

DESIGN DRAWING STANDARDS AND TOLERANCES INDEX

PAGE	DATE	DESCRIPTION
A-1	02/13/08	Design Drawing Standards and Tolerances Index
A-2	09/07/99	Metric Drafting Standards
A-3	02/13/08	Metric Drafting Standards
A-4	04/06/06	Metric Drafting Standards
A-5	03/01/96	Metric Drafting Standards
A-6	03/01/96	Tolerance stickers
A-7	09/07/99	Installation Torques for Metric Screws
A-8-10	02/12/97	Bill Of Materials Instructions
A-11-15	02/12/97	System B.O.M. Instructions
A-16-18	02/12/97	Assembly Line B.O.M. Instructions
A-19-20	09/01/00	Assembly Line B.O.M. Instructions
A-21	02/12/97	Tool B.O.M. Instructions
A-22	09/01/00	Tool B.O.M. Instructions
A-23	02/12/97	Tool B.O.M. Instructions
A-24-25	09/01/00	Tool B.O.M. Instructions
A-26-27	02/12/97	Unit B.O.M. Instructions
A-28-29	09/01/00	Unit B.O.M. Instructions
A-30-33	02/12/97	Unit B.O.M. Instructions
A-34	09/01/00	Unit B.O.M. Instructions
A-35	02/12/97	B.O.M. Templates
A-36	02/12/97	System B.O.M. Template
A-37	09/15/00	Line B.O.M. Template
A-38	09/15/00	Tool B.O.M. Template
A-39	02/12/97	Unit B.O.M. Template

METRIC DRAFTING STANDARDS

1. INTRODUCTION
 - 1.1 These Metric Drafting Standards are an integral part of the NAAMS Global Standard Components, Assembly.
2. DEFINITIONS
 - 2.1 Hard Metric: A dimension in millimeters, established in metric and not a result of converting from U.S. customary units to equivalent metric.
 - 2.2 Soft Metric: A dimension in millimeters, resulting from directly converting an established U.S. customary base dimension.
3. DRAWING PROJECTION
 - 3.1 Current drafting practices pertaining to multiview and sectional view drawings are defined and illustrated in ANSI Y 14.5M - 1994.
 - 3.2 All drawings should be drafted using third angle projection on orthographic views.
 - 3.3 When sections or views are projected on the same or on other sheets, they shall be projected and drawn perpendicular to the cutting or viewing plane.
 - 3.4 When sections or views are projected onto other sheets, directional arrows shall be shown and cross referencing notes added onto the respective view.
4. CONSTRUCTION MATERIAL
 - 4.1 When plate, tubing, angles, channels, etc. that are produced to U.S. customary units are specified, the cross section dimensions should be called out in U.S. customary units and the cut length in metric.
5. TRANSFERS
 - 5.1 Transfers within a tooling system shall have their construction dimensioned in metrics.
 - 5.2 Travel distance, both horizontal and vertical, shall be dimensioned in metrics, with equivalent U.S. customary setup dimensions to interface coordination points with plant facilities and plant equipment.
6. FASTENERS
 - 6.1 It is recommended that all tool builders and suppliers use only hard metric fasteners.
 - 6.2 All metric threads are assumed to be coarse unless otherwise specified.
 - 6.3 The preferred minimum screw size is M8, except for the attachment of commercial and standard items that have predetermined mounting holes.
 - 6.4 Fasteners for kits shall remain to their existing standard screw size.
7. ENERGY, INERTIA, TORQUE, POWER AND WORK
 - 7.1 These entities shall remain to current standards.
 - 7.2 For future U.S. customary / metric conversion, refer to the NAAMS Metric Equivalent Charts #1 & #2.
8. DIMENSIONING AND TOLERANCING
 - 8.1 Dimensioning and tolerancing practices shall be as defined and illustrated in ANSI Specification #Y14.3M - 1994.
 - 8.2 A zero before the decimal point shall be used for a number less than 1.0 (Example 0.5).

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METRIC DRAFTING STANDARDS

GLOBAL STANDARD COMPONENTS

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Assembly

02/13/08

9. METRIC DRAWING SCALE
 - 9.1 For general design work, drawing scales shall be full size wherever possible.
 - 9.2 The recommended reduced scale for fixture designs are 1:2, 1:5, 1:10, 1:20 and 1:50.
 - 9.3 When increased scales are necessary, the scales shall be 2:1, 5:1, 10:1, 20:1 and 50:1.
 - 9.4 The drawing scale for system layout drawings should be coordinated with each individual plant.
10. LETTERING
 - 10.1 All text height shall be 2 mm minimum on 11 x 17 CAD drawings and 3 mm minimum on all other drawings.
 - 10.2 Notes and descriptions shall be 5 mm minimum.
 - 10.3 View callouts, section, unit no's, switch and cylinder callouts shall be 7 mm minimum.
11. BODYLINES
 - 11.1 On fixture drawings, only one body line is required in each direction provided its relationship to the zero datum line is shown. These shall be identified with a 25 mm diameter balloon.
 - 11.2 All auxiliary worklines shall be identified with a 25 mm square box, showing originating bodyline intersection and angle used for worklines.
 - 11.3 When a dimension originates from a workline, the origin should be indicated.
12. DIMENSION ARRANGEMENT
 - 12.1 Dimensions should be shown in true views and should not be taken from hidden lines.
 - 12.2 Dimensions should be located outside the outline of the detail wherever possible.
 - 12.3 Screw and dowel sizes shall be written along the center-line of the fastener in its side view on assembly drawings.
13. COMMERCIAL COMPONENTS
 - 13.1 Metric commercial components are preferred when available and approved by customer.
 - 13.2 Pivot shaft diameters, bushing & bearing sizes, cylinders and stroke of cylinders etc., shall remain to existing standards.
 - 13.3 Gears, racks, etc., shall retain inch pitch diameters.
 - 13.4 Pipe threads shall remain to existing standards.
14. SETUP DIMENSIONS
 - 14.1 Machined surfaces, pivot centerlines, hole patterns, fab dimensions and NC block mounting surfaces should be set up in 5 mm increments whenever possible.
15. DETAILS OF A UNIT
 - 15.1 All items that are detailed shall be identified with a 20 mm diameter split balloon with the item number of the detail in the top half and the sheet number where the detail is drawn in the bottom half.
 - 15.2 If a detail is shown & opposite on a particular unit, the same detail number should be used with "SHN." and "OPP." written alongside the appropriate balloon.

