

Maintenance Staffing Calculator User Guide

**Ken Mall, Principal Investigator
EDSI Consulting**

with

Transportation Learning Center

Transit Resource Center

and

June Sekera

This work was sponsored by the Federal Transit Administration (FTA) in cooperation with the Transit Development Corporation. It was conducted through the Transit Cooperative Research Program (TCRP), which is administered by the Transportation Research Board (TRB) of the National Academies of Sciences, Engineering, and Medicine.

This work was prepared under TCRP Project E-10.

The material herein has not been edited by TRB.

Contents

OVERVIEW & PURPOSE.....	3
WORKSHEET OVERVIEW.....	5
FLEET INVENTORY WORKSHEET.....	7
CURRENT STAFFING WORKSHEET	9
REQUIRED HOURS – CORE MAINTENANCE WORKSHEET	13
REQUIRED HOURS – HEAVY REPAIR & OVERHAUL WORKSHEET.....	19
RESULTS – STAFFING SUFFICIENCY WORKSHEET.....	21
RESULTS – STAFFING COMPARISON WORKSHEET	23
BENCHMARKS WORKSHEET	25

This document provides instructions for entering data into the maintenance staffing calculator. It describes the calculations made and the results presented; offers insight into interpreting the results; and discusses ways the calculator can be used to model changes to fleet makeup, maintenance intervals and times, or expected productive hours. Additional context of the research is available in TCRP Report 184.

OVERVIEW & PURPOSE

The Bus Maintenance Staffing Calculator has three related purposes:

1. To measure how your current maintenance staffing levels compare with agencies in your peer group who were part of the E-10 staffing study.
2. As a planning tool to determine necessary staffing levels for your particular maintenance operation based on existing factors such as the number of buses in your fleet, PMI intervals, time to complete each PMI, expected productive hours, historical unscheduled maintenance, etc.
3. To model possible changes to maintenance policy and intervals, fleet size and make up, and/or average maintenance times for various tasks to determine the impact it will have on your maintenance staffing levels. For example, using the calculator you can add additional buses to the fleet to determine how a planned expansion will influence your staffing needs. Likewise, you could add or subtract hours needed to do engine rebuilds to determine how in-sourcing or out-sourcing of rebuild work would affect staffing needs.

The calculator addresses only mechanics/technicians, i.e., those who conduct PMIs, make repairs, and rebuild bus components. It does not address service line workers, facility maintenance staff, parts and warranty personnel, clerks, or supervisors unless they also perform bus maintenance tasks; nor does it account for mechanics/technicians who exclusively maintain non-revenue vehicles.

The accuracy of the calculator depends on the accuracy of the information entered – the more accurate the input, the more accurate the resulting calculations. The calculator is designed to be used with current data to determine if the existing staffing level is appropriate, and additionally with projected data for considered changes in fleet size, composition, or maintenance times and intervals.

Although entering the input fields is pretty straightforward, instructions for completing each worksheet are included below with notes to provide additional assistance. The Maintenance Staffing Calculator is designed to allow for easy input of current data and the ability to revise the current data. It also provides side by side comparisons of the revised staff levels to existing staff levels and calculated necessary staff levels. This calculator can be used in either miles or kilometers, and maintenance tasks scheduled by distance or time.

The calculator will provide information based on three sets of staff level calculations.

1. Existing staffing levels— this is your current staff and task calculations based on your agency's data and your input.
2. Calculated necessary staffing levels— these are the results of the data entered and are affected by the accuracy of the current data entered. Ideally the results of the existing staff and the calculated necessary staff should be equal. A difference between the existing staff and the calculated necessary staff results indicates reporting inconsistencies or incorrect data entry.

Maintenance Staffing Calculator User Guide

3. Revised staffing levels—this is where you get to enter different variables such as distance traveled, task times, task intervals, fleet size, etc. and will see how these revised entries affect staff levels.

NOTES FOR USER:

Rows and columns must not be added or subtracted from the sheets in this calculator. If row and columns are added or deleted, formulas will be affected. Sufficient rows and columns have been included to allow for use by the largest agencies. If fewer rows or columns are desired, simply hide the unused columns or rows, but do not delete them. To hide rows or columns, highlight rows or columns to be hidden, right-click with mouse, and click “Hide” from menu. To unhide, highlight the items above and below, or to the right and left, of the hidden columns, right-click with mouse, and click “Unhide” from menu.

The calculator was created in MS Excel 2013 and this version is recommended for best results. The file has been tested for compatibility with MS Excel 2007 as of April 2015. Earlier versions of MS Excel may not work to open or use the file as intended.

WORKSHEET OVERVIEW

The calculator is an excel spreadsheet comprised of seven individual worksheets: four data entry worksheets, two results worksheets, and a benchmark worksheet. Below is a brief description of each worksheet:

Fleet Inventory - where you enter details about your bus fleet. Entries made here are automatically carried over to other worksheets as needed to make staffing calculations based on your specific fleet including the number of buses, distance traveled, unit of measure (miles or kilometers), etc.

Existing Staff – where you enter details about your current technicians, both full and part time (only those involved with maintaining transit buses identified in the previous worksheet). Based on your inputs the calculator automatically determines the number of full time equivalent technicians (FTEs) and the annual expected productive hours per FTE.

Required Hours – Core Maintenance – where you use your agency’s data to enter the amount of tasks completed per year for different levels of PMIs, brake relines, seasonal inspections, etc. This is also where you enter your current average times per task. Sections for both distance and time based PMI intervals are included. In this worksheet you also enter the average number of hours spent on follow up repairs to PMIs, and unscheduled maintenance activities – those that develop unexpectedly throughout the year such as road calls and faults discovered by operators during their inspections. Once this information is entered you can then enter revised per unit mileage, task intervals, times per task, number of vehicles in sub-fleets, etc. The revised information is used to answer the “what if” (i.e., how a change in interval, mileage, or time affects my staff level needs).

