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NAVY DEPARTMENT

DAVID TAYLOR MODEL BASIN

WASHINGTON, D.C.

PREPARATION, LABELING, AND IDENTIFICATION OF GRAPHS AND FIGURES

June 1943

Report R-128

FOREWORD

The instructions contained in this booklet have been prepared as advance copy for a Taylor Model Basin report now being written, entitled "The Preparation of Technical Reports." They include beneficial suggestions made from time to time in the past few years by various members of the staff and others, and are intended to extend the benefit of these instructions to all who may have to do work of this kind.

The Reports, Records and Translations Section is engaged continuously on this type of work, and is kept posted on the latest developments in this art. One of the principal duties of this section is to be of assistance and service to all members of the staff in the preparation of descriptive matter for technical reports. Members of the staff are urged to call upon this section for help and advice on all possible occasions.

It will be noted that this booklet is made up, as far as practicable, in the form recommended for technical reports. The procedure to be followed is illustrated by carrying it out in the preparation of a series of examples, and the particular points to be observed are explained in legends or footnotes directly under each example.

Any resemblance between the fanciful curves used as examples in the figures of this booklet and the results of any tests, past, present and future, is purely coincidental.

PREPARATION, LABELING, AND IDENTIFICATION OF GRAPHS AND FIGURES

GENERAL

Experience has demonstrated that the greater part of all test and research results at the David W. Taylor Model Basin, theoretical as well as practical, can be shown more clearly, reliably, and comprehensibly by properly constructed figures, graphs, and diagrams than by any amount of text, no matter how well written. Graphic plots and diagrams are smaller, neater and in general much more useful and valuable to the reader than the text necessary to cover an equally comprehensive verbal description. Moreover, such graphs and diagrams frequently have great value independently of the original report in which they occur. It must always be remembered that the principal purpose of any discussion or report is to impart the full and correct meaning of the results of a program of research or of a test or series of tests to the activity which requested or authorized them, with the minimum of effort on the part of a reader in that activity.

Many features of this practice of maximum graphical representation, developed by various sections of the Taylor Model Basin and by other activities, are set down herein for the benefit of all sections of the Technical Division. It is desired that the general rules outlined herein be followed unless better rules can be developed to supersede them, in which case these instructions will be revised.

SIZE OF SHEETS

When graphs, diagrams, or sketches are to accompany letters or are to form a part of typed letter reports, they shall, wherever practicable, be placed on single letter-size sheets, with trim lines, border lines, and punched holes corresponding approximately to those shown on single-sheet S-sketches; Figure 1. Instructions concerning legends on these sheets will be found on page 9 following.

If a single sheet is too small, a folded double sheet corresponding to the double S-sketch sheet, Figure 2, may be used. This can be filed conveniently and easily read.

It is recognized that in many cases larger sheets must be used, as for the delineation of lines of flow and wave profiles; these will not be standardized for the present as to size, but in their preparation the instructions of this memorandum will be followed.

For every plot, sketch, or diagram which is to be placed in letter files with top clips, a clear margin of 1 1/2 inch shall be left at the top.

If practicable, 1 inch shall also be allowed at the left side of every graph and figure for side binding, for the convenience of those who have side binding booklets or files. It is an excellent practice to indicate by a simple sketch, as in Figure 3, the exact size of the margin and the folding desired in the print.

The final size of any graph, figure, diagram or drawing shall be established before the final draft is made, so that the sizes of the letters,

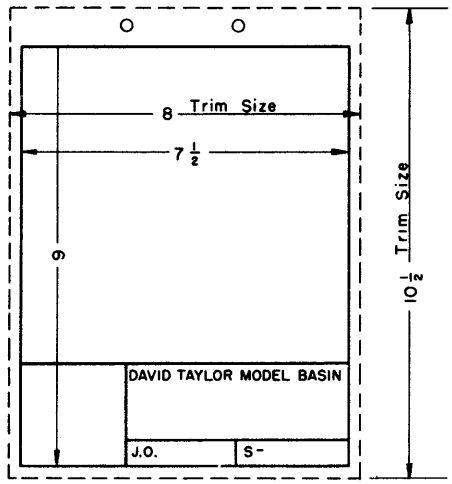


Figure 1 - Single Sketch Sheet

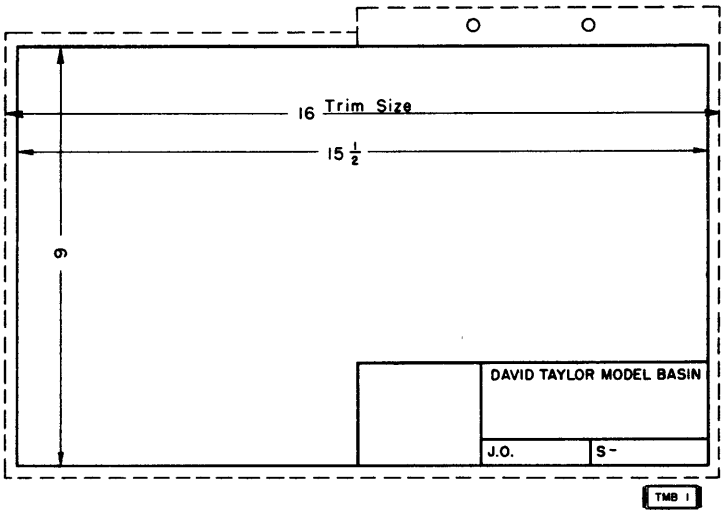


Figure 2 - Double Sketch Sheet

The size and proportions are as indicated. The legend block shown is for working plans; it may and should be modified to suit the particular needs in each case.

