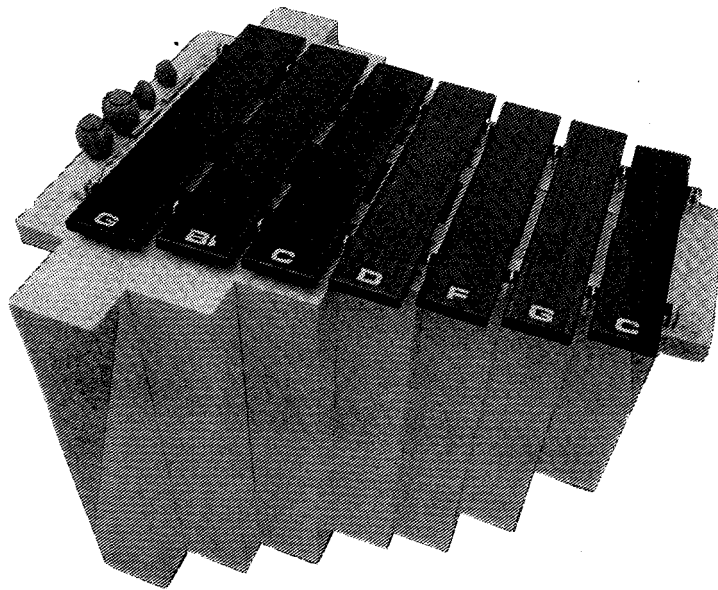


Melodic Bar Percussion Science

RHYTHMIC BASS MARIMBA (7-Note Configuration)

Engineering Design Specification



Christopher Banta

Document Update History

- Initial Release - May 1991
- First Revision - June 1992

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1 INTRODUCTION

This Engineering Design Specification describes the information used in the design and construction of a class of mallet percussion instrument known as a "Rhythmic Bass Marimba".

This document is divided into two sections. The first section, which is divided into eight chapters, contains information relevant to the instrument's design and its components. The second section, in appendix form, contains pure engineering data necessary to the instrument's functional fabrication.

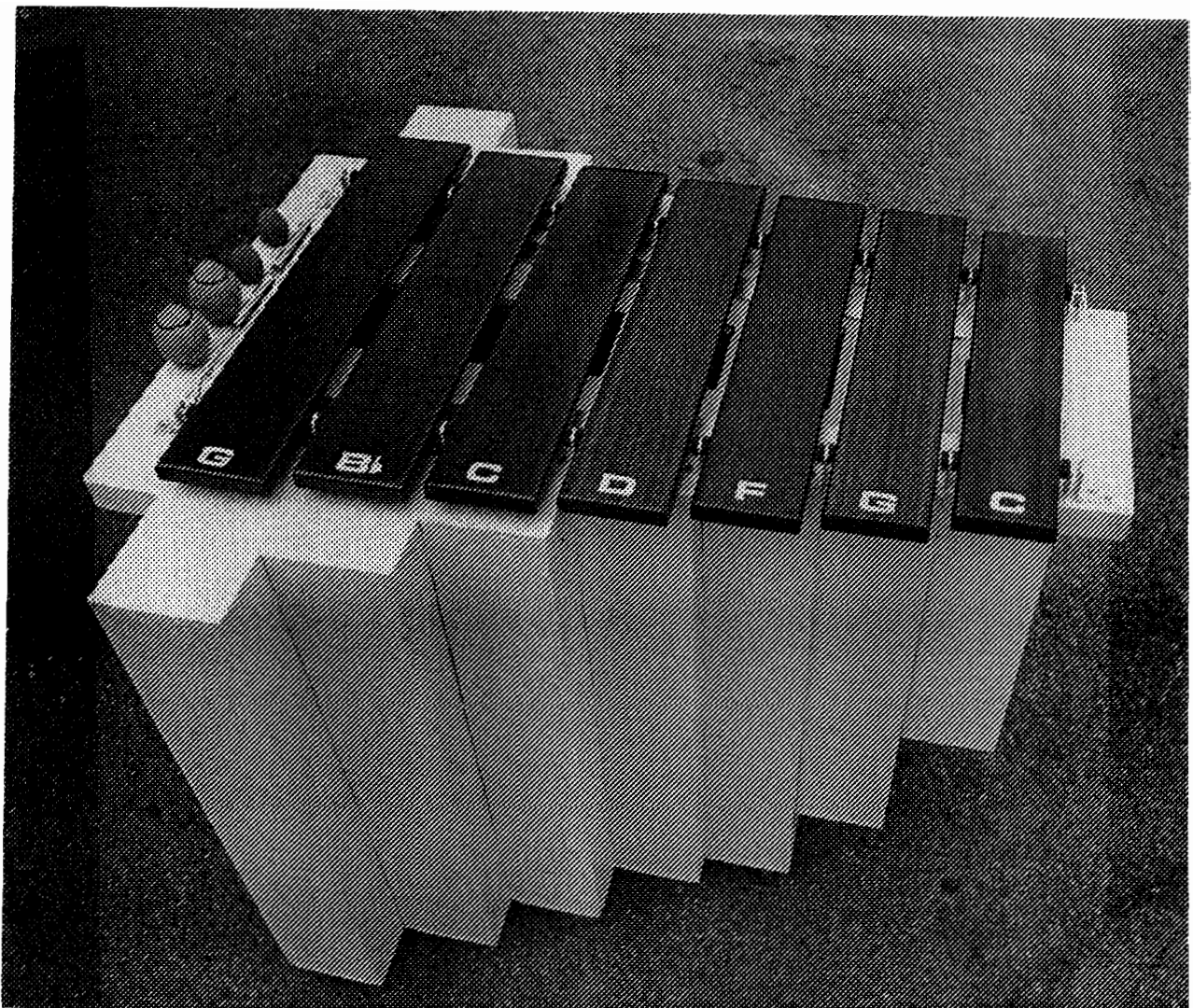
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2 INSTRUMENT DESCRIPTION

The following is an Engineering definition of the Rhythmic Bass Marimba:

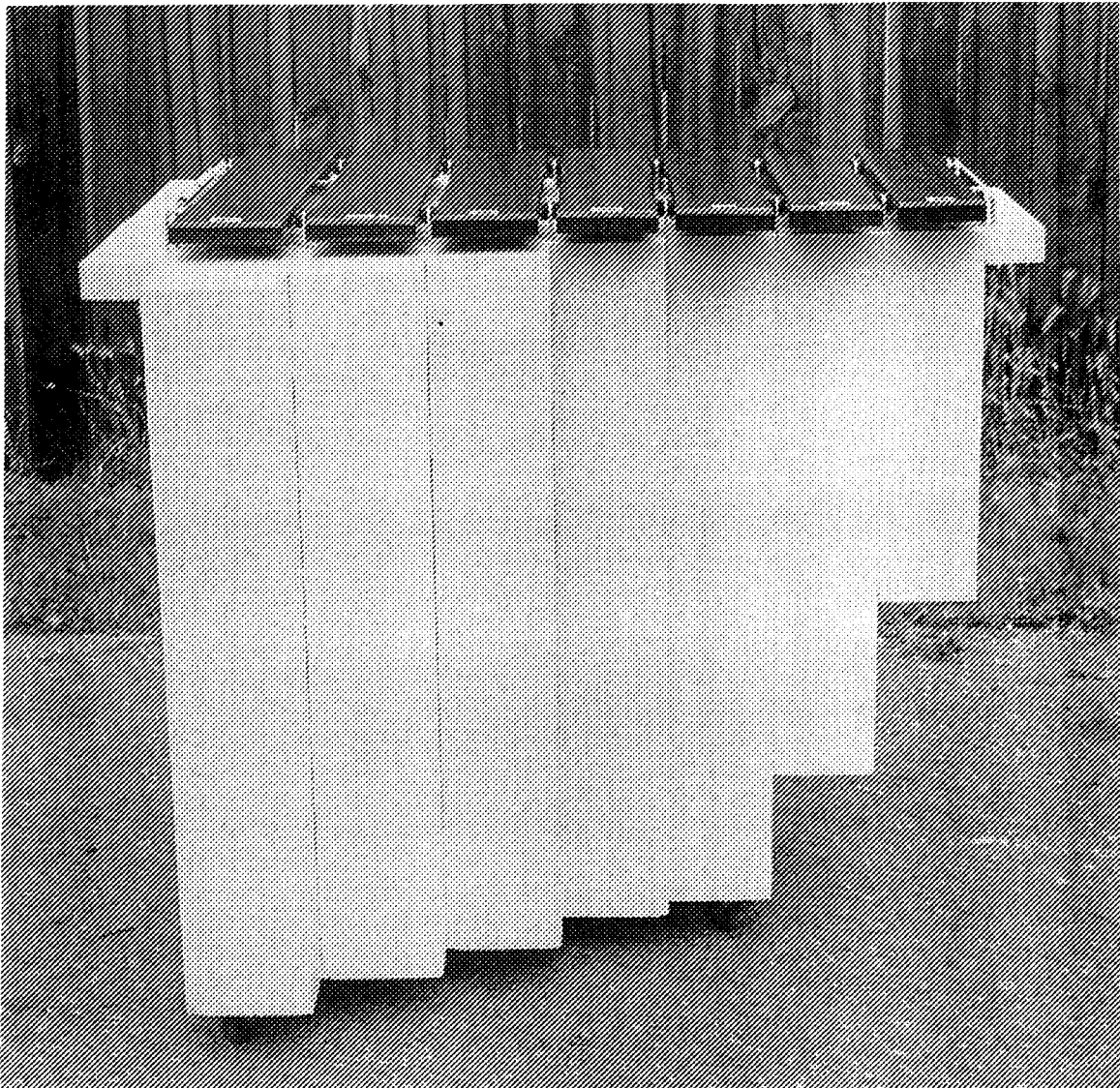
The Rhythmic Bass Marimba shall contain seven notes to match the Western Scale pitches of G, B-flat (A#), C, D, F, G, and C. The frequency of 49.99 Hz shall be assigned to the low G, and the frequency of 130.8 Hz shall be assigned to the high C as derived from the pitch standard of A-440 Hz. The bars shall ascend in frequency from left to right when facing the performer, and shall have a space not exceeding 3/4" between each note. The frequency of each bar shall be acoustically amplified through resonance with the aid of a cavity (or Helmholtz) resonator. Each resonator shall be constructed in a shape that allows its opening to sit directly beneath the center of its corresponding bar. Resonators shall be ganged together to create a single unit, and to provide a foundation from which the bar suspension system can be mounted. The bars shall be contained at their fundamental node points using a taught cord. Casters shall be used to make the instrument mobile.

