Forest Service Handbook
National Headquarters - Washington Office
Washington, DC

Forest Service Handbook 2409.12 – Timber Cruising Handbook
Chapter 60 - Quality Control

Amendment: 2409.12-2000-6

Effective date: April 20, 2000

Duration: This amendment is effective until superseded or removed.

Approved by: Mike Dombeck

Date approved:

Responsible Staff:

Last Change: 2409.12-2000-5 to FSH 2409.12,60 Contents.

Superseded Document(s): Amendment 2409.12-93-1 to chapter 60

Digest: Following is an explanation of the changes throughout the directive by section.

This amendment extensively revises the entire chapter 60 to establish check cruising standards. This amendment also recodes and reorganizes direction and makes minor editorial and formatting changes throughout the chapter.

60.4: Adds a responsibility section incorporating direction formerly in section 61.

61: Sets up qualified cruiser and advanced cruiser as separate levels of cruiser competency, instead of production cruiser sublevels of certification.

61.3: Adds requirements for check cruisers to maintain an active field check cruising program and retain sufficient records to verify cruiser certification levels and competency. Requires that check cruise results must be filed in the sale folder (FSH 6209.11).

61.4: Eliminates the previous requirement for master cruisers to have all the skills required of check cruisers.

61.5: Provides for check cruiser and master cruiser certification as indefinite, provided there is evidence that the cruiser's performance continues at a satisfactory level. (1) For all levels of cruisers, sets minimum requirements for refresher training before a cruiser may resume cruising, if inactive for a period of more than one year, and (2) Continuing education

requirements. Loss of check cruiser certification may occur based on unsatisfactory performance.

62: Sets out evaluation and documentation requirements for inspections, as well as actions necessary in the event of unsatisfactory work.

62.1: Requires the use of a field measurement evaluation for qualified cruisers and sets out a sample evaluation format in exhibit 01.

62.2: Eliminates the previous requirement for inspections of an advanced cruiser to be performed by a certified check or master cruiser. Provides an exhibit of a checklist of elements to be used by an advanced cruiser in designing cruises, in addition to the scorecard required for qualified cruisers.

62.3: Adds requirements for inspection of check cruisers.

62.4: Sets the minimum frequency for cruiser inspections.

63: Requires sale inspections to evaluate cruising procedures and sales volume determinations, and provides a sample check sheet and evaluation report format.

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60.2 - Objective

To ensure accurate, objective, and uniform measurement and estimates of product volume and value of National Forest System timber through quality control that includes:

1. Cruiser training and certification.
2. Inspection of cruiser performance.
3. Inspection of timber sale cruises.

60.4 - Responsibility

(FSM 2442.04). Cruise assistants may be used to help in the collection of cruise data. Assistants must complete appropriate training and must be capable of operating necessary measurement equipment. They must be personally supervised on-site by a certified cruiser when collecting data. The certified cruiser in charge remains accountable for the accuracy of work done by assistants.

The Forest Supervisor certifies qualified, advanced, and check cruisers
(FSM 2442.04b).

61 - Cruiser Training and Certification Standards

This section specifies the minimum levels of experience, technical knowledge, and field ability a cruiser must have to be certified. The Regional Forester has overall responsibility for the quality control program for cruising in the Region (FSM 2442.04a).

Minimum national standards provide for four levels of cruiser competency: qualified cruiser (sec. 61.1), advanced cruiser (sec. 61.2), check cruiser (sec. 61.3), and master cruiser (sec. 61.4).

Standards and requirements for each of the certification levels are specified in the following sections 61.1 to 61.4.

61.1 - Qualified Cruiser

A qualified cruiser is responsible for applying a variety of volume determination techniques. Working alone, as a crew member, or as a crew leader, a qualified cruiser must ensure all necessary field work is completed in compliance with cruise plan instructions. This includes, but is not limited to, preparation of data for computer compilation.

The knowledge and training requirements for qualified cruiser certification are:

1. Proficiency in timber cruising fundamentals, including as a minimum:

    a. Tree measurement (diameters and heights).

    b. Species identification.

    c. Defect recognition and determination.

    d. Quality determination.

    e. Use of timber cruising tools.

    f. Map reading and compass use.

    g. Traverses.

    h. Elementary use of aerial photography.