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METRIC DRAFTING STANDARDS

GLOBAL STANDARD COMPONENTS

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Assembly

04/06/06

- 15.3 For all items that are not detailed, such as purchased and standard items, the balloon shall contain only the identification number of the detail; no sheet number is required.
16. READING DIRECTION
- 16.1 Unless otherwise specified, all dimensions and notes should be placed on the drawing so that they may be viewed from the bottom of the sheet.
17. OUT OF SCALE
- 17.1 Dimensions out of scale should be avoided, but when a dimension cannot be made to scale (as a result of a drawing revision), then the dimension should be underlined. (Example: 5.62 DIA.)
- 17.2 When details must be shown broken due to sheet size restrictions, the dimension for the missing section shall be written.
18. CHANGES
- 18.1 The information recorded in the change column should be brief and accurate, but complete to the extent that the drawing could be reverted back to its original form.
- 18.2 A change letter used when recording a change should continue to be used on all of the affected sheets (assembly, B.O.M., etc.) pertaining to that change.
- 18.3 A change letter (upper case) should be enclosed in a 6 mm diameter balloon.
- 18.4 All changes should be recorded in the change column on the affected sheet or sheets.
- 18.5 Change letters should be placed in a vertical row in the change column.
- 18.6 A change letter and balloon should be placed near the revision on the affected sheet.
- 18.7 A change letter and balloon should also be placed at the bottom and end of the sheet (title block end) outside the border for ease of locating revisions made to the drawing.
19. STOCK LIST OR BILL OF MATERIALS
- 19.1 Stock lists or bills of material should not be shown on layout drawings. (See Bills of Material in this section.)
20. FAB "O" LINE DIMENSIONING
- 20.1 Fab "O" line dimensions should always start from the same edges as the machining datum line start dimensions.
- 20.2 Primary Fab "O" lines (X, Y & Z planes) should be established on the primary sub-detail. (Usually the largest sub-detail or the footprint of the detail.)
- 20.3 All fab setup dimensions for sub-details should be dimensioned from the two primary Fab "O" lines.
- 20.4 When sub-details require "CUT" dimensions, secondary Fab "O" lines should be established for that particular sub detail.
- 20.5 The Fab "O" line callout should reflect the sub-detail item letter. Example: Fab "O" line "A", Fab "O" line "B" etc: these cut dimensions are used only for the specific sub-detail that is being defined.

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METRIC DRAFTING STANDARDS

GLOBAL STANDARD COMPONENTS



Assembly

03/01/96

21. HOLES AND SLOTS

- 21.1 All tapped, dowel and clearance holes on details are assumed to be through; it will no longer be specified on a drawing that the hole is "THRU". When a hole requires that a depth be specified, the depth shall be incorporated into the hole callout.
- 21.2 Construction holes are assumed to be through as shown on the drawing, or to a cross hole if applicable.
- 21.3 Depths for counterbored holes shall not be specified unless they are non-standard, in which case "AS SHOWN" should be noted on the drawing.
- 21.4 All tapped holes are assumed to have coarse threads unless otherwise specified.
- 21.5 On detail drawings with 3 or more hole sizes, holes shall be tabulated using the label shown.

#		AFTER DOWEL SIZE, "H6" INDICATES PRESS FIT AND "F7" INDICATES SLIP FIT			
ALL HOLES THRU EXCEPT AS NOTED					
QTY.	TAPS	QTY.	CLEARANCE HOLES	QTY.	DOWELS
	AM-M5 X 0.8		HM-5.6		QM-6
	BM-M6 X 1.0		JM-6.6		RM-8
	CM-M8 X 1.25		KM-9.0		SM-10
	DM-M10 X 1.5		LM-11.0		TM-12
	EM-M12 X 1.75		MM-13.5		VM-16
	FM-M16 X 2.0		NM-17.5		WM-20
	GM-M20 X 2.5		PM-22.0		

- 21.6 For slots, callouts for "CENT.", "TYP.", and "RADIUS" or "R" are assumed, and are no longer required.

22. GENERAL

- 22.1 All detail drawings should be datum lined.
- 22.2 Numbers should be used when labeling "AUX. MACHINE O-LINES".
- 22.3 No stock sizes shall be dimensioned on the drawing except that, when a stock size is close to being square, one side should be dimensioned.
- 22.4 Stock sizes should not be noted on Bills of Material unless the item is ND (non-detailed item).
- 22.5 Detail identification balloons (detail sheet) shall be 20 mm diameter and sub-detail balloons 7 mm diameter.
- 22.6 The recommended construction or tooling ball stud diameter is 6 mm.

TOLERANCE STICKERS

METRIC DETAIL TOLERANCES

NOTE:

UNLESS OTHERWISE SPECIFIED:

MAXIMUM ALLOWABLE ROUGHNESS OF ALL:

- 1 PLACE FINISH DIMENSIONS TO BE 6 MICRONS
- 2 PLACE FINISH DIMENSIONS TO BE 3 MICRONS
- 3 PLACE FINISH DIMENSIONS TO BE 1.6 MICRONS

EXCEPT AS NOTED TOLERANCES SHALL BE:

- 1 PLACE MACHINING ± 0.3
- 1 PLACE FABRICATION ± 1.5
- 2 PLACE ± 0.08 BETWEEN MACHINED SURFACES
 - ± 0.03 BETWEEN SINGLE DOWEL AND A HEEL SURFACE
 - ± 0.03 BETWEEN DOWELS IN THE SAME PLANE
 - ± 0.10 BETWEEN DOWELS IN DIFFERENT PLANES
 - ± 0.13 TO SCREW HOLES, NON ACCUMULATIVE

DOWEL HOLE TOLERANCES
FOR PRESS FIT USE H6
FOR SLIP FIT USE F7

DOWEL TOLERANCE
m6

ALL MACHINING \sqrt{Q} SURFACES MUST BE FINISHED EXCEPT FOR COLD DRAWN OR COLD ROLLED SURFACES.

