1974

Preliminary, Research and Final Reports on Multi-dimensional Tic Tac Toe Game Production Kit

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Please return to:

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Old Dominion University

PRELIMINARY, RESEARCH, AND FINAL
REPORTS

ON

MULTI-DIMENSIONAL TIC TAC TOE GAME PRODUCTION KIT

Paul Coussens

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Preliminary Report

THREE-DIMENSIONAL TIC TAC TOE GAME PRODUCTION KIT

INDUSTRIAL ARTS COURSE NUMBER 395

Paul H. Coussens

June 20, 1974

The Problem:

Re-design and manufacture components and accessories for a Three-Dimensional TIC TAC TOE Game Production Kit.[1]

Purpose of the Project:

1. To assign a new name and re-design the components of the game so that the parts can be manufactured in production line process without infringement on the original copyright by ODU students and Instructors.
2. Provide the Industrial Arts Department of ODU with a production kit that may be used to provide students with learning experiences involving industrial production line methods as well as individual parts production procedures.

Research will involve:

1. Selection of appropriate text from ODU Library concerning research methods and design.
2. Selection of proper research method or combination of methods best suited to the project.
3. Selection of an appropriate name for the kit.
4. Determination of measurements of all parts of the original kit.
5. Re-design and assignment of new measurements to appropriate components so as to make manufacture as simple as possible.
6. Investigation of local sources and costs of all desired materials.
7. Review of drafting techniques.[2]

8. Selection of proper views and preparation of sketches and production drawings of components.
9. Preparation of procedures for measuring, cutting, manufacturing, drilling, threading, finishing, and assembling components.
10. Obtaining or manufacturing all components and assembly of parts.
11. Preparation of a time chart for performing operations.
12. Preparation of a production flow chart involving all operations.
13. Research methods of manufacturing drilling jigs[3] and manufacture jig for drilling holes in acrylic plastic shelves.
14. Preparation of final written instructions for use of kit.

Through this project, an attempt will be made to prove that an inexpensive and useful product can be manufactured efficiently using production line methods by students in an Industrial Arts Laboratory.

Reasons for selecting the problem:

The project was selected because of its versatility of use, the many production processes and learning activities it offers for the secondary school and college student, and it provides the college instructor as well as the secondary school teacher with an interesting ready-made kit with which to provide learning experiences for the student in communications, manufacturing, and mass-production procedures.

Implications for Industrial Arts:

It not only provides a useful product for the Industrial Arts Student, but it gives him learning experiences in measuring, threading, cutting steel and acrylic plastics, drilling, manufacturing, finishing, and assembling oomponents as well as participating in modern production line procedures.

The student will construct:

1. A drilling jig for drilling all holes in the plastic shelves of the kit.
2. A complete model of the Three-Dimensional TIC TAC TOE Game with manufacturing and assembly instructions.
3. An operational flow chart of the manufacturing and assembly process.

Research methods to be used:

A combination of the Single Cell Survey and possible the Activity Analysis Methods of research will be used.[1]

BIBLIOGRAPHY

1 McGraph, J. H., Research Methods and Design, Chapters 4 and 5.

2 Wright, Lawerence S., Grafting, Technical Communications.

3 Begeman, Myron L., and Amstead, B. H., Manufacturing Processes, pages 516-517.

RESEARCH REPORT

MULTI-DIMENSIONAL TIC TAC TOE GAME PRODUCTION KIT

INDUSTRIAL ARTS COURSE NUMBER 395

Paul H. Coussens

July 12, 1974

Results of Research:

Research was performed in accordance with the procedures set forth in the preliminary report.

The Tic Tac Toe game model was analyzed, a new name was assigned, several dimensions were altered, a drilling jig for drilling holes in the shelves was designed, materials sources and prices were identified, required tools and materials have been procured, and a tentative flow chart prepared (not included in this report because its schedule will depend upon the timed manufacture and assembly process yet to be performed).

No changes in the original problem was necessary.

Drawings:

Problems did arise in the sketching and production blue prints manufacture due to the lack of drafting experience during the past two years. Mr. Buchanan of the ODU Industrial Arts Department earned my sincere gradi-tude for patience, and his many bits of advice and constructive criticism during this course.

Jig design:

I am also greatful to Mr. Buchanan and Mr. Deal for their suggestions on types of drilling jigs that would be appropriate. Mr. Buchanan suggest-ed a wooden jig; Mr. Deal suggested metal. I selected metal for longer endurance which may have been a questionable selection. Neither Instructor's recommendations were followed explicitely.

Problems:

Problems can be expected in brazing the parts of the jig. All dimensions of the jig have been checked thoroughly and the dimensions as well as squar-ing must be accurate to one thirty-second of an inch. Experimental brazing of a proto-type indicated that the required heat distorts the parts in ex-cess of the maximum allowance. I propose to solve this problem by grinding

away the areas where the alowable tolerence is exceeded.

Both rough sketches and production masters (with blue prints) are included in this report.

Problem versus time:

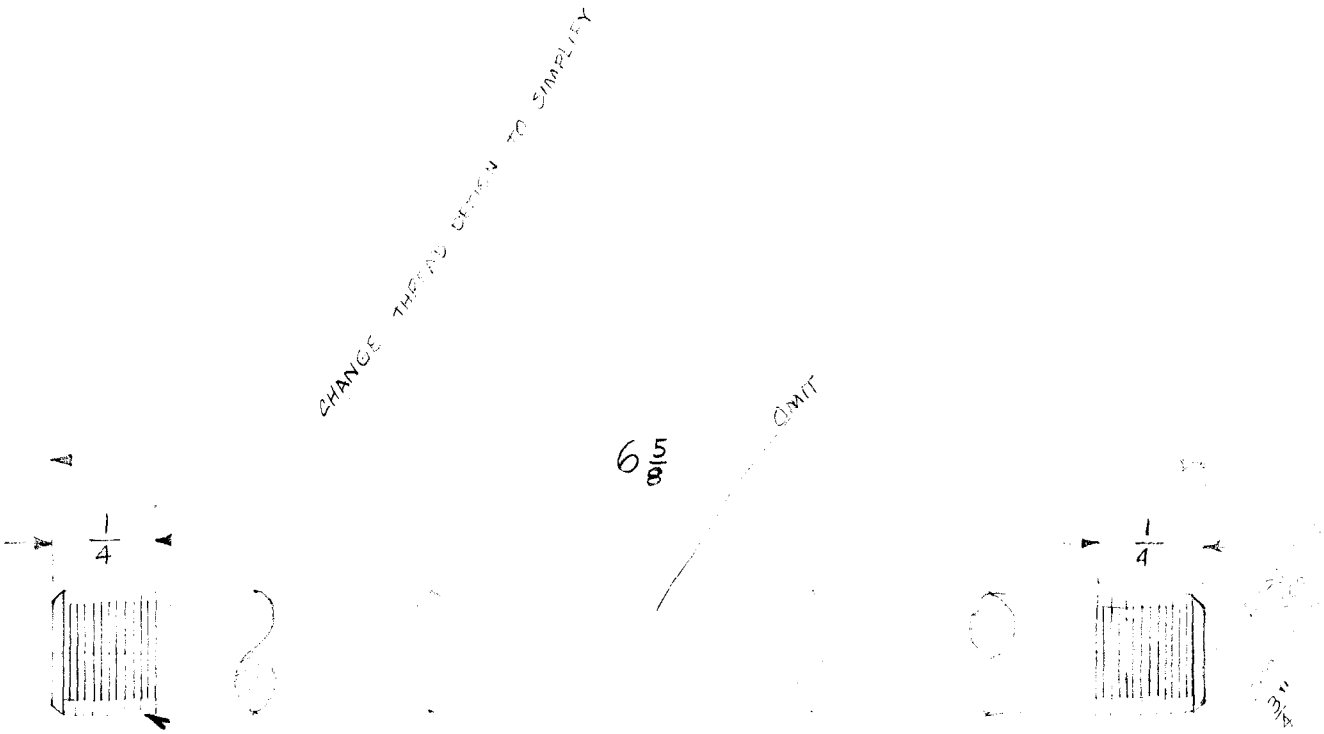
I has been very difficult to full fill the requirements I set for my problem during this abbreviated course and I hope that I can meet them by the end of the term.

Bibliography:

No additional bibliography has been added.