Required Hours – Heavy Repair and Overhaul – where you enter either the total current number of annual hours or more detailed tasks and times spent on body and paint work, machine work, major unit overhauls, small component rebuilding, midlife overhauls, and other programs and campaigns. The user can make changes and see side by side comparisons between the current and revised results.

Results – Staffing Sufficiency – where a comparison is made between your existing staffing levels, calculated necessary maintenance levels, and the revised staffing levels (i.e., what you have in terms of staffing versus what you should have based on the data entered).

Results – Staffing Comparisons – where your agency is compared to others in your peer group in terms of fleet usage (i.e., average fleet age, annual miles traveled per vehicle, etc.) and current staffing ratios (i.e., vehicles maintained per technician, vehicle miles per technician, etc.). The results of the existing, calculated necessary, and revised staff levels are compared side to side.

Maintenance Staffing Calculator User Guide

Benchmarks - where all data are summarized and presented including number of agencies represented in each peer group, the average number of buses maintained per technician, annual maintenance hours per vehicle, number of technicians per vehicle miles (or kilometers) and hours, and other vital comparative statistics for each peer group.

The calculator fields are color coded throughout all the worksheets to make it easy to follow the data inputs and results on the different sheets of the calculator.

Table 1- Cell Color Explanation

The YELLOW cells are used to provide instruction or context.
The GREEN cells are for the entry of existing fleet and staffing data. It may be helpful to go through all worksheets and complete these cells before going back and completing the cells for revised data.
The cells with NO FILL are the results of current data entries and provide baseline information used in the comparisons. The NO FILL cells also have general messages and information.
The LAVENDER cells are the calculated results based on the existing fleet and staff data.
The LIGHT BLUE cells are for the input of revised data to be entered to calculate the staff level based on changes to distance, intervals, time etc.
The DARK BLUE cells are the calculated results based on the revised data inputs.

FLEET INVENTORY WORKSHEET

Use this sheet to enter details regarding your bus fleet. The calculator is designed to be entirely flexible in this area. You can break down the fleet with as much or as little detail as you'd like. For instance, the list could be broken down by every distinct sub-fleet (year, manufacturer, etc.), or just by major categories such as 35 foot buses, articulated buses, and cut-away buses; and by fuel type. The level of detail you provide depends on the type of analysis you wish to perform, and the level of detail you desire in the outcome. Up to 15 distinct sub-fleets can be entered. The rest of the calculator, particularly the Core Maintenance Required Hours Worksheet, will be based on the breakdown of sub-fleets you enter here. Because entries made here will play a significant role in determining staffing levels, you are strongly encouraged to take the time and itemize each bus type in the fleet as opposed to entering broad groupings or one general category. Providing more detail will allow you to identify if a particular group of buses is taking up a disproportionate share of maintenance time, and to better model potential changes through new bus purchases.

When it comes to entering buses on this worksheet you have several choices. Before we get to those choices, it is important to remember that the fleet data you enter in this worksheet must match the workforce you are trying to calculate. In other words, the buses you list in the "Fleet Inventory" worksheet need to be the ones maintained by the workforce you identify in the next "Existing Staff" worksheet.

If all buses in your fleet are maintained at one location by one set of technicians, either all in-house or all contracted out, the task is straightforward --- you create one Excel spreadsheet file to capture staffing levels for that operation. You could then use that worksheet to create other files to determine how changes in your operation will affect staffing levels.

However, in cases where some buses are contracted out, you may want to create one base spreadsheet file for buses maintained by your in-house staff and another for the buses maintained by the contractor. Likewise, if you have multiple locations you may want to create separate spreadsheet files to capture and analyze the staffing requirements at each location – the choice is yours.

Row 3 – In the green cell, enter either "Miles" or "Kilometers" for how you will enter data throughout this and other worksheets. This will adjust the text, benchmarks, comparisons, and calculations throughout the workbook accordingly.

Please note: selecting miles or kilometers must be done before data is entered. Once you select either miles or kilometers it should not be changed because the values that you entered will not change. For example: If you select "Miles" and enter 100,000 in the "Miles per year per vehicle" cell, then change your selection kilometers – the algorithm assumes that the calculation is 100,000 kilometers. The cell header will change to "Kilometers per year per vehicle."

Maintenance Staffing Calculator User Guide

Column A – Quantity: Enter the number of buses for each bus type in the fleet. Again, here you can get as detailed as you want breaking out each sub-fleet by manufacturer, year and size. Because data here are used to automatically populate other worksheets, the more sub-fleet detail you provide here the more accurate the staffing level calculations will be.

Column B – Manufacturer/Model: Enter the make and model for each sub-fleet classification (e.g., Gillig/Phantom, Orion/7, etc.).

Column C – Year(s): Enter the year of each sub-fleet classification. Here you can enter the model year or year the bus was delivered. Be consistent in the method chosen.

Column D – Size: Enter the size for each bus classification in your fleet (e.g., 40', 22', etc.).

Column E – Miles per year per vehicle: Enter the average total mileage that each bus in the sub-fleet travels in a year. This number should be the total annual miles accumulated, not just revenue miles, since total miles will determine maintenance times in other worksheets. The calculator will automatically calculate annual miles for this sub-fleet in other worksheets.

Column F –Hours per year per vehicle (Optional): Enter the average total hours each bus in this sub-fleet accumulates in a year. This number should be total annual hours, not just scheduled hours. The calculator will automatically calculate annual hours for this sub-fleet in other worksheets. This is used to determine duty cycle in comparison to other agencies.