2 INSTRUMENT DESCRIPTION (continued)



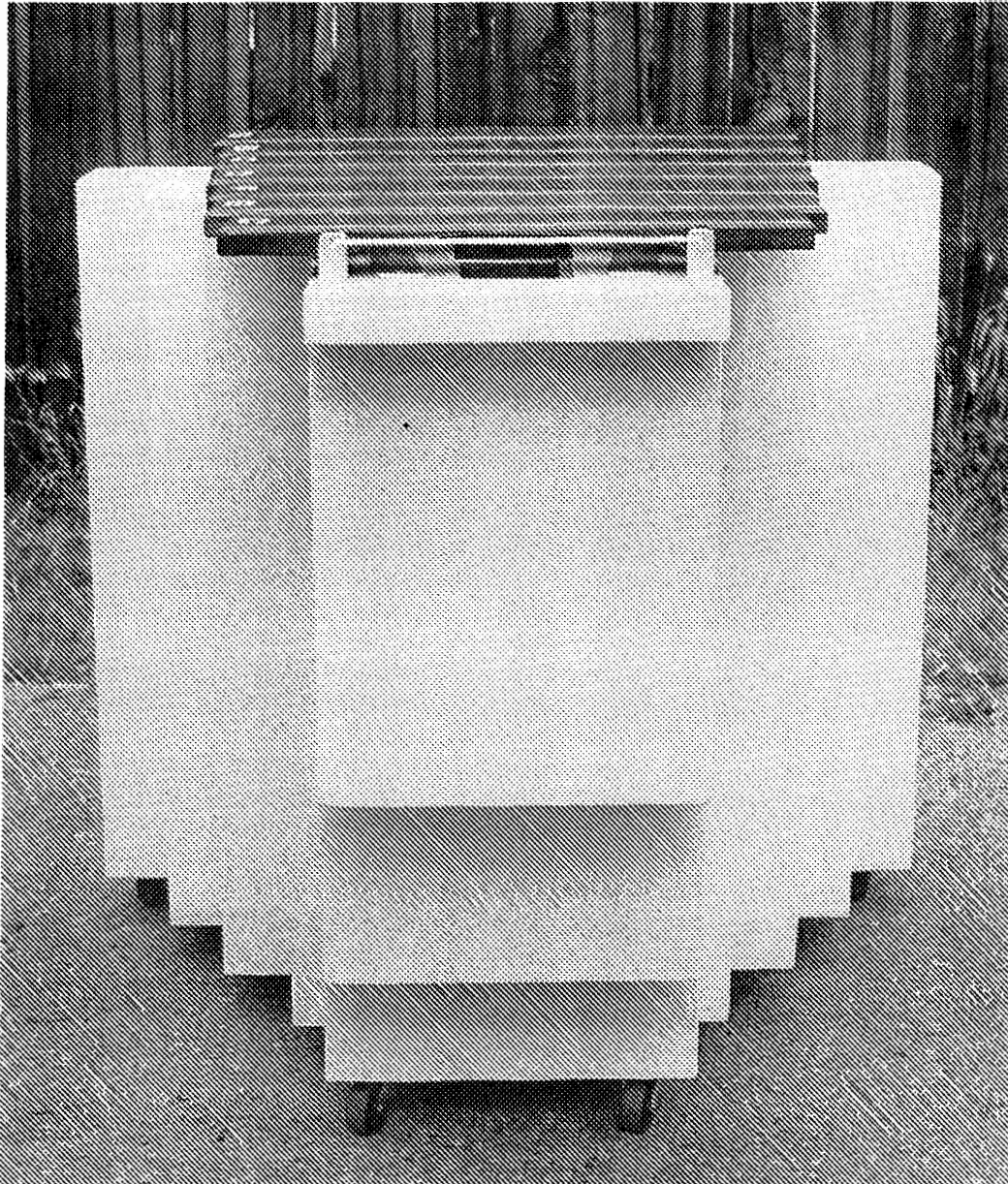
Rhythmic Bass Marimba (Perspective View)

2 INSTRUMENT DESCRIPTION (continued)



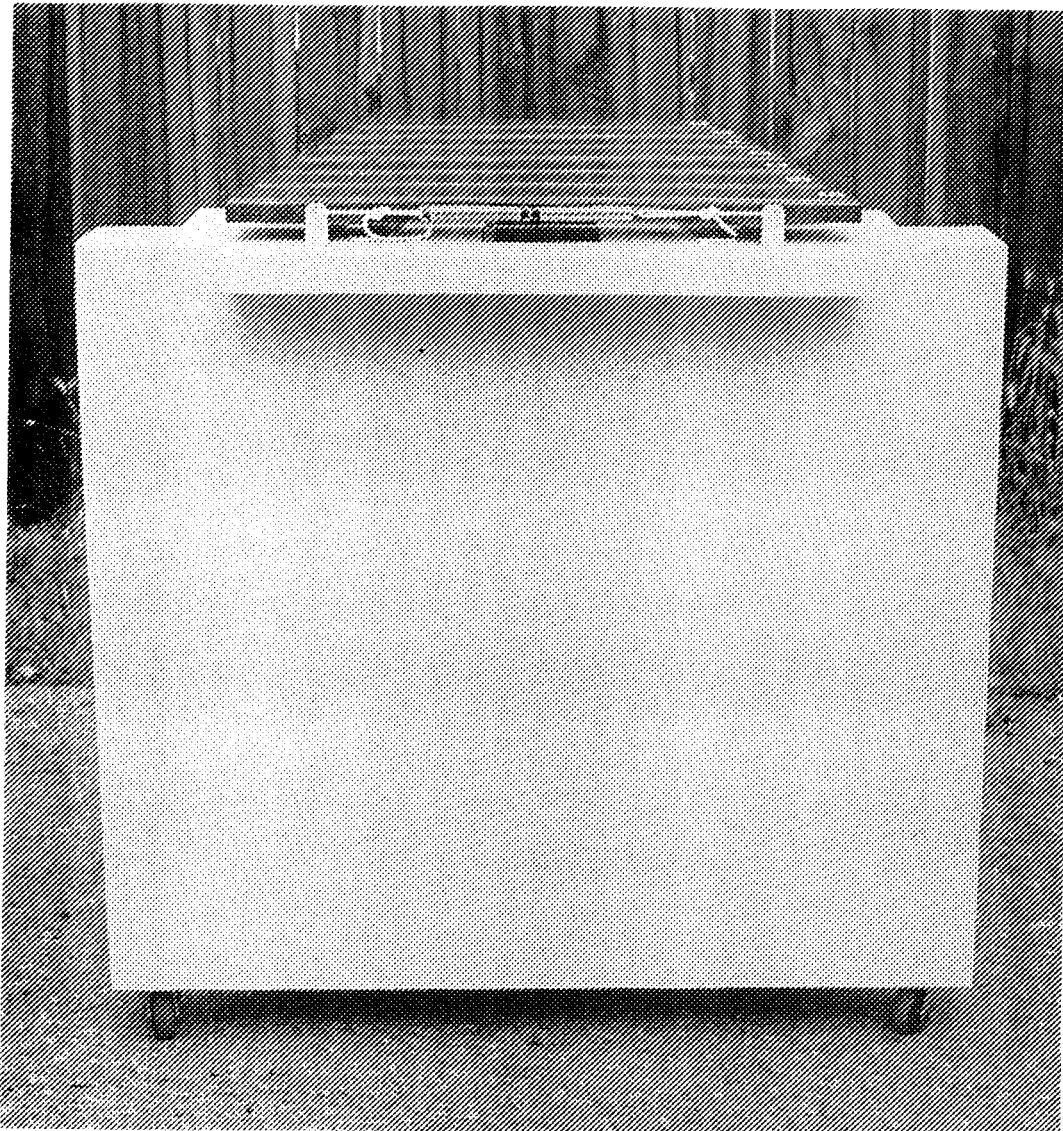
Rhythmic Bass Marimba (Rear View, player's side)

2 INSTRUMENT DESCRIPTION (continued)



Rhythmic Bass Marimba (Right-Side View)

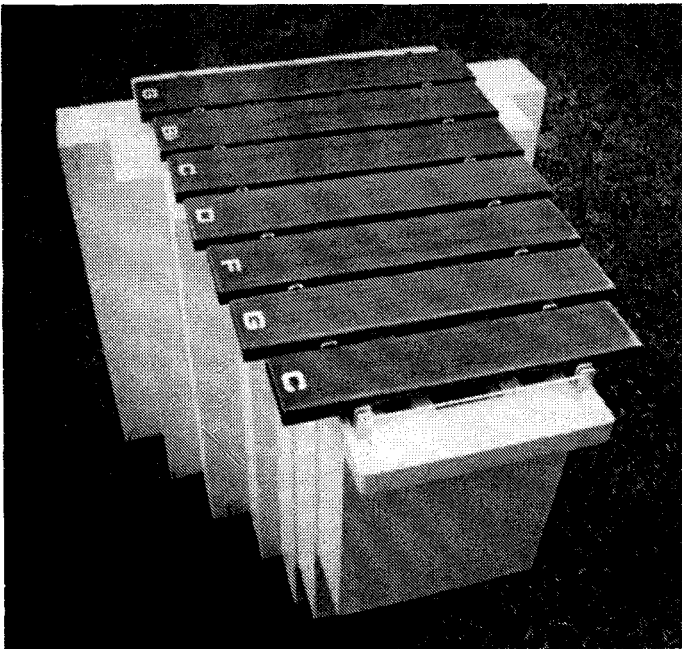
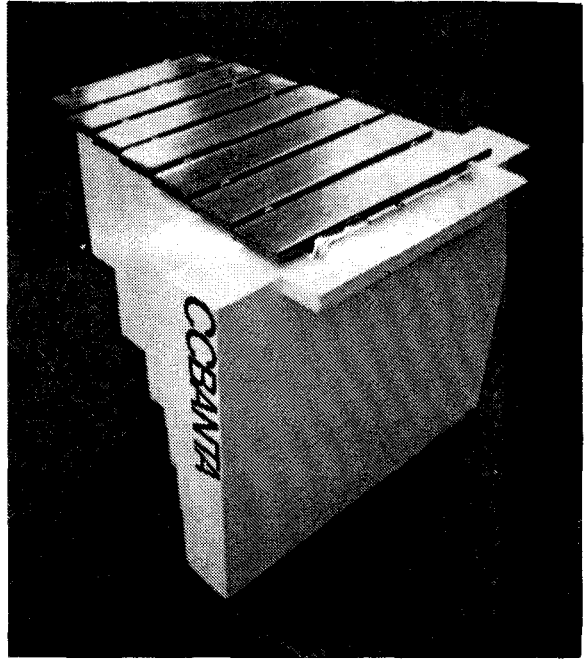
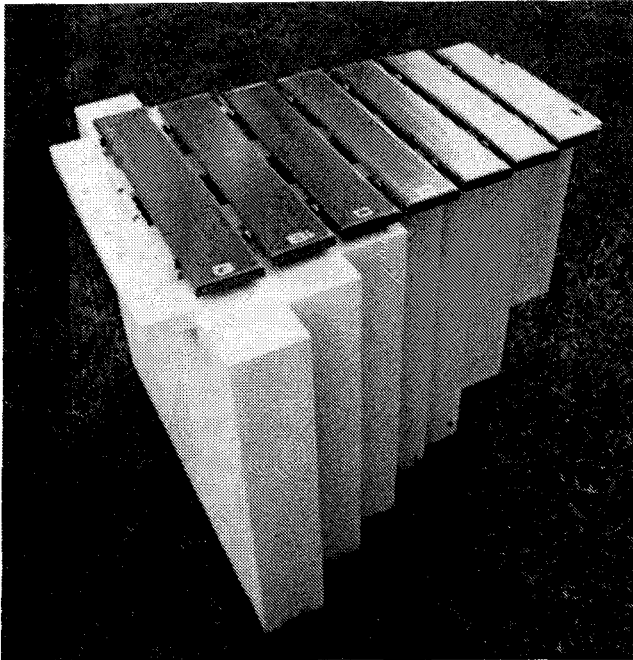
2 INSTRUMENT DESCRIPTION (continued)



