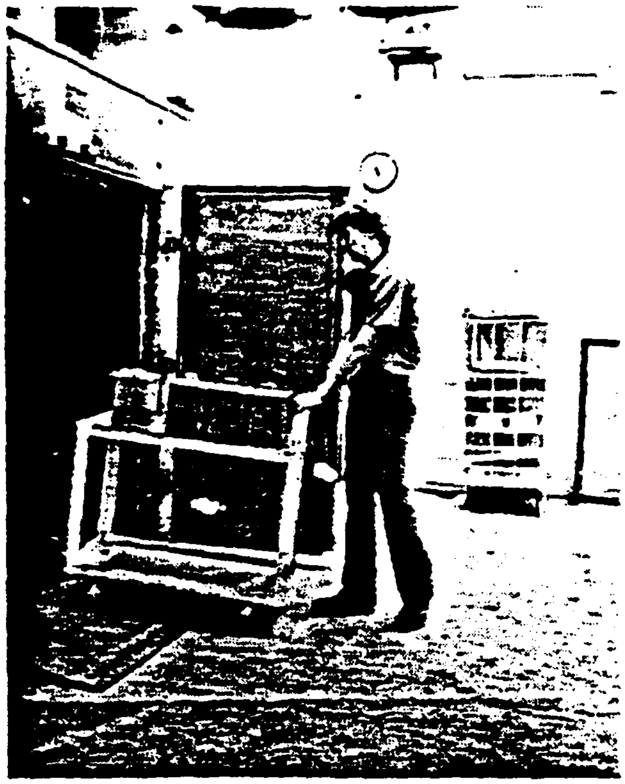


Figure 2-13. WALK-IN OVEN

Make-up air for the paint booths is supplied through the air curtain that separates the walk-in oven from the booths. The make-up air is specially filtered to ensure the cleanest possible air for the paint room.

2.3.2 Potential Painting Improvements

Conveyor - The present method of painting requires individual handling of hardware numerous times as the parts are loaded on and off the carts, into and out of the booth. The obvious solution to reducing this material handling time, and one of the initial thrusts of the project, would be to install a conveyor, where all parts would be hung on racks or hangers, attached to the conveyor, and carried through the booth at a constant speed. Once the parts were hung on the conveyor they would not be removed until after priming, painting, and possibly drying. Since priming takes half the time that final coating takes, a properly balanced line would dictate one booth for priming followed by two booths for final coating. Each booth would have an operator with a paint spray gun. The use of automatic (robot) paint spray guns was not considered because of the high variety and relatively low volume of parts. Potential savings of 1 minute per part multiplied by an annual volume of 20,000 painted parts indicate savings of $12,000 per year could be achieved against a cost of approximately $18,000.

Racks - The "rackability" of parts going through the paint shop was never considered to be a problem. Three rack vendors (Rack Technology, Southwest Rack, and Racko) were invited in to review 25 typical part numbers, using sample parts and engineering drawings. Two of the three vendors submitted proposals.

Booths - The two existing spray booths, because of their age, dissimilarity in size, and dissimilar construction, were not adaptable to a conveyor-type assembly-line painting operation. The two booths would have to be replaced with three booths to accommodate the new throughput operation. Make-up air would also be required, sufficient in size to supply the three booths, either from a central location or by separate ducting to each booth.

Oven - The existing walk-in oven is over 13 years old and is a gas-burning convection-type oven used only intermittently. Since it is an open-flame-type oven, the only reason it could be within 25 feet of the existing paint booths was the fact that the air-curtain located between the oven and the booths separated the room into "two rooms." This arrangement was considered in compliance with NFPA and OSHA codes. The idea of leaving the parts on the conveyor to carry them through an oven for drying would dictate replacing the walk-in oven with a tunnel oven and would also eliminate considerable material handling and reduce work-in-process waiting time for drying. The parts would be cured immediately and faster in the tunnel oven; the parts would be cooled and ready to handle when they came off the line, and ready to go directly to the next operation (ID, silkscreening, etc.). The air-drying option would always be a back-up method for paint curing.

The length of any tunnel oven would be dictated by the conveyor speed and the required drying time. Typical conveyor speeds would be 4-12 feet per minute (fpm). Drying times would depend on the type of tunnel oven used. Market research showed that selection of a flameless infrared catalytic tunnel oven would shorten the conventional oven drying times by a factor of 3 to 1. Parts samples and paints were sent off to two IR oven manufacturers for testing. Both reported that a 6-6.5 minute drying time was required for the MIL SPEC paint Tracor uses. A 6-6.5 drying time combined with a line speed of 4 feet per minute dictates a tunnel oven 25 feet long. The length of the tunnel oven would have to be minimized because of cost and space limitations in the shop. In other words, the shorter the better.

There was another reason the IR oven was desirable as a replacement for the walk-in oven: it was Factory Mutual approved for placement within 25 feet of a paint spray booth. In fact, it was approved for placement co-located with a paint spray booth. This removal of the 25-foot clear area requirement between oven and booth was later to be an important factor in the final rearranged layout of the shop.

The IR oven would have one limitation: its infrared rays are line-of-sight, that is, it must see all sides and every niche on the part. This meant that the conveyor would have to turn the part as it took the part through the oven. This feature could easily be incorporated in the conveyor requirements at little expense.

One unique advantage that the IR oven would offer had to do with its principle of operation. The infrared rays pass directly through the paint coating to the solid part and heat the coating from the inside out. This means that the prime coat, which lies underneath the top or final coat, would be cured first and the top or final coat would be cured last. This is a definite advantage in reducing the time delay between priming and final coating. As long as the prime coat was given sufficient time to "flash off" the solvents it contained (3-5 minutes), the part could actually be top-coated before the prime coat was finished drying.

Another advantage of the IR oven is that it is 80% more fuel efficient than a conventional convective oven.

Guns - Investigation of electro-static paint spray guns was directed in the project. Four brands were examined: Binks, DeVilbiss, Ransburg, and Nordson. All four companies advertised a 25-35% savings in paint usage due to the attraction of the positively charged paint particles to the negatively charged (i.e., grounded) object being painted. That 25-35% of the paint is normally blown past the parts as overspray in a conventional, non-electrostatic spray gun system. The 25-35% paint savings equated to a savings of approximately $2,250 per year for Tracor, versus an equipment cost of $9,000-$12,000.

Of course, the electrostatic spray guns could not be used on the "plastic" fiberglass blocks since they are not metal. When painting blocks, the operator would simply turn the electrostatic feature off and use the gun as a conventional spray gun and accept the wasted overspray. There is a good possibility that a conductive coating could be sprayed on the blocks to permit electrostatic painting and that idea will be pursued at a later date.

The selection of racks would be given special emphasis if electrostatic guns were to be used. The racks not only transport the parts through the booths and the oven, they must also ensure electrical continuity between the part and the grounded conveyor system. No difficulty was anticipated in this regard.

Some concern was expressed by Engineering concerning the "wrap-around" effect of electrostatic painting. Any such process change would have a potential impact on assembled products; and although they did not expect any detrimental effect, they did request that necessary tests be run to qualify the process before releasing parts to the field.

2.4 Masking

2.4.1 Methods - Approximately forty percent of the 289 different part numbers that require painting must be masked prior to painting. See Figure 2-14. On an annual basis, of the 25,000 units that are painted each year approximately 10,000 require masking.

The engineering drawings specify the exact areas on each part that are to be masked, generally three or more places per part. All masking is accomplished using 1" or 2"

Figure 2-14. MASKING A BLOCK

masking tape, medium stock paper (to cover wider expanses), precut dots, scissors, and an exacto knife. The precut dots usually mask holes where electrical contact must be made between a screw and the bare metal. Occasionally Engineering establishes masking requirements which are difficult, if not impossible, to accomplish. In these cases the shop foreman contacts the engineer involved and resolves the questions.

Masking is accomplished in the masking room (see Figure 1-4) by three employees, two of whom are fully occupied in masking at any one time. The other is busy with Bondo work, sanding, or material handling. Because of the man-hours involved, an effort was made to develop new masking methods, and this was one of the initial objectives of the project.

2.4.2 Potential Masking Improvements - The use of quick-attach preforms or peel-away decals was considered both in Phase I and II of this project. When the cost of the preforms was considered, along with the time required to order them and the space required to store them, the masking tape method was found to be cheaper and more flexible. In effect, the need to order separate preforms in the right quantities to match scheduled production of the 58 part numbers, and get them in time to use them and not have a lot of extra ones on hand occupying file drawers, turned out to be more of an administrative nightmare than the small amount of time saved on masking the parts. With higher volume, such as blocks, peel-off masks might be effective, and this may be pursued at a later date.

Mechanical masking of standard hardware was another technique that was to be investigated. This referred to the masking of the fiberglass "blocks" (Figure 2-14) which come through the shop at a steady rate of 100 per week (see Section 2.7). One of the three typical "blocks" was selected for mechanical masking. The effort was successful; but once again the cost of the mechanical masks, the weight they added to the blocks, and the projected space requirements for 300 (3 different types times 100 per month) fairly bulky fixtures proved less cost effective than the present "paper-and-masking-tape" approach. In addition, all three common blocks have tapped holes (8-32) at both ends which are used to connect the hangers for painting. The 8-32 holes got covered up by the mechanical masks, which was another reason these masks didn't work out.

Another masking idea suggested was strippable plastic-dip coating. This alternative was ruled out for the following reasons:

- Cost of materials,
- Harmful solvent vapors,
- Inability to reliably establish the recyclability of the material,
- Expense of complying with future EPA rules.

After considering all alternatives it was decided to defer any potential masking improvements to a later date when more masking techniques might be available and when the new Finishing Shop arrangement might dictate requirements not now known. Thus, no savings were to be realized in the masking area.

2.5 Silkscreening

2.5.1 Method - Silkscreening is a relatively old technique of applying epoxy paint in different colors to flat smooth-surfaced objects. The epoxy paint makes a hard bond on the smooth surface and, unlike ink, withstands almost unlimited wear and tear without loss of color or brilliance. It is almost impossible to wear it off without using some form of sandpaper.

Silkscreening is accomplished by forcing the desired epoxy paint through a screen which has been prepared using a photographic process. The Finishing Shop has the capability to create new silkscreens using this photographic process, which involves an arc lamp and an exposing unit.

In the Finishing Shop there are 112 production part numbers that call for silkscreening which is done by two experienced employees in the silkscreening/ID area. Volume per year exceeds 16,000 units. Parts to be silkscreened vary in size from 4" x 4" to the size of a breadbox. There are two workplaces that are equipped with silkscreening fixtures, one of which is shown in Figure 2-15. One is used for relatively thick parts, with a 12" cavity below it; the other has little room below the hinge section and is used for flatter parts.

For each part number the shop maintains a "tollgate" file with an engineering drawing showing exactly what the silkscreen part is supposed to look like. Many silkscreens have text on them in foreign languages (e.g., Israeli, German, etc.). The shop keeps over 100 screens on hand, which requires considerable storage space.

Paint is mixed for each job and any one job could require up to three colors. Four paints are available: white enamel, black epoxy, white epoxy, and red epoxy. The paint is mixed with a catalyst in an aluminum cup on a 25:1 ratio (epoxy to catalyst). The catalyst is added to help it dry faster. After the paint is mixed, its viscosity is checked by touch and past experience.

Once the paint is prepared and the right size squeegee is sharpened and ready, the screen is clamped in the hinged fixture. The screen is raised, the first part is placed in position, using various thicknesses of aluminum shim material to raise it to the right height. The screen is lowered over the part, the paint is drawn across the screen with the squeegee and the screen is raised. The part is removed, placed on the cart to dry and the next part is placed under the screen. After all parts are completed and dry, a second color could be applied using a second screen as called for by that part. A third screen could be required for a third color. Some part numbers require silkscreening on up to three different sides of the part with more than one color on each side. In all cases, the fixture requires very exact adjustment to be in the correct position each time in relation to the screen itself.

Figure 2-15. OPERATOR SILKSCREENING A PART

The nature of the silkscreening process results in a lot of setup time for each part number, even if the required screen has already been created. On the A-10 countermeasures block, for example, the setup time is 48 minutes. If a new screen is required, the setup time is considerably more.

In some cases parts that have been silkscreened leave the shop to go to another work center, such as sheet metal assembly, but later return to the Finishing Shop for touch-up and wrapping.

2.5.2 Potential Silkscreening Improvements - One of the objectives of the project was to investigate the use of decals and labels to take the place of the time-consuming silkscreening operation, especially for countermeasures "blocks." This possibility was considered, but rejected. There was no decal or label on the market that was as durable as the silkscreening image and could withstand the wear and tear and temperature extremes that the silkscreening image could. Under the circumstances, without feasible alternatives, Engineering was not in a position to consider a change. Only the silkscreening operation could meet all MIL-SPEC, customer, and environmental criteria. No savings were therefore to be realized in this labor intensive operation.

2.6 Identification

2.6.1 Method - Of 1665 part numbers routed to the Finishing Shop, 1301 require identification (ID). Most parts requiring ID, which is performed in the same area as silkscreening and by the same two employees, come directly to ID after chemical finishing. (See Figures 2-16 and 2-17.)

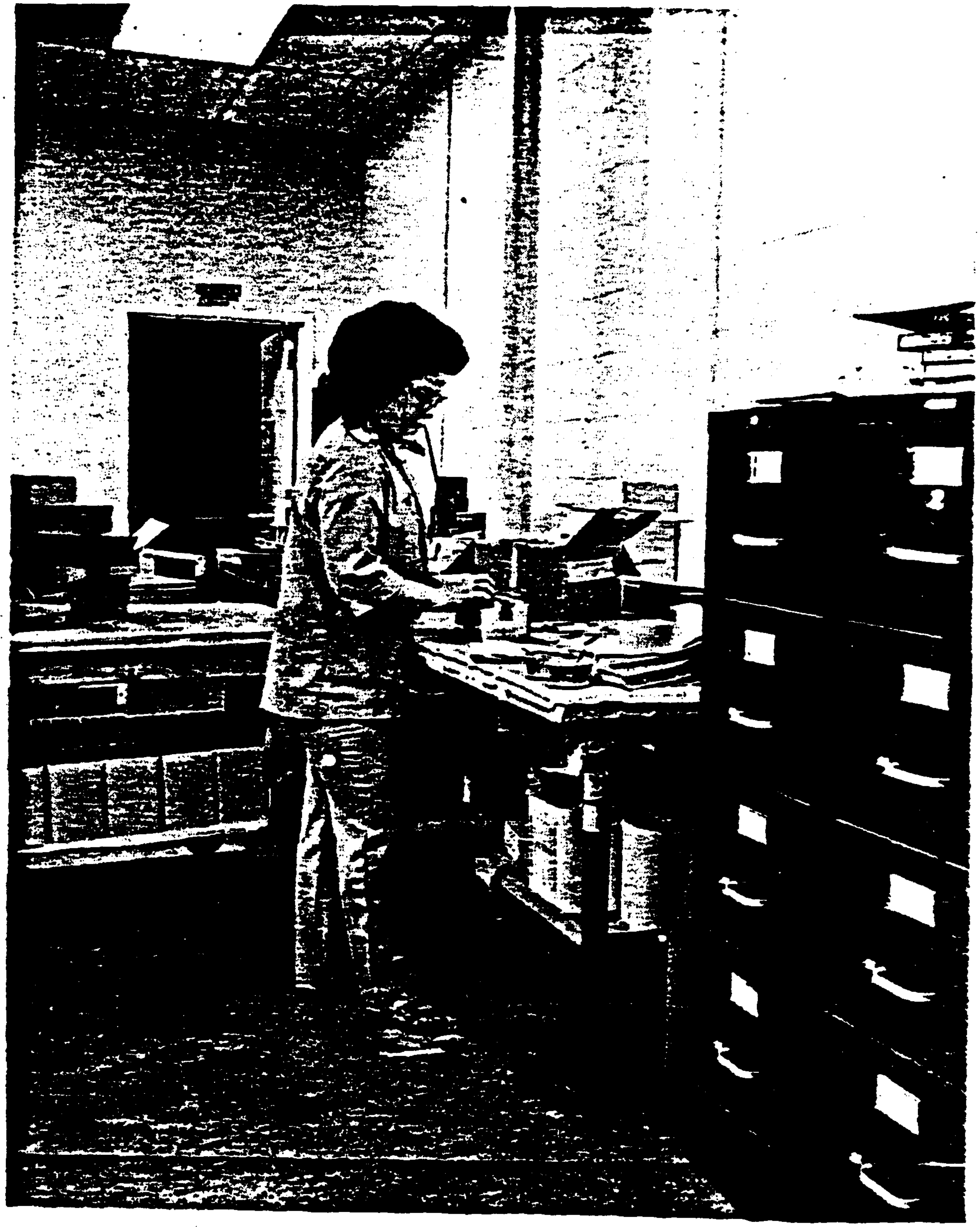


Figure 2-16. MARKING OF PARTS

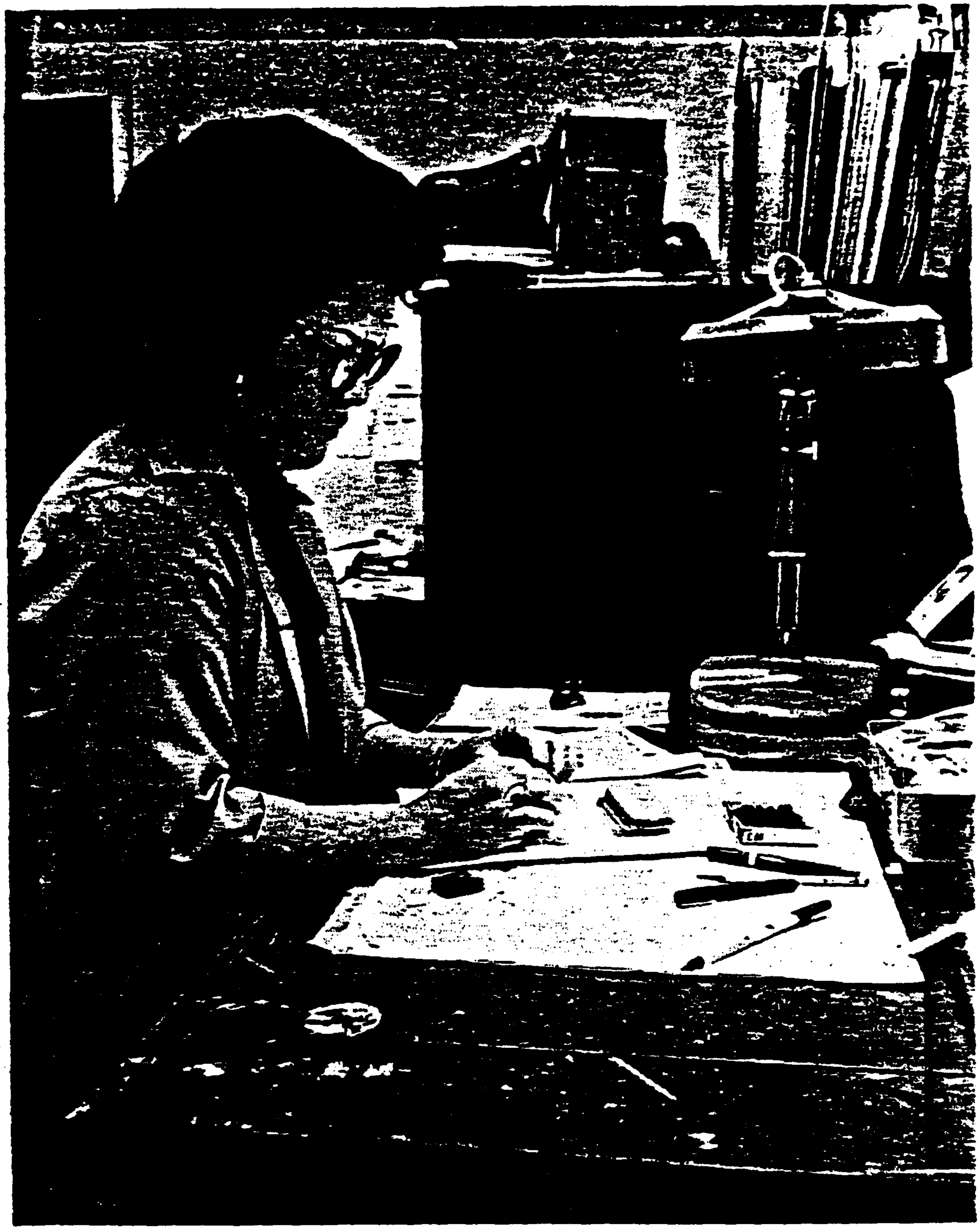


Figure 2-17. IDENTIFICATION OF PARTS

The ID process, or marking, consists of making a rubber stamp of the particular part number, inking the stamp, and stamping the part, usually in three or more places, depending on what the engineering drawing calls for.

2.6.2 Potential Identification Improvements - There were no specific objectives associated with the assessment of ID. The difficulty in automating or otherwise improving the productivity of this function lies in the variability in size and shape of the parts to be ID'd. No changes were deemed appropriate in this function and so labor savings before and after were nil.

2.7 Block Preparation

2.7.1 Method - Tracor produces molded, fiberglass-reinforced "blocks" under a proprietary process in Building 8.

Approximately 100 "blocks" a week are processed through the Finishing Shop, making it one of the steadiest workloads in the shop. The three primary blocks are as follows:

BLOCK #	USED IN LRU #	DESCRIPTION
133489-0001	133896-0001	Chaff magazine for F-4
134046-0001	133686-0001	Flare magazine for F-16, F-4, and Harrier
135896-0001	135912-0001	Chaff magazine for F-16, A-10, A-7, C-130, F-1, and Harrier

When the blocks arrive in the Finishing Shop, they require surface rework and filling of voids for functionality, proper appearance, and ability to accept silkscreening later in the process.

To fill the voids, an epoxy cement called Bondo is used (see Figure 2-18). The Bondo will stick to the fiberglass surface only after a mist coat of paint is applied. Prior to applying the mist coat, the ends of the magazine must be masked so that paint does not intrude into the chambers of the magazine. The order of operation therefore is mask, paint (mist coat), fill the voids with Bondo, dry (cure) the Bondo, sand the excess Bondo off the block to a smooth finish, prime and paint, air dry (or oven cure), silkscreen, assemble, and wrap. The last two steps in the sequence, assemble and wrap, are pictured in Figure 2-19.