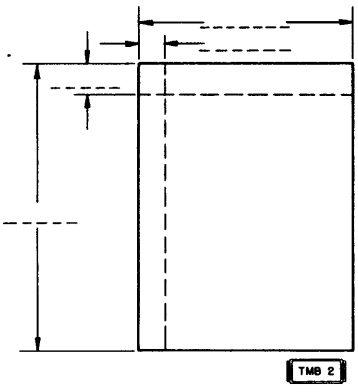


Figure 3 - Graphic Method of Ordering Prints

The dimensions indicated may be represented graphically by drawing the sheet to the exact size, they may be indicated in pencil on the sheet to be copied, or they may be placed, with the sketch, on an accompanying sheet.

the weights of the lines and corresponding features may be known when the smooth drawing is prepared. This will insure that letters and figures are large enough for legibility, that the lines are not too heavy or too light, and that there is sufficient but not too much detail.

ARRANGEMENT OF SHEETS

Whenever possible, photographs, diagrams, sketches, graphs, and figures shall be arranged to read with the long dimension of the sheet vertical, in accordance with the filing system, and in accordance with the pages in technical reports. Lettering along the left-hand edge of the sheet shall read from the bottom, as shown in Figure 4.

If a graph or figure must be turned the long way of the sheet and must carry lettering at right angles to the normal reading position, the rotation of the sheet for reading shall always be clockwise, as shown in Figure 5.

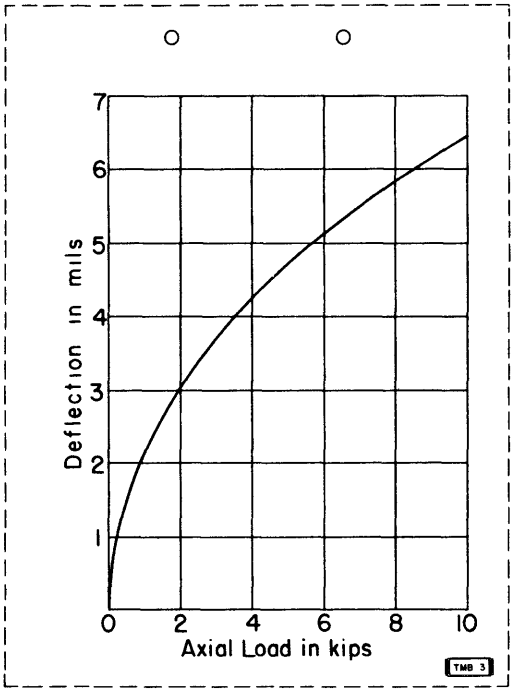


Figure 4 - Lettering on Vertical Graphs

The weight of the curve is about twice that of the coordinate lines.

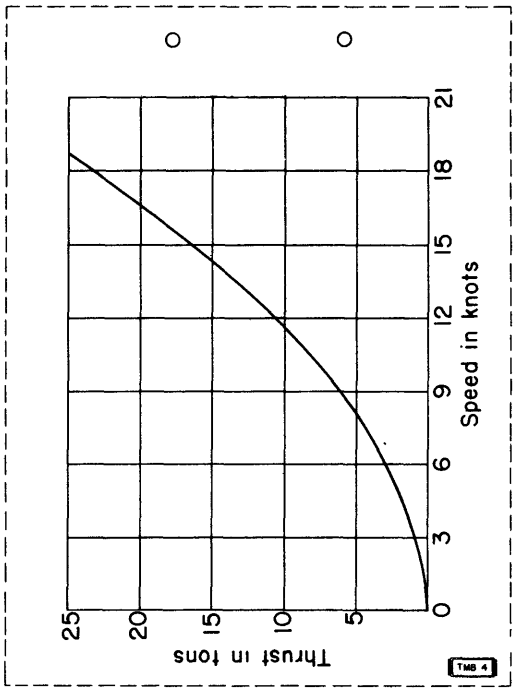


Figure 5 - Lettering on Horizontal Graphs

This type of sheet is always to be read from the right.

For graphs or figures to be read with the long dimension horizontal, it is the custom to label the left-hand ordinate from bottom to top, although the lettering is then upside-down along the bottom when the sheet is filed with the long dimension vertical. For an example, see Figure 5.

Whenever the full meaning of the information delineated on a sheet can be made clear by the addition of a diagram or sketch forming a part of the sheet, and reference to text on another sheet can thereby be avoided, this shall be done, as shown on Figure 6. The plot or graph sheet shall