Rhythmic Bass Marimba (Left-Side View)

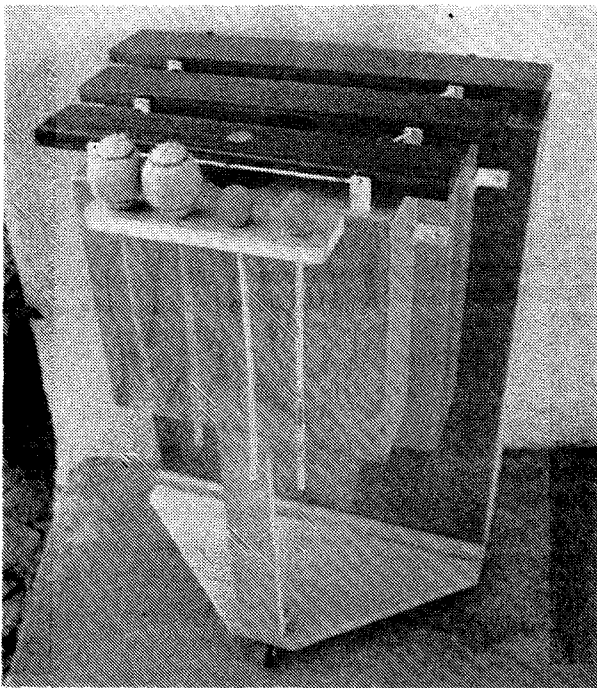
2 INSTRUMENT DESCRIPTION (continued)

Miscellaneous Views



3 INSTRUMENT'S PURPOSE AND USE

The idea for the Rhythmic Bass Marimba came from an early three-note marimba that was assembled from old resonators and bars in the author's shop. The three notes were Cello C (65.4Hz), G (97.99Hz), and Tenor C (130.8Hz). The instrument measured 34" High, by 23" wide, by 17-3/4" deep.



3-Note Rhythmic Bass Marimba

As an expanded version of the three-note instrument, the *Rhythmic Bass Marimba* was designed to explore the rhythmic possibilities

3 INSTRUMENT'S PURPOSE AND USE (continued)

within a small ensemble. Its *single-line* bar layout was employed to simplify the execution of rhythmic beats while suggesting certain tonalities or key centers. Since the instrument was not designed with *chromatic* notes, linear "walking" lines are not possible.

Pitch Rationale

The pitches of G, B-flat, C, D, F, G, and C were chosen so the instrument could support music played in three widely used keys; C, F, and G. The following table provides a breakdown of key usage:

RHYTHMIC BASS MARIMBA NOTE AND KEY COMPLIMENT				
KEY	TONIC (I)	II	SUB-DOMINATE (IV)	DOMINATE (V^7)
C	C	D	F	G
F	F	G	B-flat	C
G	G	-	C	D
B-flat	B-flat	C	-	F

NOTE: The I/IV/ V^7 progression is useful for the blues. The II/ V^7 /I progression is useful for phrasing resolution in jazz.

3 INSTRUMENT'S PURPOSE AND USE (continued)

Two notes are doubled up; C and G. This allows the performer to play rhythmic lines requiring higher notes for contrast and to eliminate the *drone* effect that occurs when playing on a single for long periods of time.

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4 INSTRUMENT SPECIFICATIONS

Physical Characteristics

Height: 36"
 Depth: 35-7/8"
 Width: 40-5/8"
 Weight: 130 lbs.

Materials

Bars: African Padouk
 Resonators: 3/8" plywood, 3/4" particle board, 5/8" doweling
 Miscellaneous: Various screws, extruded aluminum parts

Musical Characteristics

Number of Notes: 7
 Pitch Standard: A = 440 Hertz
 Pitch Range: G1 to C3 (GGG to C)
 Frequencies (Hz):

G	-	48.99
B-flat (A#)	-	58.27
C	-	65.40
D	-	73.42
F	-	87.31
G	-	97.99
C	-	130.80

Musical Range:



4 INSTRUMENT SPECIFICATIONS (continued)

Instrument Assembly

Completion Date: May 27, 1991

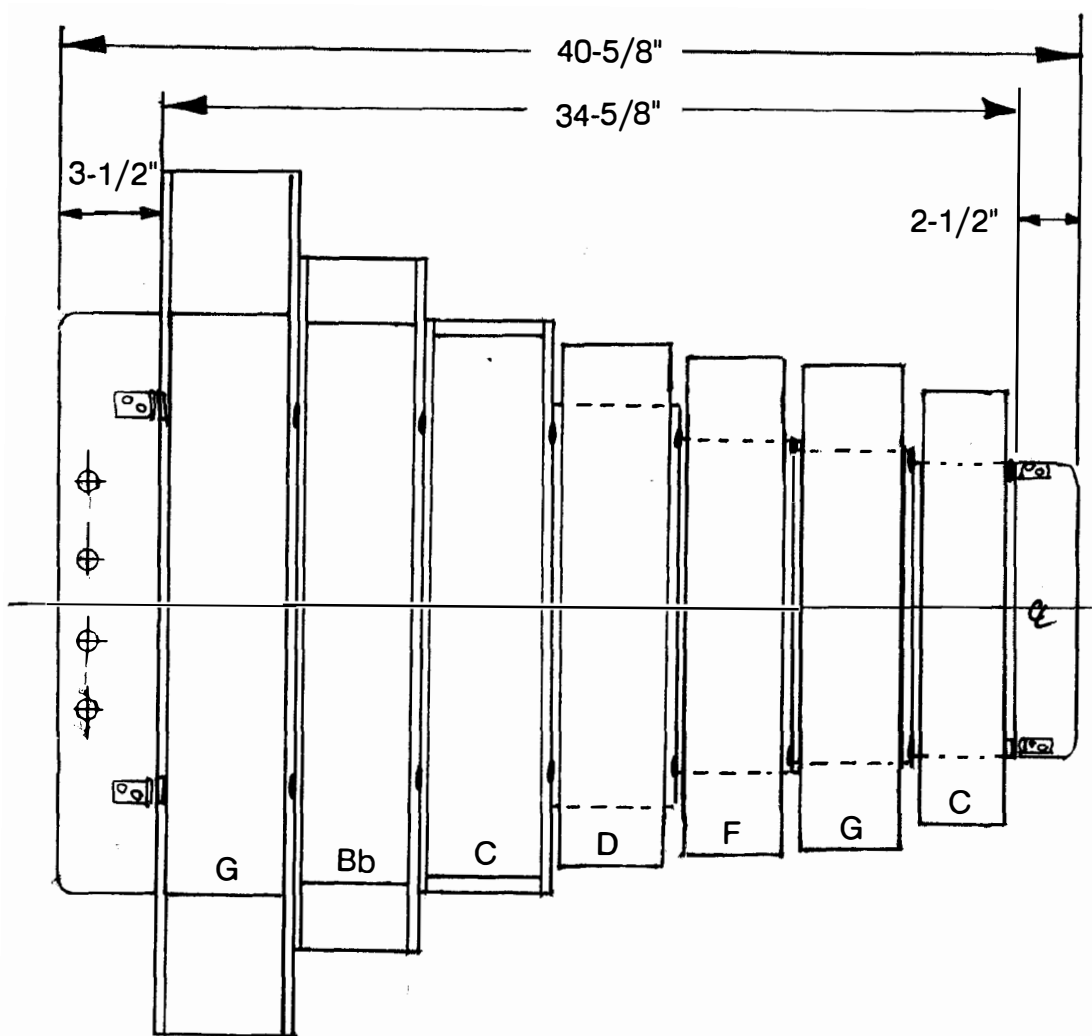
Construction Time: 32 hours

5 ORTHOGRAPHIC PROJECTIONS

Orthographic projections provide views of the instrument from three different angles. The TOP view is used for showing instrument *width*. The REAR view is used for showing instrument *height*. The RIGHT-SIDE view is used for showing instrument *depth*. Width, height, and depth dimensions are used to establish the instrument's *envelope* which is useful for overall sizing and placement concerns.

5 ORTHOGRAPHIC PROJECTIONS (continued)

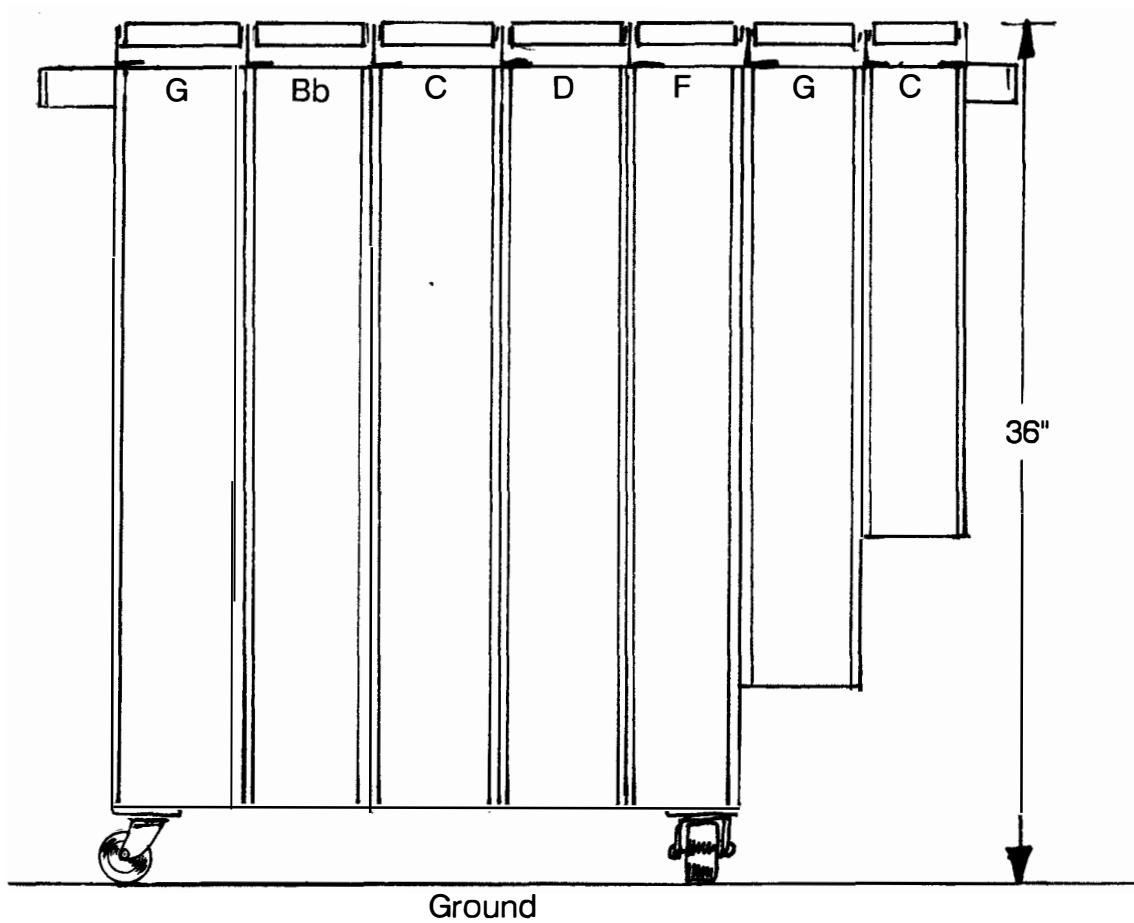
TOP VIEW (showing width)



