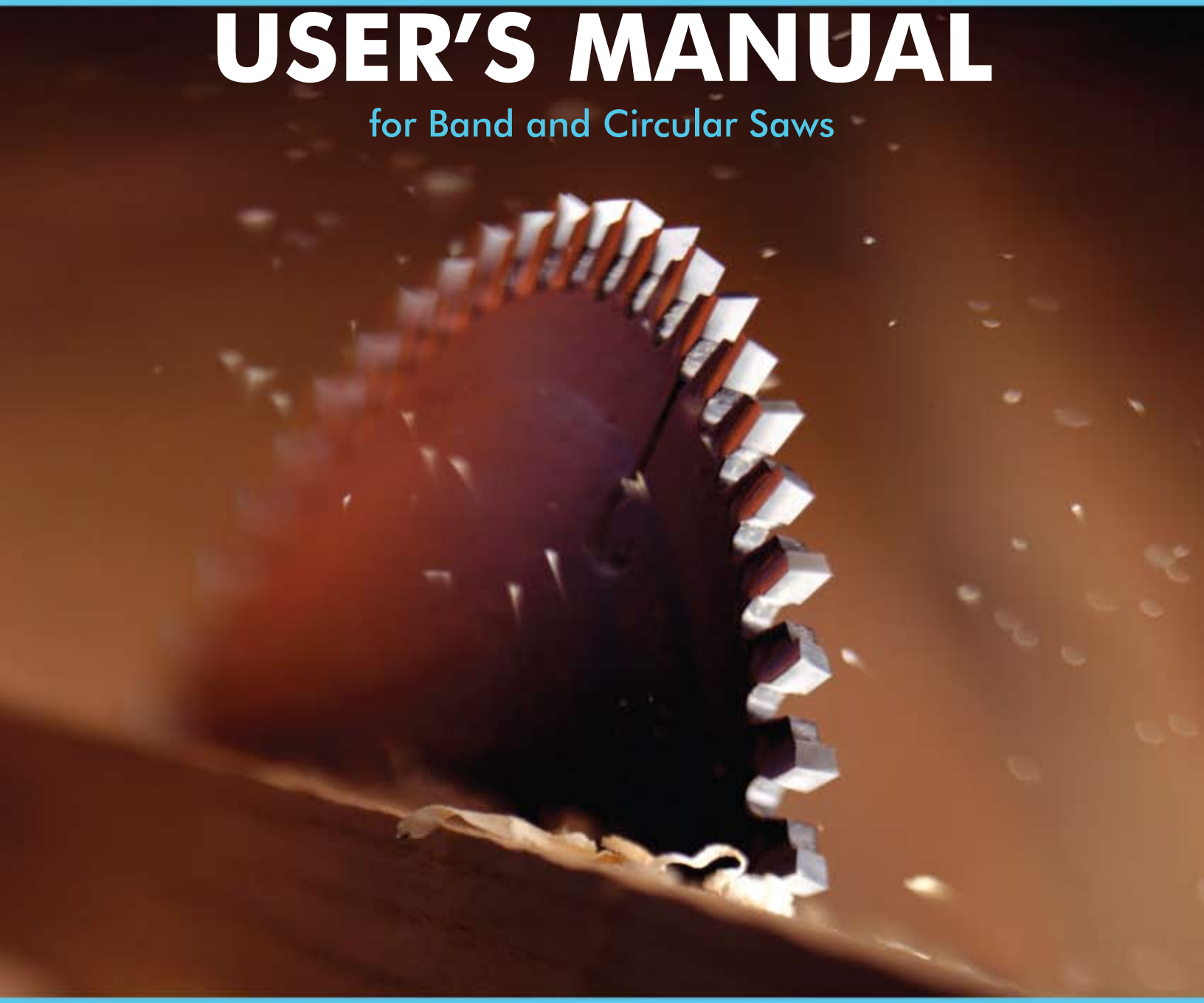
Saw Engineering and Troubleshooting Software (SETS)

USER'S MANUAL

for Band and Circular Saws



Developed by:
Department of Forest Products
Forest and Wildlife Research Center
Mississippi State University

The Forest and Wildlife Research Center at Mississippi State University was established by the Mississippi Legislature with the passage of the Renewable Natural Resources Research Act of 1994. The mission of the Center is to conduct research and technical assistance programs relevant to the efficient management and utilization of the forest, wildlife, and fisheries of the state and region, and the protection and enhancement of the natural environment associated with these resources. FWRC scientists conduct research in laboratories and forests administered by the University and cooperating agencies and industries throughout the country. Research results are made available to potential users through the University's educational program and through Center publications such as this, which are directed as appropriate to forest landowners and managers, manufacturers and users of forest products, leaders of government and industry, the scientific community, and the general public. Dr. George M. Hopper is director of the Forest and Wildlife Research Center.

Authors

Dr. Philip Steele is a professor in the department of forest products. Craig Boden is a research associate in the department of forest products.

Acknowledgement

This research is funded by the Wood Education and Resource Center, Northeastern Area State and Private Forestry, Forest Service, U.S. Department of Agriculture; the USDA Forest Service, State and Private Forestry, Technology Marketing Unit; and Mississippi State University's Forest and Wildlife Research Center. This manual was developed in cooperation with Simonds International, Fitchburg, MA.

To Order Copies

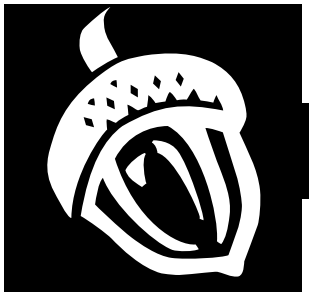
Copies of this and other Forest and Wildlife Research Center publications are available from:

Publications Office
Forest and Wildlife Research Center
Box 9680
Mississippi State, MS 39762-9680

Please indicate author(s), title and publication number if known.
Publications are also available at the web site at www.cfr.msstate.edu

Citation

Steele, P.H., C. Boden. 2009. Saw Engineering and Troubleshooting Software (SETS) User's Manual for Band and Circular Saws. Forest and Wildlife Research Center, Research Bulletin, Mississippi State University. 11 pp.



Research Bulletin FP521

FOREST AND WILDLIFE RESEARCH CENTER

Mississippi State University

Saw Engineering and Troubleshooting Software (SETS)

USER'S MANUAL

for Band and Circular Saws

1. INTRODUCTION

This manual describes the functional capabilities of the Saw Engineering and Troubleshooting (SETS) software. SETS is a PC-based software system designed for sawmill managers or millwrights who wish to purchase, optimize or troubleshoot their circular or band saws. This manual provides information on the background for the software and a tutorial. The tutorial will prompt for information that sawmill staff will be able to input without engineering training. Saw designs for new sawing machines, and optimizing and troubleshooting of current saws will be provided by the SETS software.

Saw mechanics engineering for the purpose of purchasing, optimizing or troubleshooting saws is a difficult task for which few sawmill managers or millwrights have training or easily-applied tools. The interaction of the following important variables are very complex: hook, rake and clearance angles; bite per tooth; material feed speed; tooth speed; side clearance; depth of cut; and horsepower requirements. Researchers such as Suchsland (Undated), Lunstrum (1985) and Taylor et al. (1999) have attempted to simplify the analysis of the interaction of these variables to allow sawmill personnel to rationally design, optimize and troubleshoot their saws. However, software to allow users to apply the required complex equations describing saw performance without an engineering background has been unavailable until now.