2. A working knowledge of the cruise systems (ch. 30) expected to be used.

3. Demonstrated ability to interpret and follow the timber cruise plan and cruise data recording instructions.

4. Passing scores on both a Regionally approved written test and a Regionally approved field test conducted on prepared certification test areas. Topics tested shall include species, measurements, defects, and grading information representative of what the cruiser normally encounters.

61.2 - Advanced Cruiser

An advanced cruiser is fully qualified to perform measurements, train prospective cruisers, conduct all types of timber cruises, and design and implement cruises. Experience, technical interest, training ability, and initiative characterize this classification.

The knowledge and training requirements for advanced cruiser certification are:

1. Documented experience as a qualified cruiser.

2. Training in cruise design, sampling theory, sale preparation, data collection, and cruise processing.

3. Passing score on a Regionally approved written examination. Topics tested shall include elementary statistics, sampling design, and impacts of biased and/or imprecise data on the measurements.

61.3 - Check Cruiser

A check cruiser is responsible for check cruising, cruiser training, and conducting evaluations to recommend certification of qualified and advanced cruisers. The check cruiser must maintain an active field check cruising program and retain records sufficient to verify cruiser certification levels and competency; check cruise results must be filed in the sale folder (FSH 6209.11). Check cruisers inspect timber sale cruises and recommend acceptance or identify necessary corrective actions. In addition, with the assistance of a master cruiser, the check cruiser establishes Forest certification test areas as needed.

The knowledge and training requirements for a check cruiser are:

1. Must be currently certified as an advanced cruiser and have at least two years of experience as an advanced cruiser.

2. Must be thoroughly familiar with all aspects of timber cruising, including cruise design, sampling theory and systems, statistical analysis, log and tree grading, defects, and use of cruising tools.

3. Must demonstrate training and leadership ability and be capable of setting up continuing training, certification testing, and check cruising programs.

61.4 - Master Cruiser

The level of master cruiser is certified by the Regional Forester. The master cruiser serves as the Regional representative for cruising and coordinates the Regional quality control program. This assigned responsibility is based on demonstrated ability in all aspects of cruising and varying timber sale situations common to the Region.

61.5 - Maintenance of Certification

Certification of all levels of cruisers is indefinite, provided there is evidence (sec. 62) that the cruiser's performance continues at a satisfactory level.

1. If the cruiser has been inactive for a period of more than one year, refresher training is required prior to resuming cruising. This should include, as a minimum, a session in fundamentals, together with field measurement of a sufficient number of plots and trees to update skills.

2. All levels of cruisers, whether inactive or active, must attend formal training or workshops intended to update their skills at least once every four years to maintain knowledge appropriate to the level of certification.

3. Check cruisers may recommend loss of a cruiser's certification to the certifying official based on unsatisfactory performance.

62 - Inspecting Individual Cruiser Performance

Inspection of the cruiser's performance includes all components of the timber cruise relevant to the level of certification. Cruiser performance is evaluated from office checks and field measurement checks of the sale. Evaluate and document physical measurements on a timely and continuing basis as each sale check is made; results shall also be reviewed on an annual basis. In the event of unsatisfactory work, take immediate corrective action such as retraining. Continued unsatisfactory performance shall result in loss of certification. Check cruisers shall maintain a historical record of office and field measurement checks identified by each cruiser.

62.1 - Qualified Cruiser

The performance check of a qualified cruiser's work must:

1. Assess compliance with the cruise plan instructions.
2. Validate the field work by conducting a check cruise that includes:
    a. Accuracy of tree measurements and species identification.
    b. Accuracy and lack of bias in sample selection.
    c. Defect estimates.
    b. Tree and log grading (quality or product identification).
    e. Area determination measurements.
    f. Tree counts for plots on area-based samples.
    g. Quality of timber designation.
    h. Sample (tree/plot/point) identification.
    i. Locally required items.
3. Assess data recording for legibility and accuracy, including timber measurement and area-determination data.
4. Review the care and use of cruising tools.
5. Verify use of appropriate volume and product estimators.
6. Assess knowledge and correct use of marking paint and paint security measures.

7. Use a scorecard for evaluating individual performance on field measurements. The Regional Foresters shall establish:

   a. The items to be checked;

   b. Tolerances;

   c. Error weights; and

   d. Acceptable scores with format similar to that shown in exhibit 01.