Figure 2-18. APPLYING BONDO TO A BLOCK

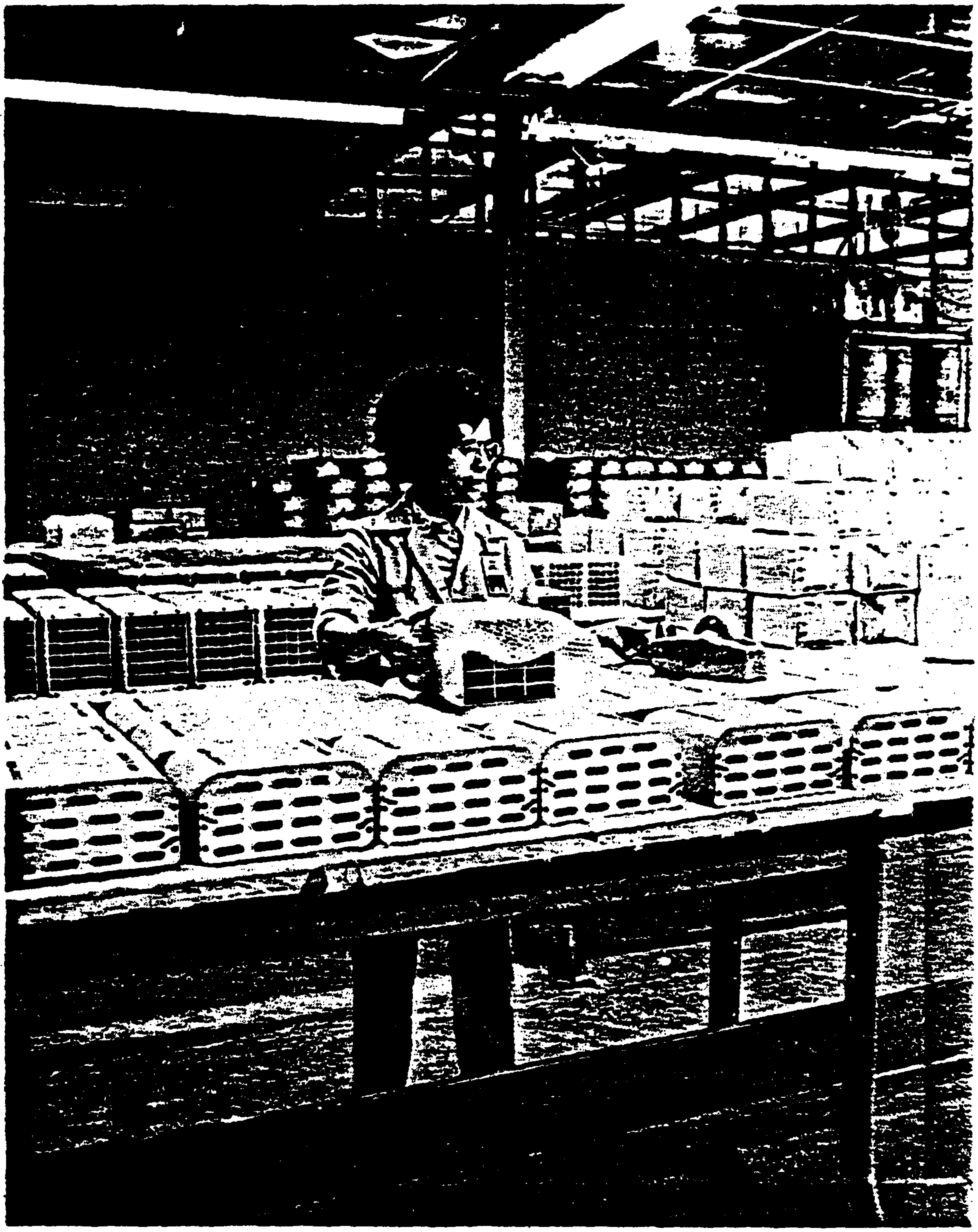


Figure 2-19. ASSEMBLY AND WRAPPING OF BLOCKS

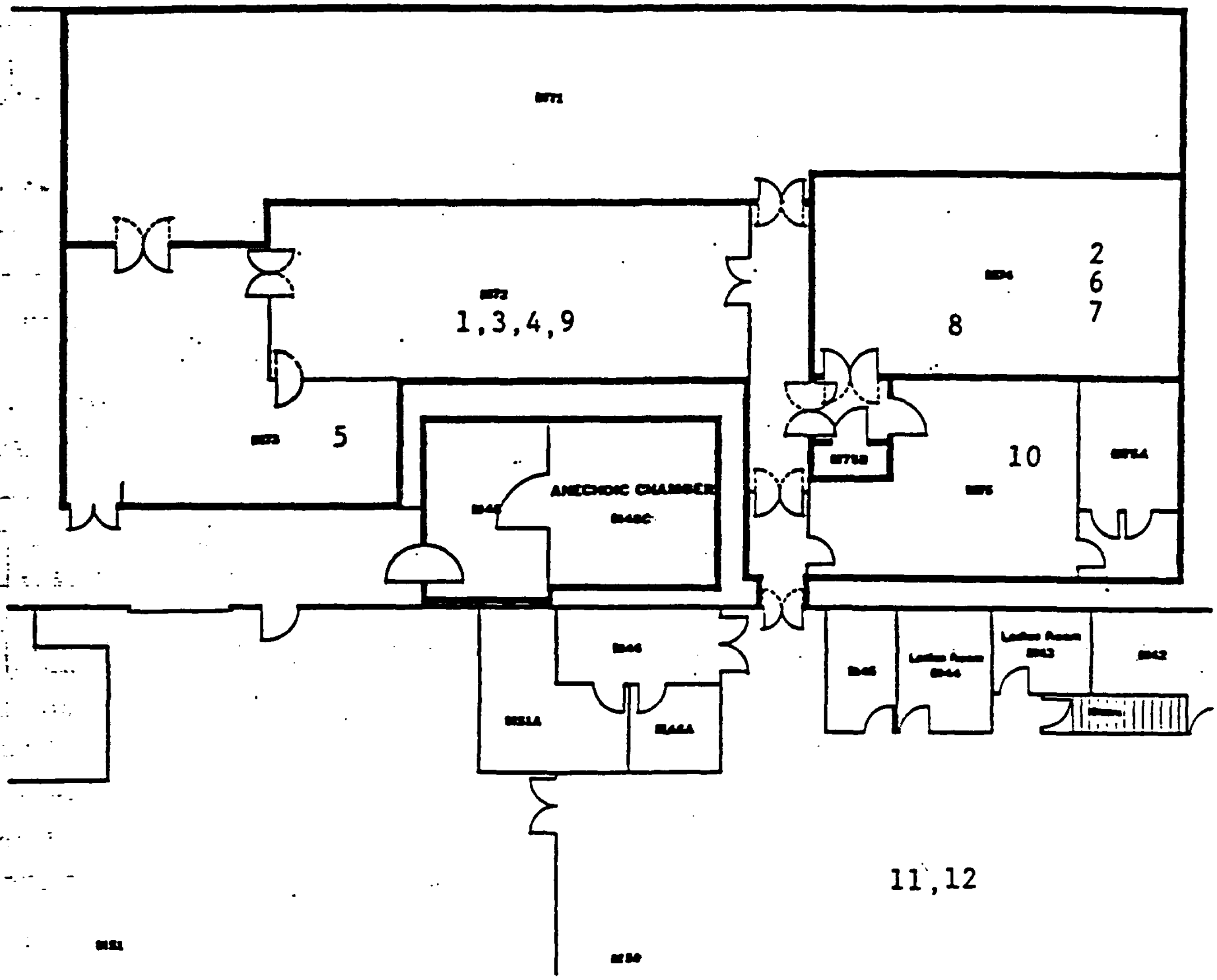
2.7.2 Potential Block Preparation Improvements

Solving the zig-zag travel pattern was one of the original objectives of the Finishing Shop project. Figure 2-20 shows the transportation routines required in the existing layout to complete the block preparation. Figure 2-21 is a table showing the travel distances involved. Any potential rearrangement could cut the 690 feet of total travel almost in half by putting masking closer to painting (presently 99 feet), having sanding closer to painting (presently 126 feet), and having silkscreening nearer to unmask (presently 96 feet).

The hand application of the Bondo to fill voids in the block was examined for improvement. A substance called Spray-Fil was discovered on the market, made to be sprayed from a paint spray gun and developed to fill small voids in a surface. This product was tested and found to be feasible for filling the small "pinhole" voids but unuseable on larger voids. The hand spatula method of filling the larger voids would still be required, but there was still a possibility of applying the Bondo with a spatula while the part was hanging from the conveyor line. This would be done in the "third" booth which was being added as a result of the project. The sequence of operations then would be:

First Booth: Apply "mist" coat of paint (prime).

Second Booth: Spray gun not used. Apply Bondo to larger voids with a spatula from a can of Bondo resting on a bench in the booth. Although the parts are in motion, the four feet per minute line speed allows sufficient time for inspecting the block, locating the larger voids and applying the Bondo, as required.



Legend:

1. Mask
2. Paint (mist-coat)
3. Apply Bondo
4. Cure Bondo
5. Sand
6. Prime
7. Paint
8. Air-dry or Oven-Cure
9. Unmask
10. Silkscreen
11. Assemble
12. Wrap

Figure 2-20. STEPS IN PREPARATION OF BLOCKS

Sequence	Distance in Feet
Staging to Masking	84
Masking to Painting	99
Painting to Bondo	99
Bondo to Sand	27
Sand to Paint	126
Paint to Unmask	99
Unmask to Silkscreen	96
Silkscreen to Assembly/Staging	60
Total	690 ft

Figure 2-21. "AS-IS" TRAVEL DISTANCE, BLOCK PREPARATION

Third Booth: Use spray gun to apply Spray-Fil to fill small pinholes in surface of block.

Additional: The blocks could then pass through a tunnel oven to cure the Bondo, after which they would be cooled on the line and removed for sanding, which would have to be an off-line operation.

No improvements in the masking and silkscreening phases of block preparation were anticipated, as mentioned earlier in Paragraphs 2.4.2 and 2.5.2, respectively.

3.0 WORK FLOW AND TRAVEL DISTANCES

3.1 Work Centers

The activities in the Finishing Shop are broken down into 11 work centers. Each work center has predetermined functions or operations for the purpose of routing analysis and the establishment of setup and run times by manufacturing engineers. The work centers and their descriptions are as follows:

471000	Finishing Shop Undefined (Wrap, Bake, etc.)
471010	Finish Shop - General Prep and Mask
471100	Metal Finish - Undefined (Clean, Sand, Fill, etc.)
471110	Metal Finish - Chem Film (Chemical Conversion)
471120	Metal Finish - Anodize
471130	Metal Finish - Passivation
471140	Metal Finish - Bead Blast
471200	Paint Operations - General
471300	Silkscreen Operations - General
471400	Identification Operations - General
471600	Assembly - Touch-up

3.2 Routing Patterns

A computer program was written to establish Routing Patterns or Parts Families in the Finishing Shop. The analysis addressed the variety of processes and possible routings which could be given to a part number in the Finishing Shop. It was felt that the routing pattern approach to the Finishing Shop would yield some manageable number of routing patterns, perhaps 12 or 14, that would then lend themselves to more intensive analysis aimed at grouping the work centers together to decrease material handling, reduce travel times, and improve work flow. Some part numbers require minimal processing. The analysis revealed that 42 of the 1665 part numbers that arrive at the Finishing Shop require only chem film. Another 685 part numbers required chem film, followed by identification. However, many part numbers have multiple processes and possible routings. For example, 26 part numbers require six operations: chem film, mask, paint, unmask, silkscreen, and ID. One part (PN 135713-0001) requires seven operations: ID, chem film, fill, touch-up, sanding, anodize, and silkscreen. Another part (PN 142094-0001) requires a combination of passivation, painting, ID, and silkscreen. These examples give some idea as to the variety of routings that the parts follow through the shop.

Represented in Figure 3-1 is a data summary of the printouts generated by the computer. The summary shows all 146 routing patterns, the number of part numbers in the routing patterns, and the work centers used in each routing pattern. As can be seen, there are only 17 routing patterns with 10 or more part numbers, and a total of 79 unique routing patterns with only one part number in them. Of the 146 total routing patterns, 121 or 85% have four part numbers or less in them. The totals show the 1665 different part numbers that visit one or more of the 11 Finishing Shop work centers. The number of different routing patterns handled by the work centers are as follows:

471000	Finishing Shop - Undefined	37
471010	Finishing Shop - General Prep & Mask	50
471100	Metal Finish - Undefined	32
471110	Metal Finish - Chem Film	61
471120	Metal Finish - Anodize	6
471130	Metal Finish - Passivation	9
471140	Metal Finish - Bead Blast	9
471200	Paint Operations - General	78
471300	Silkscreen Operations - General	62

471400	Identification Ops - General	102
471600	Assembly - Touch-up	19

Although the 146 different routing patterns identified by the computer program appeared to be of little help at first, it did accomplish two things: First, it shed some light on the possible complexities of scheduling work into the shop, management-wise; and second, it allowed analysis of 146 parts families rather than the impossible task of analyzing 1665 individual part numbers.

The following observations were made possible as a result of the routing pattern analysis:

- o Of the 1665 different part numbers that currently pass through the Finishing Shop, 1413, or 85%, require an ID or silkscreening, or both.
- o Of the 1665 part numbers, 1209, or 73%, require chem film, anodizing, or passivation.
- o Of the 1209 individual part numbers that require chemical finishing, 1149, or 95%, require an ID of one form or another, including silkscreening, marking, or application of a label.
- o Of the 289 part numbers that require painting, 260 require subsequent silkscreening or ID.
- o Of the 289 part numbers that require painting, 115 require prior masking and subsequent unmasking.

Routing Pattern	No. of Parts	% of Total Parts	Undfnd (Wrap, Bake, etc) 471000	Gen Prep & Mask 471010	Metal Finish Undfnd 471100	Chem Film 471110	Anodize 471120	Passiv. 471130	Bead Blast 471140	Paint 471200	Silk Screen 471300	ID 471400	Asmbly Touch-Up 471600
1	2	0.1										X	X
2	2	0.1									X	X	X
3	1	0.1				X							X
4	9	0.5											X
5	3	0.2	X										
6	1	0.1	X										
7	1	0.1	X		X	X					X		X
8	1	0.1								X		X	X
9	1	0.1										X	
10	1	0.1									X	X	
11	1	0.1			X	X	X				X	X	X
12	1	0.1		X								X	
13	2	0.1	X									X	
14	152	9.1										X	
15	2	0.1	X								X	X	
16	6	0.4									X	X	
17	2	0.1									X	X	
18	3	0.2									X		
19	1	0.1									X		
20	1	0.1									X		
21	1	0.1			X	X					X		
22	5	0.3			X						X		
23	38	2.3									X		
24	1	0.1								X		X	
25	15	0.9								X		X	
26	1	0.1								X	X	X	X
27	4	0.2								X	X	X	
28	8	0.5								X		X	
29	3	0.2								X	X	X	
30	11	0.7								X			
31	4	0.2							X			X	
32	1	0.1				X			X			X	
33	1	0.1	X						X			X	
34	1	0.1	X						X				

Figure 3-1. ROUTING PATTERN DEFINITION

Routing Pattern	No. of Parts	% of Total Parts	Undfnd (Wrap, Bake, etc) 471000	Gen Prep & Mask 471010	Metal Finish Undfnd 471110	Chem Film 471100	Anodize 471120	Passiv. 471130	Bead Blast 471140	Paint 471200	Silk Screen 471300	ID 471400	Asmbly Touch-Up 471600
35	1	0.1						X			X	X	
36	119	7.1						X				X	
37	1	0.1						X		X	X	X	
38	3	0.2						X		X		X	
39	1	0.1						X		X	X	X	
40	1	0.1						X	X				
41	1	0.1		X				X		X		X	
42	11	0.7						X					
43	83	5.0					X					X	
44	1	0.1					X			X	X	X	
45	3	0.2					X						
46	1	0.1	X	X		X				X		X	X
47	1	0.1	X			X							
48	9	0.5				X						X	
49	6	0.4				X					X	X	
50	1	0.1				X				X		X	
51	1	0.1			X	X				X		X	
52	1	0.1			X	X						X	
53	1	0.1		X		X				X		X	
54	1	0.1	X			X						X	
55	685	41.1				X						X	
56	1	0.1		X		X				X	X	X	X
57	1	0.1				X				X	X	X	
58	1	0.1	X			X					X	X	
59	23	1.4				X					X	X	
60	1	0.1				X				X	X	X	
61	2	0.1	X			X				X	X	X	
62	1	0.1				X					X		
63	2	0.1				X				X		X	
64	45	2.7				X				X		X	
65	13	0.8				X				X	X	X	
66	4	0.2				X				X		X	
67	1	0.1			X	X				X		X	
68	1	0.1		X		X				X		X	

Figure 3-1. ROUTING PATTERN DEFINITION (cont.)

Routing Pattern	No. of Parts	% of Total Parts	Undfnd (Wrap, Bake, etc) 471000	Gen Prep & Mask 471010	Metal Finish Undfnd 471100	Chem Film 471110	Anodize 471120	Passiv. 471130	Bead Blast 471140	Paint 471200	Silk Screen 471300	ID 471400	Asmbly Touch-Up 471600
69	1	0.1		X		X				X	X	X	
70	2	0.1	X			X				X		X	
71	2	0.1	X			X				X			
72	3	0.2				X				X			
73	2	0.1				X						X	
74	2	0.1			X	X						X	
75	3	0.2		X		X				X		X	
76	1	0.1		X		X				X	X	X	
77	1	0.1		X		X				X		X	
78	1	0.1	X	X		X				X		X	
79	51	3.1		X		X				X		X	
80	1	0.1		X		X				X	X	X	
81	1	0.1	X	X		X				X	X	X	
82	26	1.6		X		X				X	X	X	
83	4	0.2		X		X				X	X		
84	1	0.1		X		X				X	X	X	
85	1	0.1		X		X				X		X	
86	1	0.1		X		X				X	X	X	
87	2	0.1		X		X				X			
88	2	0.1		X		X				X			
89	2	0.1		X		X	X					X	
90	1	0.1		X		X	X				X	X	
91	1	0.1		X		X						X	
92	1	0.1	X	X		X						X	
93	1	0.1	X	X		X				X	X	X	
94	42	2.5				X							
95	2	0.1			X					X	X	X	X
96	1	0.1		X	X				X	X	X	X	
97	14	0.8			X							X	
98	1	0.1			X						X	X	
99	3	0.2			X					X	X	X	X
100	1	0.1			X					X	X	X	X
101	3	0.2			X					X			
102	1	0.1		X	X				X	X			

Figure 3-1. ROUTING PATTERN DEFINITION (cont.)

Routing Pattern	No. of Parts	% of Total Parts	Undfnd (Wrap, Bake, etc) 471000	Gen Prep & Mask 471010	Metal Finish Undfnd 471100	Chem Film 471110	Anodize 471120	Passiv. 471130	Bead Blast 471140	Paint 471200	Silk Screen 471300	ID 471400	Asmbly Touch-Up 471600
103	2	0.1			X	X						X	
104	3	0.1			X							X	
105	1	0.2			X					X	X		X
106	1	0.1			X					X	X		X
107	1	0.1			X					X	X		
108	1	0.1			X					X	X		X
109	1	0.1			X					X	X		
110	1	0.1			X								
111	1	0.1		X	X					X		X	
112	2	0.1		X	X					X	X	X	
113	1	0.1		X	X					X	X		
114	3	0.2	X		X								
115	6	0.4			X								
116	4	0.2		X								X	
117	1	0.1		X						X		X	
118	15	0.9		X						X		X	
119	1	0.1		X						X	X	X	X
120	4	0.2		X						X	X	X	
121	1	0.1	X	X						X		X	X
122	2	0.1		X						X	X	X	
123	1	0.1		X	X					X		X	
124	1	0.1	X	X						X			
125	1	0.1		X						X	X	X	
126	1	0.1		X					X				
127	2	0.1		X		X					X	X	
128	1	0.1		X						X		X	
129	1	0.1		X								X	
130	1	0.1		X									
131	6	0.4	X									X	
132	1	0.1	X								X	X	
133	1	0.1	X							X		X	
134	1	0.1	X							X		X	
135	1	0.1	X						X			X	
136	2	0.1	X					X				X	

Figure 3-1. ROUTING PATTERN DEFINITION (cont.)

Routing Pattern	No. of Parts	% of Total Parts	Undfnd (Wrap, Bake, etc) 471000	Gen Prep & Mask 471010	Metal Finish Undfnd 471100	Chem Film 471110	Anodize 471120	Passiv. 471130	Bead Blast 471140	Paint 471200	Silk Screen 471300	ID 471400	Asmbly Touch-Up 471600
137	3	0.2	X			X						X	
138	2	0.1	X	X		X				X		X	
139	1	0.1	X	X		X				X	X	X	
140	1	0.1	X	X		X				X	X	X	
141	2	0.1	X		X					X	X		
142	2	0.1	X		X					X	X		
143	1	0.1	X	X		X				X	X		X
144	4	0.2	X										
145	1	0.1	X										
146	78	4.7	X										
146	1665	102.8	37	50	32	61	6	9	9	78	62	102	19

Figure 3-1. ROUTING PATTERN DEFINITION (cont.)

The above observations dictate that any rearrangement of the shop should:

a. Shorten the distance from the stage-in point to chemical finishing,

b. Shorten the distance from chemical finishing to silk-screening/ID,

c. Shorten the distance from masking to painting, and

d. Shorten the distance from unmasking to silk-screening/ID.

e. A fifth requirement for any rearrangement would be to smooth out and shorten the path taken by the "blocks" through the shop which require mask-paint-bondo-cure-sand-paint-unmask-silkscreen. This is due to the continuing heavy workload of 100 "blocks" per week. These blocks are actually the chaff and flare magazines used in Tracor's dispensers.

3.3 Travel Distances

Preliminary to correcting the zig-zag work flow and extended travel distances in the Finishing Shop, measurements were taken on the distance from operation to operation. They are shown in Figure 3-2. Figure 3-3 shows the product being moved out of painting into the hallway. Figure 3-4 shows the product being moved from the hallway into the masking area. These distances will serve as a baseline for comparison with the revised layout.

Using the distances shown, one can easily compute this distance for any routing pattern. For example, one common routing pattern is staging/chem film/ID/staging. The total distance traveled in this routing pattern would be 176', calculated as follows:

Staging to Chem Film	52'
Chem Film to ID	64'
ID to Staging	60'
Total	176'

The blocks travel 690 ft. during processing, which demonstrates how inefficient their work flow is. The calculation was as follows:

Staging to Mask	84'
Mask to Paint	99'
Paint to Bondo (Mask)	99'
Bondo to Sand	27'
Sand to Paint	126'
Paint to Unmask	99'
Unmask to Silkscreen	96'
Silkscreen to Assembly/Staging	60'
Total	690'

FROM	TO	DISTANCE (FT.)
Staging	ID/Silkscreen	28'
Staging	Chem Fin	52'
Staging	Mask	84'
Staging	Paint	66'
Paint	Unmask	99'
Mask/Unmask	ID/Silkscreen	78'
Mask	Paint	99'
Chem Fin	ID/Silkscreen	64'
Chem Fin	Mask	56'
Chem Fin	Paint	67'
Paint	ID/Silkscreen	77'
Paint	Bondo	99'
Bondo	Sand	27'
Sand	Paint	126'
ID/Silkscreen	Outstage	60'
Chem Film	Outstage	84'

Figure 3-2. FINISHING SHOP "AS-IS" TRAVEL DISTANCES

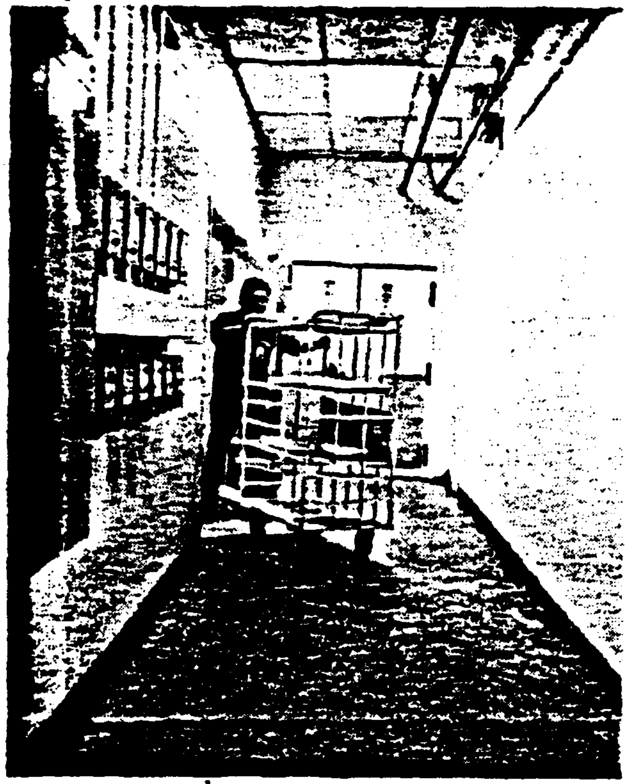


Figure 3-3. MOVING PARTS FROM PAINT SHOP TO HALLWAY

Figure 3-4. MOVING PARTS FROM HALLWAY TO MASKING

4.0 PROJECT DESCRIPTION

The assessment of the "AS-IS" condition brought out the key factors involved in establishing an efficient and cost effective Finishing Shop at Tracor Austin. The decision-making on the project revolved around what equipment was to be purchased and how it could be fitted into the space available, and the budget, and create a smooth process flow with minimum travel distances. Those four factors interacted: equipment, budget, space available, and process flow. The rationale and decision-making that evolved from the interaction of these four factors is described below. Refer to Figures 4-1 and 4-2 to understand the changes from the "AS-IS" layout to the "TO-BE" layout.

