NAUTICAL CHART MANUAL - VOLUME 1 - POLICIES AND PROCEDURES

Seventh (1992) Edition

CHAPTER 2 - GENERAL PRACTICES AND PROCEDURES

U.S. Department of Commerce
Office of Coast Survey

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

MEMORANDUM FOR: All Cartographers
Marine Chart Division

July 26,2000

FROM: Fannie B. Powers
Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Chapter 2

Effective immediately, the attachment replaces Chapter 2, revised July 12, 2000 in the Nautical Chart Manual, Volume 1, Part I, Seventh (1992) Edition, in its entirety. References to Chapter 2 in places, such as the Table of Contents and the Index in the Nautical Chart Manual, will be updated.

1 Attachment
Chapter 2, dated July 26, 2000

2 GENERAL PRACTICES AND PROCEDURES

2.1 Organization and Responsibilities

The primary responsibility for nautical chart production is vested in the Office of Coast Survey (OCS). Source data used in chart production is also received from the National Geodetic Survey (horizontal and vertical control), Center for Operational Oceanographic Products and Services (COOPS)(tidal data and tide tables), Office of Marine and Aviation Operations (OMAO)(hydrographic surveys); and outside of NOS, the National Environmental Satellite, Data, and Information Service, a unit of NOAA (magnetic data).

OCS is responsible for providing basic maps, charts, publications, and other specialized data required for safe marine navigation.

2.2 Production Scheduling

Ideally, the existing stock of the chart would be on the verge of depletion when a New Edition of that chart is printed. The nautical charting program attempts to strike a balance between running out of charts and throwing away numerous copies of obsolete editions. To this end, the production manager prepares an annual charting plan. The plan takes into account charting priorities set by the production manager and production branches and current funding restraints. After the plan is approved by management, it constitutes the basic charting program for the year.

This is a flexible schedule that is examined at least once a year and modified as new requirements are identified and available resources are evaluated.

Administrative data which can alter the annual charting plan may come from a variety of sources:

1. Production Branches

In the daily examination and application of cartographic data received, the production branches may recommend extending or shortening the printing cycle of a chart or printing a chart ahead of schedule because of excessive corrections.

2. Quality Assurance, Plans and Standards Branch (QAPSB)

Quite often the issuance of Cartographic Orders and directives by QAPSB calling for the implementation of new procedures or techniques can result in significant increases to the annual workload, especially if changes to symbols are required. Major charting actions resulting from NGA requirements for national defense, user surveys, and examinations for in-house efficiencies, may also affect scheduling.

3. Nautical Data Branch (NDB)

The charting schedule can be altered based on notification by NDB of the anticipated arrival of new revision data, e.g., new aids to navigation projects or new harbor construction projects.

4. Distribution Branch

The Distribution Branch may request revisions to the printing schedule based on stock inventory.

5. Remote Sensing Division (RSD) and Hydrographic Surveys Division (HSD)

Chart scheduling depends on timely completion of surveys by these two divisions.

6. U.S. Coast Guard (USCG)

The USCG can affect the charting program by making extensive changes to aids to navigation.

7. National Geospatial-Intelligence Agency (NGA)

NGA has the largest effect on the charting program because its sudden high-priority requirements for New Charts must be met.

8. Coast and Geodetic Survey Management

The charting schedule can be altered by decisions of management to meet special NOS requirements or objectives.

9. Other Federal Agencies or Non-Federal Sources

Other sources may make charting demands (sometimes through Congress) requiring prompt action.

2.3 Sources of Cartographic Data

Charting material consists principally of topographic and hydrographic surveys made by NOS, supplemented by miscellaneous surveys and textual information provided by other organizations. All material must be critically examined, with particular attention directed to the actual date of the survey, geographic datum, depth unit, plane of reference, purpose and quality of the survey, and whether it is an original source or from another compilation, e.g., a Canadian chart or USGS quadrangle map. **The latest information does not necessarily supersede all earlier data.** In areas not subject to extensive changes, well-controlled hydrographic surveys of other organizations should be considered along with the basic NOS surveys. In areas undergoing constant and extensive change, only the latest information should be used. In regions where some areas undergo rapid change while other areas do

not, partial supersession of the various surveys may be necessary. The proper acceptance, rejection, and coordination of available information constitute the supreme test of the cartographer's skill, since lives and property damage in the millions of dollars are at stake. In particular, shoal soundings over obstructions or rocks must not be deleted without convincing proof that these dangers have been removed or are nonexistent.

The original source material is to be used in the compilation of New Charts and in correcting existing charts. Large-scale charts that have been corrected from original source material in turn become the source material for small-scale charts. In this case, the original source material is referred to only where necessary to check questionable information.

Cartographers should not hesitate to initiate an inquiry through their Branch Chief whenever information is lacking or when existing information requires checking.

Original source material is retained in the NDB until it is microfilmed for permanent storage. Original Chart Letters and Blueprints are usually discarded after microfilming. Microfilm copies of discarded source material are available for reference and research.

All available sources of information should be used in the construction of a chart. These sources include the Military and other Federal Government agencies, State and local agencies and private organizations.

A partial listing of sources of cartographic data follow:

2.3.1 Military Sources

1. U.S. Army Corps of Engineers:
   - Harbor improvement projects
   - Channel maintenance surveys
   - Channel tabulations
   - Annual Reports
   - Port Series publications
   - Project Maps (in book form)
   - Construction permits
   - Cable clearances
   - Intracoastal Waterway maps
   - River and inland waterway maps
   - Navigation regulations
   - Dumping grounds, disposal areas, and spoil areas
   - Danger zones and restricted areas
   - Pipeline areas

2. U.S. Coast Guard:
   - Local Notice to Mariners
   - Light Lists
   - Anchorage areas
   - Rules of the Road
   - Bridge clearances and regulations
   - Traffic Separation Schemes (TSS)
   - Vessel Traffic Service (VTS) Areas

3. National Geospatial-Intelligence Agency:
   - Weekly Notice to Mariners
   - LORAN data
   - NGA reference number
   - Surveys and charts
   - Fleet Guides, Sailing Directions, etc.

2.3.2 Other Federal Sources

1. NOAA/Office of Coast Survey/National Ocean Service:
   - Hydrographic surveys
     - Basic, Wire Drag, Navigable Area, Field Examination
     - Chart Evaluation Surveys
   - Photogrammetric surveys
     - New Aeronautical and Nautical Charting Investigations (NANCI)
   - Geodetic surveys
   - Aeronautical charts
   - Tides and currents
   - Geographic names
   - Coast Pilot inspections

2. U.S. Geological Survey:
   - Topographic Quadrangles

3. St. Lawrence Seaway Development Corp.:
   - Seaway regulations

4. Environmental Protection Agency:
   - Ocean dump sites

5. U.S. National Park Service:
   - Park and reservation boundaries

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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MARCH 14, 2002

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Fannie B. Powers
Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Nautical Chart Manual Correction Pages - Acknowledgment Note

Effective immediately, the following attachment replaces pages 2-5 and 2-6 in the Nautical Chart Manual, Volume 1, Part I, Seventh (1992) Edition, and serves to improve the legibility of the Acknowledgment Note.

Pages 2-5 and 2-6 are to be inserted into the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition immediately after page 2-4.

Attachment

6. State Department:
   Maritime limits

7. NOAA/National Weather Service:
   Weather Warning Maps

8. NOAA/National Marine Fisheries:
   Marine sanctuaries

9. National Archives:
   Code of Federal Regulations

10. NOAA/National Environmental Satellite, Data, and Information Service:
    Magnetics

2.3.3 State and Local Sources

1. Park and reservation boundaries
2. Local regulations
3. Port authorities

2.3.4 Private

1. U.S. Power Squadrons Cooperative Charting Program
2. U.S. Coast Guard Auxiliary Chart Updating Program
3. Private reports and queries
4. Pilots associations
5. Lake Carriers' Association
6. Fishing associations
7. Marina owners
8. Publishers (Waterway Guide and others)

2.3.5 Foreign and International Sources

1. Canadian Sources:
   Canadian Hydrographic Service
   Canadian Coast Guard
      Notice to Mariners
      List of Lights, Buoys, and Fog Signals
   Dominion Marine Association
   St. Lawrence Seaway Authority of Canada

2. Other Sources:
   United Kingdom Hydrographic Department
   International Maritime Organization Regulations
   International Hydrographic Organization Chart Specifications

2.3.6 Adopt-A-Chart Program

An acknowledgment note shall be added to selected nautical charts being monitored by members of the United States Power Squadrons (USPS) through the Cooperative Charting Adopt-A-Chart Program. This program is designed to resolve charted discrepancies and give recognition to participating USPS units. The note shall be revised to indicate the appropriate Power Squadron and District. The selected nautical charts will be documented in Chart Letters and noted on the Nautical Chart Standard.

ACKNOWLEDGMENT

The National Ocean Service acknowledges the exceptional cooperation received from members of the Xxxxxxxx Power Squadron, District X, United States Power Squadrons, in continually providing essential information for revising this chart.

The note shall be printed in black, 7 point Swiss Light type and placed near the title block if possible The second preference shall be outside the border at the bottom of the chart.

2.4 Cartographic Revision

Cartographic data from any source (see Section 2.3) may require revisions to the chart.

2.4.1 Registration and Screening of Data

All cartographic source documents received by NOS (except NM) are evaluated first by NDB before being registered for entry into the nautical charting system. Additional information is requested for incomplete reports, and useless information is discarded. Registration consists of assigning a unique identification number to each document, indexing the document on the appropriate chart Standards, and cross-referencing it to previously received documents.

After a source document is registered, NDB screens it for appropriate charting information. If the document contains no appropriate charting information, it is marked as "HISTORY" on the chart Standard and the document is archived. If the document does contain usable information, it is forwarded to the production branches for further processing.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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JANUARY 8, 2001

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Fannie B. Powers
Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Chapter 2

Effective immediately, the attachment replaces the following Chapter 2 pages of the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition:

1. Page 2-7 / Page 2-8
2. Page 2-15 / Page 2-16
3. Page 2-17 / Page 2-18
4. Page 2-19 / Page 2-20
5. Page 2-21 / Page 2-22
6. Page 2-37 / Page 2-38
7. Page 2-39 / Page 2-40
8. Page 2-47 / Page 2-48
9. Page 2-49 / Page 2-50
10. Page 2-51 / Page 2-52
11. Page 2-53 / Page 2-54
12. Page 2-55 / Page 2-56
13. Page 2-59 / Page 2-60
14. Page 2-61 / Page 2-62
15. Page 2-67 / Page 2-68
16. Page 2-69 / Page 2-70
17. Page 2-71 / Page 2-72
18. Page 2-73 / Page 2-74
19. Page 2-75 / Page 2-76
20. Page 2-81 / Page 2-82
21. Page 2-85 / Page 2-86

In an effort to bring the analog edition of the Nautical Chart Manual into agreement with its digital counterpart, the attachment contains only minor grammatical changes to the information provided.

The digital version of the Nautical Chart Manual can be accessed on the Web using either of the two following addresses:

1. http://ocsnet.ncd.noaa.gov/mcd/chartman/index.htm
or
2. http://ocsnet.ncd.noaa.gov/mcd.htm

NATIONAL OCEAN SERVICE
Office of Coast Survey
Marine Chart Division

CARTOGRAPHIC ORDER 012/02 JULY 23, 2002

FILE WITH NAUTICAL CHART MANUAL, VOLUME 1, PART 1, SECTION 2.4.3

TO: All Cartographers
Marine Chart Division

SUBJECT: Edition Dates and Corrected Through Dates

APPLICATION: All Nautical Charts

Effective immediately, the attachment shall replace pages 2-7 and 2-8 in the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition.

As a result of changing edition dates and adding "Corrected through" dates to nautical charts, NCM Section 2.4.3 has been revised. Edition dates for all newly published nautical charts are no longer the Saturday date of the last applied weekly NM, but are now represented by the month and year that the new editions are printed. See NCM Sections 1.4.5.2 and 1.4.5.3. "Corrected through dates" for all newly published nautical charts are now displayed. See NCM Section 1.4.5.5.

Attachment

Nicholas E. Perugini
Captain, NOAA
Chief, Marine Chart Division

2.4.2 Evaluation for Critical Information

When the production branches receive a document, it is immediately examined for critical information. If a hazard to navigation is found, the data is immediately applied to all affected charts. The production branches evaluate the data and, if appropriate, write up the item for publication in the NM or the LNM. If the corrections are extensive, a reproducible page-size chartlet is made, reproduced, and forwarded to NGA and/or the USCG District for inclusion in the NM and/or LNM, as appropriate. See Section 4.2.4 for more information concerning how reports of dangers to navigation are handled. The source is then filed until the affected charts are scheduled to be updated for printing.

The NM Update Service examines the USCG's LNM and NGA's weekly NM immediately on arrival to determine chartable items. They are applied to copies of the digital files and reviewed similarly to the application of other source data. Channel tabulations are prepared by examining channel surveys (blueprints and digital files) and tabulation letters.

2.4.3 Application of Data

Compilers and reviewers are reminded of their responsibility to assure that overlapping and adjoining charts are in agreement. Although large scale charts that have been corrected from original source material become source material for smaller scale charts, this does not relieve cartographers from the responsibility of researching original source material in resolving discrepancies between overlapping and adjoining charts.

Approximately 16 to 23 weeks before the scheduled print date of the chart, a compiler from one of the production branches retrieves all of the source data, evaluating them, resolving any discrepancies, and applying them to the digital chart files. If source data are found to be inadequate for charting, they are returned to NDB which will attempt to obtain additional information.

Cartographers apply both critical and noncritical source data to the digital chart files using the following application process: Required horizontal and vertical datum conversions shall be computed and applied, and source material shall be converted. Revisions shall be applied to the digital chart files, working from one chart to the next through progressively decreasing scales. The source and disposition shall be recorded on each chart history for each item applied (see Section 2.13). Supportive services may be requested from RSD, HSD, or the QAPSB. The cartographers application of all source material shall be reviewed by a more experienced cartographer for accuracy, completeness, legibility, and general appearance.

Cartographers shall notify Marine Information Specialists in Coast Pilot by informal memorandum of changes made during chart compilation that will affect the Coast Pilots but will not be published in NM. This can be accomplished by a handwritten memo noting the Coast Pilot affected and substance of change with authority reference such as chart letter, blueprint number, etc.

Before charts are "sent forward" for reproduction the production branches must make certain that all current source material has been applied, all cartographic policies and procedures have been taken into consideration, that items such as the New Print correction copy have been applied, and magnetic variations and tide boxes have been updated, if necessary. Tints must be examined for conflicts. Cartographers should make frequent reference to a printed copy of the current edition of the chart in order to be aware of underlying tints.

Corrections to topography made by RSD shall be revised as necessary to conform to chart standards.

The existing printed chart must be consulted to avoid making corrections that would conflict with other color information.

Comparison and agreement must be made with all overlapping charts at the same scale and larger.

Edition dates represent the month and year that a new edition is printed.

"Corrected through dates" are the dates through which the new Edition has been corrected by the NGA weekly NM and the U.S. Coast Guard LNM.

The printed copy of the chart is "cleared" for issue after checking it against the proof to verify that all revisions have been made correctly.

2.4.4 3-E (Economy, Efficiency, and Effectiveness)

The Department of Commerce (DOC) inaugurated its 3-E Improvement Program aimed at achieving greater economy, efficiency, and effectiveness of operations in August 1964 under Administrative Order 211-1. The nautical charting program was identified as an area where significant reductions in cost could be achieved. Small-scale charts were examined to identify specific areas covered by larger-scale charts where duplicate chart coverage on different chart scales could not be justified by navigational needs. The elimination of duplicate coverage has reduced maintenance cost and extended some printing cycles.

The effort to eliminate duplicate chart coverage continues. As New Charts are published and existing chart limits are revised, small-scale charts shall be examined to see if there are areas of charted detail that cannot be justified by navigational needs. Areas selected for the 3-E Program shall have all charted detail below the shoreline plane of reference and all aids to navigation removed. Blue tint No. 1 shall be added to the entire water area. Labels identifying the next largest scale chart shall be added throughout the areas, as appropriate. The labels shall be in 7 pt. Swiss Light Italic; e.g., (use chart 12222). Overhead cables and their identifying labels shall be retained, however the vertical clearance shall be deleted. All bridge labels shall be deleted. The channel limits of USACE maintained channels shall be retained, but all depth references are removed.

2.4.5 Quality Review and Quality Assurance

1. Compilation Review

The basic review of all source material application is performed by the senior compilers in the production branches. This review is a complete item-by-item check of all corrections made to the digital chart files by the cartographer. The emphasis of this review is the accurate representation of source data at the scale of the chart. The compilation supervisor will occasionally perform this review, but generally does a more cursory inspection of the chart files.

2. Senior Reviewer Inspection

A senior reviewer in each production branch also inspects the total chart revision package with primary emphasis on clarity of presentation and for adherence to NOS cartographic specifications. The source material is rarely reexamined except in the event of obvious discrepancies.

3. Notice to Mariners Inspection

The NM Update Service inspects the digital files of charts going forward for possible NM items that may have been overlooked during compilation. In addition, a general inspection is made of the charted aids to navigation. Also, a check of the accuracy and completeness is made of NM references on the chart.

4. Source Data Inspection

NDB makes a cursory inspection of the histories and checks that all indexed source material has been either applied or addressed.

5. Quality Inspection

The production branches do a complete item-by-item check of the final printed chart. If everything is in order, they declare the chart cleared for public issue.

2.5 New Chart Requirements

The majority of requests for new charts are received from user sources. There are, however, other justifications which determine the validity of whether a particular chart is needed, justifications which may not have been articulated by users but nonetheless are based on user needs.

The basic longstanding justification for charts is that it is the mission of NOS to produce adequate nautical charts for the Nation's navigable waterways and to participate in and keep pace with the

evolution of revised or new chart standards as presented in the resolutions of the IHO.

A justification for a particular chart will be as unique as the chart to which it is related. The vast majority of justifications is derived directly from user requests. Whether the justification is related to general standards or a particular local circumstance, a subjective judgment is required as to the relative strength of the justification. Chart actions are either taken immediately or as resources permit.

2.5.1 Chart Numbers

Chart numbers are assigned to identify each chart for placement into a logical geographical sequence, taking into account both geographical location and scale.

Charts are divided into five categories with each category having a different number of digits.

The first category of charts are those identified by a single character and include those peculiar charts that have no scale, such as the booklet of nautical charts symbols (Chart No. 1).

The second category of charts have two-digit numbers and scales of 1:9,000,001 and smaller.

The third category of charts have three digit numbers and scales from 1:2,000,001 to 1:9,000,000.

The forth category is reserved from special purpose maps and charts not included in the categories for navigational charts. These charts are identified by four characters.

The fifth category include nautical charts that are 1:2,000,000 and larger and have five digit numbers. The first of the five digits indicates the Region. Within each Region, the geographical Subregions are numbered counterclockwise around the continent. The second digit indicates a geographical Subregion. Within each Subregion, the basic series is also numbered counterclockwise around the continent. The last three digits identify the charts in a geographic order within the Subregion. Many numbers have been left unused so that future charts may be placed in their proper geographical order as they are produced.

Chart numbers are assigned by NGA. Written request must be submitted for all new charts and for changes in existing chart numbers. NGA reference numbers will be assigned along with chart numbers.

2.5.2 User Participation

Unsolicited letters from chart users describing chart deficiencies and charting needs arrive on a continuing basis. Principal users of nautical charts include those responsible for the defense or national security of the United States; those involved in domestic and international waterborne commerce; and

NATIONAL OCEAN SERVICE
Office of Coast Survey
Marine Chart Division

CARTOGRAPHIC ORDER 009/03 May 28, 2003

FILE WITH NAUTICAL CHART MANUAL, VOLUME 1, PART 1, SECTION 2.5.2

TO: All Cartographers
Marine Chart Division

SUBJECT: Chart Formats

APPLICATION: All Affected Nautical Charts

Effective immediately, the attachment replaces pages 2-11 and 2-12 in the Nautical Chart Manual, Volume1, Part 1, Seventh (1992) Edition.

The attachment revises Section 2.5.5 by eliminating the route and area small-craft chart as formats currently produced by the Marine Chart Division. All small-craft charts which were previously issued in these formats have been re-designed and re-formatted into the pocket fold format

Pages 2-11 and 2-12 are to be inserted into the Nautical Chart Manual, Volume1, Part 1, Seventh (1992) Edition, immediately after page 2-10.

Attachment

Nicholas E. Perugini
Captain, NOAA
Chief, Marine Chart Division

those involved in recreational boating in the Great Lakes and coastal waters of the United States.

The nautical chart and associated data are also used by land-use planners, conservationists, oceanographers, marine geologists, and others having an interest in the coastal zone's physical environment. Each request is evaluated and acknowledged. Existing chart coverage is examined to see what adjustments are necessary to meet the users needs. This task may be accomplished by adjusting existing chart limits, adding an inset to an existing chart, reconstructing a chart at a different scale, or compiling a new chart.

A full-size mock-up of the proposed solution is then constructed. User surveys are conducted among the chart users most likely to be affected by the charting action. The user surveys are evaluated and appropriate modifications are made to the proposed charting action to alleviate concerns expressed in the surveys. An approval letter for the charting action is prepared for signature at the appropriate level of management.

2.5.3 Chart Priority Plan

NOS has developed a point system for assigning weights to request for charting action in order to establish a priority listing. This listing has been programmed on a computer so that revised priority listings will be available as new requests are received. Because of their inherent application to national security, charting request from NGA are always considered to carry a high priority. Equally important are requests from the USCG and Port Authorities because of their "safety at sea and in ports" significance, and requests from major industries because of their economic significance. Congressional request (constituent request forwarded through Members of Congress) are generally given the next highest numerical value. The lowest point value is assigned to request from individuals that are not supported by other request or are ill defined.

2.5.4 Chart Coverage

The requirements, both present and anticipated, of the expected primary chart user must be taken into consideration when determining chart coverage. The database should be examined to determine the availability of source material of sufficient quality to produce a chart with the proposed limits. Coverage must allow for adequate overlap with adjoining charts while avoiding unnecessary duplicate coverage. Dangerous passages should not be located near the border in order to allow for adequate maneuverability. Chart coverage must include all aids to navigation and landmarks required for position fixing. The preferred layout would be a rectangular chart, without border breaks, and without jogs in the border. Skewed projections are acceptable in order to reduce the number of charts required to cover an area.

2.5.5 Chart Formats

NOS uses a variety of chart formats, each designed for a particular segment of the boating public. However, reductions in funding over the last few years has restricted the selection of chart formats available for new charts. Currently, the format for New Charts will be selected from the conventional format, the pocket fold format, and the marine facility format.

The conventional format is a flat chart.

The pocket fold format is a single long, narrow sheet, printed front and back and folded similar to a road map (see Nautical Chart Manual, Volume 2, Appendix IV, page IV-14.3).

The marine facility format is a conventional chart overprinted with small craft information. Additional small craft information is printed on the back side.

Other formats currently in use are the folio format and the recreational format.

The folio format consists of two to four sheets, printed front and back, accordion-folded and bound in a protective cardboard jacket (see Nautical Chart Manual, Volume 2, Appendix IV, page IV-14.1).

The recreational format consists of a series of large-scale charts providing sequential page coverage and published in a book format.

Formats which formerly were in use were the route format and the area format. These formats are no longer being published, however, the charts which were previously issued in these formats have been re-designed and re-formatted into the pocket fold format.

2.5.6 Metric Charts

NOS produced metric nautical charts of domestic and adjoining waters. Some of these charts were published in back-to-back format, with one side in metric and the other in traditional units. Some of these charts are currently being phased out and will be replaced by English only versions.

2.5.7 Sounding Units

The three options for sounding units on all New and Reconstructed charts are feet, fathoms, and meters. The charts that use fathoms as the sounding unit will show fathoms and feet to eleven fathoms and then whole fathoms. General guidelines have been established for selecting the appropriate depth Unit for each chart series. The same depth Unit shall be used throughout a single chart. General and Sailing charts along all coast and Coast charts along the Pacific coast should use fathoms as the depth unit. On all other charts on the Great Lakes, Atlantic, and Gulf coast the depth unit should be feet, as in the case with most of the Harbor charts on the Pacific Coast. Charts of Alaska and the Hawaiian Islands are generally in fathoms. Metric depth units shall be used on International charts and charts co-produced with the Canadian Hydrographic Service in the boundary water area.

2.5.8 Chart Modernization

The reconstruction of charts is the procedure used to improve the quality of the chart and incorporate new symbology. Changes in type style, changes in symbology, changes in cartographic philosophy, etc., accumulate over the years until the chart presents a mixture of type styles and outdated symbology. In addition, some procedures used in the reproductive process, such as making new negatives with the washout process, has caused a gradual deterioration of the imagine, with the line work and type becoming thickened and less distinct. This presents an unsafe condition for the chart user. Also some charts still use symbolized depth curves instead of labeled solid lines, sanding in low water areas in place of green tint, and excessive road patterns instead of urban tint. Revising charts with antiquated symbology is time consuming and adds to the cost of chart production, with no increase in benefits to the chart user for the additional cost.

The modernization of nautical charts is being accomplished through the use of raster recollection. This will enable NOS to incorporate many of the recommendations of the IHO Chart Specifications Committee. Some IHO recommendations, such as metrication and pictorial landmark symbols, have met with user resistance and will not be included in the specifications for new charts until sometime in the future.

2.5.9 Chart Size

Nautical chart size is directly related to chart scale which, in turn, is dependent on the amount of detail that must be charted to provide a concise, legible, graphic representation of necessary data. Generally, nautical chart size is also dependent on inclusion of appropriate geographic features to satisfy navigation demands and a basic chart purpose.

Another factor to be considered in selecting a chart size is the requirement of various nations throughout the world to reprint and reissue charts of another nation, reformatted in their native language. Some nations do not have printing presses that will accept the NOS maximum size paper, which is 42 1/2 in.

by 59 7/8 in. In order to obtain uniformity and compatibility between nations, the IH0 recommends the use of a standard metric A0 paper, defined as having dimensions of 841 mm by 1189 mm (33.11 in. by 46.81 in.). The use of the internationally accepted A0 size paper will help standardize the size of nautical charts and allow for exchange of chart reproducibles among nations for the multi-nation printing of individual charts.

NOS began in 1975 planning new and reconstructed conventional nautical charts to fit A0 paper size having an internationally accepted maximum chart neatline size of 750 mm by 1100 mm. Many existing NOS charts have neatline sizes larger than this desired maximum size and will require changes in scale or limits when reconstructed, if they are to conform to the international size requirements. It should be noted that printing charts on A0 paper is desired for compliance with IH0 recommendations related to exchanging reproducibles between countries, and every effort is being made to meet those conditions. However, there is no mandatory requirement that all charts fit A0 neatline or paper size. Modification of chart scales or limits must incorporate an evaluation of contemporary user needs which a new chart scheme would be designed to satisfy.

The guidelines listed below should be used in constructing new charts.

NEW CHART CONSTRUCTION PARAMETERS

PAPER SIZE

mm	inches
914.4 X 1219.2	(36 X 48)
914.4 X 1371.6	(36 x 54)
841.0 X 1189.0	(33.11 x 46.81)

NORMAL NEATLINE

mm	inches
818.0 X 1141.8	(32.2 X 44.95)
818.0 X 1294.2	(32.2 X 50.95)
750.0 X 1100.0	(29.53 X 43.31)

MAXIMUM NEATLINES

mm	inches
837.1 X 1167.2	(32.96 X 45.95)
837.1 X 1319.6	(32.96 X 51.95)
760.0 X 1138.2	(29.92 X 43.7)

NORMAL WORK LIMITS

mm	inches
863.6 X 1168.4	(34 X 46)
863.6 X 1320.8	(34 X 52)
790.2 X 1138.2	(31.11 X 44.81)

MAXIMUM WORK LIMITS

mm	inches
882.7 X 1193.8	(34.75 X 47.0)
882.7 X 1346.2	(34.75 X 53.0)
809.3 X 1163.6	(31.86 X 45.81)

Figure 2-1

2.5.10 Chart Scale

The nautical chart is designed as a work sheet on which courses are plotted and positions determined. It assists the mariner in avoiding dangers and arriving safely at his destination. The design of a nautical chart depends upon the navigational requirements in a particular area. A vessel sailing between distant ports and restricted to the main channels in entering a port does not need the same information on a chart that a small pleasure boat needs while cruising in protected waterways, and which may be required to venture into unfamiliar places. The amount of detail, physiographic and geographic, that can be adequately shown on a chart is dependent on its scale. To meet these different needs a variety of scales is used, ranging from 1:2500 to about 1:5,000,000. Large-scale charts cover relatively small areas and are used by the mariner for inshore or harbor navigation; small-scale charts covering large areas are used for offshore navigation.

There are a number of factors that must be evaluated when selecting a scale that will be the most effective for the expected user of a proposed chart. The limits of the area to be covered will influence the selection of a scale. Adjustments to chart limits must be made in order to include important aids and significant dangers to navigation. Such items should not be allowed to fall just outside the chart limits. The number, size, and draft of vessels using the waterway and whether the new chart is intended for commercial or recreational small craft must be considered in selecting the proper scale. The waterfront industry involved in maritime commerce will give an indication of the type of vessels expected to use the chart. The selected scale should conform to existing chart series scales and provide an adequate ratio with other charts covering the same area. The scale of existing topographic and hydrographic surveys must be considered when selecting a chart scale. Generally, the scale of the chart should be one-half the scale of the surveys in order to ensure adequate coverage. The scale must be large enough to adequately display the aids to navigation and include enough shore features to facilitate position fixing. Also, enough overlap must be included with adjoining charts so that the vessels position can be transferred. Areas of complexity or where passage is restrictive will require large scale charts. The nature of the sea

bottom will affect the selection of scales. Irregular or changeable areas will require a larger scale to ensure safe navigation than areas of smooth bottom.

2.5.11 Source

The success of the NOS nautical charting program does not depend solely on the cartographic expertise available to produce the charts. Of prime importance is the availability of contemporary and credible information for use in chart production and its timely dissemination to the user, thus ensuring the mariner maximum safety and usable information. Some of this information is acquired by NOS through its own field survey efforts and some is obtained from more than 60 outside sources.

Credibility of NOS basic data is ensured today more than ever before through established standards under which NOS field surveys are performed, both with respect to the acquisition of the raw field data and the processing of it. The availability of data consistent with charting needs is being ensured through two principal efforts:

(1) the application of automation in the acquisition and processing of field survey data and
(2) the concerted effort made to schedule surveys in advance of projected data need.

2.5.12 Survey Support

The availability of adequate hydrographic surveys must be considered when establishing a priority schedule. When the charting request is justified, a study is made to determine if the existing hydrographic surveys in the area of the proposed charting change are adequate for the desired charting action. If they are, the change is scheduled for chart compilation as priorities warrant and as resources become available. If adequate surveys do not exist, a hydrographic survey requirement is identified. It should be noted that the need for hydrographic data is not restricted solely to support new chart construction, but is often in support of improving existing chart depiction.

Generally, for a survey to be considered adequate, it must have been performed to certain prescribed standards or specifications, some of which are general and some are peculiar to the area being surveyed. In many instances the minimum qualifications of an adequate survey is one performed since 1940 which employed a continuous bottom profiling echo sounder to acquire water depth information. Today, the survey standards reflect the latest techniques in source data acquisition and automation while at the same time preserving continuity with the principles of plane, geodetic, cadastral, and hydrographic surveying.

2.5.13 In-House Chart Examination

There is an ongoing program in which the history of each chart from its initial construction through the various printings is reviewed. The initial justification for the chart is reevaluated to see if a need still exist and if it is being met currently. Frequently, these analysis result in consideration of cancellation

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

MARCH 14, 2002

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Fannie B. Powers
Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Nautical Chart Manual Correction Pages - Chart Specifications Form

Effective immediately, the following attachment replaces pages 2-17 through 2-20 in the Nautical Chart Manual, Volume 1, Part I, Seventh (1992) Edition.

The attachment:

1. Revises the form number of the Chart Specifications form (as referenced in paragraph 2.5.15) from 86-192 to the correct form number 76-192,

2. Adds the section heading " **2.5.15.1 NOAA FORM 76-192**" before the line by line descriptions of form 76-192, and,

3. Improves the legibility of the NOAA Form 76-192 example (i.e. Figure 2-2).

Pages 2-17 through 2-20 are to be inserted into the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition immediately after page 2-16.

Attachment

of the chart, or reveal the need for new or revised chart coverage. The present adequacy of each chart is also reviewed. Adequate, in this chart examination, is determined by a positive answer to three basic questions:

(1) Is the source material-geodesy, topography, hydrography, cultural detail--of sufficient quality to meet national and international standards?
(2) Is the scale of the chart large enough to provide sufficient detail for the anticipated use?
(3) Have new editions been issued with sufficient frequency to ensure that pace is kept with both natural and man-made changes?

Office analysis also involves periodically examining the layout and scale of a suite of charts covering a discrete area. These analyses may reveal that the coverage could better serve the user by alteration of chart layout and scale. This may be a derivative of changing needs in the area or a recognition that the current layout was accumulated over the years to meet specific needs that arose without consideration of the relationship to the charts in the suite.

The user demand for individual charts is periodically monitored. If a chart shows particularly low demand, or historically a low rate of change, consideration will be given to a longer issue interval, cancellation of the chart in favor of others, reformatting the chart, absorbing it as an inset on another chart, or merging two or more charts into one chart. Conversely, evidence of special needs, increasing user demand, or an increasing higher rate of change may warrant a shorter issue interval and reexamination of coverage.

Questionnaires have been developed and are circulated to both the commercial and the recreational users. Responses to these questionnaires provide information concerning the status of NOS nautical charts and other products from the users' point of view. Contract studies accomplished in past years provided an excellent analysis of various facets of nautical charting as related to the user and have been relied on as a guidance where appropriate.

2.5.14 Scheduling

Chart and survey priorities are established and modified in order to provide products in a descending order, starting with those that are most needed to ensure safety of navigation and to satisfy defense needs, to those that might be considered luxuries. Chart priorities and survey priorities are also interwoven in that the data collected from all field surveys ultimately appears on nautical charts, either in the form of a new chart or as a revision to an existing chart.

A set of interrelated parameters are employed to assist in the placement of charts and surveys in a reasonable order for accomplishment:

1. How safe (or hazardous) to navigation is the area?
2. What type of craft frequent the area?
3. What is the volume of traffic in the area?
4. What resources are available for field surveys?
5. Where are the field resources and when can they be made available?
6. What and when can support data (e.g., tide, photogrammetry, geodesy) be supplied?
7. What are weather conditions in the area?
8. What would be the logistics situation?
9. What has been the volume and weight of request?
10. What production resources are available to translate field data to charts?

Management of the chart and survey schedule is the joint responsibility of MCD and HSD.

2.5.15 Chart Specifications

A list of specifications is compiled for each New Chart and Reconstructed Chart. The specifications are listed on NOAA Form 76-192 (see Figure 2-2) and are filed with the chart history when work is completed. These specifications should not be revised or modified in any manner without the approval of the Chief, NSD.

2.5.15.1 NOAA FORM 76-192

Item "A": specifies the chart number, whether a New Chart or a Reconstructed Chart is planned, and the fiscal year the chart is scheduled to be printed.

Item "B": specifies the selected chart title and any approved sub-titles.

Item "C": specifies the chart scale and the mid latitude of the chart. The chart price is no longer shown on the chart.

Item "D": specifies the latitude of the northernmost and southernmost chart limits; and the longitude of the eastern and western chart limits.

NOAA FORM 76-192
(11-77)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Chart

Edition

A. CHART_____ SPECIFICATIONS FOR NC RECONSTR PROGRAM DATE_____

B. TITLE_____

_____

_____

_____

C. SCALE_____ at Lat._____ PRICE_____ cents

D. LIMITS: Lat. _____to Lat._____; Long._____ to Long._____

E. DIMENSIONS: Neatline _____ inches; Border_____inches.

F. SOUNDINGS IN (FEET FATHOMS) AT (MLW MLLW)

G. BASIC SURVEYS: (Type, Year, General evaluation) _____

_____

_____

_____

_____

H. ADDITIONAL SURVEYS AND / OR PHOTOS: (Recommended Requested) Date _____

_____

_____

I. SUPPLEMENTARY SURVEYS: _____

_____

_____

J. SPECIAL DATA AND INSTRUCTIONS: (Reference materials attached) _____

_____

_____

_____

K. DRAWING:_____

L. METHOD OF REPRODUCTION: _____

M. COLOR PLATES:_____

N. RELIEF:_____Datum_____

O. CULTURE: (Extent to be charted and method)_____

_____

_____

_____

_____

P. HYDROGRAPHY: Depth Curves_____Tint Curve _____

_____

_____

Q. NAVIGATIONAL REQUIREMENTS: _____

_____

_____

_____

_____

R. PLANE GRID:_____

** *(see reverse side for additional information)*

Figure 2-2

Item "E": specifies both the north-south and the east-west inner neatline dimensions in millimeters and the boarder subdivision in millimeters.

Item "F": indicates the sounding unit selected and the chart datum.

Item "G": is a brief and general evaluation of the hydrographic and topographic surveys currently available or planned.

Item "H": lists additional surveys and/or aerial photography that is recommended or has been requested and the date it is expected to be available.

Item "I": lists supplementary surveys, such as USACE or privately produced surveys, that are available for chart compilation.

Item "J": list any special data or instructions that should be used in the compilation process.

Item "K": states the method that will be used to compile the original drawing of the new or reconstructed chart.

Item "L": method of reproduction; will be computer assisted for all new and reconstructed charts.

Item "M": lists all color plates that will be used on the chart.

Item "N": specifies the contour interval, if land contours are to be charted, and the datum the contours are referred to.

Item "O": furnishes guidelines for the addition of culture to the chart. The amount of culture to be shown, the distance inshore culture should be charted, and whether urban tint should be used or road patterns will be stated.

Item "P": lists all depth curves to be charted and identifies the blue tint curves.

Item "Q": provides additional navigational requirements, such as dredged channels, safety fairways, Loran C, etc.

Item "R": lists the zones of State Plane Coordinates to be charted. Often the back of this form is used for additional information, such as the specifications for planned insets.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

MARCH 14, 2002

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Fannie B. Powers
Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Nautical Chart Manual Correction Pages - Chart Parameter Correction Form; Sales Agent Credit Symbol

Effective immediately, the following attachment replaces pages 2-21 and 2-22 in the Nautical Chart Manual, Volume 1, Part I, Seventh (1992) Edition, and serves to improve the legibility of the following:

Nautical Chart Manual Volume	Nautical Chart Manual Page	Illegible Item Introduced during Digital Conversion
1	2-21	Chart Parameter Correction Form example
	2-22	Sales Agent Credit Symbol example

Pages 2-21 and 2-22 are to be inserted into the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition immediately after page 2-20.

Attachment

NATIONAL OCEAN SERVICE
Office of Coast Survey
Marine Chart Division

CARTOGRAPHIC ORDER 011/02

JULY 22, 2002

FILE WITH NAUTICAL CHART MANUAL, VOLUME 1, PART 1, SECTION 2.6

TO: All Cartographers
Marine Chart Division

SUBJECT: Edition Dates

APPLICATION: All Affected Nautical Charts

Effective immediately, the attachment shall replace pages 2-21 and 2-22 in the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition.

The Sales Agents Credit Symbol graphic on page 2-22 has been revised as a result of changing the edition date portrayal and adding "Corrected through" dates on all new editions of nautical charts.

Attachment

Nicholas E. Perugini
Captain, NOAA
Chief, Marine Chart Division

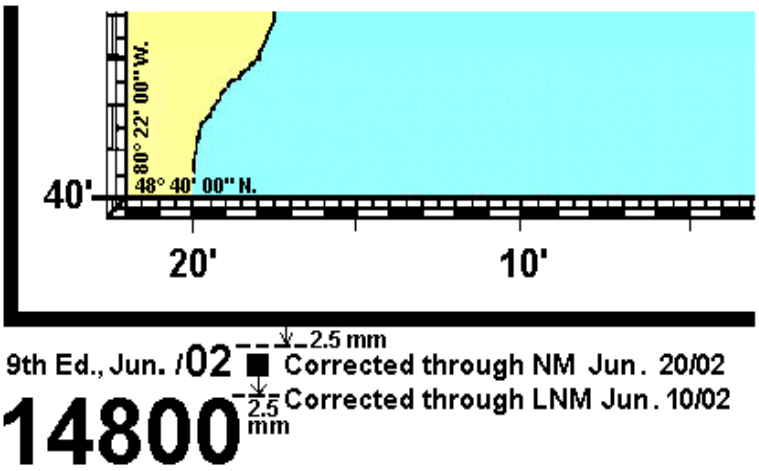
2.5.16 Chart Parameters Corrections Form

With the advent of automated plots of nautical charts, projections, and data, precise corner information must be calculated and stored in a data base for use by cartographic plotting programs. Cartographers must check the digital Chart History and Plotting Parameters File (CHAPP) each time a new edition, reconstruction, or new chart goes forward and modify all projection corners which have been changed or added. Each panel on each chart must be checked and, if necessary, modified. See corrections form below:

CHART KAPP COAST GUARD DISTRICT
FORMAT
SIDE_PG_ID
IE_CODE
IE_NUM
TITLE
TITLE2
SND_UNIT
VDATUM
PRJ
HDATUM
SHIFT_NS
SHIFT_EW
PRJ_INTVL
CENTRAL
SCALE
GRIDZONE
GRIDINT
WINDOW1
WINDOW2
WINDOW3
WINDOW4
SKEW
NO_CORNERS
POLY1
POLY2
POLY3
POLY4
POLY5
POLY6
POLY7
POLY8
POLY9
POLY10
POLY11
POLY12
POLY13
POLY14
POLY15
POLY16
POLY17
POLY18
POLY19
POLY20
POLY21
POLY22

2.6 Sales Agents Credit Symbol

Authorized NOS nautical charts sales agents are given a refund credit for unsold charts that are made obsolete by the issuance of a New Edition. The agent is directed to return the portion of the chart that contains both the chart number and the edition information. A solid black square box label identifier is placed on every chart immediately after the chart number/edition line. This box shall be a 1.7 mm square, aligned with the type baseline and following the edition or revised print year by an equivalent letter space as shown below:



Guidelines have been established to ensure that only one credit symbol will be shown on back to back or multiple page charts.

