ULTRAMOD Spreadsheet

NATIONAL TRUCK EQUIPMENT ASSOCIATION

Enclosed is the ULTRAMOD spreadsheet, a useful software package for calculating the weight distribution of a truck, including additional axles or wheelbase modification. Wheelbase changes can be the result of moving axles or frame modifications. ULTRAMOD's easy-to-follow steps lead you through the required process for calculating weight distributions based on these measurements. ULTRAMOD allows you to generate necessary engineering data quickly and efficiently and warns of axle and vehicle overloading conditions.

Please note that ULTRAMOD is NOT an independent software package. It relies on spreadsheet programs such as Microsoft Excel. Attempts to run ULTRAMOD without a spreadsheet program will be unsuccessful.

Copies of ULTRAMOD are formatted in Microsoft Excel.

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USING ULTRAMOD. First, make a copy of ULTRAMOD under another name for data entry. Your ULTRAMOD disk should remain a master without being used to make calculations. Copies of the ULTRAMOD spreadsheets could be saved under customers' names to perform the calculations.

Before data is entered, some of the Cells will contain the message "ERR" or "0.00" or "#VALUE!" or "#NAME?". That indicates that the Cell is a formula that depends on data from other Cells that has not been entered. As the information is entered into the other Cells, numbers will appear in these Cells.

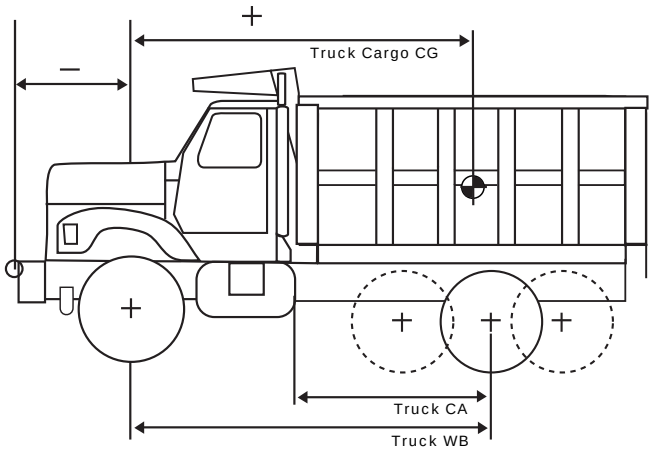
Print only Cells A2 through F58. Intermediate calculations are performed in Columns G through K (they are necessary for the calculation process, but do not contain output information).

Data is input in the shaded boxes and output is shown at the bottom of the spreadsheet. The two exceptions are the Chassis "HOR–CG" / Cell B28, and Chassis "Weight" / Cell D28. Data is automatically inserted into Cells B28 and D28 from spreadsheet calculations above.

Complete instructions and figure calculations are included in this booklet. Input forms for organizing the necessary information are also enclosed. If you have any problems using ULTRAMOD, call the National Truck Equipment Association's (NTEA) Technical Services Department at 1-800-441-6832.

National Truck Equipment Association
37400 Hills Tech Drive
Farmington Hills, MI 48331-3414
1-800-441-NTEA
(248) 489-7090 • FAX (248) 489-8590
info@ntea.com • www.ntea.com

Introduction



	A	B	C	D	E	F
2	**CENTER OF GRAVITY AND WEIGHT DISTRIBUTION**					**4/23/02**
	WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION					**(C) Copyright Toner Associates 2002**
3	VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)		
4	A4-A5	B4	C4	D4	**GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.**	
5						
6	**Chassis Components Before Modification**					
7	Original Wheelbase:	B7	*inches*			
8	Cab to Axle/Trunion:	B8	*inches*			
9	Number of Original Rear Axle(s):	B9				
10						
11		Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)	**Note: The accuracy of these calculations depends on the accuracy of the input data.**	
12	Base Chassis Weights	B12	C12	0		
13						
14	**New Wheelbase and/or Additional Axle(s)**					
15		New Wheelbase, or enter original if not altering (inches)	Axle Weight (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)	
16	Data for Original Rear Axle(s):	B16	C16	D16	E16	
17						
18	**Additional Axles**					
19	Axle Number 1:	B19	C19	D19	E19	
20	Axle Number 2:	B20	C20	D20	E20	
21	Axle Number 3:	B21	C21	D21	E21	
22	Axle Number 4:	B22	C22	D22	E22	
23	Axle Number 5:	B23	C23	D23	E23	
24						
25						
26	**Added Components**	Horizontal CG				
27	Component	(inches)	Vertical CG (inches)	Weight (lbs.)		
28	CHASSIS	#VALUE!	C28	#VALUE!		
29	A29	B29	C29	D29		
30	A30	B30	C30	D30		
31	A31	B31	C31	D31		
32	A32	B32	C32	D32		
33	A33	B33	C33	D33		
34	A34	B34	C34	D34		
35	A35	B35	C35	D35		
36	A36	B36	C36	D36		
37	A37	B37	C37	D37		
38	A38	B38	C38	D38		
39	A39	B39	C39	D39		
40	A40	B40	C40	D40		
41	A41	B41	C41	D41		
42	A42	B42	C42	D42		
43	A43	B43	C43	D43		
44	A44	B44	C44	D44		
45	A45	B45	C45	D45		
46	A46	B46	C46	D46		
47	DESIRED PAYLOAD	B47	C47	D47		
48			Total Weight:	**#VALUE!**	**#VALUE!**	
49	Horizontal CG:	**#VALUE!**	*inches*			
50	Vertical CG:	**#VALUE!**	*inches*			
51	Rear Axles Proportioned for Capacity			% of Total Vehicle Weight		
52	Front Weight (lbs.):	**#VALUE!**	**#VALUE!**	% Weight on Front:	#VALUE!	
53	Total Rear Weight (lbs.):	**#VALUE!**		% Weight on All Rear:	#VALUE!	
54						
55	*Original Rear Axle(s) Wt. (lbs.)*	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
56	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**
57	**#VALUE!**					
58		**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Note: The accuracy of these calculations depends on the accuracy of the input data.