Figure 1- Example Completed Fleet Inventory Worksheet

	A	B	C	D	E	F
1	Please provide the following information about your transit vehicle fleet at the facility or facilities you wish to analyze. Fleets can be broken down in whatever manner you wish:					
2						
3	Enter Unit of Measure to use throughout, either Miles or Kilometers				Miles	
4						
5	Quantity	Manufacturer / Model	Year(s)	Size	Miles per year per vehicle	Hours per year per vehicle (optional)
6	299	Nabi CNG	2004	40'	30,000	2000
7	45	Neoplan QM	2004	60'	14,975	1850
8	25	New Flyer Hybrid	2010	60'	25,644	2105
9						

Maintenance Staffing Calculator User Guide

EXISTING STAFF WORKSHEET

Note: As mentioned above, the data entered in this worksheet for existing staffing levels must reflect those technicians responsible for maintaining the buses listed in the previous “Fleet Inventory” worksheet. Again, you’ll need to create separate files if you want to analyze staffing needs for buses not included in the “Fleet Inventory” worksheet.

For rows 6-14, enter information on your existing full time and part time staff and their functions.

Figure 2- Existing Staff Worksheet, Rows 6-14

6	Number of FULL TIME Vehicle Mechanics / Technicians performing maintenance for this fleet:		145	
7				
8	Is any of the above listed FULL TIME mechanics / technicians' time spent maintaining non-revenue vehicles, buildings, or other direct work not on the fleet identified above? (Answer Yes or No)	no	If Yes, what % of these mechanics/technicians hours are NOT spent on maintaining the fleet listed above:	
9	Do any supervisors spend any part of their time on direct maintenance tasks (i.e. PMs, Scheduled or Unscheduled Repairs, or Heavy maintenance/overhaul) of the fleet listed above? (Answer Yes or No)	no	If Yes, how many supervisors are there?	If yes, what % of these supervisors hours are spent on direct maintenance of the fleet listed above?
10	Do any other positions (mechanic helpers, trainees, apprentices, etc.) spend any of their time on direct maintenance tasks (i.e. PMs, Scheduled or Unscheduled Repairs, or Heavy maintenance/overhaul) of the fleet listed above? (Answer Yes or No)	no	If Yes, how many are in these positions?	If yes, what % of those in these positions' hours are spent on direct maintenance of the fleet listed above?
11				
12	Number of PART TIME Vehicle Mechanics / Technicians performing maintenance for this fleet:		10	
13				
14	Is any of the above listed PART TIME mechanics / technicians' time spent maintaining non-revenue vehicles, buildings, or other direct work not on the fleet identified above? (Answer Yes or No)	no	If Yes, what % of these mechanics/technicians hours are NOT spent on maintaining the fleet listed above:	

Row 6: Enter the total number of **full time** mechanics and technicians responsible for maintaining vehicles identified in the previous worksheet. Vehicle mechanics or technicians are defined as those whose primary job function is to perform maintenance, repair and/or body, machining, and/or overhaul tasks.

Note: Do not include service line workers, mechanic helpers, trainees, apprentices, clerks, etc.; there will be a way to capture any time they spend on direct maintenance tasks later.

Maintenance Staffing Calculator User Guide

Row 8: The responses here capture any time the mechanics/technicians entered on row 6 spend maintaining non-revenue vehicles, buildings, or other direct work not attributed to the fleet identified in the previous “Fleet Inventory” worksheet including parts room assignments, warranty processing, etc. Answer yes or no, and if yes estimate the percentage of all mechanic/technicians’ hours spent not performing direct maintenance work (i.e., PMIs, repairs, overhauls) on the fleet.

Row 9: The responses here capture any time supervisors spend directly performing fleet maintenance tasks (i.e., PMIs, repairs, overhauls). Answer yes or no, and if yes enter the number of supervisors doing maintenance work and estimate the percentage of these supervisors’ hours spent performing fleet maintenance tasks.

Row 10: The responses here capture the time other positions such as mechanic helpers, trainees, apprentices, etc. spend directly performing fleet maintenance tasks. Answer yes or no, and if yes enter the number of staff in other positions doing maintenance work and estimate the percentage of all hours for those positions spent on performing fleet maintenance tasks.

Row 12: Enter the total number of **part time** mechanics and technicians responsible for maintaining vehicles identified in the previous worksheet. Vehicle mechanics and technicians are defined as those whose primary job function is to perform maintenance, repair and/or body, machining, and/or overhaul tasks.

Row 14: The responses here capture any time the **part time** mechanics or technicians entered on row 12 spend maintaining non-revenue vehicles, buildings, or other direct work not attributed to the fleet identified in the previous “Fleet Inventory” worksheet including parts room assignments, warranty processing, etc. Answer yes or no, and if yes estimate the percentage of all mechanic/technicians’ hours spent not performing direct maintenance work (i.e., PMIs, repairs, overhauls) on the fleet.

Maintenance Staffing Calculator User Guide

For rows 17-34, enter full time staff information in Column B and part time staff information in Column H.