4.1 Conveyor Application

It was clear that a conveyor was required to eliminate material handling in painting. It was not clear as to where it would be located and whether the conveyor could carry the parts through a tunnel oven. The variability of masking and sanding dictated that they be done "off-line."

Several layouts were considered. At one point the conveyor was routed through the sanding room but since not all painted parts require sanding, and since there was an obvious danger of sanding dust being picked up by freshly painted parts, this routing was ruled out. A "power-and-free" conveyor was considered next, which would involve one main conveyor loop and two secondary loops, one to the tunnel oven and one to the sanding room. Under this concept, parts would stay on the main line until and unless they needed to go to the oven or to sanding, at which time a switch would be thrown to route them that way. The "power-and-free" conveyor idea was soon ruled out, however, due to cost; it was 2-3 times the cost of a single,

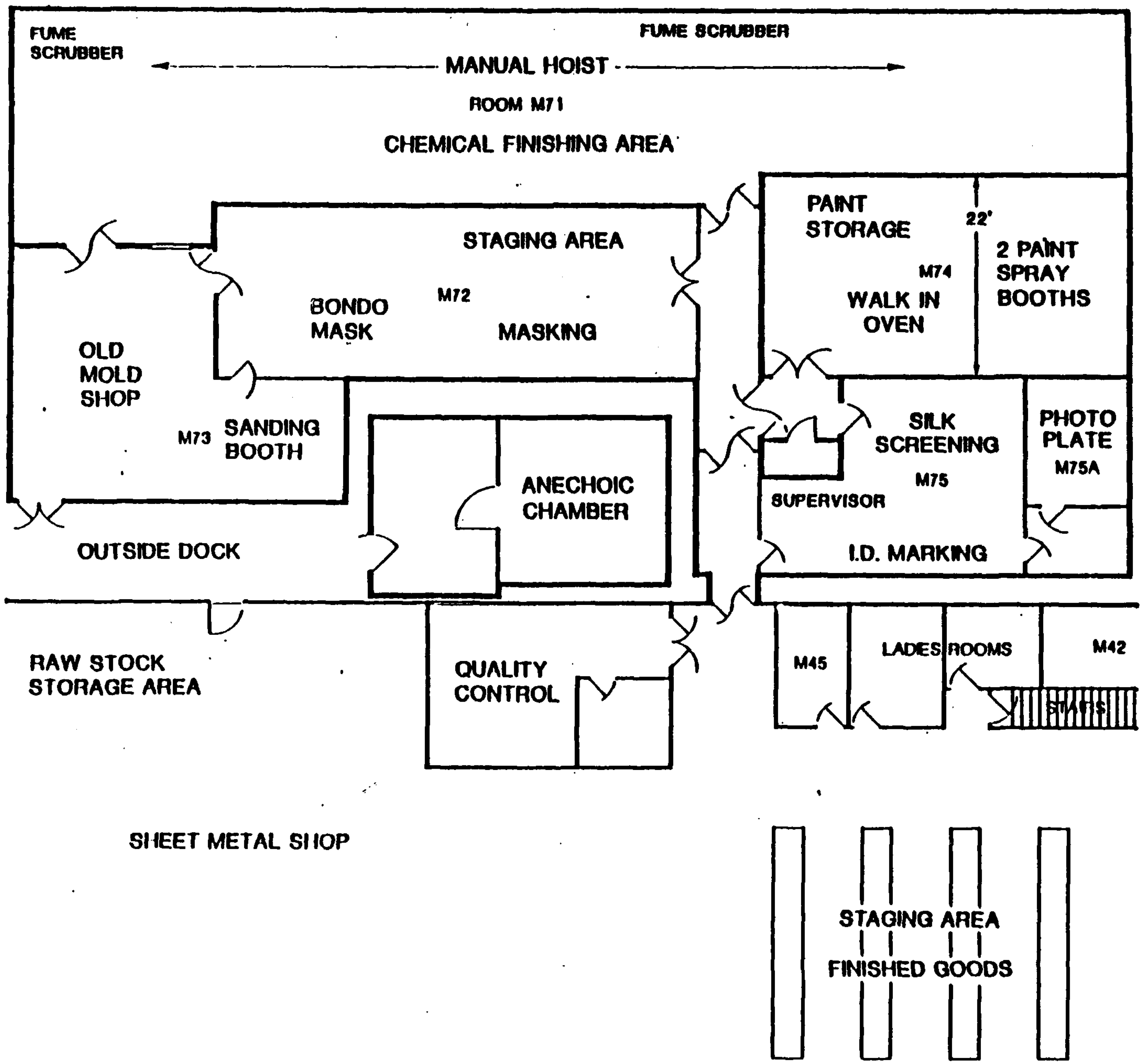


Figure 4-1. FINISHING SHOP "AS-IS" LAYOUT

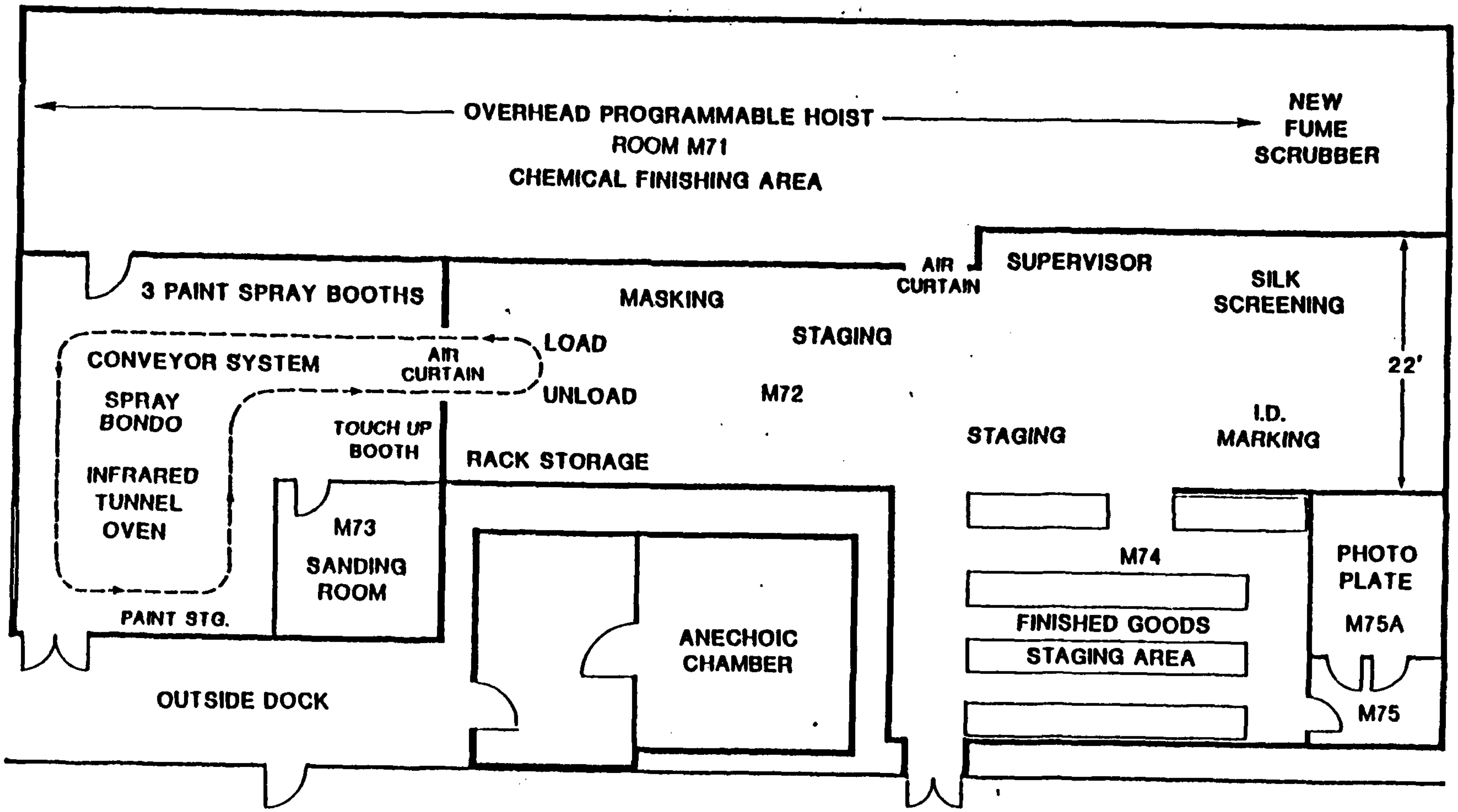


Figure 4-2. FINISHING SHOP "TO-BE" LAYOUT

continuous loop conveyor. Therefore, one continuous conveyor loop was decided on.

At one point the idea of swapping the mask/bondo area with the ID/silkscreen area (see Figure 4-1) was given strong consideration. This would have put masking in the present silkscreening area, adjacent to the paint room, with the conveyor running between the two rooms. This meant the paint room would stay where it was. The key question then was whether or not the booth, the conveyor, and the oven could all fit into the existing paint room. The answer was "no."

4.2 Three Spray Booths

Since 3 new dry-filter paint spray booths would be required in a conveyorized line (1 for prime, 2 for paint), the painting room had to be large enough to accommodate all 3, plus the conveyor, plus the oven, if possible. The existing 40' x 22' paint room was not large enough. Expanding the room into the present ID/silkscreening area would mean that masking would not be adjacent to it. The only location with room enough for 3 booths, an oven, and a conveyor system, and room enough for masking nearby, was the old mold press area. This way the masking area would not be moved to painting; instead, painting, along with the new tunnel oven, would be moved adjacent to the existing mask/bondo area.

4.3 Tunnel Oven

The move into the old mold press area would provide space for the 3 booths, the conveyor system, and, by using the available overhead space and moving a wall, a 25-foot tunnel oven. Elevating the oven would allow more clear floor space below for personnel movement. It would be necessary also to limit the tunnel oven to 25 feet in length. The new paint room would measure 36' x 32'. The oven would have to be of the type that is FM approved for placement in the same room as the booths (IR).

4.4 Sanding

The sanding room is used during "block" preparation which is presently 100 units a week. It is not used on too many other parts, one of which is pictured in Figure 4-3. Since the blocks are sanded after prime paint and Bondo, and before final painting, the location of the sanding function, in close proximity to the new paint shop, was considered an advantage. Precautionary measures had to be taken, however, to isolate the sanding from the painting. This was done by enclosing the sanding booth in its own sanding room and providing make-up air in the paint room with a slight positive pressure. This would ensure that any ambient air movement in the room would be from the painting room to the sanding room, rather that vice versa. The make-up air unit, to be roof-mounted, was upgraded in size to ensure the positive pressure in the paint room. The make-up air unit would also be equipped with specially designed pre-filters to ensure clean air for the new paint room.

4.5 Staging

When upper management approved the assignment of the vacant mold press area to the Finishing Shop for its new painting area, they required the shop to give up the existing staging area for finished goods, which is located in Building 2 proper, close to the Finishing Shop (see Figure 4-1). The new finished goods staging area would have to be moved into either the old paint room, or the present ID/silkscreening area. The latter was selected.

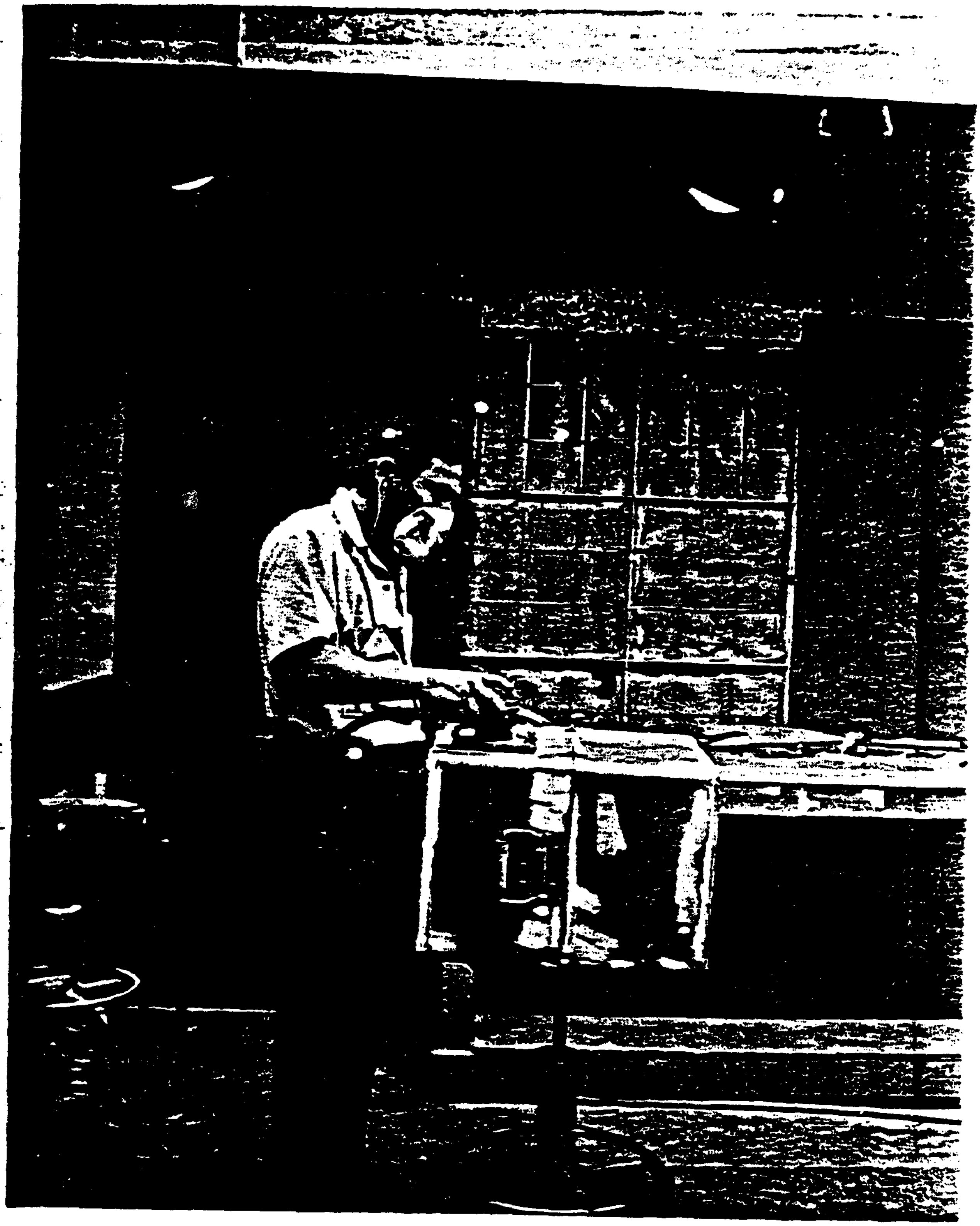


Figure 4-3. SANDING A TEST SET COVER

4.6 Opening Up the Area

With the old paint room vacated, and the ID/silk-screening function taking its place, there was no longer any reason to retain the cinder block walls, which were originally installed to provide a "cleanliness barrier" between the paint room and the silkscreen area. By removing most of the walls, including the paint storage closet, and relocating some electrical junction boxes, a clear area would be created inside the shop including the new staging area, the new ID/silkscreening area, and extending across to the masking area. Opening up the area created an area for staging of incoming goods, eliminated zig-zag process flows, and provided increased flexibility, visibility, control, and communications.

As shown by comparing Figures 4-1 and 4-2, (page 62 and 63) the small rooms used for silkscreen creation and paint storage were to remain as is, which would save relocation costs on the sink and hood and still keep the equipment close enough to the silk-screeners.

The location of ID/silkscreening in the area previously occupied by painting put it in an ideal location in relation to chemical finishing. As pointed out earlier 95% of the parts that go to chemical finishing go to ID/silkscreening next. This arrangement would shorten that distance.

4.7 Chemical Finishing

The revised layout had no effect on the chemical finishing area. The wall at the west end of the area will be moved to straighten out the wall, but this is minor. The plans to purchase an overhead programmable hoist and a drying tank were not affected by the new layout. The location of the load/unload station along the chemical finishing line had already been selected in close proximity to the entry point to the area.

4.8 Work Flow

Figure 4-4 shows the flow of typical work through the shop under the "AS-IS" layout. Note the number of paths and retracing of paths to move product through the shop. Note also the lack of any point from which work could be controlled. Figure 4-5 shows the flow of work through the shop under the revised layout. Note the natural emergence of a control point made possible by the opening up of the area and the additional useable space that was generated.

4.9 Changes in Travel Distances

Figure 4-6 shows the old and the new travel distances and the difference between the two. This reduced travel time makes a significant contribution to the reduction in direct labor hours.

The example used earlier for the parts coming into the shop for chemical finish and ID results in a 78-foot savings as follows:

	OLD	NEW	Savings
Staging to Chem Fin	52'	18'	
Chem Fin to ID	64'	46'	
ID to Staging	60'	34'	
Total	176'	98'	78'

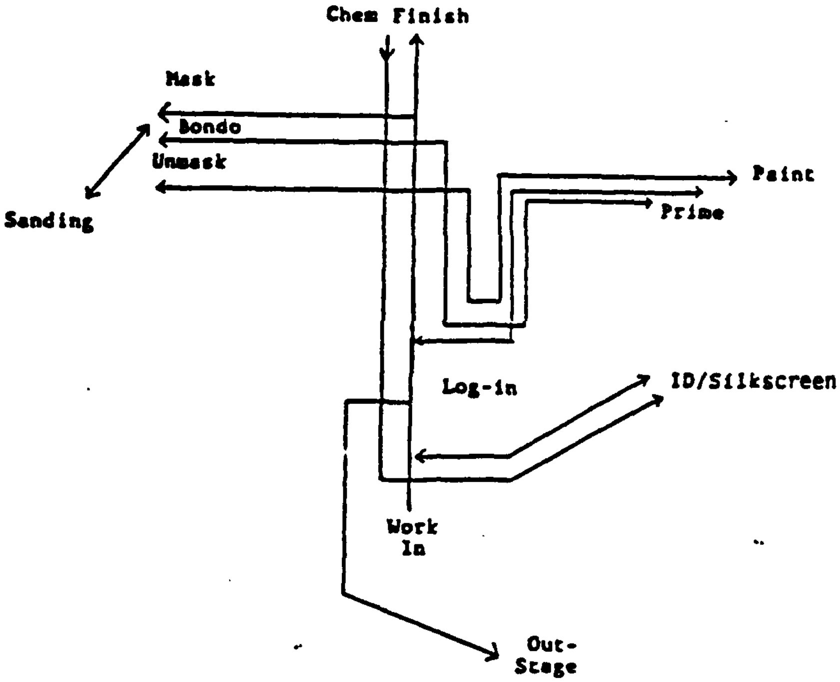


Figure 4-4. OLD WORK FLOW SCHEMATIC

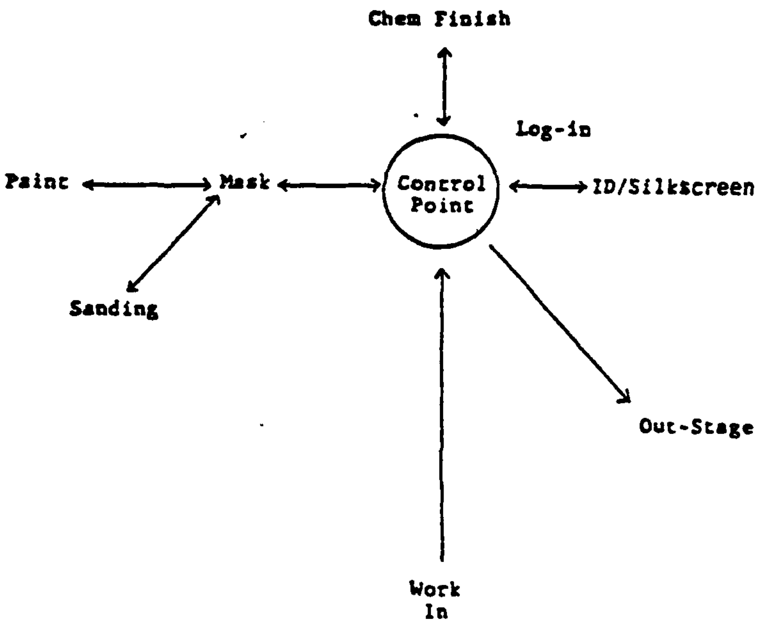


Figure 4-5. NEW WORK FLOW SCHEMATIC

FROM	TO	OLD DISTANCE (FT.)	NEW DISTANCE (FT.)	DIFFERENCE (FT.)
Staging	ID/Silkscreen	28'	28'	-0-
Staging	Chem Fin	52'	18'	34'
Staging	Mask	84'	28'	56'
Staging	Paint	66'	38'	28'
Paint	Unmask	99'	12'	87'
Mask/Unmask	ID/Silkscreen	78'	54'	24'
Mask	Paint	99'	12'	87'
Chem Fin	ID/Silkscreen	64'	46'	18'
Chem Fin	Mask	56'	32'	24'
Chem Fin	Paint	67'	44'	23'
Paint	ID/Silkscreen	77'	64'	13'
Paint	Bondo	99'	-0-	99'
Bondo	Sand	27'	42'	15'
Sand	Paint	126'	42'	84'
ID/Silkscreen	Outstage	60'	34'	26'
Chem Film	Outstage	84'	40'	44'

Figure 4-6. BEFORE AND AFTER TRAVEL DISTANCES

On block preparation the shop will save 466 ft., which is a savings of two-thirds. The before and after distances are as follows:

	OLD	NEW	
Staging to Mask	84'	28'	
Mask to Prime	99'	12'	
Prime to Bondo	99'	-0-	
Bondo to Sand	27'	42'	
Sand to Paint	126'	42'	
Paint to Unmask	99'	12'	
Unmask to Silkscreen	96'	54'	
Silkscreen to Assembly/Staging	60'	34'	Savings
Total	690'	224'	466'

4.10 Equipment Procured

4.10.1 Summary - The following is a summary of the equipment purchased in the project. The cost figures are approximate and do not include taxes, material handling, or installation. Other details are listed below, following the cost summary:

		($000) Est Cost	Date Ordered	Date Delivered
1.	Conveyor System	18.5	Nov 84	Dec 84
2.	3 Paint Booths & Make-up Air	17.2	Nov 84	Dec 84
3.	IR Oven	41.2	Nov 84	Dec 84
4.	Spray Guns	11.2	Nov 84	Jan 85
5.	Rinse Tanks	18.7	Nov 84	Jan 85
6.	Fume Scrubber	15.7	Nov 84	Dec 84
7.	Overhead Prog. Hoist	49.9	May 85	Nov 85
8.	Process Tanks	21.8	Feb 85	Jun 85
9.	Touch-Up Booth	1.3	Mar 85	Apr 85

10.	Air Curtain	1.3	Mar 85	Apr 85
11.	Storage Cabinets	1.8	Mar 85	Apr 85
12.	Drying Tank	10.8	Sep 85	Oct 85
13.	Paint Racks	5.5	Oct 85	Dec 85
14.	Chem Film Racks	2.4	Oct 85	Dec 85
15.	Waste Treatment Equipment	*87.9	Sep 85	Dec 85

* Includes installation and tax. All other items are purchase price only.