MULTI-DIMENSIONAL TIC TAC TOE GAME PARTS DRAWINGS

ROUGH SKETCH



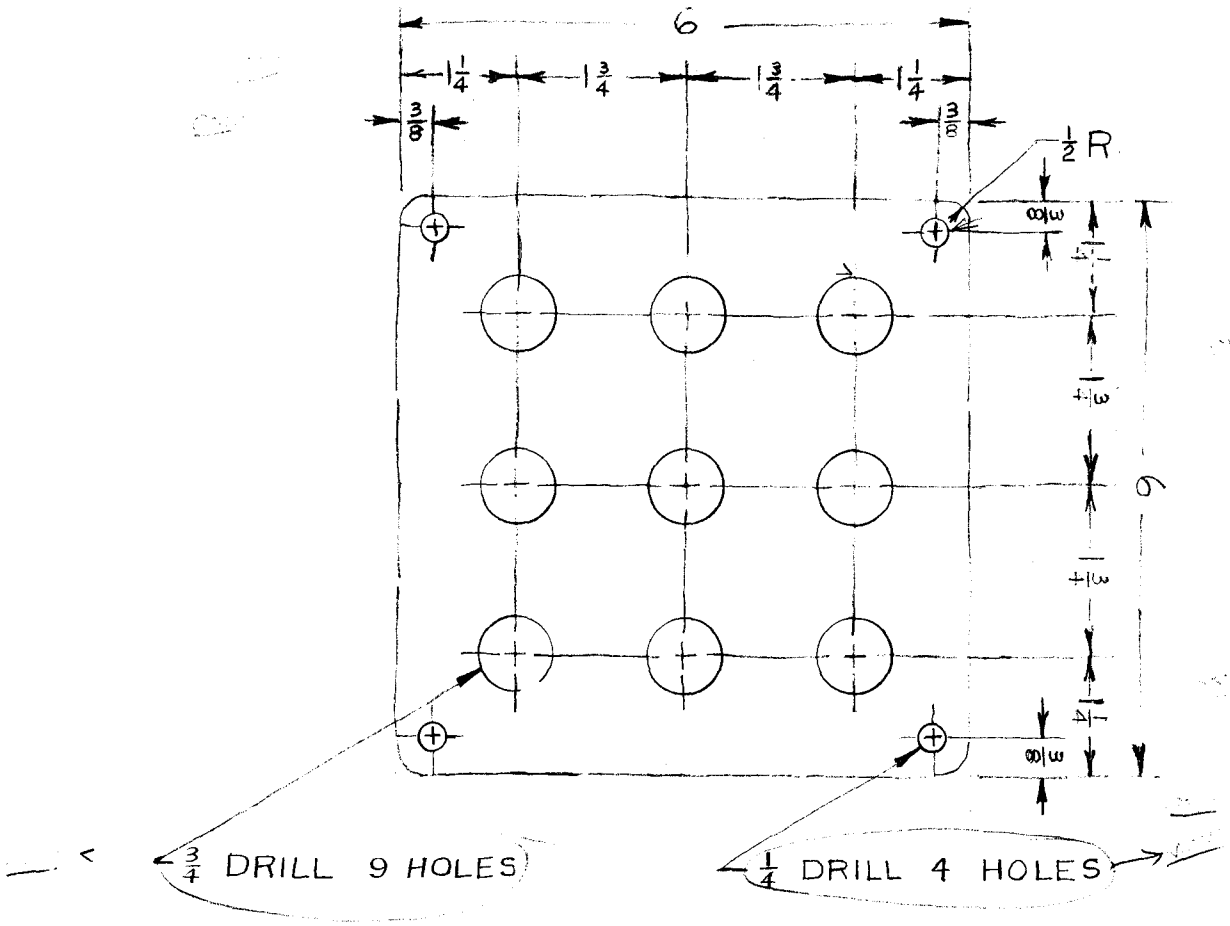
#10-24 UNC THREAD BOTH ENDS

NOTE: STANDARD #10-24 STEEL CAP NUTS USED ON EACH END OF BOLT, 4 BOLTS REQUIRED

MATERIAL: STANDARD NO. 10 ROUND STEEL STOCK - THREADED OR UNTHREADED OMIT INSERT

OLD DOMINION UNIVERSITY	TITLE: BOLT	SCALE: 4-1	NO: 1
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 6-25	IAE

ROUGH SKETCH



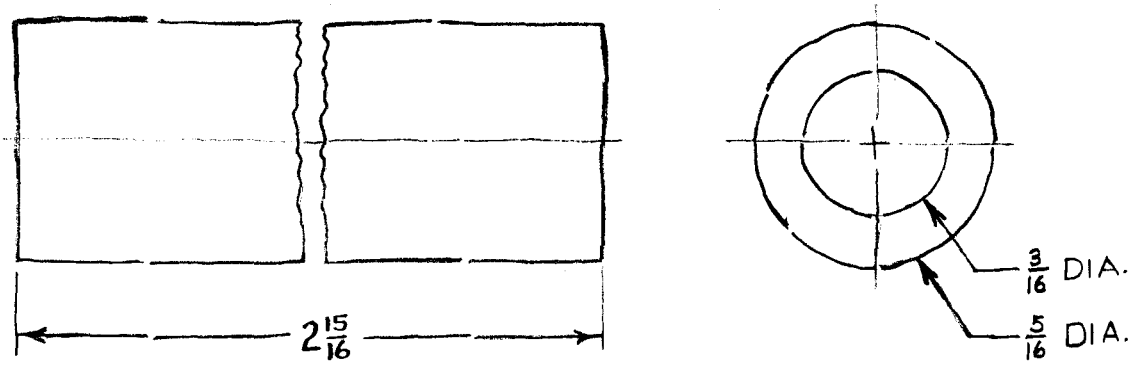
MATERIAL: 1/8 SHEET ACRYLIC

3 SHELVES

OLD DOMINION UNIVERSITY	TITLE: SHELF	SCALE: 1/2 - 1	NO: 2
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 6-26	IAE

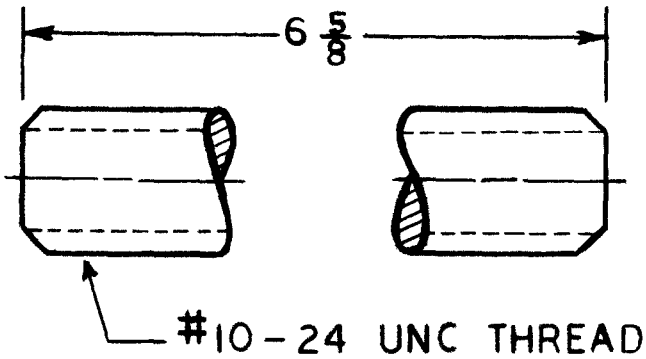
PDF

ROUGH SKETCH



MATERIAL: 8 PIECES CLEAR ACRYLIC TUBING

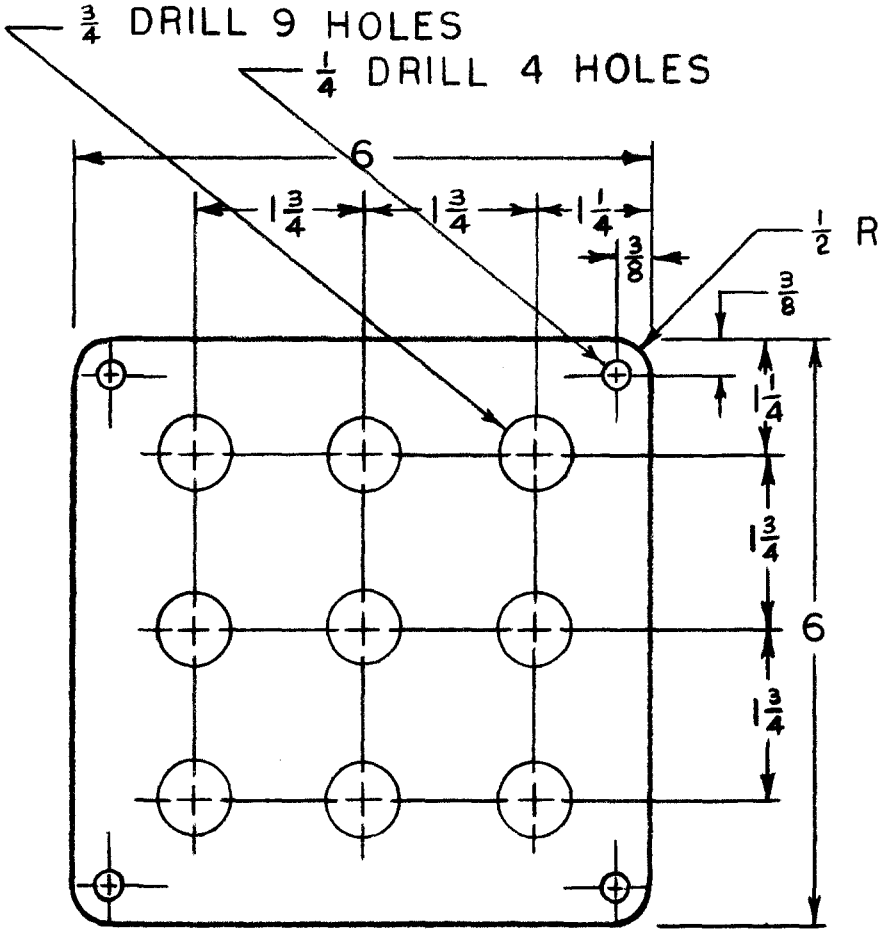
OLD DOMINION UNIVERSITY	TITLE: TUBING	SCALE: 3-1	NO: 3
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-11	IAE