Figure 3- Existing Staff Worksheet, Rows 17-37

	A	B	C	D	E	F	G	H	I
17					Please complete the section below for part-time staff calculations				
18	Please complete the section below for full time.								
19	Percentage of staff that is full time	90.91%			Percentage of staff that is part time			9.09%	
20	Hours per week for full time staff	40			Average scheduled hours per week			20	
21	Available hours per year	2080			Available hours per year			1040	
22	Available scheduled FTE from full time employees	100			Available Scheduled FTE from Part Time employees			5.00	
23	Annual Average <u>hours</u> per maintenance staff identified in rows 5-9:				Annual Average <u>hours</u> per maintenance staff identified in rows 11-13:				
24									
25	Vacation, holidays and sick leave	315			Vacation, holidays and sick leave			110	
26	Training	24			Training			24	
27	Meetings				Meetings				
28	Other non-productive time	216			Other non-productive time			40	
29	Subtotal of expected available productive hours	1525			Subtotal of expected available productive hours			866	
30	Length of shift in hours		To differentiate between 4-10s and 5-8s, etc., and calculate total number of shifts and annual hours of paid breaks		Average length of shift in hours			6	
31	Time allotted for PAID breaks per shift in hours	0.50			Time allotted for PAID breaks per shift in hours			0.25	
34	Expected Productive Hours Per Full Time Technician:	1430			Expected Productive Hours Per Part Time Technician:			830	
35	Equivalent Productive Hours per FTE Technician	1375.2							
36									
37	Average annual overtime hours per technician assigned to core maintenance and heavy repair:	60			Average annual overtime hours per part time technician assigned to core maintenance and heavy repair:			10	

Row 20: Enter the gross scheduled hours per week per person, i.e. 40, 38.5, 30 etc.

Row 25: Enter the combined average annual vacation, holiday and sick leave hours per person.

Row 26: Enter the average annual time for training per person.

Row 27: Enter the average annual time spent in meetings per person.

Row 28: Enter the average annual estimated other non-productive hours per person.

Row 30: Enter the length of the scheduled shift in hours *including* break time.

Row 31: Enter the amount of paid breaks per shift.

Row 37: Enter the average annual overtime hours per technician assigned to core maintenance and heavy repair.

Maintenance Staffing Calculator User Guide

Calculations Shown:

Row 19: The FT/PT staff breakdown in % of total hours is shown.

Row 21: Shows gross hours of labor available per person in each group.

Row 29: Shows a subtotal of available productive hours before subtracting breaks.

Row 34: Shows bottom line expected productive hours per FT and PT maintenance employee.

Row 35: The Equivalent Productive hours is the FTE hours based on the calculated percentage of full and part time staff hours (row 19) and row 34.

Maintenance Staffing Calculator User Guide

REQUIRED HOURS – CORE MAINTENANCE WORKSHEET

This worksheet represents the heart of the calculator in that it captures the number of annual hours needed at your agency to perform core maintenance activities such as conducting PMIs, brake relines, and unscheduled maintenance such as road calls and running repairs. This worksheet requires several entries. Entries are required for each light green shaded cell as applicable; calculations are automatically displayed in the white cells based on the inputs. (Heavy maintenance such as paint and body work and drivetrain overhauls are addressed on the next worksheet.) It is recommended to fully complete the worksheet based on current data (green cells) before including any revised data (light blue cells).

In this worksheet, existing fleet information is automatically entered in Columns A-F from entries you made earlier. It may be helpful to hide any rows for which there is no corresponding sub-fleet entered. Data entries required by you are divided into eight sections of columns, for each set of columns you'll enter data across a set of rows for each sub-fleet that appears:

- Fleet usage and composition revisions (Columns G and H)
- Miles based Preventive Maintenance Inspections (PMIs) (Columns I-R)
- Time based Preventive Maintenance Inspections (PMIs) (Columns S-Z)
- Repair of Defects Noted During PMIs (Column AA)
- Other Time Based Activities (Columns AB-AH)
- Other Distance Based Activities (Columns AI-AO)
- Unscheduled Maintenance & Repairs (Column AQ)

Fleet Usage and Composition Revisions (Columns G and H)

While columns A-F will be automatically entered from the Fleet Inventory worksheet, columns G and H allow you to model a change to the fleet by changing the number of vehicles or miles per year per vehicle by sub-fleet. You should complete the green “current data” fields before entering data into the “light blue” revision fields.

Figure 4- Req Hours – Core Maintenance Worksheet, Columns I-Y (Mileage and Time Based PMI and Repair of Related Defects)

1	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
	Mileage Based Preventive Maintenance Inspections (PMI)								Time (Days) Based Preventive Maintenance Inspections (PMI)								Repair of defects noted during PMIs (list total annual hours for each sub-fleet, exclude any minor repairs already included in the inspection times in columns to left)
2	Completed task and current average is from own maintenance records	PMI Mileage 1	PMI Mileage 2	PMI Mileage 3	PMI Mileage 4	PMI Mileage 5	PMI Mileage 6	Miles based PMI Totals	Completed task and current average is from own maintenance records	PMI Days 1	PMI Days 2	PMI Days 3	PMI Days 4	PMI Days 5	PMI Days 6	Days based PMI Totals	
3	Inspection Type, Name or Interval	6000	12000	18000	24000	30000	36000	N/A	Inspection Type, Name or Interval	30	60	90	180	360	720	N/A	
4	Current Annual Completed Tasks	109	194	212	157	190	117	979	Current Annual Completed Tasks	109	194	212	157	190	117	979	
5	Current Average Time/Task	4	8	8	8	8	8	7.3	Current Average Time/Task	4	8	8	8	8	8	7.3	
6	Current Annual Hours Required:	436.0	1552.0	1696.0	1256.0	1520.0	936.0	7396.0	Current Annual Hours Required:	436.0	1552.0	1696.0	1256.0	1520.0	936.0	7396.0	
7	Revised Time/Task	4.0	8.0	8.0	8.0	8.0	8.0	7.3	Revised Time/Task	4.0	8.0	8.0	8.0	8.0	8.0	7.3	
8																	
9	Calculated Revised Annual Tasks	120	214	234	173	210	129	1081	Calculated Revised Annual Tasks	120	214	234	173	210	129	1081	
10	Revised Annual Time Required:	481.2	1712.9	1871.8	1386.2	1677.6	1033.0	8162.8	Revised Annual Time Required:	481.2	1712.9	1871.8	1386.2	1677.6	1033.0	8162.8	
11																8,000	