Suchland's equations allow development of a performance limitations graph that provides the minimum and maximum feed speed constraints for a saw operating at gullet capacity. These constraints are as specific to each saw as fingerprints are to humans. If a saw's maximum feed speed is exceeded, the saw teeth will be over loaded resulting in potential, or real, damage; if saw speed falls below minimum feed speed, sawdust will be smaller than the side clearance and will spill onto the saw face resulting in friction and creation of destabilizing heat in the saw body.

Taylor et al. (1999) have developed new equations for horsepower computation that provide a new and simplified means to compute horsepower for both circular and band saws. This method corrects significant errors in past approaches.

The SETS software uses both Suchland's equations to draw a performance limitations graph and Taylor's horsepower equations to compute the maximum required horsepower for the specific circular or band saw defined by user-supplied saw characteristic data. Thus, SETS allows sawmill managers unfamiliar with saw engineering mechanics to determine whether their saw is being operated within its design limitations and to design, optimize, and troubleshoot their saws for best performance. Use of the SETS software will reduce the need for mechanical engineering specialists to perform these tasks.

Always follow manufacturer's instructions and warnings, maintain appropriate safety guarding and protocols, and utilize appropraite personal protective equipment. Mississippi State University assumes no liability for the content of this publication or for action taken based on the content herein.

2. SYSTEM REQUIREMENTS

The minimum system requirements for installing and running SETS are:

- PC with a Pentium II 450 MHz processor (Pentium III 667+ MHz processor recommended).
- SETS can be installed on the following operating systems: Microsoft Windows® 2000 Professional, Windows 2000 Server, Windows XP Professional, Windows XP Home Edition, Windows Server 2003, or Windows Vista.
- Minimum RAM requirements: 96 MB for Windows 2000 Professional; 192 MB for Windows 2000 Server; 160 MB for Windows XP Professional; 96 MB for Windows XP Home Edition; 160 MB for Windows Server 2003 (256 MB for all operating systems recommended).
- 20 MB of available hard-disk space on the installation drive.

- CD-ROM or DVD-ROM drive.
- Super VGA (1024 x 768) or higher resolution display with 256 colors.
- Microsoft Mouse or compatible pointing device.

SETS is written in Microsoft® Visual Basic® .NET, version 2003 (Microsoft Corp. 2003).

3. INSTALLING AND RUNNING SETS

SETS must be installed and run on your computer's hard drive. The program will not run directly from the installation CD. To install SETS, perform the following steps:

1. Begin at the Windows desktop.
2. Insert the SETS installation CD into your CD-ROM or DVD-ROM drive.
3. If the installation program does not start automatically, follow these steps:
   a. Click the **Start** button on the taskbar and then click the **Run...** command appearing on the **Start menu**. The **Run** dialog box appears.
   b. Type **E:\SETUP** in the **Open** textbox of the **Run** dialog box. (If your CD-ROM or DVD-ROM drive is designated by a letter other than **E**, substitute that letter for **E**.)
   c. Click the **Ok** button on the **Run** dialog box.
4. Follow the on-screen instructions provided by the SETS installation program.

To run SETS, perform the following steps:

1. Click the **Start** button on the taskbar.
2. Point to **All Programs**.
3. Point to the **SETS** folder icon appearing in the All Programs list, and then click the **SETS.exe** icon.
4. Alternatively, you can double-click the SETS shortcut icon on your Windows desktop.

4. THE SETS MAIN FORM

The SETS software consists of a main form (Figure 1) used for creating a new saw file, opening an existing saw file, closing a saw file, and saving and printing input and output data. The main form's menu bar consists of a **File** menu that contains the following choices:

- **New** – Creates a new saw file.
- **Open** – Opens an existing saw file.
- **Close** – Closes the currently opened saw file.
- **Save Input** – Saves the input data of the current saw under the current input file name.
- **Save Input As** – Opens the Save As dialog box allowing the user to save the input data of the current saw under a specified file name.
- **Save Results** – Opens the Save As dialog box allowing the user to save the output results of the current saw under a specified file name.
- **Print** – Prints the input data and the output results of the current saw.
- **Exit** – Closes the SETS software.

5. CREATING A NEW SAW FILE

The SETS software allows you to create and maintain as many individual saw files as desired. To create a new saw file, choose **File**, **New** on the menu bar. Under the **File**, **New** menu option, a submenu appears (Figure 2) consisting of the following three menu choices:

- Design Band Saw
- Optimize-Troubleshoot Band Saw
- Optimize-Troubleshoot Circular Saw

Select one of the above three choices and SETS will display the appropriate data input form(s). You can then save the new saw file to your computer's hard drive at any time by clicking the **Save Input** or the **Save Input As** menu choice under the **File** menu.

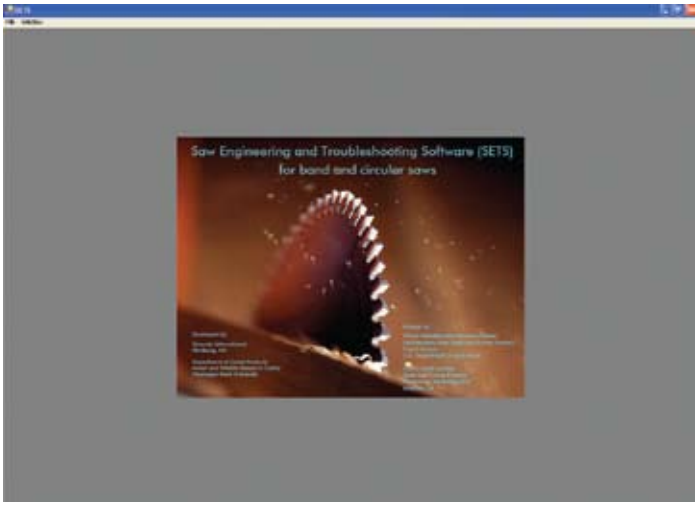


Figure 1. SETS main form

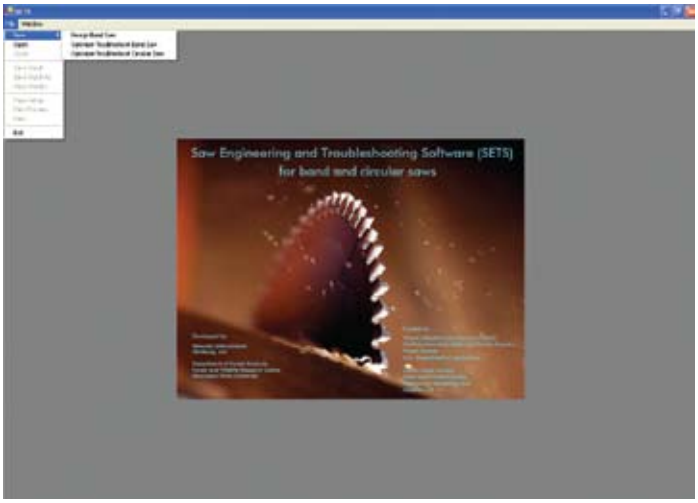


Figure 2. File, New submenu.