FOUR BOLTS REQUIRED. USE #10-24 HEXAGONAL STEEL CAP NUTS ON BOTH ENDS OF BOLTS

MATERIAL: #10 ROUND THREADED STEEL STOCK

OLD DOMINION UNIVERSITY	TITLE: BOLT	SCALE: 4-1	NO: 1
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-11	IAE



MATERIALS: ⅛ SHEET ACRYLIC
3 SHELVES

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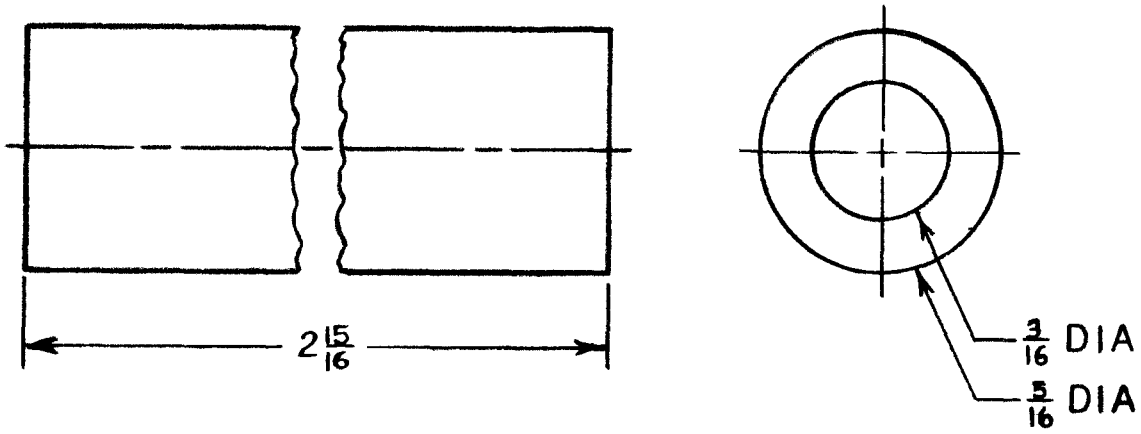
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-9	IAE



MATERIAL: 8 PIECES CLEAR ACRYLIC TUBING

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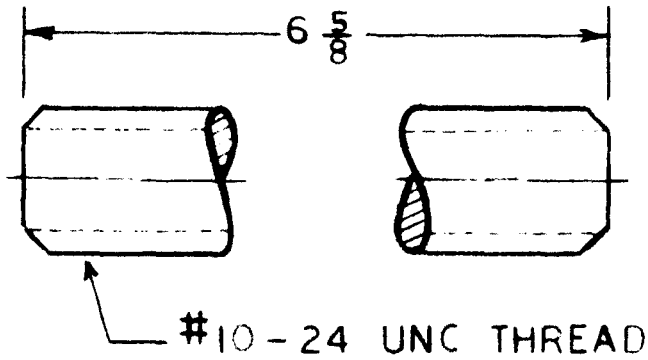
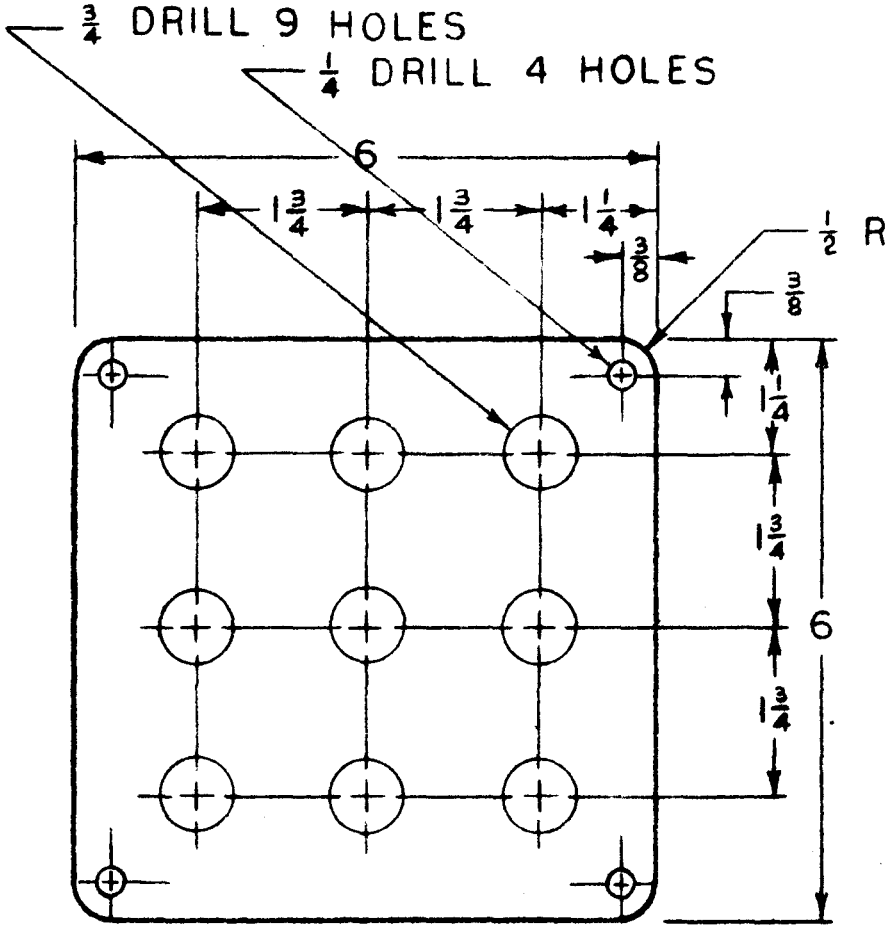


FOUR BOLTS REQUIRED. USE #10-24 HEXAGONAL STEEL CAP NUTS ON BOTH ENDS OF BOLTS

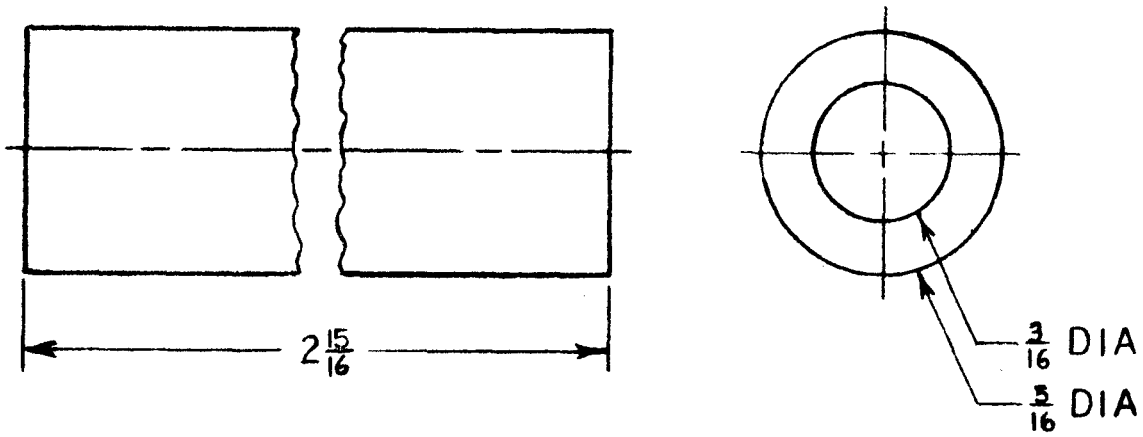
MATERIAL: #10 ROUND THREADED STEEL STOCK