Preventive Maintenance Inspections (PMIs) (Columns I-Z)

Understanding that some buses may require different PMIs at different intervals (i.e., A inspection, B inspection, etc.), and that different PMIs take different amounts of time to complete based on vehicle characteristics, these columns allow you to enter the annual completed tasks and the current task time for each PMI variation in the **green rows**. To help identify each PMI, the top green row in each vehicle section can be used to enter the interval, type, or name of the PMI etc. This is for reference only and does not directly affect the calculations. Only enter the time it takes to complete the inspection itself and the repair of any minor defects done concurrently with the inspection, not the time it takes to repair any substantial defects found during the inspection that are the result of follow up work orders, this is covered elsewhere. Include the combined labor time for all mechanics/technicians working on the PMI (i.e., two mechanics working four hours each is eight hours).

Based on your entries the worksheet will automatically calculate the total completed PMI tasks, average time per task, yearly hours per task and total required. Results in the **lavender** rows are the calculated annual hours per task based on the current task and staff data.

If you choose to see how changes in number of vehicles, and per unit distance travelled affect the staff requirements, use the light blue columns G and H. For each sub-fleet you will need to enter a value for both even if one value is not changing.

If your agency uses entirely mileage based or time based PMI intervals, just complete the relevant section and leave the other section of PMI blank.

Repair of Defects Noted During PMIs (Column AA)

Enter the total annual hours spent repairing defects noted during all of the PMIs listed in columns J-Q (mileage-based PMIs) and columns T-Y (time/day-based PMIs) for each sub-fleet.

Exclude any minor repairs already included in the inspection times entered, only include the time needed to repair substantial defects after the basic inspection is completed. Do not include any paint and body work resulting from a PMI; this will be accounted for later.

Enter the current hours in the green cells and the revised times in the light blue cells.

Total hours needed to repair all defects noted during PMIs are automatically calculated and provided at the bottom.

Maintenance Staffing Calculator User Guide

Figure 5- Req Hours – Core Maintenance Worksheet, Columns AB–AO (Other Time and Distance Based Maintenance Activities)

	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO
1	Other Time and Distance Based Maintenance Activities – If Additional Columns Are Required, Enter the Information on the Heavy Repair Sheet													
2	In the columns to the right, enter time Based Seasonal or Annual Inspections such as HVAC, State Inspection, Annual DPF, etc.	HVAC	State Inspection	Air System	Annual DPF	Other 1	Other 2	In the columns to the right, enter tasks that have a correlation to distance traveled.	Front Brake Reline	Middle Axle Brake Relines	Rear Brake Reline	Road calls	Other 1	Other 2
3	Task Interval (Days)	90	90	90	360			Task Interval (Distance)	10000					
4	Annual Completed Tasks	1200.0	1200.0	1200.0	300.0			Annual Completed Task	1200.0					
5	Current Average Time/Task	2.0	6.0	2.0	2.0			Current Average Time/Task	2.0					
6	Yearly Hours Required:	2400.0	7200.0	2400.0	600.0	0.0	0.0	Yearly Hours Required:	2400.0	0.0	0.0	0.0	0.0	0.0
7	Revised Time/Task	2.0	6.0	2.0	2.0			Revised Time/Task	2.0					
8	Revised Interval (Days)	120.0	120.0	120.0	360.0			Revised Interval (Distance)	10000.0					
9	Revised Annual Completed Tasks	993	993	993	331	0	0	Revised Annual Completed Tasks	1324	0	0	0	0	0
10	Revised Yearly Hours Required	1986.6	5959.9	1986.6	662.2	0.0	0.0	Revised Yearly Hours Required	2648.8	0.0	0.0	0.0	0.0	0.0

Other Time Based Maintenance Activities (Columns AB-AH)

There are six columns in this section to enter time based maintenance activities.

In row 2, enter the type of time based activity such as state inspections, annual DPF replacements, seasonal HVAC inspections etc. Row 2 is for reference only.

In the green cells, enter the annual current completed tasks and current average time per task. The results will be in the lavender cells

In the light blue cells, enter the revised time per task and the revised interval in days. This will calculate the revised annual completed tasks and revised annual hours in the dark blue cells. Note that the revised number of vehicles in the sub-fleet from column G carries over to these calculations. (The distance traveled is not relevant to tasks in this section since they are strictly calendar based.)

Maintenance Staffing Calculator User Guide

Other Distance Based Maintenance Activities (Columns AI-AO)

This section is for other tasks that have a correlation to distance traveled. There are six columns in this section.

In Row 2 enter the type or name of the task such as front, middle, or rear brake relines.

In the green cells enter the corresponding annual completed tasks and the current average time per task. The calculated yearly annual hours will be in the lavender cells. In the light blue cells, enter the revised time per task and the revised task interval. The revised annual completed tasks and revised annual hours are calculated with the results in the dark blue cells. Note that the revised number of vehicles and distance per vehicle from columns G and H carry over to these calculations.