6. OPENING A PREVIOUSLY SAVED SAW FILE

To open a saw file that was previously saved in the SETS software, follow these steps:

1. Click **File**, **Open** on the menu bar to display the **Open** dialog box (Figure 3).
2. Use the **Look in** drop-down list on the **Open** dialog box to go to the folder containing the saw file and select the file from the files list. Alternatively, you can type the file path and file name in the **File** name text box of the **Open** dialog box.
3. Make sure the file name appearing in the **File name** text box has a **.sets** extension.
4. Click the **Open** button.

The contents of the saw file will be loaded into the SETS software, and you may start entering, editing, or deleting the input data.

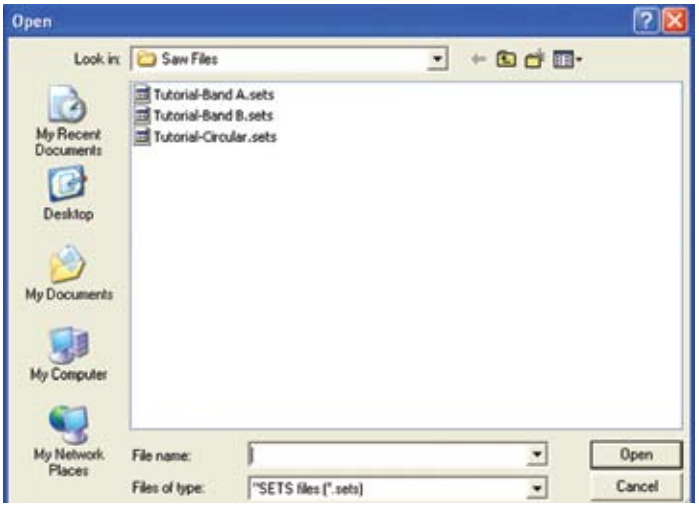


Figure 3. Open dialog box.

7. SAVING DATA AND RESULTS

Saving data in the SETS software consists of saving either the input data describing your saw or the output results describing your saw's performance limitations. Input saw data are saved in SETS using a .sets file extension, while the output results are saved using the .txt file extension.

You can save the input saw data to your computer's hard drive at any time by clicking either the **Save Input** or the **Save Input As** menu choice under the **File** menu. Clicking the **Save Input** menu choice saves the input data appearing in the SETS saw data form under the current input file name (if one exists). If an input file name has not been given for the current input data, the **Save As** dialog box will appear allowing you to enter a file name and save the data. Clicking the **Save Input As** menu choice automatically opens the **Save As** dialog box allowing you to save the current input data using either a file name other than the current input file name or the current input file name itself.

Once the output results data for the current saw have been generated and appear on the SETS main form, they can be saved to your computer's hard drive by clicking the **Save Results** menu choice under the **File** menu. Clicking the **Save Results** menu choice opens the **Save As** dialog box allowing you to enter a file name for the output results and save the results.

8. PRINTING DATA AND RESULTS

The SETS software allows you to print both input saw data and output results to a local printer or a network printer. To print to a printer, choose **File**, **Print** on the menu bar. If the output results have been generated and appear on the screen, both input and output data will be printed. If the output results have not been generated, only the input data will be printed.

9. OPTIMIZE-TROUBLESHOOT BAND SAW DATA ENTRY FORM

The Band Saw Data Entry form (Figure 4) allows users to enter band saw data describing a specific band saw and to calculate the saw's performance output results. To display this form click **File, New, Optimize-Troubleshoot Band Saw** on the menu bar. This form consists of text boxes that prompt you to enter values of various characteristic variables that describe your particular band saw and cutting practices. These variables include the following:

- Gullet area
- Pitch
- Plate thickness / gauge
- Saw kerf
- Surface speed
- Rotations per minute (RPM)
- Wheel diameter
- Wood species or specific gravity

When entering data in the Band Saw Data Entry form, you can use the Tab key, the Enter key, or the mouse pointer to navigate from one text box to another. After entering data for all variables, click the **Calculate** button and SETS will generate the output results and the performance limitations graph.

10. OPTIMIZE-TROUBLESHOOT CIRCULAR SAW DATA ENTRY FORM

The Circular Saw Data Entry form (Figure 5) allows users to enter circular saw data describing a specific large circular saw and to calculate the saw's performance output results. To display this form click **File, New, Optimize-Troubleshoot Circular Saw** on the menu bar. This form consists of text boxes that prompt you to enter values of various characteristic variables that describe your particular circular saw and cutting practices. These variables include the following:

- Number of teeth
- Gullet area
- Plate thickness
- Saw diameter
- Saw kerf
- Rotations per minute (RPM)
- Wood species or specific gravity

When entering data in the Circular Saw Data Entry form, you can use the Tab key, the Enter key, or

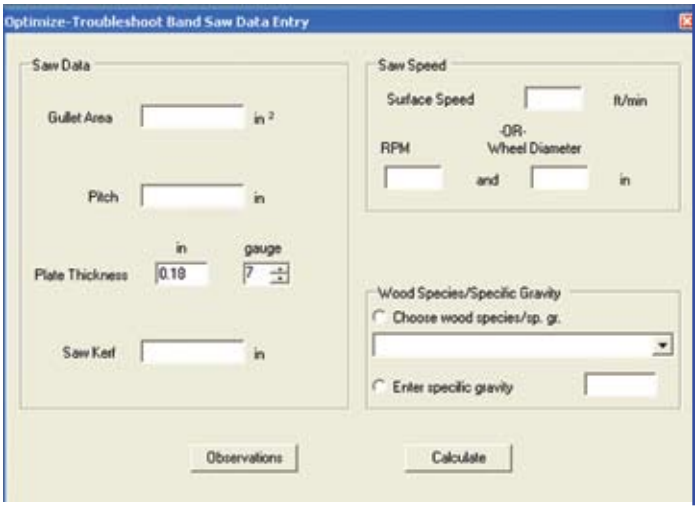


Figure 4. Band Saw Data Entry form.

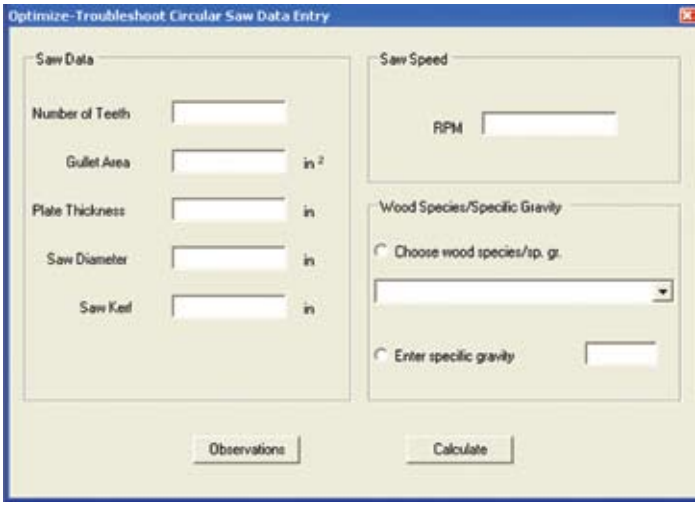


Figure 5. Circular Saw Data Entry form.