The following instructions are broken into five sections, each covering a specific portion of the ULTRAMOD spreadsheet. Each section explains the necessary data that must be entered for the program to make proper calculations. Three completed figures follow these five sections.

The reference points for all horizontal measurements are the front axle of the chassis. Refer to the diagram at left for an illustration of the reference points. For the chassis, dimensions are positive from the front axle to the rear and negative forward of the front axle. An example of a negative horizontal center of gravity (CG) dimension would be the horizontal CG for a winch mounted on the front bumper. These reference points are used throughout all sections.

The following information must be gathered prior to running ULTRAMOD:

- Chassis Front Gross Axle Weight Rating (FGAWR)
- Chassis Rear Gross Axle Weight Rating (RGAWR)
- Chassis Gross Vehicle Weight Rating (GVWR)
- Chassis Original Wheelbase
- Chassis Cab to Axle
- Chassis Curb Weight on the Front Axle
- Chassis Curb Weight on the Rear Axle
- Component Weights and Locations (e.g. body, hoist, additional axles, etc.)
- Desired Payload
- Gross Axle Weight Rating (GAWR), Weight, and Location for the Additional Axles (if additional axles added).

The Worksheet included with this manual can be used to gather and record this necessary information.

Section 1

	A	B	C	D	E	F
2	**CENTER OF GRAVITY AND WEIGHT DISTRIBUTION**				**4/16/02**	
	WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION			**(C) Copyright Toner Associates 2002**		
3	VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)		
4	A4-A5	B4	C4	D4	**GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.**	
5						

IDENTIFICATION INFORMATION. A description of the vehicle or customer name can be entered in Cells A4 and A5. The chassis FGAWR is entered in Cell B4. The chassis RGAWR is entered in Cell C4. The total chassis GVWR is entered in Cell D4. The information in Cells B4 and D4 will be used to determine if either the vehicle FGAWR or GVWR are exceeded.

Warning: If you raise the vehicle GVWR, you are responsible for assuring that the vehicle meets all applicable Federal Motor Vehicle Safety Standards (FMVSS). If you plan on raising the GVWR of a vehicle after adding an additional axle, one of the following should be done:

1) Get a letter from the chassis manufacturer stating the new GVWR with the additional axle added and instructions on how the new axle is to be mounted and added to the braking system, *or*

2) Retest the vehicle to all applicable FMVSS's including braking (FMVSS 121 for air braked vehicles, FMVSS 105 for hydraulically braked vehicles) that includes dynamic and parking brake system tests, assuring the vehicle frame strength is sufficient to support the new GVWR and assuming all responsibility as the chassis manufacturer.

Check State, Local and Federal Weight Laws to assure you are not exceeding their maximum vehicle weight restrictions.

Section 2

	A	B	C	D	E	F
6	**Chassis Components Before Modification**					
7	Original Wheelbase:	B7	*inches*			
8	Cab to Axle/Trunion:	B8	*inches*			
9	Number of Original Rear Axle(s):	B9				
10						
11		Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)	**Note: The accuracy of these calculations depends on the accuracy of the input data.**	
12	Base Chassis Weights	B12	C12	0		
13						

CHASSIS SPECIFICATIONS BEFORE MODIFICATIONS. The vehicle's original wheelbase measured in inches is entered in Cell B7. The original cab to axle/trunnion (CA/CT) in inches is entered in Cell B8 and the number of original rear axles is entered in Cell B9.

The base chassis weight in pounds is added next. The front base chassis weight for the vehicle is entered in Cell B12. The rear base chassis weight is added in Cell C12. The total base chassis weight is calculated and appears in Cell D12.

Section 3

	A	B	C	D	E	F
14	**New Wheelbase and/or Additional Axle(s)**					
15		New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)	
16	Data for Original Rear Axle(s):	B16	C16	D16	E16	
17						
18	Additional Axles					
19	Axle Number 1:	B19	C19	D19	E19	
20	Axle Number 2:	B20	C20	D20	E20	
21	Axle Number 3:	B21	C21	D21	E21	
22	Axle Number 4:	B22	C22	D22	E22	
23	Axle Number 5:	B23	C23	D23	E23	

NEW WHEELBASE AND/OR ADDITIONAL AXLE(S). This section is used to change the existing wheelbase and/or add additional axles. Even if the original wheelbase is not changed, the "Data for Original Axle(s)" section must be completed for the spreadsheet to work. First the original wheelbase must be entered in Cell B16 or, if the original wheelbase is being changed, the new wheelbase is entered. Next, the rear axle assembly weight is entered in Cell C16. (Normally a single rear axle will weigh approximately 2,500 lbs. and a tandem axle will weigh approximately 5,000 lbs. Consult the chassis manufacturers' literature for the actual axle assembly weight.) Next, the desired axle load for weight proportioning is entered in Cell D16 (this is the weight that you want to be carried on the axle/s). Next, the GAWR is entered in Cell E16. This will be used in determining if an axle is overloaded. *Note: Do not specify a desired axle load that is greater than the gross axle weight rating.*

The next section is for any additional axles you want to add (up to five additional axles can be added). The location of the additional axle (pusher or tag) is measured from the center of the front (steering) axle. The location of Additional Axle Number One is entered in Cell B19. The weight of the additional axle, including suspension, tires and wheels are added in Cell C19. The desired load to be carried on the additional axle is added in Cell D19. The GAWR for the additional axle is added in Cell E19. The additional axle's GAWR will be based on the lowest rating of the axle, tire and rim, or the suspension components. The GAWR will be used in checking for axle overloading. If more than one axle is added, the steps above are to be repeated for Additional Axle Numbers Two through Five.