U.S. SYSTEM DETAIL TOLERANCES

NOTE:

UNLESS OTHERWISE SPECIFIED:

MAXIMUM ALLOWABLE ROUGHNESS OF ALL:

- 2 PLACE FINISH DIMENSIONS TO BE 250 MICROINCHES
- 3 PLACE FINISH DIMENSIONS TO BE 125 MICROINCHES
- 4 PLACE FINISH DIMENSIONS TO BE 63 MICROINCHES

EXCEPT AS NOTED TOLERANCES SHALL BE:

- 2 PLACE MACHINING ± 0.01
- 2 PLACE FABRICATION ± 0.06
- 3 PLACE ± 0.003 BETWEEN MACHINED SURFACES
 - ± 0.001 BETWEEN SINGLE DOWEL AND A HEEL SURFACE
 - ± 0.001 BETWEEN DOWELS IN THE SAME PLANE
 - ± 0.004 BETWEEN DOWELS IN DIFFERENT PLANES
 - ± 0.005 TO SCREW HOLES, NON ACCUMULATIVE

DOWEL HOLE TOLERANCES
P.F. +0.0000/-0.0005
S.F. +0.0010/+0.0005

ALL MACHINING \sqrt{Q} SURFACES MUST BE FINISHED EXCEPT FOR COLD DRAWN OR COLD ROLLED SURFACES.

INSTALLATION TORQUES FOR METRIC SCREWS

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B

This page has been discontinued.
Please refer to the Fastener Installation and Torquing Procedure, page F-2.3.

BILL OF MATERIAL INSTRUCTIONS

The purpose of the Bill of Material (B.O.M.) forms is to supply the Processing and Manufacturing Departments with a common order/build document, rather than utilizing various customers stock list and build charts.

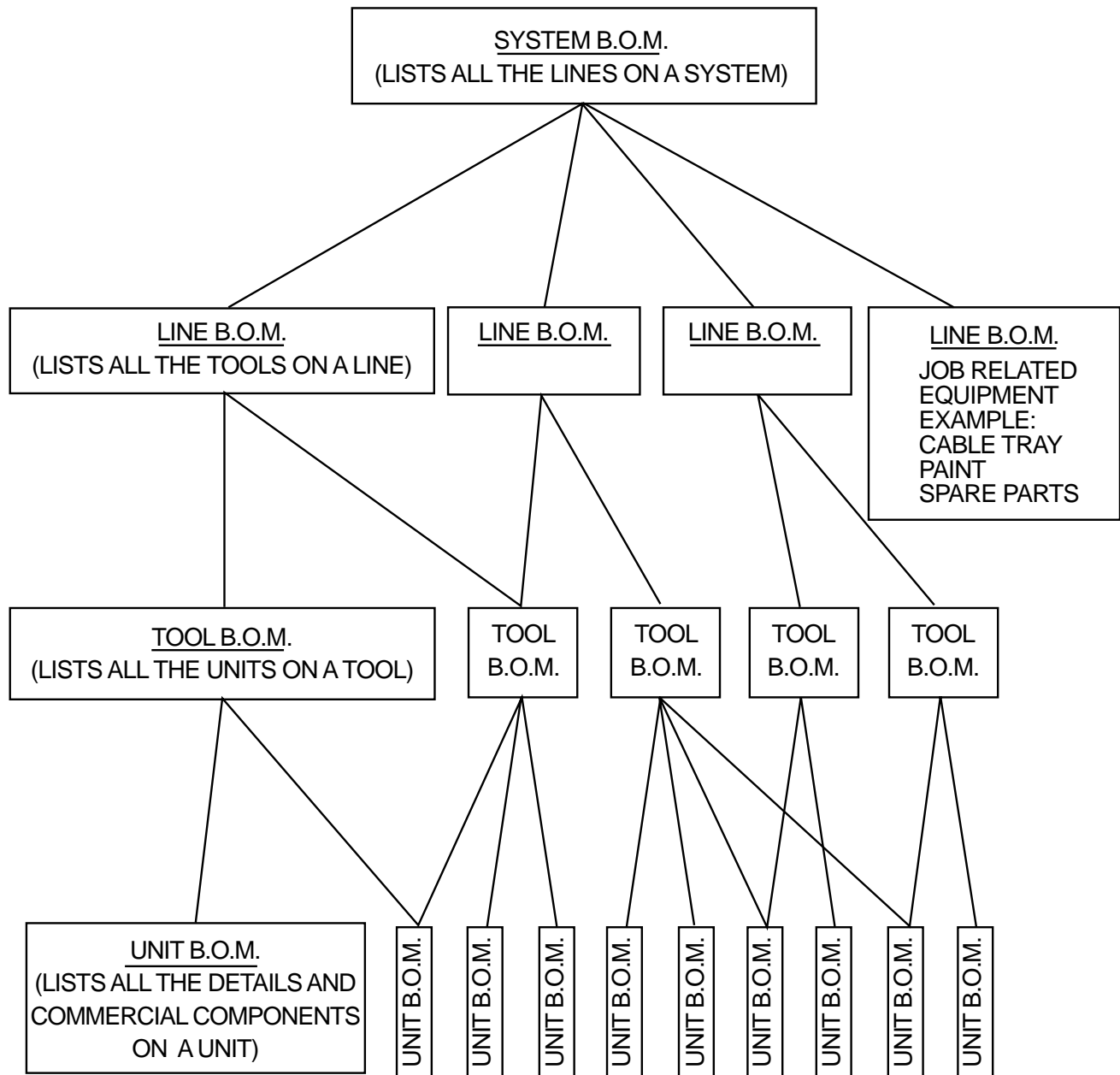
Four types of B.O.M.'s are available to supply the necessary information for processing and manufacturing. All of the following B.O.M.'s or a combination of the four may be needed.