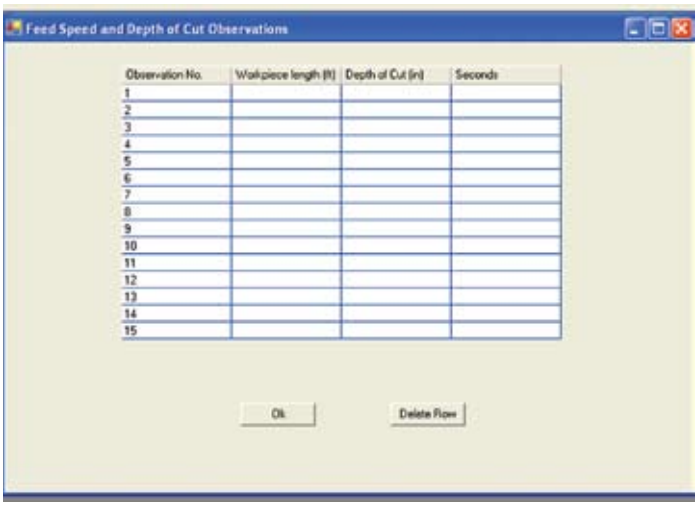


Figure 6. Feed Speeds and Depth of Cut Observations form.

the mouse pointer to navigate from one text box to another. After entering data for all variables, click the **Calculate** button and SETS will generate the output results and the performance limitations graph.

11. FEED SPEEDS AND DEPTH OF CUT OBSERVATIONS FORM

The Feed Speeds and Depth of Cut Observations form (Figure 6) allows the user to enter data to calculate the current feed speeds in a particular mill. This form contains a data table that prompts the user for data values of up to fifteen observations. These data values consist of the following:

- Workpiece length (ft.)
- Depth of cut (in.)
- Seconds

Feed speeds will be computed based on the above values. Each feed speed along with its corresponding depth of cut will be plotted on the performance limitations graph (Section 13).

12. PERFORMANCE LIMITATIONS RESULTS FORM

The Performance Limitations Results form (Figure 7) displays numerical results describing the optimum cutting conditions for the saw defined by the user-supplied characteristic saw data. This form displays

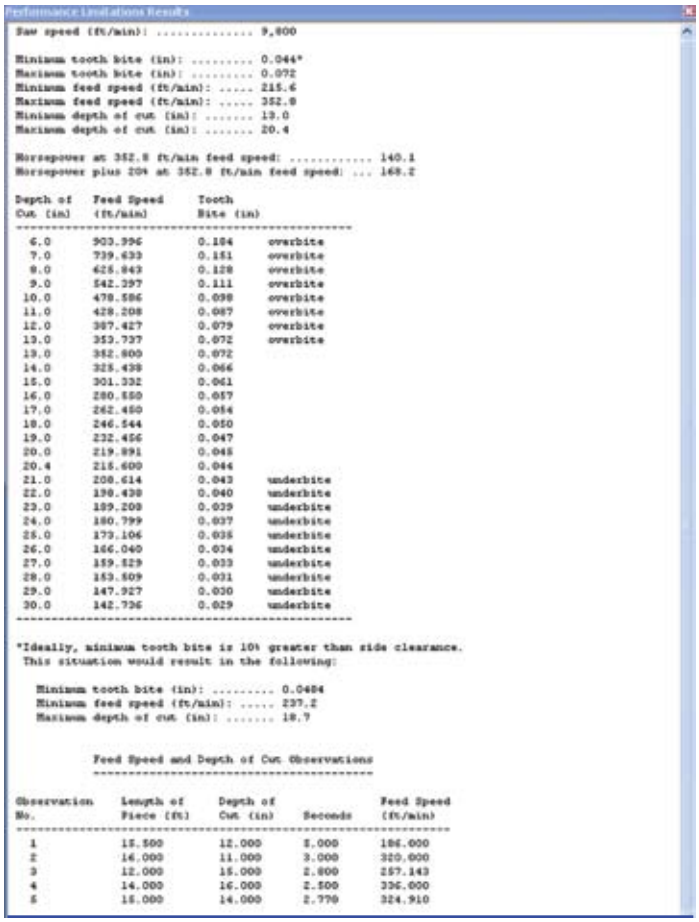


Figure 7. Performance Limitations Results form.

the following output data describing the acceptable operating range for the saw at gullet capacity:

- Saw speed (ft/min)
- Minimum tooth bite (in)
- Maximum tooth bite (in)
- Minimum feed speed (ft/min)
- Maximum feed speed (ft/min)
- Minimum depth of cut (in)
- Maximum depth of cut (in)
- Maximum horsepower

This form also tabulates the feed speed and tooth bite at gullet capacity for a depth of cut ranging from 6 inches to 30 inches. This tabulation indicates whether the feed speed and corresponding tooth bite are within the acceptable operating range for the saw.

This form also displays the data entered in the Feed Speeds and Depth of Cut Observations form (Section 11) and shows the corresponding feed speed for each observation.

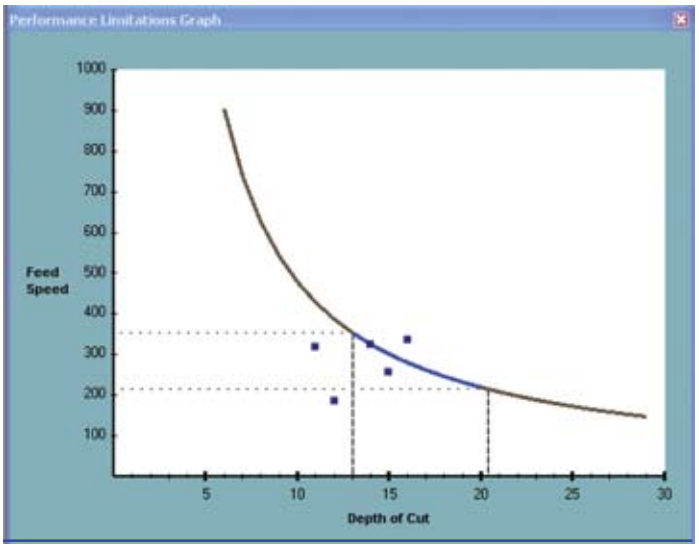


Figure 8. Performance Limitations Graph.

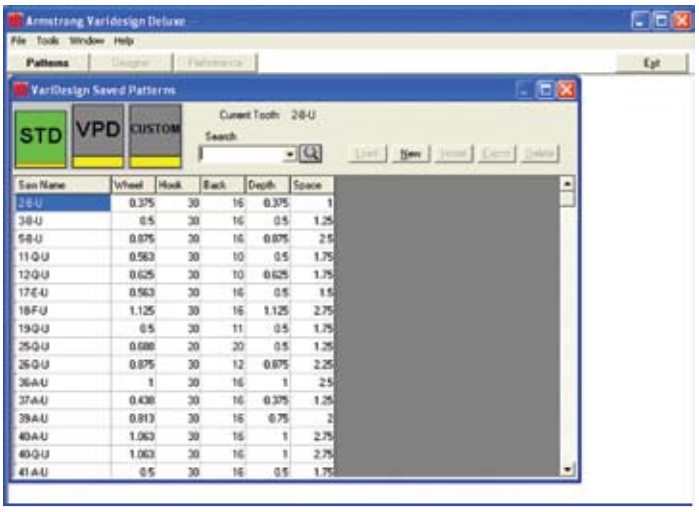


Figure 9. Armstrong VariDesign Deluxe main form.

13. PERFORMANCE LIMITATIONS GRAPH

The Performance Limitations Graph (Figure 8) displays a curve indicating the relationship between feed speed and depth of cut at gullet capacity for the saw defined by the user-supplied characteristic saw data. At any point along the curve, the saw is operating at gullet capacity. Any point above the curve would exceed the gullet capacity and any point below the curve means the saw is operating below gullet capacity.