1. Placement shall be on the primary side of Conventional Charts, Canoe Charts, and Mineral Lease Charts. Placement shall be on the primary side only, e.g., downstream, LORAN-C, or as directed by the Chief, Marine Chart Division.
2. Placement shall be on page B of Small-Craft Folio Charts.
3. Placement shall be on side A of regular Small-Craft Route Charts.
4. Placement shall be in the title panel of Pocket Fold Small-Craft Route Charts.
5. The credit symbol applied to the Conventional Chart black base will also serve the credit purpose of Small-Craft Area Charts, regular and pocket fold.
6. Placement shall be on the cover of Small-Craft Book Charts.

2.7 Reproduction of NOS Charts

Foreign Reproductions

NOS permits foreign governments to reproduce NOS charts under the following conditions:

The published National Ocean Service (NOS) charts and related publications are in the public domain and are not copyrighted. To avoid any misrepresentation with the possibility of misleading

users, we request that evidence be deleted of this agency's involvement in any reproduction made by private United States or foreign organizations. This includes the deletion of information that would identify NOS, NOAA, or the Department of Commerce as the United States producers of the chart along with any other detail that might imply that the reproduction is an official United States publication.

> Where selected information is extracted from NOS nautical charts for recompilation into a private producer's product, NOS requests that NOS not be identified since the data from the original chart used for source may be condensed, expanded, generalized, supplemented, omitted, or may be out of date when the recompiled product is published. NOS assumes no liability as to the accuracy or completeness of the recompiled information.
>
> The NOS does not provide reproducibles to those individuals desiring to republish its charts. However, reproducibles are provided, on a nonreimbursable basis, for the small-scale "International Chart Series" to International Hydrographic Organization (IHO) member countries through IHO agreements. Reproducibles for other nautical charts are normally provided to foreign governments, on a nonreimbursable basis, provided a bilateral agreement exists with NGA.

Private Domestic Reproductions

A similar statement is provided for domestic requesters, preceded by this additional caveat:

> It is the policy of the National Ocean Service (NOS) not to provide reproducible materials of navigational charts to the public. The NOS is charged, under the provisions of 33 U.S.C. 883, with the production of charts to meet civil and military requirements. This mission includes the stringent control of informational material to ensure that the safety of the using public is protected. Only the printed product ensures that there is consistent control and reflects all current changes and conditions.
>
> As an exception to the above, NOS will sell reproducible materials to private companies when the requirement is for a contract with a Federal or State agency for nonprofit projects. Evidence of the contractual arrangement, such as a letter from the agency, will be necessary. Also, State agencies will be required to ensure that the resulting products will not be for sale.

Also for domestic requesters, the following statement replaces the third paragraph cited above:

> Under the rules of public domain, the NOS cannot control how purchased NOS charts will be used or prevent their being reproduced. However, court interpretations of the Federal Tort Claims Act have tended to hold the U.S. Government liable for damages due to incorrectly charted information. Reproducers of NOS charts may be subject to similar liability.

NOS frequently receives requests from individuals and industry for permission to reproduce NOS publications. This following statement reflects NOS policy with respect to such reproduction:

> The published NOS charts and related publications are in the public domain and are not copyrighted. To avoid any misrepresentation with the possibility of misleading users, we request that evidence be deleted of this Agency's involvement in any reproduction made by private U.S. organizations. This includes the deletion of information that would identify NOS, the National Oceanic and Atmospheric Administration, or the Department of Commerce as the U.S. producers of the chart along any other detail that might imply that the reproduction is an official U.S. Publication. In the interest of users' safety, NOS strongly requests that each reproduction which may possibly be used for navigational purposes should prominently display a note, "THIS REPRODUCTION IS NOT FOR USE IN NAVIGATION."
>
> Under the rules of public domain, NOS cannot control how purchased NOS charts will be used or prevent their being reproduced. However, court interpretations of the Federal Tort Claims Act have tended to hold the U.S. Government liable for damages due to incorrectly charted information. Reproducers of NOS charts may be subject to similar liability.

2.8 Datums

A datum is a reference point, line, or surface used as a reference in surveying and mapping. In charting, horizontal datums (also called horizontal control datums and horizontal geodetic datums) and vertical datums (also called vertical control datums and vertical geodetic datums) must be considered. The former form the basis for computations of horizontal control surveys in which the curvature of the earth is considered, while the latter is the basis to which evaluations are referred.

2.8.1 Horizontal Datums

1. Background

During the early years of survey operations, many independent triangulation networks were established in the United States each referenced to a horizontal datum based on independent astronomic observations within the network. Consequently, hydrographic and topographic surveys conducted within such areas were based on these independent local datums. Since 1844, two spheroids of reference have been used by this agency in its geodetic triangulation. From 1844 to 1880, the Coast Survey used the Bessel's spheroid of reference; since then it has used the Clarke's spheroid of 1866. Various independent datums were based on each until 1901 when the U.S. Standard Datums was adopted.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

MARCH 14, 2002

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Fannie B. Powers
Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Nautical Chart Manual Correction Pages - North American Datum Labels and Notes

Effective immediately, the following attachment replaces pages 2-25 and 2-26 in the Nautical Chart Manual, Volume 1, Part I, Seventh (1992) Edition, and serves to improve the legibility of the following labels and notes:

Nautical Chart Manual Volume	Nautical Chart Manual Page	Illegible Label/Note Introduced during Digital Conversion
1	2-25	North American Datum of 1983/World Geodetic System 1984 label examples
	2-26	Horizontal Datum Notes

Pages 2-25 and 2-26 are to be inserted into the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition immediately after page 2-24.

Attachment

A new adjustment of the U.S. network of horizontal control known as the "North American Datum of 1983" (NAD 83) has been adopted as the standard datum for nautical charts. The parameters of the ellipsoid of reference used with NAD 83 are very close to those used for the World Geodetic System of 1984 (WGS 84). The ellipsoid used for NAD 83, Geodetic Reference System 1980, is earth centered or geocentric as opposed to the nongeocentric ellipsoids previously employed. This means that the center of the ellipsoid coincides with the center of mass of the earth.

At present, the majority of charts published by NOS are on NAD 83. Other datums in use are the following:

1. Old Hawaiian Datum
2. Local Astronomic Datums
3. Guam 1963 Datum

2. Charting Procedure

The horizontal chart datum shall be specified in the title notes on all charts.

With the exception of the charts of the Hawaiian Islands and other western Pacific islands (which will be compiled on WGS 84) all New Charts and Reconstructed Charts shall be produced on NAD 83. New Editions are produced using computer processes to convert to NAD 83 whenever the average shift values have been received from the National Geodetic Survey (NGS).

Even though NAD 83 can be extended to NOS charts of the Hawaiian Islands and other western Pacific islands, the Director of NOS decided that these charts will be compiled on WGS 84. For charting purposes, there is virtually no difference between WGS 84 and NAD 83, and the use of WGS 84 will satisfy a DOD requirement. The selection of the appropriate datum for each chart will be decided when the conversion values are ordered.

NAD 83 conversion values will be provided when the latitude and longitude of the chart corners are submitted through the Chief, NDB, to NGS. The values provided will be a mean for the entire chart.

As shown below the primary datum reference in the title block shall be shown in 10 pt. Swiss Light. The secondary datum reference shall be shown in parentheses in 8 pt. Swiss Light. On revised conventional charts, both datum references shall be shown in 8 pt. Swiss Light. On small craft charts, both datum references shall be shown in 8 pt. Swiss Light.

North American Datum of 1983 (World Geodetic System 1984)	World Geodetic System 1984 (North American Datum of 1983)	North American Datum of 1983 (World Geodetic System 1984)

When the magnitude of the shift between the existing chart datum and NAD 83 will not result in a

significant plottable difference (less than 0.20 millimeters), the conversion to NAD 83 can be accomplished by revising the datum reference in the chart title block and, for informational purposes, adding a temporary chart note.

The informational note shall be as follows:

HORIZONTAL DATUM

The horizontal reference datum of this chart is North American Datum of 1983 (NAD 83), which for charting purposes is considered equivalent to the World Geodetic System of 1984 (WGS 84). Geographic positions referred to the North American Datum of 1927 do not require conversion to NAD 83 for plotting on this chart.

When the shift in projection is plottable (shift greater than 0.20 mm), the projection on the black plate shall be revised, the datum reference shall be changed, and a conversion note shall be added. The values shown in the note will represent a +/- mean datum shift for the chart as a whole and will facilitate the transfer of data from the previous datum to NAD 83. An example of a note is as follows:

HORIZONTAL DATUM

The horizontal reference datum of this chart is North American Datum of 1983 (NAD 83), which for charting purposes is considered equivalent to the World Geodetic System of 1984 (WGS 84). Geographic positions referred to the North American Datum of 1927 must be corrected an average of 0.000" xxxxxward and 0.000" xxxxward to agree with this chart.

This note shall remain on the chart until it is deemed no longer necessary.

If available resources or other considerations do not permit revising the projection, a temporary note describing the magnitude of the shift from NAD 83 to the chart datum shall be added to the new edition of the chart. The value shown in the note will represent a +/- mean datum shift for the chart as a whole. An example of the note is as follows:

HORIZONTAL DATUM

The horizontal reference datum of this chart is North American Datum of 1927. Geographic positions on North American Datum of 1983 (NAD 83) must be corrected an average of 0.271" southward and 0.322" eastwa rd to agree with this chart. For charting purposes, NAD 83 is considered equivalent to the World Geodetic System 1984 (WGS 84) datum

All horizontal datum notes, unless otherwise stated, shall be black 7 pt. Swiss Light.

The method for determining the direction of the horizontal datum shifts is shown below. In general, latitude corrections will be positive in the Gulf, on the East Coast, in the eastern Great Lakes and southern California. They will be negative in the western Great Lakes, on the West Coast, Alaska, Hawaii and Puerto Rico.

REVISED MARCH 14, 2002

HORIZONTAL DATUM SHIFT DETERMINATION

Corrections received from NGS are based on subtracting the NAD 1927 positions of triangulation stations from the NAD 1983 positions.

For charts getting a projection shift:

	Latitude		Longitude	
If the correction is:	Positive	Negative	Positive	Negative
(1) The projection lines will move:	South	North	East	West
(2) The note (27 to 83) will read:	Northward	Southward	Westward	Eastward
(3) Corrections to GP's will be:	Added	Subtracted	Added	Subtracted

For charts on which the projection shift is not made and the 83 to 27 note is used:

(4) The note will read:	Southward	Northward	Eastward	Westward
(5) Corrections to GP's will be:	Subtracted	Added	Subtracted	Added

For charts on east longitude, the actions under longitude in (3) and (5) will be reversed.

Longitude corrections will be positive in the western Gulf, the western Great Lakes, the West Coast and Alaska. They will be negative in Hawaii, Puerto Rico, on the East Coast and the eastern Great Lakes.

Correction values from NGS for Hawaiian charts are based on the OLD Hawaiian datum and those for Puerto Rican charts are based on the Puerto Rico datum even if the listings refer to NAD 27. In the Great Lakes, the reference to NAD 27 is true. If a chart is on the 1902 datum the difference between that and NAD 27 must be determined before the shift to NAD 83 can be made.

2.8.2 Vertical Datums

A vertical datum is a reference point or place to which elevations of the land or depths of the sea are tied.

The base from which NOS measures vertical heights is the National Geodetic Vertical Datum of 1929. This datum was called the "Mean Sea Level Datum of 1929" prior to being renamed in 1973. This datum will be further adjusted and replaced by the North American Vertical Datum of 1988.

Sounding datums used in coastal areas for nautical charting are not referred to the 1929 datum but are

determined by local observations, ideally over a period of 19 years. The official time period over which tide observations are taken to obtain mean values for tidal datums has been standardized by NOS. The present National Tidal Datum Epoch is from 1960 through 1978. There have been two epochs used previously in this century; 1924 through 1942, and 1941 through 1959.

1. Definitions

Mean higher high water (MHHW) is a tidal datum which is the average of the higher high water of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station in order to derive the equivalent datum of the National Tidal Datum Epoch.

Mean high water (MHW) is a tidal datum which is the average of all the high water heights observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station in order to derive the equivalent datum of the National Tidal Datum Epoch.

Mean sea level (MSL) is a tidal datum which is the arithmetic mean of hourly heights observed over the National Tidal Datum Epoch. Shorter series are specified in the name -- e.g., monthly mean sea level and yearly mean sea level.

Mean water level (MWL) is the mean surface elevation as determined by averaging the heights of the water at equal intervals of time, usually hourly, over the National Tidal Datum Epoch. MWL is used in areas of little or no range in tide.

Mean low water (MLW) is a tidal datum which is average of all the low water heights observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station in order to derive the equivalent datum of the National Tidal Datum Epoch.

Low water datum (LWD) is the dynamic elevation for each of the Great Lakes and Lake St. Clair and the corresponding sloping surfaces of the St. Mary's, St. Clair, Detroit, Niagara, and St. Lawrence Rivers to which are referred the depths shown on the navigational charts and the authorized depths for navigation improvement projects. LWD may also be an approximation of MLW that has been adopted as a standard reference for a limited area and is retained for an indefinite period regardless of the fact that it may differ slightly from a better determination of MLW from a subsequent series of observations. Such an approximation is used primarily for river and harbor engineering purposes. Boston LWD is an example.

Mean lower low water (MLLW) is a tidal datum which is the average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series,

simultaneous observational comparisons are made with a control tide station in order to derive the equivalent datum of the National Tidal Datum Epoch.

Extreme low water is the lowest elevation reached by the sea as recorded by a tide gage during a given period. NOS routinely documents monthly and yearly extreme low water for its control stations.

Gulf coast low water datum (GCLWD) is a tidal datum consisting of MLLW when the type of tide is mixed and MLW (pre-National Tidal Datum Convention definition, November 28, 1980) when the type of tide is diurnal.

2. Sounding Datums

The datums of reference currently used for depths on nautical charts published by the NOS are as follows:

1. For the Atlantic Ocean, certain areas of the Caribbean, the Gulf of Mexico, and the Pacific Ocean, MLLW.
2. For the Great Lakes and connecting waterways, LWD.
3. For most other larger navigable rivers and lakes, special datums.

a. Atlantic Coast

MLLW was authorized for use as the chart sounding datum for the east coast of the United States with the adoption of the National Tidal Datum Convention of 1980. It has been determined that the MLW values observed during the 1941-59 epoch are, for charting purposes, the same as the MLLW values observed during the newer 1960-78 epoch. However, this change in datums has only recently been approved for implementation on charts due to limited resources. Information will be provided by the Center for Operational Oceanographic Products and Services (COOPS), N/OPS, as part of its regular review of tidal datum information. No adjustments are to be made in the soundings, shoreline, low water line, heights, elevations, or the application of tide predictions for navigational purposes. Hydrographic surveys that use MLLW as the sounding datum can be applied to charts that use MLW as the chart datum since the two datums are equivalent.

b. Gulf Coast

The chart datum for soundings and depth curves on charts covering coastal waters from Mangrove Point, Florida (latitude 25°22'33"N, longitude 80°18'36"E) to the United States-Mexico border was changed to MLLW from GCLWD, effective November 28, 1980. This datum change, also the result of the National Tidal Datum Convention of 1980, was announced in the Federal Register (vol. 45, no. 207, October 23, 1980). The Center for Operational Oceanographic Products and Services, began providing datum label changes from GCLWD to MLLW for nautical charts in its regular review of

tidal datum information beginning in December 1982. All references to GCLWD shall be changed to MLLW on all nautical charts, Coast Pilots, and other related publications published after January 1, 1983.

No adjustments are to be made in the soundings, shoreline, low water line, clearances, heights, elevations, or the application of tide predictions for navigational purposes.

c. Great Lakes

The Great Lakes-St. Lawrence River system, shared by the United States and Canada, requires international coordination to establish a common elevation reference or datum by which water levels can be measured. The first common datum between the United States and Canada was the International Great Lakes Datum (1955) or IGLD (1955). Due to movement of the earth's crust, the datum reference system used to define water levels within the Great Lakes-St. Lawrence River system must be adjusted every 25 to 35 years.

A new vertical datum, for referencing elevation values for the Great Lakes Vertical Control Network, has been established. The new datum, known as the International Great Lakes Datum (1985) or IGLD (1985), has replaced the old datum of IGLD (1955). As part of the datum revision, a new zero reference location (the point to which all other elevations are referenced) has been established. The zero reference point of IGLD (1985) is located at Rimouski, Quebec, Canada.

The following table indicates the revised Low Water Datum (LWD) reference for each lake from IGLD 1955 to IGLD 1985:

	Low Water Datum			
	Meters		Feet	
	IGLD 55	IGLD 85	IGLD 55	IGLD 85
Lake Superior	182.9	183.2	600.00	601.10
Lake Michigan	175.8	176.0	576.80	577.50
Lake Huron	175.8	176.0	576.80	577.50
Lake St. Clair	174.2	174.4	571.70	572.30
Lake Erie	173.3	173.5	568.60	569.20
Lake Ontario	74.0	74.2	242.80	243.30

On all affected Great Lakes-St. Lawrence River navigation charts, the LWD (or chart datum) shall be changed from IGLD (1955) to IGLD (1985). Correspondingly, references to zero point shall be changed to Rimouski, Quebec, and charted LWD elevations shall be revised to the IGLD 85 figures shown above. Charted water depths will not require modification.

The LWD for connecting channels, affecting some nautical charts of the Great Lakes-St. Lawrence River system, is based on the sloping surface of the water at selected points referred to the gage

NATIONAL OCEAN SERVICE
Office of Coast Survey
Marine Chart Division

CARTOGRAPHIC ORDER 022/01

DECEMBER 14, 2001

FILE WITH NAUTICAL CHART MANUAL, VOLUME 1, PART 1, SECTION 2.9.1

TO: All Cartographers
Marine Chart Division

SUBJECT: Response to Distorted Projection Lines

Effective immediately, the attachment (pages 2-33 through 2-33.2) shall replace page 2-33 in the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition, Section 2.9.1.

The attachment contains explanations for distorted projection lines on current nautical charts.

ATTACHMENT

Nicholas E. Perugini
Captain, NOAA
Chief, Marine Chart Division

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

MARCH 14, 2002

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Fannie B. Powers
Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Nautical Chart Manual Correction Pages - Lake Diagram; Sounding Units Label (Canadian Chart Coverage); Heights Note

Effective immediately, the following attachment replaces pages 2-31 through 2-34 in the Nautical Chart Manual, Volume 1, Part I, Seventh (1992) Edition, and serves to improve the legibility of the following Figure, labels and notes:

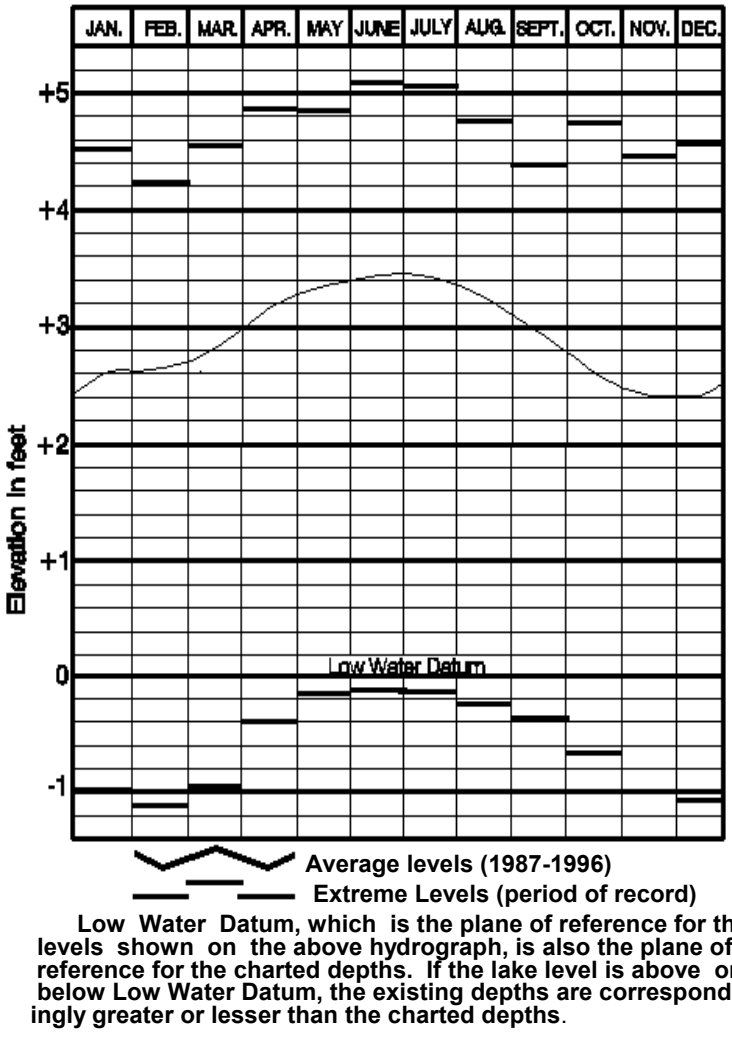
Nautical Chart Manual Volume	Nautical Chart Manual Page	Illegible Figure/Label/Note Introduced during Digital Conversion
1	2-31	Lake Diagram example
	2-32	Soundings in Fathoms label
	2-33	Heights Note

Pages 2-31 through 2-34 are to be inserted into the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition immediately after page 2-30.

Attachment

readings at those points. As these charts go forward, the referenced profile stations should be provided to the Measurement Branch, Great Lakes Section, for updating. Charted water depths will not require modification.

The values of LWD were chosen so that during the navigation season the actual water levels in each lake would be above the LWD elevation most of the time. A hydrograph of average monthly water levels with respect to the sounding datum is shown on each chart (see Figure below). The averages are based on the most recent 10-year period of observations available. In addition, it also shows the extreme high and low monthly water levels for the period of observation.



Low Water Datum, which is the plane of reference for the levels shown on the above hydrograph, is also the plane of reference for the charted depths. If the lake level is above or below Low Water Datum, the existing depths are correspondingly greater or lesser than the charted depths.

Shoreline shown on Great Lakes charts represents the level of the water at the time the survey was accomplished. If there is an appreciable displacement between the shoreline thus determined and the line representing the sounding plane of reference, the sounding datum line will be charted using the symbol labeled A 10 in Chart No. 1 and a green tint will be shown between that line and the shoreline.

In the Great Lakes and St. Lawrence River where the United States and Canada have overlapping chart coverage, Canadian soundings for the most part are based on the same datum as soundings on NOS charts. Any exceptions are stated by notes on the Canadian charts; in this case, soundings must be corrected accordingly before being transferred to NOS charts.

In other areas where NOS charts cover Canadian waters, notably Dixon Entrance, the Washington-British Columbia area, and the Maine-New Brunswick area, soundings on the Canadian side of the boundary are applied directly from the Canadian sources and the datum reference is revised as needed (see below). The only exceptions to this practice are in the narrow portions of Lubec Channel and St. Croix River where soundings on both sides of the international boundary are referred to MLW.

SOUNDINGS IN FATHOMS
AT MEAN LOWER LOW WATER IN U.S. TERRITORY
AT LOWEST NORMAL TIDES IN CANADIAN TERRITORY

d. Pacific Coast

The chart sounding datum for Pacific coast charts is MLLW.

e. Navigable Rivers and Special Datums

In the Mississippi River above Head of Passes, Louisiana, soundings are referred to an Adopted Average Low Water Plane (ALWP) established by the USACE and referred to MSL. It varies from approximately MSL at Chalmette, Louisiana, to over 5 feet above MSL at Bayou Sara, Louisiana, 263 miles above Head of Passes.

In the Columbia River between Harrington Point and Bonneville Dam, the sounding datum is the Columbia River Datum which is the plane of MLLW during lowest river stages. In the impoundments behind dams in the Columbia River and elsewhere, soundings are referred to normal pool level.

Similarly in the Hudson River above Haverstraw Bay, soundings are referred to Hudson River Datum which is defined as MLW during lowest river stages.

There are some nontidal coastal areas, most notably Laguna Madre, Texas, Biscayne Bay, Florida, and Pamilco Sound, North Carolina, where a special LWD is applied because of lack of regular tide signals in these areas. In such areas the periodic tide has a mean range less than one-half foot. The soundings are based upon a low water datum equal to one-half foot below mean sea level.

3. Chart Notes

In general, heights and clearances on NOS charts are referred to MHW except in nontidal areas where they are referred to the sounding datum. Any variations to this practice should be clearly stated in an explanatory note in the title area of the chart. In tidal areas when the information is available, the note "Heights in feet above Mean High Water" shall be used. When contour and spot elevations based on the plane of mean sea level are charted, the following note shall be used:

HEIGHTS
Elevations of rocks, bridges, landmarks and lights are in feet and refer to Mean High Water. Contour and summit elevation values are in feet and refer to Mean Sea Level.

On metric charts, the reference to "feet" will be replaced by "meters."

2.9 Projections and Grids

Projections are the lines representing the parallels of latitude and meridians of longitude drawn on a chart. Grids, in contrast, are a pattern of squares or rectangles superimposed on a chart to permit location of any point by a system of rectangular coordinates.

2.9.1 Projections

The construction of any map or chart requires that points on the earth's spheroidal surface be transferred to points on a plane surface (the map or chart). In order for features displayed on the resulting map or chart to bear some resemblance, in regard to shape and relative position, to the corresponding features on the earth, a suitable transformation system is required.

The parallels of latitude and the meridians of longitude constitute a framework (or projection) for accurately placing all detail when constructing a nautical chart. They are essential to the navigator for plotting and scaling all data and positional information.

Very few projections used in charting are true projections in the geometrical sense. They are instead mathematical constructions intended to possess certain desirable qualities.

Numerous inquiries have been received by Marine Chart Division regarding inaccurate projection lines on some nautical charts. Marine Chart Division response, when directed by the Chief of MCD:

1 Background:

Since NOS' beginning in the early 19th century, the production of nautical charts has been accomplished by using the most efficient compilation methods and storage media available at the time. However, regardless of the compilation method or storage medium used, ruled projections were examined and found to always be within the acceptable tolerance set by NOS.

The majority of NOS chart projections were originally ruled prior to 1920 and involved the use of either a Projection Ruling Machine or Coordinate Plotter. Although the names of these machines may imply that a projection was produced automatically, the ruling processes were basically

manual, requiring the cartographer to (a.) calculate all appropriate meridian and parallel distances, and (b.) manually operate the machine. Manual cartographic processes were also used to incorporate the change from a horizontal datum of NAD27 to NAD83 in the 1980's.

The storage media used during the years has included copper plates, glass plates, film and scribe coat. Each medium represented the most stable medium available at the time of its use, however, each medium also exhibited varying degrees of stability.

Projections ruled by hand more than eighty (80) years ago, datum changes applied manually and various mediums introducing their own degree of stability have created a suite of nautical charts containing projection lines that could not possibly agree with a computer generated projection.

II Scanning and Warping Didn't Make It Better:

In 1994, the entire suite of nautical charts was scanned and converted to raster format. These initial scanned images were used to produce the first NOS raster charts made available to the public on CD-ROM's.

In addition to any pre-existing projection distortion being inherited by the scanned raster, an additional degree of distortion was introduced because of the inappropriate choice and use of a non-vacuum scanner. The use of a vacuum scanner during the scanning process would have prevented any movement of the chart as it was being loaded into or as it was exiting the scanner. Such movement however, only introduced the greater degree of distortion in the borders and did not cause a level of distortion that (a.) exceeded the NOS projection tolerance for either the border or the inner neatline, or (b.) was considered navigationally significant or a danger to the chart user.

In 1996, a requirement arose to establish an accurate geo-reference system for the suite of raster charts. This geo-reference system was necessary (a.) to bring the distorted raster projections further into agreement with a perfect projection, and, (b.) to ensure the positional accuracy of all charting information.

To establish the proper geo-reference system, each projection intersection within the raster chart panel was warped (referenced) to its corresponding projection intersection within a computer-generated projection. The corners of the raster chart panel were not used as warp reference points because priority was given to ensuring the integrity of the internal projection intersections. All deviations from the computer-generated "perfect" projection existing after the warping process was completed were within the acceptable tolerance level set by NOS.

III Conclusion:

1. To reiterate: Projections ruled by hand more than eighty (80) years ago, datum changes

applied manually and various mediums introducing their own degree of stability created a suite of nautical charts containing projection lines that could not possibly agree with a computer generated projection.

1. During the scanning process, (the process required to produce the first NOS raster charts), (a.) any pre-existing projection distortion was inherited by the scanned raster and (b.) an additional level of distortion was introduced because of the inappropriate choice and use of a non-vacuum scanner.

3. Although a warping procedure was performed by NOS in an attempt to bring the imperfect raster projection into greater agreement with a computer-generated "perfect" projection, an amount of deviation still existed. However, this deviation was within the tolerance level set by NOS.

2. The only charts which NOS produces and which may have perfect projections are those which were reconstructed on a computer-generated projection. Limited funding and resources prevent NOS from reconstructing its full suite of charts solely for the purpose of containing perfectly generated projections. All processes which have affected NOS' charted projections [i.e., manual ruling, varied storage medium, manual datum shift, scanning, warping], (a.) did not result in a deviation amount that was not within the tolerance level set by NOS, and, (b.) did not affect the quality or the positional accuracy of all navigational information.

Historically, the two basic projections used by NOS have been Mercator and polyconic. The ease of construction of these two projections was a factor in their use until the advent of automated plotting techniques. The Mercator projection is still used for most NOS nautical charts, except for Great Lakes charts. These are mostly polyconic, but are being converted to Mercator as resources permit and as the charts are converted to metric units. Polyconic projections are still widely used for hydrographic field sheets and photogrammetric surveys. Recently, NOS has begun using the Lambert conformal conic and transverse Mercator projections along with the polyconic, for large-scale hydrographic and photogrammetric surveys.

1. Mercator Projection

Nautical charts which are constructed on the Mercator projection have meridians of longitude and parallels of latitude represented by straight lines intersecting at right angles. The distances between meridians are equal throughout the chart and distances between parallels increase progressively from the equator toward the poles to compensate for the fact that the meridians are not converging as they do on a globe. This results in a constantly increasing scale going from the equator toward the poles.

This projection has a number of advantages, among which are its rectilinearity, simplicity of construction, convenience in plotting positions from the border subdivisions, and the fact that a course can be laid off from any meridian or compass rose within its borders. Its principal advantage, however, and the one responsible for its worldwide use for nautical charts is that any straight line drawn on it in any direction is a rhumb line (loxodromic curve). Thus the rhumb line, or the track of a ship on a constant course, is a straight line on the projection and will pass all features along that line exactly as they are charted. This is a great advantage in coastal navigation since the straight line represents a planned course and will indicate at once the distance at which dangers will be passed abeam if this course is maintained.

Disadvantages of the Mercator projection are that it makes comparison of areas very misleading on small-scale charts when large differences of latitude are involved, and that great circle routes cannot be plotted conveniently on it without the use of an auxiliary gnomonic chart. Other disadvantages are that the scale constantly and slightly changes with the latitude, with the result that a graphic scale cannot be used on smaller-scale charts, making it necessary to measure distances along the border divisions for the various latitudes. (On all nautical charts, a minute of latitude is considered to be approximately 1 nautical mile.) Also, for long distances such as those encountered in radionavigation, bearings must be adjusted before plotting.

Both radio waves and light travel along great circles. But except in high latitudes, visual bearings are short enough that they can usually be plotted as straight lines on a Mercator chart without significant error. Radio bearings, however, are often observed at such distance from the transmitter that the use of a rhumb line is not satisfactory. A conversion angle is customarily applied as a correction to the observed angle to find the equivalent rhumb line. These conversion angles are listed in NGA Pub. 117, Radio Navigational Aids, and in the appendix of the Coast Pilots in abbreviated form. A complete set of conversion angle tables are given in the American Practical Navigator (Bowditch), vol. II, table 1.

2. Polyconic Projection

The polyconic projection was devised by Ferdinand Hassler, the first superintendent of the Coast Survey. The primary advantage of this projection is its ease of mechanical construction and the fact that a general table for its use has been calculated for the whole earth. No calculation is required to construct this projection other than to reduce the table values to the scale of the projection.

The polyconic projection is not conformal, nor do the parallels and meridians intersect at right angles. However, it is sufficiently close to other types of projections having these properties that the ease of construction makes this projection attractive for field applications, especially at large scales. Until recently this projection was used for almost all NOS field survey sheets. It is still used for most charts

of the Great Lakes and will continue to be used until the charts can be converted to the Mercator projection using automated techniques.

3. Lambert Conformal Conic and Transverse Mercator Projections

These projections are used as the base for the various State grid systems and as such show the State systems as true rectangular coordinate systems. These are discussed in more detail in the following discussion of grids.

4. Modified Universal Transverse Mercator Projections

With the advent of electronic computing and plotting equipment this projection has come into use as the base projection for NOS field sheets.

2.9.2 Grids

A grid is two sets of mutually perpendicular lines dividing a map or chart into squares or rectangles to permit location of any point by a system of rectangular coordinates. Following is a description of grids frequently used on NOS charts.

1. State Plane Coordinate Systems

State plane coordinate systems for the United States were defined for each State in 1933. These coordinate systems were initially intended to facilitate the use of geodetic control stations by highway engineers, land surveyors, and others who were accustomed to using grid (rectangular) coordinates (x and y) rather than geodetic (geographic) coordinates (latitude and longitude). The State plane coordinate projections were designed to have scale factors very close to 1.0000 (actually between 0.99990 and 1.00010). This required the larger States to be divided into several zones. The Lambert conformal conic projection was chosen for those States or zones that were long in the east-west direction, such as Pennsylvania. The transverse Mercator was chosen for States or zones of long north-south extent, such as Indiana. A rectangular grid was superimposed upon each projection. The central meridian was assigned a numerically large x-coordinate, such as 2 million feet, so that any survey station within the zone would have a positive x-coordinate.

2. Universal Transverse Mercator Grid

The Universal Transverse Mercator (UTM) grid is one of several grids devised to simplify the problems of giving directions, distances, and positions in military operations. Since these computations must be simple, rapid, and accurate, a system based on latitude and longitude was found to be unwieldy. During World War I, the French adopted rectangular grids superimposed upon the Lambert conformal conic projection. After the war, the Germans and Russians adopted transverse grids. Unfortunately, the United

States established a polyconic based grid, which is not conformal. The British developed several systems, in yards, for various parts of their empire. By the end of World War II, about 100 different grids were in use. At that time, the U.S. Army Map Service reviewed the existing situation and devised the UTM grid, plus the Universal Polar Stereographic (UPS) grid, to cover the entire world in a well-planned system using metric units.

The UTM and UPS grids have grown in importance in recent years. They are used in Europe and the U.S.S.R. for surveying purposes as well as for mapping and military purposes.

There are 60 UTM and 2 UPS zones which together cover the world. Each of the UTM zones covers 6° of longitude and extends from 80° S to 84° N. The UPS zones cover the two polar areas.

3. USACE Rectangular Coordinates (Local)

Local control systems must be established in localities where NGS triangulation stations are not available from which State grid systems can be extended into a survey area.

The local grid systems used by the USACE are rectangular and have a progressive deviation from the meridians and parallels. The meridian through the origin of the system is ordinarily parallel to the north-south grid line. However, caution must be exercised in using local grids, because in some cases the north-south grid line is not parallel to the meridian at the zero point of the system. The point to be used as the origin for computations is the point at which the grid line and meridians are parallel; otherwise a rotation computation must be used.

When the USACE began using the State plane coordinate systems for referencing or controlling their surveying, dredging, breakwater construction, and other harbor and waterway improvement projects, USACE cartographers soon recognized the benefit of having a State plane coordinate grid system on the chart to facilitate application of USACE data. NOS has printed State plane coordinate grid ticks along the borders and within selected charts and insets for decades. Generally, the scale of these charts and insets is 1:40,000 or larger.

Geographic positions of USACE coordinate grid intersections have also been computed, but not charted, for many other harbors of the United Sates. These coordinate grids have been transferred to a reference copy of the chart filed in the NDB. When USACE blueprints showing plane coordinate control are applied to a chart compilation, the geographic position of the grid intersection should be scaled from the chart copies showing these grids and transferred to the compilation to furnish control for the blueprints.

2.9.3 Constructing Projections

Almost all projection constructions and coordinate computations are now performed using electronic computers and plotters.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

MARCH 14, 2002

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Fannie B. Powers
Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Nautical Chart Manual Correction Pages - Chart Projection Figures

Effective immediately, the following attachment replaces pages 2-37 through 2-42.2 in the Nautical Chart Manual, Volume 1, Part I, Seventh (1992) Edition, and serve to improve the legibility of the following Figures:

Nautical Chart Manual Volume	Nautical Chart Manual Page	Illegible Figure Introduced during Digital Conversion
1	2-38 (Figure 2-3)	Mercator Projection Data Form Example
	2-39 (Figure 2-4)	Mercator Projection Construction Plate Example
	2-40 (Figure 2-5)	Polyconic Projection Construction Module
	2-42.2 (Figure 2-5a)	Rhumb Line Computation Diagram

Pages 2-37 through 2-42.2 are to be inserted into the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition immediately after page 2-36.

Attachment

The following information is offered for use only in the absence of modern computing and plotting equipment.

1. Construction of a Mercator Projection

A Mercator projection is constructed by first drawing a straight line for a central meridian and then drawing a central parallel perpendicular to it. Each should be as central to the sheet as the selected intervals of latitude and longitude will permit. To ensure greater accuracy on large sheets, the longer line of the two should be drawn first and the shorter line erected perpendicular to it.

For example, suppose a Mercator projection is required for a New Chart of Corpus Christi Bay, Texas, extending from latitude 27°38' to 27°55'30"; longitude 97°00' to 97°27'; scale of middle parallel to be 1:40,000; projection interval 5 minutes, with construction line subdivisions 1 minute apart. (For convenience, all measurements will be determined in millimeters.)

a. The Meridians of Longitude

The middle parallel being 27°47', the length of a minute of longitude is found by reference to the C&GS Special Publication No. 5 (see "Tables for a Polyconic Projection of Maps," page 64) to be 1642.66 meters (the value of 5 minutes = 8213.3 divided by 5 = 1642.66). At the scale of the chart, 1 minute of longitude equals 1642.66 divided by 40,000 = 0.0410665 meters or 41.067 mm. Lines representing 5-minute intervals of longitude (5 x 41.067 = 205.335 mm and 1-minute subdivisions for construction purposes (41.067 mm) may now be drawn.

b. The Parallels of Latitude

The distance between parallels of latitude is obtained from the C&GS Mercator Projection Tables, Clarke Spheroid of 1866 (1955), page 7, by multiplying the differences between any two parallels of latitude by the value of 1 minute of longitude. For example, the value of a minute of latitude between 27°38' and 27°39' is 1.12283 x 41.067, or 46.111 millimeters. The spacings for all desired intervals may be obtained in the same way.

The latitude and longitude values thus obtained should be entered on C&GS Form 1016, Mercator Projection Data on N.A. 1927 Datum (see Figure 2-3). After the necessary data have been tabulated, the required projection lines are drawn parallel to the central meridian and central parallel as shown in Figure 2-9. When the coordinate plotter is used, the sum of the intermediate distances should be tabulated as shown on the sample Form 1016 (Figure 2-3).

FIGURE 2-3 WILL BE INSERTED AT A FUTURE DATE.

Figure 2-3

FIGURE 2-4 WILL BE INSERTED AT A FUTURE DATE.

Figure 2-4

2. Construction of a Polyconic Projection

The following procedures are extracted from C&GS Special Publication No. 5.

Having the location to be covered by a projection, suppose the scale and the interval of the projection lines which will be most suitable for the work in hand must be determined. The following construction descriptions are to be used along with Figure 2-5.

a.. Small-Scale Projections (1:500,001 and Smaller)

Draw a straight line for a central meridian and a construction line (ab) perpendicular thereto, each as central to the sheet as the selected interval of latitude and longitude will permit.

On this central meridian and from its intersection with the construction line, lay off the extreme intervals of latitude, north and south (m2, m4), and subdivide the intervals for each parallel (m1, m3) to be represented, all distances being taken from Special Publication No. 5 (page 7, Lengths of degrees of the Meridian).