Figure 6 - Req Hours – Core Maintenance Worksheet, Columns AP-BB (Unscheduled Maintenance and Repairs and Column Calculations)

	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB
1	Total PM and Other Distance Based Maintenance Hours	Unscheduled Maintenance & Repairs (list total annual hours for each sub-fleet)	Total Fleet Core Maintenance Hours		Maintenance Hours Per Bus Per Year for each sub-fleet	Maintenance Hours Per 10k vehicle Miles by subfleet		Actual Number of PMIs Performed Each Year by Sub-fleet		% of time on Scheduled Maintenance	% of time on Unscheduled Maintenance		
2													
3													
4													
5													
6	38,792.00	50,000.00	88,792.00		297.0	99.0		979.0		44%	56%	Current Yearly Hours Required:	88,792.00
7													
8													
9													
10	37,569.77	40,000.00	77,569.77		259.4	86.5		1,080.5		48%	52%	Revised Yearly Hours Required:	77,569.77

Unscheduled Maintenance & Repairs (Column AQ)

Transit has no official definition for unscheduled maintenance. For the purposes of this calculator, unscheduled maintenance includes:

1. The repair of defects noted by the driver that get repaired before the next scheduled PMI
2. Any other running repairs that occur, and haven't been accounted for in the other columns
3. Repairs as a result of failures in service can be included here.
4. If you choose not to enter road calls in columns AA-AM, the time can be included here.

If the time wasn't captured under scheduled maintenance earlier in this worksheet, or included in the next worksheet under heavy maintenance, it needs to be identified here as unscheduled maintenance. Enter the annual hours spent on unscheduled maintenance and repairs for each sub-fleet.

Maintenance Staffing Calculator User Guide

Column Calculations:

Column AR: Here the worksheet calculates the hours needed for all core maintenance activities captured in rows J-AO for each sub-fleet. Totals for scheduled and unscheduled maintenance are automatically calculated and provided at the bottom.

Columns AT and AU:

Here the worksheet calculates for each sub-fleet the number of maintenance hours per year per bus, and the number of maintenance hours per 10k vehicle miles. This will allow you to identify if there are particular sub-fleets consuming a disproportionate amount of maintenance resources and to model the effect of replacing them if you desire. The lavender results are based on the current information and the dark blue on the revised information.

Column AW: Here the worksheet calculates for each sub-fleet the number of PMIs performed each year. The lavender results are based on the current information and the dark blue on the revised information.

Column AY and AZ: Here the worksheet calculates the percentage of maintenance time that is scheduled and unscheduled (based on the definitions discussed above) for each sub-fleet. The lavender results are based on the current information and the dark blue on the revised information.

Summary Calculations at Bottom of Worksheet:

Row 140: This row provides total scheduled and unscheduled maintenance from the current (lavender) cells in columns AP and AR.

Row 142: This row contains the productive hours per FTE calculated on the current staffing worksheet.

Row 144: The number of required FTEs needed based on the current staff and task information entered. (lavender)

Row 146: This row shows the percentage of core maintenance that is unscheduled based on current information. (lavender)

Row 148: This row shows the calculated full time staff needed, based on current staff percentages for current task and time information. (lavender)

Row 150: This row shows the calculated part time staff (FTE) needed, based on current staff percentages for current task and time information. (lavender)

Row 156: This row provides total scheduled and unscheduled maintenance from the revised (blue) cells in columns AP and AR.

Maintenance Staffing Calculator User Guide

Row 158: This row contains the productive hours per FTE calculated on the revised staffing worksheet.

Row 160: The number of required FTEs needed based on the revised staff and task information entered. (blue)

Row 162: This row shows the percentage of core maintenance that is unscheduled based on revised information. (blue)

Row 164: This row shows the calculated full time staff needed, based on current staff percentages for revised task and time information (blue)

Row 166: This row shows the calculated part time staff (FTE) needed, based on Current staff percentages for revised task and time information. (blue)

This sheet only calculates the staff for the work on this sheet and will be combined with the heavy repair overhaul hours on the results sheets.

Maintenance Staffing Calculator User Guide

REQUIRED HOURS – HEAVY REPAIR & OVERHAUL WORKSHEET

Please carefully review this worksheet, even if your agency's general practice is to outsource all heavy repair work.

Figure 7- Req Hours - Hvy Rep_Overhaul Worksheet

	A	B	C	D	E	F	G	H	I
	List number of occurrences of each type of event for the entire set of buses entered on the "Fleet Inventory" worksheet, and the average number of hours per event. Use column B for quick results if that data is available or use columns C and D to get a more detailed result. If column B is used, leave columns C and D blank. For revised results, use column F for a quick revision, or use columns G and H together. If column F is used, leave columns G and H blank. Items in column A are starting examples but can be changed to match the types of work completed at your agency.	Total Annual Demanded Hours-Quick Results	Current Average Hours Per Task	Quantity of Buses or Components for this task per year	Demanded Total Annual Hours	Total Annual Revised Hours-Quick Results	Revised Hours Per Task	Revised Quantity of Buses or Components for this task per year	Revised Total Annual Hours
1									
2	Body Work				0				0
3	Paint				0				0
4	40' bus		80	100	8000		75	75	5625
5	60' bus		100	40	4000		85	85	7225
6	components				0				0
7					0				0
8									

This worksheet allows you to enter the time in hours needed for other maintenance activities not previously captured in the previous worksheet. Likely examples include body and paint work, brake machining, major unit overhaul, small component rebuild, midlife bus overhaul, and a “catch-all” category for other maintenance programs and campaigns. You can revise the items in column A to match the work you want to track in this worksheet. For each type of work enter either the combined time in hours in column B for the entire set of buses identified in the Fleet Inventory worksheet, OR complete columns C and D for a more detailed breakdown. Enter the quantity of buses or components being overhauled in column D and the average time to complete each task in column C. The calculated results are in the lavender column E. For each row you can make a different determination of the method to use, but only use one method per row.