SCALE: 1-1/2" = 1 Foot

5 ORTHOGRAPHIC PROJECTIONS (continued)

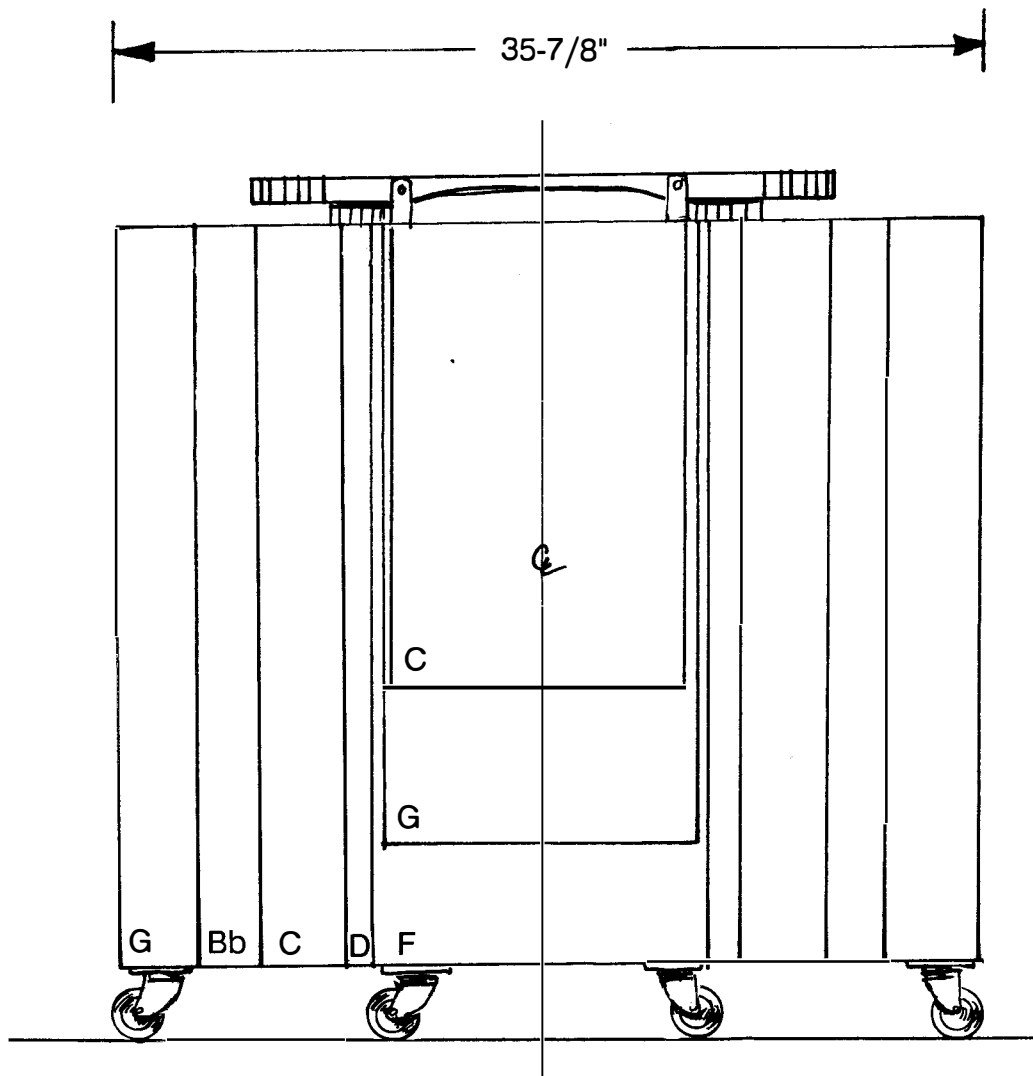
REAR VIEW (showing height)



SCALE: 1-1/2" = 1 Foot

5 ORTHOGRAPHIC PROJECTIONS (continued)

RIGHT-SIDE VIEW (showing depth)



SCALE: 1-1/2" = 1 Foot

6 BAR DATA

Physical Data

Material: African Padouk
 Material Thickness: 7/8"
 Bar Finish: Varithane (semi gloss or satin)

Bar Dimensions

PITCH	FREQ	WIDTH	LENGTH
(Note)	(Hertz)	(Inches)	(Inches)

G	48.999	4-5/8	24-3/8
B-flat	58.27	4-1/2	23-1/4
C	65.406	4-3/8	22-1/2
D	73.416	4-3/16	21-3/4
F	87.307	4-1/16	20-5/8
G	97.998	3-7/8	19-7/8
C	130.812	3-3/4	18

Tuning Accuracy (all bars)

1st Harmonic (fundamental) (1:1)	+2 -0 cents
2nd Harmonic (1:4)	+2 -0 cents
3rd Harmonic (1:10)	+5 -0 cents

6 BAR DATA (continued)

Mounting Holes

Hole Quantity: 2

Hole Location: 7/16" from the top, 7/16" from the bottom, with
holes placed at the bar's fundamental node points

Hole Size: 3/16" dia (with countersink for ease of cord
insertion)

Pitch Identification

Press-on Lettering: Microgramma, bold, 72 pt. (3/4"), white

Location: Front of bar facing performer, 1/2" from end,
centered.

7 RESONATOR DATA

Materials

Resonator sides (width):	3/8" plywood
Resonator top/bottom/sides (depth):	3/4" particle board
Resonator Box Finish:	Flooring enamel, high-gloss, "Navajo White"

Resonator Box Dimensions

PITCH (Note)	FREQ (Hertz)	OPENING DIMENSIONS (Inches)	OPENING AREA (Sq. In.)	RESONATOR DIMENSIONS - OD (H x W x D) - ID (Inches)	RESONATOR BOX VOLUME (Cu. In.)
G	48.99	4-5/8 x 4-5/8	21.39	31 x 35.89 x 5.38 (29.5 x 34.39 x 4.625)	4,692.7
B-flat	58.27	4-1/2 x 4-1/2	20.25	31 x 28.8 x 5.25 (29.5 x 27.3 x 4.5)	3,623.9
C	65.406	4-3/8 x 4-3/8	19.14	31 x 23.17 x 5.13 (29.5 x 21.66 x 4.375)	2,796.4
D	73.416	4-3/16 x 4-3/16	17.54	31 x 16.82 x 4.94 (29.5 x 15.32 x 4.1875)	1,892.6
F	83.307	4-1/16 x 4-1/16	16.5	31 x 13.66 x 4.81 (29.5 x 12.16 x 4.0625)	1,457.34
G	97.99	3-7/8 x 3-7/8	10.65	25 x 13.0 x 4.625 (23.5 x 11.5 x 3.875)	1,050.00
C	130.81	3-3/4 x 3-3/4	14.06	19.80 x 12.5 x 4.50 (18.30 x 11.00 x 3.75)	754.98

Tuning Accuracy

Fundamental: + 10 -0 cents

7 RESONATOR DATA (continued)

Opening Info

Opening Placement: Top center on resonators GGG thru C.

Stiffness Control

Bracing: 5/8" birch dowel, placed between large planes, from front to back.

8 MISCELLANEOUS DATA

Bar Containment

- Support Brackets: 1-1/2" x 1-1/2" x 1/8" aluminum angle, cut to 3/4" width (Qty 20)
- Mounting Screws: 3/4" x 8 flat-head phillips (Qty 2 per bracket)
- Spacing Control: Medium front-rail punchings (felt washers) (Qty 4 per bar)
- Suspension Cord: 9/64" nylon
- Taughtness Control: Extension coil springs (Qty 2)

Resonator Construction

- Glue: Alphatic Resin (yellow carpenter's glue)
- Nails: 1-1/4" finishing (3/8" plywood)
1-3/4" finishing (3/4" particle board)
- Stiffeners: 5/8" dia dowel

Instrument Assembly

- Resonator Interfaces: Friction fit using 1-1/2" x 1/8" x 34" aluminum strapping for containment (Qty 4: 2 top, 2 bottom).
- Mounting Screws: 3/4" x 8 flat-head phillips (Qty 14 per strap)

8 MISCELLANEOUS DATA (continued)

Mobility

Casters: 2" dia rubber (Qty 4), overall height 3"

Mounting Screws: 3/4" x 10 pan-head phillips (Qty 4 per caster)

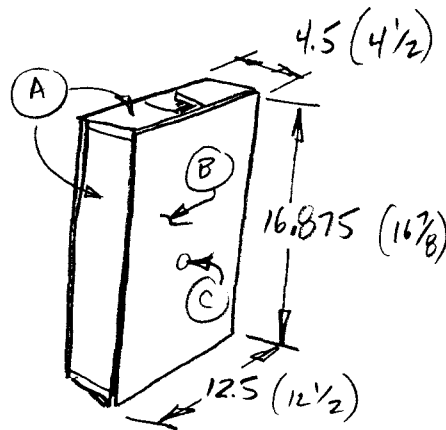
APPENDIX A

Additional Design Data and Analyses

CAVITY RESONATOR DATA SHEET

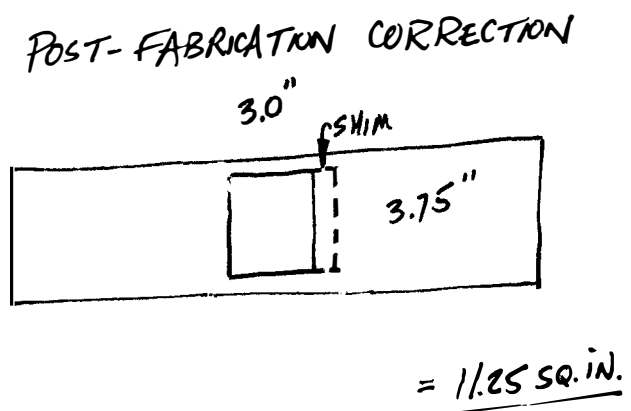
C³VOLUME (Inside Dimensions)Height (inches) 15.375 (15 3/8)Width (inches) 11.00Depth (inches) 3.75 (3 3/4)Calculated Volume (cu in) 634.218OPENING AREAShape: Round Diameter (inches) Shape: Square Rectangular XLength (inches) 3.437 (3 7/16)Width (inches) 3.75 (3 3/4)Calculated Area (sq in) 12.89RESONANT FREQUENCYMeasured Frequency (Hertz) 136.6Pitch (Note) C# (Cents) -25Calculated Factor: 1815.544ADDITIONAL ATTRIBUTES