As can be seen from the graph, the relationship between feed speed and depth of cut is inversely related. Thus, cutting smaller diameter logs would require an increased feed speed to maintain gullet capacity and cutting larger diameter logs would require a decreased feed speed. There are limits, however, on the size of logs that can be cut for a given saw at gullet capacity. Cutting smaller diameter logs would increase the tooth bite due to the increased feed speed, and hence, subject the saw teeth to excessive strain. Cutting larger diameter logs would decrease the tooth bite due to the lower feed speeds, and hence, produce very fine saw dust particles that may spill from the gullets into the spaces on each side of the blade. Thus, acceptable operating conditions for a saw are restricted to only a portion of the curve. The blue portion of the curve shown in Figure 8 indicates this acceptable operating range. The horizontal and vertical lines extending from the y-axis and the x-axis to the curve indicate, respectively, the minimum and maximum feed speeds and corresponding depths of cut that define the acceptable operating range.

14. BAND SAW TUTORIAL A

This section provides a tutorial intended to help users design a band saw using the Armstrong Varidesign Deluxe software (2003). This tutorial also shows how to optimize or troubleshoot the band saw using the SETS software. An explanation of the results and an interpretation of the performance limitations graph is also given.

To run this tutorial, follow these steps:

1. Start the SETS software as described in Section 3.
2. On the SETS main form, click **File, New, Design Band Saw**. The **Armstrong VariDesign Deluxe** main form (Figure 9) appears.
3. Maximize both windows of the Armstrong Varidesign Deluxe main form.
4. Scroll down the list of standard saws and click on the saw named 380-Q-U.
5. Click the **Load** button. The **VariDesign Deluxe Tooth Designer** form (Figure 10) appears.

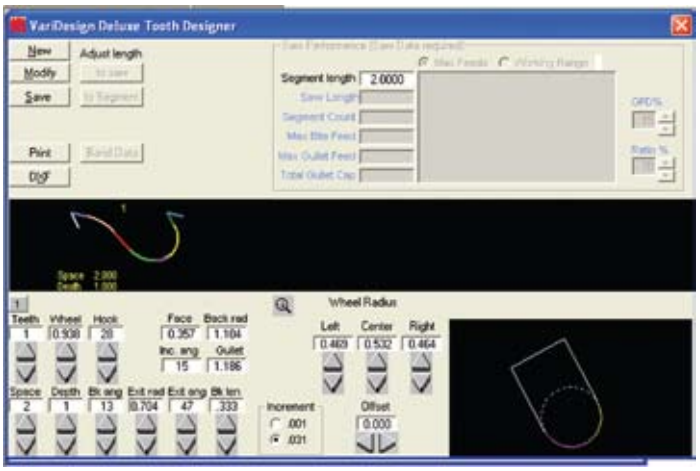


Figure 10. VariDesign Deluxe Tooth Designer form.

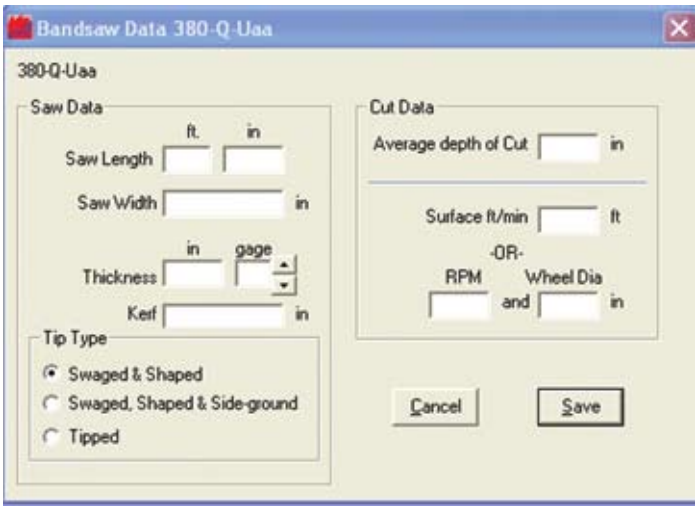


Figure 11. VariDesign Deluxe Bandsaw Data form.

6. To modify the 380-Q-U standard tooth design, click the **Modify** button.
7. Enter **380-Q-Ua** in the **Tooth Name text box** for the name of the new tooth and click **Ok**.
8. Click the **Band Data** button. The **Bandsaw Data** form (Figure 11) appears.
9. Enter the following data into the Bandsaw Data form:

   Saw Length: 38 ft. 0 in.
   Saw Width: 10 in.
   Thickness/gauge: 0.072in. / 15
   Kerf: 0.16 in.
   Tip Type: Swaged&Shaped
   Avg. depth of cut: 18 in.
   Surface Speed: 9800 ft/min
10. Click the **Save** button.

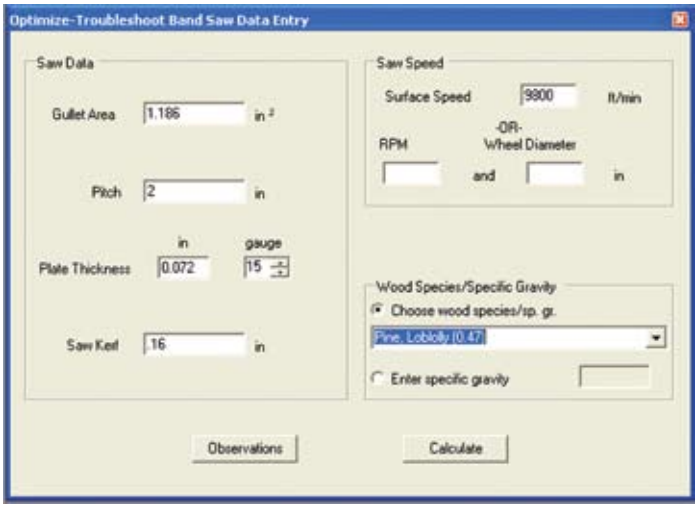
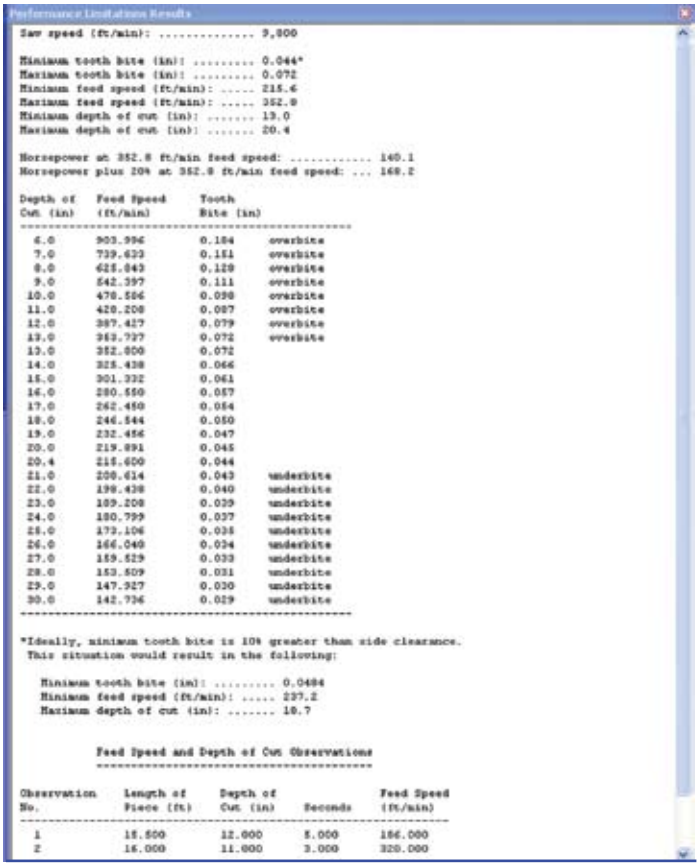


Figure 12. Band Saw Data entry form for band saw tutorial A.