For revised times the same method applies. For each row enter a total number of hours in column F, or complete both column G and column H for a more detailed calculation.

Do not enter any hours for outsourced jobs. Again, the labor time listed on this worksheet is for work performed by the maintenance staff identified in the "Existing Staff" worksheet.

Maintenance Staffing Calculator User Guide

Various calculations are displayed in rows at the bottom of the worksheet:

Figure 8- Req Hours - Hvy Rep_Overhaul Worksheet (Results)

40			
41	Total Required labor hours for Heavy Repair and Overhaul:	16400	15000
42			
43	Expected Productive Hours Per Technician per year (Entered from "Current Staffing" data):	1377	1377
44			
45	Total Number of FTE Technicians Needed for Heavy Repair and Overhaul:	11.9	10.9
46			
47	Total Number of Full Time Technicians Needed for Heavy Repair and Overhaul:	11.1	10.2
48			
49	Total Number of Part Time Technicians (FTE) Needed for Heavy Repair and Overhaul:	0.8	0.7

Row 41: This row provides the total calculated necessary (lavender) and revised (blue) labor hours based on the tasks and times entered above.

Row 43: This is the productive hours based on the current staff as calculated on the Existing Staff worksheet.

Row 45: The total number of technicians needed based on the current staff for calculated necessary (lavender) and revised (blue) labor hours based on the tasks and times entered above.

Row 47: The total number of full time technicians needed based on the current staff for calculated necessary (lavender) and revised (blue) labor hours based on the tasks and times entered above.

Row 49: The total number of part time technicians needed based on the current staff for calculated necessary (lavender) and revised (blue) labor hours based on the tasks and times entered above.

This sheet only calculates the staff for the work on this sheet and will be combined with the core maintenance on the results sheets.

Maintenance Staffing Calculator User Guide

RESULTS – STAFFING SUFFICIENCY WORKSHEET

This worksheet compares the number of hours and FTEs “Calculated Necessary Staff Based on Existing Task, Times, Intervals” (lavender) by the maintenance tasks entered in the “Req Hours Core Maintenance” and “Req Hours Hvy Rep_Overhaul” worksheets, with your existing staffing levels and available hours (white) based on the data entered in the Existing Staff worksheet, as well as your revised (blue) entries.

Figure 9- Staffing Sufficiency Worksheet (Completed Example)

	A	B	C	D	E	G	H
1	Comparisons of Current Staffing Levels to Calculated Demanded Maintenance Levels						
2							
3		Calculated Necessary Staff Based on Existing Task, Times, Intervals	Currently Available (excluding OT)	Currently Available (with expected OT)	Revised Staff Based on Revised Task, Times, Intervals		
4	Full Time Technician Staff Demanded / Available	159.0	155.0	161.4	140.1		
5	Annual Productive Hours Demanded/Available from Full Time Technicians	218,876.0	213,402.19	222,202.19	192,944.8		
6							
7	Total of the Average Overtime Hours			8,800.00			
8							
9							
10	Equivalent staff needed to meet the calculated "Demanded" staff level. This is the difference between the current staff and calculated requirement.			(2.42)	A difference between the Demanded and the Current staff level indicates reporting inconsistencies or incorrect data entry		
11							
12							
13							
14	Equivalent staff needed to meet the calculated "Revised" staff level, based on times, task and interval changes. This is the difference between the current staff and the Revised calculated requirement.			(14.86)	A calculated Revised Staff that is less than the Current Available will be indicated by a number in parenthesis		
15							
16							
17							
18	Equivalent additional FULL Time Staff needed to eliminate overtime based on reported FULL time Productive Hours on Current Staffing Tab (No overtime for Part time staff)			6.22	This is for Current Staff only		
19							
20							
21							
22	Staff Summary Using Existing Full and Part Time Staffing Ratios						
23							
24	STAFF	FULL TIME	PART TIME	TOTAL	FTE	FTE with OT	
25	Current Staff	145.0	10.0	155.0	150.0	161.4	
26	Demanded Staff, Core and Heavy Repair	148.7	10.3	159.0	153.8	n/a	
27	Revised Staff, Core and Heavy Repair	131.1	9.0	140.1	135.6	n/a	
28							
29							

Maintenance Staffing Calculator User Guide

Rows 3-5: Column B shows the number of FTE technicians and labor hours necessary to complete the maintenance tasks entered with the number of productive hours per technician calculated. Columns C-D show what you currently have available to you with and without expected overtime. Ideally column D should be equal to the results in column B. A difference between the calculated necessary and existing staff level may indicate inconsistencies in data available, incorrect data entry, or possible recent changes in staffing. There may also be inconsistencies in the calculated productive hours and the number of productive hours actually achieved. Column E is the staff required based on revised task, time, intervals and mileage entered in the previous sheets.

Row 7: This row shows the average overtime hours based on the difference between the current available hours and the current available hours with overtime in row 5.

Row 10: This is the difference between the current staff and the calculated necessary (lavender) staff. The closer this result is to "0" the more accurate the calculations will be.

Row 14: This is the equivalent staff needed to meet the revised staff level. A result in parentheses indicates an existing staff that is greater than the calculated staff needed based on the revised inputs.

Row 18: This is the equivalent additional staff needed to eliminate overtime based on full time productive hours with no overtime for part time staff and is for existing staff only.

Rows 25-27: This section allows for an easy staff summary comparison between existing (white), calculated necessary (lavender), and revised (blue) staff for full and part time, total and FTEs. Note that Current FTEs with overtime is included and will be the basis for current calculations on the staffing comparison sheet.