Through each of the points (m1, m2, m3, m4) on the central meridian, draw additional construction lines (cd, ef, gh, ij) perpendicular to the central meridian and mark off the ordinates (x, x1, x2, x3, x4, x5) from the central meridian corresponding to the values of "X" taken from the table titled

Coordinates of Curvature (pages 11 to 189), for every meridian to be represented.

At the points (x, x1, x2, x3, x4, x5), lay off from each of the construction lines the corresponding values of "Y" from the table under "Coordinates of Curvature" in a direction parallel to the central meridian, above the construction lines if north of the equator, to determine points on the meridians and parallels.

Draw curved lines through the points thus determined for the meridians and parallels of the projection.

b. Intermediate-Scale Projections (1:500,000 to 1:10,001)

To construct a projection on an intermediate scale, follow the rigid method for small-scale projections to the extent required to give a projection as accurate as can be constructed graphically.

c. Large-Scale Projections (1:10,000 and Larger)

The method for constructing a small-scale projection can be simplified in constructing a projection on a large scale. Draw the central meridian and the construction line ab, as directed above. On the central meridian, lay off the distances mm2 and mm4 taken from the table titled "Continuous Sums of Minutes" for the intervals in minutes between the middle parallel and the extreme parallels to be represented, and through the points m2 and m4, draw straight lines cd and ef parallel to the line ab.

On the lines ab, cd, and ef, lay off the distances mx5, m2x5, and m4x5 on both sides of the central meridian, taking the values from the table under "Arcs of the Parallel in Meters" corresponding to the latitude of the points m, m2, and m4, respectively. Draw straight lines through the points thus determined, x5, for the extreme meridians.

At the points x5 on the line ab, lay off the value of "Y" corresponding to the intervals in minutes between the central and the extreme meridians, as given in the table under "Coordinates of Curvature," in a direction parallel with the central meridian and above the line, if north of the equator, to determine points in the central parallel. Draw straight lines from these points to point m for the middle parallel, and from the points of intersection with the extreme meridians, lay off distances on the extreme meridians, above and below, equal to the distances mm2 and mm4 to locate points in the extreme parallels.

Subdivide the three meridians and three parallels into parts corresponding to the projection interval and join the corresponding points of subdivision by straight lines to complete the projection.

In the large-scale projection method, the use of the table, Arcs of the Parallel," instead of X-coordinates, although not theoretically correct, is sufficiently accurate for projections to 1:40,000 scale. Since X-coordinates are not supplied in the table for latitudes other than whole degrees, it is convenient to use arc lengths instead of X-coordinates to avoid interpolation. However, in projections of large longitudinal extent in scales smaller than 1:40,000, it is necessary to check the two sets of values and to use the X-coordinates when they become smaller than the values taken from the "Arcs of the Parallel."

Y-coordinates must be used more frequently as scales become smaller than 1:10,000. On intermediate scales up to 1:40,000, it is generally sufficient to apply the Y-coordinates on the central, upper, and middle parallels at their extremities and at intermediate intervals of such frequency as will be graphically useful.

3. Conversion of State Plane Coordinates

C&GS Plane Coordinate Projection Tables for the appropriate State are required to convert plane coordinates to geographic positions and geographic positions to plane coordinates. In addition, if the coordinate system under consideration is the Lambert system, a copy of C&GS Special Publication No. 246, "Sines, Cosines, and Tangents to Ten Decimal Places," is required.

(The remainder of this page is intentionally blank.)

FIGURE 2-5 WILL BE INSERTED AT A FUTURE DATE.

Figure 2-5

2.9.4 Grid Computations

1. Computation of Rhumb Lines

The following is a simplified approach to computing points along rhumb lines, useful for determining such things as where a rhumb line crosses a chart neatline when one or both ends of the line are outside the limits of the chart (see below).

Given: A rhumb line connecting points A and B.

A = 45°00' N 75°00' W
B = 50°00' N 70°00' W

Required: Latitude where the line intersects the meridian, 72°30', at point C.

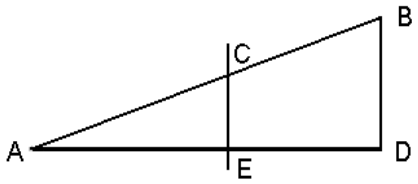


Figure 2-5a

In minutes of longitude:

AD = 300
AE = 150

(The remainder of this page is intentionally blank.)

From the Mercator Projection Tables:

50° = 3456.62418
45° = -3013.46698
BD = 443.15720

The values from the Mercator Projection Tables are also expressed in minutes of longitude.

By similar triangles:

CE/BD = AE/AD
CE = BD x (AE/AD)
CE = 443.15720 x (150/300) = 221.57860

Mercator Projection Table value for C:

3013.46698
+ 221.57860
3235.04558

To determine the latitude represented by 3235.04558, interpolation is required between the values shown in the Mercator Projection Tables.

From the Mercator Projection Tables:

47°33' = 3234.16181
3235.04558 Diff. = 1.47725
47°34' = 3235.63906

The fractional part of the minute is determined by the proportion of the partial meridional difference to the total meridional difference for one minute of latitude.

$$\frac{3235.04558 - 3234.16181}{3235.63906 - 3234.16181} = \frac{0.88377}{1.47725}$$

This ratio times 60 seconds will provide the increment of latitude which must be added to 47°33' to give the latitude of point C.

$$\frac{0.88377}{1.47725} \times 60 = 35.895 \text{ seconds}$$

Latitude of point C = 47°33'35.9"

2. Conversion of Local Coordinates

When geographic coordinates have not been computed for the area of the survey to which they are to be applied, it will be necessary to compute the positions on C&GS Form 89, "Computation of Geographic Coordinates from Plane Coordinates, as shown in the following examples. When this is accomplished, the form should be attached to the Chart History.

The following examples show how to find the geographic position of a point whose rectangular coordinates from a known geographic position are given:

a. Example No. 1

To compute the geographic position of a point whose local grid coordinates are 40,000 ft. S. and 160,000 ft. E.:

(1 foot=0.3048006096)

Origin of coordinates: Cape Disappointment Lighthouse, Washington

Lat. 6°16' 1038 m. Coordinate value of origin} N. or S. 0.0 feet
Long. 124°03' 67 m. referred to the Zero } E. or W. 0.0 feet

Name of Station: X
Coordinates: N. or S. 40,000 feet = 12,192 m.
E. or W. 160,000 feet = 48,768 m.

Latitude N. - S. coordinates:

N. or S. 40,000 feet	=	12,192 m.
+ or - seconds in meters	=	1,038 m.
N. or S. of 46°16'	=	11,154 m.
*From table + or - 7'	=	12,968 m.
Lat. (uncorrected) 46°09'	=	1,814 m.
**Curvature --	=	194 m.
***Latitude 46°09'	=	1,620 m.

*From Special Publication No. 5, page 103.
**Correction from formula for curvature corrections, See Section C. below
***Use in taking out longitude values from Polyconic Projection Tables, Special Publication No. 5, C&GS, page 102.

Longitude E. - W. coordinates:

E. or W. 160,000 feet	=	48,768 m.
+ or - seconds in meters	=	67 m.
E. or W. of 124°03'	=	48,701 m.
***From table + or - 38'	=	48,914 m.
Longitude 123°25'		213 m.

b. Example No. 2

To compute the geographic position of a point whose local grid coordinates are 30,000 ft. N. and 155,000 ft. W.

(1 foot = 0.3048006096)

Origin of coordinates: Maryland

Lat. 38°20' 426 m. Coordinate value of origin} N. or S. 0.0 feet
Long. 75°10' 315 m. referred to the Zero } E. or W. 0.0 feet

Name of Station: Y

Coordinates:	N. or S.	30,000 feet	= 9,144 m.
	E. or W.	155,000 feet	= 47,244 m.

Latitude N. - S. coordinates:

N. or S.	30,000 feet	= 9,144 m.
+ or - seconds in meters		= 426 m.
N. or S. of 38°20'		= 9,570 m.
*From table + or - 5'		= 9,250 m.
Lat. (uncorrected) 38°25'		= 320 m.
**Curvature--		= 138 m.
***Latitude 38°25'		= 182 m.

Longitude E. - W. coordinates

E. or W. 155,000 feet	= 47,244 m.
+ or - seconds in meters	= 315 m.
E. or W. of 75°10'	= 47,559 m.
***From table + or - 31'	= 46,579 m
Longitude 75°42'	980 m.

*From Special Publication No. 5, page 87.
**Correction from formula for curvature corrections, see Section C. below
***Use in taking longitude values from Polyconic Projection Tables, Special Publication No. 5, C&GS, page 86.

c. Curvature Corrections (Example based on Example No. 1 above)

$$\text{Curvature correction (see note)} = A \times \left| \frac{\text{long}}{10{,}000} \right|^2$$

$$\text{Case No. 1 (page 102)} \quad 8.15 \times \left| \frac{48{,}768}{10{,}000} \right|^2 = 194 \text{ m.}$$

NOTE: In computing A, use the interpolated uncorrected latitude of point whose geographic position is being computed (see table below.)

TABLE OF CURVATURE FOR 10,000 METERS

Lat.	A. meters	Lat.	A. meters	Lat.	A. meters	Lat.	A. meters
25°	3.65	31°	4.71	37°	5.90	43°	7.30
26°	3.82	32°	4.90	38°	6.12	44°	7.56
27°	3.99	33°	5.09	39°	6.34	45°	7.83
28°	4.16	34°	5.28	40°	6.57	46°	8.10
29°	4.34	35°	5.48	41°	6.80	47°	8.39
30°	4.52	36°	5.69	42°	7.05	48°	8.69

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

JULY 23, 2004

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Allen L. Taylor
Acting Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Potential Revision of Projection Ticks on Source Diagrams for Nautical Charts Converted to International Borders/Neatlines

Cartographers are reminded that a revision to the projection interval of any chart may require a corresponding revision to a charted Source Diagram.

Specifications for converting Marine Chart Division nautical charts to International Hydrographic Office borders/neatlines are contained in Cartographic Order 005/04 (dated June 14, 2004), SUBJECT: IHO/NOS International Border/Neatline Specifications.

A relationship exists between the projection interval of the chart and the graduation ticks displayed on the charted Source Diagram. Projection intervals (expressed in seconds) on some insets and extensions may have to be revised to conform to the IHO interval (a multiple of six seconds). Specifications for Source Diagrams are contained in the Nautical Chart Manual, Section 4.2.2, Pages 4-19 through 4-24. The following excerpts have been extracted with pertinent information highlighted for emphasis.

> "Projection ticks 2.0 mm in length, 0.15 mm line weight, shall be shown along the inside border and labeled in 6 pt. Swiss Light. The intervals of these ticks shall be such that **each projection line on the base chart is represented by a tick on the diagram."** and ...
>
> **"Procedures for adding graduation ticks and values to insets and extensions are the same as for the base diagram."**

No change pages to the Nautical Chart Manual are required.

Please file with Nautical Chart Manual, Volume 1, Part 1, Section 2.9.5, Projection Specifications.

NATIONAL OCEAN SERVICE
Office of Coast Survey
Marine Chart Division

CARTOGRAPHIC ORDER 005/04 June 14, 2004

FILE WITH NAUTICAL CHART MANUAL, VOLUME 1, PART 1, SECTION 2.9.5

TO: All Cartographers
Marine Chart Division

SUBJECT: IHO/NOS International Border/Neatline Specifications

APPLICATION: All Affected Nautical Charts

Effective immediately, the attachment replaces pages 2-47 through 2-56.6 and adds pages 2-56.7 through 2-56.66 to the Nautical Chart Manual, Volume1, Part 1, Seventh (1992) Edition.

The attachment:

1. provides the Marine Chart Division's comprehensive documentation and specifications for the application of the International Hydrographic Organization's international border (and neatline) to Marine Chart Division nautical charts,

2. represents specifications adapted from the official IHO publications [i.e., INT2 - Borders, Graduation, Grids and Linear Scales, Edition 1990; and M - 4 (Regulations of the IHO for International Charts and Chart Specifications of the IHO), Edition 1988], and

3. represents specifications developed by the Quality Assurance, Plans and Standards Branch (QAPSB) of relevant items left to the discretion of each individual Hydrographic office (e.g., type font and size, minor subdivision unit to be indicated, etc.).

NOTE: Specifications provided for the application of the international format to existing charts (i.e., New Editions) will vary from the specifications which are provided for the application of the international format to New and Reconstructed MCD charts. [See Section 2.10.1.2(A)]

Implementation Procedures:

- All **New** and **Reconstructed** charts **shall** conform to the international specifications provided in the attached documentation.

- **Existing** charts (i.e., **New Editions**) shall be converted to the international specifications **ONLY on specific direction and authorization** by the Chief, Marine Chart Division.

Pages 2-47 through 2-56.66 of the attachment are to be inserted into the Nautical Chart Manual, Volume1, Part 1, Seventh (1992) Edition, immediately after page 2-46.

This cartographic order supersedes Cartographic Order 028/00 dated July 27, 2000 - SUBJECT: Selective Implementation of International Hydrographic Office Border/Neatline Subdivision Specifications.

Attachment

James C. Gardner
Captain, NOAA
Chief, Marine Chart Division

2.9.5 Projection Specifications

2.9.5.1 Map Projections

Definition: **Map Projection.** A systematic drawing of lines on a plane surface to represent the parallels of latitude and the meridians of longitude of the earth or a section of the earth. A map projection may be established by analytical computation or may be constructed geometrically. [1]

Definition: **Graticule.** The network of lines representing meridians and parallels on a map, chart or plotting sheet. [1]

Projection lines are full lines extending from neatline to neatline. Projection lines shall be shown as continuous lines except where legibility is excessively impaired. Projection lines shall **ONLY** be deleted for large items such as the chart title, notes, bar scales, and a "1" sounding or other single-line features when aligned with the projection. Every effort shall be made to preserve the projection intersections that bound charted features.

The scale of a chart constructed on a Mercator projection is based on a parallel of latitude usually at or near the center of the chart. The scale of a chart constructed on a Polyconic projection is based on a central meridian of longitude.. The central parallel (latitude) or the central meridian (longitude) at which a chart is constructed is **ALWAYS** published in the title block of the base chart. Whenever a chart shall include insets or extensions, these **MUST** be constructed on the same projection and with the same central parallel (or meridian) as the base chart. This is especially important when scaling or transferring information from the base chart to the inset or extension and vice versa. Exceptions **MUST** be approved by the Chief, Quality Assurance, Plans and Standards Branch.

NOTE: Historically, the two basic projections used by NOS have been Mercator and Polyconic. Although the Mercator projection remains the primary projection used for most NOS nautical charts, those NOS nautical charts originally constructed with a Polyconic projection (i.e., Great Lake charts) are, as resources permit, currently being converted to a Mercator projection. **ALL** New and Reconstructed charts shall be constructed on a Mercator projection and therefore based on a central parallel of latitude.

To comply with International Hydrographic Organization chart specifications (see Nautical Chart Manual, Section 2.5.9, Chart Size), neatline dimensions of all New and Reconstructed Charts should not exceed 750 millimeters by 1,100 millimeters. Only in exceptional cases may these neatline dimensions be extended (i.e., to include navigationally critical features). This will enable most charts to be printed on the standard metric A0 (pronounced "A Zero") paper size of 841 millimeters by 1,189 millimeters. (See Nautical Chart Manual, Section 2.10.1.5, International Border Dimensions to obtain the specifications for charting neatline dimension values.)

2.9.5.2 Projection Line Intervals

Definition: **Interval.** The extent of difference/distance between two qualities; conditions. [42]

The interval of projection lines is always dictated by the scale of the chart, inset, extension, etc. The interval in which projection lines shall be constructed shall be based on the following National Ocean Service specifications:

Scale of Chart	Interval of Projection Lines	Scale of Chart	Interval of Projection Lines
1: 5,000	30"	1: 300,000	30'
1: 10,000	1'	1: 400,000	30'
1: 15,000	1'	1: 500,000	1°
1: 20,000	2'	1: 600,000	1°
1: 30,000	2'	1: 700,000	1°
1: 40,000	5'	1: 800,000	1°
1: 50,000	5'	1: 1,000,000	2°
1: 60,000	5'	1: 1,500,000	2°
1: 80,000	10'	1: 2,000,000	2°
1: 100,000	10'	1: 3,000,000	5°
1: 125,000	10'	1: 4,000,000	5°
1: 200,000	20'	1: 5,000,000	5°
1: 250,000	20'	1: 10,000,000	10°

Figure 2-6

The interval of graduation numbering is chosen from the sequence: 30", 1', 2', 5', 10', 20', 30', 1°, 2°, 5° and 10°. Equal intervals of subdivision, numbering and dicing are normally given for latitude and longitude. **ALL** parallels and meridians shown **SHALL** be numbered.

Intervals between projection lines should not exceed 20 centimeters nor be closer than 10 centimeters regardless of scale. The major exceptions to this policy are 1:40,000-scale small-craft charts with a 2-minute projection interval, and 1:40,000-scale and 1:80,000-scale conventional charts with 5-minute and 10-minute projection intervals, respectively. On occasion, intervals between meridians may be less than 10 centimeters in the higher latitudes where parallel and meridian intervals differ greatly. Similarly, intervals between parallels may be slightly greater than 20 centimeters so that the meridians will not be awkwardly close. This shall be individually determined either by chart series or individual chart.

Figure 2-7, which is a proximate reciprocal of Figure 2-6, shows the scale limits between which various latitude intervals fall into the 10- to 20- centimeter spacing.

PROJECTION LINE INTERVALS		
Projection Interval (Latitude)	**Limiting Scales**	
	20-cm Spacing	10-cm Spacing
15"	2,315	4,630
30"	4,630	9,260
1'	9,260	18,520
2'	18,520	37,040
5'	46,300	92,600
10'	92,600	185,200
15'	138,900	277,800
20'	185,200	370,400
30'	277,800	555,600
1°	555,600	1,111,200

Figure 2-7

2.9.5.3 Subdivision of Selected Projection Lines

General Requirements:

1. Authority.

To assist mariners in plotting positions, selected projection lines shall be subdivided and labeled on nautical chart panels specifically authorized by the Chief, Marine Chart Division. At present, skewed chart panels, small-craft charts and charts based on polyconic projections are excluded from consideration.

2. Requirements for Authorized Charts Only.

Alternating projection lines shall be subdivided along their entire lengths. The projection lines to be subdivided shall be selected in a manner that assures that a chart displays subdivisions along at least one projection line of latitude and one projection line of longitude when the chart is folded in quarters. It is preferable that the projection lines selected for subdivision not be in close proximity to the chart borders.

The selected projection lines shall be subdivided along their entire lengths at major intervals, intermediate intervals and minor intervals. The spacing of major intervals, intermediate intervals, and minor intervals is dependent on the charted projection interval and the scale of the chart panel. Subdivision intervals are specified in Figure 2-8.

(The remainder of this page is intentionally blank.)

SUBDIVISION INTERVALS

PROJECTION INTERVAL	SCALE	MAJOR INTERVAL	INTERMEDIATE INTERVAL	MINOR INTERVAL
12"	All Scales	6"	None	1"
24"	All Scales	6"	None	1"
30"	All Scales	6"	None	1"
36"	All Scales	6"	None	1"
1'	1:1 to 1:25,000	30"	6"	1"
1'	1:25,001 to 1:40,000	30"	None	6"
1'	1:40,001 and smaller	30"	None	None
2'	1:1 to 1:25,000	1'	30"	6"
2'	1:25,001 and smaller	1'	30"	6"
4'	All Scales	1'	30"	6"
5'	1:1 to 1:100,000	1'	30"	6"
5'	1:100,001 and smaller	1'	None	30"
10'	1:1 to 1:80,000	5'	1'	6"
10'	1:80,001 to 1:100,000	5'	1'	12"
10'	1:100,001 and smaller	5'	1'	30"
15'	All Scales	5'	1'	30"
20'	All Scales	10'	1'	30"
30'	All Scales	10'	5'	1'
1°	All Scales (except Chart 14500)	20'	5'	1'
1°	Chart 14500 only	10'	None	None
2°	All Scales	1°	30'	5'
5°	All Scales (except Chart 530)	1°	15'	5'
5°	Chart 530 only	1°	None	15'
10°	Chart 50 only	5°	1°	30'

Figure 2-8

Some small chart panels have existing projection lines which do not accommodate the above scheme. In such cases, the existing projection lines must be deleted and new projection lines selected to accommodate projection subdivisions based on tenths of a minute, fractions of tenths of a minute or multiples of tenths of a minute. New projection lines shall be selected only with prior approval of the Chief, Quality Assurance, Plans and Standards Branch.

To accommodate subdivision of selected projection lines, border scale graduation along the neatline must agree with Chart Specifications of the IHO, Section 200 and "International 2, Borders, Graduation, Grids and Linear Scales" (INT 2), which is an ANNEX to Chart Specifications of the IHO, Section 200.

Any chart border that is based on a subdivision scheme other than tenths of a minute (6 seconds), or multiples of tenths of a minute, must be converted before selected projection lines can be subdivided. Under no circumstances may a chart panel show a ten second border scale graduation and a six second projection line subdivision.

A sample section of a chart with selected subdivided projection lines is shown in Figure 2-9.

Line Type and Weight:

Subdivision ticks intersecting selected projection lines at major intervals, shall be charted with a solid line, 0.1 mm line weight, 4.0 mm long.

Subdivision ticks intersecting selected projection lines at intermediate intervals, shall be charted with a solid line, 0.1 mm line weight, 3.0 mm long.

Subdivision ticks intersecting selected projection lines at minor intervals, shall be charted with a solid line, 0.1mm line weight, 2.0 mm long.

Location and Orientation:

Subdivision ticks charted at major, intermediate and minor intervals, shall be charted perpendicular to the selected projection lines they intersect and shall extend on both sides of those selected projection lines.

Labels and Notes:

All subdivided projection line intersections shall be labeled in the following manner:

Latitude shall be labeled in the lower right quadrant of the intersection, aligned with the latitude projection line and shall be followed by the capital letter N or the capital letter S to denote north or south latitude.

Longitude shall be labeled in the upper left quadrant of the intersection, aligned with the longitude projection line (rotated 90 degrees from the latitude labels) and shall be followed by the capital letter W or the capital letter E to denote west or east longitude.

Projection line subdivisions shall be labeled in the following manner:

Projection line subdivision ticks for major intervals of latitude or intermediate intervals of latitude shall be labeled to the right of the tick and laterally centered on the tick. Cartographic judgement is required for selecting which major or intermediate latitude ticks shall be labeled. Depending on the number and spacing of the ticks, a particular chart panel might be most useful with all intermediate ticks labeled or just labeling the ticks marking major intervals. At least two projection line subdivision ticks need to be labeled between each set of adjacent projection lines of latitude. These values shall be oriented with the latitude projection lines.

Projection line subdivision ticks for major intervals of longitude or intermediate intervals of longitude shall be labeled directly above the tick and centered on the tick. Cartographic judgement is required for selecting which major or intermediate longitude ticks shall be labeled. Depending on the number and spacing of the ticks, a particular chart panel might be most useful with all intermediate ticks labeled or just labeling the ticks marking major intervals. At least two projection line subdivision ticks need to be labeled between each set of adjacent projection lines of longitude. These values shall be oriented with the longitude projection lines, rotated 90 degrees from the latitude labels.

Projection line subdivision ticks at minor intervals shall not be labeled.

All subdivided projection line intersection labels and projection subdivision tick labels shall be 8 point Swiss Bold type.

Labels shall be placed three (3) millimeters from and centered with the ticks.

Judgment must be used when adhering to the above labeling conventions. Under no circumstances may projection labeling be allowed to interfere with important charted detail such as dangers, shoal soundings or aids to navigation.

Color and Screening:

Ticks subdividing projection lines and all associated labeling shall be charted in black.

SAMPLE PROJECTION LINE SUBDIVISION

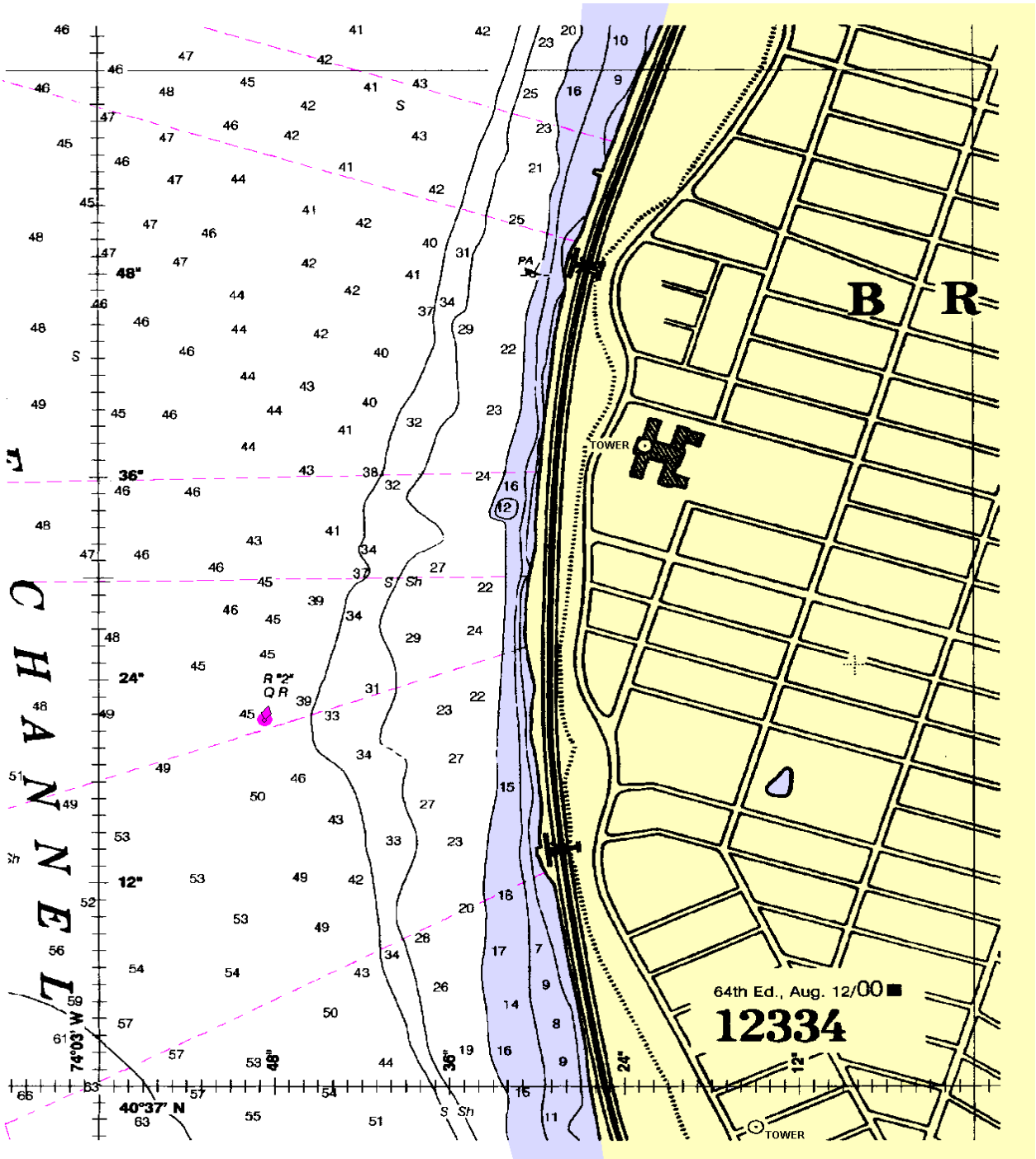


Figure 2-9

2.10 Chart Scales

Nautical charts have a variety of scales used for plotting, scaling and conversions. The style, placement and selection of the scales will vary from chart to chart depending on the type of chart, area of coverage and primary chart user. The following guidelines/specifications should be used in selecting the proper scale and format for each chart.

2.10.1 Border Scales

Four basic styles of border scales are currently in use on National Ocean Service charts. They are the standard Coast Survey chart border, the Great Lakes chart border, the small-craft chart border and the international chart border. A number of variations to these styles have also come into use over the years.

To comply with the specifications published in Section 200 of the International Hydrographic Organization Chart Specifications, and its ANNEX– INT 2, "Borders, Graduation, Grids and Linear Scales", National Ocean Service charts shall now have the international style border and graduation pattern. Specific guidelines for applying the international specifications to NOS charts are provided in Sections 2.10.1.5 through 2.10.1.12.

The guidelines provided have been adapted from the official specifications published by the International Hydrographic Organization, and include those specifications, developed by the Quality Assurance, Plans and Standards Branch, of relevant items left to the discretion of each individual Hydrographic office (e.g., type font and size; minor subdivision unit to be indicated, etc.).

> The specifications developed by the Quality Assurance, Plans and Standards Branch are not enumerated as such. For this reason, the Nautical Chart Manual shall be used as the authoritative source for border specifications.

Definition: **Chart Border.** A line which serves as an enclosing boundary and which encompasses the neatline and graphic area of a nautical chart. [10] See Figures 2-11 and 2-12 for examples.

Definition: **Graduation.** The division and subdivision of latitude and longitude shown in the borders of a chart at the outside of the neatline. [17]

Definition: **Neatline.** Line separating the body of a chart from the chart border. [17]

2.10.1.1 Plan Borders and Scale Borders

International borders consist of two mutually exclusive styles (or types) and **are based on the scale of the chart.** These two styles are: plan and scale.

Definition: **Plan Border.** The type of border used by a large scale map or chart of a small area. NOS charts having a chart scale larger than 1:50,001 shall have plan borders. [1] (See Figure 2-11)

Definition: **Scale Border.** The type of border used by a small scale map or chart of a large area. NOS charts having a chart scale of 1:50,001 and smaller shall have a scale border. [1] (See Figure 2-12)

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2.10.1.2 Implementation of the IHO Chart Specifications for Borders

Due to a number of factors, the implementation of IHO chart specifications for borders is not currently applicable to all NOS charts. The following paragraphs delineate these factors (with respect to currently charted border styles) and enumerate the applicability of IHO border and graduation specifications.

Specific guidelines for applying the international specifications to NOS charts are provided in Sections 2.10.1.5 through 2.10.1.12.

NOS implementation of the IHO specifications for borders and graduation will:

(1) Standardize most MCD nautical chart borders with the IHO specifications, (NOTE: Small-craft charts and charts having a skewed or Polyconic projection shall not be revised),

(2) Provide continuous graduation and labeling along neatlines, and

(3) Revise the graduation units to a system based on one-tenth of a minute (6 seconds).

The following four sections differentiate implementation requirements/considerations for **ALL** National Ocean Service chart products.

A. Existing NOS Conventional Charts

In order to obtain uniformity and compatibility between charts printed by different nations, the IHO recommends the use of a standard metric A0 (pronounced "A Zero") paper size, defined as having dimensions of 841 millimeters x 1,189 millimeters (33.1 inches x 46.81 inches) and an internationally accepted maximum chart neatline size of 750 millimeters x 1,100 millimeters. Many existing NOS charts have neatline sizes larger than this desired maximum size. To comply with the IHO size requirements, many existing NOS charts would require changes in chart scale or limits.

In addition, many NOS margin/border notes were placed based on distances from the traditional borders. To comply with the IHO size requirements, many existing borders would have to be extended, and, although there is no mandatory requirement that all charts fit A0 neatline or paper size, the extension of many NOS borders would exceed NOS maximum paper size requirements (i.e., 42.5 inches by 59.875 inches).

Therefore, taking into consideration practical production factors including paper sizes, margin/border note recollection, and Print-on-Demand requirements, the standardization of existing NOS conventional chart neatlines and borders **shall only involve the revision of the existing graduation to the appropriate international style graduation pattern specified for the particular chart scale** (see Section 2.10.1.8); **and the deletion of the 0.1mm inner border line**. (See Figure 2-10)

The 1.5 millimeter black border on an existing NOS conventional chart border **shall not be shifted or moved** from its current location **nor shall it be revised from its current line weight** of 1.5 millimeters to the IHO specified width of 1.0 millimeter.

Existing inner borders (see Figure 2-10) shall be deleted from **ALL** conventional charts.

See Nautical Chart Manual, Section 2.10.1.5 for the dimensions and graphic representations of the conversion of existing NOS conventional charts to IHO specifications.

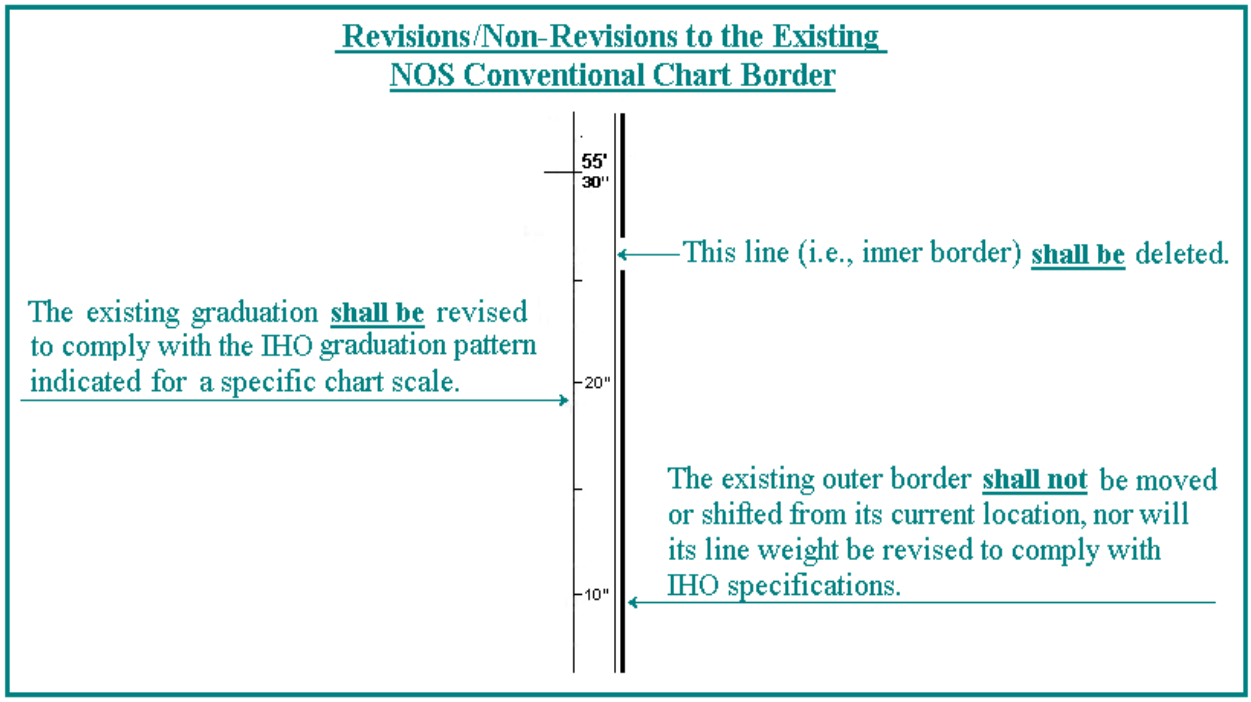

Figure 2-10

B. Polyconic Charts, Small-Craft Charts and Charts with a Skewed Projection

Polyconic charts, small-craft charts and charts having a skewed projection shall **NOT** be converted to the IHO format. It shall be the responsibility of the Chief, Marine Chart Division, to determine the feasibility of re-formatting or reconstructing charts in these categories, to comply with established IHO specifications.

C. Nautical Charts Previously Constructed with International Style Chart Borders

Nautical charts previously constructed with international style chart borders shall be re-evaluated for specific compliance to the IHO/NOS border/neatline specifications provided in the following Nautical Chart Manual, Sections 2.10.1.5 through 2.10.1.12. Included in these sections are those specifications, developed by the Quality Assurance, Plans and Standards Branch, of relevant items left to the discretion of each individual Hydrographic Office. Because these specifications may or may not affect currently charted international borders, compliance to the provided specifications will have to be assessed on a chart by chart basis.

D. Non-Standard Variations in Border Styles

Any existing nautical chart that does not conform to one of the basic border styles or which can not be converted to the IHO/NOS specifications provided in Nautical Chart Manual, Sections 2.10.1.5 through 2.10.1.12 shall be referred to the Chief, Quality Assurance, Plans and Standards Branch for evaluation.

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2.10.1.3 International Border Component Identification

The purpose of this section is to identify the component parts of international style borders. Each graphic example provided shall apply to the specific chart classification(s), chart printing(s) and chart scale(s) indicated in the associated table. [NOTE: Graphic examples are not shown to scale and have been enlarged for illustrative purposes. Graphic lines and labels indicated in black represent information as it shall be printed on the nautical chart. Lines, labels and arrows indicated in green are not to be printed on the nautical chart and are only being provided as descriptive elements.]

Cross-references to International 2 (INT 2), "Borders, Graduation, Grids and Linear Scales", have also been provided and are indicated in Figure 2-64 in the following parallel format: (T)

Note: There are *two* International Border Component Identification Figures. Figure 2-11 delineates the IHO PLAN Border and Figure 2-12, the IHO SCALE Border.

Definitions:

Chart Classification. The three categories of charts produced by NOS (i.e., conventional, small-craft and marine facility). (See Nautical Chart Manual, Section 1.3, Chart Classification)

Chart Printing. Chart production terminology indicating the type of chart edition to be published. The primary types of chart printings are a New Edition (i.e., existing chart), a Reconstructed Chart or a New Chart. (See Nautical Chart Manual, Section 1.4, Chart Production Terminology)

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Component Identification: International PLAN Border	
Chart Classifications Affected:	Conventional
Chart Printings Affected:	New Editions, Reconstructed Charts, New Charts
Charts Scales Affected:	Larger than 1:50,001

- Corresponding border dimensions are provided in Figures 2-15 and 2-17.

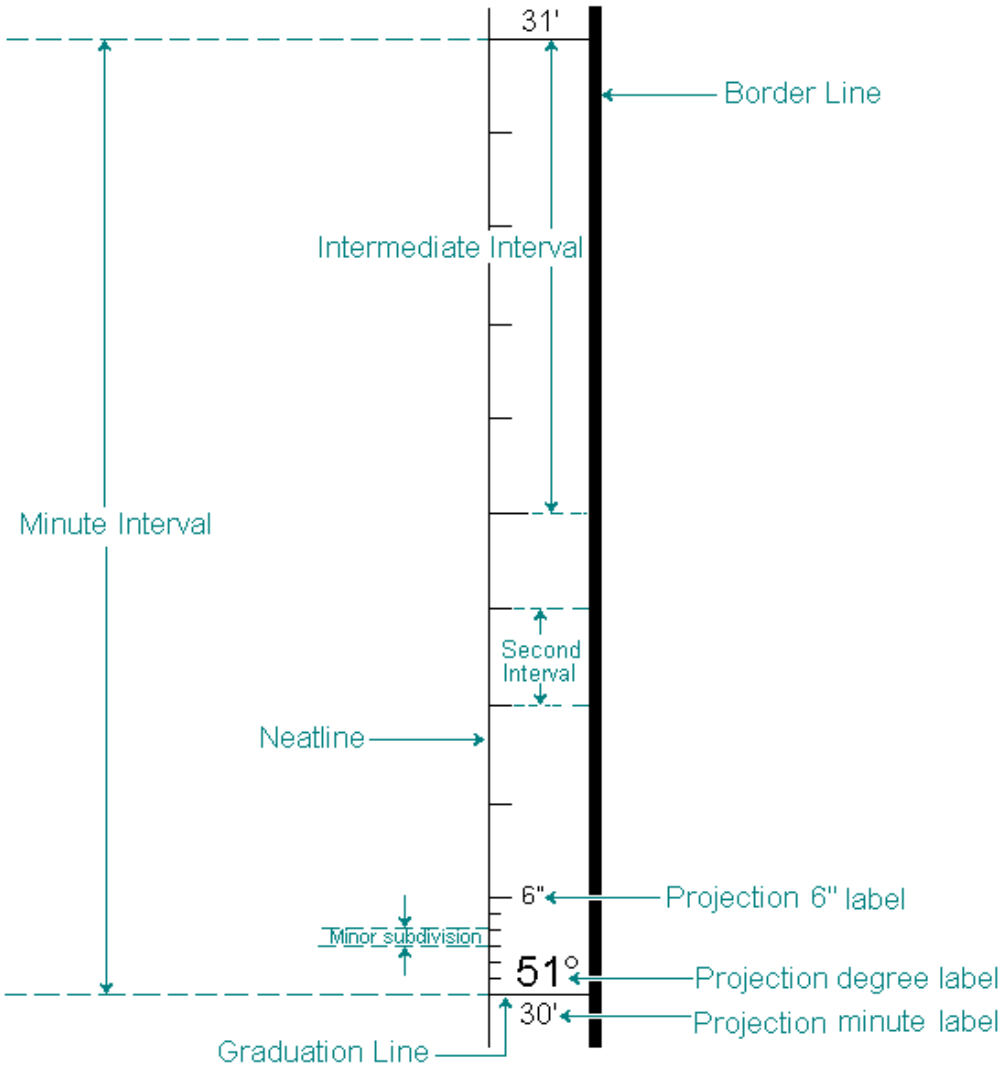

Figure 2-11

Component Identification: International SCALE Border	
Chart Classifications Affected:	Conventional
Chart Printings Affected:	New Editions, Reconstructed Charts, New Charts
Charts Scales Affected:	1:50,001 and smaller

- **ALL** corners for SCALE borders shall be mitred.
- Corresponding border dimensions are provided in Figures 2-16 and 2-18.