Section 4

	A	B	C	D	E	F
26	**Added Components**	Horizontal CG				
27	Component	(inches)	Vertical CG (inches)	Weight (lbs.)		
28	CHASSIS	#VALUE!	C28	#VALUE!		
29	A29	B29	C29	D29		
30	A30	B30	C30	D30		
31	A31	B31	C31	D31		
32	A32	B32	C32	D32		
33	A33	B33	C33	D33		
34	A34	B34	C34	D34		
35	A35	B35	C35	D35		
36	A36	B36	C36	D36		
37	A37	B37	C37	D37		
38	A38	B38	C38	D38		
39	A39	B39	C39	D39		
40	A40	B40	C40	D40		
41	A41	B41	C41	D41		
42	A42	B42	C42	D42		
43	A43	B43	C43	D43		
44	A44	B44	C44	D44		
45	A45	B45	C45	D45		
46	A46	B46	C46	D46		
47	DESIRED PAYLOAD	B47	C47	D47		

ADDED COMPONENTS. All Horizontal CG measurements must be taken from the same reference point, normally the center of the front axle. All Vertical CG measurements must be taken from the same reference point, normally the ground. Horizontal CG information is necessary to successfully calculate the weight distribution. The Vertical CG information is optional (it typically can be used to compare the chassis manufacturer's allowable limit for conformity to FMVSS 105 or FMVSS 121).

In this section, the additional equipment that will be installed on the truck chassis is entered. The chassis Horizontal CG and weight are automatically calculated in Cells B28 and D28, respectively, from data previously entered in the spreadsheet. The Vertical CG for the chassis (if used) is added in Cell C28.

Cells A29 through D46 are used for entering the data of other components such as body, bumper, hoists, lift gates, snowplows, winch, etc. Cells A29 through A46 are used for naming the added component. The Horizontal CG for each added component is entered in Cells B29 through B46 with the reference point being the front axle. Components toward the rear would have a positive dimension while components added in front of the front axle would have a negative dimension (for example, a front mount winch). Cells C29 through C46 are for vertical center of gravity of the added component. Cells D29 through D46 are for the component weights.

Cells A47 through D47 are for payload data. The payload Horizontal CG is entered in Cell B47. The body Horizontal CG can be used for the payload Horizontal CG for water level loading in a uniform body (e.g., dump body, van body, grain body, etc.). The Vertical CG (if desired) is entered in Cell C47. The desired payload weight is entered in Cell D47.

Section 5

	A	B	C	D	E	F
48				Total Weight: **#VALUE!**	**#VALUE!**	
49	Horizontal CG:	**#VALUE!**	*inches*			
50	Vertical CG:	**#VALUE!**	*inches*			
51	Rear Axles Proportioned for Capacity			% of Total Vehicle Weight		
52	Front Weight (lbs.):	**#VALUE!**	**#VALUE!**	% Weight on Front:	#VALUE!	
53	Total Rear Weight (lbs.):	**#VALUE!**		% Weight on All Rear:	#VALUE!	
54						
55	*Original Rear Axle(s) Wt. (lbs.)*	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
56	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**
57	**#VALUE!**					
58		**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**

RESULTS. First, the Total Weight for the vehicle and payload (if added) is calculated and displayed in Cell D48. If the total weight exceeds the vehicle GVWR, a note stating "Warning - Vehicle Overloaded!" will display on the total weight line. Next, the Horizontal CG of the completed vehicle will be displayed in Cell B49. The Vertical CG of the completed vehicle (if data is added) will be displayed in Cell B50.

Next, the Front Weight of the completed vehicle is shown in Cell B52. If the Front GAWR is exceeded, a note stating "Warning - Axle Overloaded!" will be displayed next to the front axle weight.

The percentage of total vehicle weight front and rear is displayed in Cells E52 and E53.

Next, the total rear axle weight for the vehicle is displayed in Cell B53. This weight includes the total weight on the original rear axle/s and the weight on any additional axles that have been added. The rear weight for the original rear axles and any additional axle is displayed in Cells A56 through F56 respectively. If any rear GAWR is exceeded, a note stating "Warning – Axle Overloaded!" will appear below the specific axle.

If any of the Warning notes are displayed, corrective action must be taken. Either a reduction of payload, change of wheelbase, addition of an axle, removal of an added component, or other corrective action must be taken. The National Highway Traffic Safety Administration has noted in an interpretation that vehicle or axle overloading may constitute a safety defect.