Materials (Thicknesses)

(A) TOP, BOT, ENDS - 3/4" PARTICLE BD.(B) SIDES - 3/8" PLYWOODBracing: YES X NO Type 5/8" DIA BIRCH DOWELING (C)
Qty 1Other Information: NAILS: 1 3/4" PARTICLE BD
(FINISHING) 1 1/4" PLYWOODILLUSTRATION

CAVITY RESONATOR DESIGN ENVIRONMENTPitch: **C3**Factor: **1815.5**

FREQUENCY		AREA		VOLUME	
Desired Frequency:	130.81	Desired Opening Size:	3.75 X 3.75	Calculated Volume:	687.53
Bar Proximity Frequency Adjustment (+2.5%)	134.08	(Depth)			
		Calculated Area:	14.06		
				Size (ID):	Mat'l Thickness
				Desired Height:	16.50 0.75
				Desired Depth:	3.75 0.375
				Calculated Width:	11.11 0.75
				Size (OD):	
				Height:	18.00
				Depth:	4.50
				Width:	12.61

LEGEND: Known Unknown

CAVITY RESONATOR DATA SHEET

G²VOLUME (Inside Dimensions)Height (inches) 23.5 (23 1/2)Width (inches) 11.5 (11 1/2)Depth (inches) 3.875 (3 7/8)Calculated Volume (cu in) 1050.00OPENING AREAShape: Round Diameter (inches) Shape: Square Rectangular XLength (inches) 3.875 (3 7/8)Width (inches) 2.75 (2 3/4)Calculated Area (sq in) 10.656RESONANT FREQUENCYMeasured Frequency (Hertz) 90.910Pitch (Note) F# (Cents) -30Calculated Factor: 1630.451ADDITIONAL ATTRIBUTES

Materials (Thicknesses)

(A) TOP, BOT, ENDS - 3/4" PARTICLE BD

(B) SIDES - 3/8" PLYWOOD

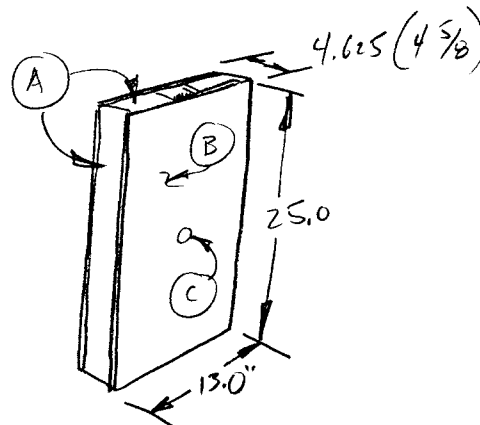
Bracing: YES X NO

Type (C) 5/8" DIA BIRCH DOWELING

Other Information: QTY 1

NAILS: 1 3/4" PARTICLE BD

(FINISHING) 1 1/4" 3/8" PLYWOOD

ILLUSTRATION

CAVITY RESONATOR DESIGN ENVIRONMENT

Pitch: **G2**Factor: **1630**

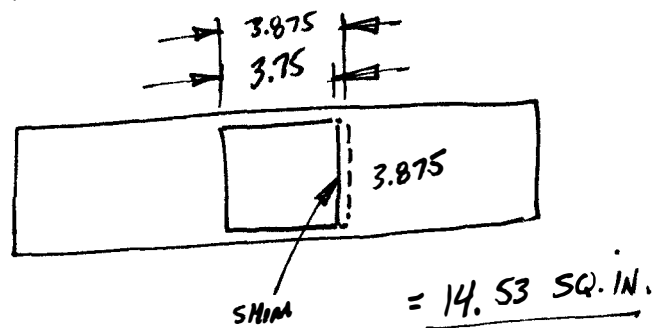
FREQUENCY		AREA		VOLUME	
Desired Frequency:	97.99	Desired Opening Size:	3.88 X 3.88	Calculated Volume:	1020.55
Bar Proximity Frequency Adjustment (+2.5%)	100.44	(Depth)			
		Calculated Area:	15.02		
				Size (ID):	Mat'l Thickness
				Desired Height:	23.50 0.75
				Desired Depth:	3.88 0.375
				Calculated Width:	11.21 0.75
				Size (OD):	
				Height:	25.00
				Depth:	4.63
				Width:	12.71

LEGEND:

 Known

 Unknown

POST-FABRICATION CORRECTION

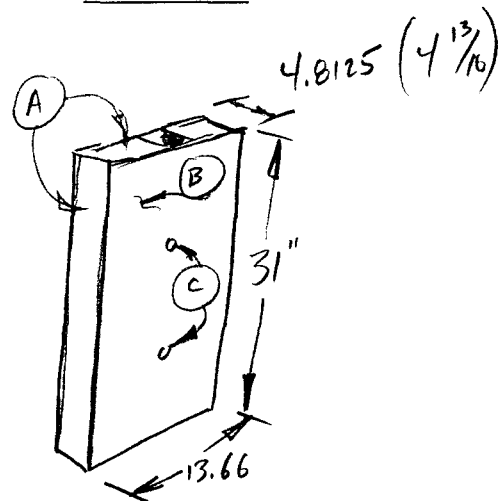


CAVITY RESONATOR DATA SHEET

F2

VOLUME (Inside Dimensions)Height (inches) 29.5 (29 1/2)Width (inches) 12.16Depth (inches) 4.0625 (4 1/16)Calculated Volume (cu in) 1457.3OPENING AREAShape: Round Diameter (inches) Shape: Square X Rectangular Length (inches) 4.0625 (4 1/16)Width (inches) 4.0625 (4 1/16)Calculated Area (sq in) 16.3769RESONANT FREQUENCYMeasured Frequency (Hertz) 84.09Pitch (Note) E (Cents) +35Calculated Factor: 1595.736ADDITIONAL ATTRIBUTES

Materials (Thicknesses)

(A) TOP, BOT, ENDS - 3/4" PARTICLE BD(B) SIDES - 3/8" PLYWOODBracing: YES X NO Type (C) 5/8" DIA BIRCH DOWELINGOther Information: 4x2NAILS: 1 3/4" PARTICLE BD(FINISHING) 1 1/4" PLYWOODILLUSTRATION

CAVITY RESONATOR DESIGN ENVIRONMENT

Pitch: **F2**Factor: **1595.7**

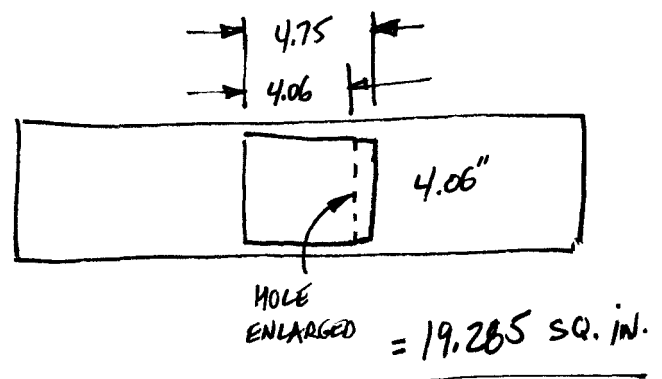
FREQUENCY		AREA		VOLUME	
Desired Frequency:		Desired Opening Size:		Calculated Volume:	
87.31		4.06 X 4.06		1291.58	
		(Depth)			
Bar Proximity Frequency Adjustment (+2.5%)		Calculated Area:		Size (ID):	Mat'l Thickness
89.49		16.50		Desired Height: 29.50	0.75
				Desired Depth: 4.06	0.375
				Calculated Width: 10.78	0.75
				Size (OD):	
				Height: 31.00	
				Depth: 4.81	
				Width: 12.28	

LEGEND:

 Known

 Unknown

POST-FABRICATION CORRECTION



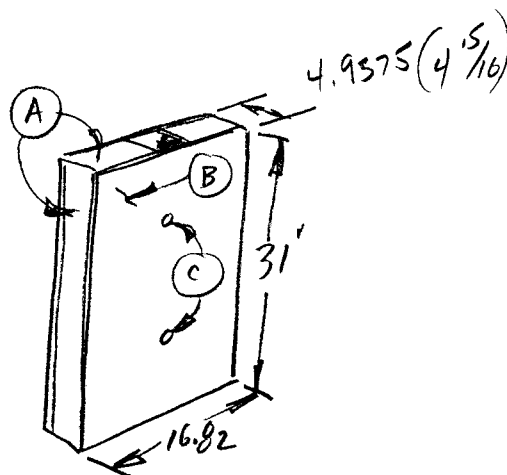
CAVITY RESONATOR DATA SHEET

D²VOLUME (Inside Dimensions)Height (inches) 29.5 (29 1/2)Width (inches) 15.32Depth (inches) 4.1875 (4 3/16)Calculated Volume (cu in) 1892.498OPENING AREAShape: Round Diameter (inches) Shape: Square ☒ Rectangular Length (inches) 4.1875 (4 3/16)Width (inches) 4.1875 (4 3/16)Calculated Area (sq in) 17.666RESONANT FREQUENCYMeasured Frequency (Hertz) 75.567Pitch (Note) D (Cents) +50Calculated Factor: 1603.487ADDITIONAL ATTRIBUTES

Materials (Thicknesses)

(A) TOP, BOT, ENDS - 3/4" PARTICLE BD


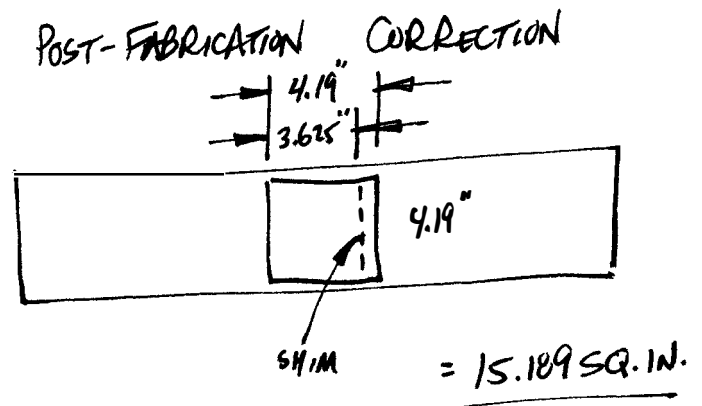
(B) SIDES - 3/8" PLYWOOD

Bracing: YES ☒ NO Type (C) 5/8" DIA BIRCH DOWELING
Q+Y 2Other Information: NAILS: 1 3/4" PARTICLE BD
(FINISHING) 1/4" PLYWOODILLUSTRATION