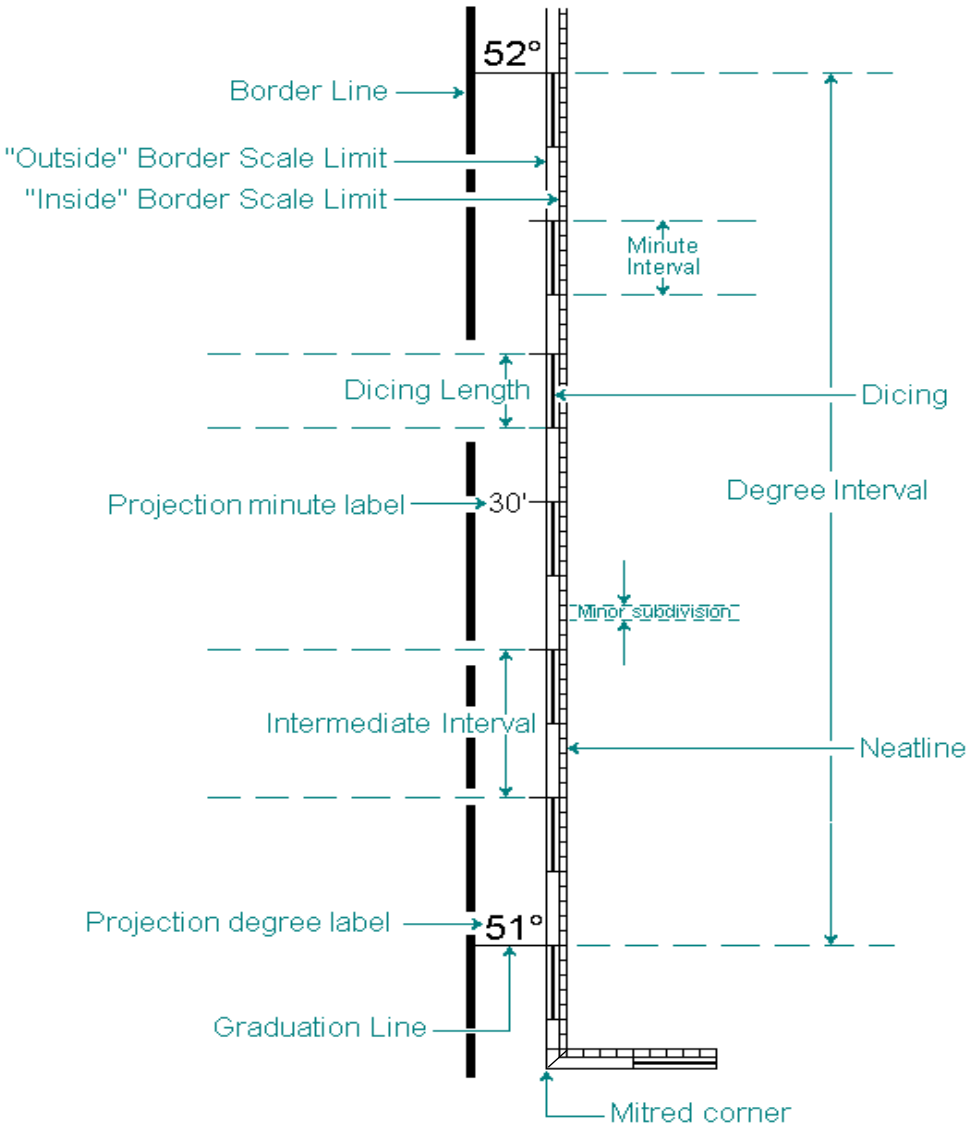

Figure 2-12

2.10.1.4 Table of Contents, Compilation Flow Chart and Figure Index

Due to the complexity and volume of the extraordinarily detailed information provided on the following pages, a Table of Contents, Compilation Flow Chart and a Figure Index, having the below listed objectives, are being provided.

A. Objectives:

1. To aid in the identification of the IHO/NOS components and border dimensions required for a specific chart scale,

2. To aid in the identification of the IHO/NOS border dimensions required for a New Edition of an NOS conventional nautical chart,

3. To aid in the identification of the IHO/NOS border dimensions required for a Reconstruction and a New Chart,

4. To aid in the identification of the IHO/NOS graduation pattern required for a specific chart scale, and

5. To aid in the identification of specific graduation pattern diagrams and nautical chart examples.

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CONSTRUCTION OF INTERNATIONAL BORDERS
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2.10.1.5 International Border Dimensions . . . . . .

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2.10.1.11 (H)(1.) Dimensions, Line and Type Specifications

2.10.1.12 IHO Adjacent Borders: Dimensions, Line and Type Specifications (Conventional Charts Only) . . . . . .

2.10.1.13 Figure Cross-Reference to International 2 (INT 2) "Borders, Graduation, Grids and Linear Scales" . . .

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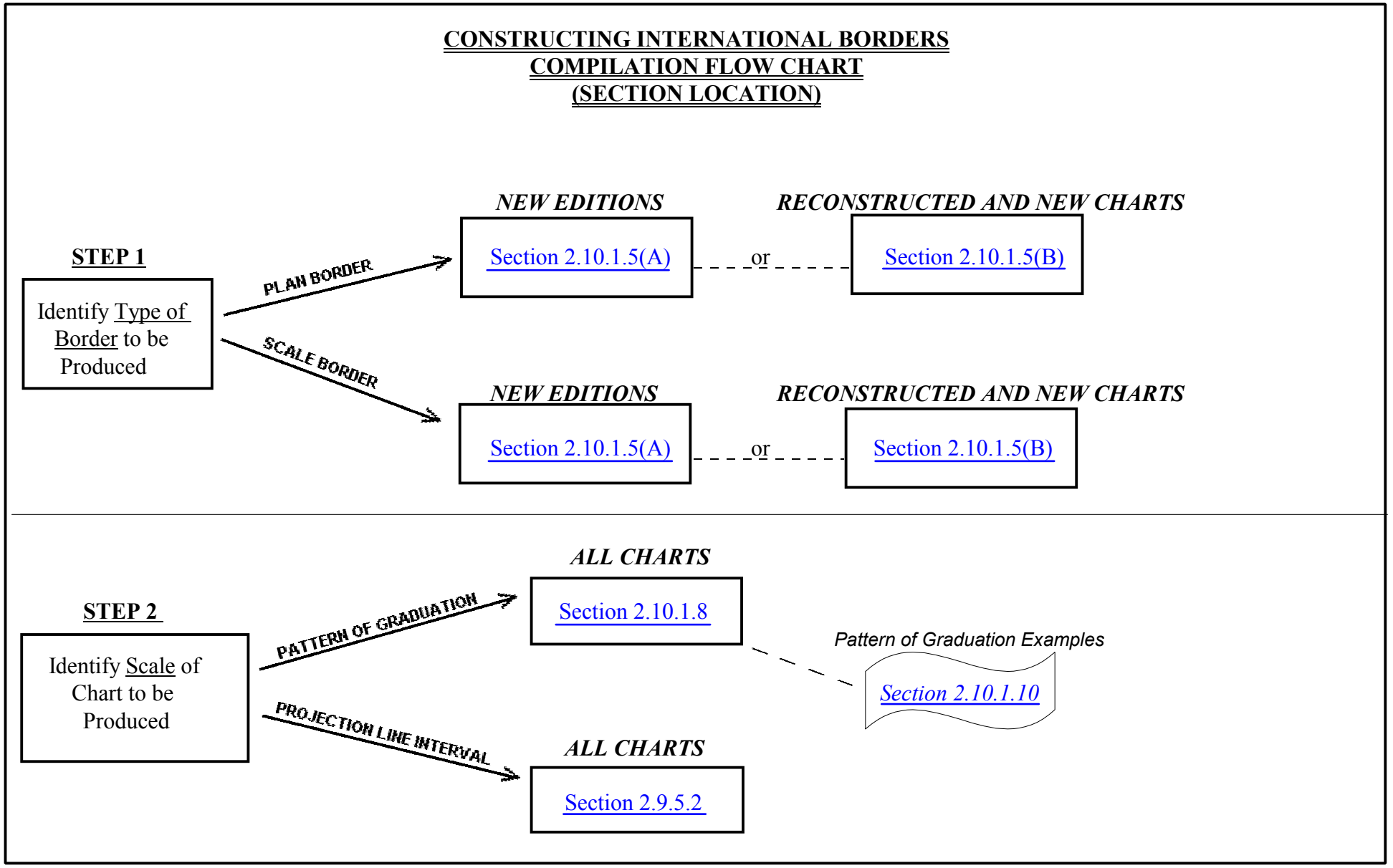
CONSTRUCTING INTERNATIONAL BORDERS
COMPILATION FLOW CHART
(SECTION LOCATION)
STEP 1
Identify Type of Border to be Produced
PLAN BORDER
SCALE BORDER
NEW EDITIONS
RECONSTRUCTED AND NEW CHARTS
Section 2.10.1.5(A)
or
Section 2.10.1.5(B)
NEW EDITIONS
RECONSTRUCTED AND NEW CHARTS
Section 2.10.1.5(A)
or
Section 2.10.1.5(B)
STEP 2
Identify Scale of Chart to be Produced
PATTERN OF GRADUATION
PROJECTION LINE INTERVAL
ALL CHARTS
Section 2.10.1.8
Pattern of Graduation Examples
Section 2.10.1.10
ALL CHARTS
Section 2.9.5.2

Figure 2-13

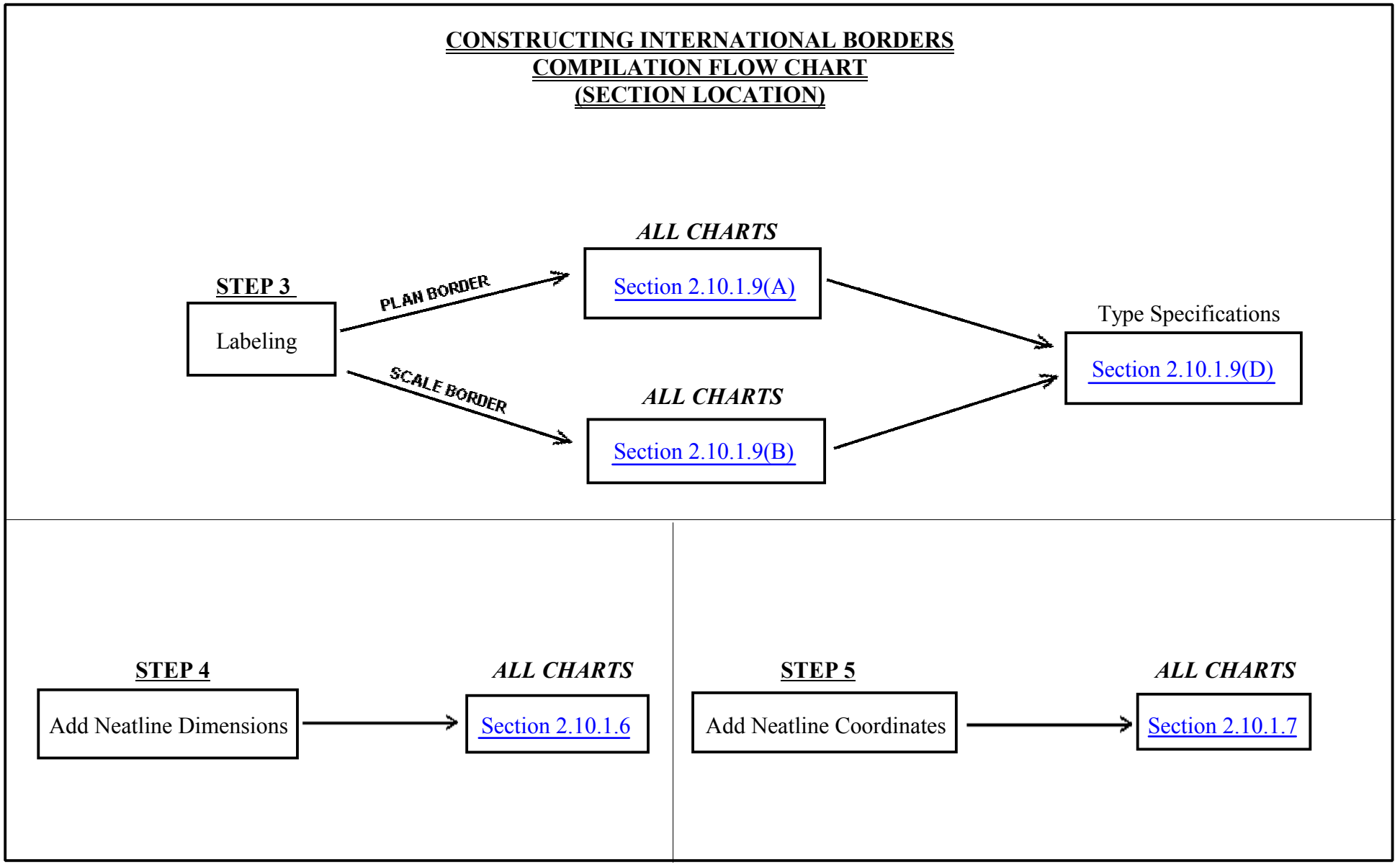
CONSTRUCTING INTERNATIONAL BORDERS
COMPILATION FLOW CHART
(SECTION LOCATION)
STEP 3
Labeling
PLAN BORDER
SCALE BORDER
ALL CHARTS
Section 2.10.1.9(A)
ALL CHARTS
Section 2.10.1.9(B)
Type Specifications
Section 2.10.1.9(D)
STEP 4
Add Neatline Dimensions
ALL CHARTS
Section 2.10.1.6
STEP 5
Add Neatline Coordinates
ALL CHARTS
Section 2.10.1.7

Figure 2-14

IHO/NOS Border Dimensions and Graduation Patterns Figures Index

IHO/NOS Border Dimensions
(Section 2.10.1.5)

New Editions	
Scale of Chart	**Figure Number**
Larger than 1:50,001	2-15
1:50,001 and smaller	2-16

Reconstructed and New Charts	
Scale of Chart	**Figure Number**
Larger than 1:50,001	2-17
1:50,001 and smaller	2-18

IHO/NOS Pattern of Graduation Diagrams
(Section 2.10.1.8)

Scale of Chart	Figure Number
Larger than 1: 5,001	2-22
1: 5,001 **to** Larger than 1: 50,001	2-23
1:50,001 **to** Larger than 1:100,001	2-24
1:100,001 **to** Larger than 1:200,001	2-25
1:200,001 **to** Larger than 1:500,001	2-26
1:500,001 **to** Larger than 1:1,500,001	2-27
1:1,500,001 **to** Larger than 1:2,250,001	2-28
1:2,250,001 **to** Larger than 1:4,750,001	2-29
1:10,000,000	2-30

IHO/NOS Pattern of Graduation - Chart Examples
(Section 2.10.1.10)

Scale of Chart	Figure Number	Example ID
Larger than 1:5,001	2-42	**1**
1: 5,001 **to** Larger than 1: 50,001	2-43	**2**
1:50,001 **to** Larger than 1:100,001	2-44	**3**
1:100,001 **to** Larger than 1:200,001	2-45	**4**
1:200,001 **to** Larger than 1:500,001	2-46	**5**
1:500,001 **to** Larger than 1:1,500,001	2-47	**6**
1:1,500,001 **to** Larger than 1:2,250,001	2-48	**7**
1:2,250,001 **to** Larger than 1:4,750,001	2-49	**8**
1:10,000,000	2-50	**9**

Other IHO/NOS Border Specifications Figures

Topic	Section Number	Figure Number
(IHO) Adjacent Borders: Dimensions, Line and Type Specifications (Conventional Charts Only)	2.10.1.12	2-59 through 2-63
Charting of Neatline Dimensions	2.10.1.6	2-19
Charting of Neatline Coordinates	2.10.1.7	2-20
Component Identification: International PLAN Border	2.10.1.3	2-11
Component Identification: International SCALE Border	2.10.1.3	2-12
Figure Cross-Reference to International 2 (INT 2) - "Borders, Graduation, Grids and Linear Scales"	2.10.1.13	2-64
Flow Chart (Constructing International Borders)	2.10.1.4	2-13 and 2-14
Insets Placed within a PLAN Border	2.10.1.11 (G)(1.)	2-52 through 2-54
Insets Placed within a SCALE Border	2.10.1.11 (H)(1.)	2-55 through 2-58
Inset Placement Near a Corner of the Main Panel	2.10.1.11 (A)(2.)	2-51
Interval of Projection Lines *(Indicates the interval in which projection lines on NOS nautical charts shall be constructed.)*	2.9.5.2	2-6
Labeling: Interval of Label Placement	2.10.1.9	2-41
Labeling: PLAN Borders	2.10.1.9 (A)	2-31 through 2-34
Labeling: SCALE Borders	2.10.1.9 (B)	2-35 through 2-39
Labeling: Type Specifications	2.10.1.9 (D)	2-40
Projection Line Intervals (*Demonstrates scale limits between which various latitude intervals fall into the 10- to 20- centimeter spacing)*	2.9.5.2	2-7
Revisions/Non-Revisions to the Existing NOS Conventional Chart Border	2.10.1.2 (A)	2-10
Subdivision Intervals	2.9.5.3	2-8

2.10.1.5 International Border Dimensions

A. New Editions (of Conventional Charts)

The dimensions of existing NOS conventional chart borders shall be revised to agree with the values provided in Figures 2-15 and 2-16. Figure 2-15 represents the dimensions for a PLAN border and Figure 2-16, a border requiring the SCALE format.

NOTE: The outer limit of the border on existing NOS conventional charts **shall not be moved** from its current location, **nor shall its line weight be revised**.

Although the specifications for independent components are also provided in Figures 2-15 and 2-16, from a practical perspective, **ALL** line weights shall be 0.1 millimeters, with the exception of the Border (1.5mm) and, when applicable, dicing (0.2mm).

Corresponding component identification graphics for a PLAN border and a SCALE border are provided in Figures 2-11 and 2-12, respectively.

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International PLAN Border Dimensions
(For New Editions of Conventional Charts - scales larger than 1: 50,001)

Component	Line Weight	Length	Distance between
(a.) Border Line [Go There]	1.5mm		
(b.) Graduation Line [Go There]	0.1mm	* 9.0mm	
(c.) Distance between border and neatline			* 9.0mm
(d.) Intermediate Interval Tick [Go There]	0.1mm	** 3.0mm	
(e.) Second Interval Tick [Go There]	0.1mm	** 1.5mm	
(f.) Minor Subdivision Tick [Go There]	0.1mm	** 0.8mm	
(g.) Neatline [Go There]	0.1 mm		

Values highlighted in yellow represent the only variations between the comprehensive IHO dimensions and NOS specifications for New Editions of conventional nautical charts.

* *Length of line or distance, as measured from center of border line to center of neatline.*

** *Length of line, as measured from outer edge of tick to center of neatline.*

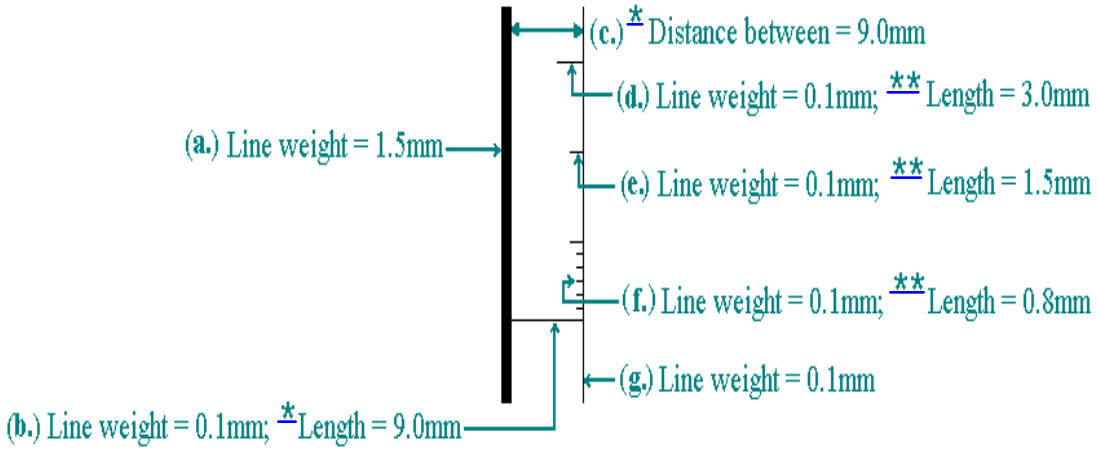

Figure 2-15

International SCALE Border Dimensions
(For New Editions of Conventional Charts - scales 1:50,001 and smaller)

Component	Line Weight	Length	Distance between
(a.) Border Line [Go There]	1.5mm		
(b.) Distance between border and neatline [Go There]			* 9.0mm
(c.) Graduation Line [Go There]	0.1mm	** 7.0mm	
(d.) Minor Subdivision Tick [Go There]	0.1 mm	*** 0.8mm	
(e.) Intermediate Interval Tick [Go There]	0.1mm	+ 1.5mm	
(f.) Distance between neatline and limit of border scales			++ 2.0mm
(g.) Distance between neatline and limit of border scales			++ 0.8mm
(h.) Dicing [Go There]	0.2mm		
(i.) Minute Interval Tick [Go There]	0.1mm	+++ 2.0mm	
(j.) Neatline [Go There]	0.1mm		
(k.) "Inside" border scale limit [Go There]	0.1mm		
(l.) "Outside" border scale limit [Go There]	0.1mm		

Values highlighted in yellow represent the only variations between the comprehensive IHO dimensions and NOS specifications for New Editions of conventional nautical charts.

* *Distance, as measured from center of border line to center of neatline.*

** *Length of line, as measured from center of border line to center of "outside" border scale limit.*

*** *Length of line, as measured from center of "inside" border scale limit to center of neatline.*

\+ *Length of line, as measured from outer edge of tick to center of "outside" border scale limit.*

++ *Distance, as measured from center of border scale limit to center of neatline.*

+++ *Length of line, as measured from center of "outside" border scale limit to center of neatline.*

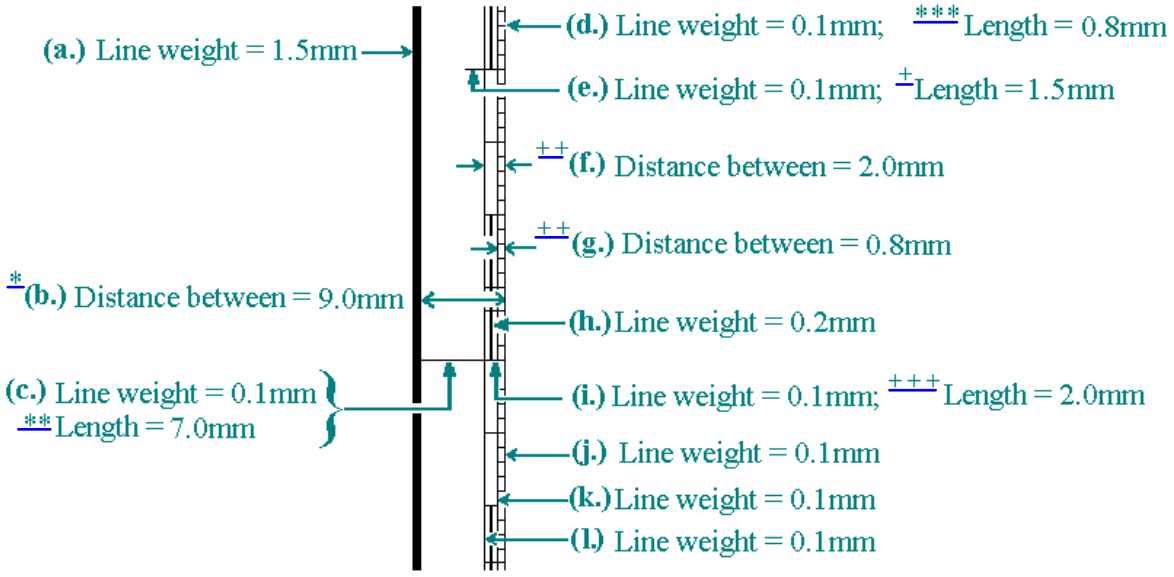

Figure 2-16

B. **RECONSTRUCTED** and **NEW** Conventional Charts

The borders on all Reconstructed and New NOS conventional charts shall be constructed based on the following IHO specified dimensions. PLAN borders shall be used for chart scales larger than 1:50,001 (Figure 2-17); SCALE borders shall be used for chart scales 1:50,001 and smaller (Figure 2-18).

International PLAN Border Dimensions
(For Reconstructed and New Charts - scales larger than 1:50,001)

Component	Line Weight	Length	Distance between
(a.) Border Line [Go There]	1.0mm		
(b.) Graduation Line [Go There]	0.1mm	* 11.5mm	
(c.) Distance between border and neatline			* 11.5mm
(d.) Intermediate Interval Tick [Go There]	0.1mm	** 3.0mm	
(e.) Second Interval Tick [Go There]	0.1mm	** 1.5mm	
(f.) Minor Subdivision Tick [Go There]	0.1mm	** 0.8mm	
(g.) Neatline [Go There]	0.1mm		

* *Length of line or distance, as measured from center of border line to center of neatline.*

** *Length of line, as measured from outer edge of tick to center of neatline.*

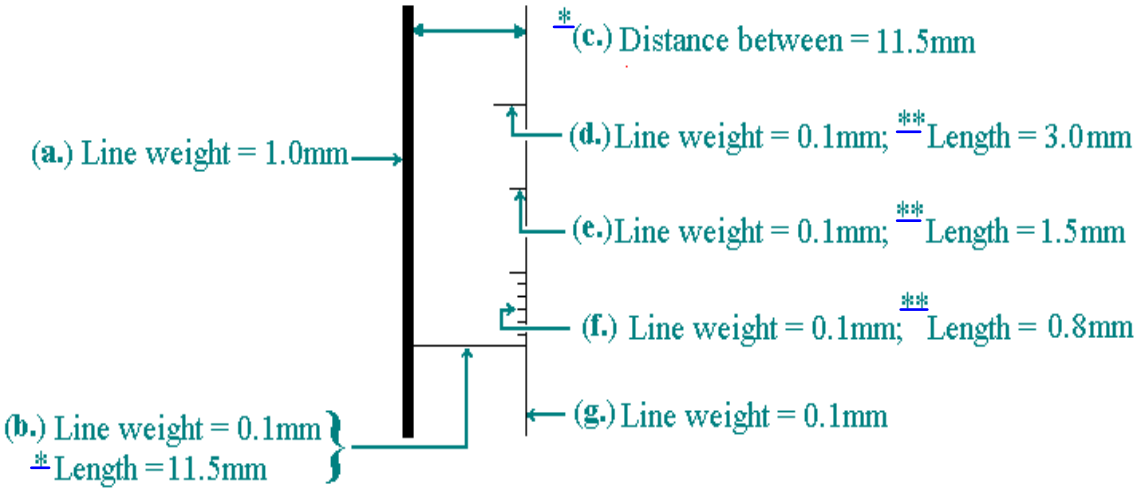

Figure 2-17

International SCALE Border Dimensions
(For Reconstructed and New Charts - scales 1:50,001 and smaller)

Component	Line Weight	Length	Distance between
(a.) Border Line [Go There]	1.0mm		
(b.) Distance between border and neatline [Go There]			* 11.5mm
(c.) Graduation Line [Go There]	0.1mm	** 9.5mm	
(d.) Minor Subdivision Tick [Go There]	0.1mm	*** 0.8mm	
(e.) Intermediate Interval Tick [Go There]	0.1mm	+ 1.5mm	
(f.) Distance between "outside" border scale limit and neatline [Go There]			++ 2.0mm
(g.) Distance between "inside" border scale limit and neatline [Go There]			++ 0.8mm
(h.) Dicing [Go There]	0.2mm		
(i.) Neatline [Go There]	0.1mm		
(j.) "Inside" border scale limit [Go There]	0.1mm		
(k.) "Outside" border scale limit [Go There]	0.1mm		
(l.) Minute Interval Tick [Go There]	0.1mm	+++ 2.0mm	

* *Distance, as measured from center of border line to center of neatline.*
** *Length of line, as measured from center of border line to center of "outside" border scale limit.*
*** *Length of line, as measured from center of "inside" border scale limit to center of neatline.*
\+ *Length of line, as measured from outer edge of tick to center of "outside" border scale limit.*
++ *Distance, as measured from center of "inside" border scale limit to center of neatline.*
+++ *Length of line, as measured from center of "outside" border scale limit to center of neatline.*

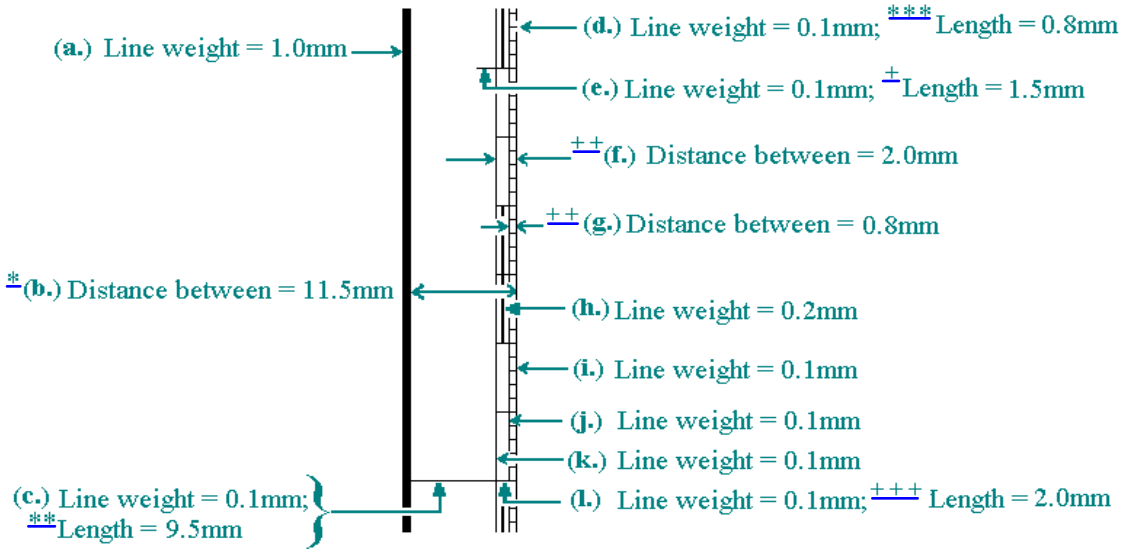

Figure 2-18

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

JUNE 15, 2004

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Allen L. Taylor
Acting Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: IHO/NOS International Border/Neatline Specifications - Replacement Pages

Effective immediately, the following attachment replaces pages **2-56.21** and **2-56.22**; **2-56.51** and **2-56.52**; **2-56.53** and **2-56.54**; **2-56.57** and **2-56.58**.

The attachment revises the following items:

1. Page 2-56.21, Item (A)(5): The neatline dimensions shall **NOT** be enclosed by parenthesis.

2. Page 2-56.52, Figure 2-51: Item **a.** has been revised from **2.0mm** to **2.4mm**.

3. Page 2-56.54, Figure 2-52: The distance specification for items **e.** and **i.** has been revised from **2.0mm** to **2.4mm**.

4. Page 2-56.57, Figure 2-55: The distance specification for items **e.** and **i.** has been revised from **2.0mm** to **2.4mm**.

2.10.1.6 Charting of Neatline Dimensions

The international chart border scheme shall include the charting of the neatline dimension values. However, neatline dimensions shall **not** be charted for insets. (NOTE: Neatline dimensions do not include detail extending beyond the neatline.)

A. Composition of Neatline Dimension Values

1. The north-south dimension shall **ALWAYS** be expressed first.
2. All values shall be expressed in millimeters to one decimal place (e.g., 980.5 X 650.5 mm). Values beyond one decimal place shall be truncated. Values calculated as whole numbers shall also be expressed to one decimal place (e.g., 860 millimeters shall be charted as 860.0).
3. The two component values shall be separated by the function symbol (Capital X).
4. The unit label for millimeters (i.e., mm) shall be placed after the last numeric value only, and shall not be followed by a period.
5. The neatline dimension values shall not be enclosed by parentheses.

B. Location of Neatline Dimension Values

(NOTE: Neatline dimensions shall not be shown for insets.)

Neatline Dimension Values shall be:

1. Located within the chart border.
2. Placed **ONLY** in the lower right-hand corner of the border.
3. Centered vertically between the outside edge of the neatline and the inside edge of the border line for a PLAN border; centered vertically between the outside edge of the graduation pattern and the inside edge of the border line for a SCALE border.
4. Located horizontally:
   a. PLAN Border - Right justified to the outside edge of the *conceivable* extension of the y-axis. See Figure 2-19, A.
   b. SCALE Border - Right justified to the outside edge of the y-axis formed by the *conceivable* extension of the outside edge of the graduation pattern. See Figure 2-19, B.

c. Alternate Preference - The first available lateral space between the longitudinal labels. See Figures 2-19, C.

C. Label Specifications for Neatline Dimension Values

1. A neatline dimension value shall be charted in black 5 point Swiss Light Vertical type.

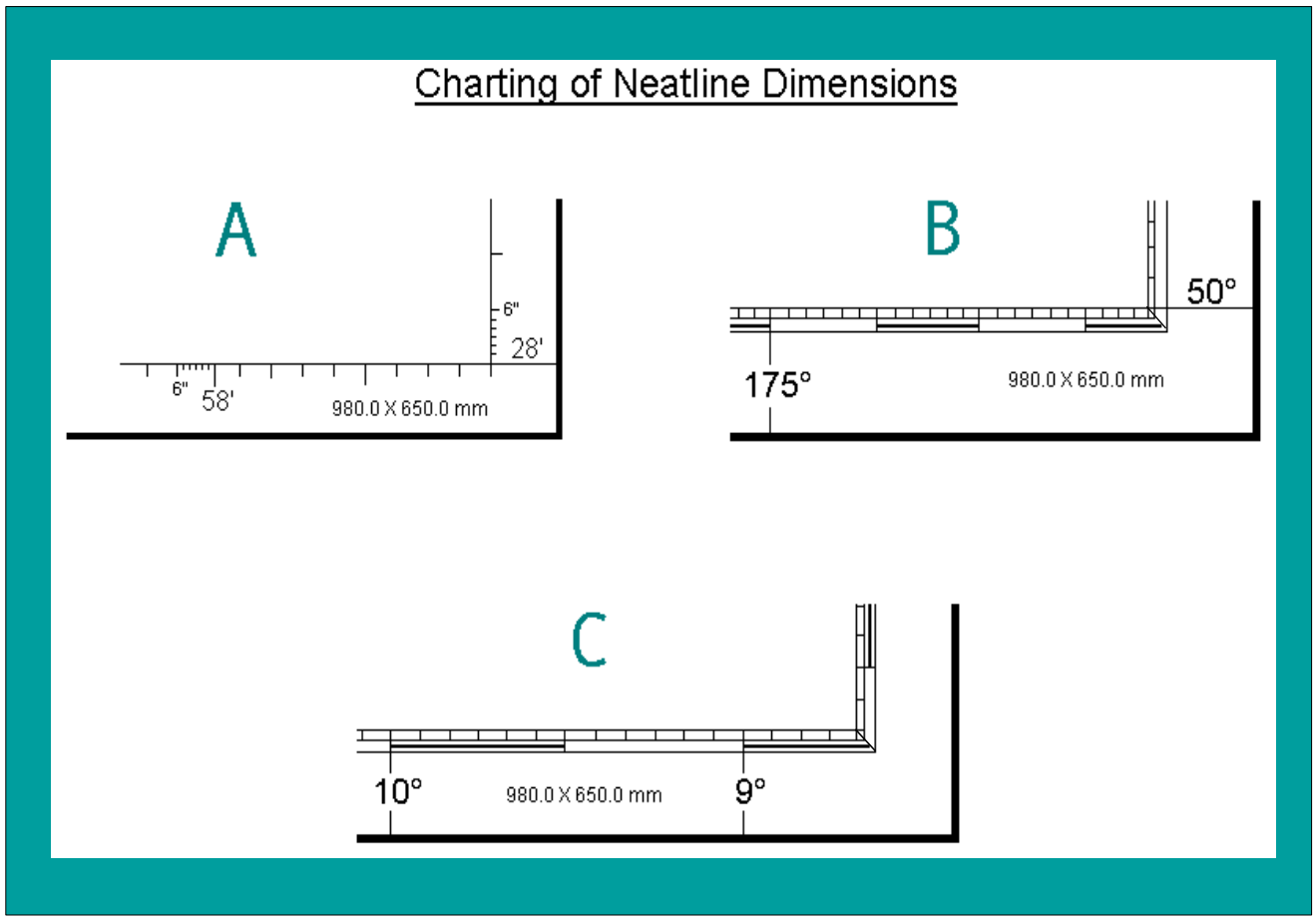

Figure 2-19

2.10.1.7 Charting of Neatline Coordinates

The international chart border scheme shall include the charting of the neatline coordinates. Neatline coordinates, unlike neatline dimension values, shall be charted on **ALL** chart panels (i.e., KAPPS).

A. Composition of Neatline Coordinates

1. Neatline coordinates shall represent the geographic position of the neatline corners.

2. Neatline coordinates shall be expressed in the conventional manner of degrees, minutes, and seconds.

   a. All New and Reconstructed Charts shall be constructed and expressed in degrees, minutes and even seconds.

   b. Existing Charts may be expressed in degrees, minutes and to the tenth of a second. Values beyond one decimal place shall be truncated.

   c. An existing chart can have a combination of coordinates expressed to the even second and coordinates expressed with a decimal second value.

3. Neatline Coordinates shall be followed by the appropriate designator (i.e., N, S, E or W). See Figure 2-20. The directional designator shall not be followed by a period.

B. Location of Neatline Coordinates

1. Neatline Coordinates shall be:

   a. located inside the neatline, and

   b. placed in both the lower left-hand and upper right-hand corners.

2. Latitudinal Coordinates shall run parallel with lines of latitude.

3. Longitudinal Coordinates shall run parallel with lines of longitude.

4. Latitudinal and Longitudinal values shall be aligned 1.0mm from the inside edge of the neatline.

5. Coordinates in the lower left-hand corner shall commence and be spaced 3.0mm from the perpendicular inside edge of the neatline corner. (See Figure 2-20, A)

   The longitudinal coordinate in the uper right-hand corner shall commence and be spaced 3.0mm from the perpendicular inside edge of the neatline corner. (See Figure 2-20, B)

   The latitudinal coordinate in the upper right-hand corner shall end and be spaced 3.0mm from the perpendicular inside edge of the neatline. (See Figure 2-20, B)

C. Label Specifications for Neatline Coordinates.

1. A neatline coordinate shall be charted in black 5 point Swiss Light Vertical type.

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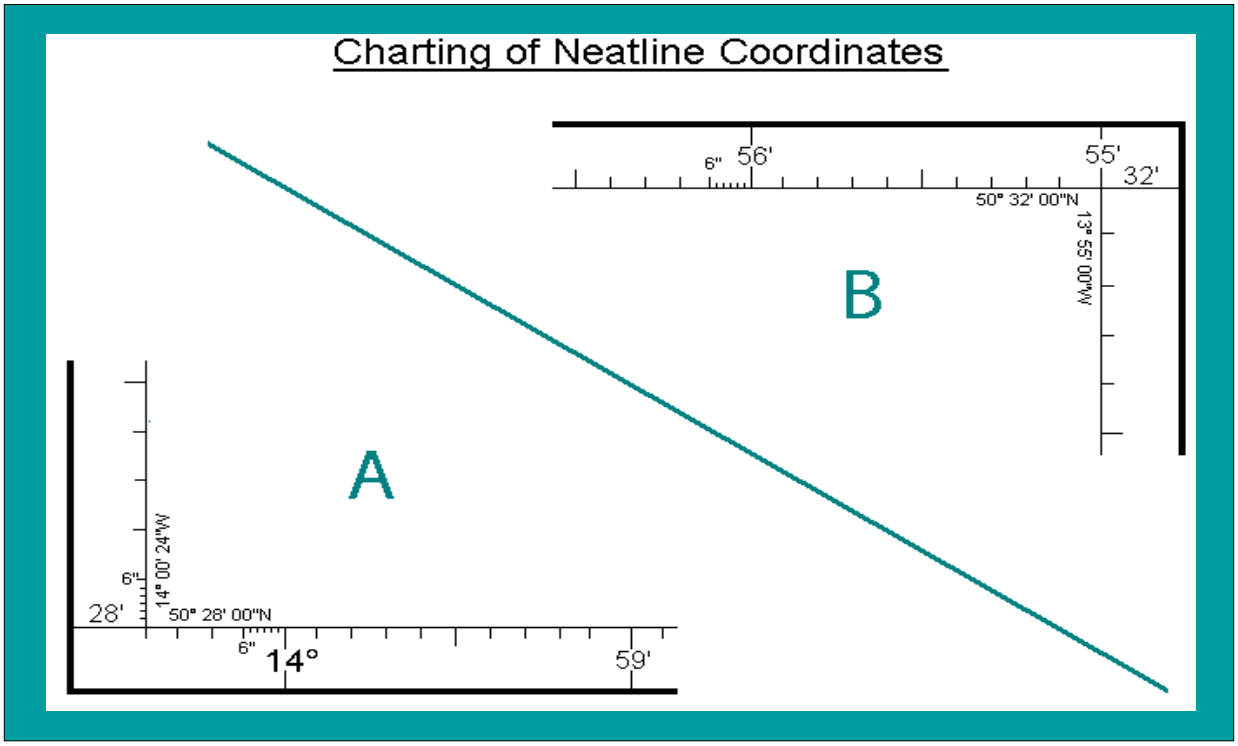

Figure 2-20

NOTE: When the neatline coordinates on a nautical chart conflict with critical charted information, that chart shall be referred to the respective Branch Chief for evaluation.