1. SYSTEM B.O.M. — To be completed by the Project Engineer, which lists all the *assembly lines* that make one complete system.
2. ASSEMBLY LINE B.O.M. — To be completed by the Project Engineer and/or Design Supervisor, which lists all the *tools* that make one complete Right Hand and/or Left Hand assembly line or group of tools.
3. TOOL B.O.M. — To be completed by the Design Supervisor, which lists all the *units* that make one complete Right Hand and/or Left Hand tool.
4. UNIT B.O.M. — To be completed by the Tool Designer, which lists all *details* and commercial items that make one complete Right Hand and/or Left Hand unit.

Note: On non-unitized tools, this B.O.M. would be used to list all details and commercial items for one Right Hand and/or Left Hand tool.

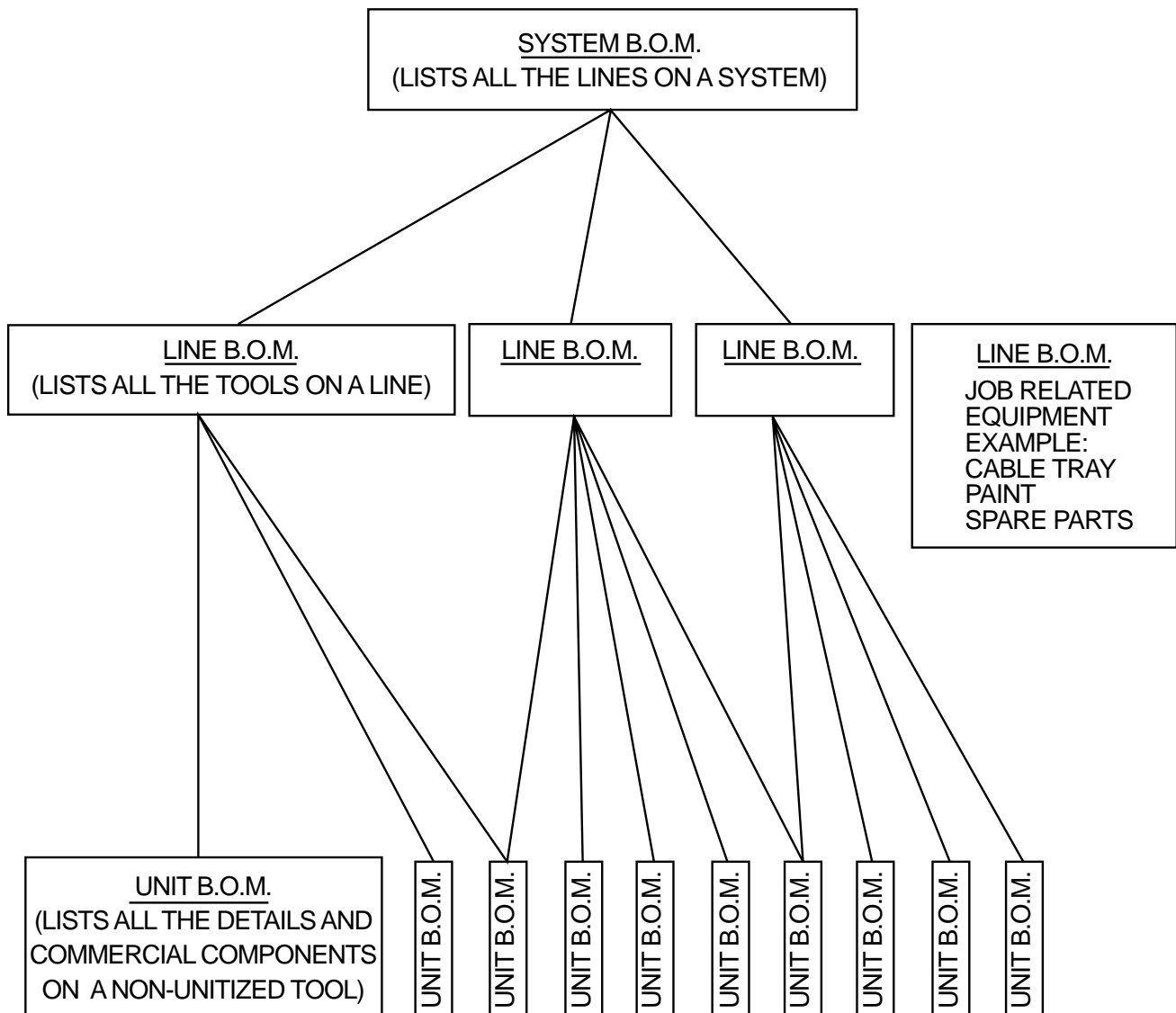
B.O.M. TREE DIAGRAM

FOR A SYSTEM WITH UNITIZED TOOLS



B.O.M. TREE DIAGRAM

FOR A SYSTEM WITH TOOLS THAT ARE NOT UNITIZED



SYSTEM B.O.M. INSTRUCTIONS

This B.O.M. is necessary for all systems which consist of multiple assembly lines. A system B.O.M. lists all the assembly lines which make up the entire system.

All spaces on the B.O.M. are to be completed by the designed Project Engineer as described below. See the following pages for the location of System B.O.M. identification balloons and B.O.M. example.

1. DESCRIPTION

The name of the system is to be printed in this block, on the first sheet of any group of Bill of Materials. Leave this space blank in all subsequent sheets of a B.O.M.

2. B.O.M. PAGE:

List the page number on each page and the total number of system B.O.M. pages on page #1 only. When adding a sheet to the sequence of a released group of B.O.M. sheets, you must revise the first sheet, you must revise the first sheet, "1 of—" , to coincide. Then list the change in the revision column accordingly and include sheet #1 in the release to processing.