CAVITY RESONATOR DESIGN ENVIRONMENTPitch: **D2**Factor: **1603**

FREQUENCY		AREA		VOLUME	
Desired Frequency:	73.42	Desired Opening Size:	4.19 X 4.19	Calculated Volume:	1899.96
Bar Proximity Frequency Adjustment (+2.5%)	75.26	(Depth)			
		Calculated Area:	17.54		
				Size (ID):	Mat'l Thickness
				Desired Height:	29.50 0.75
				Desired Depth:	4.19 0.375
				Calculated Width:	15.38 0.75
				Size (OD):	
				Height:	31.00
				Depth:	4.94
				Width:	16.88

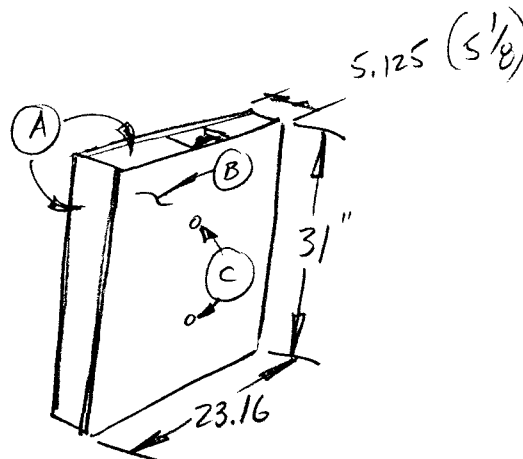
LEGEND:

 Known Unknown

CAVITY RESONATOR DATA SHEET

C²VOLUME (Inside Dimensions)Height (inches) 29.5 (29 1/2)Width (inches) 21.66Depth (inches) 4.375 (4 3/8)Calculated Volume (cu in) 2795.49RESONANT FREQUENCYMeasured Frequency (Hertz) 63.54Pitch (Note) C (Cents) -50Calculated Factor: 1606.268OPENING AREAShape: Round Diameter (inches) Shape: Square ☒ Rectangular Length (inches) 4.375 (4 3/8)Width (inches) 4.375 (4 3/8)Calculated Area (sq in) 19.14ADDITIONAL ATTRIBUTES

Materials (Thicknesses)

(A) TOP, BOT, ENDS - 3/4" PARTICLE BD.(B) SIDES - 3/8" PLYWOODBracing: YES ☒ NO Type (C) 5/8" DIA BIRCH DOWELINGOther Information: Qty 2NAILS: 1 3/4" PARTICLE BD
(FINISHING) 1/4" PLYWOODILLUSTRATION

CAVITY RESONATOR DESIGN ENVIRONMENT

Pitch:

C2

Factor:

1606

FREQUENCY		AREA		VOLUME	
Desired Frequency:		Desired Opening Size:		Calculated Volume:	
65.40		4.38 X 4.38		2511.11	
		(Depth)			
Bar Proximity Frequency Adjustment (+2.5%)		Calculated Area:		Size (ID):	Mat'l Thickness
67.04		19.14		Desired Height: 29.50	0.75
				Desired Depth: 4.38	0.375
				Calculated Width: 19.46	0.75
				Size (OD):	
				Height: 31.00	
				Depth: 5.13	
				Width: 20.96	

LEGEND: Known

 Unknown

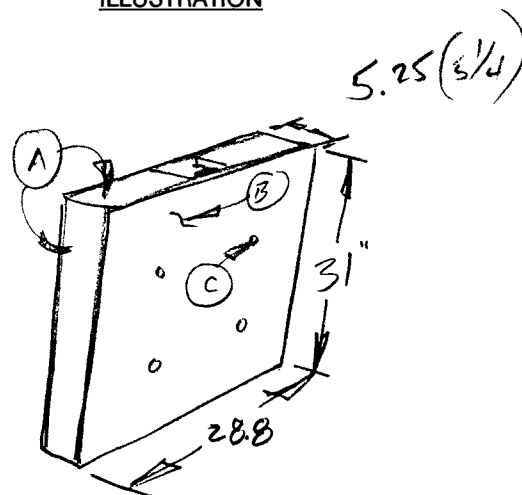
*NO POST-FABRICATION
CORRECTION REQUIRED
ON OPENING.*

CAVITY RESONATOR DATA SHEET

Bb 1

VOLUME (Inside Dimensions)Height (inches) 29.5 (29 1/2)Width (inches) 27.3Depth (inches) 4.5 (4 1/2)Calculated Volume (cu in) 3624.075OPENING AREAShape: Round Diameter (inches) Shape: Square ☒ Rectangular Length (inches) 4.5 (4 1/2)Width (inches) 4.5 (4 1/2)Calculated Area (sq in) 20.25RESONANT FREQUENCYMeasured Frequency (Hertz) 59.805Pitch (Note) A# (Bb) (Cents) + 45Calculated Factor: 1697.188ADDITIONAL ATTRIBUTES

Materials (Thicknesses)

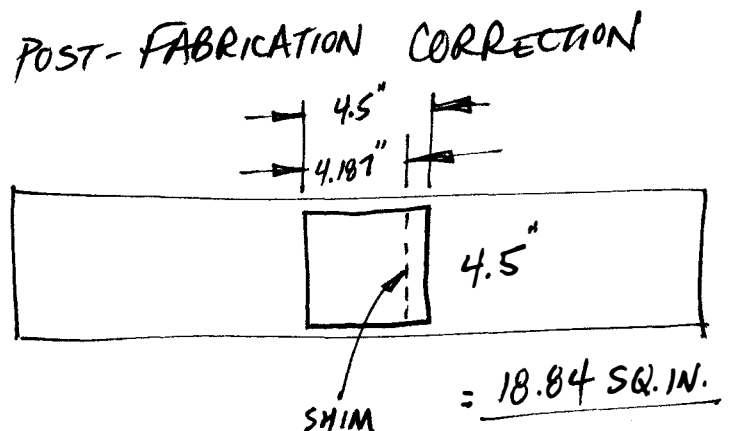
(A) TOP, BOT, ENDS - 3/4" PARTICLE BD(B) SIDES - 3/8" PLYWOODBracing: YES ☒ NO Type (C) 5/8" DIA BIRCH DOWELINGOther Information: QTY 4NAILS: 1 3/4" PARTICLE BD(FINISHING) 1 1/4" PLYWOODILLUSTRATION

CAVITY RESONATOR DESIGN ENVIRONMENTPitch: **B-flat1**Factor: **1697**

FREQUENCY		AREA		VOLUME	
Desired Frequency:	58.27	Desired Opening Size:	4.50 X 4.50	Calculated Volume:	3632.77
Bar Proximity Frequency Adjustment (+2.5%)	59.73	(Depth)			
		Calculated Area:	20.25	Size (ID):	Mat'l Thickness
				Desired Height:	29.50 0.75
				Desired Depth:	4.50 0.375
				Calculated Width:	27.37 0.75
				Size (OD):	
				Height:	31.00
				Depth:	5.25
				Width:	28.87

LEGEND:

 Known

 Unknown


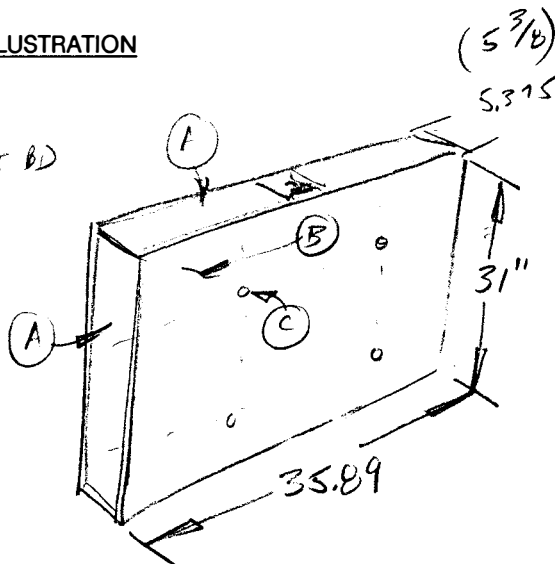
CAVITY RESONATOR DATA SHEET

G¹VOLUME (Inside Dimensions)Height (inches) 29.5"Width (inches) 34.39"Depth (inches) 4.625"Calculated Volume (cu in) 4692.085OPENING AREAShape: Round Diameter (inches) Shape: Square X Rectangular Length (inches) 4.625 (4 5/8)Width (inches) 4.625 (4 5/8)Calculated Area (sq in) 21.39"RESONANT FREQUENCYMeasured Frequency (Hertz) 50.145Pitch (Note) G (Cents) +40Calculated Factor: 1597.195ADDITIONAL ATTRIBUTES

Materials (Thicknesses)

(A) TOP, BOTTOM, ENDS - 3/4" PARTICLE BD

(B) FLAT SIDES 3/8 PLYWOOD

Bracing: YES X NO Type 5/8" DIA BIRCH DOWELING
Qty 4 pcsOther Information: FINISHING
NAILS (PARTICLE BD) 1 3/4"NAILS (PLYWOOD) 1 1/4"ILLUSTRATION

CAVITY RESONATOR DESIGN ENVIRONMENT

Pitch:

G1

Factor:

1597

FREQUENCYDesired
Frequency:

48.99

Bar Proximity Frequency
Adjustment (+2.5%)

50.21

AREADesired
Opening Size:

4.63

X

4.63

(Depth)

Calculated Area:

21.39

VOLUMECalculated
Volume:

4677.99

Size (ID):

Desired Height: 29.50

Desired Depth: 4.63

Calculated Width: 34.29

Mat'l
Thickness

0.75

0.375

0.75

Size (OD):