Section 6

EXAMPLES. ***The following examples cover three different body and equipment applications.***

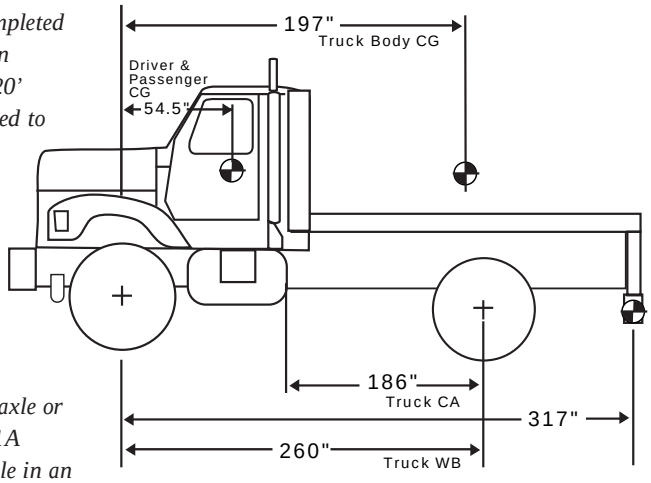
Example #1. This example, in two parts, shows a completed weight distribution spreadsheet for a 20' platform body added to a chassis cab without any changes in wheelbase or additional axles. It demonstrates the programs' ability to check for overloading of an axle or vehicle. Example 1A shows the front axle in an overloaded condition and Example 1B shows how lowering the payload by 3,000 lbs. (from 12,500 lbs. to 9,500 lbs.) eliminates the overloading on the front axle.

Example #2. This example, in two parts, shows a completed weight distribution spreadsheet for a 20' van body added to a chassis cab and a 55" wheelbase extension. Example 2A shows the rear axle overloaded with the front axle weight at less than half of its 12,000-lb. FGAWR. Example 2B shows that by lengthening the wheelbase 55", the rear axle is no longer overloaded and nearly 6,000 lbs. of weight is transferred to the front axle.

Example #3. This example, in four parts, shows a completed weight distribution spreadsheet for a 14 yd. dump body added to a chassis cab, with a lift axle added and the wheelbase changed for proper weight distribution. Example 3A shows the original rear axle overloaded. Example 3B shows the wheelbase being changed to 217", with the rear axle still overloaded. Example 3C shows the addition of a 13,000-lb. lift axle with a desired axle load of 10,000 lbs. and a weight of 1,700 lbs. — also, the wheelbase needed to be changed to 224" to accommodate the additional axle, but the total vehicle weight now exceeds the GVWR by 1,490 lbs. Example 3D shows the payload reduced by 1,500 lbs. to prevent the total weight from exceeding the GVWR. The additional axle weight of 1,700 lbs. required the payload to be reduced by 1,500 lbs.

Example 1A

This example, in two parts, shows a completed weight distribution spreadsheet for a 20' platform body added to a chassis cab without any changes in wheelbase or additional axles. It demonstrates the program's ability to check for overloading of an axle or vehicle. Example 1A shows the front axle in an overloaded condition.



CENTER OF GRAVITY AND WEIGHT DISTRIBUTION
WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION

5/10/02

VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)	
2003 Ford F-650 Reg Cab 4x2	9,000	17,500	26,000	**GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.**

Chassis Components Before Modification

Original Wheelbase:	260.0	*inches*
Cab to Axle/Trunion:	186.0	*inches*
Number of Original Rear Axle(s):	1	

	Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)	
Base Chassis Weights	5,599	3,770	9,369	**Note: The accuracy of these calculations depends on the accuracy of the input data.**

New Wheelbase and/or Additional Axle(s)

	New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)
Data for Original Rear Axle(s):	260.0	2,500	17,500	17,500
Additional Axles				
Axle Number 1:				
Axle Number 2:				
Axle Number 3:				
Axle Number 4:				
Axle Number 5:				

Added Components

Component	Horizontal CG (inches)	Vertical CG (inches)	Weight (lbs.)
CHASSIS	104.6		9,369
Driver/Passenger	54.5		300
20' Flatbed Body	197.0		3,500
Rear Bumper	317.0		320
DESIRED PAYLOAD	197.0		12,500
		Total Weight:	**25,989**

Horizontal CG:	**163.5"**
Vertical CG:	**0.0"**

Rear Axles Proportioned for Capacity

Front Weight (lbs.):	**9,643**	**Warning-Axle Overload!**	% Weight on Front: 37.1%
Total Rear Weight (lbs.):	**16,346**		% Weight on All Rear: 62.9%

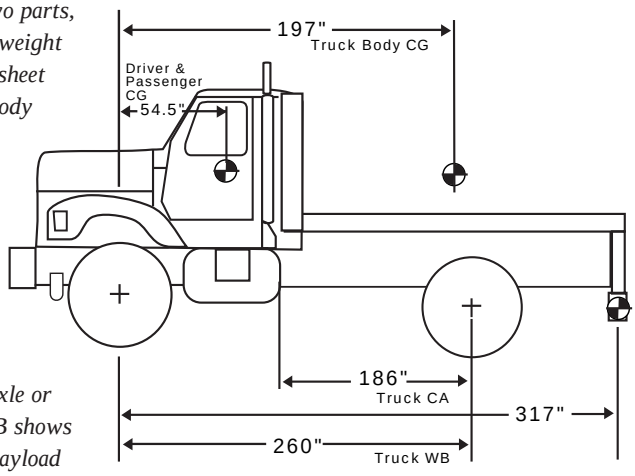
Original Rear Axle(s) Wt. (lbs.)	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
16,346	**0**	**0**	**0**	**0**	**0**

Note: The accuracy of these calculations depends on the accuracy of the input data.