3. CUSTOMER:

Enter customer name.

4. PROGRAM:

Enter program code name.

5. ASSEMBLY LINE/TOOL NUMBER:

When a customer has assigned a number to each assembly line which covers a group of tools, then enter the assembly line number. If the right hand assembly line has a different assembly line number than the left hand, write the numbers on different spaces. Leave a blank space between each line of text for subsequent revisions.

ASSEMBLY LINE NO.	DESCRIPTION
1234	B/S INNER LINE
1235	B/S INNER LINE

SYSTEM B.O.M. INSTRUCTIONS

6. DESCRIPTION:

List the name of each assembly line when the right hand and left hand lines have different assembly line numbers. (See example above). If the right hand and left hand assembly lines do not have different assembly line numbers assigned to them, the names can be entered on the same description line. Then note the quantity of each in area nine (See example below). Leave a blank space between each line for subsequent revisions.

DESCRIPTION	DESIGN SOURCE	BUILD SOURCE	L.H.	R.H.
	CONTACT	CONTACT	LINE	LINE
B/S OUTER LINE	B. ENGINEERING	D. FABRICATION	1	1
	J. BLOUGH	J. DOE		

7. DESIGN SOURCE/CONTACT:

For inside design, list the design supervisor. For outside design vendors, list the name of the design company, and below it list the Project Engineer.

8. BUILD SOURCE/CONTACT:

For inside build, list the build processor. For outside build vendors, list the name of the build company and below it, list the contact.

9. QUANTITY:

List quantities in their respective column. If the assembly line is neither hand, the quantities are shown in the right hand column. If the assembly line is right hand and left hand, the quantities are shown in both columns.

10. SOURCE:

Enter a symbol from the source legend which indicates the method of acquisition of each assembly line.

11. BY:

Enter the Project Engineers name.

12. CHECKER:

The checker will enter their first initial and last name after completion of check,

13. DATE RELEASED/RELEASED BY:

Enter the release date and initials, diagonal arrowed lines are acceptable. The System B.O.M. will be the first B.O.M. released on a multiple assembly line system. The System B.O.M. will be released to processing one time only, unless there are revisions, cancellations, or additions.

SYSTEM B.O.M. INSTRUCTIONS

14. REVISIONS:

Enter the revision date and change letter for this particular B.O.M. page. Enter a description of the revision and note what the B.O.M. "was" before the revision. Enter the initials of the designer and checker upon completion of revision. All changes to a released B.O.M., such as quantity or a cancellation, must be recorded in the revision column and released immediately to the Processing Department. If a line has been canceled or removed from a B.O.M., then that change only affects that particular B.O.M. sheet. Lines removed or canceled from a B.O.M. must be crossed out with a single line and not erased.

15. LOGO BLOCK:

This area is reserved for the appropriate logo.

ASSEMBLY LINE B.O.M. INSTRUCTIONS

This B.O.M. Is necessary for all assembly lines or group of tools which consists of multiple tool numbers. A Line B.O.M. lists all the separate tool numbers which make one right hand and/or left hand line. It acts as a multiplier of tool B.O.M.'s much like a build chart. All spaces are to be completed by the project engineer and/or design supervisor as described below for each assigned assembly line or group of tools. See the following pages for the location of Line B.O.M. Identification balloons and B.O.M. example.

1 DESCRIPTION:

The name of the system, assembly line or group of tools is to be printed in this block, on the first sheet of any group of Bill of Materials. Leave this space blank in all subsequent sheets of a B.O.M.

2. TOOL NUMBER:

If a customer has assigned a tool number to an assembly line or a group of tools, then enter the tool number which is shown, in the upper space and the one which is opposite, in the lower space.

Right hand and left hand lines must be indicated using the suffix of -R or -L after the tool number.

TOOL NO.	16ZF-53515-R (SHOWN)
	16ZF-53516-L (OPPOSITE)

RIGHT HAND SHOWN & LEFT HAND OPPOSITE

TOOL NO.	16ZF-53518 (SHOWN))
	_____ (OPPOSITE)

SINGLE HAND TOOL

TOOL NO.	T49465-S-L (SHOWN)
	T49465-S-R (OPPOSITE)

LEFT HAND TOOL SHOWN & RIGHT HAND OPPOSITE (TRUCK & BUS)

3. B.O.M. PAGE:

List the page number on each page and the total number of line B.O.M. pages on page #1 only. When adding a sheet to the sequence of a released group of B.O.M. sheets, you must revise the first sheet, "1 of—" , to coincide. Then list the change in the revision column accordingly and include sheet #1 in the release to processing.

4. CUSTOMER:

Enter customer name.

5. PROGRAM:

Enter program code name.

ASSEMBLY LINE B.O.M. INSTRUCTIONS

6. DESIGN SOURCE:

The name of the design source is to be printed in this block on Sheet #1 only.

7. BUILD SOURCE:

The name of the build source is to be printed in this block on Sheet #1 only.

8. TOOL NUMBER:

List the tools in numerical order. Leave one blank space between each line of text for subsequent revisions.

9. DESCRIPTION:

Enter a simple tool description.

10. QUANTITY:

Enter the quantity of each tool required to build only one SHOWN and/or OPPOSITE line in their respective columns. If the line will be built as shown on the tool layout drawings, place the required quantity in the SHOWN column. If the line will be built opposite (mirror image) to what is shown on the tool layout drawings, place the required quantity in the OPPOSITE column. The line B.O.M. acts as a multiplier of tool B.O.M.'s.

11. SOURCE:

Enter a symbol from the source legend which indicates the method of acquisition of each assembly line.

12. PROJECT MANAGER:

Enter the Project Managers first initial and last name.

13. DESIGN SUPERVISOR:

Enter the Design Supervisors first initial and last name.

14. CHECKER:

The checker will enter their first initial and last name after completion of check.

15. DATE RELEASED/RELEASED BY:

Enter the release date and initials. Diagonal arrowed lines are acceptable. The Line B.O.M. will be released to the processing department after the system B.O.M. (if applicable) and before the tool B.O.M.'s are released. The Line B.O.M. will be released to processing one time only unless there are revisions, cancellations or additions.