OLD DOMINION UNIVERSITY	TITLE: BOLT	SCALE: 4-1	NO: 1
INDUSTRIAL ARTS DEPT	DR BY: PAUL COUSSENS	DATE: 7-11	IAE



MATERIALS: ⅛ SHEET ACRYLIC
3 SHELVES

OLD DOMINION UNIVERSITY	TITLE: SHELF	SCALE: ½-1	NO: 2
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-9	IAE

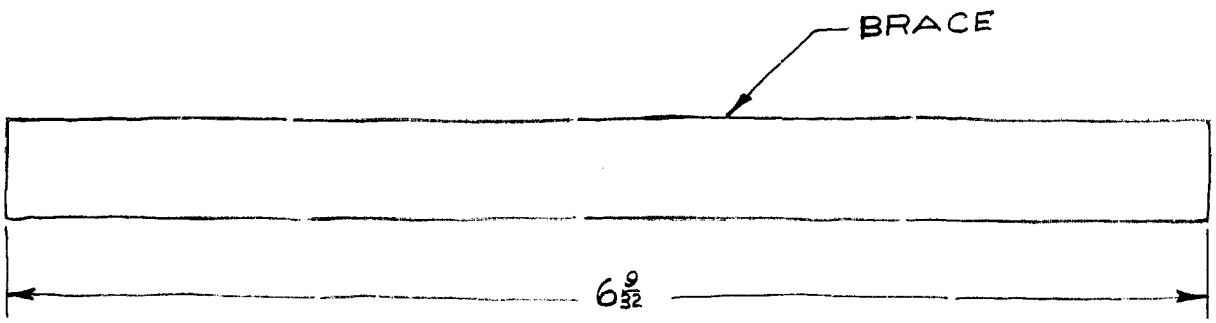


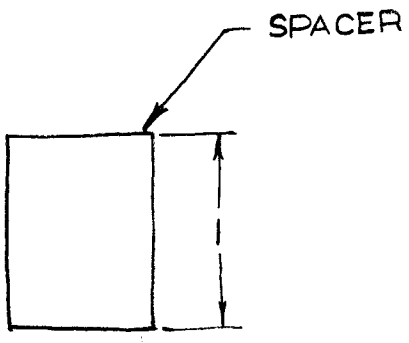
MATERIAL: 8 PIECES CLEAR ACRYLIC TUBING

OLD DOMINION UNIVERSITY	TITLE: TUBING	SCALE: 3-1	NO: 3
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-11	IAE

DRILLING JIG PARTS DRAWINGS

ROUGH SKETCH

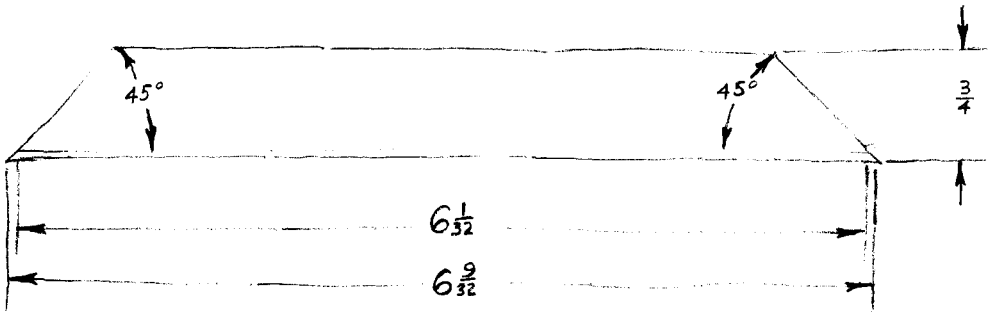




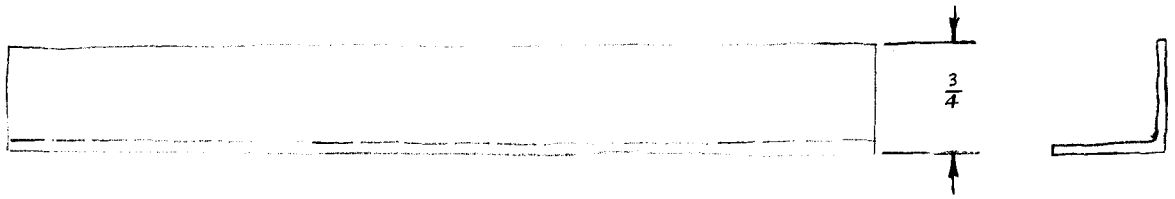
MATERIAL: SPACER $\frac{3}{4}$ HOT ROLL ANGLE IRON OMIT
BRACE $\frac{1}{2}$ HOT ROLL BAND IRON

OLD DOMINION UNIVERSITY	TITLE: DRILL JIG	SCALE: 1-1	NO: 4
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-2	IAE

ROUGH SKETCH



TOP

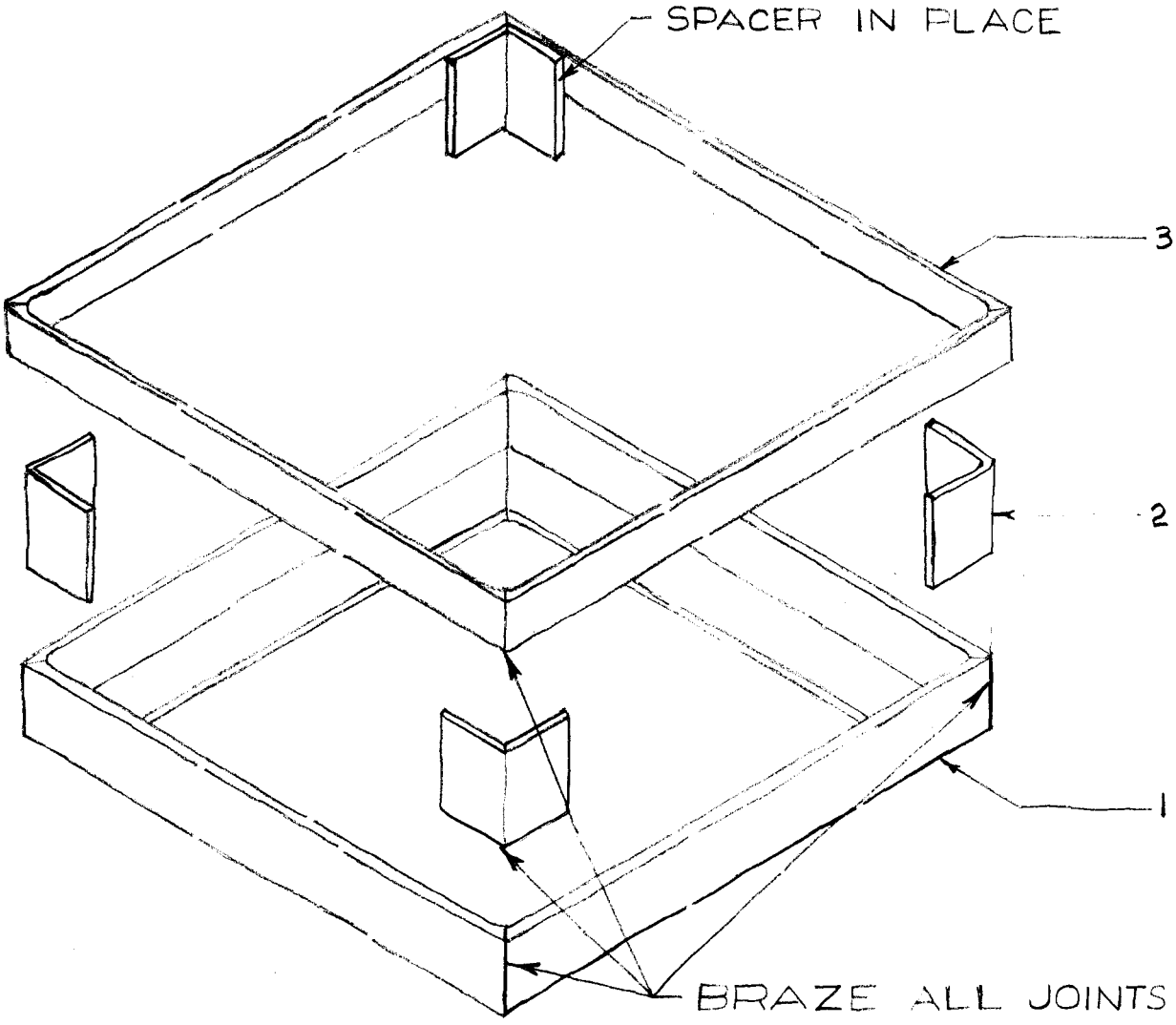


FRONT END

FOUR REQUIRED, FORM SQUARE BASE AND BRAZE
MATERIAL: STANDARD HOT ROLL $\frac{3}{4}$ ANGLE IRON, STEEL

OLD DOMINION UNIVERSITY	TITLE: DRILL JIG BASE	SCALE: $\frac{3}{4}$ - 1	NO: 5
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 6-28	IAE