B4 Front GAWR: 9,000 lbs.
C4 Rear GAWR: 17,500 lbs.
D4 GVWR: 26,000 lbs.
B7 Original WB: 260 in.
B8 Original CA: 186 in.
B9 # of original rear axles: 1
B12 Base Chassis Weight (front): 5,599 lbs.
C12 Base Chassis Weight (rear): 3,770 lbs.
B16 New Chassis WB: 260 in.
(same as original if unchanged)
C16 Weight of Chassis Rear Axles: 2,500 lbs.
D16 Desired Axle Load (rear): 17,500 lbs.
E16 GAWR (rear): 17,500 lbs.
B19 Additional Axle #1 WB: _____ in.
C19 Additional Axle #1 wt: _____ lbs.
D19 Additional Axle #1 Desired Load: _____ lbs.
E19 Additional Axle #1 GAWR: _____ lbs.
B20 Additional Axle #2 WB: _____ in.
C20 Additional Axle #2 wt: _____ lbs.
D20 Additional Axle #2 Desired Load: _____ lbs.
E20 Additional Axle #2 GAWR: _____ lbs.
B21 Additional Axle #3 WB: _____ in.
C21 Additional Axle #3 wt: _____ lbs.
D21 Additional Axle #3 Desired Load: _____ lbs.
E21 Additional Axle #3 GAWR: _____ lbs.
B22 Additional Axle #4 WB: _____ in.
C22 Additional Axle #4 wt: _____ lbs.
D22 Additional Axle #4 Desired Load: _____ lbs.
E22 Additional Axle #4 GAWR: _____ lbs.
B23 Additional Axle #5 WB: _____ in.
C23 Additional Axle #5 wt: _____ lbs.
D23 Additional Axle #5 Desired Load: _____ lbs.
E23 Additional Axle #5 GAWR: _____ lbs.
C27 Chassis Vert-GC: _____ in.
B28 Added Component Hor-CG: 54.5 in.
C28 Added Component Vert-CG: _____ in.
D28 Added Component wt: 300 lbs.
B29 Added Component Hor-CG: 197 in.
C29Added Component Vert-CG: _____ in.
D29 Added Component wt: 3,500 lbs.
B30 Added Component Hor-CG: 317 in.
C30 Added Component Vert-CG: _____ in.
D30 Added Component wt: 320 lbs.
B31 Added Component Hor-CG: _____ in.
C31 Added Component Vert-CG: _____ in.
D31 Added Component wt: _____ lbs.
B32 Added Component Hor-CG: _____ in.
C32 Added Component Vert-CG: _____ in.
D32 Added Component wt: _____ lbs.
B33-45 Added Component Hor-CG: _____ in.
C33-45 Added Component Vert-CG: _____ in.
D33-45 Added Component wt: _____ lbs.
B46 Payload Hor-CG: 197 in.
C46 Payload Vert-CG: _____ in.
D46 Payload wt: 12,500 lbs.

B4 Front GAWR: 9,000 lbs.
C4 Rear GAWR: 17,500 lbs.
D4 GVWR: 26,000 lbs.
B7 Original WB: 260 in.
B8 Original CA: 186 in.
B9 # of original rear axles: 1
B12 Base Chassis Weight (front): 5,599 lbs.
C12 Base Chassis Weight (rear): 3,770 lbs.
B16 New Chassis WB: 260 in.
(same as original if unchanged)
C16 Weight of Chassis Rear Axles: 2,500 lbs.
D16 Desired Axle Load (rear): 17,500 lbs.
E16 GAWR (rear): 17,500 lbs.
B19 Additional Axle #1 WB: in.
C19 Additional Axle #1 wt: lbs.
D19 Additional Axle #1 Desired Load: lbs.
E19 Additional Axle #1 GAWR: lbs.
B20 Additional Axle #2 WB: in.
C20 Additional Axle #2 wt: lbs.
D20 Additional Axle #2 Desired Load: lbs.
E20 Additional Axle #2 GAWR: lbs.
B21 Additional Axle #3 WB: in.
C21 Additional Axle #3 wt: lbs.
D21 Additional Axle #3 Desired Load: lbs.
E21 Additional Axle #3 GAWR: lbs.
B22 Additional Axle #4 WB: in.
C22 Additional Axle #4 wt: lbs.
D22 Additional Axle #4 Desired Load: lbs.
E22 Additional Axle #4 GAWR: lbs.
B23 Additional Axle #5 WB: in.
C23 Additional Axle #5 wt: lbs.
D23 Additional Axle #5 Desired Load: lbs.
E23 Additional Axle #5 GAWR: lbs.
C27 Chassis Vert-GC: in.
B28 Added Component Hor-CG: 54.5 in.
C28 Added Component Vert-CG: in.
D28 Added Component wt: 300 lbs.
B29 Added Component Hor-CG: 197 in.
C29Added Component Vert-CG: in.
D29 Added Component wt: 3,500 lbs.
B30 Added Component Hor-CG: 317 in.
C30 Added Component Vert-CG: in.
D30 Added Component wt: 320 lbs.
B31 Added Component Hor-CG: in.
C31 Added Component Vert-CG: in.
D31 Added Component wt: lbs.
B32 Added Component Hor-CG: in.
C32 Added Component Vert-CG: in.
D32 Added Component wt: lbs.
B33-45 Added Component Hor-CG: in.
C33-45 Added Component Vert-CG: in.
D33-45 Added Component wt: lbs.
B46 Payload Hor-CG: 197 in.
C46 Payload Vert-CG: in.
D46 Payload wt: 9,500 lbs.

This example, in two parts, shows a completed weight distribution spreadsheet for a 20' platform body added to a chassis cab without any changes in wheelbase or additional axles. It demonstrates the program's ability to check for overloading of an axle or vehicle. Example 1B shows how lowering the payload by 3,000 lbs. (from 12,500 lbs. to 9,500 lbs.) eliminates overloading the front axle.