ASSEMBLY LINE B.O.M. INSTRUCTIONS

16. REVISIONS:

Enter the revision date and change letter for this particular B.O.M. page. Enter a description of the revision and note what the B.O.M. "was" before the revision. Enter the initials of the designer and checker upon completion of revision. All changes to a released B.O.M., such as quantity or a cancellation, must be recorded in the revision column and released immediately to the Processing Department. If a tool has been canceled or removed from a B.O.M., then that change only affects that particular B.O.M. sheet. Tools removed or cancelled from a B.O.M. must be crossed out with a single line and not erased. If a carry over tool has been removed or canceled from all lines, then all affected line B.O.M.'s and line layout drawings must be revised and released.

17. LOGO BLOCK:

This area is reserved for the appropriate logo.

TOOL B.O.M. INSTRUCTIONS

This B.O.M. is necessary for all tools which consist of multiple units. A Tool B.O.M. lists all the separate units which make one right hand and/or left hand tool. The Tool B.O.M. acts as a multiplier of unit B.O.M.'s much like a build chart. All spaces are to be completed by the Design Supervisor as described below. See the following pages for the location of Line B.O.M. identification balloons and B.O.M. example.

1. DESCRIPTION:

The name of the system, assembly line or group of tools is to be printed in this block, on the first sheet of any group of Bill of Materials. Leave this space blank in all subsequent sheets of a B.O.M.

2. TOOL NUMBER:

Enter the customers assigned tool number which is shown, in the upper space and the one which is opposite, in the lower space.

Right hand and left hand lines must be indicated using the suffix of -R or -L after the tool number.

TOOL NO.	16ZF-53515-R (SHOWN)
	16ZF-53516-L (OPPOSITE)

RIGHT HAND SHOWN & LEFT HAND OPPOSITE

TOOL NO.	16ZF-53518 (SHOWN)
	_____ (OPPOSITE)

SINGLE HAND TOOL

TOOL NO.	T49465-S-L (SHOWN)
	T49465-S-R (OPPOSITE)

LEFT HAND TOOL SHOWN & RIGHT HAND OPPOSITE (TRUCK & BUS)

3. B.O.M. PAGE:

List the page number on each page and the total number of system B.O.M. pages on page #1 only. When adding a sheet to the sequence of a released group of B.O.M. sheets, you must revise the first sheet, "1 of—", to coincide. Then list the change in the revision column accordingly and include sheet #1 in the release to processing.

4. CUSTOMER:

Enter customer name.

5. PROGRAM:

Enter program code name.

6. DESIGN SOURCE:

The name of the design source is to be printed in this block on Sheet #1 only.

7. BUILD SOURCE:

The name of the build source is to be printed in this block on Sheet #1 only.

TOOL B.O.M. INSTRUCTIONS

8. TOOL NUMBER:

Enter the tool number for each unit. Diagonal arrowed lines are acceptable to minimize writing. This column is necessary because some customers will allow units to be carried over from other tools.

9. UNIT NUMBER:

List the units in numerical order starting with the Key Sheet. This information is basically a duplication of the Key Sheet.

Carry over units will be identified with the symbol C/O following the unit number. In the special instruction column show from what tool it originated from within that program. Leave one blank space between each line of text for subsequent revisions.

10. DESCRIPTION:

Enter a simple unit description.

11. QUANTITY:

Enter the quantity of each unit required to build only one SHOWN and/or OPPOSITE tool in their respective columns. If the unit will be built as shown on the unit layout drawings, place the required quantity in the SHOWN column. If the unit will be built opposite (mirror image) to what is shown on the unit layout drawings, place the required quantity in the OPPOSITE column. The tool B.O.M. acts as a multiplier of unit B.O.M.'s.

12. SOURCE:

Enter a symbol from the source legend which indicates the method of acquisition of each unit.

13. PROJECT MANAGER:

Enter the Project Managers first initial and last name.

14. DESIGN SUPERVISOR:

Enter the Design Supervisors first initial and last name.

15. CHECKER:

The checker will enter their first initial and last name after completion of check.

16. DATE RELEASED/RELEASED BY:

Enter the release date and initials. Diagonal arrowed lines are acceptable. The Tool B.O.M. will be released to the processing department after the Line B.O.M. (if applicable) and before the unit B.O.M.'s are released. The Tool B.O.M. will be released to processing one time only unless there are revisions, cancellations or additions.

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TOOL B.O.M. INSTRUCTIONS

17. REVISIONS:

Enter the revision date and change letter for this particular B.O.M. page. Enter a description of the revision and note what the B.O.M. "was" before the revision. Enter the initials of the designer and checker upon completion of revision. All changes to a released B.O.M., such as quantity or a cancellation, must be recorded in the revision column and released immediately to the Processing Department. If a unit has been canceled or removed from a B.O.M., then that change affects only that particular B.O.M. sheet. Units removed or canceled from a B.O.M. must be crossed out with a single line and not erased. If a carry over unit has been removed or canceled from all tools, then all affected tool B.O.M.'s and tool Key sheet drawings must be revised and released.

18. REVISIONS LEVEL:

Enter Rev. level letter of the unit in this column when the job is completed and shipped.

19. SUPPLIER UNIT NO.:

When applicable, list the Supplier Unit Number.

20. LOGO BLOCK:

This area is reserved for the appropriate logo.