Assess the cruiser's measurements and judgments by comparative analysis of check cruise data versus original data.

62.1 - Exhibit 01

Sample Format for Field Measurement Evaluation

Check Cruise Elements	Tolerance	Total Possible Correct Answers	Number of Incorrect Answers	Error Weight	Total Error (bxc)	Percent Correct (1-(d/a))x100
		(a)	(b)	(c)	(d)	(e)
In/out trees	none	123	3	5	15	88
Species	none	123	1	5	5	96
DBH	± 0.2 in.	123	2	1	2	98
Height	± 4 ft.	123	3	1	3	97
Defect	± 10%	123	5	1	5	96
Region Item 1						
Region Item 2						
						Overall Percent Correct

Overall Percent Correct = Total of (e) ÷ number of items about which information is checked.

Note: To pass this check, each item checked must have at least 80 percent correct and the overall accuracy must be at least 85 percent.

The "Total Possible Correct Answers" (a) is the number of trees measured by the check cruiser. For plot or point cruises, the "Total Possible Correct Answers" of "in/out trees" is the number of trees identified by the check cruiser; for all other elements, it is the number of correctly identified in/out trees.

Recommendation:

_____

Measurements ok at 95%, passed check

_____

_____

_____

_____

_____

_____

Tom Short (Certified Check Cruiser) — *Jan. 1, 2000*

Signature — Date

62.2 - Advanced Cruiser

When an advanced cruiser is designing cruises, check the cruise design and other applicable elements from section 63.1, exhibit 01. For production cruising, check the field cruising procedures as listed under qualified cruiser (sec. 62.1).

62.3 - Check Cruiser

Each check cruiser shall be periodically reviewed by an authorized official at a higher administrative level. Evaluate the check cruiser on the basis of the following items:

1. Maintenance of training records for qualified and advanced cruisers.

2. Maintenance of cruiser roster and individual performance checks.

3. Comprehensive sale inspections.

4. All inspection items listed for the performance check of the advanced cruiser if the check cruiser is also designing sales or production cruising.

Check cruisers need not be checked on a fixed schedule unless they are working as qualified cruisers. If this is the case, check cruises should be performed by a check cruiser from another administrative unit.

62.4 - Cruiser Inspection Frequency

Review qualified or advanced cruiser records for the past year to ensure the following minimum of work checked: 5 plots for plot-based cruises, 25 trees for tree-based cruises, or an equivalent combination of trees and plots for a combination of cruising methods. These annual minimums should be used when checking measurement technique and sample application for an individual, and they constitute a qualified check cruise. The minimum number of plots or trees need not be from a single sale, but can be from several sales. When the minimum has not been checked, either schedule the individual for a check, or consider the cruiser as inactive. Inactive cruisers must demonstrate proficiency prior to resuming production cruising.

63 - Inspecting Sales

Conduct sale inspections to evaluate cruising procedures and sale volume determination. Sale inspections also serve to monitor cruiser performance. Indicate when results of a sale inspection are unsatisfactory and recommend corrective action needed to make the cruise acceptable. Inspections shall not be used to adjust sale volumes, but to indicate potential problems that need further investigation. Problems identified in the check cruise must be addressed and the resolution documented in the sale folder.

Regional Foresters shall establish the methods and standards for what constitutes an acceptable or satisfactory evaluation.

63.1 - Inspection Elements

Cruises should be systematically reviewed for completeness. Exhibit 01 includes a list of office and field components that should be examined as appropriate; the list also includes cross-references to the sections or chapters in this Handbook and other Handbooks containing related direction. Use this list to develop a unit checklist similar to the sample shown in exhibit 02 that can be initialed, dated, and filed in the sale folder after the inspection has been completed.