4.10.2 Equipment Details

1. Conveyor System
   PR: 313718
   PO: 702542
   Cost: $18,530
   Mfg: Unibilt
   Vendor: Texas Materials Handling, San Antonio, Texas
   Length: 200 ft. enclosed track
   Mounting Height: 7 ft. (lower level) 12'6" (upper level)
   Other: Universal link chain, enclosed track, welded, 72 "H" attachments from which to suspend parts using rotatable star wheels, Caterpillar #300 drive unit, variable speed with reducer (3.5 to 20 feet per minute), control panel, chain inspection gate, chain oiler, take-up unit, expansion joints, anti-backup stop, anti-runaway stop, and hanging steel.
2. 3 Paint Booths and Make-up Air
   PR: 313717
   PO: 702555
   Cost: $17,237
   Mfg: DeVilbiss, Toledo, Ohio
   Vendor: Alamo Iron Works, San Antonio, Texas
   Booths: 8 ft. wide x 7 ft. high x 6 ft. deep inside

dimension, 9 ft. deep outside dimension, lights, 24 filters, 24" fan, 3 Hp motor and exhaust ducting, conveyor opening each side 20 in. wide by 24 in.
Make-up Air: DeVilbiss, roof-mounted, down-blast, 30,000 cu. ft. per minute, 20 Hp with variable speed drive, filter, heater with remote temperature control.

3. IR Oven
   PR: 313724
   PO: 702543
   Cost: $41,249
   Mfg: Bruest Industries, Inc., Independence, Kansas
   Vendor: Bruest Industries, Inc., Independence, Kansas
   Oven: Flameless gas infrared radiant catalytic heater panels. Factory Mutual approved.
   Length: 25 ft.
   Mounting Height: Bottom of tunnel is 8 ft. from floor level.
   Cross Section: 5 ft. x 4 ft.
   Temperature: 125 F to 300 F, variable
4. Spray Guns
   PR: 313723
   PO: 702582
   Cost: $11,177
   Mfg: Nordson Corp, Amherst, Ohio
   Vendor: Nordson Corp, Grand Prairie, Texas
   Guns: 3 each Nordson AN-8 Manual Air Electrostatic Paint Spray Guns with extra hose and quick-change pattern
   Power Unit: EPU-8 Electrostatic 115/230V
   Power unit and integral pump, heater filters, circulation valve, electrostatic cable and 2-gallon pressure pot.
5. Rinse Tanks
   PR: 313720
   PO: 702544

Cost: $18,725
Mfg: Houston, Texas fabricator
Vendor: Plastic Piping Systems, Austin, Texas
Tanks: Seven rinse tanks, 44 inches wide, 72 inches long, and 48 inches deep. Dual-laminate construction with polypropolene interior and fibrelass backing. Overflow baffle with upper and lower drains.

6. Fume Scrubber
   PR: 313721
   PO: 702541
   Cost: $15,761
   Mfg: Midwest Air Products Co., Inc., Owosso, Michigan
   Vendor: International Supply of Austin, Austin, Texas
   Scrubber: The fume scrubber is a ventilation system for the process tanks in the chemical finishing area. Noxious and dangerous fumes are drawn from each tank using lip vents and carried away through horizontal ducting attached to the wall behind the tanks. Included a 20 HP roof-mounted fan, a floor-mounted single-pack vertical scrubber, and a pH control package.

7. Overhead Programmable Hoist
   PR: 313719
   PO: 702691
   Cost: $49,937
   Vendor: Programmed Machine Systems, Inc., Madison Heights, Michigan
   Length: 110 ft.
   Other: Floor mounted superstructure, crain guide rail, single electric/hydraulic lift mechanism, programmable controller, microprocessor, power connections, adapters, 12 carrier bars, 16 sets of saddles (1 set electrified), and 2 load/unload carrier bar dollies.

8. Process Tanks
   PR: 313729
   PO: 702660
   Cost: $21,818
   Mfg: Houston, Texas fabricator
   Tanks: Nine process tanks, 44 inches wide, 72 inches long, and 48 inches deep. Dual laminate construction with polypropolene interior and fibreglass backing. No overflow baffle and a single lower drain.
9. Touch-up Booth
   PR: 313721
   PO: 702662
   Cost: $1,250
   Mfg: Spray Booth Systems, Fort Worth, Texas
   Vendor: Spray Booth Systems, Fort Worth, Texas
   Size: 4 ft. wide x 4 ft. high x 5 ft. deep
   Leg-mounted, with light, fan, blower motor and filter
10. Air-Curtain
   PR: 313726
   PO: 702661
   Cost: $1260
   Mfg: Chalfant Air Doors
   Vendor: Texas Materials Handling Systems,
   San Antonio, Texas
   Size: 8 ft. x 8 ft., 2 Hp
11. Storage Cabinets
   PR: 313730
   PO: 702663
   Cost: $1829
   Mfg: VWR Scientific
   Vendor: VWR Scientific, Dallas, Texas
   Quantity: 3 Flammable Paint Storage Cabinets (Yellow)
   1 Acid Storage Cabinet (Blue)
   Size each: 45 gallon, 2 shelves, 43" W x 18" D x 65" H

Welded double-wall construction, 18-gauge steel, 2 door, manual close

12. Drying Tank

    PR: 313727

    PO: 702868

    Cost: $10,550

    Vendor: Custom Fabrication Company, Houston

    Single-station capacity with cavity measuring 44" wide x 72" F.B. x 48" deep. Steam heat, blower recirculation, two fans, 1300 cfm, temperature control, over-temperature protection, non-corrosive inner and outer jacket.

13. Paint Racks

    PR: 314220

    PO: 703010

    Cost: $4,945

    Vendor: Rack Technology, Inc., Grand Prairie, Texas

    Racks: Four different rack designs were required to handle the variety of Tracor parts that require painting. Quantities of each rack varied from 20 to 100. Prices varied from $17 to $41. The racks are basically 1/4" x 1" cold-rolled steel with .090 inch stainless steel spring wire attachment.

14. Chem Film Racks

    PR: 109801

    PO: 837297

    Cost: $2,442

    Mfg: Vulcanium Corporation, North Brook, Illinois

    Vendor: A-Brite Co., Dallas, Texas

    Racks: Titanium splines, hooks, disc racks and baskets used in chem-film and anodizing.

15. Waste Treatment Equipment

Facility Improvement Request (FIR): 85-092

FIR date: Sept. 24, 1985

Cost: $87,875

Contractor: Cematco, Inc., Austin, Texas

Waste treatment equipment required to upgrade and expand Tracor's ability to handle the chemical by-products of the Finishing Shop operations. Required to meet EPA compliance items. The price shown includes installation of equipment and taxes.

4.11 Project Management Plan

The Project Investigator for this project was Pat Casey, Industrial Engineer. Earlier work in Phase I was done by Rhonda Broussard, Industrial Engineer. The Project Investigator reports directly to the Industrial Tech Mod Program Manager, who is Russ Petrie. Responsibilities of the Project Investigator include project management, cost, schedule, and technical conformance.

Those departments contributing direct support to the project include Manufacturing, Manufacturing Engineering, Engineering, and Quality Engineering. Considerable overhead support was contributed by Cost Accounting, Purchasing, Facility Planning, and Central Services.

The organization for this project is depicted in Figure 4-7. The required man-hours for this project appear in Chapter 5 (Attachment C) and are summarized below.

DESCRIPTION	MAN-HOURS
Project Investigator	1,441.0
Manufacturing (including Mfg. Eng.)	1,262.3
Engineering (including Qual. Eng.)	77.0
Total	2,780.3

Revised 5-30-86

The Project Master Schedule for this project is shown in Figure 4-8.

Construction on the project began in September 1985 and was completed in early 1986.

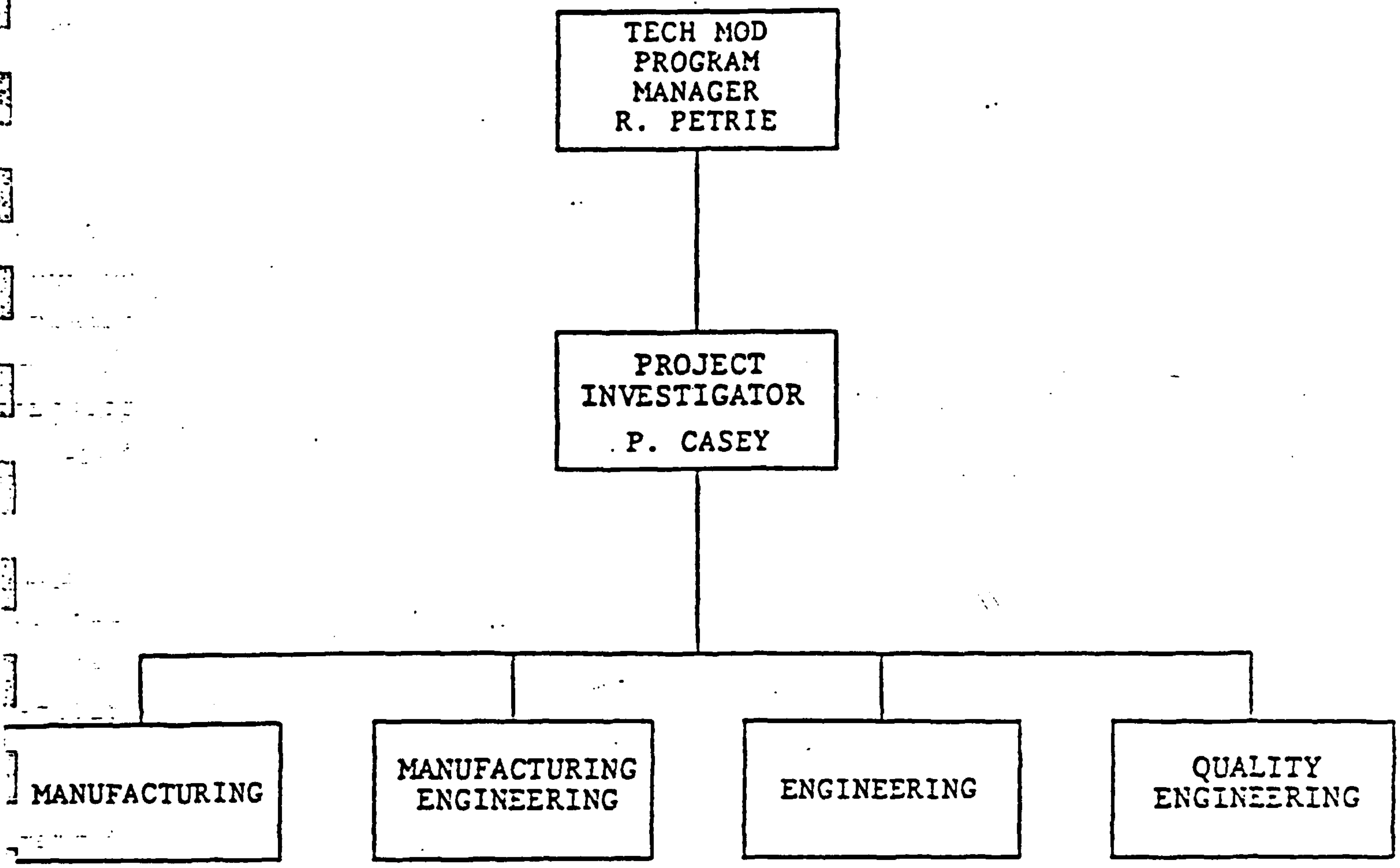


Figure 4-7. ORGANIZATION CHART

Tracor Aerospace

Page 1 of 2

APPROVED BY: RUSS PETRIE

PREPARED BY: PAT CASEY

PROGRAM NO. FINISHING SHOP

ORIG. DATE January 1, 1983

REV. DATE AUG 31, 1985

ITEM	DESCRIPTION	1984 MAY	JUN.	JUL.	AUG	SEPT.	OCT.	NOV.	DEC.	1985 JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEPT.	OCT.
1	I. DEFINE REQUIREMENTS																		
2	A. Write Statement of Work	▲	▲																
3																			
4	B. Hold Kickoff Meeting		▲																
5																			
6	C. Review Production Schedules		▲		▲														
7																			
8	D. Define Performance Requirements		▲		▲														
9																			
10	E. Arrange for "AS IS" Photographs			△							▲								
11																			
12	F. Define Equipment Specifications		▲		▲														
13																			
14																			
15	II. LIST ALTERNATE SOLUTIONS																		
16																			
17	A. Identify Alternate Equipment		▲				▲												
18	on the Market																		
19																			
20	B. Develop Alternate Configuration			▲			▲												
21																			
22	C. Evaluate Alternate				▲		▲												
23	Configurations																		
24																			
25																			
26	III. SELECT BEST ALTERNATIVE AND					▲	▲												
27	PRESENT TO MANAGEMENT FOR FINAL																		
28	DECISION																		
29																			
30																			

△ SCHEDULED

▲ COMPLETED ON SCHEDULE

△ - - - △ SCHEDULE COMPLETION EXPECTED TO SLIP

▲ - - - △ COMPLETED AHEAD OF SCHEDULE

△ - - - ▲ COMPLETED BEHIND SCHEDULE

▲ — △ PROGRESS (IN % COMPLETION)

NOTES

Tracor Aerospace

APPROVED BY: RUSS PETRIE

PREPARED BY: PAT CASEY

PROGRAM NO. FINISHING SHOP

ORIG. DATE JANUARY 1, 1983

REV. DATE AUG. 31, 1985

ITEM	DESCRIPTION	1984 APR–JUNE	1984 JULY–SEP	1984 OCT–DEC	1985 JAN–MAR	1985 APR–JUNE	1985 JULY–SEP	1985 OCT–DEC	1986 JAN–MAR	1986 APR–JUNE
1	IV. PREPARE EQUIPMENT JUSTIFICATION									
2	AND PURCHASE REQUESTS AND									
3	PROCURE EQUIPMENT									
4										
5	V. PREPARE AND IMPLEMENT INSTALLATION									
6	PLAN									
7										
8	A. DEVELOP WORKAROUND PLAN									
9										
10	B. ACCOMPLISH OPERATOR TRAINING									
11										
12	C. ACCOMPLISH INSTALLATION WORK									
13										
14	D. RE-WRITE PRODUCTION WORK ORDER									
15										
16	VI. PREPARE PHASE III PROPOSAL									
17										
18	A. PREPARE PROPOSAL									
19										
20	B. ARRANGE FOR "TO-BE" PHOTOGRAPHS									
21										
22	C. COMPUTE SAVINGS, BY LRU, BY									
23	YEAR									
24										
25	D. DETERMINE INTERNAL RATE OF									
26	RETURN									
27										
28	VII. SUBMIT PROPOSAL									
29										
30										

△ SCHEDULED

▲ COMPLETED ON SCHEDULE

△ - - △ SCHEDULE COMPLETION EXPECTED TO SLIP

△ COMPLETED AHEAD OF SCHEDULE

△ COMPLETED BEHIND SCHEDULE

▲ PROGRESS (IN % COMPLETION)

NOTES

5.0 COST

See Attachment C.

6.0 ESTIMATED SAVINGS

The methodology used in the calculation of savings involved the use of "sampling" at two levels. First, 12 major routing patterns were selected as a sample to represent the total of all 146 routing patterns. Next a sample of at least 5 part numbers was selected from each of those routing patterns to represent all the part numbers in the routing pattern. These 2 levels of sampling, combined with the use of "predetermined times" for the "AS-IS" and "TO-BE" methods, formed the basis for the savings calculations.

6.1 The Primary Routing Patterns

Figure 6-1 shows the 12 routing patterns (parts families) that were selected to represent the 146 total routing patterns, along with the number of part numbers they contain. As can be seen, the 12 primary routing patterns contain 81.5% of the 1665 total part numbers that go through the Finishing Shop and account for 66.5% of planned production during the last half of 1986. The 12 primary routing patterns are thus considered a representative sample since the remaining 134 routing patterns contain only 18.5% of the part number population.

It was felt that if the savings could be calculated for these 12 parts families it would be a major step towards calculation of overall savings. However, the percentage of direct labor hours saved in the different parts families would undoubtedly be different, because each routing pattern involves different work centers, or processing, in the shop. But the percentage of hours saved, once determined for a given routing pattern, would probably be the same for all part numbers in that routing pattern. That was the assumption that was made.

ROUTING PATTERN	ROUTING	NO. OF PART NUMBERS	% OF ALL PART NUMBERS	PROD. QTY 7-1-86 TO 12-31-86	% OF PROD. QTY
14	ID only	152	9.1	14,620	4.8
23	Label only	38	2.3	844	0.2
25	Paint/ID	15	0.9	317	0.1
36	Passivate/ID	119	7.1	50,362	16.6
43	Anodize/ID	83	5.0	6,865	2.3
55	Chem Film/ID	685	41.1	108,986	36.0
59	Chem Film/Silk-screen/ID	23	1.4	1,180	0.4
64	Chem Film/Paint/ID	45	2.7	1,074	0.4
79	Chem Film/Mask/Paint/ID	51	3.1	1,337	0.4
82	Chem Film/Mask/Paint/Silkscreen/ID	26	1.6	1,717	0.6
94	Chem Film only	42	2.5	11,862	3.9
146	Process Label Array	78	4.7	2,070	0.7
SUBTOTAL		1,357	81.5%	201,234	66.5%
Other RP's		308	18.5%	101,283	33.5%
TOTAL 146		1,665	100.0%	302,517	100.0%

Figure 6-1. PRIMARY ROUTING PATTERNS

6.2 Percentage of Hours Saved

If the new equipment were already installed and the rearrangements complete it would be a simple matter to compare actuals "before" and actuals "after," as was done in the Machine Shop Project. Since this was not the case in the Finishing Shop, another method was required. The method selected is called "predetermined times." It is a system of elemental times for basic body motions such as get, place, walk, turn, transport, etc. These motions are further broken down. For example "place" could be any of 1 of 6 actions

		Minutes per 100
1.	Drop Release	.07
2.	Full Release	.14
3.	Down & Release	.44
4.	Pre-position, Down & Release	.63
5.	Straighten, Down & Release	.74
6.	Pre-position, Straighten, Down & Release	.93

The times, in minutes per 100 parts, are Motion Time Standards (M.T.S.) taken from lengthy time studies recorded with a variety of operators on different manufacturing jobs under varying conditions. M.T.S. was developed by General Electric.

To use the M.T.S. predetermined times, a task must be broken down into its elements. For each task in the Finishing Shop, the individual work elements had to be established, first using "AS-IS" methods, equipment, and layout, and then, once more, using the "TO-BE" methods, equipment and layout. The distances between individual work centers "before" and "after" would have to be factored in also, otherwise the savings in travel time would not be reflected.

Figure 6-2 below shows the process times arrived at for the different tasks, "AS-IS" and "TO-BE." Figure 6-3 shows the travel distances and travel times between the different work centers, "AS-IS" and "TO-BE," based on the standard M.T.S. 30-inch pace.

Task	"AS-IS" Min/Part	"TO-BE" Min/Part
Chem Film	*2.4620	1.2877
Anodize	4.1577	1.9552
Passivation	2.4201	2.4201
Paint	9.2881	7.6218
Silkscreen	2.5924	2.5924
ID	0.6481	0.6481
Label	1.5618	1.5618
Mask	0.8648	0.8648
Process Label	0.7469	0.7469

* Actual time charges Feb 84 through Oct 84 show 2.96 minutes per part based on 4648 parts chem-filmed in 13,782 minutes. The difference between 2.4620 and 2.96 would be explained by personal, fatigue, and delay (PF&D) as well as other direct labor (ODL).

Figure 6-2. "AS-IS" AND "TO-BE" PROCESS TIMES

FROM	TO	AS-IS DISTANCE FEET	TRAVEL TIME MIN/PART	TO-BE DISTANCE FEET	TRAVEL TIME MIN/PART	DIFFERENCE IN FEET
Staging	ID/Silkscreen	28'	.1490	28'	.1490	-0-
Staging	Chem Fin	52'	.2286	18'	.1158	34'
Staging	Mask	84'	.3349	28'	.1490	56'
Staging	Paint	66'	.2750	38'	.1822	28'
Paint	Unmask	99'	.3847	12'	.0958	87'
Mask/Unmask	ID/Silkscreen	78'	.3149	54'	.2353	24'
Mask	Paint	99	.3847	12'	.0958	87'
Chem Fin	ID/Silkscreen	64'	.2689	46'	.2087	18'
Chem Fin	Mask	56'	.2419	32'	.1622	24'
Chem Fin	Paint	67'	.2784	44'	.2021	23'
Paint	ID/Silkscreen	77'	.3116	64'	.2685	13'
Paint	Bondo	99'	.3847	-0-	-0-	99'
Bondo	Sand	27'	.1490	42'	.1955	15'
Sand	Paint	126'	.5402	42'	.1955	84'
ID/Silkscreen	Outstage	60'	.2252	34'	.1689	26'
Chem Film	Outstage	84'	.3349	40'	.1888	44'

Figure 6-3. TRAVEL DISTANCES AND TIMES

The percent savings for each of the 12 primary routing patterns can be rolled up by adding the process times and travel times. The percentage savings for Routing Pattern 82, for example, is 21.2% calculated as shown in Figure 6-4 below.

	PRESENT "AS-IS" MIN. PER PART PREDETERMINED TIMES	FUTURE "TO-BE" MIN. PER PART PREDETERMINED TIMES
Travel	0.2286*	0.1158*
Chem Film	2.4620	1.2877
Travel	0.2419	0.1622
Mask	0.8648	0.8648
Travel	0.3847	0.0958
Paint	9.2881	7.6218
Travel	0.6996	0.3311
Silkscreen	2.5924	2.5924
No Travel	-	-
ID	0.6481	0.6481
Travel	0.2252	0.1689
	17.6354	13.8886

Difference = 3.7468 min.

$$\text{Savings} = \frac{3.7468}{17.6354} \times 100 = 21.2\% \;**$$

*NOTE: See Figure 6-3 for Staging to Chem Fin travel time
**NOTE: Used in Figure 6-5, page 89

Figure 6-4. PERCENT SAVINGS CALCULATION
ROUTING PATTERN 82

Revised 5-30-86

In the same manner the percent savings was calculated for each of the other 11 primary routing patterns. They are shown in Figure 6-5. The percent savings for "all other" routing patterns was 25.69%, arrived at by taking a weighted average of the 1986 PWO hours and percent savings in each of the 12 primary routing patterns.

Predetermined times were not developed for those work centers/operations where no touch labor savings were to be realized. Those operations included masking, silkscreening, labeling, and identification. All of these operations were moved in the rearrangement, but the individual processes were not changed at all. For that reason, it was possible to use an average time per part from past actuals for both "before" and "after." (See Figure 6-2.) The travel distances into and out of these jobs did change, and that was taken into account in computing "AS-IS" and "TO-BE" times for the routing patterns.

6.3 Production Hours per Year

In order to use the percent savings figures summarized in Figure 6-5, and project future savings in the 12 different routing patterns, it would be necessary to have some idea of the hours that would be expended in the Finishing Shop if no Finishing Shop improvements were made at all. Multiplying those hours to be expended in each routing pattern by the percent savings would then yield the hours saved in each routing pattern.

Based on the LRU build schedule for July-Dec 1986, and using the established setup and run times for parts in the Finishing Shop being built for those LRU's, the total production hours (PWO hours) could be calculated for each of the 12 major routing patterns. For example:

ROUTING PATTERN	DESCRIPTION	PRESENT "AS-IS" MIN. PER PART PREDETERMINED TIMES	FUTURE "TO-BE" MIN. PER PART PREDETERMINED TIMES	SAVINGS MIN. PER PART	PERCENT SAVINGS
14	ID only	1.0223	.9660	.0563	5.5%
23	Label only	1.9360	1.8797	.0563	2.9%
25	Paint/ID	10.7480	8.8895	1.8585	17.3%
36	Passivate/ID	3.7909	3.5616	.2293	6.0%
43	Anodize/ID	5.5285	3.0967	2.4318	44.0%
55	Chem Film/ ID	3.8328	2.4292	1.4036	36.6%
59	Chem Film/Silk-screen/ID	6.4252	5.0216	1.4036	21.8%
64	Chem Film/Paint/ID	13.4420	10.3129	3.1291	23.3%
79	Chem Film/Mask/Paint/ID	15.0430	11.2962	3.7468	24.9%
82	Chem Film/Mask/Paint/Silk-screen/ID	17.6354	13.8886	3.7468	21.2% *
94	Chem Film only	3.0255	1.5923	1.4332	47.4%
146	Process Label Array	1.1211	1.0648	0.0563	5.0%
Other	---	---	---	---	25.69%

* See page 87 for explanation.