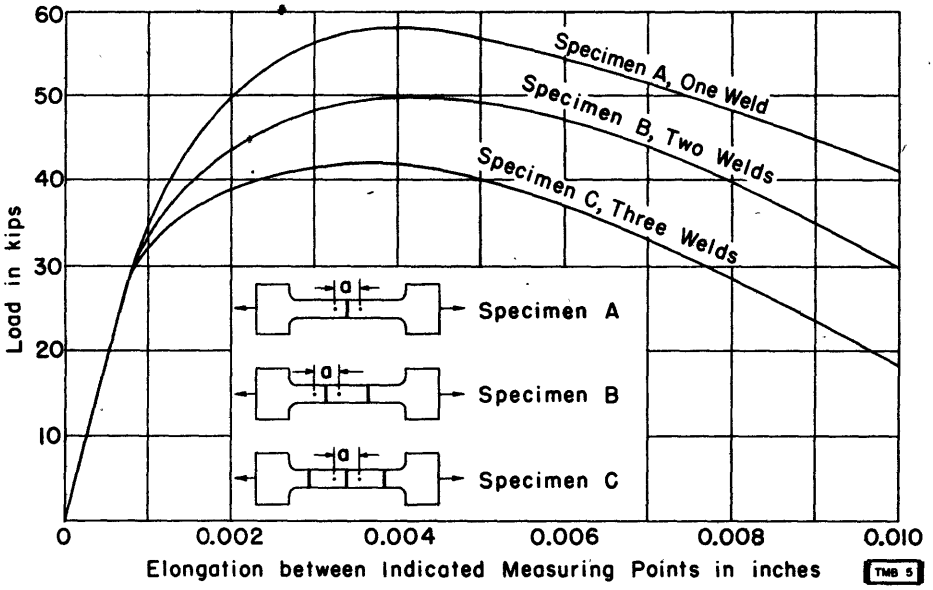


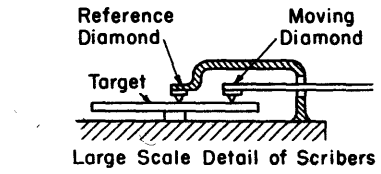
Figure 6 - Graph with Complementary Sketch

When the lower left-hand corner is the point of origin for both coordinate systems, only one zero sign (0) shall be used. The scales in every graph shall be clearly identified. All numbers in scales shall be placed upright in the reading position. Words describing the units in all coordinate scales shall not be capitalized.

carry enough of the story to make it essentially complete by itself, requiring no reference to a separate letter or text. It is distracting, and exasperating, for a reader to have to finger pages back and forth to obtain the full meaning of a complicated discussion, part of which is in the text, and the remainder on separate sheets containing curves or diagrams.

Diagrams, graphs, figures and other drawings shall be inserted in letter and technical reports as close as practicable to the corresponding text. They shall not be bunched at the end of the report.

When making diagrams and sketches, and when marking up photographs, avoid the use of letters or numbers with a separate key to which reference must constantly be made. Place the name of each part on or near it; this often requires artistic handling to produce an acceptable result, but it can be done. If parts are too small to permit writing the names near them, include a



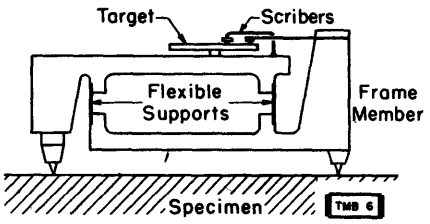


Figure 7 - Diagram with Large-Scale Sketch to Clarify Detail

The arrangement and relative position of parts in the two diagrams shall be alike, to avoid confusion. The descriptive words shall be small enough to prevent their obscuring the general picture.

larger-scale diagram on which the names can be shown, see Figure 7.

If sketches refer to certain curves, be careful to spare the reader the ordeal of referring from the curve to the block in which the test conditions are enumerated and thence to the sketch for identification. Whenever practicable, identification shall be by simple sketches, placed adjacent to the curves to which they apply, as in Figure 6.

When a series of curves represent the same test condition except for one variable, that variable shall be indicated directly on each curve.

IDENTIFICATION

Every plot and graph sheet, and ***every*** diagram or sketch, unless forming part of a test or technical report with a formal heading, or unless securely clipped to another sheet which is properly identified, shall carry at least the following information for identification:-

DAVID W. TAYLOR MODEL BASIN*
(date)

Examples of this procedure will be found in Figures 8 and 9.

Every sheet carrying graphs and figures, except those securely and permanently bound in a dated test or technical report, shall carry a date. Reference to graphs and figures in correspondence is by date, and frequently a date is the only convenient means of identifying a revised copy.

Dates shall always be written thus:- 29 January 1942. If space is at a premium they may be abbreviated to:- 29 Jan 42.

Below each figure, graph, or diagram intended for inclusion in a test or technical report shall be given a brief descriptive title, which will ultimately be typed in large type, known as "medium roman," thus:-

Figure 6 - Dynamic Load Factor**

Each figure, graph or diagram prepared as a separate sheet, such as an enclosure in a letter report, shall carry a legend sufficiently complete to make the sheet practically self-explanatory; see Figures 8 and 9.

When explanatory remarks are appropriate or are required, they shall appear below the main descriptive title, in complete sentences. In many cases, it is possible, and preferable, to place descriptive matter in a caption of this kind instead of in the text. These sub-titles shall appear in smaller type, known as "elite," thus:-

The disturbances are of the type of Figure 4,
varying as to rate of application of load.**

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* This name shall not be abbreviated in any legend, except when it is used as an adjective, as in "TMB strain gage."

** These examples are here printed full size. The text of this report was typed in medium roman, the footnotes in elite, and then reduced photographically.