63.1 - Exhibit 01

Timber Sale Preparation and Check-Cruise Elements

Element (Cross-References Are to FSH 2409.12 or Other Directives)

A. CRUISE DESIGN PLAN
   1. Harvest Guidelines
      a. Stand Marking Guide (sec. 41)
      b. Minimum Product Merchantability Specifications (sec. 41)

   2. Sample Method Analysis
      a. Population Stratification Identification (sec. 31.5, 41.4)
      b. Precruise Documentation (sec. 41.31)
      c. Sampling Intensity and Allocation Documentation (sec. 33.2, 34.3, 35.3, 36.3)
      d. Sample Error Standards (sec. 41.1)

   3. Sampling Controls
      a. Sample Tree/Plot Distribution and Location (sec. 33.11, 34.21, 35.21)
      b. Plot Monumentation (sec. 34.21, 35.21)
      c. Cruise Trees Numbered (sec. 33.11, 34.21, 35.21)
      d. Supplemental Samples (sec. 41.32)
      e. Limiting Distance/Mirage Method (Plot Edge Effect) (sec. 35.22)
      f. 3P KPI Estimates and Random Number List (sec. 36.2)

B. TREE VOLUME DETERMINATION
   1. Volume Estimators (sec. 22)
   2. Form Class (sec. 14.3)
   3. Visible Defect Deduction Instructions (sec. 22.3, 22.31a-d)
   4. Hidden Defect and Breakage Instructions (sec. 22.31e)
   5. Tree Height Instructions (sec. 14.2)
   6. Special Measurement Techniques (ch. 10)

C. TIMBER DESIGNATION AND PRODUCT ACCOUNTABILITY
   1. Unit Boundary Instructions/Applications (sec. 71.22, 71.4)
   2. Tree Designation Instructions/Applications (sec. 71.3, 72.2)
   3. Tracer Paint Testing and Security (sec. 72.11, 72.12, 72.6)

D. TREE VALUE DETERMINATION
   1. Approved Log/Tree Grade Instructions

63.1 - Exhibit 01--Continued

E. AREA DETERMINATION
1. Traverse Notes Security (sec. 50)
2. Traverse Maps Available (sec. 50)
3. Area Determination Standards (sec. 50)
4. First Station Marked with Stake (sec. 52.12)

F. FINAL CRUISE PRINTOUT AUDIT
1. Sample Error Standards Met (sec. 41.1)
2. Validation of Cruise Data and Reports (sec. 65, 66)

G. SALE AREA MAP
1. Unit and Road Locations (FSH 2409.18, sec. 53.24, 54.2)
2. Unit Designation (CC, ITM, LTM) (Timber Sale Contract Provision B&C Sale Area Map)

H. SAFETY CONSIDERATIONS
1. Tailgate Safety Meetings Prior to Cruising (FSH 6709.11, Health and Safety Code Handbook, sec. 04.2, 05, and 22.4)
2. Local Safety Issues (for example, paint safety films)

I. CRUISED BY CERTIFIED CRUISERS (FSM 2442.03)

J. TIMBER SALE MEASUREMENTS EVALUATION (sec. 41.1)

K. JUSTIFICATION DOCUMENTATION FOR NOT SELLING TREE MEASUREMENT TIMBER SALES (TMS)

L. CERTIFICATION OF CRUISE STANDARDS DOCUMENTED AND SIGNED (sec. 43.5)

M. DOCUMENTATION OF CRUISE PLAN CHANGES

63.1 - Exhibit 02

Timber Sale Evaluation Report

TIMBER SALE CRUISE EVALUATION REPORT - PAGE 1						
FOREST: *My Forest*	CHECK CRUISER: *Joe*					
DISTRICT: *My District*	DATE INSPECTED: *Jan. 1, 2000*					
SALE NAME: *My Sale*	CRUISE METHOD(S): *Sample Tree*					
TYPE OF SALE: SCALE | | TMS |x|	DATE CRUISED: *Nov. 5, 1999*					
SALE PREPARATION ELEMENTS OFFICE-FIELD	O	F	SATIS	UNSAT	NA	
A. CRUISE DESIGN PLAN						
1. Harvest Guidelines						
a. Stand marking guide			X			
b. Minimum product merchantability specifications			X			
2. Sample Method Analysis						
a. Population stratification identification			X			
b. Precruise sample documentation			X			
b. Precruise sample documentation			X			
c. Sampling intensity and allocation documentation			X			
d. Cost analysis of cruise methods			X			
e. Sample error standards			X			
3. Sample Controls						
a. Sample tree/plot distribution and location			X			
b. Plot monumentation			X			
c. Cruise trees numbered			X			
d. Supplemental samples					X	
e. Plot/point edge effect (Mirage Method)					X	
f. Guide for KPI estimates					X	
B. TREE VOLUME DETERMINATION						
1. Volume Estimators			X			
2. Form Class			X			
3. Visible Defect Deduction Instructions			X			
4. Hidden Defect and Breakage Instructions			X			
5. Tree Height Instructions			X			
6. Special Measurement Techniques					X	
C. TIMBER DESIGNATION AND PRODUCT ACCOUNTABILITY						
1. Unit Boundary			X			
2. Quality of Tree Designation			X			
3. Tracer Paint Analysis			X			
4. Documentation for Sale Modifications			X			
D. TREE VALUE DETERMINATION						
1. Approved Log/Tree Grade Instructions			X			
E. AREA DETERMINATION						
1. Traverse Notes Available/Secure			X			
2. Traverse Maps Available			X			
3. Error of Closure (N/A for GPS)			X			
4. First Station Marked with Stake			X			
5. Traverse Boundary follows Posted Unit Boundary			X			
F. FINAL CRUISE PRINTOUT AUDIT						
1. Data Recorded Accurately			X			
2. Sample Error Standards met			X			
3. Validate Volume Reports			X			
4. Validate Species			X			