ROUGH SKETCH

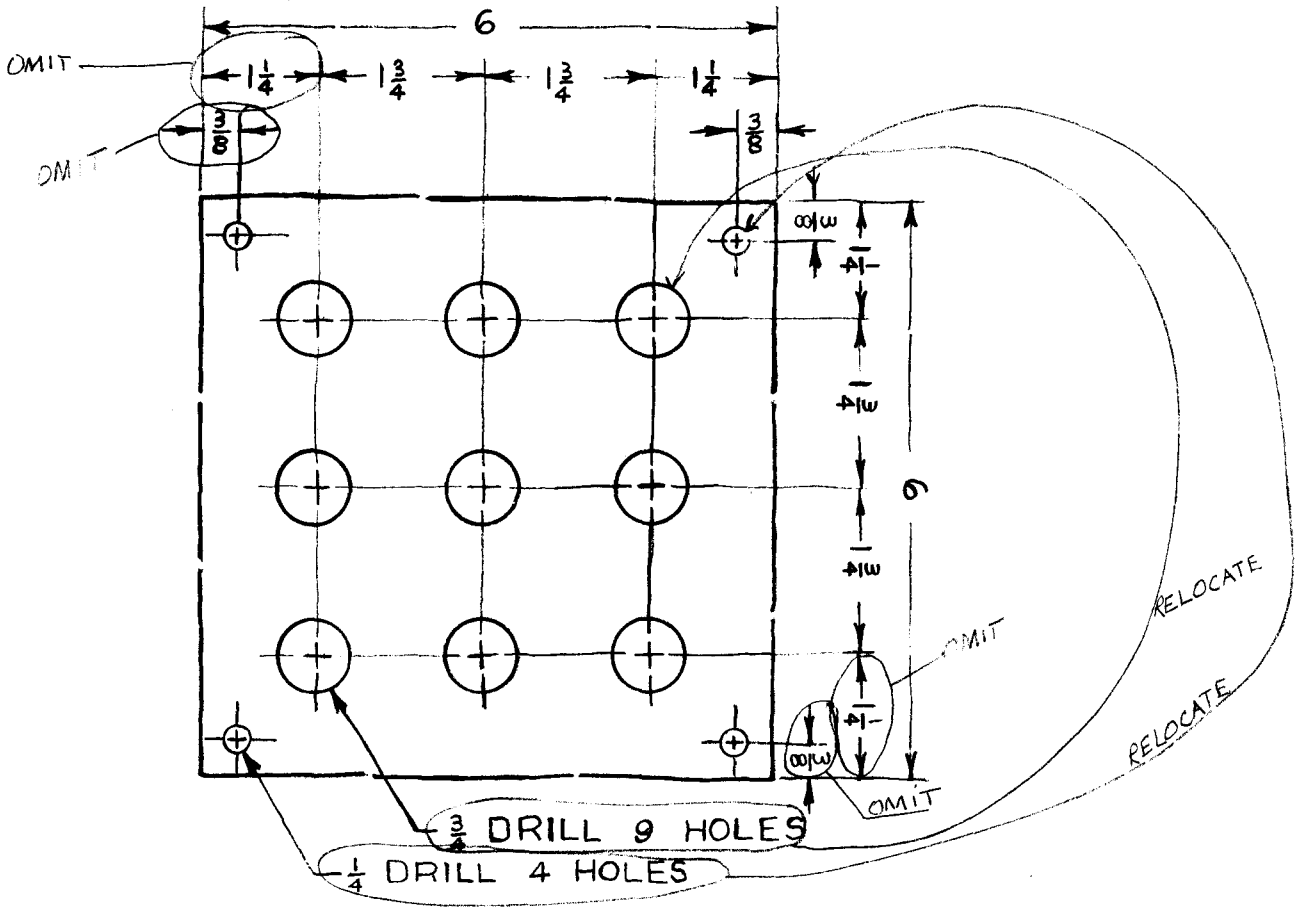


MATERIAL: PART NO. 1 $\frac{3}{4}$ HOT ROLL ANGLE IRON, STEEL
PART NO. 2 $\frac{3}{4}$ HOT ROLL ANGLE IRON, STEEL
PART NO. 3 $\frac{1}{2}$ HOT ROLL BAND IRON, STEEL

REF. NO.	REQ. NO.	PART NUMBER	DESCRIPTION
3	4	3	BRACE
2	4	2	SPACER
1	4	1	BASE

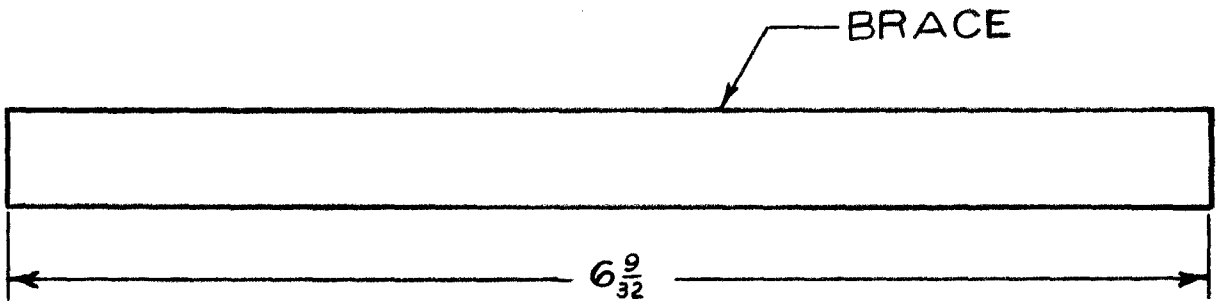
OLD DOMINION UNIVERSITY	TITLE: DRILL JIG	SCALE: $\frac{1}{2}$ - 1	NO: 6
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-1	I A E

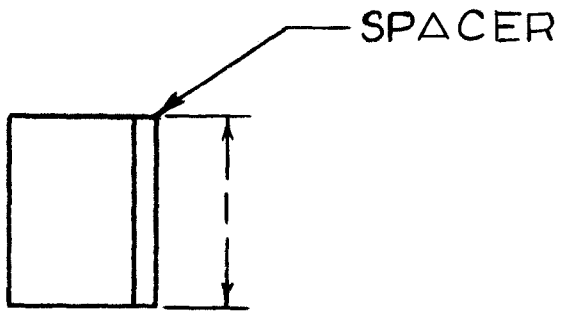
ROUGH SKETCH



MATERIAL: 1 PIECE 1/8 SHEET STEEL

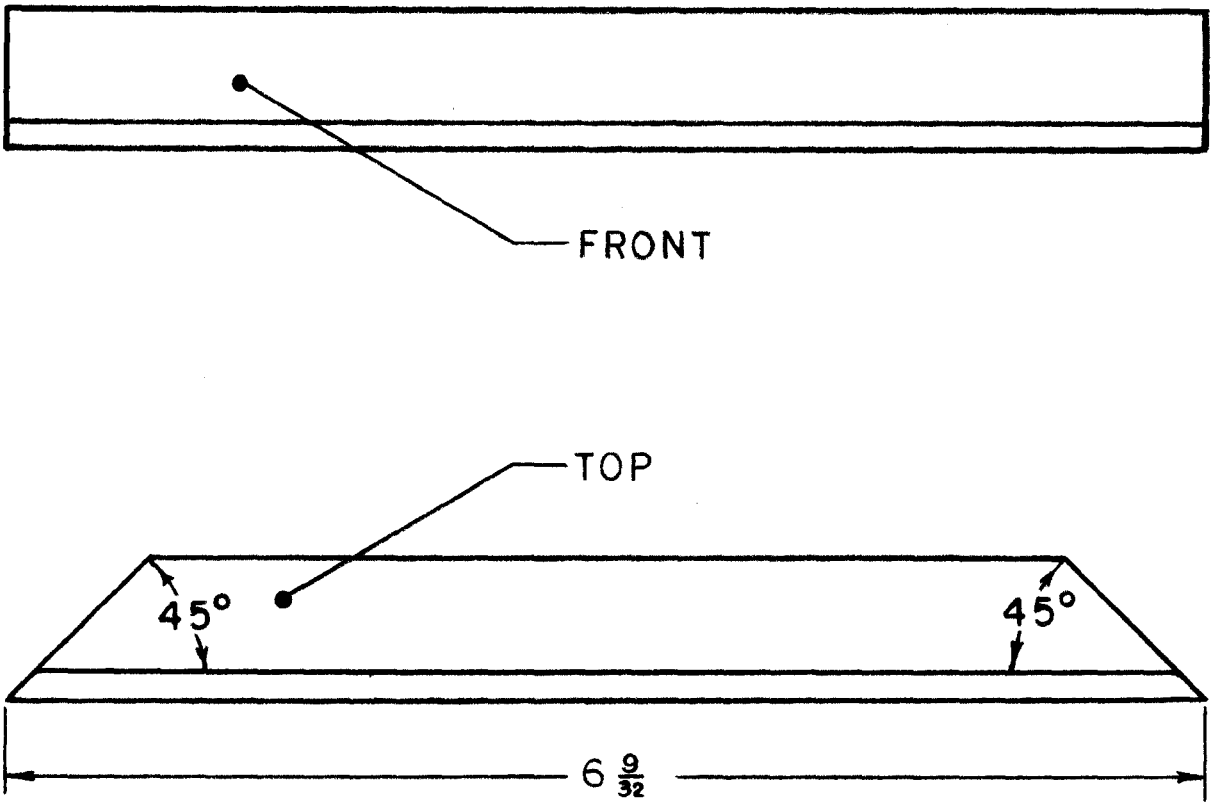
OLD DOMINION UNIVERSITY	TITLE: TEMPLATE	SCALE: 1/2 - 1	NO: 7
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-6	I A E