Figure 6-5. PERCENT SAVINGS FOR PRIMARY ROUTING PATTERNS

Routing Pattern:	82
Description:	CF/Mask/Paint/Silkscreen/ID
Prod. Qty 7-1-86 to 12-31-86	1717 parts
Total PWO Hours:	350.3 hours
Percent Savings:	21.2%
Hours Saved	74.3 hours

The 74.3 hours to be saved in Routing Pattern 82 during the last half of 1986 would only be as accurate as the PWO hours shown (350.3). The accuracy of the PWO hours, and the underlying PWO setup and run times, all of which were established by manufacturing engineers at the time the parts were first put into production, could not necessarily be assumed. Some effort would have to be made to establish, from past history, a ratio of "actual hours charged" to "PWO hours", for each routing pattern. This ratio, sometimes called "realization factor," could then be applied to convert PWO hours to "expected actual hours" for each routing pattern.

6.4 Realization Factors

A sample size of 5 to 24 different part numbers was selected from each of the 12 major parts families. Actual time charges from past production runs were obtained from accounting records for each of the part numbers. In most cases, 3 to 5 PWO's (production runs) were recorded during the past 18-24 months for each part number. Figure 6-6 shows the realization factors for the 12 primary routing patterns and for "all other" routing patterns. The realization factors vary from 0.395 to 1.516, averaging out at .933 for the entire shop. This variability in realization factors made it all the more important to apply it to the savings calculations, to ensure some degree of accuracy.

ROUTING PATTERN NO.	NO. OF PARTS IN ROUTING PATTERN	SAMPLE SIZE	18 MOS. PWO HRS	18 MOS. ACTUAL HRS	"REALIZATION FACTOR" RATIO OF ACTUAL HRS TO PWO HRS
14	152	7	132.2	87.0	.658
23	38	9	39.7	27.5	.692
25	15	5	129.1	167.7	1.290
36	119	18	388.0	274.6	.708
43	83	8	206.2	196.0	.950
55	685	24	1110.8	875.5	.788
59	23	5	286.3	179.4	.627
64	45	6	493.3	477.3	.967
79	51	7	213.2	254.4	1.193
82	26	7	522.1	791.8	1.516
94	42	5	53.5	48.4	.903
146	78	5	54.3	21.5	.395
Other	308	11	339.9	303.7	.893
TOTAL 146	1665	117	3969.3	3704.8	.933

Figure 6-6. REALIZATION FACTORS FOR ROUTING PATTERNS

6.5 Touch Labor Savings Per Part Number

Expected touch labor savings for each of the 1665 part numbers that go through the Finishing Shop can now be calculated by combining PWO hours, Realization Factors, and Percentage of Hours Saved for each part. For example:

PN: 144601-0001 Shell Assembly Antenna
Routine Pattern: 25
Work Center Routing: 471200 Paint
471400 ID
Total Set-up time: 1.8 hrs. (Incl. Paint & ID)
Total Run time: 0.074 hrs/part (Incl. Paint & ID)
Lot quantity: 200 (for calculation purposes)
PWO Hrs: (200) times (0.074) plus (1.8) = 16.6 hrs.
PWO Hrs per part: (16.6) divided by (200) = 0.083 hrs/part
Realization Factor for Routing Pattern 25: 1.290 (Fig. 6-6)
Expected actual hours: (1.290) times (0.083)= 0.107 hrs/part
Expected savings for Routing Pattern 25: 17.29% (Fig. 6-5)
Expected savings per part: (.1729) times (0.107) = 0.0185 hrs/part

In this same manner the expected savings can be calculated for each part number in each routing pattern. These calculations were performed by the computer program referred to earlier in Section 3.2 A file was thus established in the computer showing 1665 part numbers and the expected hours saved per part for each part number. The next step would be to determine the touch labor savings for each LRU that Tracor delivers to its customers.

6.6 Touch Labor Savings Per LRU

A list was established of every "deliverable" LRU that Tracor has ever shipped or plans to ship to its customers. This list contains 2148 Tracor part numbers and was derived from a Mapper Program in the Contracts Division and the Customer Order Book in Operations Services. The list contains LRU's (Line Replaceable Units), SRU's (Shop Replaceable Units), Spares, Minor Orders, Circuit Card Assemblies, Test Sets, etc.

Existing computer software developed for the Machine Shop Tech Mod Project in 1984 could then be used to determine touch labor savings on each of the 2148 "deliverable" part numbers. The computer looked at the Bill of Materials (BOM) for each "deliverable" part number, compared it to the list of 1665 finishing shop part numbers and printed out the results. This portion of the software is called the "Seek" program. The printout shows each "deliverable" part number, the finishing shop part numbers it contains, the quantity of these part numbers, and the total hours saved. The next step would be to determine how many of each "deliverable" part number Tracor expects to produce during the seven years following project implementation.

6.7 Instant Build Schedules

Instant, or Firm-Planned, Build Schedules were extracted by computer software from the Customer Order Book in Operations Services, Manufacturing Division, in October 1985. The Customer Order Book is the official record of Tracor Aerospace Austin's delivery schedule and drives all manufacturing activities. It is kept meticulously up-to-date by technicians based on inputs from Contracts Division through and in conjunction with, the respective Program Managers. The Instant Build Schedule contains "deliverable" part numbers, project numbers, quantities, and dates. Since the project number refers to the customer, it was a simple matter to divide up the project numbers into one of four customer categories:

1 - F-16 (General Dynamics, Ft. Worth)
2 - USAF
3 - DoD (other than USAF)
4 - Commercial

This was done, and the result was an Instant Build Schedule for all four customer categories showing "deliverable" part numbers, quantities, and years (1986-1993). Deliveries prior to July 1, 1986 had to be eliminated from the Instant Build Schedules because parts finished in the "improved" Finishing Shop in March 1986 would not be contained in finished units, ready for shipment, until July 1986. This results from the standard Tracor month-to-month manufacturing sequence which calls for February-Fabrication, March-Finish, April-PCB, May-Assembly, June-Test, and July-Ship. Since only half a year's production was contained in 1986 the follow-on Build Schedule would have to extend six month to June 30, 1993.

6.8 Follow-On Build Schedules

Follow-On Build Schedules were extracted from the Business Development Bookings Forecast. The document is updated monthly by the Business Development Division, based on inputs from the program managers. It contains system identifiers, delivery dates, customer information, etc. For Tech Mod's purposes a separate file was sent up to tie the system identifiers to existing LRU's, where possible. Where this was not possible, the system identifiers were sometimes tied to "representative" LRUs, i.e., an LRU that would be roughly equivalent in terms of the manufacturing resources required. In some cases the bookings forecast could not be defined in terms of manufacturing hours required.

The Bookings Forecast as presently structured has four customer codes. They are:

C - Commercial	- Non-military domestic sales
G - Government	- U.S. Government sales where the intended use is the U.S. Government
F - Foreign	- Foreign Military Sales (FMS). Sales initiated through a U.S. Government procurement activity where the intended use is a foreign government
I - International	- Direct foreign sales of any product

By combining the Government (G) and Foreign (F) categories a build schedule entitled "Government" was created; by combining the Commercial (C) and International (I) categories a build schedule entitled "Commercial" was created.

The computer was programmed to look at all bookings, determine the LRU's (based on the system identifier) and multiply the probability of capture by the gross quantities shown. It then printed out the build schedules showing the LRU's and the year in which they would be built.

The follow-on savings in this project are not broken down into F-16, USAF, DoD and Commercial which was the breakout used on the Instant Savings. Since they are a direct reflection of the follow-on build schedules, the follow-on savings are broken down into only two customer categories: Government and Commercial. Please note that the savings to be realized by the F-16 SPO, though not broken out separately, are definitely included in the "Government" follow-on savings. Tracor contracts with WRALC include hardware that is shipped directly to General Dynamics, Fort Worth Division, and the quantities are not known until the contracts are negotiated and signed.

6.9 Direct Labor Savings

The computer program had all the inputs necessary to calculate expected Direct Labor Savings on the Finishing Shop Project. The software is represented schematically in Figure 6-7.

The Touch Labor Savings described in Section 6-5 were rolled up into Savings Per LRU as described in Section 6-6. These figures were then multiplied by the Instant and Follow-on Build Schedules described in Sections 6-7 and 6-8. The result was four listings of Instant Savings, by LRU, and by year -- one each for F-16, USAF, DoD, and Commercial. Also produced were two listings of Follow-on Savings, by LRU, and by year -- one for Government and one for Commercial.

The results are shown in Figure 6-8, which is a complete listing of expected direct labor savings on the project. These figures were fed directly into the IRR model, along with other parameters, to determine dollar savings.

A comparison of the Instant Savings in Figure 6-8 with the Nov. 85 Instant Savings shows only one change which was brought about by a reduction in hardware to be delivered to WRALC in 1989. As shown, the hours saved that year decreased from 313 hours to 139 hours.

The level of Follow-on Savings shown in Figure 6-8 differs somewhat from the Follow-on Savings shown in the original proposal. There are two reasons for this. First, the method used to acquire the follow-on build numbers changed from a manual exercise using the Resource Plan, to a program interface with the Bookings Forcast, which should be more accurate; second, much of the follow-on savings in the 1990-1993 timeframe were extrapolated from 1989 in the original proposal, which tended to

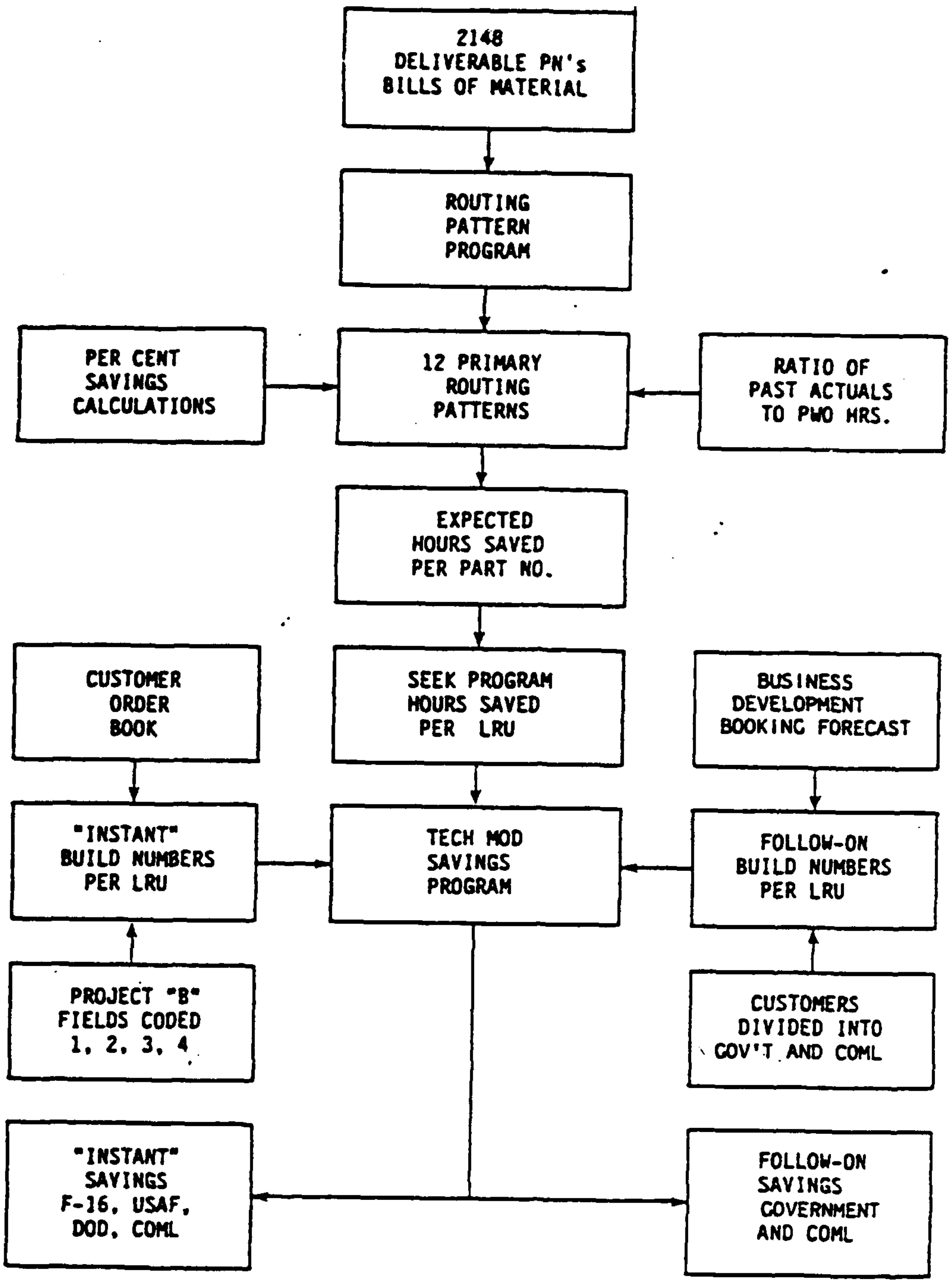


Figure 6-7. SCHEMATIC FLOW DIAGRAM OF COMPUTER-CALCULATED DIRECT HOUR SAVINGS

	1986	1987	1988	1989	1990	1991	1992	1993	TOTALS
Instant									
F-16	31	186	6						223
USAF	1432	1134	732	139					3437
DoD	37	445	288						770
COML	315	153	2						470
Sub-Total	1815	1918	1028	139					4900
Follow-On									
Gov't	385	1037	2843	2762	1477	439	151	17	9111
COML	51	318	412	487	342	297	167	20	2094
Sub-Total	436	1355	3255	3249	1819	736	318	37	11,205
GRAND TOTAL	2251	3273	4283	3388	1819	736	318	37	16,105

Figure 6-8. DIVISION OF LABOR SAVINGS (IN HOURS) INTO INSTANT AND FOLLOW-ON CUSTOMER CATEGORIES

inflate the totals. Suffice it to say that the reader could safely presume somewhat higher Follow-on Savings in the 1990-1993 timeframe than is shown in Figure 6-8, resulting from business opportunities not clearly defined at this time, but which will certainly materialize in the months and years immediately ahead.

6.10 Direct Material Savings

The use of electrostatic spray equipment on metallic parts is advertised by the manufacturers to save 30-35% in paint usage. This savings comes about because the paint molecules, being positively charged, are drawn to the metal object being painted, which is grounded, or negatively charged. This "wraparound" effect will cover edges to be painted without moving the gun over to paint the edge separately. The paint saved would normally be blown past the object and deposited in the exhaust filters.

Since 20% of Tracor's hardware to be painted is non-metallic fiberglass "blocks," the 30-35% paint savings was reduced to 25% for the calculations.

Material control records show a past annual consumption of 300 gallons of paint a year in the Paint Shop, costing approximately $30 a gallon. Annual savings would therefore be projected at 25% or 75 gallons a year, which results in $2250 of material savings for a full year's production schedule. The $2250 was established as the proper direct material savings for the base period, a full year of production in the improved shop. Savings for the different years (1986-1993) and for the customer categories (F-16, USAF, DoD and Commercial) are shown in Figure 6-9, and were established proportionate to the direct labor savings in Figure 6-8. An adjustment was made for inflation, but other adjustments were

	1986	1987	1988	1989	1990	1991	1992	1993	TOTALS
Instant									
F-16	17	103	3						123
USAF	772	627	416	81					1896
DoD	20	246	163						429
COML	170	85	1						256
Total Mat'ls	979	1061	583	81					2704
Follow-On									
Gov't	208	556	1613	1608	882	269	95	11	5242
COML	27	171	234	283	204	182	105	13	1219
Total Mat'ls	235	727	1847	1891	1086	451	200	24	6,461
GRAND TOTAL	$1214	$1788	$2430	$1972	$1086	$451	$200	$ 24	$ 9,165

NOTE: Figures reflect the $2250 base year savings adjusted for inflation. Other adjustments (i.e., overhead, fee, and cost of money) are made by the IRR model.

Figure 6-9. DIVISION OF MATERIAL SAVINGS IN DOLLARS INTO INSTANT AND FOLLOW-ON CUSTOMER CATEGORIES included in the IRR model (see Volume II).

6.11 Total Direct Savings

The total estimated savings from the project would be the total of the direct labor and direct materials; this computation was performed by the IRR model, taking into account the approximate shop rates, cost of money, etc. (see Volume II).

6.12 Verification of Savings

Just as the piece-part savings estimates form the basis for the total savings across LRU's and customer categories, it will be the verification of piece part savings that will serve to verify the overall savings. The reason for this is that the 1665 individual part numbers that flow through the Finishing Shop are used in various quantities in Tracor's production LRU's. The LRU's, in turn, are sold to customers in all four customer categories. To try to isolate Finishing Shop savings at the LRU level would require that "all other things remained equal" for that LRU during an 18-24 month period, which would be a difficult requirement to meet and, at best, a questionable assumption to make. "All other things" will not remain equal at the LRU level.

The real evidence of a project's success in terms of savings realization should be at the piece part level. What was the time per part before the project went in and what was it afterwards? What was the annual paint consumption before versus what it was afterwards? A data base of actual hours charged per part before project implementation can easily be obtained from Tracor's TMCS system. The hours charged per part before project implementation will be compared to hours charged per part 12-15 months later in order to verify savings.

The past 18 months' actuals used to determine the realization factor (ratio of actual hours charged to PWO hours allowed) also constitute a "baseline" prior to Tech Mod improvements. A total of 117 different part numbers taken from all 12 major routing patterns and other miscellaneous part numbers were used. Each part number was represented by 2-5 different production lots completed between April 1982 and October 1984, a 30-month period. Actual time charges for each part number were averaged to get a "baseline" hours per part for all 117 part numbers, as well as for the 12 primary routing patterns.

Assuming these 117 part numbers are still in production 12-18 months after the project is implemented, data on actuals will be taken and compared with this baseline. A second sampling of data would be recommended at a point 24-30 months following project implementation in order to obtain a 30-month "window," similar to the 30-month data base used "before" implementation.

7.0 IMPACT OF PROJECT SAVINGS ON FUTURE PROPOSALS

Beginning 1 Nov 85 all proposals that left Tracor included a slight price reduction as a result of Tech Mod improvements in the Finishing Shop. Although these improvements were physically put in place during the Fall of 1985, and the shop was up and running under the new setup on 1 March 86, the parts coming through the improved shop will not show up in LRU's to be shipped until July 1986. This is due to the normal scheduling of parts through the sequence of Fab-Finish-PCB-Assembly-Test-Ship.

For the purpose of proposals, Tracor has eliminated any possibility of submitting old labor and material estimates on parts that are knowingly being produced in the "improved" Finishing Shop. This section explains the procedures being used in properly pricing proposals that contain Finishing Shop parts.

During the first five months of operation in the modernized Finishing Shop (Mar 86 - Jul 86), all 1665 part numbers that are currently going through the Finishing Shop will be processed through the shop once. This is based on the average length of time between PWO runs on a variety of Finishing Shop part numbers from past records. Some part numbers are run weekly or monthly; some part numbers are run only once or twice a year, but the average, based on 331 PWO runs in 1348 months, is once every five months. It will take a second five-month period (Aug - Dec 86) for two lots of all part numbers to get through the shop, another five months for three lots, etc. It is assumed that it will take five five-month periods, or 25 months (1 Mar 86 - 31 Mar 88), before the average Finishing Shop part number will have been through the Finishing Shop five times, for five "new" actuals.

Normally, Tracor bases its proposals on the average labor and materials cost on the last five runs of each part number that goes into an LRU. Tracor will continue to roll-up manufacturing bids based on the last five actuals, but will make an adjustment <u>at the LRU level</u> to take into account the savings expected in the Finishing Shop. The adjustment will depend upon when the data on the last five runs is gathered.

The following explains how the adjustment is being and will be made during the March 1986 - March 1988 time frame:

1 Nov 85 - 28 Feb 86

During this period all five manufacturing lots were "old" touch labor actuals, recorded in the "unimproved" Finishing Shop. For a proposal being prepared during this period with contractual delivery in July 1986 or later, each LRU was adjusted downward by an amount equal to 100% of the expected Finishing Shop savings for the LRU. The savings data was identified by LRU and was provided to our Proposals people concurrently with the submittal of this proposal in November 1985. (see Section 6-6)

1 Mar 86 - 31 Jul 86

The proposals prepared during this period are based on four "old" lots and one "new" lot. We cannot deduct the full savings from manufacturing estimates on each LRU because the figures already reflect some improvement based on the <u>one</u> new lot. Therefore, 80% of the full LRU savings will be deducted from the manufacturing estimates during this time period.

1 Aug 86 - 31 Dec 86

Since the manufacturing actuals will now show three "old" lots and two "new" lots, 60% of the full LRU savings will be deducted from manufacturing estimates for each LRU during this period.

1 Jan 87 - 31 May 87

The manufacturing actuals during this period will now contain two "old" lots and three "new" lots. Forty percent of the full LRU savings will be deducted from each LRU during this period.

1 June 87 - 31 Oct 87

Actuals now contain just one "old" lot and four "new" lots. Deduct 20% of full LRU savings during this period.

1 Nov 87 - 31 Mar 88 and after

After 1 Nov 1987 all five manufacturing lots are assumed to be "new" actuals, recorded in the "improved" Finishing Shop. Since the data fully reflects the full savings, there is no longer any adjustment required at the LRU level.

As accounting data is generated on actual hours per part following implementation of the Finishing Shop project, savings data will be compared to expectations. Depending on whether savings are higher or lower than expected, there may have to be some revisions made to the systematic procedures and percentage adjustments outlined above.

Figure 7-1 shows some typical Tracor LRU's and the expected savings on each. It also shows the direct labor hours to be deducted from each LRU by the Manufacturing Proposals Section, depending on the time period when the last five actuals are gathered.

SAMPLE OF FINISHING SHOP SAVINGS

LRU/SRU #	DESCRIPTION	NO. OF PARTS	1 Nov 85–28 Feb 86 (100%)	1 Mar 86–31 Jul 86 (80%)	1 Aug 86 – 31 Dec 86 (60%)	1 Jan 87–31 May 87 (40%)	1 June 87–31 Oct 87 (20%)
141900-0001	TRIT	169	1.3129	1.05024	0.7877	0.5251	0.2626
151800-0001	MUTT	24	0.2945	0.2356	0.1767	0.1178	0.0589
132400-0002	AFSAT	86	0.8168	0.6534	0.4901	0.3267	0.1634
132500-0002	AFSAT	34	0.7362	0.5890	0.4417	0.2945	0.1472
141625-0002	FRCT TCM	18	0.1046	0.0837	0.0628	0.0418	0.0209
141987-0001	Omega Ant T.D.	9	0.1078	0.0862	0.0647	0.0431	0.0216
156476-0003	Bookcase PLD	103	1.6686	1.3349	1.0012	0.6674	0.3337
1951-1-4027-1	QF Contr Ind.	27	0.2866	0.2293	0.1720	0.1146	0.0573
135603-0201	CM Test Set	15	0.2979	0.2383	0.1787	0.1192	0.0596
133800-0001	Prog	13	0.1721	0.1377	0.1033	0.0688	0.0344
133800-0002	Prog	21	0.1837	0.1470	0.1102	0.0735	0.0367
134001-0001	Disp	34	0.5476	0.4381	0.3286	0.2190	0.1095
141020-0002	ALE-45 Prog	3	0.0821	0.0657	0.0493	0.0328	0.0164

NOTE: Shows number of direct labor hours to be deducted from each LRU/SRU depending on the time period during which the manufacturing data is bid.