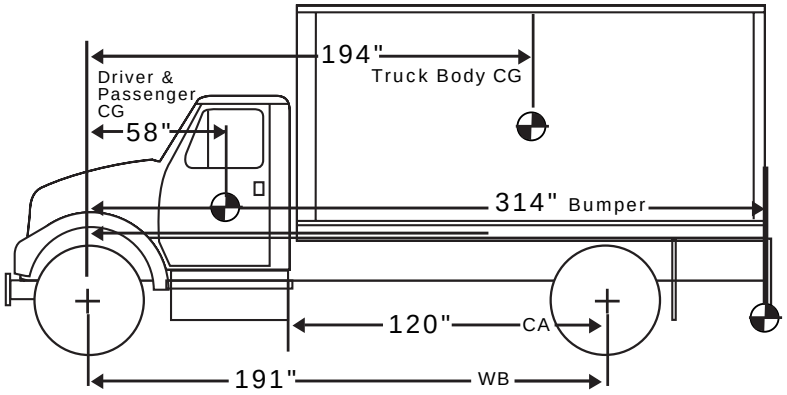


	A	B	C	D	E	F
2	**CENTER OF GRAVITY AND WEIGHT DISTRIBUTION**					5/10/02
	WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION				**(C) Copyright Toner Associates 2002**	
3	VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)		
4	2003 Ford F-650 Reg Cab 4x2	9,000	17,500	26,000	**GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.**	
5						
6	**Chassis Components Before Modification**					
7	Original Wheelbase:	260.0 *inches*				
8	Cab to Axle/Trunion:	186.0 *inches*				
9	Number of Original Rear Axle(s):	1				
10						
11		Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)	**Note: The accuracy of these calculations depends on the accuracy of the input data.**	
12	Base Chassis Weights	5,599	3,770	9,369		
13						
14	**New Wheelbase and/or Additional Axle(s)**					
15		New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)	
16	Data for Original Rear Axle(s):	260.0	2,500	17,500	17,500	
17						
18	Additional Axles					
19	Axle Number 1:					
20	Axle Number 2:					
21	Axle Number 3:					
22	Axle Number 4:					
23	Axle Number 5:					
24						
25	**Added Components**	Horizontal CG				
26	Component	(inches)	Vertical CG (inches)	Weight (lbs.)		
27	CHASSIS	104.6		9,369		
28	Driver/Passenger	54.5		300		
29	20' Flatbed Body	197.0		3,500		
30	Rear Bumper	317.0		320		
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46	DESIRED PAYLOAD	197.0		9,500		
47				Total Weight:	**22,989**	
48	Horizontal CG:	**159.2"**				
49	Vertical CG:	**0.0"**				
50	Rear Axles Proportioned for Capacity			% of Total Vehicle Weight		
51	Front Weight (lbs):	**8,916**		% Weight on Front:	38.8%	
52	Total Rear Weight (lbs):	**14,073**		% Weight on All Rear:	61.2%	
53						
54	*Original Rear Axle(s) Wt. (lbs.)*	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
55	**14,073**	**0**	**0**	**0**	**0**	**0**
56						
57						

Note: The accuracy of these calculations depends on the accuracy of the input data.

Example 2A

This example, in two parts, shows a completed weight distribution spreadsheet for a 20' van body added to a chassis cab and a 55" wheelbase extension. Example 2A shows the rear axle overloaded with the front axle loaded to less than half of its 12,000-lb. FGAWR prior to extension of the wheelbase.



	A	B	C	D	E	F
2	**CENTER OF GRAVITY AND WEIGHT DISTRIBUTION**					**5/13/02**
	WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION				**(C) Copyright Toner Associates 2002**	
3	VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)		
4	2003 Kenworth T300 Reg Cab 4x2	12,000	21,000	33,000	**GVWR should not be**	
5					**increased unless an FMVSS**	
6	**Chassis Components Before Modification**				**121 analysis is performed.**	
7	Original Wheelbase:	191.0 *inches*			**See instruction manual for**	
8	Cab to Axle/Trunion:	120.0 *inches*			**additional information.**	
9	Number of Original Rear Axle(s):	1				
10						
11		Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)	**Note: The accuracy of these**	
12	Base Chassis Weights	6,222	3,577	9,799	**calculations depends on the**	
13					**accuracy of the input data.**	
14	**New Wheelbase and/or Additional Axle(s)**					
15		New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)	
16	Data for Original Rear Axle(s):	191.0	2,500	20,000	21,000	
17						
18	Additional Axles					
19	Axle Number 1:					
20	Axle Number 2:					
21	Axle Number 3:					
22	Axle Number 4:					
23	Axle Number 5:					
24						
25	**Added Components**	Horizontal CG				
26	Component	(inches)	Vertical CG (inches)	Weight (lbs.)		
27	CHASSIS	69.7		9,799		
28	Driver/Passenger	58.0		300		
29	20' Van Body	194.0		4,000		
30	Rear Bumper	314.0		250		
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46	DESIRED PAYLOAD	194.0		17,500		
47				Total Weight:	**31,849**	
48	Horizontal CG:	**155.4"**				
49	Vertical CG:	**0.0"**				
50	Rear Axles Proportioned for Capacity			% of Total Vehicle Weight		
51	Front Weight (lbs.):	**5,932**		% Weight on Front:	18.6%	
52	Total Rear Weight (lbs.):	**25,917**		% Weight on All Rear:	81.4%	
53						
54	*Original Rear Axle(s) Wt. (lbs.)*	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
55	**25,917**	**0**	**0**	**0**	**0**	**0**
56	**Warning-Axle Overload!**					
57						