63.1 - Exhibit 02--Continued

TIMBER SALE CRUISE EVALUATION REPORT - PAGE 2						
SALE PREPARATION ELEMENTS	OFFICE-FIELD	O	F	SATIS	UNSAT	NA
G. SALE AREA MAP						
1. Unit Locations				X		
2. Road Locations				X		
3. Unit designation (CC, ITM, LTM)				X		
H. SAFETY CONSIDERATIONS						
1. Local Safety Issues (for example, Paint Safety Films)				X		
2. Tailgate Safety Meeting Prior to Cruising				X		
I. CRUISED BY CERTIFIED CRUISERS				X		
J. TIMBER SALE CHECK CRUISE						
1. Met Gross Volume Standards						X
2. Met Net Volume Standards				X		
3. Met Value Standards						X
4. Met Field Measurement Evaluation Standards				X		
K. CERTIFICATION OF CRUISE STANDARDS DOCUMENTED AND SIGNED				X		
L. DOCUMENTATION OF CRUISE PLAN CHANGES/ACCOMPLISHMENTS				X		

Following are: comments on the performance or unsatisfactory work under the above cruise plan elements. Make reference in Item No. below for the element listed above.

Item No.	Description

63.11 - Check Cruise Field Measurement Inspection

Measurement checks should be designed to obtain a representative sample of the original number of sample units and not to concentrate on individual cruisers. The sample should be dispersed throughout the cutting units in the sale area to determine if all significant variables, including measurement problems, species, larger trees, or defect, have been identified. Consider the amount of time required to conduct a check cruise, and vary requirements depending on the sampling system being used, the number of cruisers, and the complexity of the particular sale being checked.

On a sale check, 25 to 150 trees may need to be checked, depending on the number of cruise methods used and other factors. Take a reasonable, quantitative sample of all conditions.

Compare the measurements and results against the original cruise data to determine accuracy.

If fundamental errors are noted on an individual cruiser's measurements during a sale check, such as incorrect species identification or missing trees on plots, all of the individual's work on the sale may need to be examined.

63.12 - Other Elements

When data are being entered from handwritten cruise cards, make a 10 percent minimum spot comparison between the computer output and the information on the cards. If errors are found, perform a 100 percent audit.

Check the management of data recorded by the cruiser. The cruiser should follow a system designed to prevent loss of recorded data; for example, each day's data should be stored in the timber sale file. Electronic field data recorder files should be deleted only after the data manager has ensured that all data have been successfully transferred to the personal computer.

63.2 - Sale Inspection Frequency

As a minimum, conduct sale cruise inspections at the following target frequencies. Perform office checks on all sales. Office checks ensure that the cruise was performed according to direction in this Handbook. Perform field measurement checks with the following frequencies and use a random draw to determine each sale in the sample to be checked:

Sale Size	Scaled Sales	Tree Measurement Sales
> $10,000 and ≦ 2000 CCF	Not applicable	1:10 (10 %)
≧ 2000 CCF	1:4 (25 %)	1:1 (100 %)

63.3 - Certification of Sale

Each sale cruise must be certified by the District Ranger or Forest Supervisor (see the sample certification in sec. 43.5). Do not advertise a timber sale for bid if the cruise inspection indicates that the timber sale does not meet sampling error standards (sec. 41.1).