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2.10.1.8 Pattern of Graduation

The graduation or graduation pattern of a chart is the division and subdivision of latitude and longitude shown in the border of a chart – adjacent to the outside of the neatline. All National Ocean Service nautical charts and insets shall be graduated.

The pattern of graduation shall vary with the scale of the nautical chart. See Figure 2-21 below for the appropriate graduation pattern to be shown for each chart scale; and Figures 2-22 through 2-30 for the respective graphic diagrams.

PATTERN OF GRADUATION FOR CHART SCALES							
See Figure	Limiting Scale	Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length	INT2 Reference
2-22	Larger than 1: 5,001	-	-	1'	1"	-	-
2-23	1: 5,001 **to** Larger than 1: 50, 001	-	30"	1'	1"	-	E
2-24	1: 50,001 **to** Larger than 1: 100,001	1°	5 '	30"	6"	1'	F
2-25	1: 100,001 **to** Larger than 1: 200,001	1 °	5'	1'	12"	1'	G
2-26	1: 200,001 **to** Larger than 1: 500,001	1°	5 '	1'	30"	1'	H
2-27	1: 500,001 **to** Larger than 1: 1,500,001	1°	10 '	5'	1'	5'	J
2-28	1: 1,500,001 **to** Larger than 1: 2, 250,001	1°	30 '	10'	2'	10'	K
2-29	1: 2,250,001 **to** Larger than 1: 4, 750, 001	1°	-	30'	5'	30'	L
2-30	1: 10,000,000	5°	-	1°	10'	1°	M

Figure 2-21

Additional IHO graduation rules include the following:

- Equal intervals of subdivision, numbering and dicing shall be shown for the latitude and longitude of a chart.
- Intervals between projection lines should not exceed 20 centimeters nor be closer than 10 centimeters regardless of scale. See Figure 2-6 for the interval of projection lines.
- *Neatlines* (on New and Reconstructed Charts) shall be located on exact graduation/subdivisions, (i.e., degrees, minutes and even seconds).
- *Minor subdivisions* indicated on plan borders shall be shown in seconds and **shall only be applied to the minute intervals adjacent to the meridians and parallels shown.**
- *Dicing* on SCALE borders shall be done in such a way that intervals east and south of even numbered ticks or graduation lines are diced.

Graphic Diagrams of Required IHO Graduation Patterns For Chart Scales

PLAN BORDER

Limiting Scale : Larger than 1: 5,001

Degree Interval	----
Intermediate Interval	----
(a.) Minute Interval	1'
(b.) Minor Subdivision	1"
Dicing Length	*N/A*
(c.) Second Interval	6"

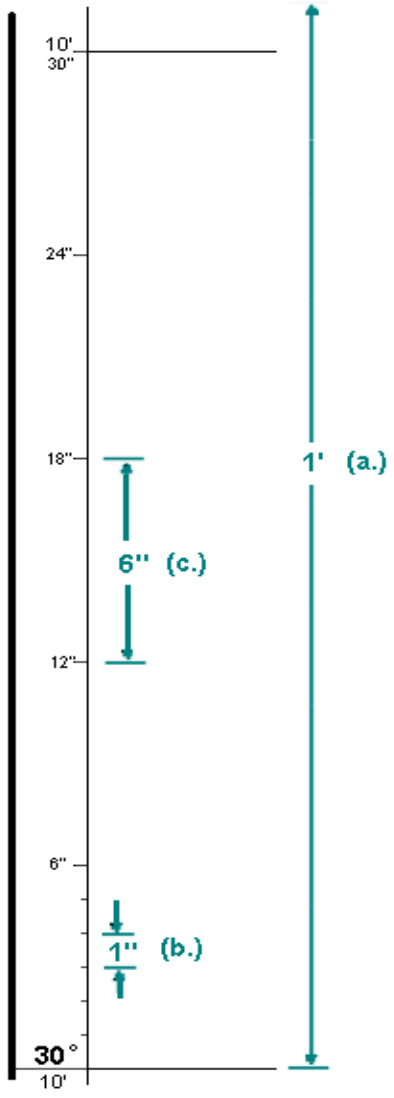

Figure 2-22

PLAN BORDER

Limiting Scale : 1: 5,001 to Larger than 1: 50,001

Degree Interval	----
(a.) Intermediate Interval	30"
(b.) Minute Interval	1'
(c.) Minor Subdivision	1"
Dicing Length	*N/A*
(d.) Second Interval	6"

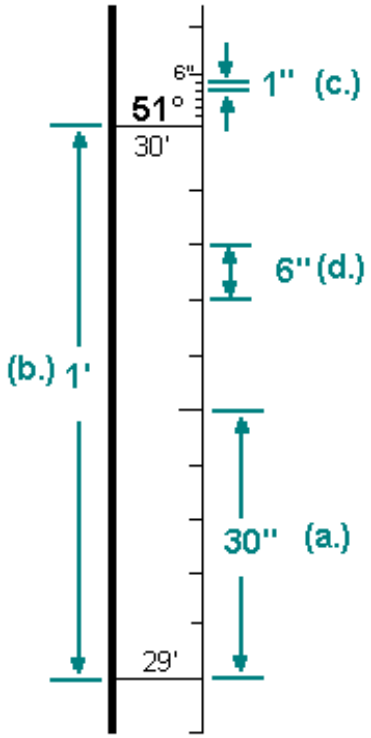

Figure 2-23

SCALE BORDER

Limiting Scale : 1: 50,001 to Larger than 1: 100,001

Degree Interval	1˚
(a.) Intermediate Interval	5'
(b.) Minute Interval	30"
(c.) Minor Subdivision	6"
(d.) Dicing Length	1'

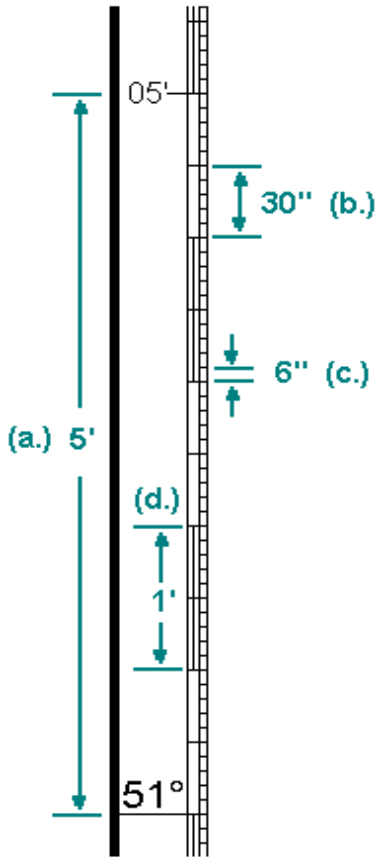

Figure 2-24

SCALE BORDER

Limiting Scale : 1: 100,001 to Larger than 1: 200,001

Degree Interval	1˚
(a.) Intermediate Interval	5'
(b.) Minute Interval	1'
(c.) Minor Subdivision	12"
(d.) Dicing Length	1'

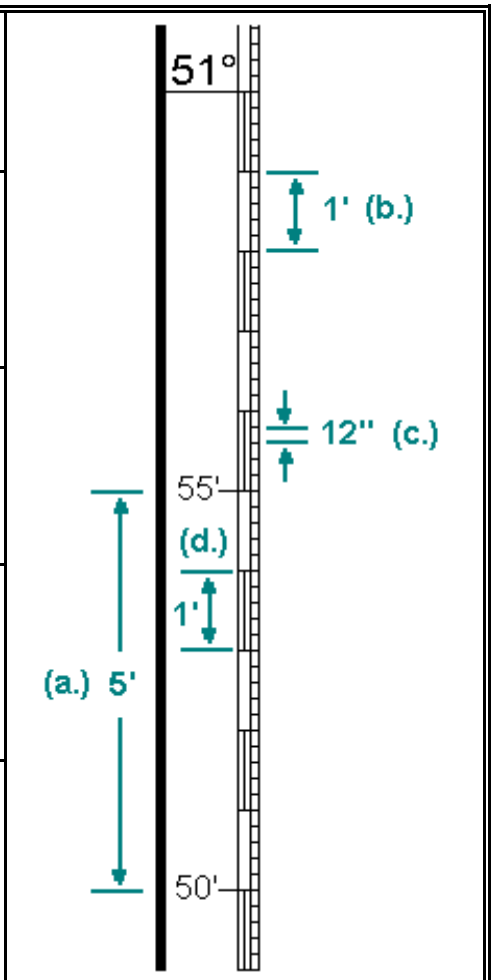

Figure 2-25

SCALE BORDER

Limiting Scale : 1: 200,001 to Larger than 1: 500,001

Degree Interval	1˚
(a.) Intermediate Interval	5'
(b.) Minute Interval	1'
(c.) Minor Subdivision	30"
(d.) Dicing Length	1'

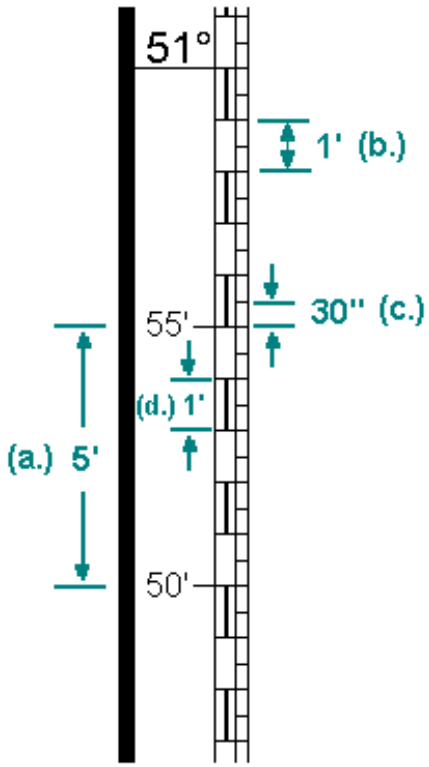

Figure 2-26

SCALE BORDER

Limiting Scale : 1: 500,001 to Larger than 1: 1,500,001

Degree Interval	1˚
(a.) Intermediate Interval	10'
(b.) Minute Interval	5'
(c.) Minor Subdivision	1'
(d.) Dicing Length	5'

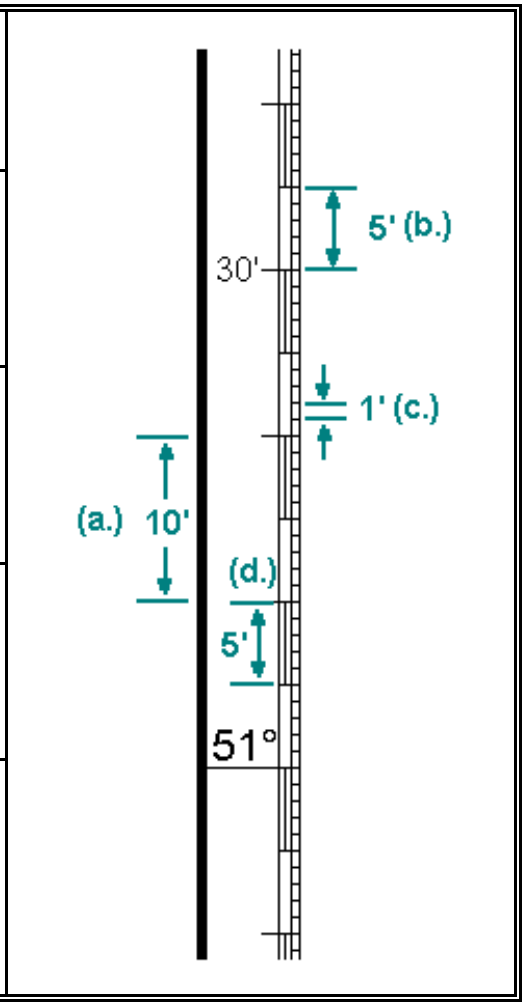

Figure 2-27

SCALE BORDER

Limiting Scale : 1: 1,500,001 to Larger than 1: 2,250,001

(a.) Degree Interval	1˚
(b.) Intermediate Interval	30'
(c.) Minute Interval	10'
(d.) Minor Subdivision	2'
(e.) Dicing Length	10'

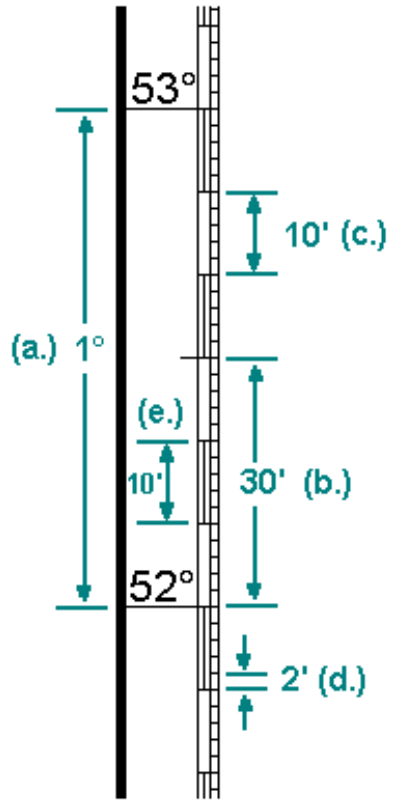

Figure 2-28

SCALE BORDER

Limiting Scale : 1: 2,250,001 to Larger than 1: 4,750,001

(a.) Degree Interval	1˚
Intermediate Interval	---
(b.) Minute Interval	30'
(c.) Minor Subdivision	5'
(d.) Dicing Length	30'

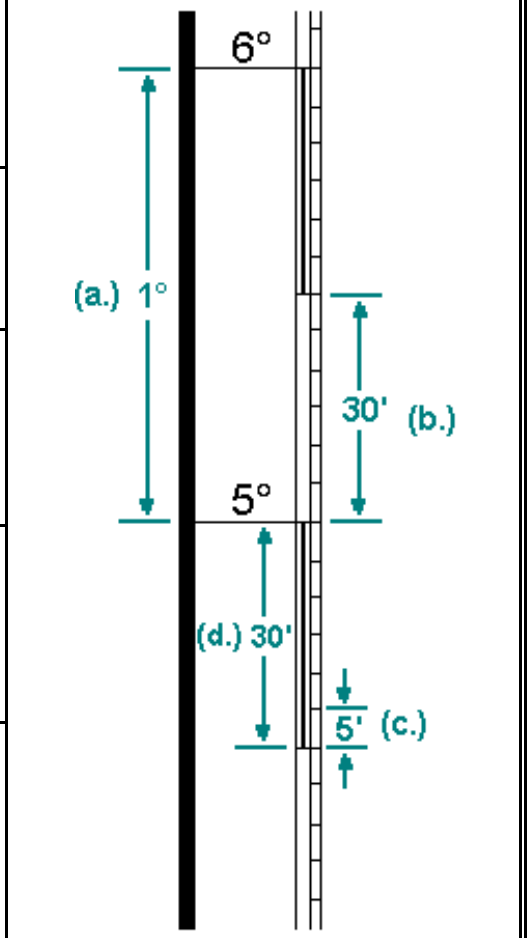

Figure 2-29

SCALE BORDER

Limiting Scale : 1: 10,000,000

(a.) Degree Interval	5˚
Intermediate Interval	---
(b.) Minute Interval	1˚
(c.) Minor Subdivision	10'
(d.) Dicing Length	1˚

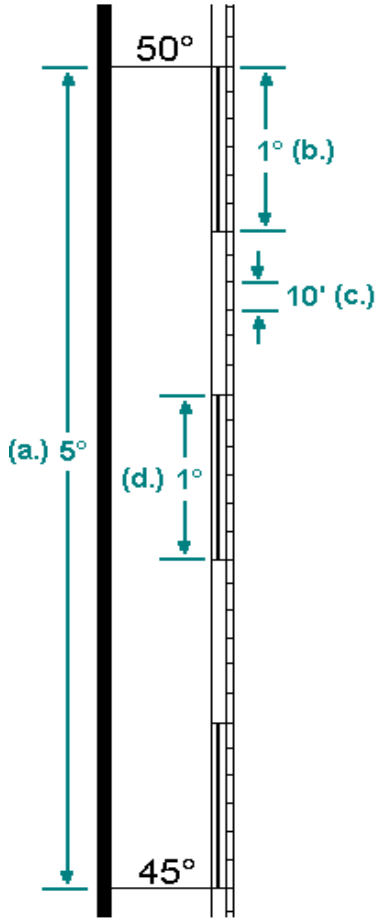

Figure 2-30

2.10.1.9. Labeling

All parallels and meridians shown shall be labeled. (See Figure 2-41 for the location of all labels to be charted.)

A. PLAN Borders (Placement of Labels)

1. Degree and Minute Labels

A latitude label consisting of both the degree label and the minute label shall be placed such that the degree label is 1.0 millimeter above the graduation line and the minute label is 1.0 millimeter below (the graduation line). The degree label is to be centered laterally between the neatline and the border; the minute label is to be centered laterally directly under the degree numeric value. (See Figure 2-31) A degree label for latitude shall be shown at least once on every panel or inset.

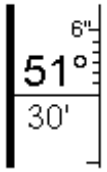

Figure 2-31

A latitude minute label unaccompanied by a degree label (or a latitude degree label unaccompanied by a minute label) shall be placed 1.0 millimeter above the graduation line and centered laterally between the neatline and the border. (See Figure 2-32)

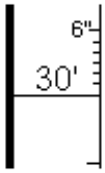

Figure 2-32

A longitude label shall be placed such that a label consisting of both the degree label and the minute label is centered horizontally and vertically on the meridian graduation line. A longitude minute label unaccompanied by a degree label (or a latitude degree label unaccompanied by a minute label) is placed such that the numeric value of the label is centered horizontally and vertically (on the meridian graduation line). The graduation line shall always be "broken" 4.0 mm for the placement of the associated label. (See Figure 2-33)

Figure 2-33

2. 6" Labels

The 6 second (6") interval of all minor subdivisions indicated on a PLAN border shall be identified by the use of 6" labels.

On north latitude charts, the 6" label shall be located above the graduation line (See Figure 2-34, A). On south latitude charts, the 6" label shall be located below the graduation line (See Figure 2-34, B).

On west longitude charts, the 6" label shall be located to the left of the graduation line (see Figure 2-34, C); and on east longitude charts, the 6" label shall be located to the right of the graduation line. (see Figure 2-34, D)

In all instances, the 6" label shall be located 0.5 mm from the 6" tick.

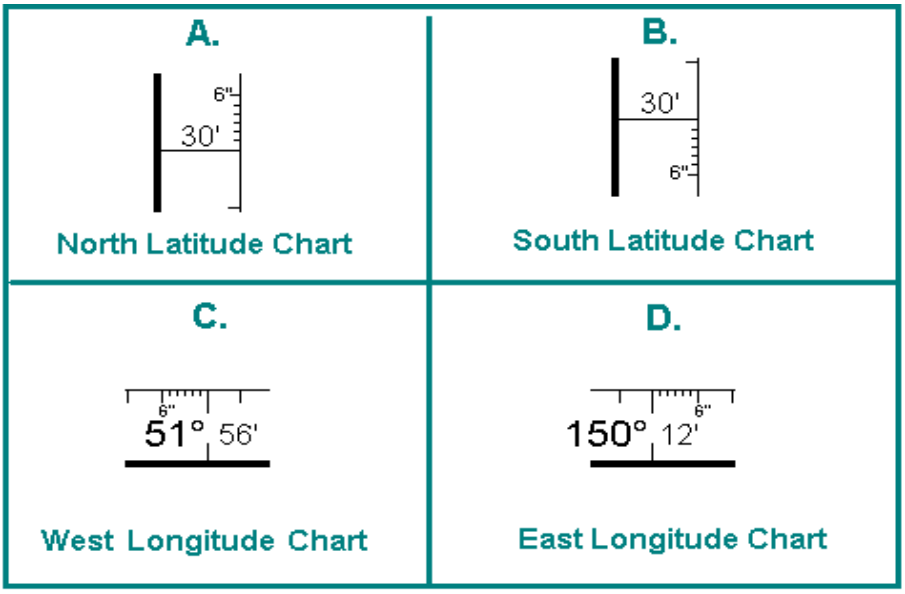

Figure 2-34

NOTE: See Section 2.10.1.8 for the location of all minor subdivisions.

B. SCALE Borders (Placement of Labels)

1. Degree and Minute Labels

A latitude label consisting of both the degree label and the minute label shall be placed such that the degree label is 1.0 millimeter above the graduation line and the minute label is 1.0 millimeter below (the graduation line). The degree label is to be centered laterally between the border and the "outside" border scale limit; the minute label is to be centered laterally directly under the degree numeric value. (See Figure 2-35.) A degree label for the latitude shall be shown at least once on every panel or inset.

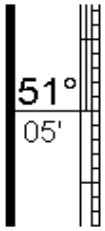

Figure 2-35

A latitude degree label unaccompanied by a minute label shall be placed 1.0 millimeter above the graduation line and centered laterally between the border and the "outside" border scale limit. (See Figure 2-36.)

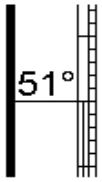

Figure 2-36

A latitude minute label unaccompanied by a degree label shall be placed such that the label is laterally located 1.0 mm from the associated tick. (See Figure 2-37)

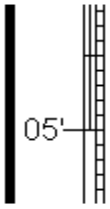

Figure 2-37

A longitude label consisting only of the degree value or consisting of both the degree and minute values shall be placed such that the numeric value of the label is centered horizontally and vertically on the meridian graduation line. The graduation line shall always be "broken" 4.0 mm for the placement of the associated label. (See Figure 2-38)

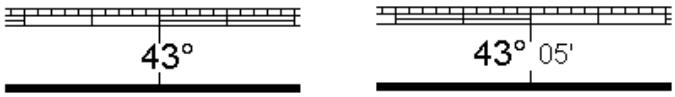

Figure 2-38

A longitude minute label *unaccompanied* by a degree label shall be placed such that the numeric value of the label is laterally located 1.0mm from the associated tick. (See Figure 2-39)

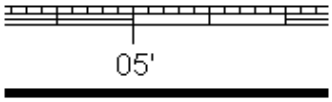

Figure 2-39

2. Second Labels

Not Applicable

C. North (N), South (S), East (E), West (W) Indicators

North (N) or South (S) indicators shall not be shown. A West (W) or East (E) indicator shall be shown at least once on every panel or inset.

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D. Type Specifications

Label	Type Style	Type Size
Degrees (57˚)	Swiss Regular Vertical	* 12 point
Minutes (41')	Swiss Regular Vertical	** 9 point
Seconds (30")	Swiss Light Vertical	6 point
6" labels	Swiss Light Vertical	5 point
Neatline dimensions	Swiss Light Vertical	5 point
Neatline coordinates	Swiss Light Vertical	5 point

* Insets: 10 point
** Insets: 8 point

Figure 2-40

E. Leading Zeros

All minute labels representing a single digit value are to be expressed with a leading zero (i.e., 05').

F. Chart Scales Larger than 1:5,001

For chart scales larger than 1:5,001, the 6", 12", 18", 24", 30", 36", 42", 48", and 54" labels shall be shown at all appropriate and respective graduation ticks.

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INTERVAL OF LABEL PLACEMENT			
Scale	**Location No.1**	**Location No. 2**	**Minor Subdivision Label**
1:5,000	Every 6"', 12", 18", 24", 30", 36", 42", 48", 54" tick.		6" tick
1: 10,000	Projection line interval (i.e., every **1'**)	N/A	6" tick
1: 15,000	Projection line interval (i.e., every **1'**)	N/A	6" tick
1: 20,000	Projection line interval (i.e., every **2'**)	Minute interval (i.e., every **1'**)	6" tick
1: 30,000	Projection line interval (i.e., every **2'**)	Minute interval (i.e., every **1'**)	6" tick
1: 40,000	Projection line interval (i.e., every **5'**)	Minute interval (i.e., every **1'**)	6" tick
1: 50,000	Projection line interval (i.e., every **5'**)	Minute interval (i.e., every **1'**)	6" tick
1: 60,000	Projection line interval (i.e., every **5'**)	Minute interval (i.e., every **1'**)	6" tick
1: 80,000	Projection line interval (i.e., every **10'**)	Intermediate interval (i.e., every **5'**)	N/A
1:100,000	Projection line interval (i.e., every **10'**)	Intermediate interval (i.e., every **5'**)	N/A
1:125,000	Projection line interval (i.e., every **10'**)	Intermediate interval (i.e., every **5'**)	N/A
1:200,000	Projection line interval (i.e., every **20'**)	Intermediate interval (i.e., every **5'**)	N/A
1:250,000	Projection line interval (i.e., every **20'**)	Intermediate interval (i.e., every **5'**)	N/A
1:300,000	Projection line interval (i.e., every **30'**)	Intermediate interval (i.e., every **5'**)	N/A
1:400,000	Projection line interval (i.e., every **30'**)	Intermediate interval (i.e., every **5'**)	N/A
1:500,000	Projection line interval (i.e., every **1˚**)	Intermediate interval (i.e., every **10'**)	N/A
1:600,000	Projection line interval (i.e., every **1˚**)	Every **30'**	N/A
1:700,000	Projection line interval (i.e., every **1˚**)	Every **30'**	N/A
1:800,000	Projection line interval (i.e., every **1˚**)	Every **30'**	N/A
1:1,000,000	Projection line interval (i.e., every **2 ˚**)	Every **1˚**	N/A
1:1,500,000	Projection line interval (i.e., every **2 ˚**)	Every **1˚**	N/A
1:2,000,000	Projection line interval (i.e., every **2 ˚**)	Every **1˚**	N/A
1:3,000,000	Projection line interval (i.e., every **5 ˚**)	Every **1˚**	N/A
1:4,000,000	Projection line interval (i.e., every **5 ˚**)	Every **1˚**	N/A
1:5,000,000	Projection line interval (i.e., every **5 ˚**)	N/A	N/A
1:10,000,000	Projection line interval (i.e., every **10 ˚**)	Every 5˚	N/A

Figure 2-41

2.10.1.10 Examples of Graduated Nautical Chart Neatlines

Following are examples of graduated charts based on the specifications provided by the International Hydrographic Organization or expanded by the Quality Assurance Plans and Standards Branch. Each pattern of graduation required for a specific chart scale has been provided as an example and includes all associated labeling and linear dimensions.

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Pattern of Graduation

Example 1

Border Type	Limiting Scale	Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length	Second Interval
Plan	Larger than 1: 5,001	-	-	1'	1"	-	6"

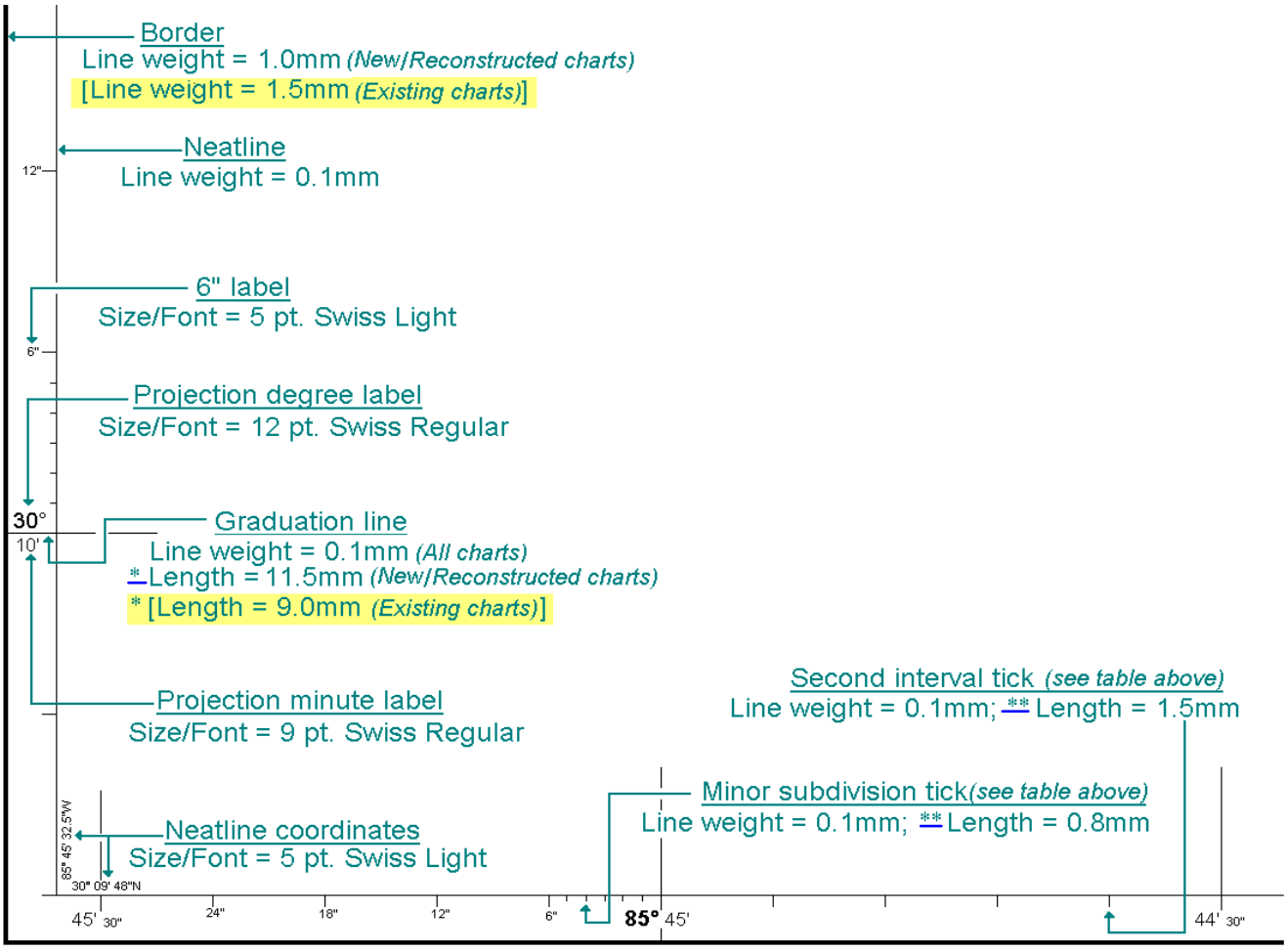

Figure 2-42

* *Length of line, as measured from center of border to center of neatline.*
** *Length of line, as measured from outer edge of tick to center of neatline.*

Values highlighted in yellow represent the only variations between the modified IHO dimensions for existing NOS conventional charts and the comprehensive IHO dimensions for New and Reconstructed NOS conventional charts.

Pattern of Graduation

Example 2

Border Type	Limiting Scale	Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length	Second Interval
Plan	1:5,001 to Larger than 1: 50,001	-	30 '	1'	1"	-	6"

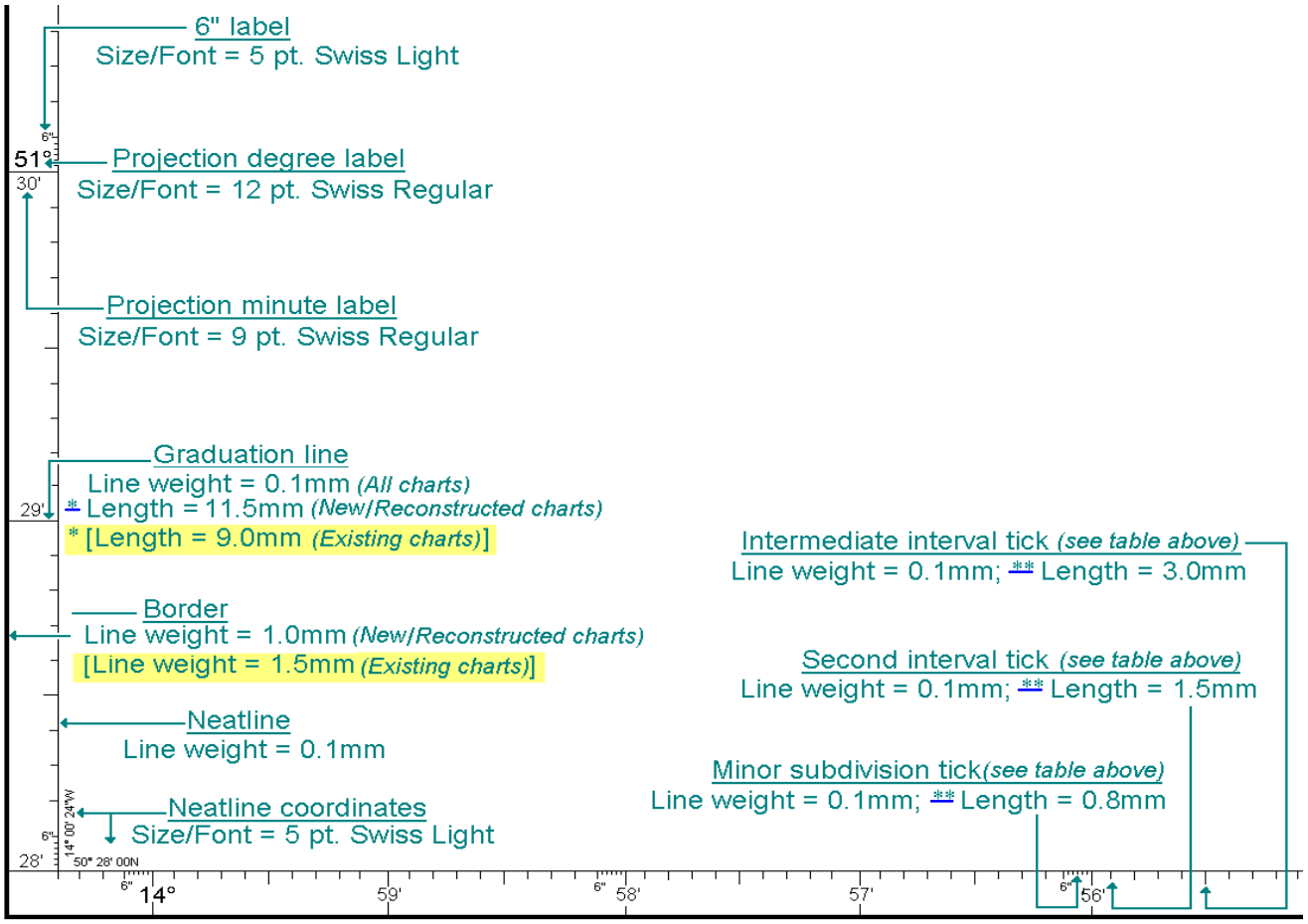

Figure 2-43

* *Length of line, as measured from center of border to center of neatline.*
** *Length of line, as measured from outer edge of tick to center of neatline.*

Values highlighted in yellow represent the only variations between the modified IHO dimensions for existing NOS conventional charts and the comprehensive IHO dimensions for New and Reconstructed NOS conventional charts.

Pattern of Graduation

Example 3

Border Type	Limiting Scale	Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length
Scale	1:50,001 **to** Larger than 1: 100,001	1°	5 '	30"	6"	1'

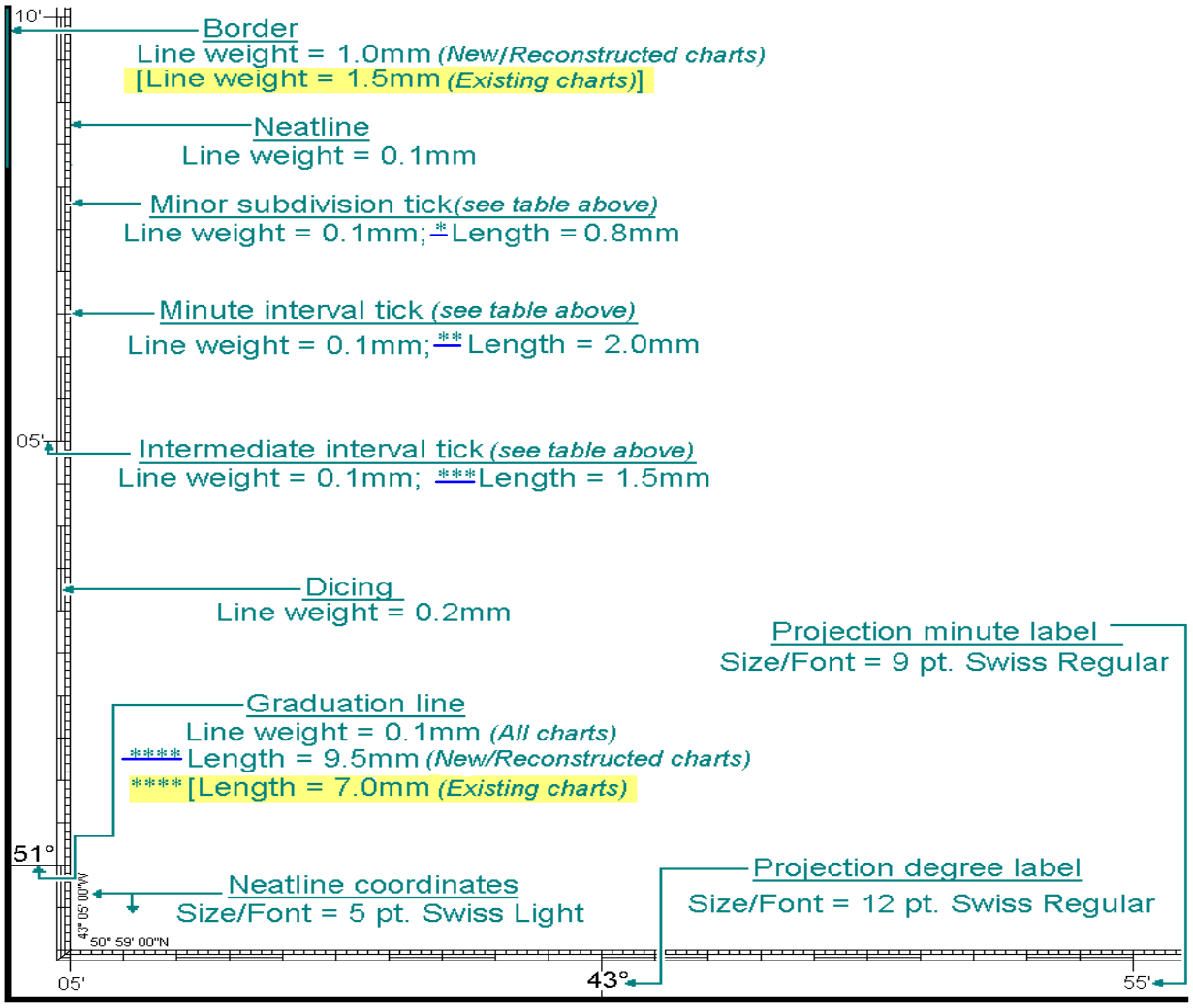

Figure 2-44

* *Length of line, as measured from center of "inside" limit of border scale to center of neatline.*
** *Length of line, as measured from center of "outside" limit of border scale to center of neatline.*
*** *Length of line, as measured from outer edge of tick to center of "outside" limit of border scale.*
**** *Length of line, as measured from center of border to center of "outside" limit of border scale.*

Values highlighted in yellow represent the only variations between the modified IHO dimensions for existing NOS conventional charts and the comprehensive IHO dimensions for New and Reconstructed conventional charts.