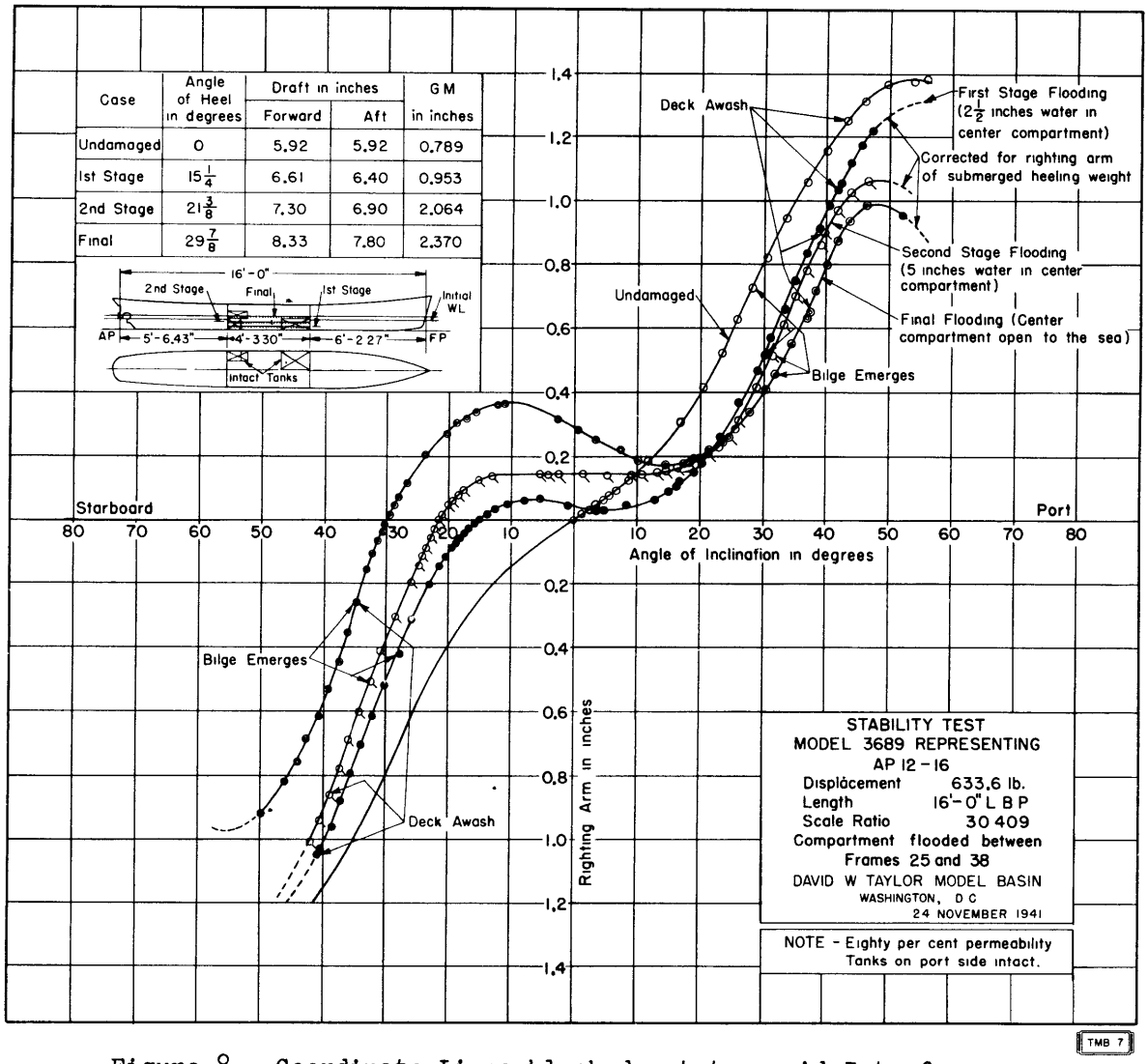

Figure 8 - Coordinate Lines blocked out to avoid Interference with Lettering and Explanatory Sketches

Unless, as in this case, the separate curves are well delineated by easily recognizable spots, special procedure must be adopted to prevent the confusion occasioned by crossing and overlapping curves.

In addition to the identification specified in the foregoing, the original of every graph, figure or diagram shall be marked to facilitate filing of the original, of photographic negatives or positives, and other copies. This shall be accomplished by at least one of the following methods:-

1. All data pertaining to towing models of ships and other craft shall carry the serial number assigned to the respective model; for example, Model 1234.

2. All data pertaining to model propellers shall carry the serial number assigned to the respective propeller; for example, Model Propeller 5678.