Height: 31.00

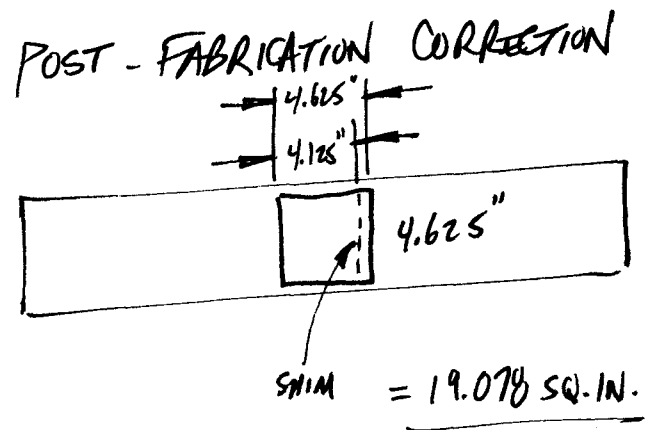
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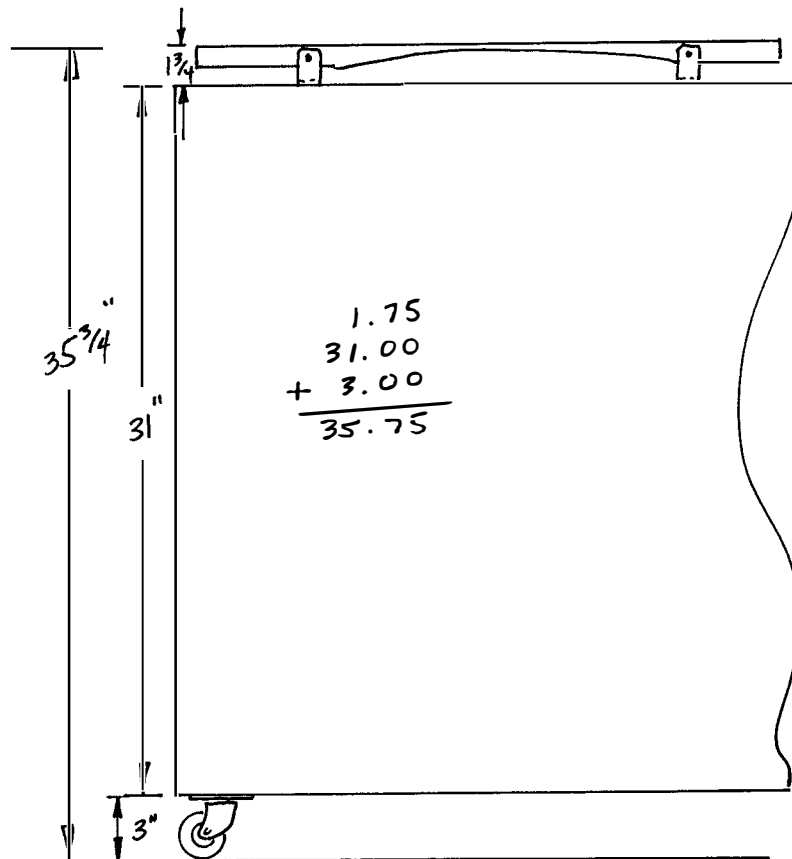
Width: 35.79

LEGEND:

Known

Unknown



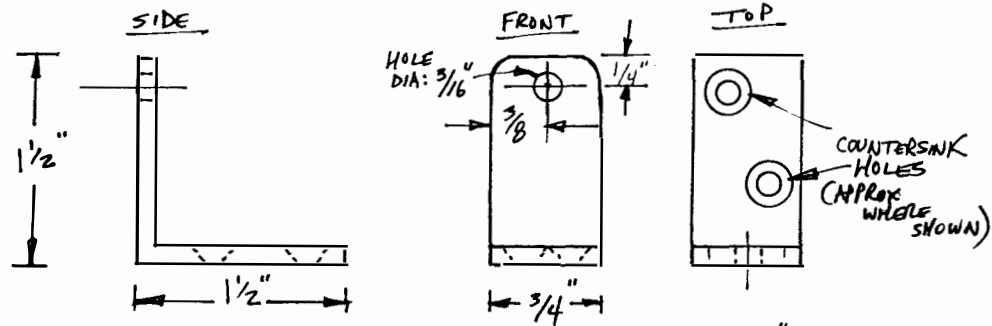
PLAYING SURFACE HEIGHT ANALYSIS

APPENDIX B

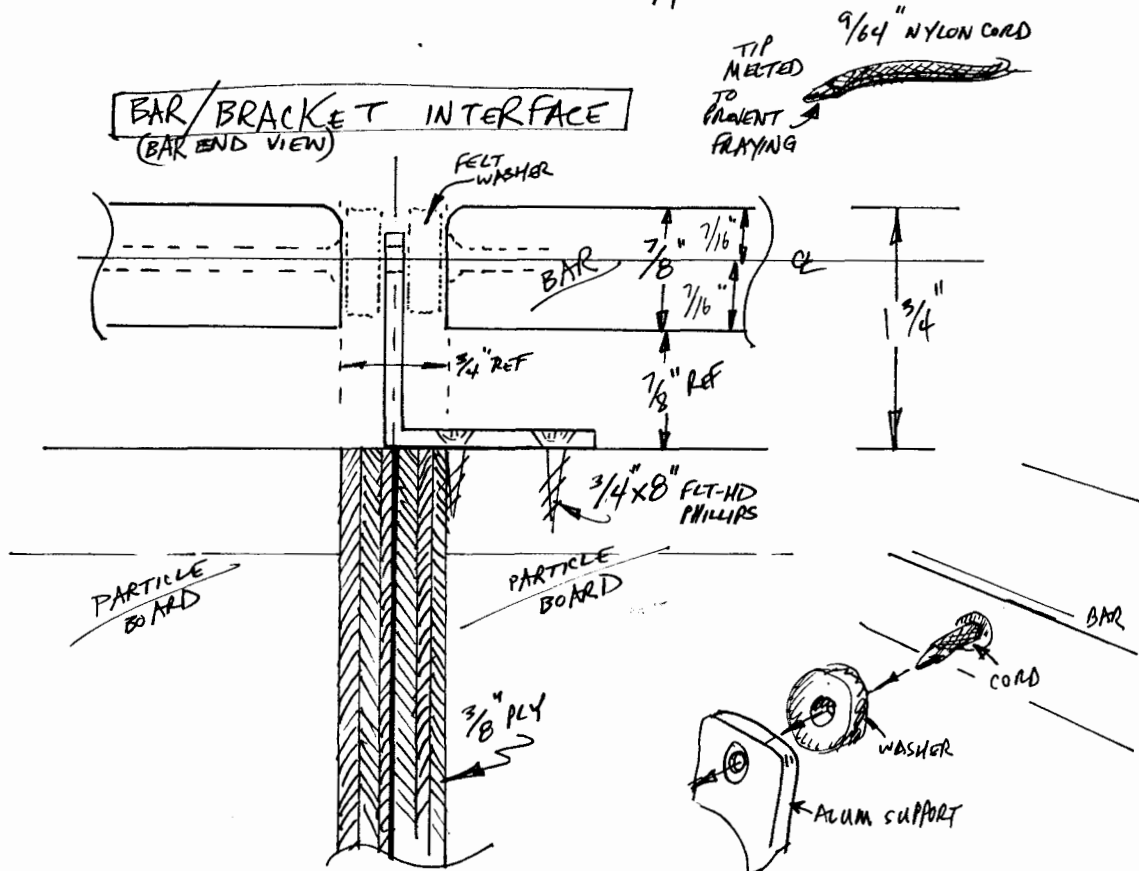
Construction Information and Data

BAR MOUNTING DETAILS


MOUNTING BRACKET

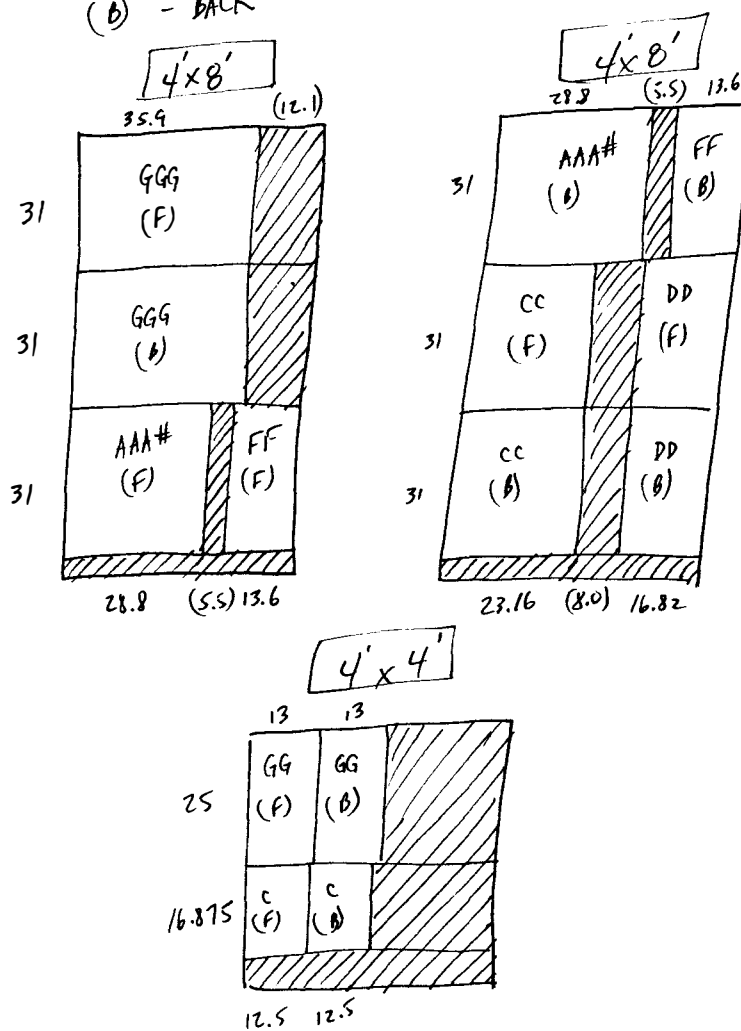


BAR/BRACKET INTERFACE (BAR END VIEW)