Figure 7-1. SAMPLE OF FINISHING SHOP SAVINGS

VOLUME I

ATTACHMENTS

Tracor Aerospace
Aerospace Austin

FINISHING SHOP IMPROVEMENTS PROJECT
Phase III Proposal
Attachment A - Project Economic Summary

Implementation Date:		March 1986
Man-Hour Savings	Instant F-16	223
	Future F-16	-0-
	Instant Other DoD	4,207
	Future Other DoD	9,111
	TOTAL	13,541
Labor and Material Savings ($ thru fees)	Instant F-16	$ 8,095
	Future F-16	$ -0-
	Instant Other DoD	$ 153,259
	Future Other DoD	$ 351,376
	TOTAL	$ 512,730
Internal Rate of Return: (Before tax in 5th year)		20.0%
Subcontractors Capital Funds:		$ 371,287
Subcontractors Related Funds:		$ 92,718
DoD Funds:		

FINISHING SHOP IMPROVEMENTS PROJECT

Phase III Proposal

Attachment B - Project Cash Flow Summary

See IRR model, Volume II, page 4.

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FINISHING SHOP IMPROVEMENTS PROJECT
Phase III Proposal
Attachment C - Expenditure Summary

Capital Labor	1984	1985	1986
Actuals thru 4/86 (loaded)			
Eng., Avg. Act. Rate, Bid Code 03			
8.0 hours x $14.97 ② x 2.2936 ①		270	
Mfg., Avg. Act. Rate, 05			
2.0 hours x $ 8.02 ② x 2.6194 ①	42		
255.0 hours x $16.08 ② x 2.5764 ①		10,565	
Installation & Training			
Mfg. Eng., Avg. Act. Rate, 05			
105.0 hours x $18.32 ② x 2.43 ①			4,674
Finishing Shop Touch,			
Avg. Act. Rate, 05			
65.0 hours x $7.86 ② x 2.43 ①			1,241
Build Paint Booth Components			
Machine Shop Touch,			
Avg. Act. Rate, 05			
30.0 hours x $10.70 ② x 2.43 ①			780
Tool Touch, Avg. Act. Rate			
1.8 hours x $8.89 ② x 2.43 ①			39
Weld Touch, Avg. Act. Rate, 05			
21.5 hours x $13.53 ② x 2.43 ①			707
TOTAL Capital Labor	$ 42	$ 11,835	$ 7,441

① 1 + Overhead rate from latest revised bid package (thru May 21, 1986).

② Arrived at by taking total dollars for category and dividing by hours.

Tracor Aerospace
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FINISHING SHOP IMPROVEMENTS PROJECT

Phase III Proposal

Attachment C - Expenditure Summary (cont.)

Capital Equipment		1984	1985	1986
Scrubber System	P.O. 702541	$ 15,761		
Conveyor System	P.O. 702542	18,530		
Oven	P.O. 702543	41,249		
Paint Booths	P.O. 702555	17,237		
Spray Guns	P.O. 702582		$ 11,177	
Air Curtain	P.O. 702661		1,260	
Touch-up Booth	P.O. 702662		1,250	
Storage Cabinets	P.O. 702663		1,829	
Hoist	P.O. 702691		49,937	
Drying Tank	P.O. 702868		10,775	
Racks, Paint	P.O. 703010		4,945	
Process Tank	P.O. 702660		21,382	
Rinse Tanks	P.O. 702544		18,725	
Racks, Chemical	P.O. 837297		2,442	
Racks, Proto	P.O. 702972		162	
Racks, Proto	P.O. 702973		370	
Bushman Index Attach.	P.O. 491785		70	
H Attachments	P.O. 493228			$ 104
Pipe	P.R. 109820			22
Bolts	P.R. 109823			9
		$ 92,777	$ 124,324	$ 135
Tax		4,739	7,615	8
Material Handling Overhead		12,053	14,830	15
TOTAL Capital Equipment		$109,569	$ 146,769	$ 158
Capital Other				
Rearrangement & Installation of Equipment (FIR's), & Waste Treatment Equipment (FIR 85-092)			$ 28,463	$160,713
TOTAL CAPITAL (Recovered)		$109,569	$ 175,232	$160,871

Tracor Aerospace
Aerospace Austin

FINISHING SHOP IMPROVEMENTS PROJECT

Phase III Proposal

Attachment C - Expenditure Summary (cont.)

Non-Recovered Expensed Costs	1984	1985	1986
Removal of old structures FIR's (85-092)		$ 8,620	$ 5,597
Actuals for Misc Costs Thru 4/86 (computer, materials, etc.)		5,001	2,613
Actuals Thru 4/86			
Program Support			
Finishing Shop Supv., Avg. Act. Rate, 05 32.0 hours x $13.88 ② x 1.247 ①		554	
Welder, Avg. Act. Rate, 05 2.0 hours x $12.08 ② x 1.263 ①			30
Rewrite of PWO's			
Mfg. Eng., Avg. Act. Rate, 05 163.0 hours x $11.45 ② x 1.247 ① 512.5 x $12.26 ② x 1.263 ①		2,327	
Cat. 2 Labor: Addition of PSI & OH Rate Changes (Loaded)		25,000	25,000
TOTAL Non-Recovered Expensed Costs		$ 41,502	$ 41,174
Recovered Expensed Costs			
Actuals Thru 4/86 (Loaded)			
Project Investigator			
Mfg. Eng., Avg. Act. Rate, 05			
496.0 hours x $15.97 ② x 1.32 ①	10,457		
823.0 hours x $16.81 ② x 1.247 ①		17,256	
122.0 hours x $18.35 ② x 1.263 ①			2,828
Program Support			
Eng., Avg. Act. Rate, 03 69.0 hours x $14.09 ② x 1.32 ①	1,283		
Mfg., Avg. Act. Rate, 05 72.5 hours x $14.60 ② x 1.32 ①	1,397		
TOTAL Recovered Expenses Costs	$ 13,137	$ 17,256	$ 2,828

① 1 + fringe overhead rate (32% '84, 24.7% '85, 26.3% '86)

② Arrived at by taking total dollars for category and dividing by hours

Revised 5-30-86

Tracor Aerospace
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FINISHING SHOP IMPROVEMENTS PROJECT
Phase III Proposal
Attachment D - Project Assumptions

No unexpected assumptions were made during the course of this project investigation.

FINISHING SHOP IMPROVEMENTS PROJECT
Phase III Proposal
Attachment E - Visual Summary of Current
& Proposed Processes

See Sections 2.0 and 3.0 for Current Processes.

See Section 4.0 for Proposed Processes.

FINISHING SHOP IMPROVEMENTS PROJECT
Phase III Proposal
Attachment F - IRR Computations

See IRR model, Volume II, page 4.

FINISHING SHOP IMPROVEMENTS PROJECT

Phase III Proposal

Attachment G - Manufacturing Schedules

The schedules will be provided at fact-finding.

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FINISHING SHOP IMPROVEMENTS PROJECT
Phase III Proposal
Attachment E - Savings Calculations

In Section 6.0 ESTIMATED SAVINGS, labor savings, material savings, and their derivations are shown. Savings shown in IRR Model, Volume II, are loaded in the following manner:

1986 COMPOSITE SHOP RATE

$14.46	Actual Avg. 608
x 9.11	Supervision
$ 1.32	
$ 8.85	Bid pkg. M05
1.32	608 Supervision
$10.17	Composite Hourly Rate w/o PSI
x 1.0246	1 + PSI (midpoint 8/86)
$10.42	Direct composite hourly rate
x 2.41	1 + allowable Mfg. OH rate
$25.10	Rate thru Overhead
x 1.164	1 + allowable G&A rate
$29.22	Rate thru G&A
x 1.15	1+ fee rate
$33.60	Rate thru fee
$10.42	Direct Composite hourly rate
x .14334	Mfg. Cost of Money (COM) rate
$ 1.49	Mfg. COM
$25.10	Rate thru OH
x .00751	G&A COM rate
$ .19	G&A COM (Mfg.)
$35.28	Rate loaded thru fee & COM ($33.60 + $1.49 + $ .19)

NOTES: Rates are from Latest Bid Rate Package Thru 5/21/86.

TOTAL SAVINGS CALCULATION (1986)

31	Instant F-16 hours
1469	Instand Other DoD hours
0	F-0 F-16 hours
385	F-0 Other DoD hours
1885	Hours saved
x$ 35.28	Composite shop rate thru fee & COM
$ 66,510	Labor savings thru fee & COM
$ 1,183	Mat'l savings
x 1.026	1 + Escalation 1985 to 1986
$ 1,214	Mat'l savings w/escalation
x 1.105	1 + allowable MH OH
$ 1,341	Mat'l savings thru OH
x 1.164	1 + G&A rate
$ 1,561	Mat'l savings thru G&A
x 1.15	1 + fee rate
$ 1,795	Mat'l savings thru fee
$ 1,214	Mat'l savings w/escalation
x .00468	Mat'l COM rate
$ 6	Mat'l COM
$ 1,341	Mat'l savings thru OH
x .00751	G&A COM rate
$ 10	Mat'l G&A COM
$ 1,811	Mat'l savings thru fee & COM ($1,795 + $6 + $10)
$ 68,321	TOTAL SAVINGS

VOLUME II

CERTIFICATION OF SAVINGS

STANDARD FORM 1411 (10-83)
(Page 3)

CONTRACT PRICING PROPOSAL COVER SHEET

1. SOLICITATION/CONTRACT/MODIFICATION NO. P. O. 1005205 F

FORM APPROVED OMB NO. 3090-0116

NOTE: This form is used in contract actions if submission of cost or pricing data is required (See FAR 15.804-6(b))

2. NAME AND ADDRESS OF OFFEROR (Include ZIP Code)
Tracor Aerospace Austin, Inc.
6500 Tracor Lane
Austin, Texas 78725

3A. NAME AND TITLE OF OFFEROR'S POINT OF CONTACT
Ralph G. Leigh, Manager,
General Contract, Administrator

3B. TELEPHONE NO.
512 929-2192

4. TYPE OF CONTRACT ACTION (Check)
- [ ] A. NEW CONTRACT
- [ ] B. CHANGE ORDER
- [ ] C. PRICE REVISION/ REDETERMINATION
- [ ] D. LETTER CONTRACT
- [ ] E. UNPRICED ORDER
- [ ] F. OTHER (Specify)

5. TYPE OF CONTRACT (Check)
- [X] FFP
- [ ] CPFF
- [ ] CPIF
- [ ] CPAF
- [ ] FPI
- [ ] OTHER (Specify)

6. PROPOSED COST (A+B=C)

A. COST	B. PROFIT/FEE	C. TOTAL
$ N/A	$ N/A	$ N/A

7. PLACE(S) AND PERIOD(S) OF PERFORMANCE

8. List and reference the identification, quantity and total price proposed for each contract line item. A line item cost breakdown supporting this recap is required unless otherwise specified by the Contracting Officer. (Continue on reverse, and then on plain paper, if necessary. Use same headings.)

A. LINE ITEM NO.	B. IDENTIFICATION	C. QUANTITY	D. TOTAL PRICE	E. REF.
03	Phase 3/Category 1 Finishing Shop Improvements Project			
	Gross Savings		512,731	Vol.II 2.0
	DoD Share of Savings		351,376	Vol.II 2.0
	Subcontractor Productivity Savings Reward (w/ Option 3 Payments)		355,746	Vol.II 2.0

9. PROVIDE NAME, ADDRESS, AND TELEPHONE NUMBER FOR THE FOLLOWING (If available)

A. CONTRACT ADMINISTRATION OFFICE
DCAS Resident Office
Attn: Lloyd Billiter
6500 Tracor Lane
Austin, Texas 78725

B. AUDIT OFFICE
DCAA Regional Office
J. R. Walters, Chief
6500 Tracor Lane
Austin, Texas 78725

10. WILL YOU REQUIRE THE USE OF ANY GOVERNMENT PROPERTY IN THE PERFORMANCE OF THIS WORK? (If "Yes," identify)
- [ ] YES
- [X] NO

11A. DO YOU REQUIRE GOVERNMENT CONTRACT FINANCING TO PERFORM THIS PROPOSED CONTRACT? (If "Yes," complete Item 11B)
- [ ] YES
- [X] NO

11B. TYPE OF FINANCING (✓ one)
- [ ] ADVANCE PAYMENTS
- [ ] PROGRESS PAYMENTS
- [ ] GUARANTEED LOANS

12. HAVE YOU BEEN AWARDED ANY CONTRACTS OR SUBCONTRACTS FOR THE SAME OR SIMILAR ITEMS WITHIN THE PAST 3 YEARS? (If "Yes," identify item(s), customer(s) and contract number(s))
- [X] YES
- [ ] NO

Block Fabrication Improvements
Machine Shop Improvements

13. IS THIS PROPOSAL CONSISTENT WITH YOUR ESTABLISHED ESTIMATING AND ACCOUNTING PRACTICES AND PROCEDURES AND FAR PART 31 COST PRINCIPLES? (If "No," explain)
- [X] YES
- [ ] NO

14. COST ACCOUNTING STANDARDS BOARD (CASB) DATA (Public Law 91-379 as amended and FAR PART 30)

A. WILL THIS CONTRACT ACTION BE SUBJECT TO CASB REGULATIONS? (If "No," explain in proposal)
- [X] YES
- [ ] NO

B. HAVE YOU SUBMITTED A CASB DISCLOSURE STATEMENT (CASB DS-1 or 2)? (If "Yes," specify in proposal the office to which submitted and if determined to be adequate)
- [X] YES
- [ ] NO

See Block A

C. HAVE YOU BEEN NOTIFIED THAT YOU ARE OR MAY BE IN NONCOMPLIANCE WITH YOUR DISCLOSURE STATEMENT OR COST ACCOUNTING STANDARDS? (If "Yes," explain in proposal)
- [X] YES
- [ ] NO

D. IS ANY ASPECT OF THIS PROPOSAL INCONSISTENT WITH YOUR DISCLOSED PRACTICES OR APPLICABLE COST ACCOUNTING STANDARDS? (If "Yes," explain in proposal)
- [ ] YES
- [X] NO

This proposal is submitted in response to the RFP contract, modification, etc. in Item 1 and reflects our best estimates and/or actual costs as of this date.

15. NAME AND TITLE (Type)
Ralph G. Leigh, Manager
General Contract Administration

16. NAME OF FIRM
Tracor Aerospace Austin, Inc.

17. SIGNATURE

18. DATE OF SUBMISSION
28 MAY 86

NSN 7540-01-142-9845 1411-101 STANDARD FORM 1411 (10-83) Prescribed by GSA FAR (48 CFR) 53.215-2(c)

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SUPPORTING INFORMATION

IRR MODEL RESULTS
SHOWING

PROPOSED SHARING ARRANGEMENT
(Pages 5 thru 12)

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05/23/86
15:45

INDUSTRIAL MODERNIZATION PROGRAM
INTERNAL RATE OF RETURN MODEL RESULTS
(MODEL IMIRRS USING FINSHP13)

FINISHING SHOP IMPROVEMENTS

	1984	1985	1986	1987
INVESTMENTS				
BUDGETED & RECOVERED CAPITAL				
COST OF CAPITALIZED LABOR	$ 42	$ 11,835	$ 7,441	$ 0
COST OF CAPITALIZED EQUIPMENT(NO TAX,OH)	$ 92,016	$ 124,324	$ 135	$ 0
COST OF CAPITALIZED OTHER (NO TAX)	$ 0	$ 26,820	$ 151,437	$ 0
TOTAL CAPITAL (AFTER % DOD BUSINESS AND WITH SALES TAX AND MIL OH)	$ 86,984	$ 149,653	$ 134,650	$ 0
BUDGETED & RECOVERED EXPENSED COSTS				
TOTAL RECOVERED EXPENSED COST (AFTER % DOD BUSINESS)	$ 10,510	$ 13,805	$ 2,262	$ 0
UNRECOVERED EXPENSE COSTS				
TOTAL NON RECOVERED EXPENSED COST	$ 0	$ 33,202	$ 32,939	$ 0
TOTAL EXPENSED COST	$ 10,510	$ 47,006	$ 35,202	$ 0
TOTAL INVESTMENT	$ 97,493	$ 196,660	$ 169,851	$ 0
TOTAL SAVINGS (NO COMM'L)	$ 0	$ 0	$ 68,054	$ 101,739
DOD SHARE	$ 0	$ 0	$ 13,900	$ 37,653
OPTIONS PAYMENTS	$ 0	$ 0	$ 97,196	$ 97,196
SUBCONT SHARE OF SAVINGS (WITH OPTION 3 PAYMENTS)	$ 0	$ 0	$ 151,349	$ 161,282
DEPRECIATION (TAX)	$ 12,395	$ 39,505	$ 67,816	$ 75,351
COM RECOVERY	$ 5,446	$ 14,049	$ 19,450	$ 20,205
SUB INCOME TAXES	$ (8,030)	$ (33,333)	$ 31,178	$ 48,823
ITC	$ 8,698	$ 14,965	$ 13,465	$ 0
DEPRECIATION	$ 11,184	$ 30,425	$ 47,737	$ 47,737
SUBCONT NET CASH FLOW AFTER TAX	$ 33,360	$ 59,570	$ 167,883	$ 180,401
DISCOUNTED CASH FLOW AFTER TAX	$ (57,196)	$ (143,328)	$ (131,174)	$ (16,525)
SUBCONTRACTOR BEFORE TAX IRR	.00%	.00%	.00%	7.98%
SUBCONTRACTOR AFTER TAX IRR	.00%	.00%	.00%	9.09%

INDUSTRIAL MODERNIZATION PROGRAM
INTERNAL RATE OF RETURN MODEL RESULTS
(MODEL THIRRS USING FINSHP13)

FINISHING SHOP IMPROVEMENTS

	1988	1989	1990	1991
INVESTMENTS				
BUDGETED & RECOVERED CAPITAL				
COST OF CAPITALIZED LABOR	$ 0	$ 0	$ 0	$ 0
COST OF CAPITALIZED EQUIPMENT(NO TAX,OH)	$ 0	$ 0	$ 0	$ 0
COST OF CAPITALIZED OTHER (NO TAX)	$ 0	$ 0	$ 0	$ 0
TOTAL CAPITAL (AFTER % DOD BUSINESS AND WITH SALES TAX AND MIL OH)	$ 0	$ 0	$ 0	$ 0
BUDGETED & RECOVERED EXPENSED COSTS				
TOTAL RECOVERED EXPENSED COST (AFTER % DOD BUSINESS)	$ 0	$ 0	$ 0	$ 0
UNRECOVERED EXPENSE COSTS				
TOTAL NON RECOVERED EXPENSED COST	$ 0	$ 0	$ 0	$ 0
TOTAL EXPENSED COST	$ 0	$ 0	$ 0	$ 0
TOTAL INVESTMENT	$ 0	$ 0	$ 0	$ 0
TOTAL SAVINGS (NO COMM'L)	$ 142,192	$ 112,877	$ 60,887	$ 19,169
DOD SHARE	$ 104,484	$ 107,469	$ 60,887	$ 19,169
OPTIONS PAYMENTS	$ 0	$ 0	$ 0	$ 0
SUBCONT SHARE OF SAVINGS (WITH OPTION 3 PAYMENTS)	$ 37,708	$ 5,407	$ 0	$ 0
DEPRECIATION (TAX)	$ 74,072	$ 56,718	$ 26,863	$ 0
COM RECOVERY	$ 14,421	$ 10,753	$ 6,296	$ 5,845
SUB INCOME TAXES	$ (10,094)	$ (18,657)	$ (8,541)	$ 2,689
ITC	$ 0	$ 0	$ 0	$ 0
DEPRECIATION	$ 47,737	$ 47,737	$ 47,737	$ 36,553
SUBCONT NET CASH FLOW AFTER TAX	$ 109,959	$ 82,554	$ 64,573	$ 39,710
DISCOUNTED CASH FLOW AFTER TAX	$ 45,869	$ 87,693	$ 116,903	$ 132,941
SUBCONTRACTOR BEFORE TAX IRR	15.96%	19.41%	21.58%	22.77%
SUBCONTRACTOR AFTER TAX IRR	18.64%	23.13%	25.49%	26.53%

INDUSTRIAL MODERNIZATION PROGRAM
INTERNAL RATE OF RETURN MODEL RESULTS
(MODEL TMIRRS USING FINSHP13)

FINISHING SHOP IMPROVEMENTS

	1992	1993	TOTAL
INVESTMENTS			
BUDGETED & RECOVERED CAPITAL			
COST OF CAPITALIZED LABOR	$ 0	$ 0	$ 19,318
COST OF CAPITALIZED EQUIPMENT(NO TAX,OH)	$ 0	$ 0	$ 216,475
COST OF CAPITALIZED OTHER (NO TAX)	$ 0	$ 0	$ 178,257
TOTAL CAPITAL (AFTER % DOD BUSINESS AND WITH SALES TAX AND MIL OH)	$ 0	$ 0	$ 371,267
BUDGETED & RECOVERED EXPENSED COSTS			
TOTAL RECOVERED EXPENSED COST (AFTER % DOD BUSINESS)	$ 0	$ 0	$ 26,577
UNRECOVERED EXPENSE COSTS			
TOTAL NON RECOVERED EXPENSED COST	$ 0	$ 0	$ 66,141
TOTAL EXPENSED COST	$ 0	$ 0	$ 92,718
TOTAL INVESTMENT	$ 0	$ 0	$ 464,004
TOTAL SAVINGS (NO COMM'L)	$ 6,980	$ 834	$ 512,731
DOD SHARE	$ 6,980	$ 634	$ 351,376
OPTION3 PAYMENTS	$ 0	$ 0	$ 194,392
SUBCONT SHARE OF SAVINGS (WITH OPTION 3 PAYMENTS)	$ 0	$ 0	$ 355,746
DEPRECIATION (TAX)	$ 0	$ 0	$ 352,722
COM RECOVERY	$ 3,894	$ 3,550	$ 105,911
SUB INCOME TAXES	$ 1,791	$ 1,633	$ 7,460
ITC	$ 0	$ 0	$ 37,129
DEPRECIATION	$ 17,312	$ 0	
SUBCONT NET CASH FLOW AFTER TAX	$ 19,415	$ 1,917	$ 759,343
DISCOUNTED CASH FLOW AFTER TAX	$ 139,942	$ 140,559	$ 140,559
SUBCONTRACTOR BEFORE TAX IRR	23.23%	23.29%	23.29%
SUBCONTRACTOR AFTER TAX IRR	26.90%	26.93%	26.93%

INDUSTRIAL TECHNOLOGY MODERNIZATION PROGRAM
INTERNAL RATE OF RETURN MODEL RESULTS
(MODEL THIRRS USING FINSHP13)

FINISHING SHOP IMPROVEMENTS

	1984	1985	1986	1987
DOD SHARE TOTAL BUSINESS	80.00 %	80.00 %	80.00 %	80.00 %
DOD SHARE OF SAVINGS	100.00 %	100.00 %	100.00 %	100.00 %
INSTANT F16 (COST)	$ 0	$ 0	$ 928	$ 5,628
FOLLOWON F16 (COST)	$ 0	$ 0	$ 0	$ 0
INSTANT OTHER DOD (COST)	$ 0	$ 0	$ 43,959	$ 47,774
FOLLOWON OTHER DOD (COST)	$ 0	$ 0	$ 11,522	$ 31,376
INSTANT F16 (SELL)	$ 0	$ 0	$ 1,119	$ 6,754
FOLLOWON F16 (SELL)	$ 0	$ 0	$ 0	$ 0
INSTANT OTHER DOD (SELL)	$ 0	$ 0	$ 53,034	$ 57,332
FOLLOWON OTHER DOD (SELL)	$ 0	$ 0	$ 13,900	$ 37,653
RECOVERED INDIRECT	$ 10,510	$ 13,605	$ 2,262	$ 0
RECOVERED DEPR (CAS 409)	$ 11,184	$ 30,425	$ 47,737	$ 47,737
UNRECOVERED INDIRECT	$ 0	$ 33,202	$ 32,939	$ 0
DEPRECIATION (TAX)	$ 12,395	$ 39,505	$ 67,218	$ 75,351

INDUSTRIAL TECHNOLOGY MODERNIZATION PROGRAM
INTERNAL RATE OF RETURN MODEL RESULTS
(MODEL IMIRP5 USING FINSHP13)

FINISHING SHOP IMPROVEMENTS

	1988	1989	1990	1991
DOD SHARE TOTAL BUSINESS	80.00 %	80.00 %	80.00 %	80.00 %
DOD SHARE OF SAVINGS	100.00 %	100.00 %	100.00 %	100.00 %
INSTANT F16 (COST)	$ 185	$ 0	$ 0	$ 0
FOLLOWON F16 (COST)	$ 0	$ 0	$ 0	$ 0
INSTANT OTHER DOD (COST)	$ 31,336	$ 4,520	$ 0	$ 0
FOLLOWON OTHER DOD (COST)	$ 87,342	$ 69,835	$ 50,695	$ 16,023
INSTANT F16 (SELL)	$ 222	$ 0	$ 0	$ 0
FOLLOWON F16 (SELL)	$ 0	$ 0	$ 0	$ 0
INSTANT OTHER DOD (SELL)	$ 37,486	$ 5,407	$ 0	$ 0
FOLLOWON OTHER DOD (SELL)	$ 104,484	$ 107,469	$ 60,687	$ 19,169
RECOVERED INDIRECT	$ 0	$ 0	$ 0	$ 0
RECOVERED DEPR (CAS 409)	$ 47,737	$ 47,737	$ 47,737	$ 36,553
UNRECOVERED INDIRECT	$ 0	$ 0	$ 0	$ 0
DEPRECIATION (TAX)	$ 74,072	$ 56,716	$ 26,663	$ 0

INDUSTRIAL TECHNOLOGY MODERNIZATION PROGRAM
INTERNAL RATE OF RETURN MODEL RESULTS
(MODEL THIRR5 USING FINSHP13)

FINISHING SHOP IMPROVEMENTS

		1992		1993		TOTAL
DOD SHARE TOTAL BUSINESS		80.00 %		80.00 %		
DOD SHARE OF SAVINGS		100.00 %		100.00 %		
INSTANT F16 (COST)	$	0	$	0	$	6,741
FOLLOWON F16 (COST)	$	0	$	0	$	0
INSTANT OTHER DOD (COST)	$	0	$	0	$	127,589
FOLLOWON OTHER DOD (COST)	$	5,834	$	697	$	293,525
INSTANT F16 (SELL)	$	0	$	0	$	8,095
FOLLOWON F16 (SELL)	$	0	$	0	$	0
INSTANT OTHER DOD (SELL)	$	0	$	0	$	153,259
FOLLOWON OTHER DOD (SELL)	$	6,980	$	834	$	351,376
RECOVERED INDIRECT	$	0	$	0	$	26,577
RECOVERED DEPR (CAS 409)	$	17,312	$	0	$	334,158
UNRECOVERED INDIRECT	$	0	$	0	$	66,141
DEPRECIATION (TAX)	$	0	$	0	$	352,722

THIS MODEL WAS CREATED TO ANALYZE CAPITAL INVESTMENTS REGUARDING
THE INDUSTRIAL TECHNOLOGY MODERNIZATION PROGRAM (TECH MOD).