Pattern of Graduation

Example 4

Border Type	Limiting Scale	Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length
Scale	1:100,001 **to** Larger than 1: 200,001	1°	5 '	1'	12"	1'

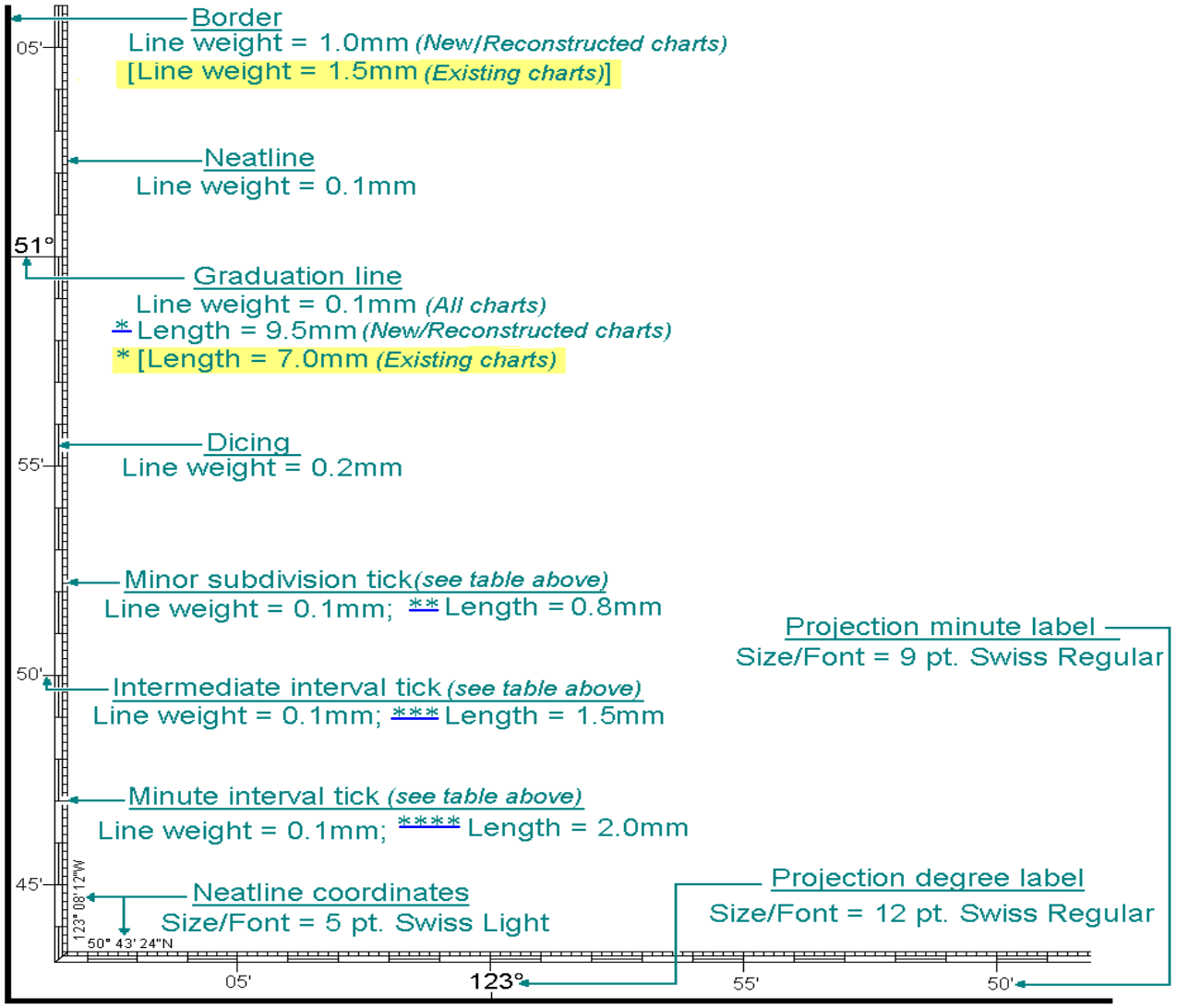

Figure 2-45

* *Length of line, as measured from center of border to center of "outside" border scale limit.*
** *Length of line, as measured from center of "inside" border scale limit to center of neatline.*
*** *Length of line, as measured from outer edge of tick to center of "outside" border scale limit.*
**** *Length of line, as measured from center of "outside" border scale limit to center of neatline.*

Values highlighted in yellow represent the only variations between the modified IHO dimensions for existing NOS conventional charts and the comprehensive IHO dimensions for New and Reconstructed conventional charts.

Pattern of Graduation

Example 5

Border Type	Limiting Scale	Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length
Scale	1:200,001 **to** Larger than 1: 500,001	1°	5 '	1'	30"	1'

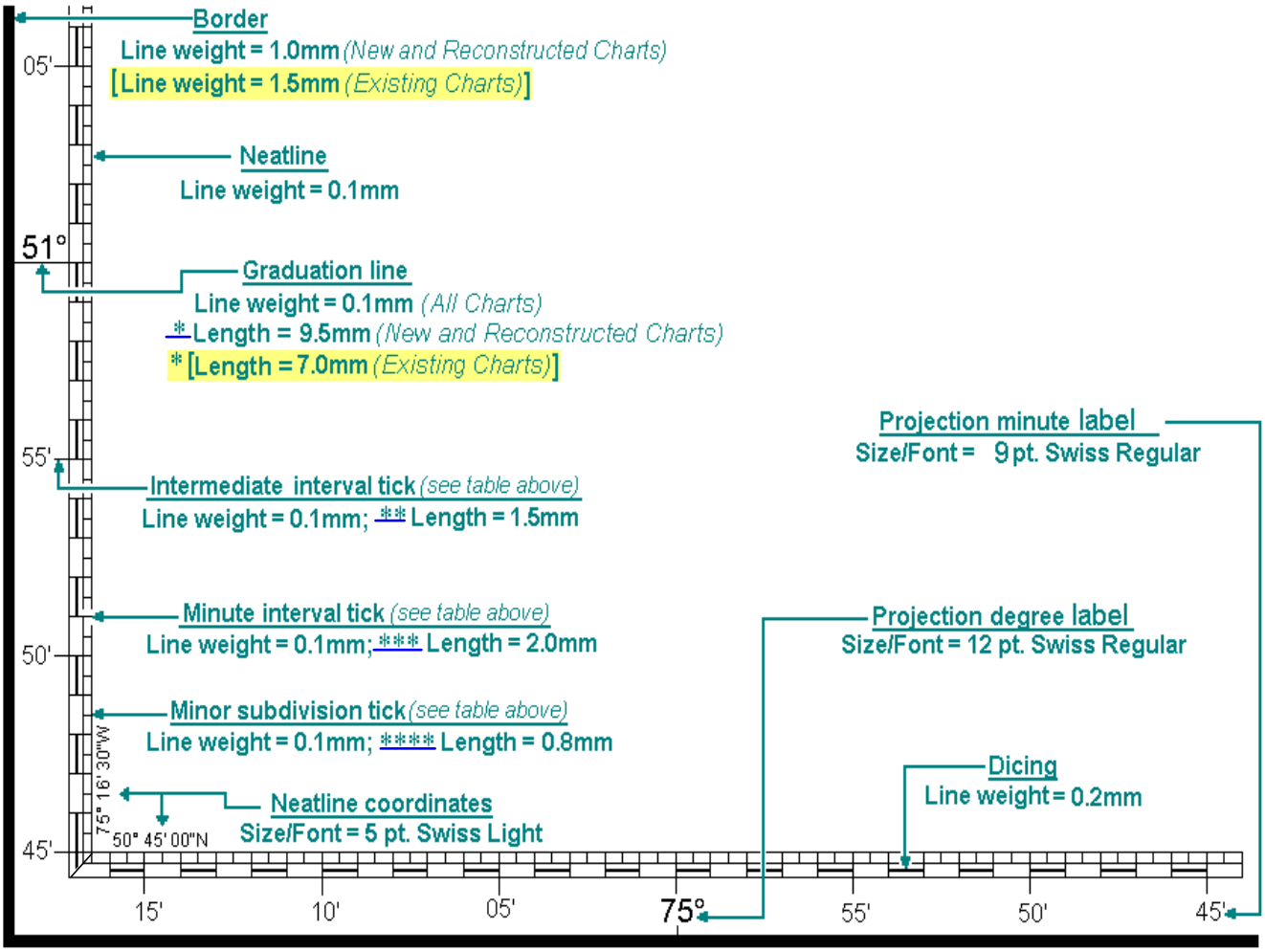

Figure 2-46

* *Length of line, as measured from center of border to center of "outside" border scale limit.*
** *Length of line, as measured from outer edge of tick to center of "outside" border scale limit.*
*** *Length of line, as measured from center of "outside" border scale limit to center of neatline.*
**** *Length of line, as measured from center of "inside" border scale limit to center of neatline.*

Values highlighted in yellow represent the only variations between the modified IHO dimensions for existing NOS conventional charts and the comprehensive IHO dimensions for New and Reconstructed conventional charts.

Pattern of Graduation

Example 6

Border Type	Limiting Scale	Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length
Scale	1: 500,001 **to** Larger than 1: 1, 500,001	1°	10 '	5'	1'	5'

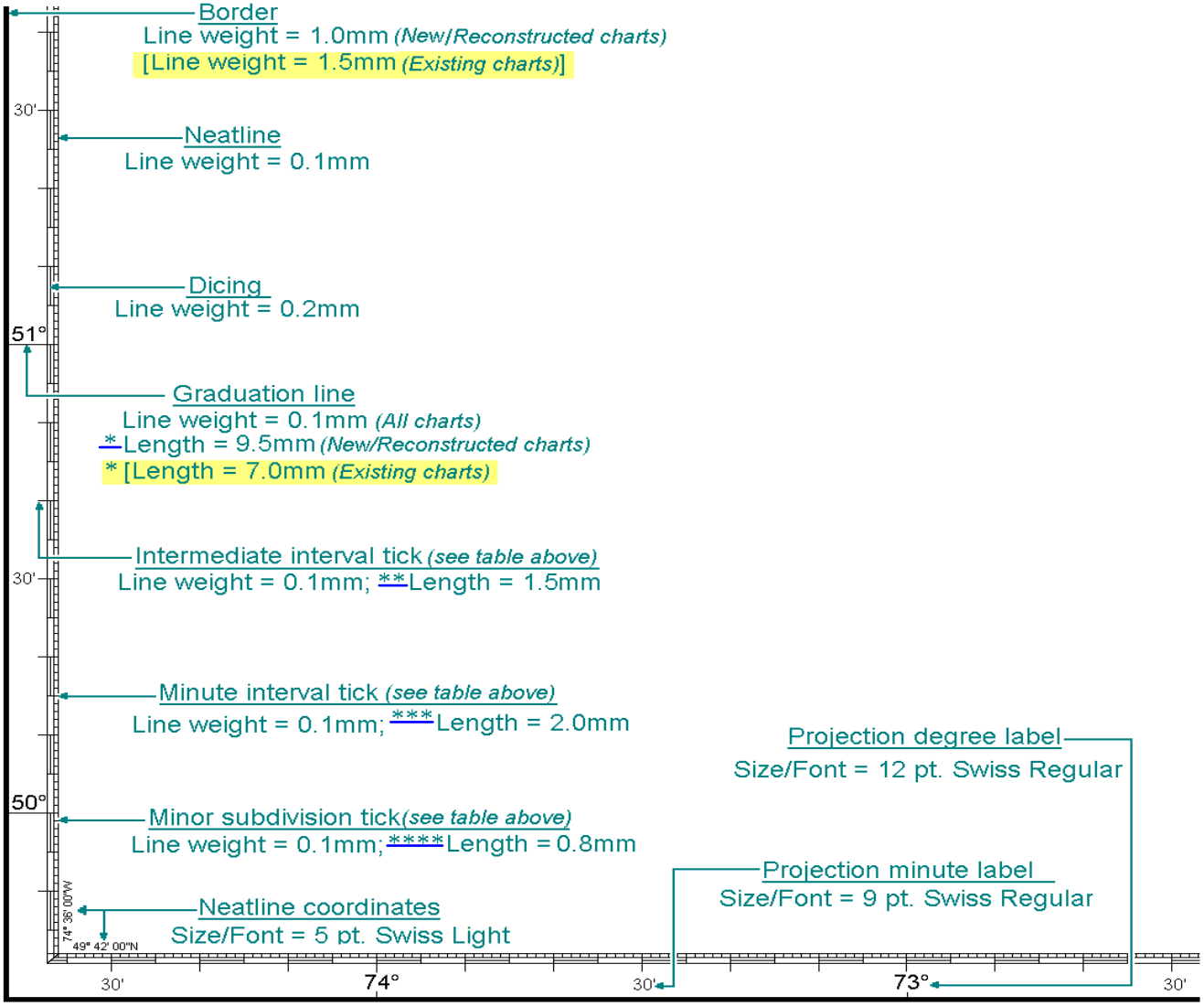

Figure 2-47

* *Length of line, as measured from center of border to center of "outside" border scale limit.*
** *Length of line, as measured from outer edge of tick to center of "outside" border scale limit.*
*** *Length of line, as measured from center of "outside" border scale limit to center of neatline.*
**** *Length of line, as measured from center of "inside" border scale limit to center of neatline.*

Values highlighted in yellow represent the only variations between the modified IHO dimensions for existing NOS conventional charts and the comprehensive IHO dimensions for New and Reconstructed conventional charts.

Pattern of Graduation

Example 7

Border Type	Limiting Scale	Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length
Scale	1: 1,500,001 **to** Larger than 1: 2, 250,001	1˚	30 '	10'	2'	10'

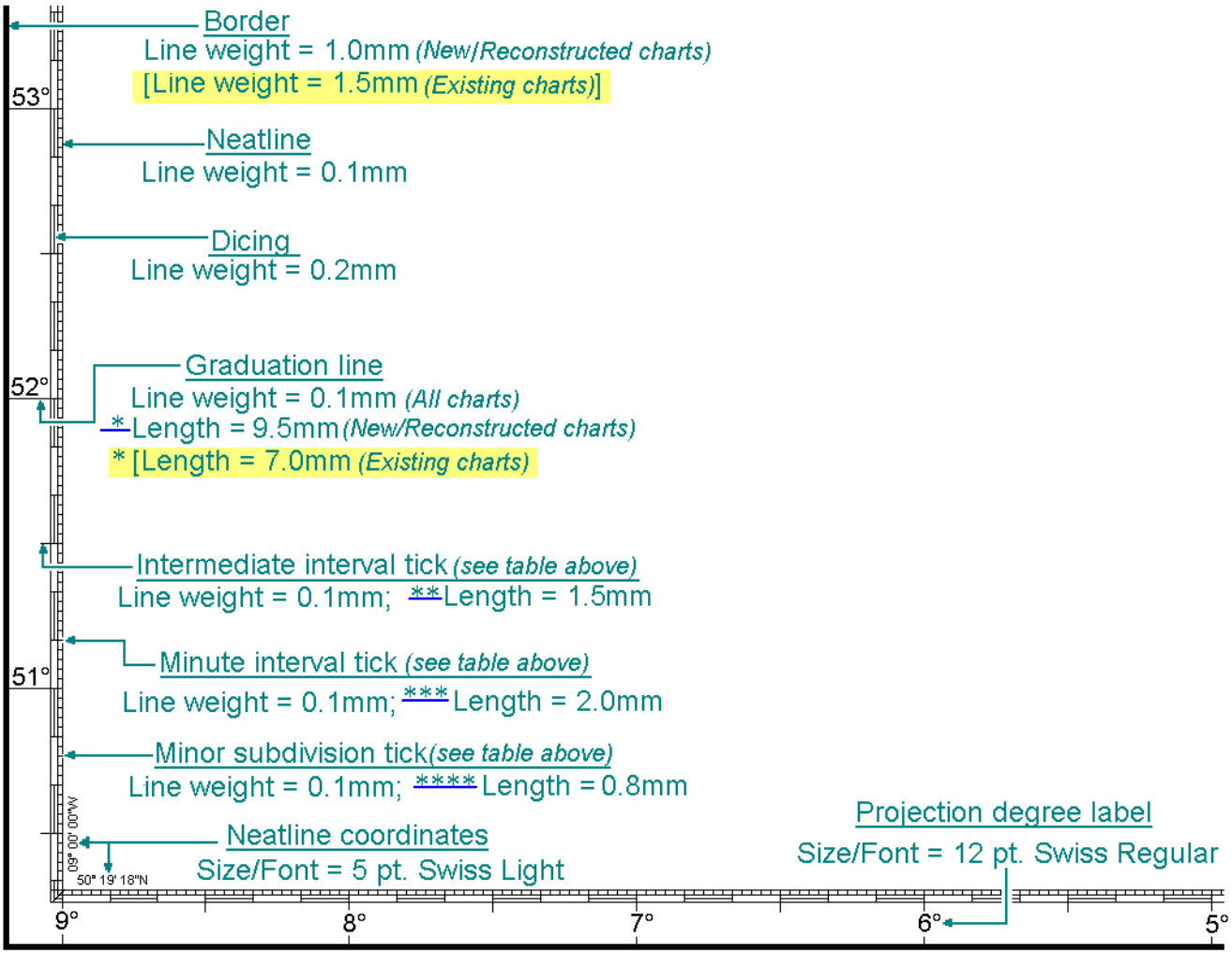

Figure 2-48

* *Length of line, as measured from center of border to center of "outside" border scale limit.*
** *Length of line, as measured from outer edge of tick to center of "outside" border scale limit.*
*** *Length of line, as measured from center of "outside" border scale limit to center of neatline.*
**** *Length of line, as measured from center of "inside" border scale limit to center of neatline.*

Values highlighted in yellow represent the only variations between the modified IHO dimensions for existing NOS conventional charts and the comprehensive IHO dimensions for New and Reconstructed conventional charts.

Pattern of Graduation

Example 8

Border Type	Limiting Scale	Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length
Scale	1: 2,250,001 **to** Larger than 1: 4,750, 001	1°	-	30'	5'	30'

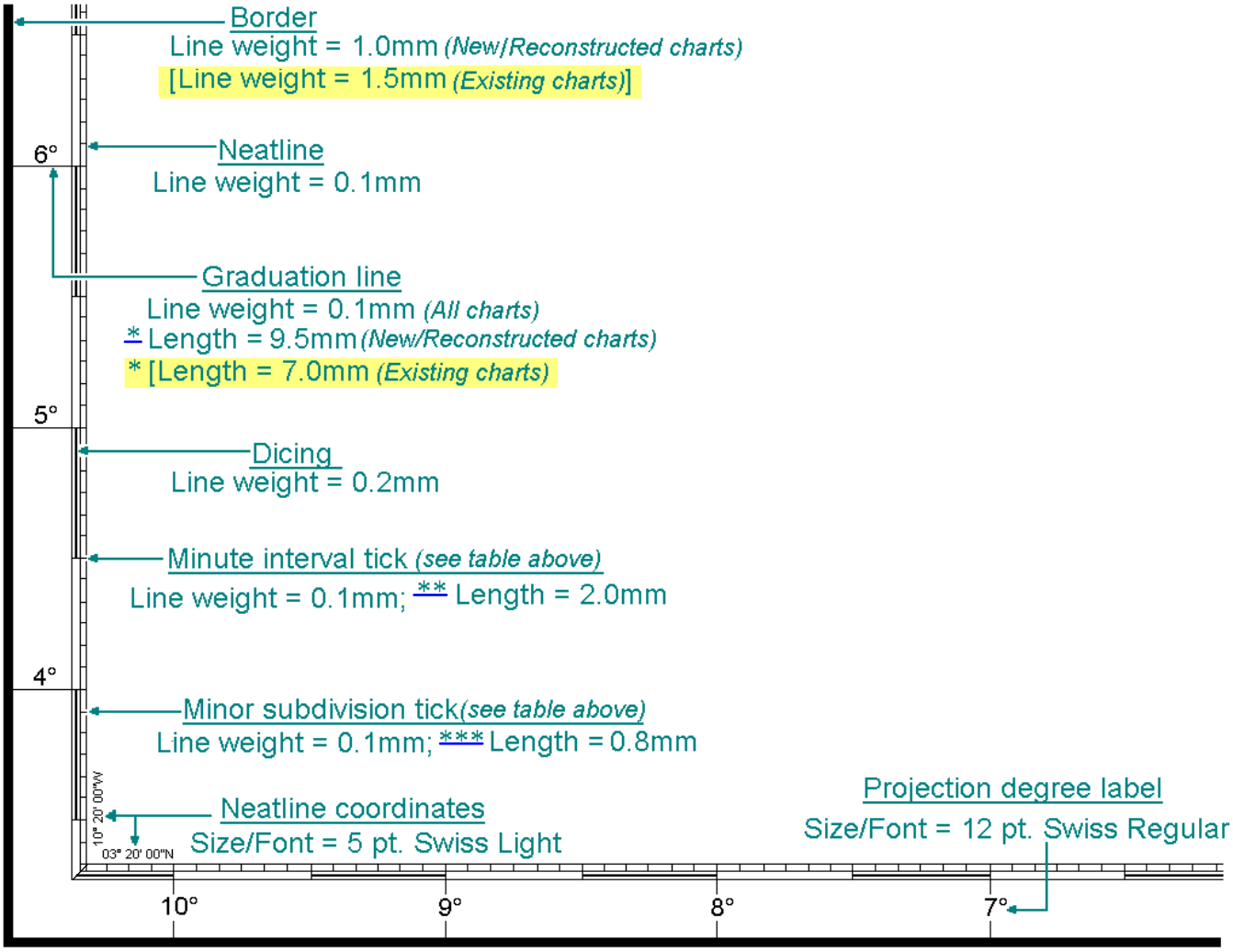

Figure 2-49

* *Length of line, as measured from center of border to center of "outside" border scale limit.*
** *Length of line, as measured from center of "outside" border scale limit to center of neatline.*
*** *Length of line, as measured from center of "inside" border scale limit to center of neatline.*

Values highlighted in yellow represent the only variations between the modified IHO dimensions for existing NOS conventional charts and the comprehensive IHO dimensions for New and Reconstructed conventional charts.

Pattern of Graduation

Example 9

Border Type	Limiting Scale		Degree Interval	Intermediate Interval	Minute Interval	Minor Subdivision	Dicing Length
	Largest	Smallest					
Scale	1: 10,000,000		5˚	-	1˚	10'	1˚

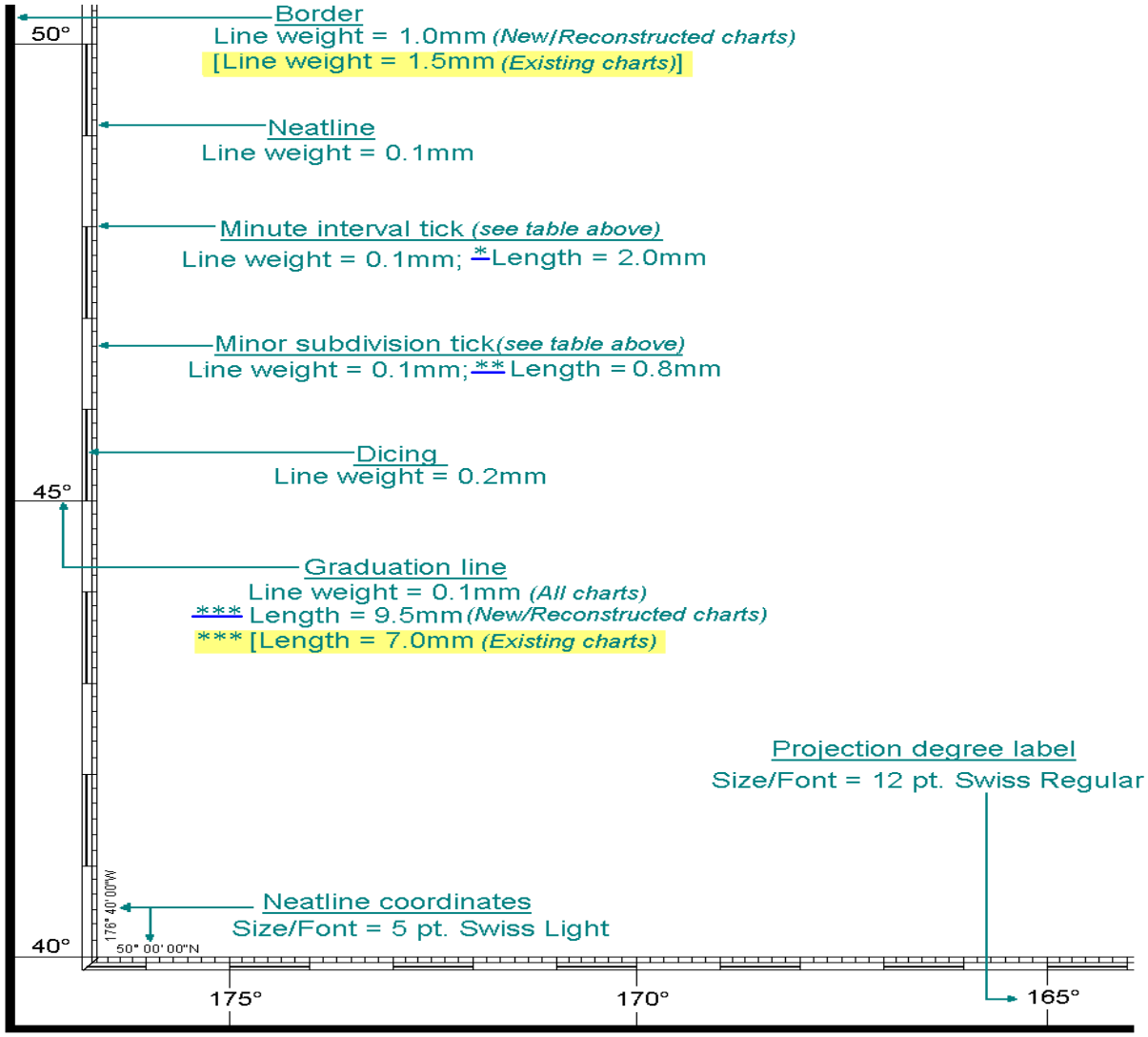

Figure 2-50

* *Length of line, as measured from center of "outside" border scale limit to center of neatline.*
** *Length of line, as measured from center of "inside" border scale limit to center of neatline.*
*** *Length of line, as measured from center of border to center of "outside" border scale limit.*

Values highlighted in yellow represent the only variations between the modified IHO dimensions for existing NOS conventional charts and the comprehensive IHO dimensions for New and Reconstructed conventional charts.

2.10.1.11 IHO Insets and Extensions

Inset: A separate chart graphic which is (a.) of a limited area (b.) placed within the neatline of a nautical chart, **and** (c.) constructed at a larger scale than the scale of the main chart panel, but at the same central latitude.

Extension: A separate chart graphic which is (a.) generally placed within the neatline of a nautical chart, (b.) constructed at the same scale and central latitude as the main chart panel, and ©.) represents a continuation of a specific area currently charted on the main panel.

A. IHO Specifications: Placement/Location of Insets and Extensions

In accordance with IHO specifications, new insets and extensions to be placed on New, Reconstructed and existing NOS nautical charts shall be placed within the neatline of a nautical chart such that the inset's or extension's border:

1. is always parallel to the corresponding border of the main panel, and

2. when near the main panel's corners, is at equal distances from the main panel's neatline (see Figure 2-51).

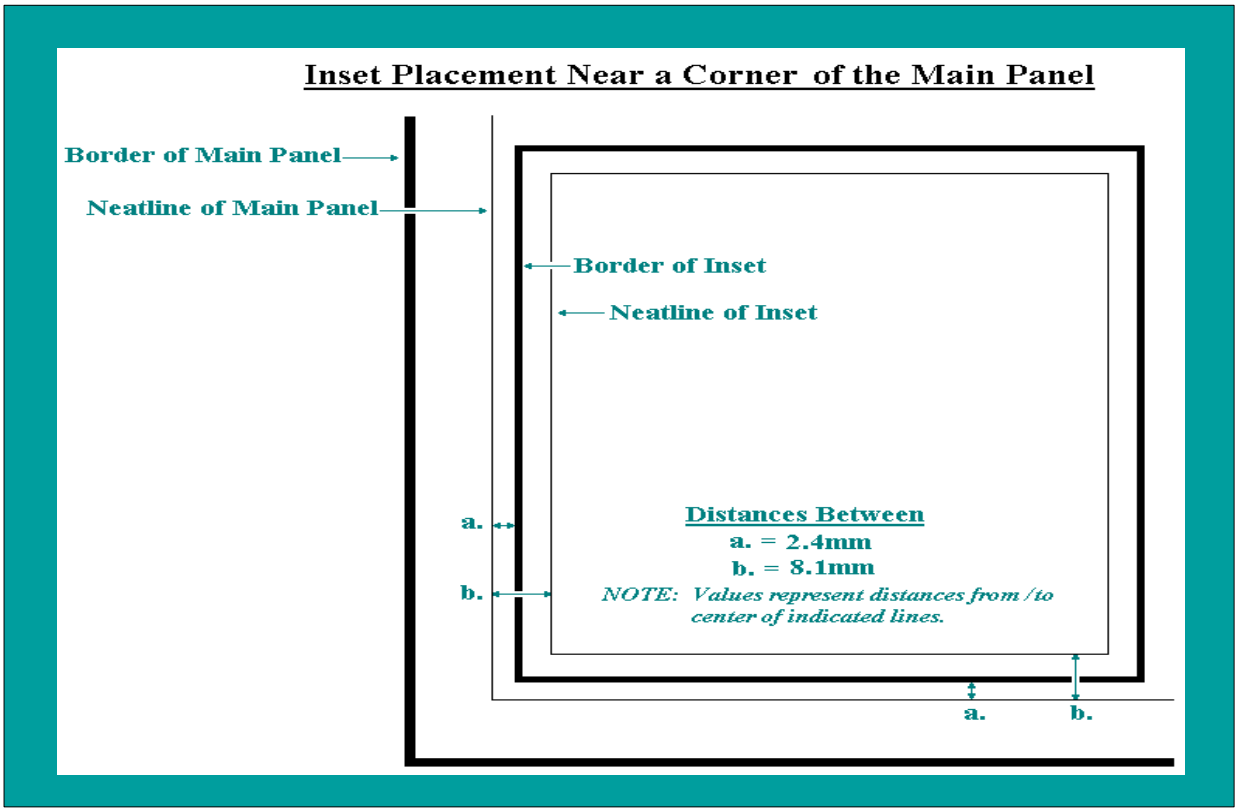

Figure 2-51

B. Projection Lines

All new insets and extensions shall have at least one parallel and one meridian shown. The interval in which projection lines shall be drawn shall be based on the specifications provided in Figure 2-6.

C. Pattern of Graduation

The graduation for all new insets and extensions shall vary with the scale of the inset. See Figure 2-21 to obtain the the appropriate graduation pattern for the scale of the inset to be constructed.

D. Neatline Coordinates

All new insets and extensions shall include the charting of the neatline coordinates. See Section 2.10.1.7 for specifications.

E. Labeling

See Section 2.10.1.9

F. Existing Insets and Extensions

Existing insets and extensions which have an irregular shape (i.e., are not square or rectangular) or which cannot easily be converted to the IHO/NOS specifications provided in Nautical Chart Manual, Sections 2.10.1.2 through 2.10.1.12 shall be referred to the Chief, Marine Chart Division for evaluation. It shall be the responsibility of the Chief, Marine Chart Division to determine the feasibility of re-formatting or reconstructing these insets or extensions and the associated main chart panel.

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G. Insets Placed within a PLAN Border

1. Dimensions, Line and Type Specifications

The following IHO dimensions shall apply in the construction and placement of new insets and extensions placed within a chart having a PLAN border. (Refer to Figure 2-54 for the location of the indicators.)

IHO Graduated Inset/Extension Dimensions, Line and Type Specifications (Insets Placed within a PLAN Border)			
Indicator	**Description**	**Item**	**Specification**
a.	Border Line (inset)	Line weight	0.8mm
b. , s.	Neatline	Line weight	0.1mm
c. , g.	Distance		8.1mm
d. , h.	Distance		5.3mm
e. , i.	Distance		2.4mm
f. , l.	Neatline coordinates	Type font	5 pt. Swiss Light Vertical
j.	Graduation line (inset)	Line weight	0.1mm
		Length	5.3mm
k. , u.	Minor subdivision tick	Line weight	0.1mm
		Length	0.8mm
m. , y.	Projection minute label	Type font	8 pt. Swiss Regular Vertical (All projection degree labels indicated.)
n.	Projection degree label	Type font	10 pt. Swiss Regular Vertical (All projection “degree” labels indicated.)

Figure 2-52

IHO Graduated Inset/Extension
Dimensions, Line and Type Specifications
(Insets Placed within a PLAN Border)
(continued)

Indicator	Description	Item	Specification
o. , t.	6" label	Type font	5 pt. Swiss Light Vertical (All 6" labels.)
p. , x.	Second interval tick	Line weight	0.1mm
		Length	1.5mm
q. , w.	Intermediate interval tick	Line weight	0.1mm
		Length	3.0mm
r.	Border (main panel)	Line weight	New/Reconstructed charts: 1.0mm *[Existing charts: 1.5mm]*
v.	Graduation line (main panel)	Line weight	0.1mm
		Length	New/Reconstructed charts: 11.5mm [*Existing charts (plan border): 9.0mm*]

Figure 2-53

(The remainder of this page is intentionally blank.)

IHO Graduated Inset/Extension:Dimensions, Line and Type Specifications
(Insets Placed within a PLAN Border)

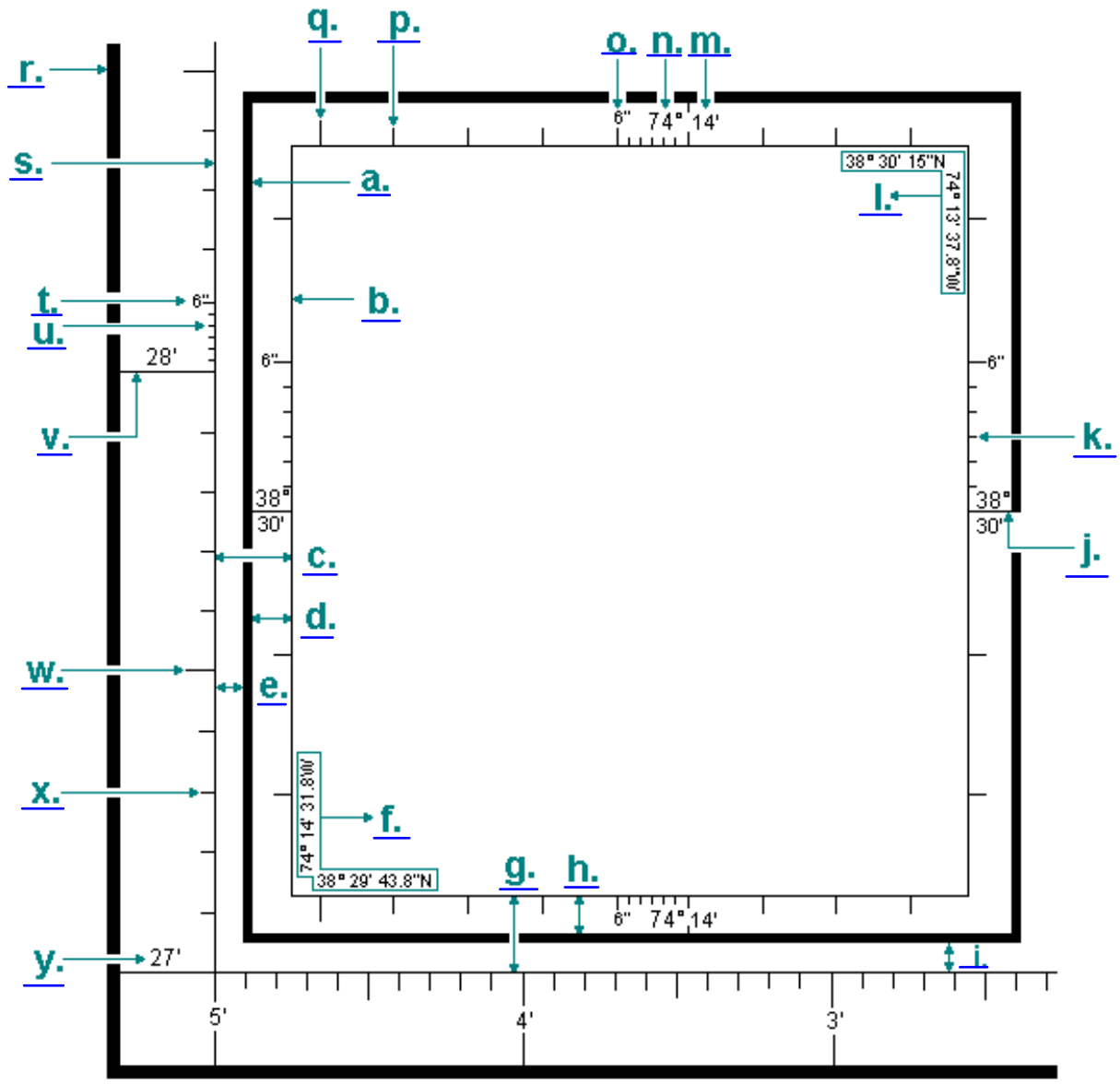

Figure 2-54

NOTE: When an inset is placed in the lower left hand corner or upper right hand corner of a chart, the neatline coordinates of the main panel shall not be indicated.

H. Insets Placed within a SCALE Border

1. Dimensions, Line and Type Specifications

The following IHO dimensions shall apply in the construction and placement of new insets and extensions placed within a chart having a SCALE border. (Refer to Figure 2-58 for the location of the indicators.)

IHO Graduated Inset/Extension Dimensions, Line and Type Specifications (Insets Placed within a SCALE Border)

Indicator	Description	Item	Specification
a.	Border Line (inset)	Line weight	0.8mm
b.	Neatline	Line weight	0.1mm
c. , g.	Distance		8.1mm
d. , h.	Distance		5.3mm
e. , i.	Distance		2.4mm
f. , l.	Neatline coordinates	Type font	5 pt. Swiss Light Vertical
j.	Graduation line (inset)	Line weight	0.1mm
		Length	5.3mm
k.	Minor subdivision tick	Line weight	0.1mm
		Length	0.8mm
m.	Projection minute label	Type font	8 pt. Swiss Regular Vertical (All projection degree labels indicated.)
n.	Projection degree label	Type font	10 pt. Swiss Regular Vertical (All projection “degree” labels indicated.)

Figure 2-55

IHO Graduated Inset/Extension Dimensions, Line and Type Specifications (Insets Placed within a SCALE Border)
(continued)

Indicator	Description	Item	Specification
o.	6" label	Type font	5 pt. Swiss Light Vertical (All 6" labels.)
p.	Second interval tick	Line weight	0.1mm
		Length	1.5mm
q.	Intermediate interval tick	Line weight	0.1mm
		Length	3.0mm
r.	Border (main panel)	Line weight	New and Reconstructed charts: 1.0mm [*Existing charts: 1.5mm*]
s.	Projection minute label	Type font	5 pt. Swiss Regular Vertical
t.	Intermediate interval tick	Line weight	0.1mm
		Length	1.5mm
u.	"Outside" border scale limit	Line weight	0.1mm
v.	"Inside" border scale limit	Line weight	0.1mm
w.	Dicing	Line weight	0.2mm
x.	30" interval tick	Line weight	0.1mm
		Length	2.0mm
y.	Minor subdivision tick	Line weight	0.1mm
		Length	0.8mm
z.	Minute interval tick	Line weight	0.1mm
		Length	2.0mm

Figure 2-56

IHO Graduated Inset/Extension Dimensions, Line and Type Specifications (Insets Placed within a SCALE Border)			
Indicator	**Description**	**Item**	**Specification**
aa.	Neatline (main panel)	Line weight	0.1mm
bb.	Projection degree label	Type font	12 pt. Swiss Regular Vertical
cc.	Graduation line (main panel)	Line weight	0.1mm
		Length	New and Reconstructed charts: 9.5mm [Existing charts: 7.0mm]

Figure 2-57

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IHO Graduated Inset/Extension:Dimensions, Line and Type Specifications
(Insets Placed within a SCALE Border)

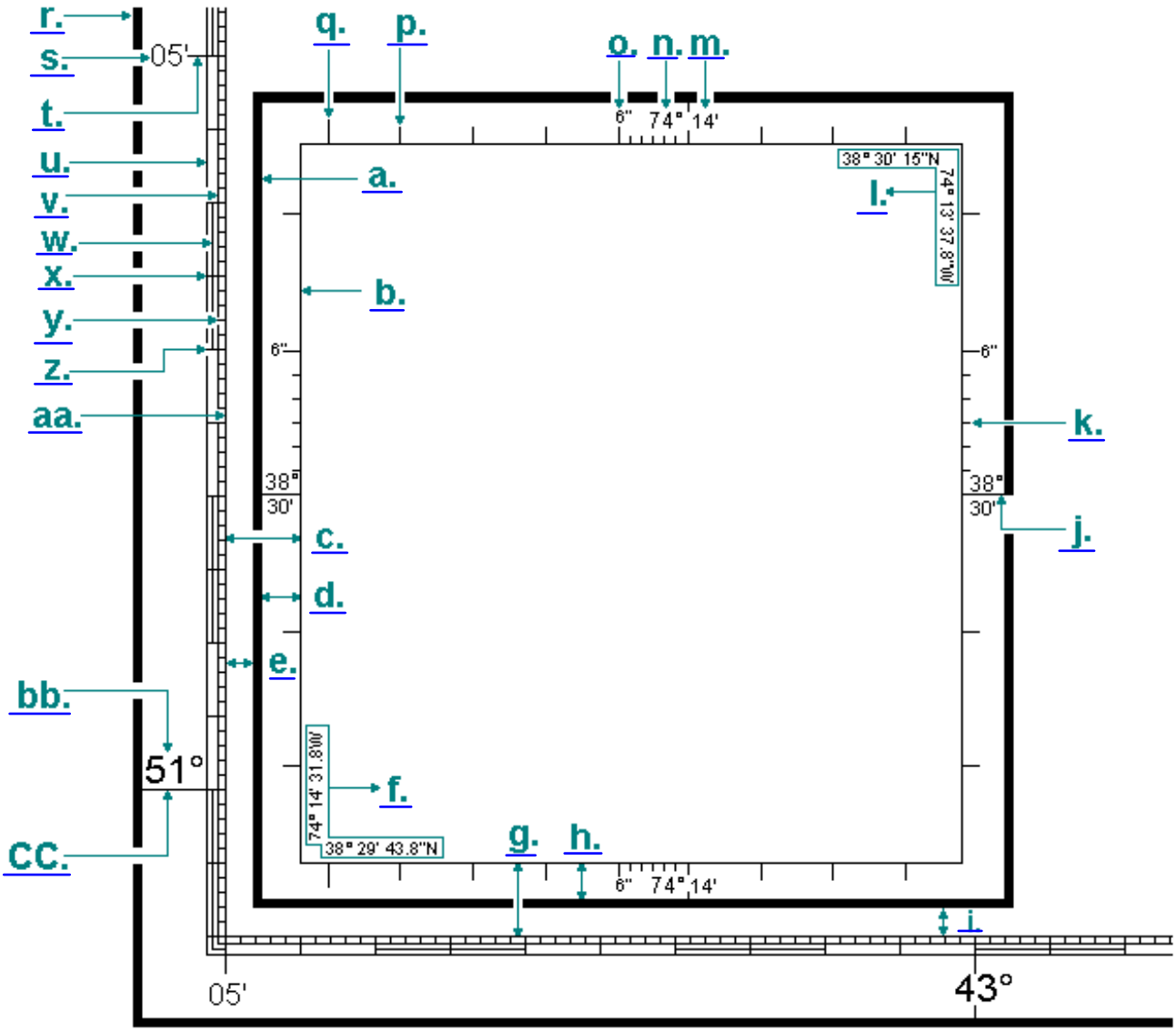


Figure 2-58

NOTE: When an inset is placed in the lower left hand corner or upper right hand corner of a chart, the neatline coordinates of the main panel shall not be indicated.