MATERIAL: SPACER $\frac{3}{4}$ HOT ROLL STEEL ANGLE
BRACE $\frac{1}{2}$ HOT ROLL BAND IRON

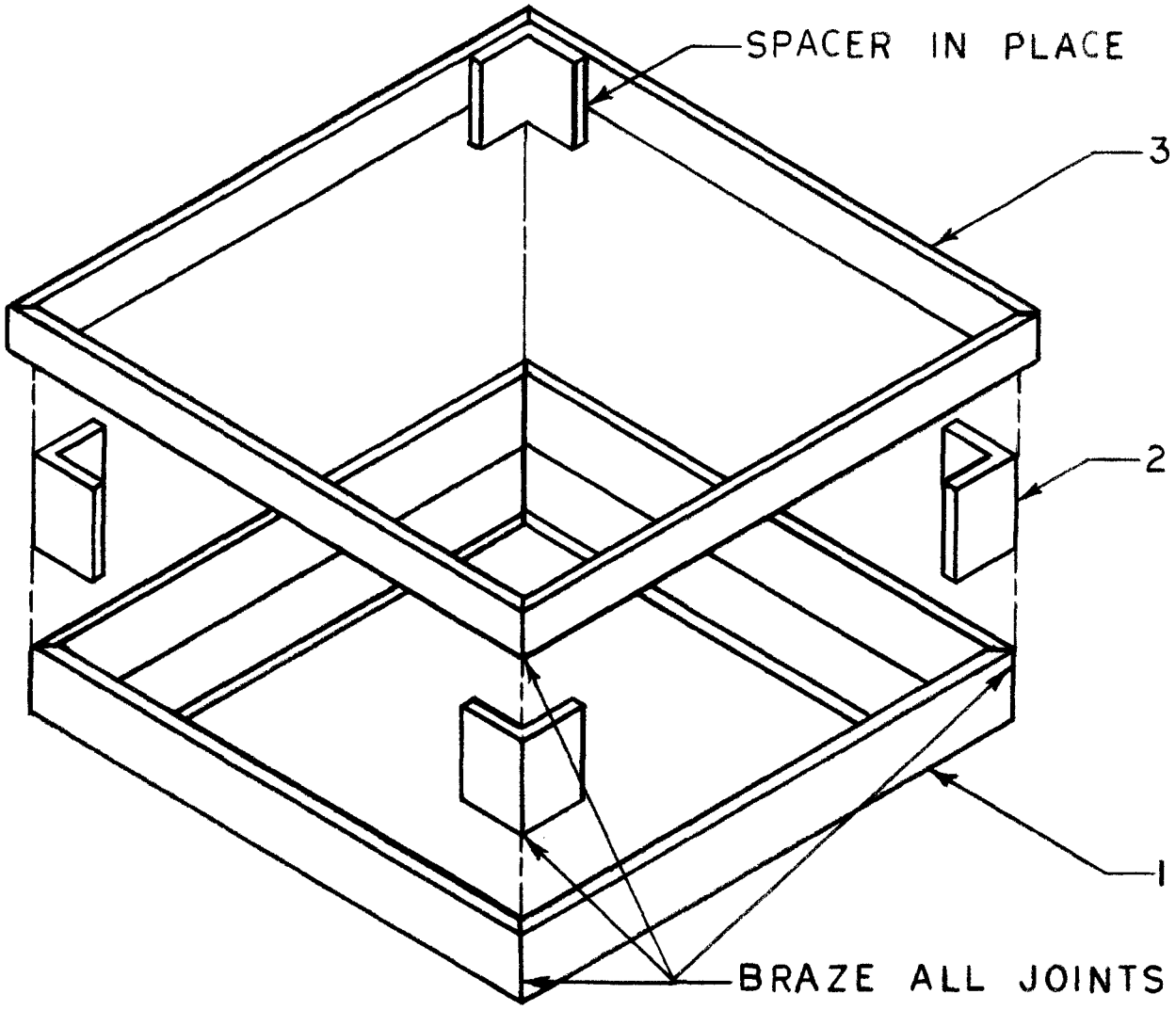
OLD DOMINION UNIVERSITY	TITLE: DRILL JIG	SCALE: 1-1	NO: 4
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-8	IAE



FOUR REQUIRED, FORM SQUARE AND BRAZE

MATERIAL: HOT ROLL $\frac{3}{4}$ STEEL ANGLE

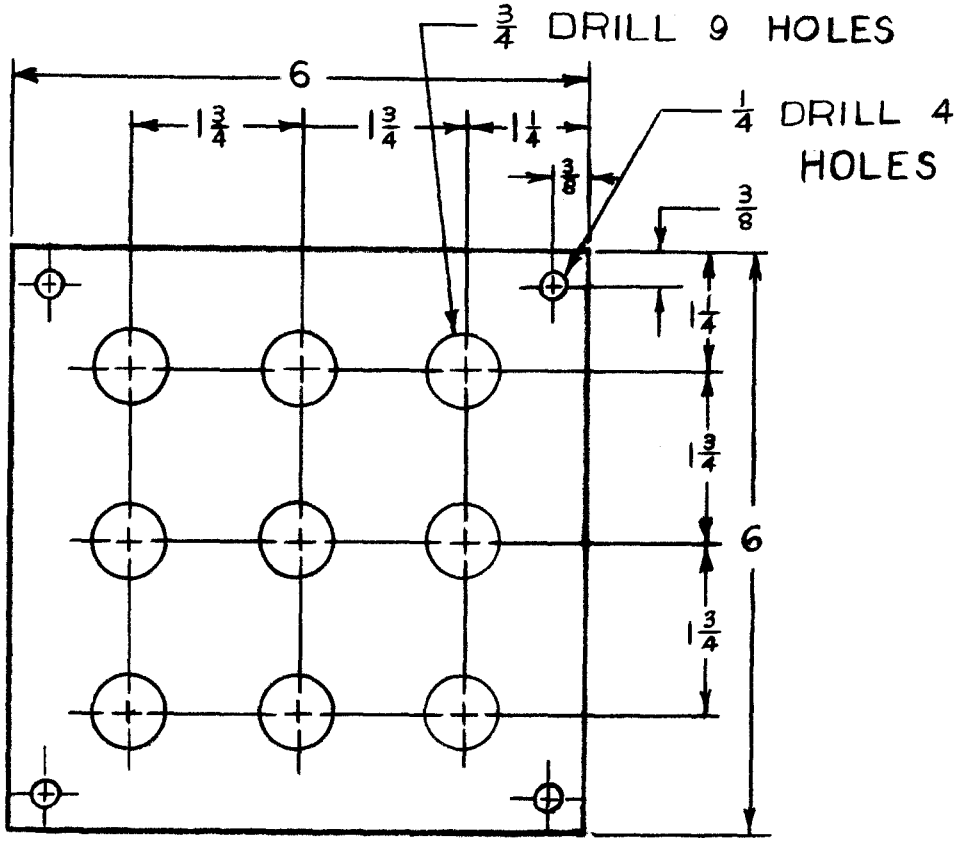
OLD DOMINION UNIVERSITY	TITLE: DRILL JIG BASE	SCALE: 1 - 1	NO: 5
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7 - 9	IAE



MATERIAL: PART NO. 1 $\frac{3}{4}$ HOT ROLL STEEL ANGLE
PART NO. 2 $\frac{3}{4}$ HOT ROLL STEEL ANGLE
PART NO. 3 $\frac{1}{2}$ HOT ROLL BAND IRON

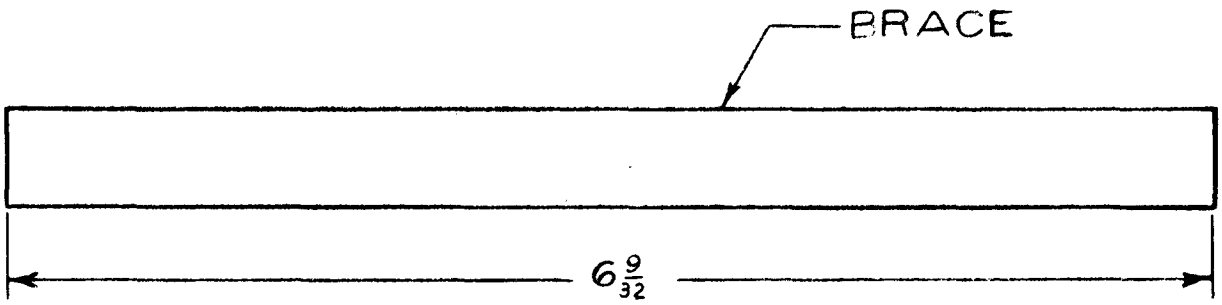
REF. NO.	REQ. NO.	PART NUMBER	DESCRIPTION
3	4	3	BRACE
2	4	2	SPACER
1	4	1	BASE

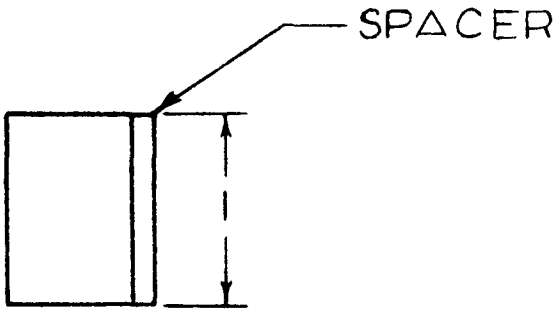
OLD DOMINION UNIVERSITY	TITLE: DRILL JIG	SCALE: $\frac{1}{2}$-1	NO: 6
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-11	IAE