YEAR1	1984	1985	1986	1987	1988	1989
DATA ELEMENTS SECTION						
SALES TAX RATE	.0513	.0613	.0613	.0613	.0613	.0613
COST OF CAPITALIZED LABO	42	11935	7441	0	0	0
COST OF CAPITALIZED EQUI	92016	124324	135	0	0	0
COST OF CAPITALIZED OTHE	0	26820	151437	0	0	0
SALES TAX M	4716	7615	6.269	0	0	0
SALES TAX C	0	1643	9276	0	0	0
MATERIAL HANDLING C	11956	14830	15.33	0	0	0
NON RECOVERED CAPITALIZE	0	0	0	0	0	0
RECOVERED EXPENSED COSTS	13137	17256	2828	0	0	0
NONRECOVERED EXPENSED CO	0	41502	41174	0	0	0
MATERIAL COST SAVED	0	0	1214	1768	2430	1972
F SIX INSTANT DIRECT DOL	0	0	323	2035	70	0
F SIX FOLLOW ON DIRECT D	0	0	0	0	0	0
OTHER DOD INSTANT DIRECT	0	0	15307	17274	11632	1708
OTHER DOD FOLLOW ON DIRE	0	0	4012	11345	32979	33945
GOVT INSTANT DIRECT DOLL	0	0	15630	19339	11902	1708
COMMERCIAL DIRECT DOLLAR	0	0	3813	5153	4602	5965
GOVT FOLLOW ON DIRECT DO	0	0	4012	11345	32979	33945
DIRECT VARIABLE LABOR DO	1	1	1	1	1	1
DIRECT FIXED LABOR DOLLA	0	0	0	0	0	0
AVERAGE DIRECT LABOR RAT	1	1	1	1	1	1
MFG RATE	0	0	1.410	1.350	1.280	1.260
ENG RATE	0	0	0	0	0	0
MH RATE	0	0	.1050	.1000	.0920	.0920
MH	.1236	.1124	.1070	0	0	0
MFG COM RATE	0	0	.1433	.1209	.1111	.1111

ENG COM RATE	0	0	0	0	0	0
MM COM RATE	0	0	.0047	.0038	.0031	.0031
GA RATE	0	0	.1640	.1560	.1350	.1350
GA COM RATE	0	0	.0075	.0072	.0048	.0048
EQUIP LIFE SL	7	7	7	7	7	7
FEE RATE	.1500	.1500	.1500	.1500	.1500	.1500
EQUIPMENT LIFE	5	5	5	5	5	5
INSTANT DOD FACTOR	0	0	0	0	0	0
DOD FACTOR	1	1	1	1	1	1
OPTIONS PAYMENTS	0	0	97196	97196	0	0
COM FACTOR	.1437	.1039	.0975	.0975	.0975	.0975
INCOME TAX RATE	.4600	.4600	.4600	.4600	.4600	.4600
ITC RATE	.1000	.1000	.1000	.1000	.1000	.1000
DISCOUNT RATE	.1200	.1200	.1200	.1200	.1200	.1200
PER CENT DOD BUSINESS	.8000	.8000	.8000	.8000	.8000	.8000

**************INVESTMENT**

TOTAL BUDGETED CAPITAL	86984	149653	134650	0	0	0
TOTAL NONRECOVERED CAPIT	0	0	0	0	0	0
TOTAL RECOVERED EXPENSED	10510	13805	2262	0	0	0
TOTAL NON RECOVERED EXPE	0	33202	32939	0	0	0
RECOVERED DEPRECIATION	11194	30425	47737	47737	47737	47737
TOTAL RECOVERED INVESTME	21693	44230	49999	47737	47737	47737
TOTAL NON RECOVERED INVE	75803	152430	119852	-47737	-47737	-47737
TOTAL CAPITAL	86984	149653	134650	0	0	0
TOTAL EXPENSED COST	10510	47006	35202	0	0	0
TOTAL INVESTMENT	97493	196660	169851	0	0	0

*******SAVINGS***

RATIO CALCULATIONS

TOTAL VARIABLE LABOR DIR	0	0	23455	35807	49683	41638
COMMERCIAL RATIO	0	0	.1626	.1439	.0967	.1437
GOVT INSTANT RATIO	0	0	.6664	.5393	.2396	.0410
GOVT FOLLOW ON RATIO	0	0	.1711	.3168	.6633	.8152
F SIX INSTANT RATIO	0	0	.0207	.1054	.0059	0
F SIX FOLLOW ON RATIO	0	0	0	0	0	0
OTHER DOD INSTANT RATIO	0	0	.9793	.8946	.9941	1
OTHER DOD FOLLOW ON RATI	0	0	1	1	1	1

LABOR COST SAVINGS

TOTAL DIRECT LABOR DOLLA	0	0	23455	35807	49683	41638
TOTAL DIRECT SAVED	0	0	23455	35807	49683	41638
LOADED AVERAGE DIRECT LA	1	1	2.805	2.702	2.588	2.568
LOADED DIRECT LABOR SAVE	0	0	65983	101764	134636	112835
COM ON MFG DIRECT LABOR	0	0	3362	4328	5518	4625

MATERIAL COST SAVINGS

LOADED MATERIAL COST SAV	0	0	1577	2263	3032	2461
MAT SAVED	0	0	1214	1768	2430	1972
COM ON MATL COST SAVED	0	0	5.662	6.777	7.533	6.113

COST OF MONEY

GA COM FOR LABOR	0	0	424.5	607.5	548.3	459.5
GA COM FOR MATERIAL	0	0	10.07	14.20	12.84	10.42
TOTAL COST OF MONEY SAVE	0	0	3802	4957	6087	5101
COM ON CAPITAL	5448	14049	23252	25162	20508	15853
COM RECOVERY	5448	14049	19450	20205	14421	10753

SAVINGS BY CUSTOMER

TOTAL DIRECT SAVINGS	0	0	24669	37595	52113	43610
TOTAL COST SAVINGS	0	0	67358	99030	131581	110195
TOTAL OVERHEAD SAVED	0	0	42689	61435	79468	66585
TOTAL SAVINGS TO SELL	0	0	81264	118642	157406	131825
TOTAL FEE	0	0	13906	19811	25024	21630
COMMERCIAL LOADED SAVING	0	0	10950	14251	12718	15839
COMMERCIAL SAVINGS TO SE	0	0	13211	17103	15214	18948
COMMERCIAL GROSS FEE	0	0	2261	2851	2496	3109
GOVT INSTANT LOADED SAVI	0	0	44886	53402	31521	4520
GOVT INSTANT SAVINGS TO	0	0	54153	64066	37708	5407
GOVT INSTANT GROSS FEE	0	0	9267	10663	6186	887.3
GOVT FOLLOW ON LOADED SA	0	0	11522	31376	87342	89835
GOVT FOLLOW ON SAVINGS T	0	0	13900	37653	104484	107469
GOVT FOLLOW ON GROSS FEE	0	0	2379	6277	17142	17634
F SIX INSTANT LOADED SAV	0	0	927.6	5628	185.4	0
F SIX INSTANT SAVINGS TO	0	0	1119	6754	221.8	0
F SIX INSTANT GROSS FEE	0	0	191.5	1126	36.38	0
F SIX FOLLOW ON LOADED S	0	0	0	0	0	0
F SIX FOLLOW ON SAVINGS	0	0	0	0	0	0
F SIX FOLLOW ON GROSS FE	0	0	0	0	0	0
OTHER DOD INSTANT LOADED	0	0	43959	47774	31336	4520
OTHER DOD INSTANT SAVING	0	0	53034	57332	37486	5407
OTHER DOD INSTANT GROSS	0	0	9075	9557	6150	887.3
OTHER DOD FOLLOW ON LOAD	0	0	11522	31376	87342	89835
OTHER DOD FOLLOW ON SAVI	0	0	13900	37653	104484	107469
OTHER DOD FOLLOW ON GROS	0	0	2379	6277	17142	17634

DEPRECIATION

NET DEPRECIABLE COST	62635	142171	127917	0	0	0
ACC DEPRECIATION	12395	39505	67818	75351	74072	56718
BOOK VALUE	70239	172905	233004	157653	83581	26863
CUMULATIVE DEPRECIATION	12395	51900	119719	195070	269141	325860
ACCEL DEPRECIATION	12395	39505	67818	75351	74072	56718
DEPRECIATION	11184	30425	47737	47737	47737	47737
BOOK VAL	75600	195029	261941	234205	166468	136731

CUM DEPRECIATION	11164	41666	69345	137062	164819	232556
DEPP						
BK VALUE						
CUMULATIVE DEPR						
TOTAL SL DEPRECIATION	11164	30425	47737	47737	47737	47737
DEFERRED DEPRECIATION	1212	9080	20082	27614	26335	8982
CAPITAL COM BASE	37900	135414	236485	258073	210336	162559
NBV CAPITAL	0	0	0	C	0	0

****************** SCHEDULE 6

PROD SAVINGS REWARD

INSTANT F SIX	0	0	1119	6754	221.8	C
FOLLOW ON F SIX	0	0	0	0	C	0
INSTANT OTHER DOD	C	0	53034	57332	37486	5407
FOLLOW ON OTHER DOD	0	0	0	0	0	C
PSR TO SELL TOTAL	0	0	151349	161282	37708	5407
DOD SHARE						
DOD SHARE INSTANT F SIX	0	C	0	0	0	0
F SIX DOD SHARE	0	0	0	0	0	0
DOD SHARE INSTANT OTHER	0	0	0	0	0	0
OTHER DOD SHARE	0	0	13900	37653	104464	107469
DOD TO SELL TOTAL	0	0	13900	37653	104484	107469
TOTAL SAVINGS TO SELL						
INSTANT F	0	0	1119	6754	221.6	0
FOLLOW ON F	0	C	C	0	0	0
INSTANT OTHER	6	0	53034	57332	37486	5407
OTHER FOLLOW ON	0	0	13900	37653	104484	107469
TOTAL SAVINGS	0	0	68054	101739	142192	112877

DOD SHARE	0	0	13900	37653	104484	107469
SUBCONTRACTOR SHARE	C	0	54153	64066	37708	5407
LOST PROFIT ON SAVINGS	0	0	2379	6277	17142	17634
SUB SHARE	0	0	51775	57609	20566	-12226

SUBC TOTAL SAVINGS	0	0	164560	178384	52922	24356
INCOME TAXES						
ITC	8698	14965	17465	0	0	6
SUB INCOME TAXES	-8030	-33333	31178	48823	-10094	-18657
LP VERSION TAXES	-8030	-33333	-14626	1225	-17979	-26768
DEFFERED TAXES	557.3	4177	9237	12702	12114	4132
SUBCONTRACTOR INCOME AIT	11667	15341	117884	132664	62223	34817

SUBCONTRACTOR NET INCOME AFTER TAX

SUBC NET INCOME AFTER TA	-728.2	-24164	50066	57313	-11849	-21901

LP A T SAVINGS	16728	48298	79865	56584	38545	14542

**************************CASH FLOW***

CASH INFLOW PRE TAX	16632	11772	145597	229224	99866	63897
CASH INFLOW AFTER TAX	33360	59570	167883	180401	109959	82554
LP INFLOW AFTER TAX	38979	96705	139102	117023	98396	66410
CUMMULATIVE CASH INFLOW	16632	27904	213501	442725	542590	606487
CUMMULATIVE CASH INFLOW	33360	92931	260814	441215	551175	633728
CUMMULATIVE LP INFLOW AF	38979	135684	274786	391809	490205	556615

DISCOUNTED CASH FLOW

NPV PRE TAX	-72134	-196767	-172004	-26329	30338	62710
NPV AFTER TAX	-57198	-143328	-131174	-16525	45869	87693
LP NPV AFTER TAX	-52181	-108708	-117040	-42669	13163	46809
SUBCONTRACTOR BEFORE TAX	0	0	0	7.985	15.96	19.41
SUBCONTRACTOR AFTER TAX	0	0	0	9.093	18.64	23.13
LP AFTER TAX IRR	0	0	0	3.179	14.18	18.78
YEAR	1984	1985	1986	1987	1988	1989

**************************TOTALING***

THIS MODEL WAS CREATED TO ANALYZE CAPITAL INVESTMENTS REGUARDING THE INDUSTRIAL TECHNOLOGY MODERNIZATION PROGRAM (TECH MOD).

YEAR1	1990	1991	1992	1993	

DATA ELEMENTS SECTION

SALES TAX RATE	.0613	.0613	.0613	.0613	
COST OF CAPITALIZED LABO	0	0	0	0	19318
COST OF CAPITALIZED EQUI	0	0	0	0	216475
COST OF CAPITALIZED OTHE	0	0	0	0	178257
SALES TAX M	0	0	0	0	12339
SALES TAX C	0	0	0	0	10918
MATERIAL HANDLING C	0	0	0	0	26801
NON RECOVERED CAPITALIZE	0	0	0	0	0
RECOVERED EXPENSED COSTS	0	0	0	0	33221
NONRECOVERED EXPENSED CO	0	0	0	0	82676
MATERIAL COST SAVED	1086	451	200	24	9165
F SIX INSTANT DIRECT DOL	0	0	0	0	2428
F SIX FOLLOW ON DIRECT D	0	0	0	0	0
OTHER DOD INSTANT DIRECT	0	0	0	0	46121
OTHER DOD FOLLOW ON DIRE	19245	6063	2209	264	110062

GOVT INSTANT DIRECT DOLL	0	0	0	0	48549
COMMERCIAL DIRECT DOLLAR	4456	4102	2443	310	31064
GOVT FOLLOW ON DIRECT DO	19245	6063	2209	264	110062
DIRECT VARIABLE LABOR DO	1	1	1	1	
DIRECT FIXED LABOR DOLLA	0	0	0	0	
AVERAGE DIRECT LABOR RAT	1	1	1	1	
MFG RATE	1.280	1.280	1.280	1.280	
ENG RATE	0	0	0	0	
MH RATE	.0920	.0920	.0920	.0920	
MH	0	0	0	0	
MFG COM RATE	.1111	.1111	.1111	.1111	
ENG COM RATE	0	0	0	0	
MH COM RATE	.0031	.0031	.0031	.0031	
GA RATE	.1350	.1350	.1350	.1350	
GA COM RATE	.0048	.0048	.0048	.0048	
EQUIP LIFE SL	7	7	7	7	
FEE RATE	.1500	.1500	.1500	.1500	
EQUIPMENT LIFE	5	5	5	5	
INSTANT DOD FACTOR	0	0	0	0	
DOD FACTOR	1	1	1	1	
OPTIONS PAYMENTS	0	0	0	0	194392
COM FACTOR	.0975	.0975	.0975	.0975	
INCOME TAX RATE	.4600	.4600	.4600	.4600	
ITC RATE	.1000	.1000	.1000	.1000	
DISCOUNT RATE	.1200	.1200	.1200	.1200	
PER CENT DOD BUSINESS	.8000	.6000	.8000	.8000	

**************INVESTMENT***

TOTAL BUDGETED CAPITAL	0	0	0	0	371287
TOTAL NONRECOVERED CAPIT	0	0	0	0	0
TOTAL RECOVERED EXPENSED	0	0	0	0	26577
TOTAL NON RECOVERED EXPE	0	0	0	0	66141
RECOVERED DEPRECIATION	47737	36553	17312	0	334158
TOTAL RECOVERED INVESTME	47737	36553	17312	0	360735
TOTAL NON RECOVERED INVE	-47737	-36553	-17312	0	103269
TOTAL CAPITAL	0	0	0	0	371287
TOTAL EXPENSED COST	0	0	0	0	92718
TOTAL INVESTMENT	0	0	0	0	464004

*******SAVINGS***

RATIO CALCULATIONS

TOTAL VARIABLE LABOR DIR	23701	10165	4652	574
COMMERCIAL RATIO	.1880	.4035	.5252	.5401
GOVT INSTANT RATIO	0	0	0	0
GOVT FOLLOW ON RATIO	.8120	.5965	.4748	.4599
F SIX INSTANT RATIO	0	0	0	0
F SIX FOLLOW ON RATIO	0	0	0	0
OTHER DOD INSTANT RATIO	0	0	0	0

OTHER DOD FOLLOW ON RATI	1	1	1	1	
LABOR COST SAVINGS					
TOTAL DIRECT LABOR DOLLA	23701	10165	4652	574	189675
TOTAL DIRECT SAVED	23701	10165	4652	574	189675
LOADED AVERAGE DIRECT LA	2.588	2.588	2.588	2.588	
LOADED DIRECT LABOR SAVE	64227	27546	12606	1555	524695
COM ON MFG DIRECT LABOR	2632	1129	516.7	63.75	
MATERIAL COST SAVINGS					
LOADED MATERIAL COST SAV	1355	562.8	249.6	29.55	11550
MAT SAVED	1086	451	200	24	9165
COM ON MATL COST SAVED	3.367	1.398	.6200	.0744	
COST OF MONEY					
GA COM FOR LABOR	261.5	112.2	51.34	6.334	2471
GA COM FOR MATERIAL	5.740	2.384	1.057	.1268	56.85
TOTAL COST OF MONEY SAVE	2903	1245	569.7	70.29	24735
COM ON CAPITAL	11199	7090	4464	3620	130646
COM RECOVERY	8296	5845	3894	3550	105911
SAVINGS BY CUSTOMER					
TOTAL DIRECT SAVINGS	24787	10616	4852	598	198840
TOTAL COST SAVINGS	62679	26964	12286	1515	511510
TOTAL OVERHEAD SAVED	37892	16248	7434	917.1	312670
TOTAL SAVINGS TO SELL	74984	32139	14699	1813	612971
TOTAL FEE	12305	5275	2413	297.6	101461
COMMERCIAL LOADED SAVING	11784	10841	6452	818.3	83654
COMMERCIAL SAVINGS TO SE	14098	12969	7719	979.0	100241
COMMERCIAL GROSS FEE	2313	2129	1267	160.7	16586
GOVT INSTANT LOADED SAVI	0	0	0	0	134330
GOVT INSTANT SAVINGS TO	0	0	0	0	161354
GOVT INSTANT GROSS FEE	0	0	0	0	27024
GOVT FOLLOW ON LOADED SA	50895	16023	5834	696.9	293525
GOVT FOLLOW ON SAVINGS T	60887	19169	6980	833.7	351376
GOVT FOLLOW ON GROSS FEE	9992	3146	1146	136.9	57451
F SIX INSTANT LOADED SAV	0	0	0	0	6741
F SIX INSTANT SAVINGS TO	0	0	0	0	8095
F SIX INSTANT GROSS FEE	0	0	0	0	1354
F SIX FOLLOW ON LOADED S	0	0	0	0	0
F SIX FOLLOW ON SAVINGS	0	0	0	0	0
F SIX FOLLOW ON GROSS FE	0	0	0	0	0
OTHER DOD INSTANT LOADED	0	0	0	0	127589
OTHER DOD INSTANT SAVING	0	0	0	0	153259
OTHER DOD INSTANT GROSS	0	0	0	0	25670
OTHER DOD FOLLOW ON LOAD	50895	16023	5834	696.9	293525
OTHER DOD FOLLOW ON SAVI	60887	19169	6980	833.7	351376

OTHER DOD FOLLOW ON GROS	9992	3146	1146	136.9	57651

DEPRECIATION

NET DEPRECIABLE COST	0	0	0	0	
ACC DEPRECIATION	26663	0	0	0	
BOOK VALUE	0	0	0	0	
CUMULATIVE DEPRECIATION	352722	352722	352722	352722	
ACCEL DEPRECIATION	26663	0	0	0	352722
DEPRECIATION	47737	36553	17312	0	
BOOK VAL	90994	54441	37129	37129	
CUM DEPRECIATION	280293	316846	334158	334158	
DEPR					
BK VALUE					
CUMULATIVE DEPR					
TOTAL SL DEPRECIATION	47737	36553	17312		334158
DEFERRED DEPRECIATION	-20874	-36553	-17312		18564
CAPITAL COM BASE	114862	72717	45765	37129	
NBV CAPITAL	0	0	0	0	

****************** SCHEDULE B

PROD SAVINGS REWARD

INSTANT F SIX	0	0	0	0	8095
FOLLOW ON F SIX	0	0	0	0	0
INSTANT OTHER DOD	0	0	0	0	153259
FOLLOW ON OTHER DOD	0	0	0	0	0
PSR TO SELL TOTAL	0	0	0	0	355746
DOD SHARE					
DOD SHARE INSTANT F SIX	0	0	0	0	0
F SIX DOD SHARE	0	0	0	0	0
DOD SHARE INSTANT OTHER	0	0	0	0	0
OTHER DOD SHARE	60887	19169	6980	833.7	351376
DOD TO SELL TOTAL	60887	19169	6980	833.7	351376
TOTAL SAVINGS TO SELL					
INSTANT F	0	0	0	0	8095
FOLLOW ON F	0	0	0	0	0
INSTANT OTHER	0	0	0	0	153259
OTHER FOLLOW ON	60887	19169	6980	833.7	351376
TOTAL SAVINGS	60887	19169	6980	833.7	512731