PLYWOOD CUTTING PLAN

 - SCRAP
 (F) - FRONT
 (B) - BACK



$\frac{3}{4}$ " PARTICLE BOARD SIZES

GGG

Qty

2 - 35.9 x 4.625

2 - 29.5 x 4.625

FF

Qty

2 - 13.66 x 4 $\frac{1}{16}$

2 - 29.5 x 4 $\frac{1}{16}$

BBBb

Qty

2 - 28.8 x 4.5

2 - 29.5 x 4.5

GG

Qty

2 - 13.0 x 3.875

2 - 23.5 x 3.875

CC

Qty

2 - 23.16 x 4.375

2 - 29.5 x 4.375

C

Qty

2 - 12.5 x 3.75

2 - 15.375 x 3.75

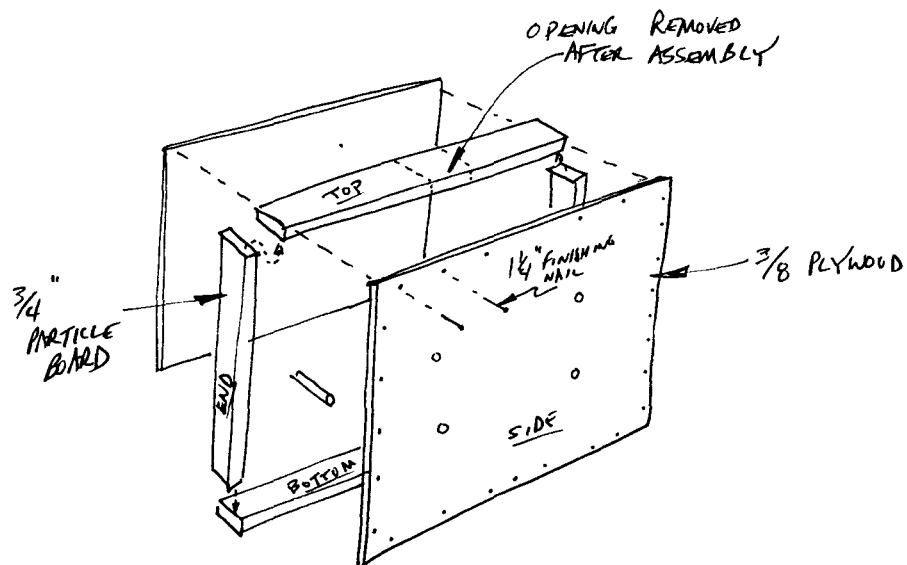
DD

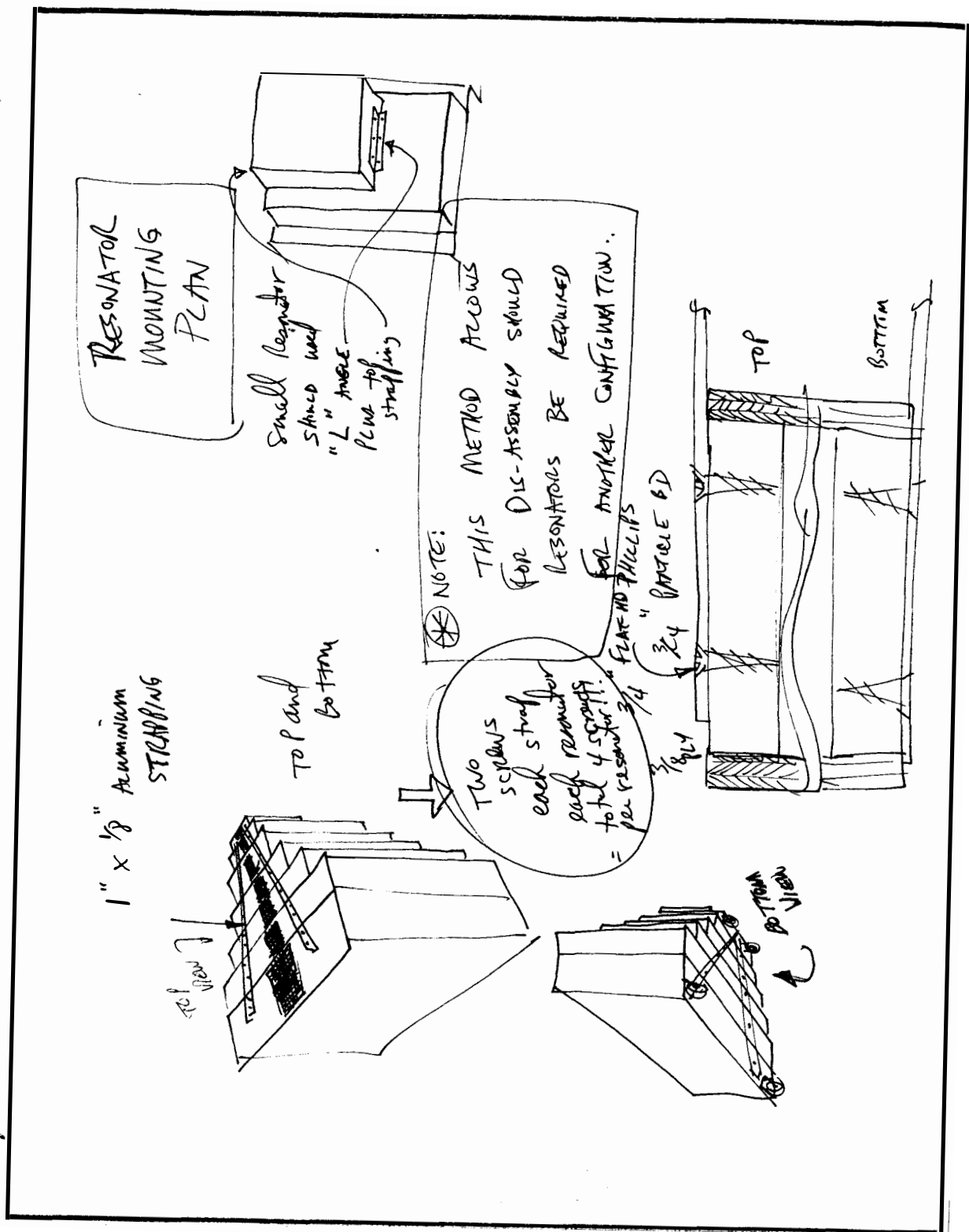
Qty

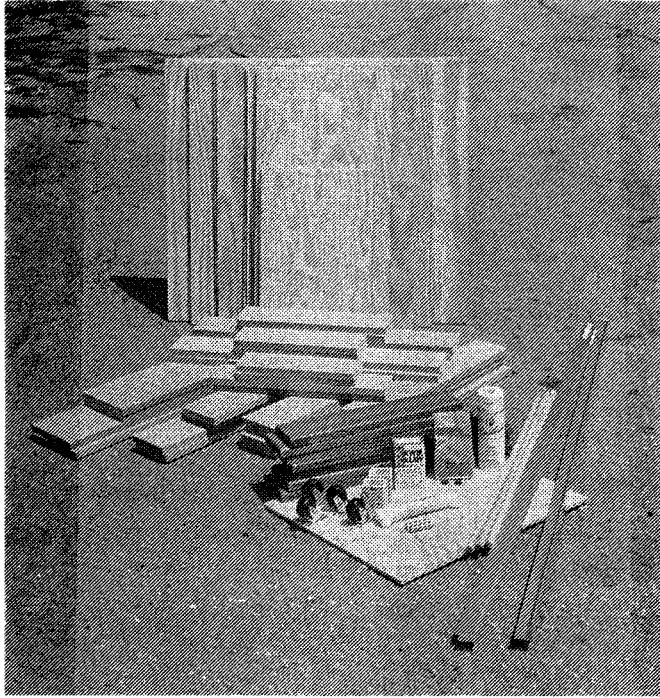
2 - 16.82 x 4 $\frac{3}{16}$

2 - 29.5 x 4 $\frac{3}{16}$

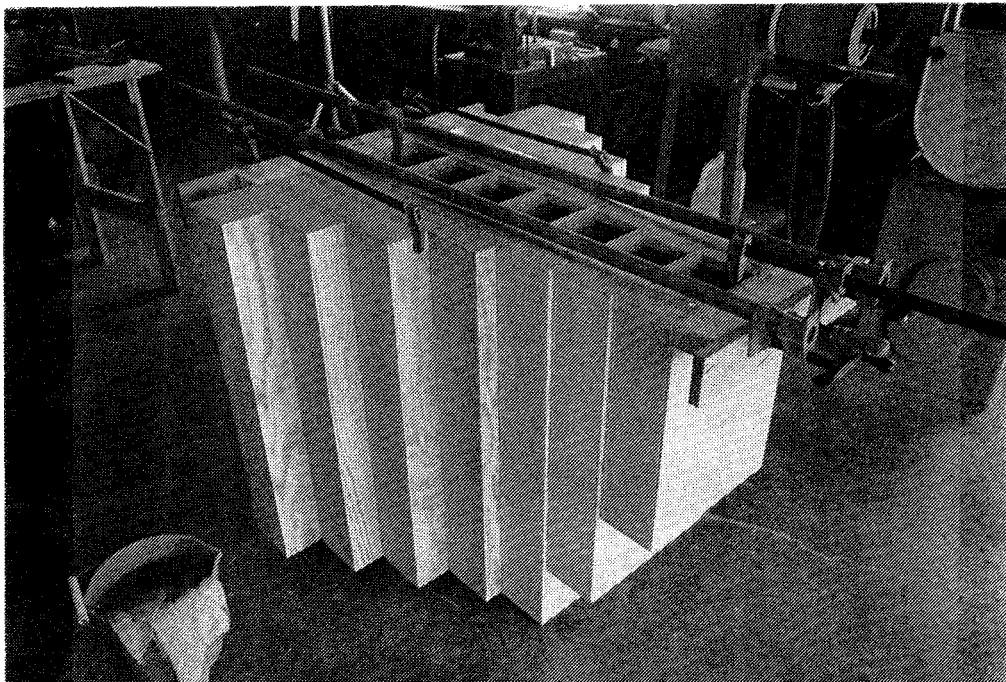
RESONATOR CONSTRUCTION (GENERAL DETAIL)







Materials and parts used in the fabrication of the marimba.



Clamps are required when holding components together for alignment, gluing, and drying. (Notice, bucket and wash cloth in lower left-hand corner are used for wiping off excessive glue during assembly.)

BLANK

APPENDIX C

Materials List

MATERIALS LIST (Rhythmic Bass Marimba, 7-Note)

ITEM NO.	ITEM	USE	QTY
1	African Padouk, 7/8" thick	Bar material	5 bd ft
2	Paint, Varithane, satin	Bar finish	2 cans (spray)
3	Particle Board, 3/4"	Resonator material - top, bot, ends	32 sq ft (1 sht)
4	Plywood, 3/8", 4' x 8'	Resonator material - sides	80 sq ft (2-1/2 shts)
5	Nail, finishing, 1-3/4"	Fastening particle board pcs	2 boxes
6	Nail, finishing, 1-1/4"	Fastening plywood to part. bd.	2 boxes
7	Glue, yellow carpenters (Alphatic Resin)	Adhesive to hold resonator wood together	1 qt
8	Paint, enamel, waterbase, Navajo White	Resonator finish	2 pts
9	Dowel, 5/8" dia, birch	Resonator stiffener	3 pcs (36" ea)
10	Cord, nylon, 9/64"	Bar suspension	1 shank (48 ft)
11	Spring, extension, 1/2" dia x 2"	Bar suspension	2 pcs
12	Aluminum, extruded, "L" angle, 1-1/2" x 1-1/2" x .125" (cut into 3/4" wide pcs)	Bar suspension bracket	20 pcs
13	Screw, flat head, philips, 3/4"-8	Bar support bracket containment	40 pcs
14	Pine, white, 1-1/2" thick x 3-1/2" wide x 24" long	Bar/mallet containment	2 bd ft
15	Pine, white, 1-1/2" thick x 2" wide x 12-1/2" long	Bar containment	1 bd ft
16	Washer, felt, front rail (piano punching)	Bar alignment, rattle suppression	28 pcs
17	Aluminum, extruded, strip, 1-1/2" x .125" x 34"	Resonator containment	2 pcs (72" ea)
18	Screw, flat head, philips, 3/4"-8	Resonator strip containment	56 pcs
19	Caster, 2-1/2" dia, rubber, swivel	Instrument mobility	4 pcs
20	Screw, pan head, slot, 3/4"-10	Casters containment	16 pcs