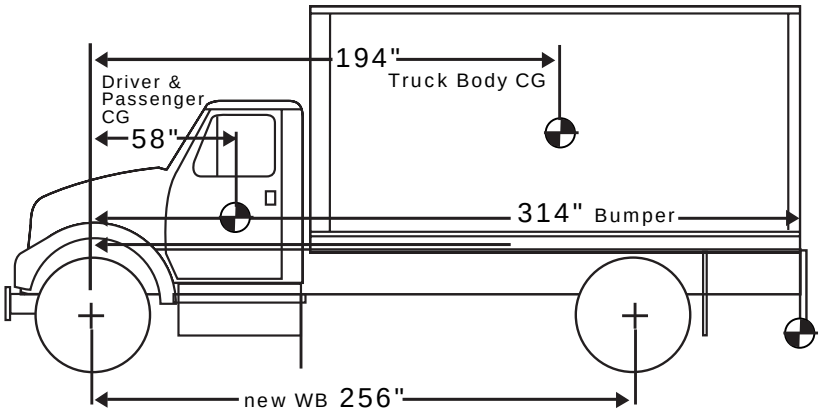
Note: The accuracy of these calculations depends on the accuracy of the input data.

B4 Front GAWR: 12,000 lbs.
C4 Rear GAWR: 21,000 lbs.
D4 GVWR: 33,000 lbs.
B7 Original WB: 191 in.
B8 Original CA: 120 in.
B9 # of original rear axles: 1
B12 Base Chassis Weight (front): 6,222 lbs.
C12 Base Chassis Weight (rear): 3,577 lbs.
B16 New Chassis WB: 191 in.
(same as original if unchanged)
C16 Weight of Chassis Rear Axles: 2,500 lbs.
D16 Desired Axle Load (rear): 20,000 lbs.
E16 GAWR (rear): 21,000 lbs.
B19 Additional Axle #1 WB: _____ in.
C19 Additional Axle #1 wt: _____ lbs.
D19 Additional Axle #1 Desired Load: _____ lbs.
E19 Additional Axle #1 GAWR: _____ lbs.
B20 Additional Axle #2 WB: _____ in.
C20 Additional Axle #2 wt: _____ lbs.
D20 Additional Axle #2 Desired Load: _____ lbs.
E20 Additional Axle #2 GAWR: _____ lbs.
B21 Additional Axle #3 WB: _____ in.
C21 Additional Axle #3 wt: _____ lbs.
D21 Additional Axle #3 Desired Load: _____ lbs.
E21 Additional Axle #3 GAWR: _____ lbs.
B22 Additional Axle #4 WB: _____ in.
C22 Additional Axle #4 wt: _____ lbs.
D22 Additional Axle #4 Desired Load: _____ lbs.
E22 Additional Axle #4 GAWR: _____ lbs.
B23 Additional Axle #5 WB: _____ in.
C23 Additional Axle #5 wt: _____ lbs.
D23 Additional Axle #5 Desired Load: _____ lbs.
E23 Additional Axle #5 GAWR: _____ lbs.
C27 Chassis Vert-GC: _____ in.
B28 Added Component Hor-CG: 58 in.
C28 Added Component Vert-CG: _____ in.
D28 Added Component wt: 300 lbs.
B29 Added Component Hor-CG: 194 in.
C29 Added Component Vert-CG: _____ in.
D29 Added Component wt: 4,000 lbs.
B30 Added Component Hor-CG: 314 in.
C30 Added Component Vert-CG: _____ in.
D30 Added Component wt: 250 lbs.
B31 Added Component Hor-CG: _____ in.
C31 Added Component Vert-CG: _____ in.
D31 Added Component wt: _____ lbs.
B32 Added Component Hor-CG: _____ in.
C32 Added Component Vert-CG: _____ in.
D32 Added Component wt: _____ lbs.
B33-45 Added Component Hor-CG: _____ in.
C33-45 Added Component Vert-CG: _____ in.
D33-45 Added Component wt: _____ lbs.
B46 Payload Hor-CG: 194 in.
C46 Payload Vert-CG: _____ in.
D46 Payload wt: 17,500 lbs.