Maintenance Staffing Calculator User Guide

RESULTS – STAFFING COMPARISON WORKSHEET

Consider this worksheet a “dashboard” that reveals vital information about how your existing staffing levels compare to other agencies in your peer group.

The Results Worksheet presents data in several useful and interesting ways:

- Vehicles maintained per technician
- Vehicle miles/kilometers per FTE Technician
- FTE Technicians per Vehicle
- FTE Technicians per 10k Vehicle Miles/kilometers
- Annual Maintenance Hours per Vehicle:
- Annual Maintenance Hours per 10k vehicle Miles/kilometers:

For each category above the calculator compares your agency to the peer group average and includes the standard deviation. In statistics, the standard deviation measures the amount of variation from the average. A low standard deviation indicates that the data points being compared are similar to one another, while a high standard deviation tells us the data points are spread out over a large range of values.

Figure 10 - Staffing Comparisons Worksheet (Rows 1-12)

	A	B	C	D	E	F	G	H	I	J
1	Comparisons of your current technician staffing level to technician staffing levels at similar sized agencies									
2										
3	Your Peer Group is:	250-499 Vehicle Maintained								
4	Total Fleet Size	369								
5	Total Fleet Annual Miles	10,284,975								
6	Total Fleet Annual Hours	733,875								
7										
8	Fleet Usage Comparison		Your Agency:	Peer Group Average	Peer Group Standard Deviation	Comparison of Your Agency to Peer Group				
9	Annual Miles Per Vehicle		27,872.6	45,120.8	8,678.8	Significantly fewer Miles per vehicle than average peer agency				
10	Annual Hours Per Vehicle		1,988.8	2,976.0	574.4	Significantly fewer hours operated per vehicle than average peer agency				
11	Average Miles Per Hour of Operation		14.01	14.6	3.5	Lower Miles per hour than average peer agency				
12	Fleet Average Age		10.59	7.0	1.8	Significantly older fleet than average peer agency				
13			If the usage of your fleet differs significantly from the peer group average, that may partially explain any significant differences in per vehicle staffing levels compared to your peer group indicated below.							

Rows 1-12: Provide context to compare your agency to the other agencies in your peer group. Here you can see if your type of operation is generally represented by the peer group or if it differs. If you differ substantially in these statistics from the peer group, the staffing comparisons that follow may not be helpful, but if your annual miles per vehicle and fleet age are fairly similar, there may be lessons to draw from how your staffing level compares to the peer agencies

Maintenance Staffing Calculator User Guide

Figure 11 - Staffing Comparisons Worksheet (Rows 14-20, Completed Example)

	Current Staffing Ratios:	Your Agency With <i>Current</i> Staff:	Your Agency With <i>Calculated necessary Staff</i> Based On current task data entry	Your Agency With <i>Revised Staff</i> Based On revised task data entry	Peer Group Average	Peer Group Standard Deviation	Comparison of Your Agency With <i>Current</i> Staff Levels to Peer Group's Current Staff Levels
14							
15	Vehicles maintained per technician	2.29	2.32	2.63	4.88	3.04	Higher staffing than average peer agency
16	Vehicle Miles per FTE Technician	63,726.80	66,851.74	82,244.94	176,163.2	54,628.8	Significantly higher staffing than average peer agency
17	FTE Technicians per Vehicle	0.437	0.417	0.368	0.250	0.093	Significantly higher staffing than average peer agency
18	FTE Technicians per 10k Vehicle Miles	0.157	0.150	0.122	0.062	0.021	Significantly higher staffing than average peer agency
19	Annual Maintenance Hours per Vehicle with No Overtime	578.3	593.2	522.9	410.1	147.0	Significantly higher staffing than average peer agency
20	Annual Maintenance Hours per 10k Vehicle Miles	207.5	212.81	173.0	97.6	28.8	Significantly higher staffing than average peer agency

Rows 14-20: Provide detailed comparisons of your current staffing, calculated necessary staffing, and projected/revised staffing against the staffing levels at peer agencies. Column B is based on the Current information entered on the previous sheets and makes various observations about how your agency compares to the peer group average (e.g., the number of vehicle hours per FTE technician at your agency is significantly lower than the average peer agency). It is important to note that these numbers, where applicable, are based on the Current staff including overtime. Column C is based on the calculated necessary (lavender) information entered in the previous sheets. Column D is based on the revised (blue) information entered on the previous sheets. Space provided in Column G and beyond offers various explanations based on the data. For example, if the usage of your fleet differs significantly from the peer group average, it may partially explain any significant differences in per vehicle staffing levels.

Based on the comparisons provided in this worksheet you could conduct a more thorough analysis if needed to determine why your staffing levels differ significantly from your peers. Note that the explanations only refer to your Current results in column B, but the calculated necessary and revised results can be compared to the peer group information in columns E and F. Also note that if the calculator is only used to assess heavy repair staff information. If the message “results not applicable—no entries in core maintenance” is displayed that is because the benchmarks are based on survey results of core and heavy repairs completed at various agencies.

As mentioned earlier, you could also use the worksheet to determine how changes in your maintenance operation would affect staffing levels. For example, if you wanted to spend an additional hour repairing defects noted during PMIs to help improve fleet condition and reduce road calls, the calculator will tell you how many more FTE technicians you’ll need. You can save spreadsheets under different file names to suit your needs; one that represents the existing staffing levels for the current fleet, another which shows a future expansion, another for taking engine rebuilds in-house, etc., or create individual sheets for each garage.

BENCHMARKS WORKSHEET

This worksheet provides a global look at all peer groups including the number of agencies represented in each peer group and how the averages in each peer group compare to one another. The distance traveled will be in either miles or kilometers based on the entry on the Fleet Inventory sheet.