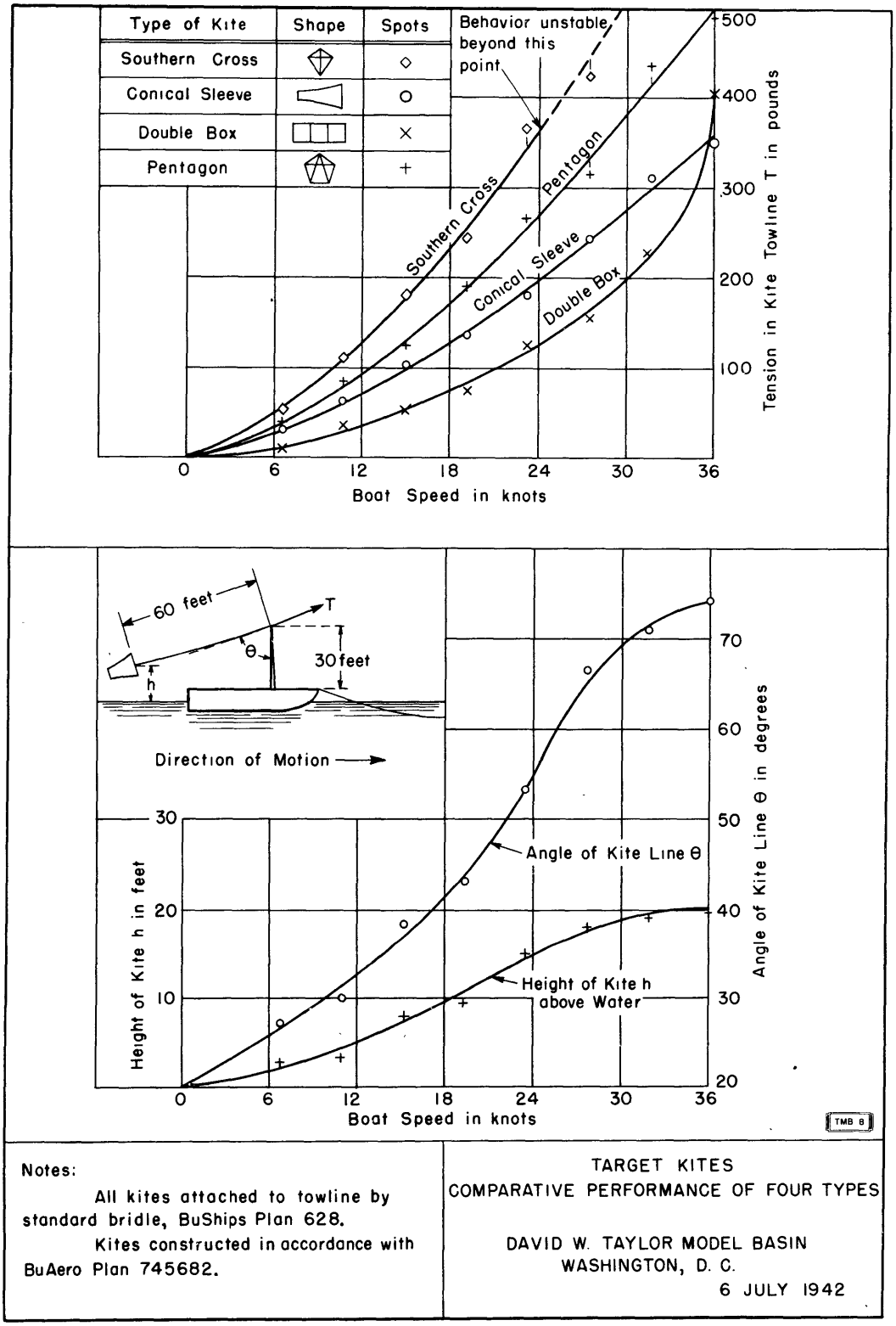

Figure 9 - Lettering along Curves facilitates Reference and Reading

Whenever experimental data are available, it is customary to show the spots on the graphs, as an indication of the amount of scatter in the test results.

The legend and notes make this sheet practically self-explanatory.

3. All drawings of miscellaneous models, test equipment and items of material shall carry a letter and serial plan number assigned in accordance with the TMB Drafting Room Manual; for example, A-1234; S-286; D-202.

4. The U.S. Patent Office regulations require that the originals of all patent drawings be forwarded *with* the applications. Photostats of all drawings prepared for patent applications shall be made, and placed in a special correspondence file, for which separate instructions have been issued.

5. All drawings prepared for the TMB Technical Information Book, including the TMB Drafting Room Manual, shall carry a serial number, preceded by "K-."

6. All graphs, diagrams, and figures which will eventually form a part of TMB letter or technical reports, *and which are not otherwise identified by numbers* as indicated in other sections of this paragraph, shall be assigned a serial number by the Reports, Records and Translations Section for reference purposes and for use in filing the originals, the photographic negatives, the duplicate copies, and the like. This serial number shall be preceded by "TMB"; for example, TMB 103. All miscellaneous drawings* of any kind, sent to the Reproduction Section via the Reports, Records and Translations Section for processing or duplication, shall have TMB serial numbers** added to the originals by that section before they are sent to be photographed or reproduced.

7. When graphs or drawings are to be embodied in technical reports, the TMB identification numbers shall be used for reference in the texts while the reports are in preparation; figure numbers will not be assigned and entered until the final draft of the manuscript is completed.

8. All photographs of test equipment and installations shall carry a serial TMB negative number assigned by the Photographic Section; for example, TMB 2315. *This number shall appear on the final framed or trimmed print of every photograph, as well as in half-tone or equivalent reproductions of these photographs in technical reports.*

9. The TMB serial numbers may be used for the identification of graphs and drawings in letters and letter reports instead of marking the sheets as

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* This shall include signs, posters, routine and special forms, telephone and address directories and any similar material intended for reproduction.

** This procedure is exactly the same as that prescribed and now followed for the identification of photographs and for the filing of photographic negatives. As the TMB negative numbers are now in the vicinity of 8000 and as the TMB drawing numbers will start at 1, it appears unnecessary to have separate blocks of numbers for the two groups. In case any misunderstanding is expected, the two items can be referred to as TMB negative 8678 and TMB drawing 1234.

enclosures. They cannot be confused with shop drawings because they are not preceded by a letter; see sub-paragraph 12. For example,

Enclosure:
(A) TMB 1234, Diagram of Forces (date) - 2 photostats

10. The TMB serial number, enclosed in a cartouche, thus [TMB 1234], shall be placed near the lower right-hand corner of its graph or drawing, as in the present report; see Figures 1 to 11.