DOD SHARE	60887	19169	6980	833.7	351376
SUBCONTRACTOR SHARE	0	0	0	0	161354
LOST PROFIT ON SAVINGS	9992	3146	1146	136.9	57851
SUB SHARE	-9992	-3146	-1146	-136.9	103503

SUBC TOTAL SAVINGS	14098	12969	7719	979.0

INCOME TAXES

ITC	0	0	0	0	37129
SUB INCOME TAXES	-8541	2689	1791	1633	7460
LP VERSION TAXES	-13137	1241	1264	1570	-108572
DEFFERED TAXES	-9602	-16814	-7964	0	8540
SUBCONTRACTOR INCOME AFT	16837	3156	2103	1917	398608

SUBCONTRACTOR NET INCOME AFTER TAX

SUBC NET INCOME AFTER TA	-10026	3156	2103	1917	45866
LP A T SAVINGS	3145	-4368	-2410	-1707	249204

************************CASH FLOW**

CASH INFLOW PRE TAX	56033	42398	21206	3550	729675
CASH INFLOW AFTER TAX	64573	39710	19415	1917	759343
LP INFLOW AFTER TAX	41290	15351	6939	-1707	618478
CUMMULATIVE CASH INFLOW	662520	704918	726125	729675	
CUMMULATIVE CASH INFLOW	698302	738011	757426	759343	
CUMMULATIVE LP INFLOW AF	597895	613246	620185	618478	

DISCOUNTED CASH FLOW

NPV PRE TAX	88056	105180	112828	113971	113971
NPV AFTER TAX	116903	132941	139942	140559	140559
LP NPV AFTER TAX	65482	71682	74184	73634	73634
SUBCONTRACTOR BEFORE TAX	21.58	22.77	23.23	23.29	23.29
SUBCONTRACTOR AFTER TAX	25.49	26.53	26.90	26.93	26.93
LP AFTER TAX IRR	20.78	21.34	21.55	21.51	21.51
YEAR	1990	1991	1992	1993	

************************TOTALING**

```
ELEMENT IFPSMJ.FINSHP13 05/23/86 15:48
MICRO &PROJECT&FINISHING SHOP IMPROVEMENTS&
MICRO &YEARS&1984,1985,1986,1987,1988,1989,1990,1991,1992,1993,TOTAL&
MICRO &COLUMNS&1&&
MICRO &COLUMNS-1&9&
SALES TAX RATE = .05125,.06125
COST OF CAPITALIZED LABOR = 42,11535,7441,0
COST OF CAPITALIZED EQUIPMENT = 92016,124324,135,0
COST OF CAPITALIZED OTHER = 0,26820,151437,0
NON RECOVERED CAPITALIZED COSTS = 0,0,0
RECOVERED EXPENSED COSTS = 13137,17256,2928,0
NONRECOVERED EXPENSED COSTS = 0,41502,41174,0
F SIX INSTANT DIRECT DOLLAR SAVINGS = 0,0,323,2035,70,0
F SIX FOLLOW ON DIRECT DOLLAR SAVINGS = 0
OTHER DOD INSTANT DIRECT DOLLAR SAVINGS = 0,0,15307,17274,11832,1708,0
OTHER DOD FOLLOW ON DIRECT DOLLAR SAVINGS = 0,0,4012,11345,32979,33945,'
19245,6063,2209,264
GOVT INSTANT DIRECT DOLLAR SAVINGS = 0,0,15630,19309,11902,1708,0
COMMERCIAL DIRECT DOLLAR SAVINGS = 0,0,3613,5153,4802,5985,4456,4102,'
2443,310
GOVT FOLLOW ON DIRECT DOLLAR SAVINGS = 0,0,4012,11345,32979,33945,'
19245,6063,2209,264
DIRECT VARIABLE LABOR DOLLARS SAVED = 1
DIRECT FIXED LABOR DOLLARS SAVED = 0
AVERAGE DIRECT LABOR RATE = 1
MFG RATE = 0,0,1.410,1.35,1.280
ENG RATE = 0
MH RATE = 0,0,.105,.100,.092
MFG COM RATE = 0,0,.14334,.12088,.11107
ENG COM RATE = 0
MH COM RATE = 0,0,.00468,.00379,.00310
GA RATE =0,0,.164,.150,.135
GA COM RATE = 0,0,.00751,.00722,.00464
FEE RATE = .15
EQUIPMENT LIFE = 5
INSTANT DOD FACTOR = 0
DOD FACTOR = 1
COM FACTOR = .14375,.10375,.0975
INCOME TAX RATE = .46
ITC RATE = .1
DISCOUNT RATE = .12
PER CENT DOD BUSINESS = .8
YEAR = 1984,PREVIOUS + 1
EQUIP LIFE SL = 7
MATERIAL COST SAVED = 0,0,1214,1788,2430,1972,1086,451,200,24
OPTIONS PAYMENTS = 0,0,97196,97196,0
MH = .1236,.1124,.107,0
END OF DATAFILE
```

ITM

DISCOUNTED CASH FLOW MODEL

(Pages 14 thru 25)

THE FIRST YEAR IN WHICH INPUTS WILL BE MADE IS*** 1984 ***

CAPITAL EQUIPMENT COSTS?---> 464990 <----

DOD SHARE TOTAL BUSINESS?*** 0.80 ***

DOD SHARE OF SAVINGS **** 0.00 ***

LATEST RATES	1984	1985	1986	1987	1988
MTL SAV->	0.0000	0.0000	0.1050	0.1000	0.0920
MFG SAV->	0.0000	0.0000	1.4100	1.3500	1.2800
ENG SAV->	0.0000	0.0000	0.0000	0.0000	0.0000
G&A SAV->	0.0000	0.0000	0.1640	0.1500	0.1350
FRINGE-->	0.3200	0.2470	0.2630	0.2630	0.2630
PROFIT>	0.1500	0.1500	0.1500	0.1500	0.1500
COM--->	0.0276	0.0278	0.0564	0.0500	0.0463
MTL INV->	0.1236	0.1124	0.1070	0.0000	0.0000
MFG INV->	1.6194	1.5764	1.4300	0.0000	0.0000
ENG INV->	0.0000	0.0000	0.0000	0.0000	0.0000

MFG ASSY & SUPV (SAVINGS)
MOS & SOB COMPOSITE RATE

1984	0.00	<<---
1985	0.00	<<---
1986	10.42	<<---
1987	10.94	<<---
1988	11.60	<<---
1989	12.29	<<---
1990	13.03	<<---
1991	13.81	<<---
1992	14.63	<<---
1993	15.52	<<---

CAPITAL
ENG AVG ACTUAL RATE
1984 0.00 <<---
1985 14.97 <<---

CAPITAL
MFG AVG ACTUAL RATE
1984 8.02 <<---
1985 16.08 <<---

CAPITAL
MFG ENG AVG ACTUAL RATE
1986 18.32 <<---

CAPITAL
TOOL TOUCH AVG ACT RATE
1986 8.89 <<---

CAPITAL
FIN SHOP TOUCH AVG ACT RATE
1986 7.86 <<---

CAPITAL
MACH SHOP TOUCH AVG ACT RATE
1986 10.70 <<---

CAPITAL
WELD TOUCH AVG ACT RATE
1986 13.53 <<---

EXPENSED (NON-RECOVERED)
WELD TOUCH AVG ACT RATE
1986 12.08 <<---

EXPENSED (RECOVERED)
PROJ INV MFG ENG ACT AVG RATE
1984 15.97 <<---
1985 16.81 <<---

EXPENSED (RECOVERED)
PROG SPT ENG ACT AVG. RATE
1984 14.09 <<---

EXPENSED (RECOVERED)
PROG SPT MFG ACT AVG. RATE
1984 14.60 <<---

EXPENSED (RECOVERED)
PROJ INV MFG ENG ACT AVG RATE
1986 18.35 <<---

```
ENTER DOD SHARE---))  0.00000 ((---    RESULTING DOD NPV***  -191594 NPV TO DOD WITH A***  -262308 ***SHARE  YIELDS***   -191594 ***
DOD DISCOUNT FACTOR)     0.12 ((---    RESULTING VND IRR***   0.2744 VENDOR IRR WITH A***   355746 ***SHARE  YIELDS***    0.2744 ***
VENDOR DISC FACTOR))     0.27 ((---    RESULTING VND NPV***     1532 VENDOR NPV WITH A***     0.27 ***DISCOUNT FACTOR*      1532 ***
```

YEAR	VENDOR CAPITAL	PSR
1984	-63603	0
1985	-110442	0
1986	10246	151349
1987	158442	161282
1988	88001	37708
1989	60595	5407
1990	42615	0
1991	22895	0
1992	11451	0
1993	1917	0
TOTAL	222117	355746

YEAR	DOD SAVINGS
1984	-25546
1985	-52091
1986	-143619
1987	-116833
1988	47379
1989	50364
1990	3779
1991	-24561
1992	-13730
1993	833
TOTAL	-274025

INSTANT F-16 SAVINGS	8093
INSTANT OTHER DOD SAVINGS	153255
TOTAL INSTANT SAVINGS	161349
CONTRACTOR PSR	355746

CONTRACTOR PERFORMANCE INCENTIVE ******* 194397 *******

****

SCHEDULE A1 FORECASTED INSTANT F-16 SAVINGS
-ALT W-

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. MATERIALS	0	0	17	102	3	0	0	0	0	0	122
2. MFG ASSY & SUPV	0	0	31	186	6	0	0	0	0	0	223
3. *HOURLY RATE	0.00	0.00	10.42	10.94	11.60	12.29	13.03	13.81	14.63	15.52	
4. SUBTOTAL	0	0	323	2035	70	0	0	0	0	0	2427
5. OTHER (SPECIFY)											0
6. TOTAL DIRECT	0	0	340	2137	73	0	0	0	0	0	2549
7. MTL SAV (ALLOWABLE OH)	0	0	2	10	0	0	0	0	0	0	12
8. MFG SAV (ALLOWABLE OH)	0	0	455	2747	89	0	0	0	0	0	3292
9. G&A SAV (ALLOWABLE OH)	0	0	131	734	22	0	0	0	0	0	887
10. TOTAL INDIRECT	0	0	588	3491	111	0	0	0	0	0	4191
11. SAVINGS THRU G&A	0	0	928	5628	184	0	0	0	0	0	6740

SCHEDULE A2 FORECASTED F/O F-16 SAVINGS
-ALT I-

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. MATERIALS	0	0	0	0	0	0	0	0	0	0	0
2. MFG ASSY & SUPV	0	0	0	0	0	0	0	0	0	0	0
3. *HOURLY RATE	0.00	0.00	10.42	10.94	11.60	12.29	13.03	13.81	14.63	15.52	
4. SUBTOTAL	0	0	0	0	0	0	0	0	0	0	0
5. OTHER (SPECIFY)											0
6. TOTAL DIRECT	0	0	0	0	0	0	0	0	0	0	0
7. MTL SAV (ALLOWABLE OH)	0	0	0	0	0	0	0	0	0	0	0
8. MFG SAV (ALLOWABLE OH)	0	0	0	0	0	0	0	0	0	0	0
9. G&A SAV (ALLOWABLE OH)	0	0	0	0	0	0	0	0	0	0	0
10. TOTAL INDIRECT	0	0	0	0	0	0	0	0	0	0	0
11. SAVINGS THRU G&A	0	0	0	0	0	0	0	0	0	0	0

SCHEDULE A3 FORECASTED INSTANT OTHER DOD SAVINGS
-ALT Y-

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. MATERIALS	0	0	791	862	579	81	0	0	0	0	2313
2. MFG ASSY & SUPV	0	0	1469	1579	1020	139	0	0	0	0	4207
3. #HOURLY RATE	0.00	0.00	10.42	10.94	11.60	12.29	13.03	13.81	14.63	15.52	
4. SUBTOTAL	0	0	15307	17274	11832	1708	0	0	0	0	46122
5. OTHER (SPECIFY)											0
6. TOTAL DIRECT	0	0	16098	18136	12411	1789	0	0	0	0	48435
7. MTL SAV (ALLOWABLE OH)	0	0	83	86	53	7	0	0	0	0	230
8. MFG SAV (ALLOWABLE OH)	0	0	21583	23320	15145	2187	0	0	0	0	62235
9. G&A SAV (ALLOWABLE OH)	0	0	6193	6231	3727	538	0	0	0	0	16690
10. TOTAL INDIRECT	0	0	27859	29638	18925	2732	0	0	0	0	79154
11. SAVINGS THRU G&A	0	0	43957	47774	31336	4521	0	0	0	0	127589

SCHEDULE A4 FORECASTED F/O OTHER DOD SAVINGS
-ALT 2-

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. MATERIALS	0	0	208	566	1613	1608	882	269	95	11	5252
2. MFG ASSY & SUPV	0	0	385	1037	2843	2762	1477	439	151	17	9111
3. #HOURLY RATE	0.00	0.00	10.42	10.94	11.60	12.29	13.03	13.81	14.63	15.52	
4. SUBTOTAL	0	0	4012	11345	32979	33945	19245	6063	2209	264	110061
5. OTHER (SPECIFY)											0
6. TOTAL DIRECT	0	0	4220	11911	34592	35553	20127	6332	2304	275	115313
7. MTL SAV (ALLOWABLE OH)	0	0	22	57	148	148	81	25	9	1	490
8. MFG SAV (ALLOWABLE OH)	0	0	5656	15315	42213	43450	24634	7760	2828	338	142194
9. G&A SAV (ALLOWABLE OH)	0	0	1623	4092	10389	10685	6054	1906	694	83	35526
10. TOTAL INDIRECT	0	0	7302	19464	52750	54283	30769	9691	3530	422	178210
11. SAVINGS THRU G&A	0	0	11521	31375	87342	89836	50896	16022	5835	696	293523

SCHEDULE A BY ELEMENT SAVINGS SUMMARY TO COST
-ALT A-

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. MATERIALS	0	0	1016	1530	2195	1689	882	269	95	11	7687
2. MFG ASSY & SUPV	0	0	1885	2802	3869	2901	1477	439	151	17	13541
3. #HOURLY RATE	0.00	0.00	10.42	10.94	11.60	12.29	13.03	13.81	14.63	15.52	
4. SUBTOTAL	0	0	19642	30654	44880	35653	19245	6063	2209	264	158610
5. OTHER (SPECIFY)											0
6. TOTAL DIRECT	0	0	20658	32184	47075	37342	20127	6332	2304	275	166297
7. MTL SAV (ALLOWABLE OH)	0	0	107	153	202	155	81	25	9	1	733
8. MFG SAV (ALLOWABLE OH)	0	0	27695	41383	57447	45636	24634	7760	2828	338	207720
9. G&A SAV (ALLOWABLE OH)	0	0	7947	11058	14138	11223	6054	1906	694	83	53102
10. TOTAL INDIRECT	0	0	35749	52594	71787	57015	30769	9691	3530	422	261555
11. SAVINGS THRU G&A	0	0	56406	84778	118862	94357	50896	16022	5835	696	427852

SCHEDULE B
-ALT B-

TOTAL SAVINGS BY PROGRAM TO SELL

		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
SUBCONTRACTOR SHARE												
1. INSTANT F-16		0	0	1120	6754	220	0	0	0	0	0	8093
2. F/O F-16		0	0	0	0	0	0	0	0	0	0	0
3. INSTANT OTHER DOD		0	0	53030	57329	37488	5409	0	0	0	0	153255
4. F/O OTHER DOD		0	0	13899	37650	104487	107471	60887	19167	6980	833	351374
5. SUBTOTAL		0	0	68049	101733	142195	112879	60887	19167	6980	833	512723
DOD SHARE												
6. INSTANT F-16		0	0	0	0	0	0	0	0	0	0	0
7. F/O F-16		0	0	0	0	0	0	0	0	0	0	0
8. INSTANT OTHER DOD		0	0	0	0	0	0	0	0	0	0	0
9. F/O OTHER DOD		0	0	0	0	0	0	0	0	0	0	0
10. SUBTOTAL		0	0	0	0	0	0	0	0	0	0	0
TOTAL SAVINGS												
11. INSTANT F-16	(SCH A1)	0	0	1120	6754	220	0	0	0	0	0	8093
12. F/O F-16	(SCH A2)	0	0	0	0	0	0	0	0	0	0	0
13. INSTANT OTHER DOD	(SCH A3)	0	0	53030	57329	37488	5409	0	0	0	0	153255
14. F/O OTHER DOD	(SCH A4)	0	0	13899	37650	104487	107471	60887	19167	6980	833	351374
15. TOTAL		0	0	68049	101733	142195	112879	60887	19167	6980	833	512723

SCHEDULE C FORECASTED EXPENSES/INVESTMENT (DOD RECOVERABLE)
-ALT C-

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. MATERIALS	0	0	0								0
2. PROJ INV MFG ENG	396.8	658.4	97.6								1152.8
3. *HOURLY RATE	15.97	16.81	18.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4. SUBTOTAL	6337	11068	1791	0	0	0	0	0	0	0	19196
5. PROG SPT ENG	55.2										55.2
6. *HOURLY RATE	14.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7. SUBTOTAL	778	0	0	0	0	0	0	0	0	0	778
8. PROG SPT MFG	58.0										58.0
9. *HOURLY RATE	14.60										
10. SUBTOTAL	847	0	0	0	0	0	0	0	0	0	847
11. OTHER (SPECIFY)											0
12. TOTAL DIRECT	7961	11068	1791	0	0	0	0	0	0	0	20820
13. FRINGE (OH ON LABOR ONLY)	2548	2734	471	0	0	0	0	0	0	0	0
14. TOTAL INDIRECT	2548	2734	471	0	0	0	0	0	0	0	5752
15. DEPRECIATION (CAS409)	11184	30425	47737	47737	47737	47737	47737	36553	17312	0	334159
16. TOTAL	21693	44226	49999	47737	47737	47737	47737	36553	17312	0	360732

SCHEDULE D FORECASTED EXPENSES/INVESTMENT (PSR RECOVERABLE)
-ALT D-

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. MISC MATERIALS, COMPUTER, ETC.	0	4001	2090	0	0	0	0	0	0	0	6091
2. FINISH SHOP SUPV.	0	25.6	0	0	0	0	0	0	0	0	25.6
3. #HOURLY RATE	0.00	13.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4. SUBTOTAL	0	355	0	0	0	0	0	0	0	0	355
5. WELDER	0	1.6	0	0	0	0	0	0	0	0	1.6
6. #HOURLY RATE	0.00	12.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7. SUBTOTAL	0	19	0	0	0	0	0	0	0	0	19
8. MFG ENG		130.4	410.0								540.4
9. #HOURLY RATE		11.45	12.26								
10. SUBTOTAL	0	1493	5027	0	0	0	0	0	0	0	6520
11. FIR 85-092 #(.8)	0	6896	4478								11374
12. TRACOR CONTRIB. (CAT 2 PROJECTS) # (.8)		20000	20000								40000
13. TOTAL DIRECT	0	32765	31595	0	0	0	0	0	0	0	64359
14. FRINGE (OH ON LABOR ONLY)	0	461	1322	0	0	0	0	0	0	0	1783
15. TOTAL INDIRECT	0	461	1322	0	0	0	0	0	0	0	1783
16. DEPRECIATION	0	0	0	0	0	0	0	0	0	0	0
17. TOTAL	0	33226	32917	0	0	0	0	0	0	0	66143

SCHEDULE E FORECASTED SUBCONTRACTOR NET INCOME

-ALT E-

		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. GROSS SAVINGS	(SCH B)	0	0	68049	101733	142195	112879	60887	19167	6980	833	512723
2. LESS EXPENSES AT SELL	(SCH C)	25546	52091	60319	57284	57108	57108	57108	43728	20710	0	431002
3. SAVINGS AVAILABLE		-25546	-52091	7730	44449	85087	55771	3779	-24561	-13730	833	81722
4. LESS: DOD SHARE		-25546	-52091	-143619	-116833	47379	50364	3779	-24561	-13730	833	-274025
5. PROD SAVINGS RWD		0	0	151349	161282	37708	5407	0	0	0	0	355746
6. LESS: EXPENSES	(SCH D)	0	33226	32917	0	0	0	0	0	0	0	66143
7. ADD: PROF/COM ON SCH C		0	0	0	0	0	0	0	0	0	0	0
8. OTHER (SPECIFY +/-)		5448	14049	19450	20205	14421	10753	8296	5845	3894	3550	105911
9. CONTRACTOR TAXABLE INCOME		5448	-19177	137882	181487	52129	16160	8296	5845	3894	3550	395515
10. LESS: CORP TAX?	0.46	2506	-8821	63426	83484	23979	7434	3816	2689	1791	1633	181937
11. ADD: INVEST TAX CREDIT		8698	14965	13465								37128
CAPITAL COSTS?	464990											
%DOD BUSINESS?	0.80											
12. SUBCONTRACTOR NET INCOME		11640	4609	87922	98003	28150	8727	4480	3156	2103	1917	250706
13. DEPRECIATION (TAX)		12395	39505	67818	75351	74072	56718	26863				352722
14. DEFERRED TAXES		557	4177	9237	12702	12114	4131	-9602	-16814	-7964	0	8539

SCHEDULE F SCHEDULE OF FORECASTED AFTER TAX CASH FLOW
-ALT F-

		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. ADD: NET INCOME	(SCH E)	11640	4609	87922	98003	28150	8727	4480	3156	2103	1917	250706
2. DEPRECIATION (CAS 409)	(SCH C/D)	11184	30425	47737	47737	47737	47737	47737	36553	17312	0	334159
3. DEFERRED TAXES	(SCH E)	557	4177	9237	12702	12114	4131	-9602	-16814	-7964	0	8539
4. NBV OF DISPOSABLE F/A												0
5. OTHER (SPECIFY)												0
6. LESS: CAPITAL INVESTMENT		86984	149653	134650								371287
7. OTHER (SPECIFY)												0
		------	------	------	------	------	------	------	------	------	------	------
8. AFTER TAX CASH FLOW		-63603	-110442	10246	158442	88001	60595	42615	22895	11451	1917	222117
9. CUMULATIVE ATC FLOW		-63603	-174045	-163799	-5357	82644	143239	185854	208749	220200	222117	222117

10. WITH A DISCOUNT FACTOR ### 0.2693 ###NPV IS# 1532 ##

11. SUBCONTRACTOR IRR 0.2744
GUESS? 0.30

##

SUPPORT FILE 1 SCHEDULE OF FORECASTED DOD PHASE 1&2 FUNDING
-ALT S-

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. PHASE 1 FUNDING	0										0
2. PHASE 2 FUNDING	0										0
	------	------	------	------	------	------	------	------	------	------	------
3. TOTAL DOD FUNDING	0	0	0	0	0	0	0	0	0	0	0
##ADJUST PREVIOUS FUNDING TO## 1984	======	======	======	======	======	======	======	======	======	======	======

##

SUPPORT FILE 2 DOD BUSINESS SHARE COMPUTATION
-ALT S-

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. NUMBER OF DOD UNITS	0	0	0	0	0	0	0	0	0	0	0
2. TOTAL NUMBER OF UNITS	0	0	0	0	0	0	0	0	0	0	0
3. DOD BUSINESS SHARE (#1/#2)	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	0.000

SUPPORT FILE 3 SUMMARY OF DOD CASH FLOWS
-ALT T-

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	TOTAL
1. SAVINGS AVAILABLE TO DOD (SCHED E)	-25546	-52091	7730	44449	85087	55771	3779	-24561	-13730	833	81722
2. DOD COMPONENT FUNDING (FILE 1)	0	0	0	0	0	0	0	0	0	0	0
3. DOD PROGRAM BENEFIT (W/O INCENTIVE)	-25546	-52091	7730	44449	85087	55771	3779	-24561	-13730	833	81722
4. NPV @ 0.12 (W/O INC)* 33057.78											
5. DOD PROGRAM BENEFIT (WITH INCENTIVE)	-25546	-52091	-143619	-116833	47379	50364	3779	-24561	-13730	833	-274025
6. NPV @ 0.12 (W/ INC)** NA											

End of Proposal