2.10.1.12 IHO Adjacent Borders: Dimensions, Line and Type Specifications (Conventional Charts Only)

Existing, New and Reconstructed conventional nautical charts which have or are to have adjacent borders shall be constructed based on the following IHO dimensions. (Refer to Figure 2-63)

IHO Adjacent Borders Dimensions, Line and Type Specifications (Conventional Charts Only)			
Indicator	**Description**	**Item**	**Specification**
a.	6" label	Type font	5 pt. Swiss Light Vertical (All 6" labels.)
b.	Minor subdivision tick	Line weight	0.1mm
		Length	0.8mm
c.	Second interval tick	Line weight	0.1mm
		Length	1.5mm
d.	Outside border	Line weight	1.0mm
e.	Neatline	Line weight	0.1mm
f.	Intermediate interval tick	Line weight	0.1mm
		Length	3.0mm
g.	Distance (from center of border to center of neatline)		6.5mm
h.	Neatline coordinates	Type font	5 pt Swiss Light Vertical
i.	Inner border	Line weight	0.8mm
j.	Distance (from center of neatline to center of neatline)		13.4mm

Figure 2-59

IHO Adjacent Borders
Dimensions, Line andType Specifications
(Conventional Charts Only)
(continued)

Indicator	Description	Item	Specification
k.	Distance (from center of neatline to center of bottom limit of border scale)		12.6mm
l.	Distance (from center of neatline to center of top limit of border scale)		11.4mm
m.	Distance (from center of neatline to center of inner border)		5.3mm
n.	Distance (from center of neatline to center of neatline)		11.4mm
o.	Distance		5.3mm
p.	Neatline	Line weight	0.1mm
q.	Inner border	Line weight	0.8mm
r.	Graduation line	Line weight	0.1mm
		Length	6.5mm (from center of neatline to center of inner border)
s.	Neatline coordinates	Type font	5 pt Swiss Light Vertical
t.	Projection second label	Type font	6 pt. Swiss Light Vertical (All projection second labels indicated.)
u.	Projection minute label	Type font	8 pt. Swiss Regular Vertical (All projection minute labels indicated.)

Figure 2-60

IHO Adjacent Borders
Dimensions, Line and Type Specifications
(Conventional Charts Only)
(continued)

Indicator	Description	Item	Specification
v.	Projection degree label	Type font	10 pt. Swiss Regular Vertical (All projection degree labels indicated.)
w.	Intermediate interval tick	Line weight	0.1mm
		Length	3.0mm
x.	Distance (from center of outer border to center of neatline)		8.5mm
y.	Distance (from center of left limit of border scale to center of neatline)		2.0mm
z.	Distance (from center of right limit of border scale to center of neatline)		0.8mm
aa.	Graduation line	Line weight	0.1mm
		Length	6.5mm (from center of outer border to center of neatline)
bb.	Right border scale limit	Line weight	0.1mm
cc.	Dicing	Line weight	0.2mm
dd.	Left border scale limit	Line weight	0.1mm
ee.	Neatline	Line weight	0.1mm
ff.	Inner border	Line weight	0.8mm
gg.	Distance from center of left panel neatline to center of right panel neatline.		15.4mm

Figure 2-61

IHO Adjacent Borders
Dimensions, Line andType Specifications
(Conventional Charts Only)
(continued)

Indicator	Description	Item	Specification
hh.	Distance from centerline of border scale left limit (left panel) to centerline of border scale right limit (right panel)		13.8mm
ii.	Distance from centerline of border scale right limit (left panel) to centerline of border scale left limit (right panel)		11.4mm
jj.	Neatline	Line weight	0.1mm
kk.	Neatline	Line weight	0.1mm
ll.	Neatline	Line weight	0.1mm

Figure 2-62

(The remainder of this page is intentionally blank.)

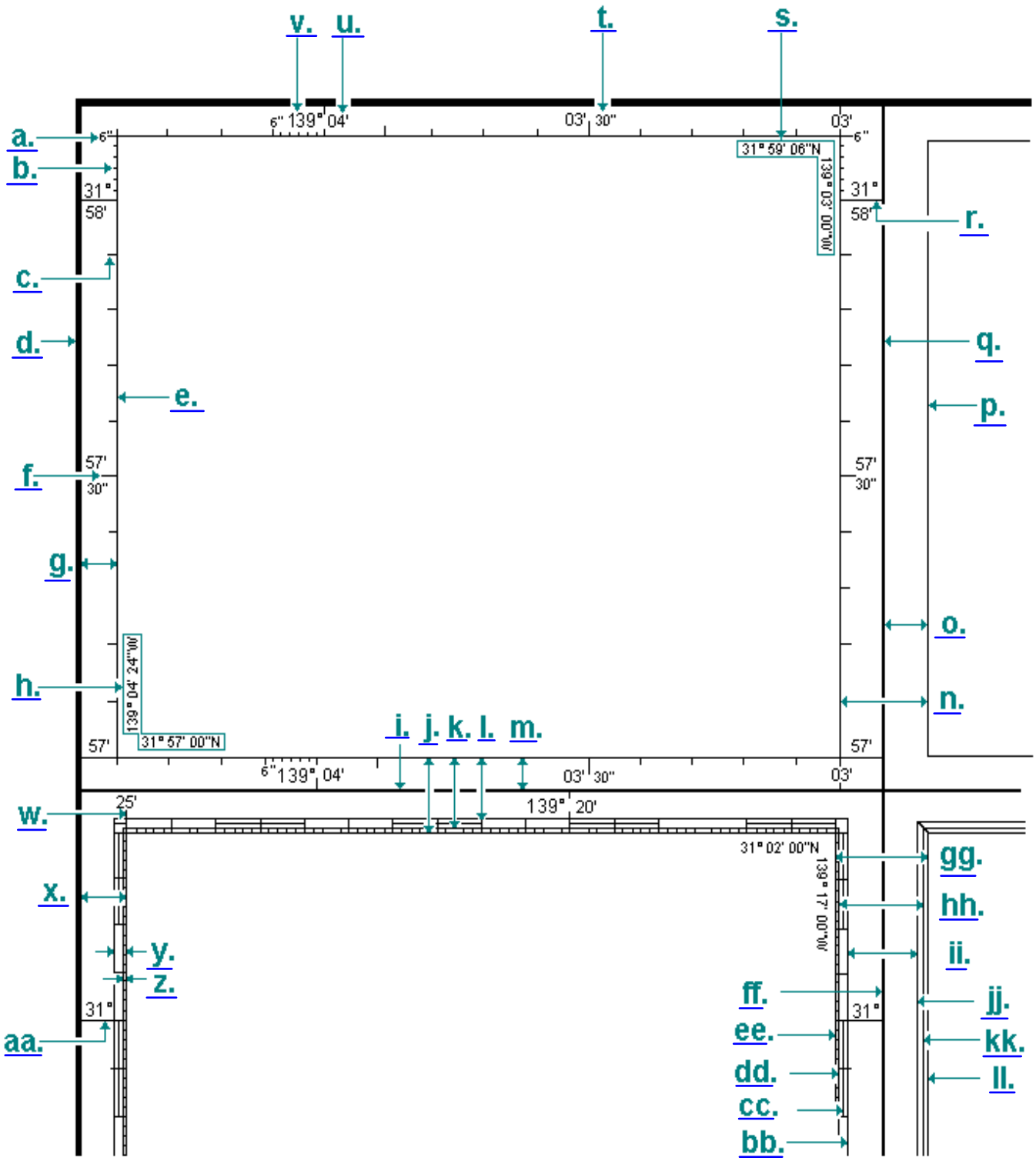

v.
u.
t.
s.
a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.
l.
m.
n.
o.
p.
q.
r.
w.
x.
y.
z.
aa.
bb.
cc.
dd.
ee.
ff.
gg.
hh.
ii.
jj.
kk.
ll.
6" 139° 04'
03' 30"
03'
31° 59' 06"N
139° 03' 00"W
31° 58'
57' 30"
139° 04' 24"W
31° 57' 00"N
25'
139° 20'
31° 02' 00"N
139° 17' 00"W

Figure 2-63

Section 2.10.1.13 Figure Cross-Reference to International 2 (INT2), "Borders, Graduation, Grids and Linear Scales"

Nautical Chart Manual Figure	INT2 Figure
2-11	T
2-12	U
2-15	A
2-16	B
2-17	A
2-18	B
2-22	------
2-23	E
2-24	F
2-25	G
2-26	H
2-27	J
2-28	K
2-29	L
2-30	M
2-42	------
2-43	E
2-44	F
2-45	G
2-46	H
2-47	J
2-48	K
2-49	L
2-50	M
2-51	D
2-54	D
2-58	D
2-63	C

Figure 2-64

2.10.2 Bar Scales

On July 1, 1954, DOC and DOD officially adopted the international nautical mile, which had been approved by the International Hydrographic Conference of 1929 and has since been adopted by nearly all maritime states.

This action, as well as the impending worldwide adoption of the meter as the uniform basic system of measurement, dictates that scales for both international nautical miles and meters must be incorporated into a graphic bar scale set for placement on NOS nautical charts.

The procedures described in this section shall routinely apply only to New and Reconstructed Charts (whether constructed by manual or automated methods).

1. Use on Charts

    a. Mercator Projection

For charts constructed on the Mercator projection, graphic scales shall be used when the scale of the chart is such that practical scale distortion is minimal. Graphic scales shall not be used when the north-south scale distortion exceeds 2 percent overall. As a general rule, this means that bar scales will not be used on Mercator charts smaller than 1:80,000 scale, except in Alaska, where the 2-percent distortion factor is generally exceeded at scales of 1:80,000. On determination of special need, bar scales may be used on smaller-scale charts in addition to the standard scale border subdivision, providing these charts do not exceed the 2-percent distortion limitation.

An exception of this rule is for Great Lake Mercator charts where bar scales are used across the scales. In addition, on Great Lake charts, different bar scales may be used across the same chart. The mariner uses the bar scale located nearest to the latitude of his position.

A simple approximate method for determining whether a chart exceeds the 2-percent limit is to take the northern and southern limits of the chart and find the length of 1 minute of longitude from C&GS Special Publication No. 5. For example, chart 17316 extends from 58°06' N. to 58°52' N. From Special Publication No. 5, the value of 1 minute of longitude at 58°06' N. is 982.8 meters and at 58°52' is 961.7 meters. Dividing the first value by the second gives 1.022, or 2.2 percent, difference over the chart. Similarly, for chart 11462, the limits are 24°48' N. and 25°36' N. with the corresponding lengths of minutes being 1685.2 meters and 1674.3 meters. Dividing the first value by the second gives 1.007, or 0.7 percent, distortion.

    b. Polyconic Projection

For charts constructed on the polyconic projection, graphic scales shall be used on all charts of

1:120,000 scale and larger. Scale is practically consistent throughout polyconic projections; scale distortion is not a limiting factor. For the Great Lake area, bar scales are used on all polyconic charts.

2. Selection of Bar Scales

a. International Nautical Mile Scale

This shall be used on charts of 1:10,000 scale and smaller, subject to the chart scale and distortion limitations noted above. Its use is optional on charts larger in scale than 1:10,000.

b. Statute Mile Scale

This shall be used only on charts of areas in which statute miles are prominently used in measuring or marking distances (e.g., the Intracoastal Waterway, Mississippi River, Great Lakes, Columbia River, etc.). Moreover, it shall be shown only when the chart falls within the chart scale and distortion limitations mentioned previously.

c. Yard and Meter Scales

These shall be used on all charts that carry the international nautical mile and/or statute mile scale, and on all charts larger than 1:10,000 scale.

3. Placement

a. On flat charts exceeding 620 square inches in area (4,000 square centimeters) within the neatline, two graphic scale sets shall be used on each chart if possible. Their location must be individually determined for each chart. However, when space permits, one scale set should be placed near the top and the other at the bottom, on opposite sides, and within the neatline. On smaller charts having an area of 620 square inches (4,000 square centimeters) and less, within the neatline, only one graphic scale set should be placed within the neatline.

b. On folded charts, when space permits, a graphic scale set shall be placed on alternate panels so that every two adjoining panels with a down-fold contain a scale set. A scale set should not be placed on folds of the printed chart.

c. Scales shall be positioned horizontally, parallel to the border frame, preferably on land area and/or near the chart title.

d. No linework of the bars shall be closer than 6 millimeters (0.236 inch) to the neatline (or the outside border when placed in the margin).

4. Construction Specifications and Units

a.. Graphic scales shall be shown in the following sequence, reading from top to bottom:

1. International nautical miles
2. Statute miles
3. Yards
4. Meters

This sequence shall remain constant, even though all four scales may not be required for all charts.

The natural scale of the chart shall be computed and labeled as a one-line ratio -- e.g., "SCALE 1:40,000". Note that "natural scale" is defined as the scale of the chart at its central parallel and is not necessarily the common central parallel of a series of charts used for projection computation (which may be outside the chart limits). This natural scale and its central parallel are also used in the chart title.

Single stroke vertical type shall be used for all labeling.

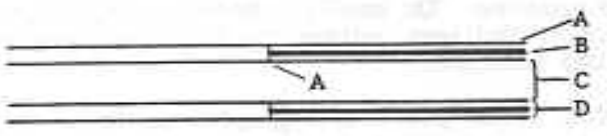
The center shading line shall be shown in each scale, except meter, in alternate major divisions beginning with the second division to the right of the reference zero. The use of the shading line in the minor division units to the left of the reference zero is optional; but if used, it should begin in the first unit left of the reference zero.

The following major divisions are to be used on yard and meter scales:

1:10,000 and larger	--	units of 100
1:10,001 to 1:20,000	--	units to 500
1:20,001 to 1:90,000	--	units of 1,000
1:90,001 to smaller	--	units of 2,000

Subdivisions on all scales shall be decimal parts of the major division.

Lineweight and spacing shall conform to these specifications:



A = .10 mm
B = .25 mm
C = 6.0 mm (space between)
D = 1.3 mm (inside dimension)

No scale shall exceed a maximum length of 185.2 millimeters.

Portions of scales may be used on insets and charts of small neatline area when space is limited.

5. Equivalents

Following is a list of the official conversion values to be used for measurements on nautical charts. Figure 2-13 shows commonly used chart scales and equivalents.

1 international nautical mile = 1,852 meters
1 statute mile = 1,609.344 meters
1 yard = 0.9144 meters
1 foot = 0.3048 meters
1 inch = 25.4 millimeter

6. Automated Production

Graphic bar scale sets complete with labeling can be produced by automated methods. Requests for these sets should be coordinated through the Chief, Marine Chart Division, and should include the following:

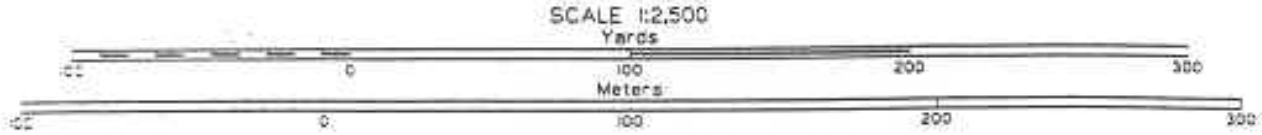
1. Scale of set
2. Whether statute mile bar scale is to be included
3. Whether standard width or shortened to specified units (for insets, etc.) is desired

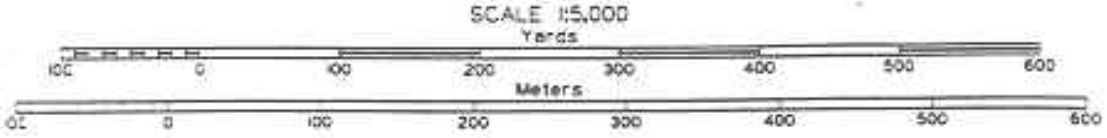
Examples of graphic bar scale sets for the most commonly used chart scales are shown in Figure 2-14. These examples should not be used for precise measurements. Sets for use at other charting scales can also be generated.

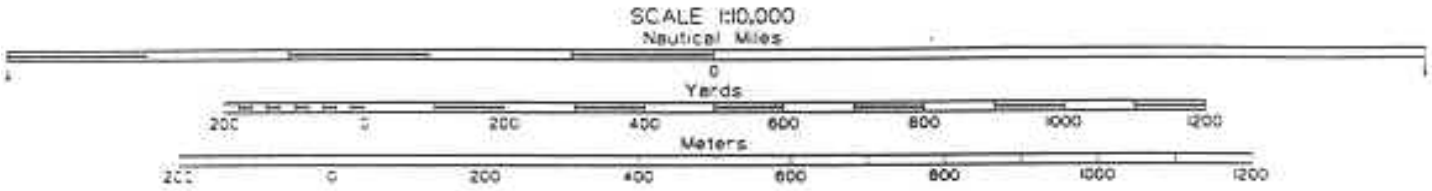
COMMONLY USED CHART SCALES AND EQUIVALENTS

Fractional scale	Dimensions are in millimeters			
	Int. Naut. Mile	Statue Mile	Meters	Yards
			100	100
1:2,500	740.800	643.738	40.000	36.576
1:5,000	370.400	321.869	20.000	18.288
1:10,000	185.200	160.934	10.000	9.144
			500	500
1:12,500	148.160	128.748	40.000	36.576
1:15,000	123.466	107.290	33.333	30.480
1:20,000	92.600	80.467	25.000	22.860
			1,000	1,000
1:25,000	74.080	64.374	40.000	36.576
1:30,000	61.733	53.645	33.333	30.480
1:40,000	46.300	40.234	25.000	22.860
1:50,000	37.040	32.187	20,000	18.288
1:60,000	30.867	26.822	16.667	15.240
1:80,000	23.150	20.117	12.500	11.430
1:100,000	18.520	16.093	10.000	9.144
1:120,000	15.433	13.411	8.333	7.620
Formula	$\frac{1,852}{\text{Scale } (1,000)}$	$\frac{1,609.344}{\text{Scale } (1,000)}$	$\frac{1,000}{\text{Scale } (1,000)}$	$\frac{914.4}{\text{Scale } (1,000)}$

Figure 2-13

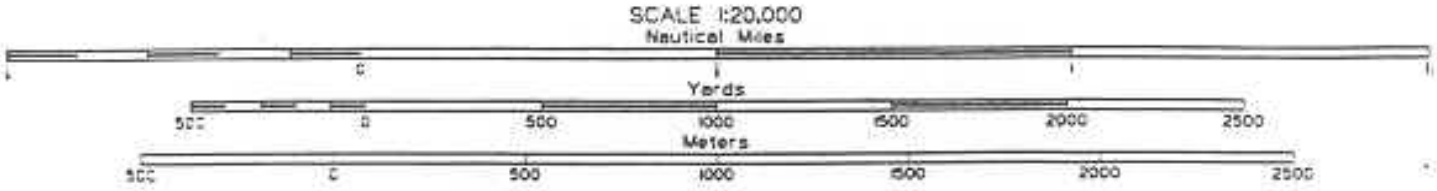

SCALE 1:2,500
Yards
0
100
200
300
Meters
0
100
200
300

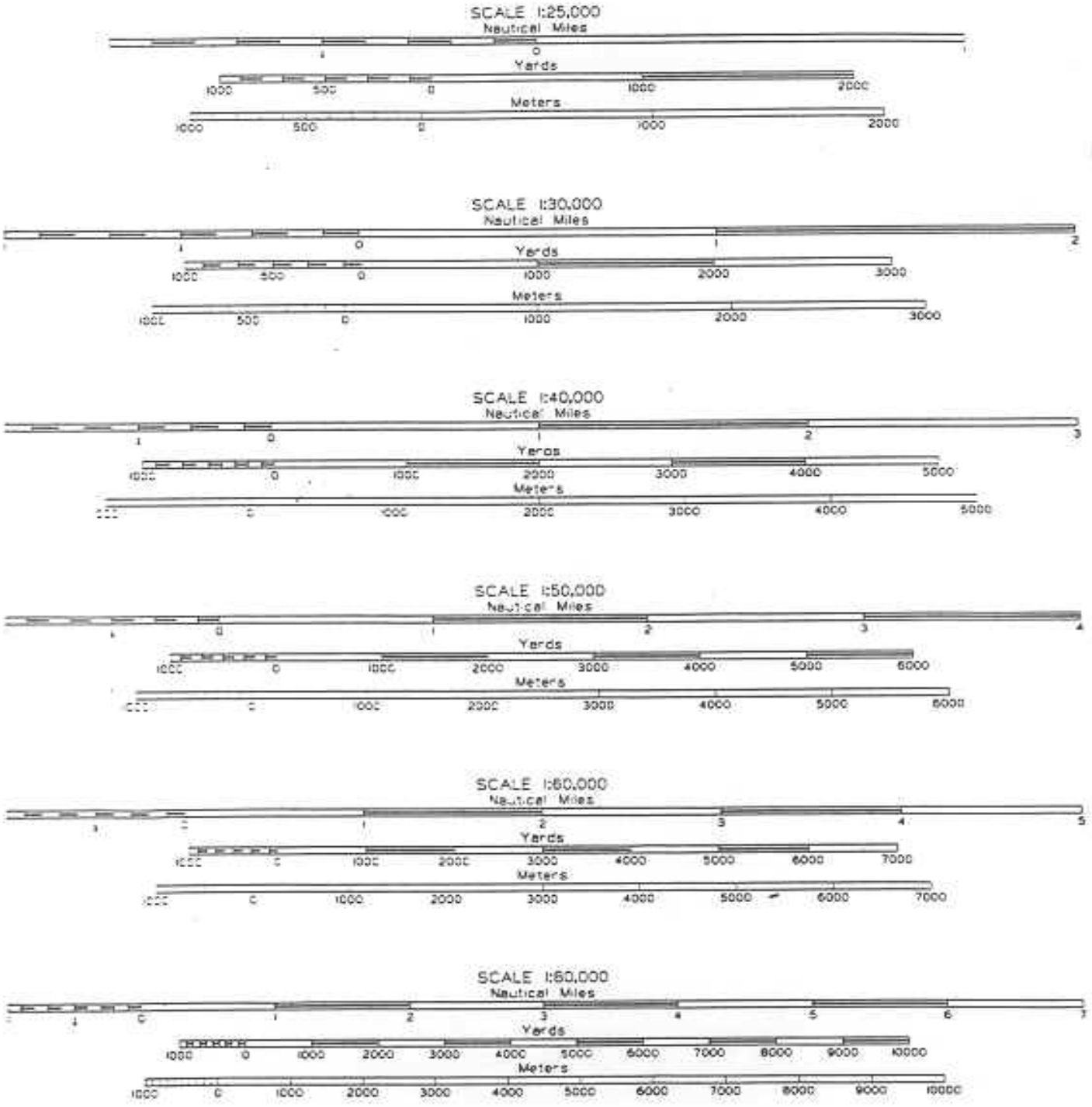

SCALE 1:5,000
Yards
100
0
400
200
300
400
500
600
Meters
0
100
200
300
400
500
600

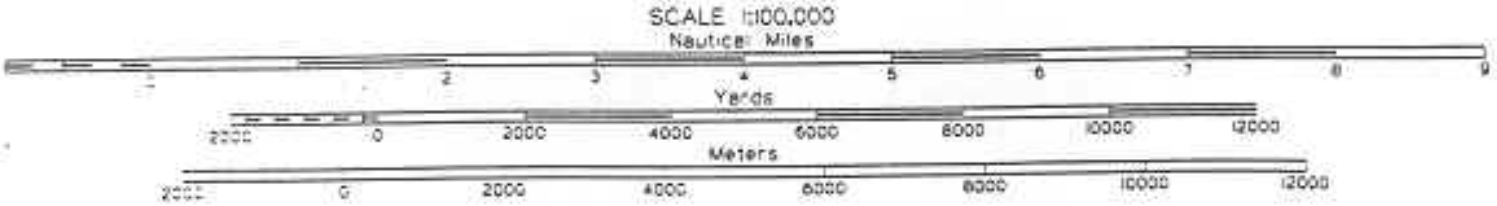

SCALE 1:10,000
Nautical Miles
0
Yards
200
0
200
400
600
800
1000
1200
Meters
0
200
400
600
800
1000
1200

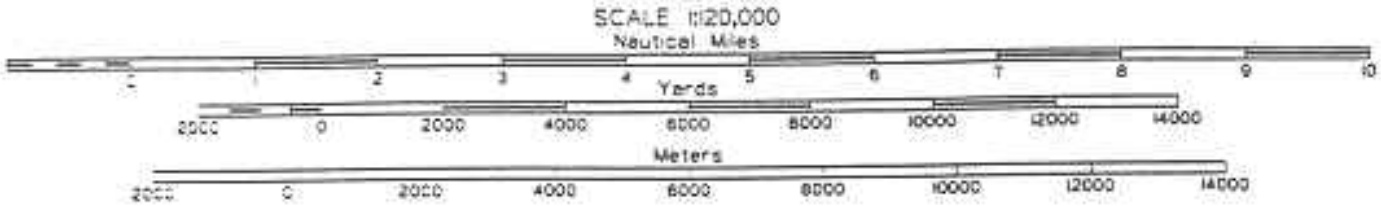

SCALE 1:12,000
Nautical Miles
0
Yards
500
0
500
1000
Meters
500
0
500
1000

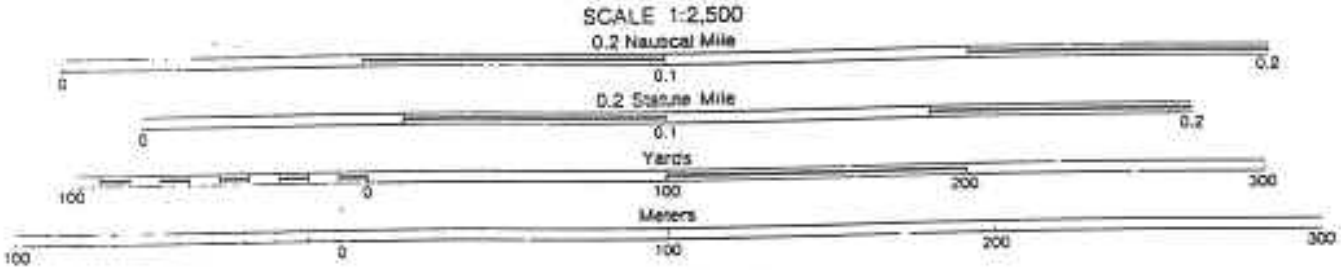

SCALE 1:15,000
Nautical Miles
0
Yards
0
500
1000
1500
Meters
0
500
1000
1500

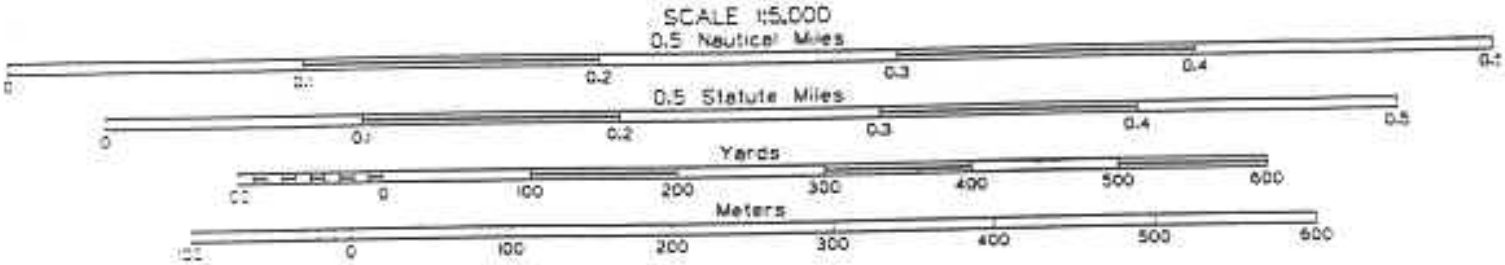

SCALE 1:20,000
Nautical Miles
0
Yards
0
500
1000
1500
2000
2500
Meters
0
500
1000
1500
2000
2500

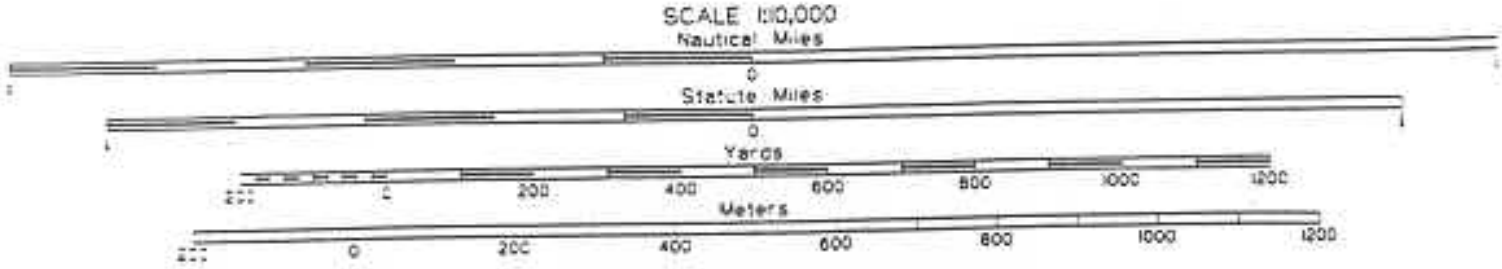

SCALE 1:25,000
Nautical Miles
Yards
1000 500 0 1000 2000
Meters
1000 500 0 1000 2000
SCALE 1:30,000
Nautical Miles
Yards
1000 500 0 1000 2000 3000
Meters
1000 500 0 1000 2000 3000
SCALE 1:40,000
Nautical Miles
Yards
1000 0 1000 2000 3000 4000 5000
Meters
1000 2000 3000 4000 5000
SCALE 1:50,000
Nautical Miles
Yards
1000 0 1000 2000 3000 4000 5000 6000
Meters
1000 2000 3000 4000 5000 6000
SCALE 1:60,000
Nautical Miles
Yards
1000 0 1000 2000 3000 4000 5000 6000 7000
Meters
1000 2000 3000 4000 5000 6000 7000
SCALE 1:80,000
Nautical Miles
Yards
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
Meters
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

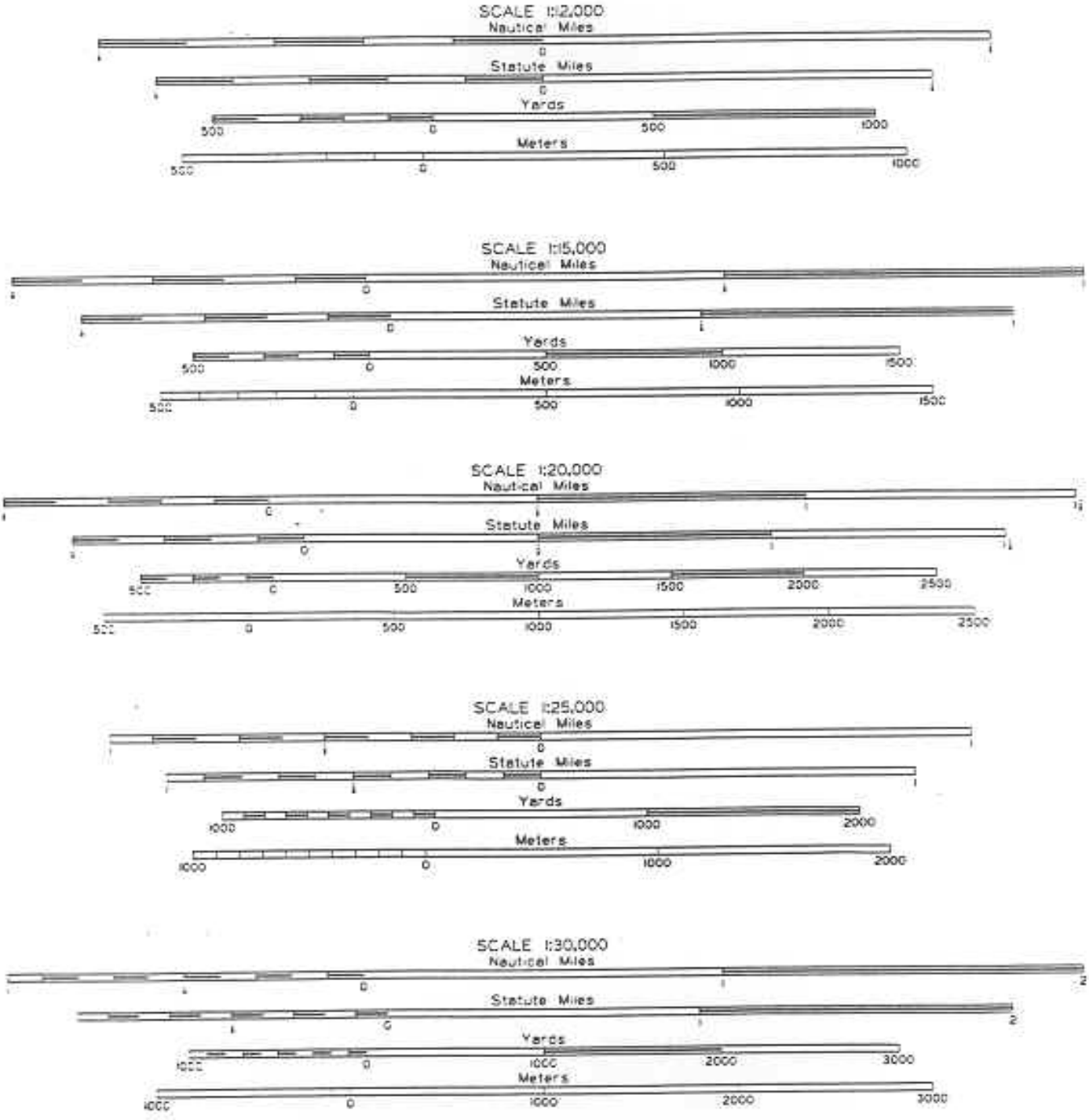

SCALE 1:100,000
Nautical Miles
1
2
3
4
5
6
7
8
9
Yards
2000
0
2000
4000
6000
8000
10000
12000
Meters
2000
0
2000
4000
6000
8000
10000
12000

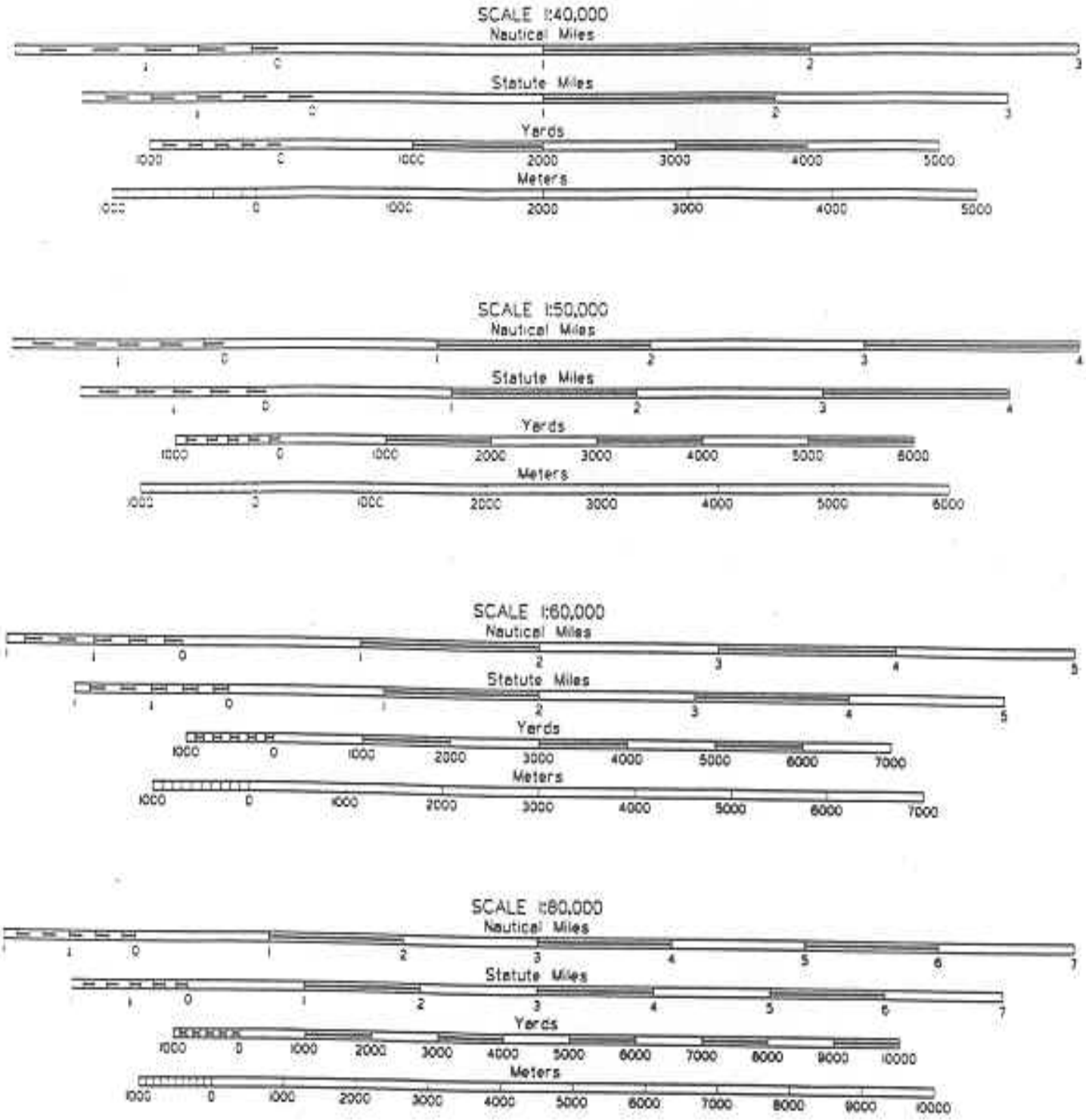

SCALE 1:20,000
Nautical Miles
1
2
3
4
5
6
7
8
9
10
Yards
2000
0
2000
4000
6000
8000
10000
12000
14000
Meters
2000
0
2000
4000
6000
8000
10000
12000
14000


SCALE 1:2,500
0.2 Nautical Mile
0
0.1
0.2
0.2 Statute Mile
0
0.1
0.2
Yards
100
0
100
200
300
Meters
100
0
100
200
300


SCALE 1:5,000
0.5 Nautical Miles
0
0.1
0.2
0.3
0.4
0.5
0.5 Statute Miles
0
0.1
0.2
0.3
0.4
0.5
Yards
0
100
200
300
400
500
600
Meters
0
100
200
300
400
500
600


SCALE 1:10,000
Nautical Miles
0
Statute Miles
0
Yards
0
200
400
600
800
1000
1200
Meters
0
200
400
600
800
1000
1200


SCALE 1:12,000
Nautical Miles
Statute Miles
Yards
500
0
500
1000
Meters
500
0
500
1000
SCALE 1:15,000
Nautical Miles
Statute Miles
Yards
500
0
500
1000
1500
Meters
500
0
500
1000
1500
SCALE 1:20,000
Nautical Miles
Statute Miles
Yards
500
0
500
1000
1500
2000
2500
Meters
500
0
500
1000
1500
2000
2500
SCALE 1:25,000
Nautical Miles
Statute Miles
Yards
1000
0
1000
2000
Meters
1000
0
1000
2000
SCALE 1:30,000
Nautical Miles
Statute Miles
Yards
1000
0
1000
2000
3000
Meters
1000
0
1000
2000
3000


SCALE 1:40,000
Nautical Miles
Statute Miles
Yards
Meters
SCALE 1:50,000
Nautical Miles
Statute Miles
Yards
Meters
SCALE 1:60,000
Nautical Miles
Statute Miles
Yards
Meters
SCALE 1:80,000
Nautical Miles
Statute Miles
Yards
Meters

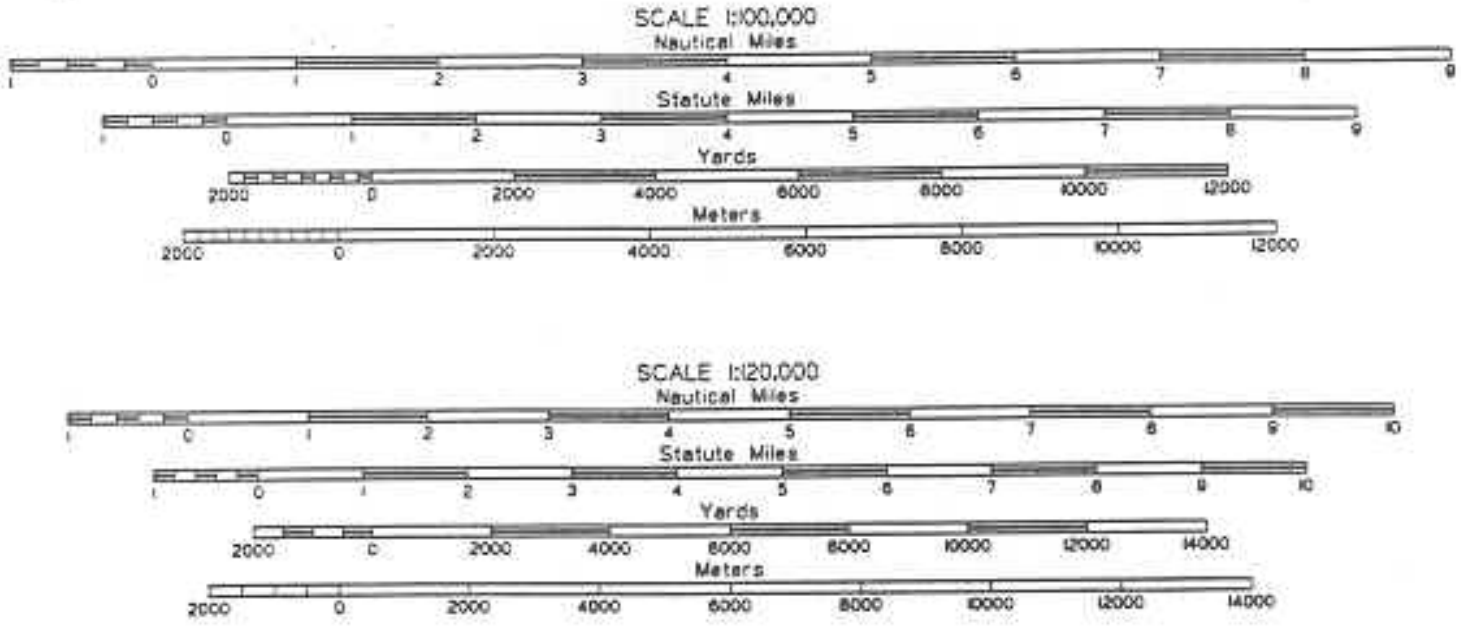


Figure 2-14

2.10.3 Logarithmic Speed Scale

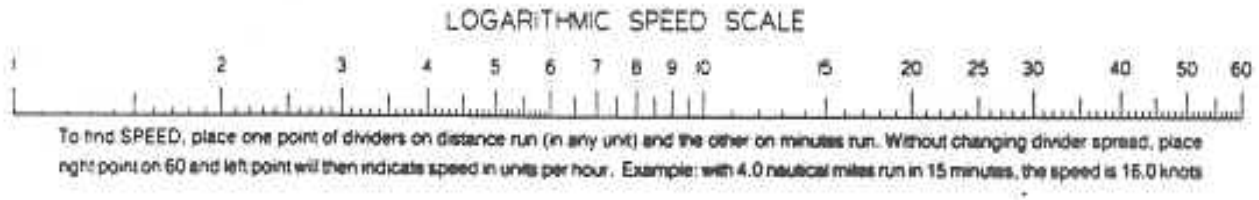
1. Use on Charts

A logarithmic speed scale shall be placed on all charts of 1:40,000 scale and larger. It may be placed on smaller-scale charts only if it will be of service to users. This will include charts designed for recreational use (e.g., those which carry listings of marine facilities) and certain smaller-scale charts of very active areas where there is no chart coverage of 1:40,000 scale or larger.