MATERIAL: 1 PIECE 1/8 SHEET STEEL

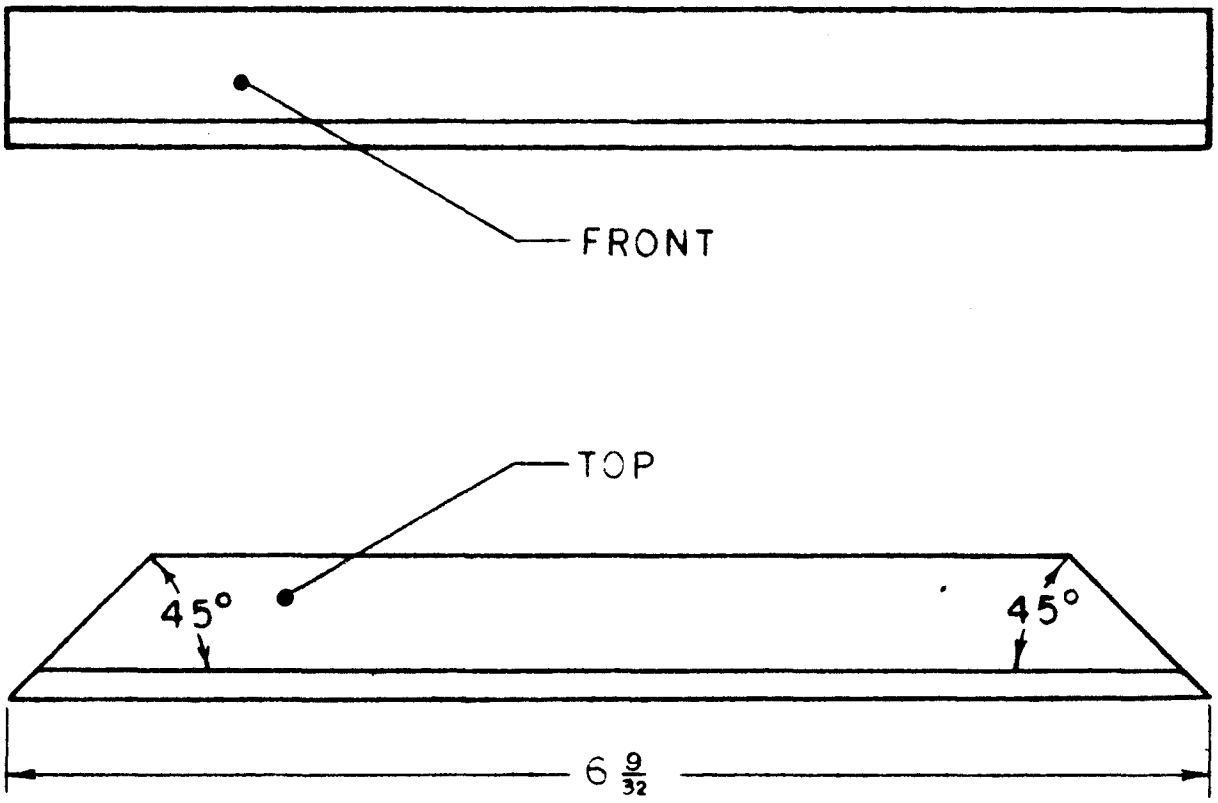
OLD DOMINION UNIVERSITY	TITLE: TEMPLATE	SCALE: 1/2 - 1	NO: 7
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-7	IAE





MATERIAL: SPACER $\frac{3}{4}$ HOT ROLL STEEL ANGLE
BRACE $\frac{1}{2}$ HOT ROLL BAND IRON

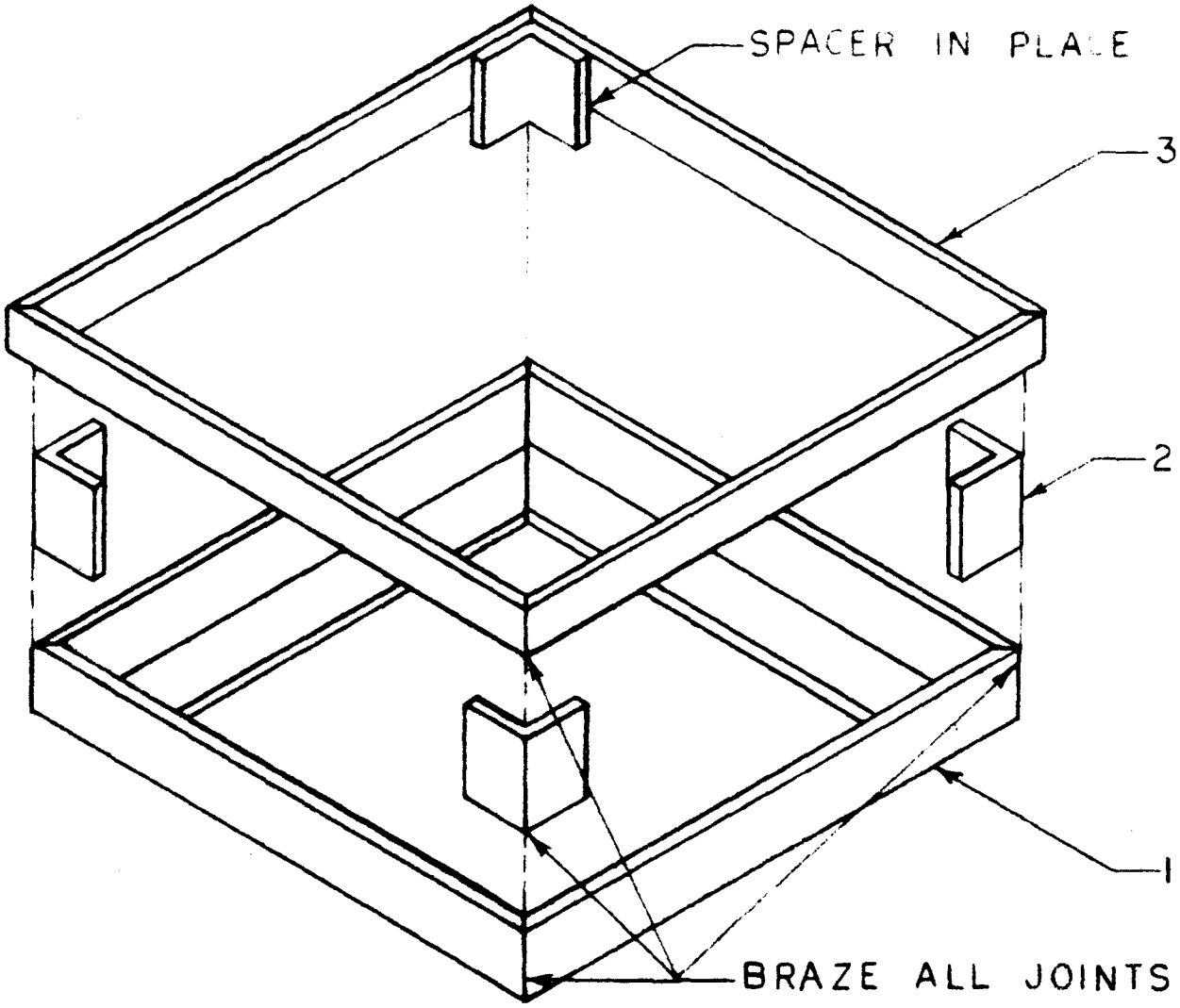
OLD DOMINION UNIVERSITY	TITLE DRILL JIG	SCALE: 1-1	NO: 4
INDUSTRIAL ARTS DEPT	DR BY: PAUL COUSSENS	DATE: 7-8	IAE