11. Lantern slides made at the Taylor Model Basin are almost invariably copies of photographs or drawings made here. They shall carry the respective TMB negative or drawing numbers, in addition to any others that may be assigned.

12. All A-, B-, C-, D-, and S- plan numbers for working and shop drawings, all Technical Information Book K-numbers, and all TMB serial numbers shall be marked clearly on every original so as to show in legible form in the *final* reproduction. The number shall preferably appear in the lower right-hand corner of the sheet when it is bound or filed in final form.

LEGEND

Every sheet carrying a graphic representation of some feature and not intended for binding in a report with a separate formal heading shall carry a legend, even if it consists only of the two lines listing the name of the establishment and the date.

The legend may be placed on the sheet in any convenient position to clear the curves, the explanatory sketches and the subject matter, but

1. it shall, if practicable, be placed near the lower right-hand corner, especially on single letter-size sheets arranged for top binding.

2. it shall always be kept well clear of the top of the sheet, when the latter is arranged for top binding.

On cross section sheets, and sheets with coordinate lines of any kind, the legend shall preferably be boxed and the box shall be clear of all such lines; see Figures 8 and 9.

LABELING

Every figure, graph or diagram shall be adequately identified and described in graphical or in any other appropriate manner. The labeling shall be readable, straightforward, and complete. When numerous people comparatively unfamiliar with the subject must read and understand a graph or figure, meticulous care in preparation exerted at the source will be fully repaid in the time and strain saved the readers. Bear in mind that, even

though curves or graphs be drawn for record only, they are invariably intended for the perusal and education of some one ***other*** than the person who makes them.

When labeling curves, place the words, numerals, or symbols as close as practicable to their respective curves. Use short arrows, avoid long or strung-out word groups by grouping words close together, and avoid, wherever practicable, crossing one or more curves with arrows going to another. If much of this occurs, the arrangement should be changed or the scale altered and the curves redrawn.

Run words along the curves, if it can be neatly done--***and***, if the reader does not have to tilt the sheet to read them; see Figure 9.

Tabulation of test conditions on or with a curve or graph is often desirable and may be found most useful, but the pertinent data shall also be placed alongside the respective curves, so that it will not be necessary to move the eye--and the attention--back and forth to a key or to an identification in some other part of the sheet; see Figure 9.

Curves or graphs shall always be labeled individually regardless of identification in the legend or elsewhere. This shall be done whether the graphs are drawn with different types of lines or not.

When labeling coordinates of a curve or graph, indicate on the axes the units employed as well as the symbol, as in Height of Kite h in feet.

When test points for several curves are plotted, and the points are scattered or lie near other curves, the association of the points and curves shall be clearly indicated by light joining lines; see Figure 10.

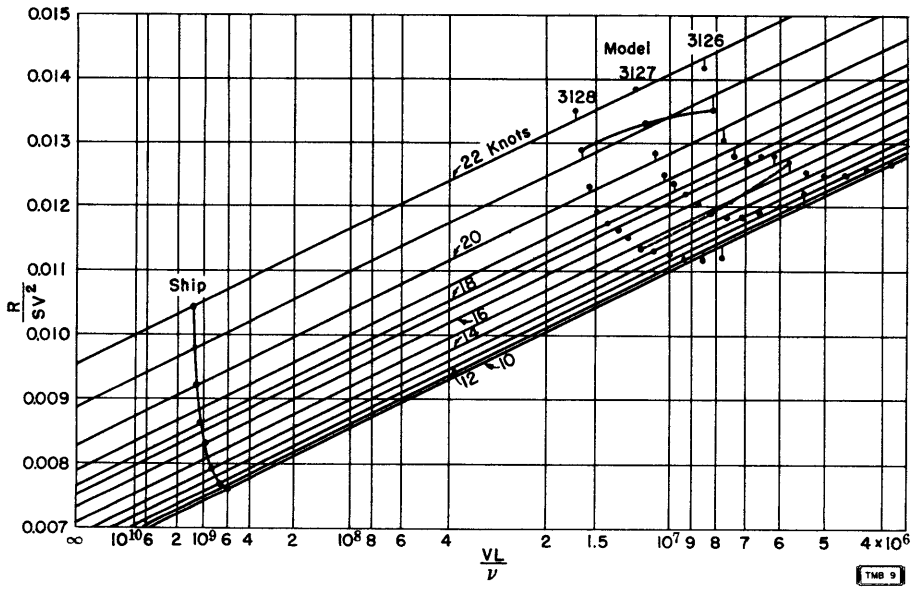

Figure 10 - Short Connecting Lines from Scattered Points to the Proper Curves prevent Confusion

Whenever practicable, the coordinates for a curve of model results shall also carry a parallel scale for the prototype or vice versa, Figure 11.

If any units are expressed by formulas which are not perfectly familiar to those who will use the data, the formulas shall be explained in a box on the sheet and the units shall be given, Figure 11.