TOOL B.O.M. INSTRUCTIONS

DESCRIPTION (FILL-OUT ON SHEET ONE ONLY)				XXX-XXXXX-R XXX-XXXXX-L			BOM PAGE 1 of 1						
1999 BRAND "X" BODYSIDE MAINLINE				TOOL B.O.M.			DTEE RELEASED						
CUSTOMER BRAND "X"	PROGRAM	XXX-27	DESIGN SOURCE	CO. "X"	BUILD SOURCE	CO. "Y"	TOOL NO.	REMARKS OR SPECIAL INSTRUCTIONS					
TOOL NO.	CUSTOMER UNIT NO.	SUPPLIER UNIT NO.	REVISION	DESCRIPTION	KEYSHEET STA. #1	INSTALLATION DRAWING	OP	SHN	OPPOSITE TOOL	SHN	OP	SHN	SOURCE
XXX-55102-3	12345	1-KS	A	KEYSHEET STA. #1			1	1					M
				INSTALLATION DRAWING									
	12346	1-1AB		PART LOADER SLIDE			1	1					M
	12347	1-1BB		PART LOADER			1	1					M
	12348	1-2AP		FRT. RETRACT PIN			2	2					M
	12349	12BC		LWR. "A" PLR. CLP.			1	1					M
	12310	1-2C		UPR. "A" PLR. CLP.			1	1					M
	12341	1-2DT		O/H GATE ACTUATOR			8	8					M
CHG LTR	DATE	REVISIONS / REASON FOR	DRAWN BY	CHKD BY	PROJECT MGR.	DESIGN SUPV.	CHECKER						
					J. DOE	J. DOE	J. DOE	SOURCE LEGEND					
								M - MAKE ITEM					
								P - PURCHASE ITEM, SUB CONTRACTED BUILD					
								F - FURNISHED, SUPPLIED BY CUSTOMER					

A

UNIT B.O.M. INSTRUCTIONS

This B.O.M. is necessary for all units or non-utilized tools. A unit B.O.M. lists all the commercial, manufactured, and customer furnished components which make one right hand and/or left hand unit. All spaces are to be completed by the Tool Designer as described below, except where noted. See the following pages for the location of Unit B.O.M. identification balloons and B.O.M. example.

Items not required on the Unit B.O.M.'s will be listed separately per Build Source.

1. DESCRIPTION:

The name of the system, assembly line or group of tools is to be printed in this block, on the first sheet of any group of Bill of Materials. Leave this space blank in all subsequent sheets of a B.O.M.

2. TOOL NUMBER:

Enter the customers assigned tool number which is shown, in the upper space and the one which is opposite, in the lower space.

Right hand and left hand lines must be indicated using the suffix of -R or -L after the tool number.

TOOL NO.	16ZF-53515-R (SHOWN)
	16ZF-53516-L (OPPOSITE)

RIGHT HAND SHOWN & LEFT HAND OPPOSITE

TOOL NO.	16ZF-53518 (SHOWN))
	_____ (OPPOSITE)

SINGLE HAND TOOL

TOOL NO.	T49465-S-L (SHOWN)
	T49465-S-R (OPPOSITE)

LEFT HAND TOOL SHOWN & RIGHT HAND OPPOSITE (TRUCK & BUS)

3. UNIT NUMBER:

Enter the unit's number. Do not add a suffix to show the unit's hand. The "shown/opposite" information is found on the tool B.O.M.

Cross out this space for non-unitized tools.

4. B.O.M. PAGE:

List the page number on each page and the total number of Unit B.O.M. pages on page #1 only. When adding a sheet to the sequence of a released group of B.O.M. sheets, revise the first sheet, "1 of ___", to coincide. Then list the change in the revision column accordingly and include sheet #1 in the release to processing.

5. CUSTOMER:

Enter customer name.

6. PROGRAM:

Enter program code name.

7. DESIGN SOURCE:

The name of the design source is to be printed in this block on Sheet #1 only.

UNIT B.O.M. INSTRUCTIONS

8. BUILD SOURCE:

The name of the build source is to be printed in this block on Sheet #1 only.

9. CUSTOMER DETAIL NUMBER:

List all detail components as shown on the layout drawings in the following order: commercial items, customer standard items, and make items last.

10. SUPPLIER DETAIL NUMBER:

When applicable list the Supplier's Detail Number.

11. SUB-DETAIL:

Enter sub-detail identification number/letter.

12. REVISION:

Enter revision level shown on the individual detail.

13. SHOWN ON LAYOUT (L/O) SHEET:

When a unit consists of three assembly layout sheets or more, enter the layout sheet number on which the detail has been "called out" (ballooned). The detail number is "called out" on one layout sheet only, although it may be "referenced" on several sheets.



14. NAME:

A name is to be given to every item listed and it should be the same name as on the detail drawing.

15. MATERIAL:

List the specific material type for make details. Use the S.A.E. material code number and specify if it is H.R.S. or C.R.S. finish.

16. SPECIFICATION AND/OR SPECIAL INSTRUCTIONS:

Enter all information necessary to obtain the material and/or altered item. Size, material specifications, model numbers "altered see L/O", one makes two symbol , cut to layout symbol , source of commercial items, are a few examples of information appearing in this column. N.D. (not drawn) detail stock sizes should also be listed in this column.

The stock sizes of each detail must be listed.

When plate, tubing, angles, channels, etc., that are produced to U.S. customary units are specified, the cross section dimensions should be called out in U.S. customary units and the cut length in metric.

UNIT B.O.M. INSTRUCTIONS

A

17. QUANTITY:

Quantity entries are determined depending if the tool is non-handed, right and/or left handed whether the tool is unitized or not. "SHOWN" means to build the detail as it is drawn. "OPPOSITE" means to build the detail opposite (mirror image) of what is drawn.

1. The following rules apply:

- A. If the tool has units that are non-handed, quantities are entered in the SHOWN unit column.

OPPOSITE UNIT		SHOWN UNIT	
OPP	SHN	OPP	SHN
			1
			1

- B. If the tool has both SHOWN and OPPOSITE units, quantities are entered in both the SHOWN and OPPOSITE unit columns.

OPPOSITE UNIT		SHOWN UNIT	
OPP	SHN	OPP	SHN
1			1
1			1

- C. If the tool contains SHOWN only or OPPOSITE only units, the quantities are entered in their respective columns.