11. Press the <**Alt-Tab**> key combination, to return to the SETS software. Do not close the VariDesign Deluxe program.
12. In the SETS software, click **File, New, Optimize-Troubleshoot Band Saw** to display the **Optimize-Troubleshoot Band Saw Data Entry** form (Figure 4).
13. Enter the data for the band saw that was just designed as shown in Figure 12.
14. Click the **Observations** button and then enter the following five observations into the Feed Speed and Depth of Cut Observations form:

Obs. No.	Workpiece Length (ft.)	Depth of cut (in.)	Sec.
1	15.5	12	5
2	16	11	3
3	12	15	2.8
4	14	16	2.5
5	15	14	2.77

15. Click **Ok** to close the Feed Speed and Depth of Cut Observations form.
16. Save the input data by following these steps:
    a. Click **File, Save Input** on the menu bar.
    b. When the **Save As** dialog box appears, enter **Tutorial-Band A.sets** in the **File name** text box.
    c. Click the **Ok** button.
17. Click the **Calculate** button to display the output



Performance Limitations Results

Saw speed (ft/min): 9,800

Minimum tooth bite (in): 0.044*
Maximum tooth bite (in): 0.072
Minimum feed speed (ft/min): 215.6
Maximum feed speed (ft/min): 352.9
Minimum depth of cut (in): 13.0
Maximum depth of cut (in): 20.4

Horsepower at 352.8 ft/min feed speed: 140.1
Horsepower plus 20% at 352.8 ft/min feed speed: ... 168.2

Depth of Cut (in)	Feed Speed (ft/min)	Tooth Bite (in)	
6.0	903.996	0.184	overbite
7.0	739.633	0.151	overbite
8.0	625.843	0.128	overbite
9.0	542.397	0.111	overbite
10.0	478.586	0.098	overbite
11.0	428.208	0.087	overbite
12.0	387.427	0.079	overbite
13.0	353.727	0.072	overbite
13.0	352.800	0.072	
14.0	325.438	0.066	
15.0	301.332	0.061	
16.0	280.550	0.057	
17.0	262.450	0.054	
18.0	246.544	0.050	
19.0	232.456	0.047	
20.0	219.891	0.045	
20.4	215.600	0.044	
21.0	208.614	0.043	underbite
22.0	198.438	0.040	underbite
23.0	189.208	0.039	underbite
24.0	180.799	0.037	underbite
25.0	173.106	0.035	underbite
26.0	166.040	0.034	underbite
27.0	159.529	0.033	underbite
28.0	153.509	0.031	underbite
29.0	147.927	0.030	underbite
30.0	142.736	0.029	underbite

*Ideally, minimum tooth bite is 10% greater than side clearance.
This situation would result in the following:

Minimum tooth bite (in): 0.0484
Minimum feed speed (ft/min): 237.2
Maximum depth of cut (in): 18.7

Feed Speed and Depth of Cut Observations

Observation No.	Length of Piece (ft)	Depth of Cut (in)	Seconds	Feed Speed (ft/min)
1	18.500	12.000	5.000	186.000
2	16.000	11.000	3.000	320.000

Figure 13. Performance Limitations Results for band saw tutorial A.

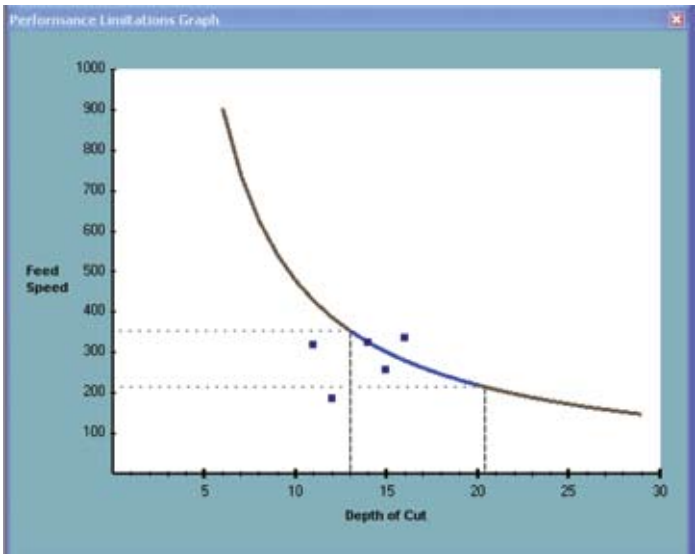


Figure 14. Performance Limitations Graph for band saw tutorial A.

results shown in Figures 13 and 14.

18. Save the output results to a text file by following these steps:
    a. Click **File, Save Results** on the menu bar.
    b. When the **Save As** dialog box appears, enter **Tutorial-Band A.txt** in the **File name** text box.
    c. Click the **Ok** button.
19. Print the input data and the output results by following these steps:
    a. Click **File, Print** on the menu bar.
    b. When the **Print** dialog box appears, select the correct printer and then click the **Ok** button.
20. If you want to modify the saw input data and run the analysis on the modified data, click the **Modify** button on the **Optimize-Troubleshoot Band Saw Data Entry** form. Change the saw data as desired and click the **Calculate** button to generate the new output results.

The blue portion of the curve in Figure 14 indicates the optimal operating range for the saw at gullet capacity. Along this portion of the curve, the log diameters are restricted to a range of 13.0 inches to 20.4 inches. For log diameters within this range, Figure 13 shows the corresponding feed speeds and tooth bite dimensions.

The region of the graph lying between the two horizontal dotted lines in Figure 14 indicates the acceptable operating conditions for the saw. Within this region the minimum feed speed is 215.6 ft/min and the maximum feed speed is 352.8 ft/min. If feed speeds exceed 352.8 ft/min, the saw teeth will be subject to excessive strain. If feed speeds fall below 215.6 ft/min, saw dust will spill from the gullets and cause the saw rim to overheat.

The five dark blue rectangles appearing on the graph are the plotted depth of cut-feed speed values. The feed speed values were computed based on the observation data entered in the Feed Speeds and Depth of Cut Observations form (Figure 6). As can be seen from the graph, there is one depth of cut and feed speed value (depth of cut = 14 in./feed speed = 325 ft/min) lying directly on the blue portion of the curve, indicating that the saw was operating at gullet capacity for that observation. There are two points (depth of cut = 15 in./feed speed = 257 ft/min and depth of cut = 11 in./feed speed = 320 ft/min) that lie below the curve but within the minimum

and maximum feed speed range, indicating that the saw was operating within the acceptable feed speed range, but the gullet capacity was underutilized for these two observations. There is one point (depth of cut = 16 in./feed speed = 336 ft/min) that lies above the curve, indicating that the saw exceeded gullet capacity for that observation. The last point (depth of cut = 12 in./feed speed = 186 ft/min) lies below the minimum feed speed, indicating that saw dust would spill out of the gullets for this feed speed-depth of cut combination.