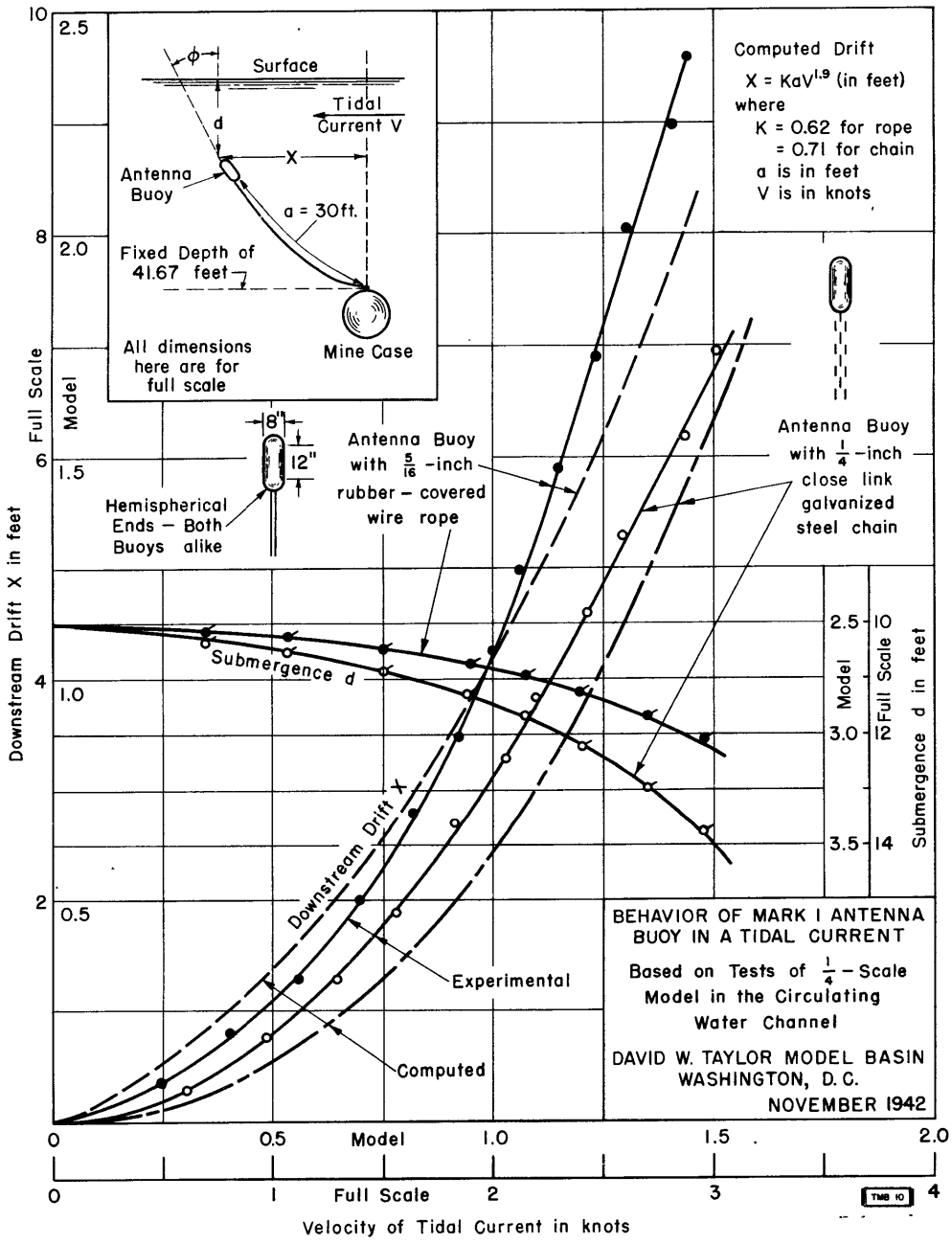

Figure 11 - An Example of a Graph in which the Whole Story is presented on One Sheet

This sheet illustrates the use of parallel scales for prototype and model.

LINES

Curves and graphs shall be drawn in somewhat heavier than the heaviest division or coordinate lines on the sheet. For general instructions relative to the weight of lines, see the TMB Drafting Room Manual.

In regions in which a curve is indeterminate because of inadequate data or unstable conditions, the curve shall be a broken line instead of the usual solid line. A broken line is made thus ---; a dotted line thus .....

Variations in the thickness of a line or the flow of ink shall be carefully avoided. They are frequently emphasized in the reproduction process unless the reduction ratio is large.

Outlines of parts in sketches shall always be about twice as heavy as the section lines used for hatching.

If plots are to be photostated, they can be drawn in pencil or ink on blue-lined coordinate sheets, and only the principal division lines filled in with black. The blue lines fade out in the reproduction process.

If plots are to be photographed, the intermediate coordinate lines shall be lightly drawn in ink.

Include only the coordinate division lines absolutely necessary for an understanding of the plot or its use in service; more lines only clutter up the background and confuse the reader. It is rarely necessary to have a spacing of coordinate lines less than 1/4 inch in the final product.

If precision in picking off values from a plot is necessary, the squares or areas crossed by the curves can be filled in with closely spaced lines, leaving the remainder of the area fairly open; see Figure 12.

LETTERING

When letters, words, numerals and the like are added to a cross section background, place them *clear of* the heavy division lines, and make them heavier than the fine division lines so that they will stand out; see Figure 12. If it is not possible to place them entirely clear of the division lines, block out the latter for an appreciable area.

Commonly used abbreviations such as TMB, RPM, SHP, etc., shall not be punctuated but shall be written as indicated.

If both capitals and lower-case letters are used in legends and scales, the names of units shall always be given in lower-case letters. For example, SPEED in knots; or Speed in knots.

Explanatory notes, when they consist of more than one or two easily legible words, shall be blocked out of the cross section background. They may or may not be surrounded by separate trim lines. This is easily done by making up white inserts, adding the necessary lettering to them, and pasting them on the sheets before photographing.