OPPOSITE UNIT		SHOWN UNIT	
OPP	SHN	OPP	SHN
			1
			1

OPPOSITE UNIT		SHOWN UNIT	
OPP	SHN	OPP	SHN
1			
1			

UNIT B.O.M. INSTRUCTIONS

A

2. In all cases, the quantity of components is to reflect the amount necessary to build only one shown and/or opposite unit. On unitized jobs a tool B.O.M. is required to show the total number of units required to make one complete tool. On non-unitized jobs a line B.O.M. is required to show the total number of tools required to make one complete line.

Non-unitized tools do not require a tool B.O.M. Treat the non-unitized tool like a unit, utilizing a Unit B.O.M.

18. SOURCE:

Enter a symbol from the source legend which indicates the method of acquisition of each item.

19. PROJECT MANAGER:

Enter the Project Managers first initial and last name.

20. DESIGNER:

Enter the tool designers first initial and last name.

21. CHECKER:

The checker will enter their first initial and last name after completion of check.

22. HI-SPOT:

The person who performed the hi-spot will enter their first initial and last name.

23. DESIGN SUPERVISOR:

Enter the Design Supervisors first initial and last name.

UNIT B.O.M. INSTRUCTIONS

24. DATE RELEASED/RELEASED BY:

These columns are to be completed by the design supervisor or design leader.

1. Fab (fabrication) Release.

To achieve the build completion dates on certain programs, it may be necessary to expedite the fabrication of some details before the machining information is available. On details such as large bases the detail drawing can be completed and checked for fabrication, but the hole pattern can not be checked and completed until the last unit that bolts to the base is drawn. Consult with the Project Engineer on which details should be preliminary released for fabrication only, to achieve the build completion dates.

To preliminary order a detail for "fabrication only", the design supervisor or design leader is to enter the release date and their initials in the "Fab" column. Diagonal arrowed lines are acceptable for the release of multiple details.

DATE RELEASED RELEASED BY	
FAB	FINAL
9-14-1986 J. Doe	

2. Final Release

A "Final Release" on any detail or component constitutes authorization to construct or order those items. Long lead commercial items which take more than six weeks for delivery will be final released to Processing during the layout process. Check with the Project Engineer for the list of long lead items.

When ordering special items use the special instructions column to enter the name of the supplier which worked with Engineering and the quoted price and delivery if available.

To final order a detail, the Design Supervisor or Design Leader is to enter the release date and their initials in the "Final" column. Diagonal arrowed lines are acceptable for the release of multiple details.

DATE RELEASED RELEASED BY		
FAB	FINAL	
	9-14-1986 J. Doe	

UNIT B.O.M. INSTRUCTIONS

25. REVISIONS:

Enter the revision date and change letter, when making a revision to an assembly and/or detail and/or B.O.M., the change letter will be the same on all affected sheets for that change. A change letter will only be used once per unit, regardless of the type of document. Enter a description of the revision, include the detail number and note what the B.O.M. "was" before the revision. Enter the initials of the designer and checker upon completion of revision. All changes to a released B.O.M., such as quantity or a cancellation, must be recorded in the revision column and released immediately to the Processing Department.

If a detail has been canceled or removed from a B.O.M., then that change only affects that particular B.O.M. sheet. Details removed or canceled from a B.O.M. must be crossed out with a single line and not erased. If a carry over detail has been removed or canceled from all units, then all affected unit B.O.M.'s and unit layout drawing must be revised and released.

26. SERVICE:

Place an "X" in this column if the detail is considered a wear item and spare parts need to be considered.

27. LOGO BLOCK:

This area is reserved for the appropriate logo.

UNIT B.O.M. INSTRUCTIONS

UNIT B.O.M. (FILL OUT ON SHEET ONE ONLY)										BOM PAGE	
1										4	
2										of	
TOOL NO.										SOURCE	
3										RELEASED	
4										FAB	
5										FINAL	
6										SERVICE	
7										RELEASED	
8										RELEASED	
9										RELEASED	
10										RELEASED	
11										RELEASED	
12										RELEASED	
13										RELEASED	
14										RELEASED	
15										RELEASED	
16										RELEASED	
17										RELEASED	
18										RELEASED	
19										RELEASED	
20										RELEASED	
21										RELEASED	
22										RELEASED	
23										RELEASED	
24										RELEASED	
25										RELEASED	
26										RELEASED	
27										RELEASED	
UNIT B.O.M.										SHOWN UNIT	
UNIT NO.										OP	
SPECIFICATIONS AND/OR SPECIAL INSTRUCTIONS										SHN	
CUT TO LAYOUT										OP	
MATERIAL										SHN	
NAME										OP	
BUILD SOURCE										SHN	
DESIGN SOURCE										OP	
PROGRAM										SHN	
SUB-DETAIL										OP	
REVISION LEVEL										SHN	
Z-LEVEL										OP	
PROJECT MGR.										DESIGN SUPV.	
DATE										HI-SPOT	
REVISIONS / REASON FOR										CHECKER	
SOURCE LEGEND										DESIGNER	
M - MAKE ITEM/REWORK											
P - PURCHASE ITEM											
MP - MAKE ITEM REQUIRED FOR SUBSTITUTION											
F - FURNISHED BY CUSTOMER											
NC - NUMERICAL CONTROLLED MACHINING											

The following four pages contain full size templates of the System B.O.M., Assembly Line B.O.M., Tool B.O.M. and Unit B.O.M.

DESCRIPTION

SYSTEM B.O.M.

BOM PAGE

— of —

CUSTOMER

PROGRAM

DATE RELEASED

ASSEMBLY LINE NO.

DESCRIPTION

DESIGN SOURCE CONTACT

BUILD SOURCE CONTACT

L.H. LINE

R.H. LINE

SOURCE

DATE RELEASED

RELEASED BY

CHG LTR

DATE

REVISIONS / REASON FOR

DRAWN BY

CHKD BY

CHECKER

SOURCE LEGEND

M - MAKE ITEM

P - PURCHASE ITEM, SUB CONTRACTED BUILD

F - FURNISHED, SUPPLIED BY CUSTOMER