As can be seen in Figure 13, the maximum required horsepower at the maximum feed speed of 352.8 ft/min is 168.2. This horsepower value is based on the horsepower equations given in Example 5 of Taylor, et. al. (1999). These horsepower equations use a range of species-specific wood densities and tooth bites to calculate the required horsepower. The SETS software adds a 20% risk factor to the resulting horsepower derived from these equations.

15. BAND SAW TUTORIAL B

This section provides a second band saw tutorial intended to help users optimize or troubleshoot a band saw using the SETS software. An explanation of the results and an interpretation of the performance limitations graph is given.

To run this tutorial, follow these steps:

1. Start the SETS software as described in Section 3.
2. Click **File, New, Optimize-Troubleshoot Band Saw**.
3. In the **Optimize-Troubleshoot Band Saw Data Entry** form, enter the following data values:

Gullet area:	1 in.2
Pitch:	2 in.
Plate thickness:	0.072 in.
Saw kerf:	0.165 in.
RPM:	531
Wheel diameter:	72 in.
Species:	Pine, Loblolly

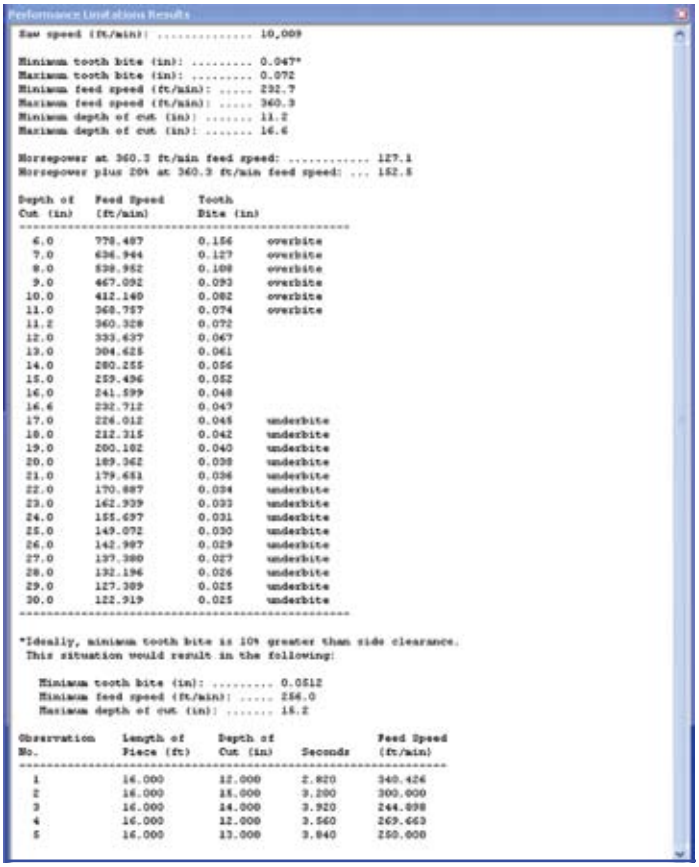


Figure 15. Performance Limitations Results for band saw tutorial B.

4. Click the **Observations** button and then enter the following five observations into the Feed Speed and Depth of Cut Observations form:

Obs. No.	Workpiece Length (ft.)	Depth of cut (in.)	Sec.
1	16	12	2.82
2	16	15	3.2
3	16	14	3.92
4	16	12	3.56
5	16	13	3.84

5. Click **Ok** to close the Feed Speed and Depth of Cut Observations form.
6. Click the **Calculate** button to display the output results shown in Figures 15 and 16.

The region between the two horizontal dotted lines in Figure 16 indicates acceptable operating conditions. The minimum and maximum feed speeds are 232.7 ft/min and 360.3 ft/min, respectively. The blue

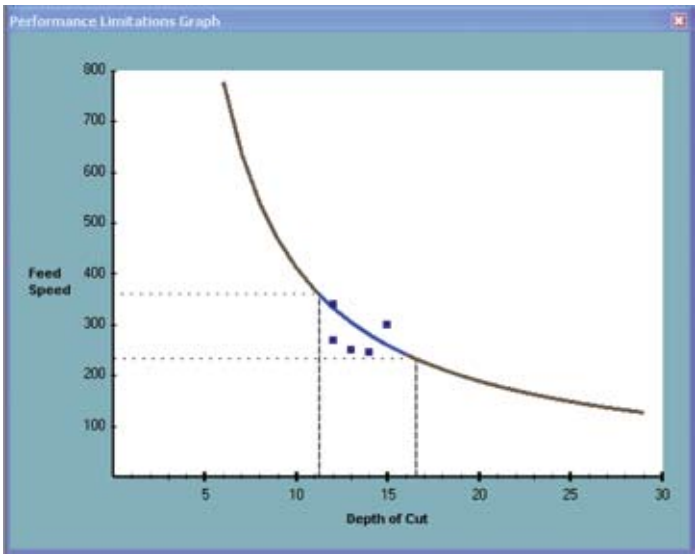


Figure 16. Performance Limitations Graph for band saw tutorial B.

portion of the curve indicates the optimal operating range for the saw at gullet capacity. Along this portion of the curve, the log diameters are restricted to a range of 11.2 inches to 16.6 inches.

Of the five observation points, three are below the curve, but lie in the acceptable feed speed range, indicating that the gullet capacity was underutilized for those observations. The other two are above the curve, indicating that the saw exceeded gullet capacity for those observations.

The maximum required horsepower at the maximum feed speed of 360.3 ft/min is 152.5.

16. CIRCULAR SAW TUTORIAL

This section provides a tutorial intended to help users optimize or troubleshoot a typical large diameter circular saw. This tutorial covers data entry, results generation, and an interpretation of the performance limitations graph.

To run the circular saw tutorial, follow these steps:

1. Start the SETS software as described in Section 3.
2. Click **File, New, Optimize-Troubleshoot Circular Saw**.
3. In the **Optimize-Troubleshoot Circular Saw Data Entry** form, enter the following data values:

Number of teeth:	50
Gullet area:	2.0 in.2
Plate thickness:	0.165 in.
Saw diameter:	54 in.
Saw kerf:	0.281 in.
RPM:	637
Species:	Pine, Loblolly