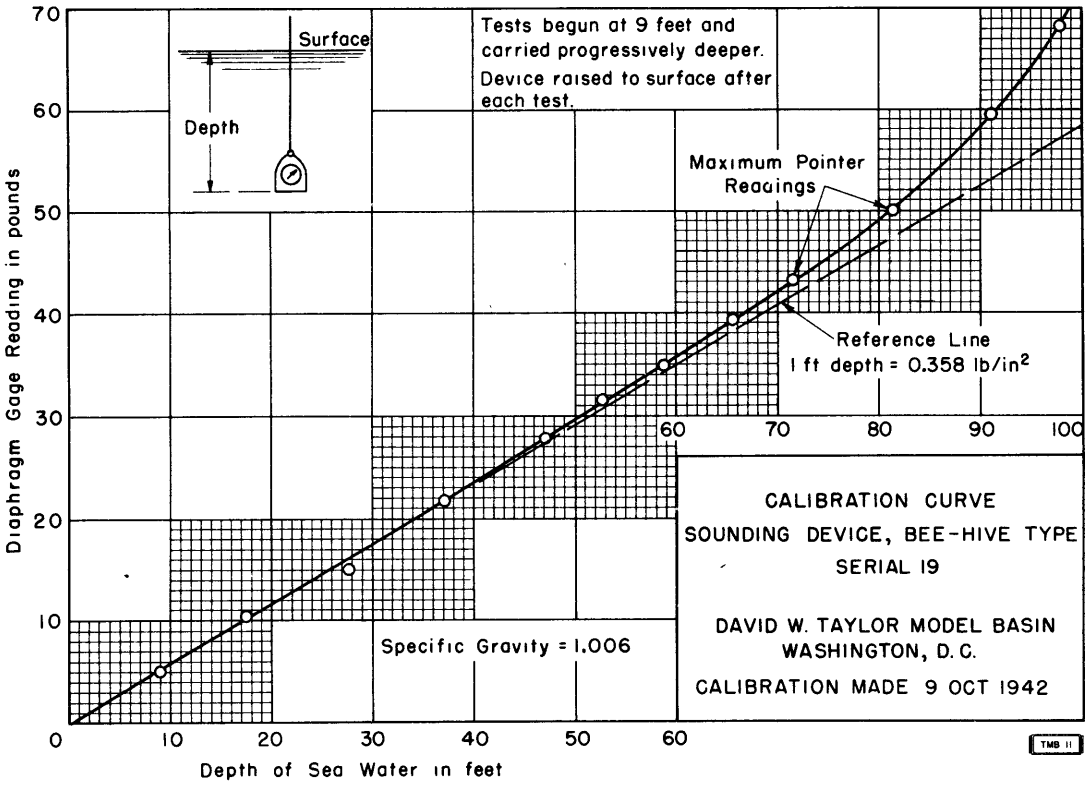

Figure 12 - Example of Graph Requiring Closely-Spaced Coordinate Lines

The fine division lines are made as light as will reproduce properly and are traced only in the blocks where they are required.

The diagrammatic sketch and the descriptive notes can be added if they do not crowd the figure unduly. When so added, they make reference to a text almost unnecessary.

Note that where no numerals precede the decimal sign, the prefix 0 is added, to call attention to the point.

Precision of measurement rules the nature of the work, and common sense should govern the number of significant figures used.

SYMBOLS

Use the word **and** in place of the symbol &, which might be mistaken for the numeral 8. For example, **Speeds and Resistances.**

Omit the abbreviation **No.** wherever this can be done; the accompanying numerals show that it is a number. For example, **Model 3640.** Do not use the symbol # for **No.**; do not use it for pounds, nor for any other word, except when the meaning is not clear without it.

Avoid the use of abbreviations, as they frequently can be misinterpreted or they become illegible if the size becomes too small in subsequent reduction. This is especially true of words describing the scales and the units used on them. For example, write pounds, per cent, degrees, inches, feet.

Exercise extreme care in showing decimals, leaving ample space for the decimal point between numerals and showing it clearly. For example, 2.5.

Decimal points shall ***always*** be preceded by some numeral. If no significant figures are involved, this numeral shall be 0, as 0.003.

Avoid the use of inch marks, small degree signs, and the like by indicating the units in words, thus

Angle of Yaw in degrees				instead of		Angle of Yaw			
5	10	15	20		5°	10°	15°	20°	

Units shall be expressed consistently; for example a combination of feet, ft. or ' shall not appear on the same graph or the same set of graphs or figures, unless special circumstances require it.

Avoid the use of parentheses wherever practicable; use commas instead.

The use of a coefficient shall be accompanied by a definition of the coefficient in symbols, followed by "where" and the meaning of each symbol. For example

$$R = \frac{PA}{V}$$

where R is the* resistance of the model in pounds,

P is the pressure on the nose of the model in pounds per square inch,

A is the cross sectional area of the model in square inches,

V is the speed of the model in feet per second.

MISCELLANEOUS

The direction of motion of moving objects depicted on the diagrams accompanying plots and graphs, and on plans and sketches, shall be uniformly toward the right. For example, see Figures 8 and 9.

Avoid the use of the expression "as per." Where these words have been used in the past, they could generally have been omitted entirely without altering the meaning.

Avoid significant figures not warranted by the test data or required by the analysis involved; they consume space and mislead the reader.

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* Do not use the sign = when explaining symbols.