FOUR REQUIRED, FORM SQUARE AND BRAZE

MATERIAL: HOT ROLL 3/4 STEEL ANGLE

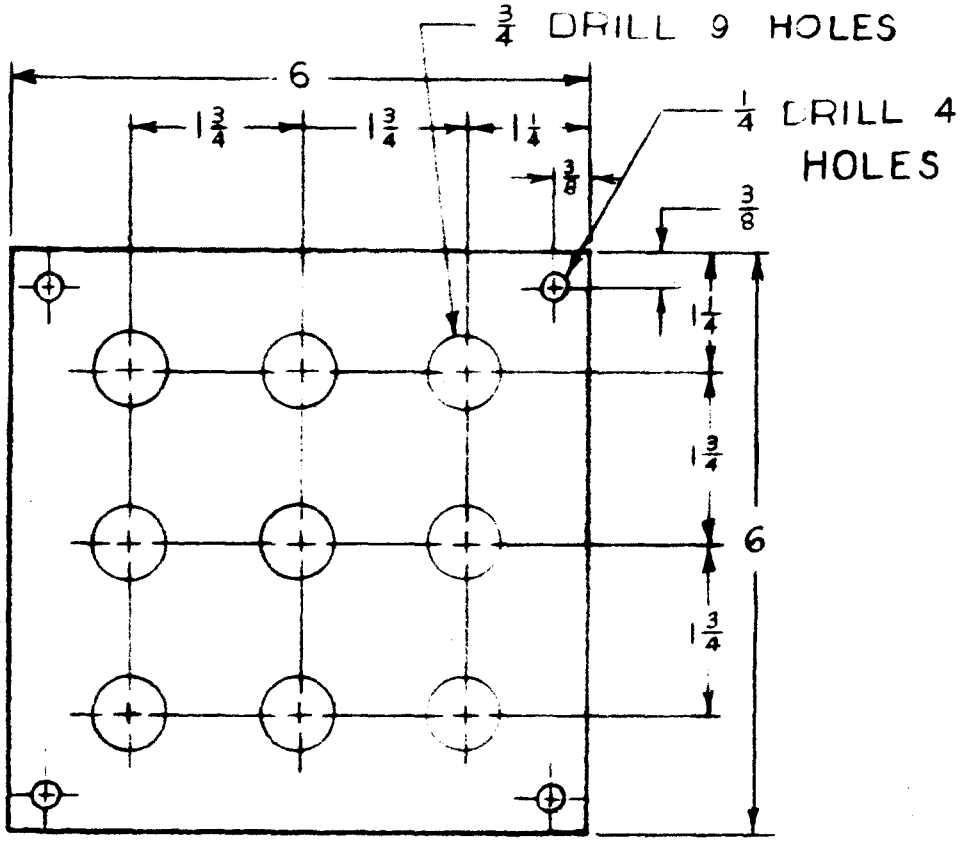
OLD DOMINION UNIVERSITY	TITLE: DRILL JIG BASE	SCALE: 1 - 1	NO: 5
INDUSTRIAL ARTS DEPT	DR. BY: PAUL COUSSENS	DATE: 7 - 9	IAE



MATERIAL: PART NO. 1 $\frac{3}{4}$ HOT ROLL STEEL ANGLE
PART NO. 2 $\frac{3}{4}$ HOT ROLL STEEL ANGLE
PART NO. 3 $\frac{1}{2}$ HOT ROLL BAND IRON

REF. NO.	REQ. NO.	PART NUMBER	DESCRIPTION
3	4	3	BRACE
2	4	2	SPACER
1	4	1	BASE

OLD DOMINION UNIVERSITY	TITLE: DRILL JIG	SCALE: $\frac{1}{2}$-1	NO: 6
INDUSTRIAL ARTS DEPT.	DR. BY: PAUL COUSSENS	DATE: 7-11	IAE



MATERIAL: 1 PIECE 1/8 SHEET STEEL

OLD DOMINION UNIVERSITY	TITLE: TEMPLATE	SCALE: 1/2 - 1	NO: 7
INDUSTRIAL ARTS DEPT	DR BY PAUL COUSSENS	DATE: 7-7	IAE

FINAL REPORT

MULTI-DINENSIONAL TIC TAC TOE GAME PRODUCTION KIT

INDUSTRIAL ARTS COURSE NUMBER 395

Paul H. Coussens

July 16, 1974

A. Description of the purpose of the research:

The purpose of the research was to develop a product similiar to the copyrighted Tri Tac Toe Game that would be simple to manufacture using industrial production line methods by Jr. High, Senior High School, and College level students. It must be inexpensive to build, practical for recreational purposes, and be visually colorful and attractive as a conversation piece in the home. Even though the cost ($3.98) is greater than originally, the value of this product far surpasses the expense to produce.

Main Features:

Originally the Single Cell Survey was selected as one of the research methods best suited for analyzing the problem. After attempting to apply the method to my research, I found that it was applicable to too large an area of research than my problem required. A derivative of the Single Cell Survey known as the Single Cell Investigation Method was then selected which fitted my need precisely.

The Single Cell Investigation is primarily used to extract desired data concerning a small and specific group of humans. The same type of data is collected on each member of the group.

In the research concerning this problem the Single Cell Investi gation technique has been applied in extracting data (such as dimensions, materials, shapes, colors, similiarity of parts, peculiarities, relationships of parts to each other as well as to the whole product, etc) from the parts as well as the whole sample unit.

The Activity Analysis Method or reasearch was applied to the investigation of the best design for a drilling rig. Considerations

investigated were durability, ease and simplicity of use where "Murphy's Law" (mistakes) is least applicable, automatic rejection of components exceeding specified tolerances, jig produced items are within accurate tolerances so that they can be used in a mass production invironment.

Activity Analysis was used to select the sequence of manufacturing kit parts, the number of persons assigned to each task and, in the assembly stage, the sequence of the assembly steps as well as the number of people required to perform each step.

The result of this analysis is the Production Flow Chart located on page

Limitations:

Reasearch provided me with the information that brazing heat distorted the metal frame of the drilling jig. It did not provide the solution to preventing the distortion of the frame. However, it did provide the grinding solution to produce a correct fit.

B. Description of operation of the research:

As related in section A, page , all parts of the sample Tri Tac Toe game were analyzed in detail. They were measured, materials determined, colors, shapes, holes located and other pertinent details were observed and recorded. The first group of readings were of such odd values that a micrometer was employed to make accurate observations. Since the measurements were not of connonly used dimensions, and the assembly was of Japanese construction, it was determined that the measurements were in the Metric System. Centimeters were converted directly to inches where possible with ease. All other measurements were

altered to sizes that were easily used inches.

The bolts used in the model assembly were a near 5/32 " in diameter. A check was made with every hardware, Building Supply Co., Steel Supply Co., Construction Steel Co., and several Hobby Shops in Portsmouth, Cheasepeake, Norfolk, and Virginia Beach but no round stock of this size was available. Three-sixteenths round stock was too large for the previously purchased tubing. Research revealed that by purchasing pre-threaded 3/16" round steel stock, the tubing would fit. This stock is plentiful locally.

Research toward developing a drilling jig for drilling exact holes in 3 or more acrylic shelves simultaneously began with a "dreamed-up model" from my own head. After mentioning jigs to Mr. Buchanan, he showed me a wooden jig he had manufactured for drilling holes very much like the ones I wished to drill. His jig was constructed of wood and required that the holding blocks or the material to be drilled be turned or both each time a hole is drilled. This, in my opinion, left too much room for error and required too many changes. My "brain child" was to be contructed of metal and would involve one drill change.

My drilling jig was to be manufactured with a solid base of one-eighth plate steel with 3/4 angle iron spacers for guides. A template, also of one-eighth steel plate, fit inside the frame on top of the material to be drilled and acts as a guide for the drill.

My plans were discussed with Mr. Deal and he felt that the jig would be more rigid and heavy than was required. After accumulating most of the required materials, I agreed. Plans were then altered to those identified in the drawings on pages 23 through 25. The

template is located on page 26.

The final area of research, manufacture and assembly of the parts for the Multi-Dimensional Tic Tac Toe Kit, involved timing the fabrication of each part and perfecting the assembly time and procedure for the kit by checking the actual operations. The number of students required to perform each operation is based upon times recorded for the operation and calibrated (as far as possible) to have each part arrive at the proper assembly stage at the most expeditious time. Since we are dealing with humans and the production schedule is still unvalidated, except by research, the data is guess work.

C. Charts and performance data on the research:

The charts consists of sketches, production drawings, and production blueprints shown on pages 5 through 26 of the Research Report. The flow chart is attached as page . The performance data is contained in the flow chart and the cost sheet located on the following page.

M-D Tic Tac Tpe Game Parts

Cost Sheet

No. Req.	Nomenclature	Supply Source	Unit Cost	Total Cost
4	Bolts, steel	Renolds Hardware	$.094	$ .38
8	Nuts, Cap, steel	Any Hardware	.10	.80
8	Tubing Acrylic (Plastic)	IAD, ODU	.04	.32
3	Shelves, Acrylic	IAD, ODU	.36	1.08
27	Marbles	Most Hobby Centers	.052	1.40
		Total		$3.98

D. No additional references materials were used.

E. Personal evaluation of problem:

The problem is an excellent exercise providing valuable experience in design analysis, material identification, selection, and dimensioning, drafting techniques, design development, motion study, selecting and utilizing various research methods, production and assembly sequences, cost evaluation and materials source identification.

Recommendations for further study:

The following recommendations are submitted:

1. Evaluate the design of the drilling jig with the intent to improve its efficiency and reduce its weight.

2. Perform an operational time study on both the construction and the assembly phases of the Kit to determine the time required for students to complete their operations. At least six classes should be timed. Adjust the number of students performing each operation in accordance with the time required to provide the most efficient flow of production toward a completed unit.

3. If an evaluation indicates a need, additional drilling jigs should be manufactured. At least three jig are necessary if the drill presses are available.

4. Other like components that may provide good subjects for Production Kits should be investigated and evaluated.