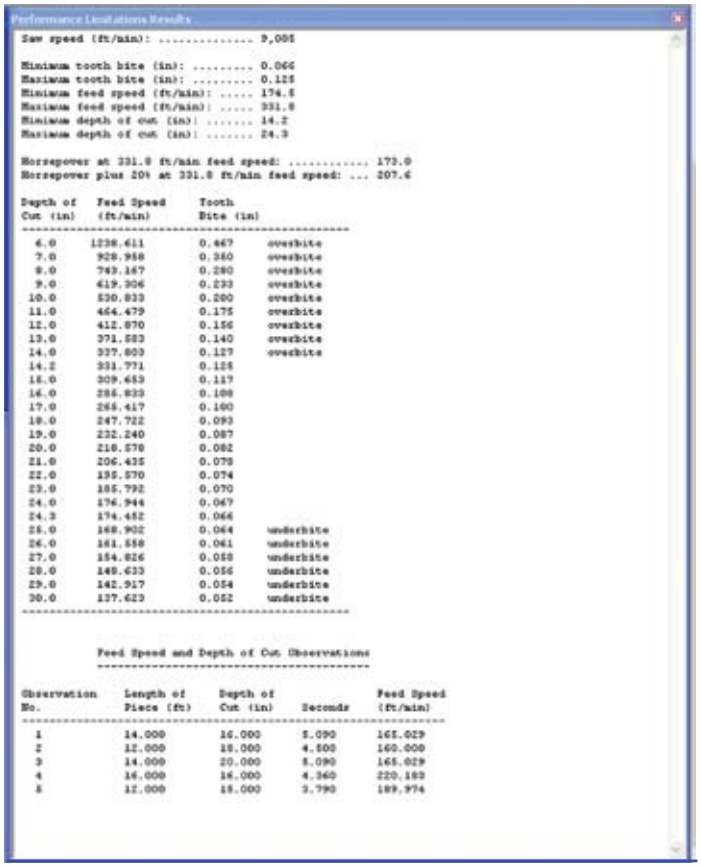
4. Click the **Observations** button and then enter the following five observations into the Feed Speed and Depth of Cut Observations form:

Obs. No.	Workpiece Length (ft.)	Depth of cut (in.)	Sec.
1	14	16	5.09
2	12	18	4.5
3	14	20	5.09
4	16	16	4.36
5	12	15	3.79

5. Click **Ok** to close the Feed Speed and Depth of Cut Observations form.
6. Click the **Calculate** button to display the output results shown in Figures 17 and 18.

The blue portion of the curve in Figure 18 indicates the optimal operating range for the saw at gullet capacity. For this saw the log diameters are restricted to a range of 14.2 inches to 24.3 inches.

The region of the graph lying between the two horizontal dotted lines in Figure 18 indicates the acceptable operating conditions for the saw. Within this region the minimum feed speed is 174.5 ft/min and the maximum feed speed is 331.8 ft/min. If feed speeds exceed 331.8 ft/min, the saw teeth will be subject to excessive strain. If feed speeds fall below 174.5 ft/min, saw dust will spill from the gullets and cause the saw rim to overheat.



Performance Limitations Results

Saw speed (ft/min): 9,085

Minimum tooth bite (in): 0.066
Maximum tooth bite (in): 0.125
Minimum feed speed (ft/min): 174.5
Maximum feed speed (ft/min): 331.8
Minimum depth of cut (in): 14.2
Maximum depth of cut (in): 24.3

Horsepower at 331.8 ft/min feed speed: 173.0
Horsepower plus 20% at 331.8 ft/min feed speed: ... 207.6

Depth of Cut (in)	Feed Speed (ft/min)	Tooth Bite (in)	
6.0	1238.611	0.467	overbite
7.0	928.958	0.360	overbite
8.0	743.167	0.280	overbite
9.0	619.306	0.233	overbite
10.0	530.833	0.200	overbite
11.0	464.479	0.175	overbite
12.0	412.870	0.156	overbite
13.0	371.583	0.140	overbite
14.0	337.803	0.127	overbite
14.2	331.771	0.125	
15.0	309.653	0.117	
16.0	286.833	0.108	
17.0	266.417	0.100	
18.0	247.722	0.093	
19.0	232.240	0.087	
20.0	218.570	0.082	
21.0	206.435	0.078	
22.0	195.570	0.074	
23.0	185.792	0.070	
24.0	176.944	0.067	
24.3	174.452	0.066	
25.0	168.902	0.064	underbite
26.0	161.558	0.061	underbite
27.0	154.026	0.058	underbite
28.0	148.633	0.056	underbite
29.0	142.917	0.054	underbite
30.0	137.623	0.052	underbite

Feed Speed and Depth of Cut Observations

Observation No.	Length of Piece (ft)	Depth of Cut (in)	Seconds	Feed Speed (ft/min)
1	14.000	16.000	5.090	165.029
2	12.000	18.000	4.500	160.000
3	14.000	20.000	5.090	165.029
4	16.000	14.000	4.360	220.183
5	12.000	18.000	3.790	189.974

Figure 17. Performance Limitations Results for circular saw tutorial.

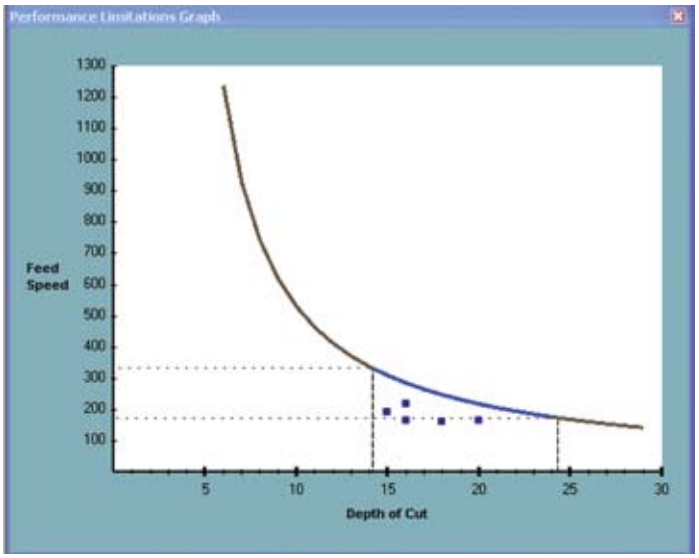


Figure 18. Performance Limitations Graph for circular saw tutorial.

Of the five observation points, two lie in the acceptable feed speed range, but are below the characteristic curve, indicating that the gullet capacity was underutilized for these observations. The other three points lie below the minimum feed speed, indicating that saw dust would spill out of the gullets for these feed speed-depth of cut combinations.

The maximum required horsepower at a feed speed of 331.8 ft/min is 207.6.

LITERATURE CITED

Armstrong Mfg. Co. 2003. Varidesign Deluxe, Version 1.305.9. Portland, OR.

Lunstrum, S. J. 1985. Balanced saw performance. Tech. Rep. No. 12. USDA Forest Service, Forest Products Laboratory, Madison, WI.17 p.

Microsoft Corporation. 2003. Microsoft Visual Basic .NET, Version 2003. Redmond, WA.

Suchsland, O. Undated. Operating characteristics and performance limitations of circular and band saws. Dept. of Forestry, Cooperative Extension Service, Michigan State University. Ext. Bull. E-1353. 6 p.

Taylor, J., A. Gingras, J. White, R. Niessen and D. Gagne. 1999. A report summary of "Power requirements for sawing and chipping". In: Proc. of Saw Tech '99 International Conference. Nov. 4-5, Seattle, WA. pp 75-84.

Feed Speed and Depth of Cut
Data Sheet

Sawing machine: _____

Date: _____

Observation No.	Workpiece Length (ft.)	Depth of Cut (in.)	Seconds
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Feed Speed and Depth of Cut
Data Sheet

Sawing machine: _____

Date: _____

Observation No.	Workpiece Length (ft.)	Depth of Cut (in.)	Seconds
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

MISSISSIPPI STATE
UNIVERSITY™

Discrimination based upon race, color, religion, sex, national origin, age, disability, or veteran's status is a violation of federal and state law and MSU policy and will not be tolerated. Discrimination based upon sexual orientation or group affiliation is a violation of MSU policy and will not be tolerated.