This scale shall be placed inside the neatline of the chart when space permits.

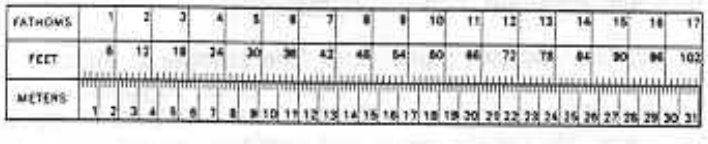
Only the standard logarithmic speed scale on file in MCD shall be used.

An example of a logarithmic speed scale follows:



2.10.4 Depth Conversion Scale

Depth conversion scales have been designed for both horizontal and vertical placement (see Figure 2-15). A scale's placement on a chart shall be based on the following order of preferences:



A. Depth conversion scale for Horizontal Placement

Figure 2-15

B. Depth conversion scale for Vertical Placement

1. Conventional Charts:

First preference is to place the horizontal version 2.5 millimeters outside the lower border and 15 millimeters left of the subtitle.

Second preference is to place the horizontal version within the chart neatline and adjacent to a graphic bar scale.

Third preference is to place the vertical version within the chart neatline near the left or right neatline.

2. Small-Craft Charts

The second or third preference above shall apply because of limited margin space.

Scales placed within the neatline should be placed on a land area if possible, and not closer than 6 millimeters (0.236 inch) to the neatline.

2.10.5 Latitude and Longitude Plotting Interpolator

A latitude and longitude plotting interpolator (see example in Figure 2-16) serves as an aid in plotting geographic positions on Great Lakes polyconic charts at scales of 1:50,000 or smaller. The interpolator,

similar to the LORAN-C interpolator and others, is designed to compensate for the converging meridians on polyconic charts. A number of interpolators are available and the proper size should be selected for a given chart depending on the spacing of projection lines. One interpolator is required for each chart.

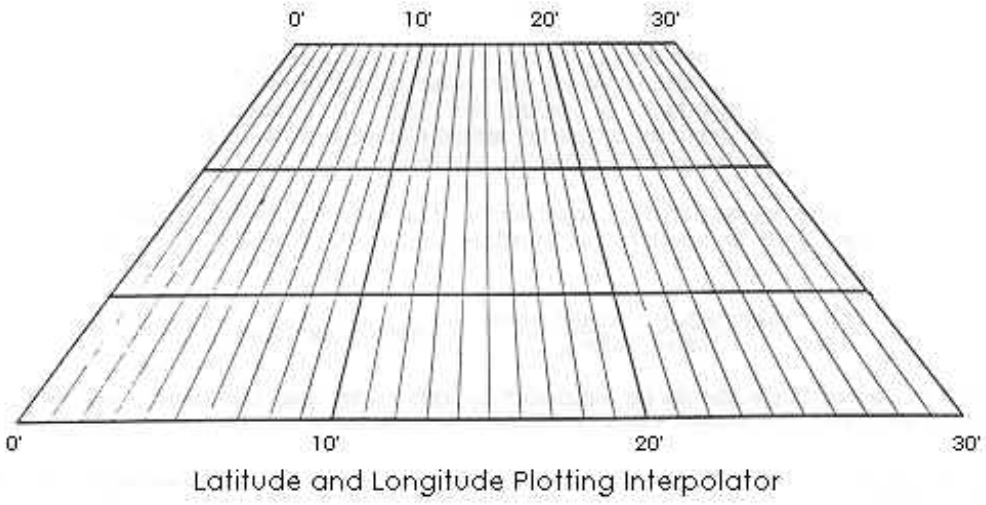


Figure 2-16

For charts and insets at scales larger than 1:50,000, the convergence of meridians is small enough so that a subdivided plan border will suffice for plotting geographic positions.

Interpolators will remain on the designated Great Lakes charts until the charts are reconstructed and converted to Mercator projections.

2.10.6 Scaling and Plotting

1. Scaling Positions

Geographic positions -- that is, latitude and longitude -- are required for many points located on graphic source materials in order to be included in the automated system. For convenience, the latitude and longitude are given in degrees and minutes with the seconds of arc in meters. The accuracy of the positions of photo (topo) points and topographic points does not warrant the scaling of the positions of these points to tenths of meters. Therefore, the seconds of arc in meters shall be scaled and corrected for any distortion of the manuscript to the nearest meter and shall be checked with the same accuracy.

The seconds in meters may be scaled or checked with a beam compass and metal meter scale, the Lockerbie Diagonal Scale, the Sylar-Lockerbie Scale, or a triangular centimeter scale if the scale (or a section thereof) is subdivided to 0.5 millimeters.

The Lockerbie Diagonal Scale may be used as follows scaling the meridional differences (dms) parallel differences (dps) of points. The zero of the scale (the small space between the two lines at the base) can be placed over the given point and any vertical line of the scale placed in coincidence with the nearest meridian line. Without further adjustment, the seconds in meters between the point and a parallel of latitude are indicated at the place where the parallel intersects one of the diagonal lines of the scale. The same process is followed to scale the longitude, except the vertical line is placed in coincidence with the nearest parallel. The seconds in meters between the point and a meridian are indicated at the place where the meridian intersects one of the diagonal lines of the scale.

The Sylar-Lockerbie Scale consists of four Lockerbie scales printed in a single diagram on the underside of a thin sheet of transparent plastic. The center point of the scale is placed directly over the point to be scaled. The vertical line of the scale nearest a meridian is oriented parallel to that meridian. The four quantities in meters forward latitude, back latitude, forward longitude, and back longitude can all be measured at the one setting. This scale is obtainable in two scale ratios -- 1:10,000 and 1:20,000.

A triangular centimeter scale with 0.5-millimeter subdivisions is useful for scaling the positions of stations on manuscripts at scales of 1:10,000 and 1:20,000. On these manuscripts, the seconds in meters may be read directly. To do so, the centimeter scale must be held parallel with the nearest meridian for scaling latitudes and parallel with a parallel of latitude for scaling longitudes, except when the manuscript is of a scale slightly smaller than 1:10,000 or 1:20,000. In the latter case, the scale is placed at a slight angle to the projection lines so that it bisects the point, the zero of the scale coincides with one meridian or parallel and the exact reading on the scale (corresponding to one subdivision of the projection at the latitude of the station) coincides with the opposite meridian or parallel. The value of the seconds in meters of latitude or longitude of the point can then be read directly from the scale. This method compensates for the scale error of the projection, and the values need not be corrected.

2. Correction for Scale Error of the Projection

Map manuscript projections often are not exactly at even scales, such as 1:10,000 or 1:20,000. Consequently, the dms or dps must often be corrected for the scale difference of the manuscript projection. In scaling positions, the manuscript projection should always be checked for scale by comparing scaled distances between projection lines with the corresponding values given in Special Publication No. 5.

To correct distances scaled from manuscripts that are distorted or constructed at a scale slightly larger or smaller than standard scales, the following relation should be used:

$$\frac{\text{tabular value} - \text{scaled value}}{\text{scaled value}} = \text{correction factor}$$

Each scaled distance should be multiplied by this factor and the amount added to or subtracted from the scaled value to obtain the true value.

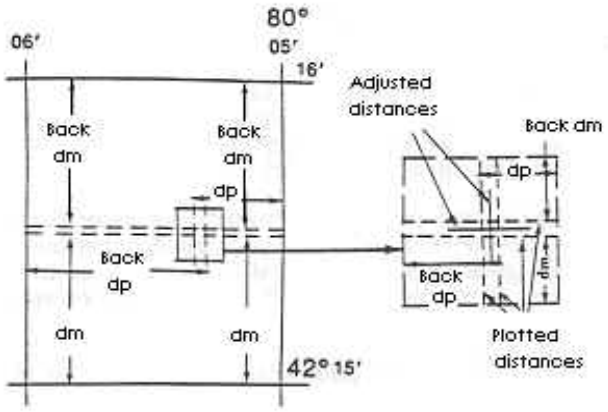
To plot a station on a distorted manuscript or one constructed at a scale slightly larger or smaller than standard scales, the following relation should be used:

$$\frac{\text{tabular value} - \text{scaled value}}{\text{tabular value}} = \text{distortion factor}$$

Each true value that is to be plotted on the manuscript should be multiplied by this factor and the amount added to or subtracted from the true value.

3. Plotting Positions

The positions of landmarks and fixed aids to navigation determined to third-order or higher accuracy shall be plotted from the computed values of latitude and longitude. The differences along adjacent meridians (dms) and the differences along adjacent parallels (dps) are plotted from the south parallel and east meridian, respectively, using a beam compass and metric scale (see below). Dividers can be used to measure short distances, but they become less accurate when spread appreciably. The dm and dp values (in meters) shall be marked by fine prick points adjacent to each set of projection lines and then connected by fine pencil lines. To check the plotting and to compensate for sheet distortion, plot the back dms and back dps from the north parallel and the west meridian. Distortion, if present, will be proportional between each set of dm and dp parallel lines. The position of the station at the intersection of the final dm and dp lines is marked by a fine needle hole that can be blackened by rotating a sharp pencil point in the hole. Ink should never be used to mark the point. The plot of the position shall be checked by the same method.



2.11 Chart Outlines and Diagrams

Chart outlines and diagrams are used to display larger scale overlapping or adjoining chart coverage on smaller scale charts. The intent is to provide the user with a reasonably complete reference by

using the chart in hand to assist in the transition from one chart to another, and to indicate the location of larger scale charts for more detailed use. This is especially important where hydrography has been eliminated on a smaller scale charts due to larger scale chart coverage.

Two methods of indicating the larger scale chart coverage may be used:

1. By directly outlining the larger scale charts

2. By showing a chart index diagram

The outlining method is preferred, although there may be instances where the legibility of the chart could be impaired by the use of additional linework. In these circumstances, a chart index diagram may be more desirable if space is available. Only in exceptional instances may both methods be used on the same base chart.

Outline method:

1. The chart outlines shall be shown with a screened unbroken line of 0.25 mm lineweight. The outline shall be a 25 percent, 200-LPI biangle screened black line for NOS charts, a 33 percent, 200-LPI biangle screened blue line for NGA charts, and a 33 percent, 200-LPI screened gold line for foreign charts.

2. The overall coverage of the larger scale chart being diagramed shall be shown, without interior linework for insets and extensions. Insets and extensions should be shown as part of this outside limit to show the complete area covered by the large-scale chart.

3. All labels referring to outlines shall be in the same color and screen tint as the lines. Although the labels will be made somewhat transparent by screening, they should be placed to avoid overprinting critical information.

4. Labels should be 12 pt. Swiss Light type style and should consist of only the chart number and scale. Size may be smaller as needed.

Diagram method:

1. Placement: preferred placement of the diagram is on land area as space permits, but not closer than 6.0 mm to the neatline of the chart. Its location should not displace any of the more important notes normally shown in a grouping. The index must not obscure important hydrographic detail.

2. Size: the size of the index is controlled to a great extent by the placement. The neatline

limits of the index shall be the same as the neatline limits of the chart on which it is placed. The scale should correspond to the chart catalog scale. Multiples of fractions of 50 percent thereof may be used when needed to enlarge for legibility or reduce to fit space.

3. Charts diagramed: next larger scale charts must be shown, with all larger scale charts being shown only where legibility permits. Smaller scale charts may be shown when considered essential information for the chart user.

4. Nomenclature: major waterways and other large and important water features must be shown as well as the largest metropolitan areas. The selection of names will be a matter of judgement in many cases, but it should be remembered that these names will provide primary chart orientation for the user.

The approximate position circle symbol may be used for larger metropolitan areas.

Boundary lines should be avoided.

5. Avoid projection lines and north arrows. Show only minimum projection ticks and label with black 6 pt. Swiss Light type style. The index, having same neatline limits as the chart, shall also be oriented the same as the chart.

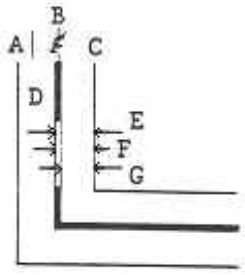
6. Notation: the statement "For detailed information use larger scale charts," in black, and tabulation of the charts with their scales shall be placed within the diagram. The chart outlines shall be labeled only with the chart number. Leaders may be used to improve legibility. Six pt. Swiss Light style type shall be used for all chart labels, tabulations, and the note. The tabulated charts shall be in the same color as their outlines (item 7).

7. Colors, screen tints, and line specifications:

The water area shall be untinted.

The land tint shall be gold 20 percent 120-LPI; the use of the urban screen should be avoided.
Shoreline: 0.15 mm black
NOS chart outlines: 0.25 mm black
NGA chart outlines: 0.25 mm blue
Foreign chart outlines: 0.25 mm gold

Diagram border detail:



A. Chart neatline
B. Diagram border, 0.8 mm
C. Diagram neatline, 0.1 mm
D. 6.0 mm minimum space
E. 6.1 mm
F. 5.7 mm
G. 5.3 mm

Any deviations from these guidelines must be approved by the Chief, QAPSB.

2.12 Type

The style, size, and spacing of type used on charts published by NOS are illustrated in the Type Specifications section of this manual.

In determining the size of type to be used, the cartographer should give the maximum size to the main line of the title. All other type should be smaller. Minor names of only local importance should be inconspicuous. The space available on the chart and the relative importance of the feature to which the name or term applies should be considered in selecting the size and spacing of the type. The legibility of place names is usually improved by increasing the space between the letters.

2.13 Chart Histories

2.13.1 Compilation Histories

The data applied to create a new edition of a nautical chart should be reflected on the chart history with the corresponding edition number. For example, the history for the first edition of a chart would be labeled "Edition No. 1".

As we operate today there are manual chart histories, automated chart histories and CRIT histories. All histories for the same edition of a chart shall carry the same edition number. All Chart Histories shall carry the edition number of the next edition of the chart in the space marked "EDITION NO." As an example, if the printed chart is the 10th edition, the Chart Histories being prepared for the next edition would be completed as "EDITION No. 11".

The "History of Cartographic Work," commonly known as a "history," is continually maintained to document the application of all source material. This form is the only permanent record of the compilation process. For this reason it must represent a complete and detailed record of all available information used or consulted in the compilation, whether it results in a New Chart, Reconstructed Chart, New Edition, Revised Print, or chartlet. The information used for the compilation may come from

various types of surveys and records such as hydrographic surveys and accompanying descriptive reports, photogrammetric maps and descriptive reports, blueprints, letters, chart evaluation surveys and reports, field examinations and reports, USACE reports, triangulation records, and the many other sources listed in Section 2.3.

It is the cartographer's duty to obtain, whenever possible, any available information in addition to that on record in NDB which is pertinent to the job in hand. Each piece of source material containing an item falling within the chart limits must be entered on the history and the disposition of each item clearly stated. In addition to source material, other sources of information affecting charting policy must also be identified on the history with a brief explanation of the charting action taken. This would include Cartographic Orders, memos, format changes, etc. Items which are unavailable or which the cartographer cannot fully apply must also be accounted for on the history.

Standard abbreviations should be used to conserve space.

The history is divided into five major sections, each of which is discussed here separately. A sample chart history form is included as Figure 2-17.

CHART 14763 DRAWING NO. 676M SHEET 1 OF PROJECT	NOAA FORM 76-71 (10-84) USCOMM-DC 51887-P72 NC REC CORR FUTURE DATE	HISTORY OF CARTOGRAPHIC WORK TO REPRODUCTION NC NE NP RP TO DATE	U.S. DEPARTMENT OF COMMERCE NOAA NATIONAL OCEAN SERVICE PROOF REC'D ☐ NO PROOF ORDERED PROOF VER PRINT DATE

REMARKS

ITEMS	COMPILED BY (Signature)	STARTED DATE	COMPLETED DATE	TIME (Hours)	CHECK LIST	COMPILER (Initial)	REVIEWER (Initial)
1	Joe Gentile	4-19	4-19-93	1.0	Data applied thru all larger scales where applicable		
2, 3	Betty Szatkowski	3-17-94	3-17-94	1.0	All overlaps at same scale in full agreement		
4, 5	Elizabeth Rwazk	4.8.97	4.8.97	2.0	General comparison with next larger scales		
6	Judith	9-15-97	9-15-97	2.0	Photo corrections examined		
					All colors checked for interference		
					All color changes clarified for engraver		

ITEMS	REVIEWED BY (Signature)	STARTED DATE	COMPLETED DATE	TIME (Hours)
1	[illegible]	4-20-93	4-20-93	.1
2-3	Tommie [illegible]	4/4/94	4/4/94	1.0
4, 5, 6	[illegible]	5-6-97	5-1997	1.0

APPLIED PART	APPLIED FULL	ITEM NO.	SOURCE OF INFORMATION FILE NO.	DATE	AUTHORITY	TYPE OF INFORMATION	LOCALITY (Use Lat./Long.)	INFORMATION APPLIED
	✓	1	Prepared		NLA	Dig	For	This Chart
	✓	2	BP150547	10-1993	CofE	Condition	44°42' 32.2" 75°28' 58"	Revise from: 18 FEET SEPT 1992
								TO: 18½ FEET OCT 1993
							44° 42' 25" 75° 29' 17"	Revise from: 18 FEET SEPT 1992
								TO: 17½ FEET OCT 1993
							44° 42' 49" 75° 28' 37"	Revised Sdg and depth curve
								Revised Sdg in channel thru
								Aid Proof History Item "C"
	✓	3	L1476/93	11-1993	CofE	TAB	Ogdensburg Harbor, N.Y.	No Correction
	✓	4	L126/97	1-24-97	CofE	Condition	Ogdensburg Harbor, N.Y.	App. thru BP160236 - 160237
	✓	5	BP160236	9-24-96	CofE	Condition	Ogdensburg Harbor NY	Revised 24 ft curve
			BP160237					
						Legend	44° 42' 31.7" 75° 29' W	Revised from 19 FEET AUG 1994
								TO: 18 FEET SEP 1996
						Soundings	44° 42' 27.5" 75° 28' 34"	Deleted 10 ft 7 ft sndgs
							44° 42' 22.3" 75° 28' 32.8" W	Revised 7 ft to 9 ft sndg

Figure 2-17

1. The Heading

The Heading is located at the top of the form extending across the page. Beginning on the left, the cartographer shall fill in chart number, drawing number, sheet number, and project number. The block titled "Future" is filled in and date-stamped when the chart is forwarded for reproduction. The block titled "To Reproduction" is filled in and date-stamped by NDB. The "Proof Received" area is filled in by the production branch. If proofs are ordered, the first line shows the date they are received and the second line is the cartographer's initials. The "Print Date" is filled in by the production branch after the chart is printed. Comments of significant importance are added in the "Remarks" area by the cartographer or reviewer.

2. The Check List

The Check List consist of a list of six items that the cartographer and reviewer must initial to verify that each item has been completed. If an item has not been completed, the cartographer or reviewer shall enter "see item #___," Referring to the item number in the Information Section which corresponds to the entry. A brief explanation of why the entry could not be completed must be included in the Information Section.

3. "Compiled By" Section

This section begins with a column is labeled "Items," which refers to the item numbers the cartographer assigns to source material used in the compilation process. These item numbers are found in the Information Section (which should be completed before this section). The cartographer should enter the number of the first item applied, followed by a dash, and then the last consecutive item number applied. The cartographer also notes the starting date and date of completion, as well as the total time spent applying these items (in hours to the nearest half hour).

4. "Reviewed By" Section

This section, located below the Check List, is filled in by the reviewer in the same way as the "Compiled by" section.

5. Information Section

This section of the history, which comprises the lower half of the form, is divided into several columns, each of which will be explained separately. The Information section is filled in by the cartographer.

a.. Applied

This column is used to indicate whether an item has been partly or fully applied. It is also used to show that an application has been deferred or that an item is unavailable or could not be located.

When the application of an item is deferred, the cartographer shall enter "FWD" (forward), through both the "Part" and the "Full" columns. The cartographer must then enter an explanation of why this action was taken in the "Information Applied" column.

If a source document is unavailable or cannot be located, it should be handled as a deferred item. The cartographer should include a reference to the last date the item was not located or was unavailable.

If an item has been partially applied, the cartographer shall place an X in the column under "Part."

If an item has been fully applied, the cartographer shall place an X in the column under "Full."

Under no circumstances shall an item be considered fully applied unless it results in a complete application of all pertinent information from the source document.

Incompletely processed hydrographic and topographic surveys can never be fully applied. Chapters 3 and 4 of this manual explain the processing stages for these documents.

b. Item Number

The cartographer shall number each item consecutively. In the event two or more items refer to each other -- i.e., a USACE channel tabulation and a USACE survey it was compiled from, they may be indicated by one number.

c. Source of Information

These entries should clearly identify the source document.

(1) File No.

If a document has been formally registered as a valid source document (given a document number), the cartographer shall enter this identification number. In all other cases, the cartographer shall enter the originator's identification as the file number.

In the case of hydrographic or topographic surveys, the cartographer shall indicate the status of the survey.

If a blueprint is a copy of a hydrographic or topographic survey, the cartographer shall indicate the survey number.

If the source document has been partially applied or forwarded, the cartographer shall underline the file number.

(2) Date

For cartographic orders, geographic names standards, hydrographic surveys and topographic surveys, the cartographer shall enter the year of the document. For all other documents, the cartographer shall enter the full date (month/day/year) where it can be established.

(3) Authority

In this column the cartographer shall enter the original source of the document, not an intermediate source.

d. Type of Information

In one or two words, the cartographer shall state the general type of information contained in the source document.

e. Locality

In this column, the cartographer shall enter the latitude and longitude of the source document or item applied. For documents which cover a large area, the cartographer shall give the limits of the area covered. On small-scale charts or where a small area is covered, the cartographer shall use an approximate center point. If the document covers the entire limits of the chart, the cartographer shall enter "Entire Chart." If several items, especially landmarks, are applied from one document, each position must be listed separately. The name of the river or channel and the stationing along the channel should be listed for USACE channel surveys.

f. Information Applied

In this column the cartographer shall briefly describe what was applied from the source document. If the application was made through a larger-scale chart, this must be stated. It is important that this entry accurately but briefly describe what was applied to the chart.

Any explanations or other information that may be of use to the reviewer or to another cartographer in the future should also be included.

A brief statement giving the reason a document is partially applied or forwarded shall also be entered in this column.

2.13.2 Section no longer exists.

2.13.3 Section no longer exists.

2.14 Section no longer exists.

2.15 Cartographic Tools

2.15.1 Section no longer exists.

2.15.2 Computer-Supported Reductions

Scanning and warping can be used to reduce paper source documents to chart scale. Digital reductions, enlargements, and enhancements are primary cartographic tools.

2.16 Standards

2.16.1 General

The public is informed of cartographic standards by publication of new or revised symbology on nautical charts with explanations published in the Coast Pilots as authorized by the legislative authorities:

1. Organic Act of February 10, 1807 (2 Stat. 4134)
2. Appropriations Act of 1843
3. Act of August 6, 1947, (61 Stat. 787); (33 USC 883a and 883b)
4. Act of April 5, 1960 (74 Stat. 16)
5. Department of Commerce Organization Order 25-58, July 11, 1971
6. 33 CFR 164

Cartographers of NOS apply the standards to the products through various internal documents such as this manual and updated cartographic directives. Most standards used in compilation of nautical products are obtained or derived from U.S. Government sources, or are developed within the agency. Other standards are adopted from the IHO and the CHS.

NOS charts are continually examined for conformance to standards for plotting of data; accuracy, completeness, and clarity of depiction of detail; and adherence to printing standards for color rendition, registration of colors, and lithographic screening.

NOS participates in the activities of standards development of the IHO, NGA, DOD, the U.S.-Canada Hydrographic Commission, the American Congress on Surveying and Mapping, and the American Society of Photogrammetry. It also participates with other groups, such as the USCG and the United Kingdom Hydrographic Department, as the occasion dictates.

Primary activities of standards development focus on the uniform worldwide standards developed and recommended by the IHO (whose 53-country participating membership includes the United States, represented jointly by NOS and NGA). All member countries vote on the proposals, and those adopted are promoted worldwide in an attempt to achieve uniform standards for all chart products. This is a long-standing and ongoing effort. Any standards being considered for adoption by NOS are extensively researched; historical records, as well as information from the sources previously identified, are studied. NOS coordinates with NGA to ensure that all U.S. charts adhere to the standards as much as is practical. To this end, Chart No. 1, "Nautical Chart Symbols and Abbreviations" is jointly prepared by NOS and NGA.

A study is currently underway with the CHS to identify and resolve as many differences as possible between U.S. and Canadian charts without violating IHO and United States standards. The goal is to attain reasonable similarity in those charts for which the two countries exchange reproducibles.

2.16.2 Accuracy Standards

Accuracy is the most important requirement of a good nautical chart, and extreme care must be exercised so that no critical or essential information is omitted and such information is depicted in the most beneficial way. There are four considerations for an accurate depiction of information on nautical charts:

1. Depiction of information
2. Type of information
3. Accuracy of position
4. Relative accuracy

All four must be taken into consideration for any application of data.

Depiction of Information

A navigator must often read charts in the dim light of a pilot house with the ship pitching or rolling in a heavy sea. These conditions necessitate clarity and legibility in chart detail. The keynote of good charting is, therefore, accuracy with simplicity. The cartographer's constant challenge is to avoid encumbering the chart with detail which is not essential for navigation. A cartographer must choose the best way to portray information as well as judging its positional accuracy.

Type of Information

Whether information is judged critical or noncritical in respect to its positional accuracy may have bearing on whether it is used in compilation. A report of a dangerous wreck with an inaccurate position shall be used because it gives the mariner at least a warning that a dangerous obstruction is in the area, whereas an accurate position of a structure not considered an aid to navigation, landmark, or obstruction would not be used.

Accuracy of Position

Cartographers shall use the most accurate information available to them. Where possible, this positional information shall conform to the National Map Accuracy Standards (see Section 1 below).

Relative Accuracy

Accuracy of position, legibility, and consistency in selection and placement of charted features, names, notes, and other details are important requirements in nautical chart compilation. However, it may be more important for charted features to be in the correct relation to each other than to be shown in their correct geographic positions. A floating aid, for example, should be charted in the proper position relative to the danger it marks. Although this may be a degradation of the reported position, it serves the mariner better.

Charts differ from maps in many ways, one of which is that standardized specifications cannot be applied indiscriminately to charts. There is only one fundamental criterion which should be applied. Each detail should be assessed for its usefulness to some important class of chart user in the context of the surrounding details and the scale of the chart. Useless details should not be charted and minor features should be excluded if their inclusion would tend to obscure more important features.

Often a fine sense of judgment is required in interpreting source materials. When discrepancies between sources are encountered, every effort should be made to initiate investigations to determine true conditions.

1. U.S. National Map Accuracy Standards (NMAS)

Publication accuracy is specified in the National Map Accuracy Standards (NMAS) which are generally followed by most Federal mapping agencies. Whenever possible, nautical chart compilation should be held to these standards. These mainly apply to topography and culture, areas for which the NMAS were originally created. It is often not possible to hold to these standards in hydrography and in the many reports which result in charted features, such as dangers, obstructions, or shoaling.

The NMAS for published maps are as follows:

a.. Horizontal Accuracy

For maps on publication scales larger than 1:20,000, not more than 10 percent of the points tested shall be in error by more than 1/30 inch (0.8 mm; 0.033 in.), measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50 inch (0.5 mm; 0.020 in.). These limits of accuracy shall apply in all cases to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as benchmarks, property boundary monuments; intersections of roads, railroads, etc.; corners of larger buildings or structures (or center points of small buildings); etc. In general what is well-defined will also be determined by what is plottable on the scale of the map within 1/100 inch (0.25 mm; 0.010 in.). Thus while the intersection of two roads or property lines meeting at right angles would come within a sensible interpretation, identification of the intersection of such lines meeting at an acute angle would obviously not be practicable within 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test points within the limits quoted, even though their positions may be scaled closely upon the map. In this class would come timber lines, soil boundaries, etc.

b. Vertical Accuracy

As applied to contour maps on all publication scales, not more than 10 percent of the elevations tested shall be in error by more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.

The accuracy of any map may be tested by comparing the positions of points whose locations or elevations are shown upon it with corresponding positions as determined by surveys of a higher accuracy. Tests shall be made by the producing agency, which shall also determine which of its maps are to be tested and the extent of such testing.

Published maps meeting these accuracy requirements shall note this fact in their legends, as follows: "This map complies with National Map Accuracy Standards."

Published maps failing to meet these requirements shall omit from their legends all mention of standard accuracy.

When a published map is a considerable enlargement of a map drawing (manuscript) or of a published map, that fact shall be stated in the legend. For example, "This map is an enlargement of a 1:20,000-scale map drawing," or "This map is an enlargement of a 1:24,000-scale published map."

To facilitate ready interchange and use of basic information for map construction among all Federal map making agencies, manuscript maps and published maps, wherever economically feasible and consistent with the use to which the map is to be put, shall conform to latitude and longitude boundaries, being 15 minutes of latitude and longitude, or 7 1/2 minutes, or 3 3/4 minutes in size.

For international accuracy standards for hydrographic surveys, see Special Publication N0. 44, Book 1, "IHO Standards for Hydrographic Surveys", 2nd Edition, 1982, IHB, Monaco.

2. Review

Every source application must be thoroughly reviewed. This review must include every sounding, elevation, name, aid to navigation, and hydrographic and topographic feature. Special care must be taken to see that every danger, danger curve, and channel is distinctly and correctly represented. If changes are necessary, the compilation must be returned to the original compiler for correction; otherwise, the same type of mistake might be repeated.

Slight and unimportant inaccuracies ordinarily need not be changed. For instance, soundings need not be moved if the locations are in error by less than the accepted tolerance.

2.16.3 Displacement Tolerances

Maximum displacement tolerances for register, point and line data, and soundings on nautical charts should seldom exceed those stated here. These tolerances have evolved over the years by considering:

(1) The preservation of safety of navigation by the accurate portrayal of navigationally critical elements such as physical hazards along navigation routes, aids to navigation including landmarks and electronic positioning systems, and hydrography limiting the draft and width of vessels through passages;

(2) What is possible and practical in the manual chart production system (automated processes now in use and being developed are well within these values);

(3) Conformance to NMAS in the cumulative total, where possible.

1. Compilation Processes, Position Displacement from Source at Compilation Scale

a. Point data: All discrete points, including landmarks, fixed aids to navigation, etc., shall be located within +/-0.15 millimeter (0.006 inch) of the correct geographic positions as measured on the digital chart files or other final compilations, or on construction plates (as for New and Reconstructed Charts). Discrete points are defined as those points for which a geodetic or grid coordinate is given.

b. Line data, axis-to-axis: One-half the symbol lineweight to a +/-0.15 millimeter (0.006 inch) maximum displacement is acceptable.

c. Soundings: A displacement equal to one-half the height of a whole number, not including superscripts or subscripts is acceptable.

2. Position Displacement from Compilation

a. Point data: The maximum displacement acceptable is one-fourth of the diameter of the symbol dot or circle, or 0.15 millimeter (0.006 inch), whichever is less.

b. Line data, axis-to-axis: The maximum displacement acceptable is one-half the symbol lineweight to a 0.15mm (0.006 inch) maximum.

c. Soundings: A displacement value equal to one-half the height of a whole number, not including superscripts or subscripts, is acceptable.

3. Reproduction Mechanical Processes

a. Adherence to lineweight +/- 0.025 millimeter (0.001 inch)

b. Prepunch +/- 0.025 millimeter (0.001 inch)

c. Register marks between repromats +/- 0.05 millimeter (0.002 inch)

d. Vacuum frame film movement +/- 0.025 millimeter (0.001 inch)

e. Film compositing +/- 0.05 millimeter (0.002 inch)

f. Press printing register, colors to black +/- 0.1 millimeter (0.004 inch)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

MARCH 14, 2002

MEMORANDUM FOR: All Cartographers
Marine Chart Division

FROM: Fannie B. Powers
Chief, Quality Assurance, Plans and Standards Branch

SUBJECT: Nautical Chart Manual Correction Pages - Bar Code Example

Effective immediately, the following attachment replaces pages 2-85 and 2-86 in the Nautical Chart Manual, Volume 1, Part I, Seventh (1992) Edition, and serves to improve the legibility of the Bar Code example on page 2-85

Pages 2-85 and 2-86 are to be inserted into the Nautical Chart Manual, Volume 1, Part 1, Seventh (1992) Edition immediately after page 2-84.

Attachment

Note that the maximum potential errors do not usually occur throughout the chart but appear at only one place on the chart. These errors are considered insignificant when distributed this way provided the maximum tolerance limit is observed.

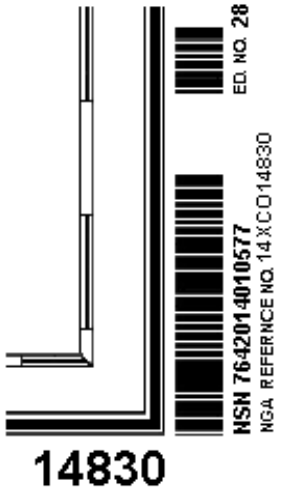
2.17 Bar Codes, Stock and Reference Numbers

Bar codes are placed on nautical charts and other NOS products at the request of the National Geospatial-Intelligence Agency (NGA) to support Department of Defense distribution procedures. The bar code identifies the national stock number (NSN) and edition number of each nautical chart. The edition number shall be updated with each new edition.

Bar Code height shall be 0.3 inches. The space between the NSN bar code and the edition number bar code shall be 0.5 inches. The space between the chart border and the bar codes shall be 1 millimeter.

The configuration of accompanying text shall be in accordance with the illustration and print in black, Swiss 721 Light type. An NSN label is located adjacent to the NSN bar code in 12.5 point type. Adjacent to the NSN text, the "NGA REFERENCE NO." text shall be 7 point. The NGA reference number shall be 12.5 point. Adjacent to the edition number bar code, the text, "ED NO." shall be 7 point and the edition number shall be 12.5 point.

Bar codes and associated text are updated using the file, BARCODE.UCM, located on the SCARS/CAC Resources Page.



NATIONAL OCEAN SERVICE
Office of Coast Survey
Marine Chart Division

CARTOGRAPHIC ORDER 016/03 July 14, 2003

FILE WITH NAUTICAL CHART MANUAL, VOLUME 1, PART 1, SECTION 2.18

TO: All Cartographers
Marine Chart Division

SUBJECT: Nautical Charts Web Site

APPLICATION: All Nautical Charts

Effective immediately, the attachment adds pages 2-87 through 2-88 to the Nautical Chart Manual, Volume1, Part 1, Seventh (1992) Edition.

Internet access among chart users continues to increase. Mariners have requested the Marine Chart Division to provide the addresses of government web sites of interest to the navigational community.

This attachment incorporates a new section to the manual, Section 2.18, which adds a note with the Office of Coast Survey's Nautical Charts web site address to each new chart edition.

The web site note directs the mariner to the Office of Coast Survey's Nautical Charts web site, where they will find internet links to other government agencies that supply navigational information of a supplementary nature.

Attachment

Alexandra B. Heliotis
Acting Chief, Marine Chart Division

2.18 Nautical Charts Web Site

General Requirements

Useful navigational information is available on the internet, both on NOAA web sites and on sites maintained by other agencies. As the number of chart users with internet access grows, the number of requests for the Marine Chart Division to provide the addresses of government web sites of interest to the mariner also grows. MCD shall accommodate in two ways:

1. The Print-on-Demand production staff will maintain an "Internet Sites of Interest" note on select "Value Added Format" POD charts. The web sites found in this note shall be limited to sites operated by government agencies, pilots' associations, harbor masters, et cetera. The maintenance of the POD note (both in selection of web sites and charts on which the note falls) shall rest with the POD production staff.

2. A note shall be added to all new nautical chart editions. Due to the ephemeral nature of web site addresses, and to facilitate future revisions, the note shall contain only one web address, the Office of the Coast Survey's Nautical Charts Home page - nauticalcharts.noaa.gov - where additional useful information, such as a page of links to other government sites, shall be located.

Feature Recommendation for a Notice to Mariners

The addition of the nautical chart web site address shall not warrant a Notice to Mariners.

Line Type and Weight

Not applicable.

Location and Orientation

Placement on Conventional Charts shall be as follows:

First Preference - in the title block, beneath the sounding datum note.

Second Preference - any land area inside the neatline.

Third Preference - any other area on the chart.

Placement on Small-Craft Folio Charts shall be:

First Preference - in the title block, beneath the sounding datum note.

Second Preference - any location on the title page.

Third Preference - any other area on the chart.

Placement on Small-Craft Pocket Fold Charts shall be:

First Preference - in the title block, beneath the sounding datum note.

Second Preference - any location outside the neatline on the cover side (usually Side B).

Third Preference - any other area on the chart.

Placement on Small-Craft Recreational Charts shall be:

First Preference - in the title block, beneath the sounding datum note.

Second Preference - any location on the title page.

Third Preference - any other area on the chart.

Size and Shape

Not applicable.

Labels and Notes

The note shall be in 7 point Swiss Light, and shall read:

Additional information can be obtained at nauticalcharts.noaa.gov.

Color and Screening

The nautical charts web site note shall print in black.

Feature Removal from Chart

If circumstances require the relocation of a web sites note, and no suitable location can be found, the note shall be deleted.