Example 2B

B4 Front GAWR: 12,000 lbs.
C4 Rear GAWR: 21,000 lbs.
D4 GVWR: 33,000 lbs.
B7 Original WB: 191 in.
B8 Original CA: 120 in.
B9 # of original rear axles: 1
B12 Base Chassis Weight (front): 6,222 lbs.
C12 Base Chassis Weight (rear): 3,577 lbs.
B16 New Chassis WB: 256 in.
(same as original if unchanged)
C16 Weight of Chassis Rear Axles: 2,500 lbs.
D16 Desired Axle Load (rear): 20,000 lbs.
E16 GAWR (rear): 21,000 lbs.
B19 Additional Axle #1 WB: _____ in.
C19 Additional Axle #1 wt: _____ lbs.
D19 Additional Axle #1 Desired Load: _____ lbs.
E19 Additional Axle #1 GAWR: _____ lbs.
B20 Additional Axle #2 WB: _____ in.
C20 Additional Axle #2 wt: _____ lbs.
D20 Additional Axle #2 Desired Load: _____ lbs.
E20 Additional Axle #2 GAWR: _____ lbs.
B21 Additional Axle #3 WB: _____ in.
C21 Additional Axle #3 wt: _____ lbs.
D21 Additional Axle #3 Desired Load: _____ lbs.
E21 Additional Axle #3 GAWR: _____ lbs.
B22 Additional Axle #4 WB: _____ in.
C22 Additional Axle #4 wt: _____ lbs.
D22 Additional Axle #4 Desired Load: _____ lbs.
E22 Additional Axle #4 GAWR: _____ lbs.
B23 Additional Axle #5 WB: _____ in.
C23 Additional Axle #5 wt: _____ lbs.
D23 Additional Axle #5 Desired Load: _____ lbs.
E23 Additional Axle #5 GAWR: _____ lbs.
C27 Chassis Vert-GC: _____ in.
B28 Added Component Hor-CG: 58 in.
C28 Added Component Vert-CG: _____ in.
D28 Added Component wt: 300 lbs.
B29 Added Component Hor-CG: 194 in.
C29 Added Component Vert-CG: _____ in.
D29 Added Component wt: 4,000 lbs.
B30 Added Component Hor-CG: 314 in.
C30 Added Component Vert-CG: _____ in.
D30 Added Component wt: 250 lbs.
B31 Added Component Hor-CG: _____ in.
C31 Added Component Vert-CG: _____ in.
D31 Added Component wt: _____ lbs.
B32 Added Component Hor-CG: _____ in.
C32 Added Component Vert-CG: _____ in.
D32 Added Component wt: _____ lbs.
B33-45 Added Component Hor-CG: _____ in.
C33-45 Added Component Vert-CG: _____ in.
D33-45 Added Component wt: _____ lbs.
B46 Payload Hor-CG: 194 in.
C46 Payload Vert-CG: _____ in.
D46 Payload wt: 17,500 lbs.

This example, in two parts, shows a completed weight distribution spreadsheet for a 20' van body added to a chassis cab and a 55" wheelbase extension. Example 2B shows by lengthening the wheelbase 55", the rear axle is no longer overloaded, and nearly 6,000 lbs. of weight has been transferred to the front axle.

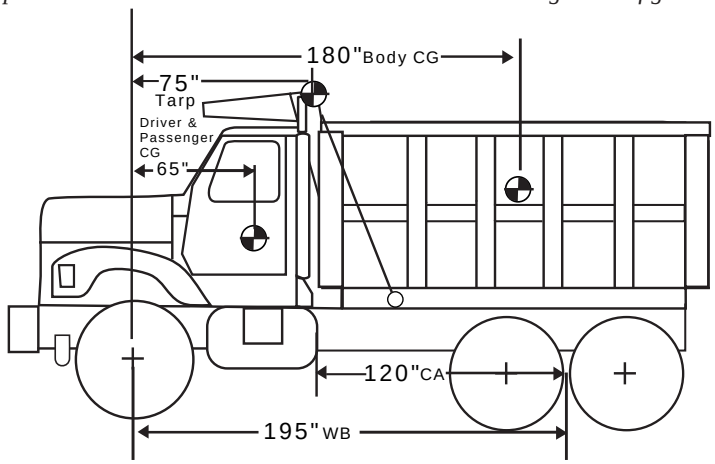


	A	B	C	D	E	F
2	**CENTER OF GRAVITY AND WEIGHT DISTRIBUTION**					5/13/02
3	**WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION**				**(C) Copyright Toner Associates 2002**	
4	VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)		
5	2003 Kenworth T300 Reg Cab 4x2	12,000	21,000	33,000	**GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.**	
6	**Chassis Components Before Modification**					
7	Original Wheelbase:	191.0 *inches*				
8	Cab to Axle/Trunion:	120.0 *inches*				
9	Number of Original Rear Axle(s):	1				
10						
11		Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)	**Note: The accuracy of these calculations depends on the accuracy of the input data.**	
12	Base Chassis Weights	6,222	3,577	9,799		
13						
14	**New Wheelbase and/or Additional Axle(s)**					
15		New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)	
16	Data for Original Rear Axle(s):	256.0	2,500	20,000	21,000	
17						
18	Additional Axles					
19	Axle Number 1:					
20	Axle Number 2:					
21	Axle Number 3:					
22	Axle Number 4:					
23	Axle Number 5:					
24						
25	**Added Components**	Horizontal CG				
26	Component	(inches)	Vertical CG (inches)	Weight (lbs.)		
27	CHASSIS	86.3		9,799		
28	Driver/Passenger	58.0		300		
29	20' Van Body	194.0		4,000		
30	Rear Bumper	314.0		250		
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46	DESIRED PAYLOAD	194.0		17,500		
47				Total Weight:	**31,849**	
48	Horizontal CG:	**160.5"**				
49	Vertical CG:	**0.0"**				
50	Rear Axles Proportioned for Capacity			% of Total Vehicle Weight		
51	Front Weight (lbs.):	**11,878**		% Weight on Front:	37.3%	
52	Total Rear Weight (lbs.):	**19,971**		% Weight on All Rear:	62.7%	
53						
54	*Original Rear Axle(s) Wt. (lbs.)*	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
55	**19,971**	**0**	**0**	**0**	**0**	**0**
56						
57						

Note: The accuracy of these calculations depends on the accuracy of the input data.

Example 3A

This example, in four parts, shows a completed weight distribution spreadsheet for a 14 yd. dump body added to a chassis cab, with a lift axle and a wheelbase change. Example 3A shows the rear axle overloaded in the vehicle's original configuration.



CENTER OF GRAVITY AND WEIGHT DISTRIBUTION — 5/10/02
WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION — (C) Copyright Toner Associates 2002

VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)	
2003 International 7400 Reg Cab 6x4	16,000	40,000	56,000	**GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.**

Chassis Components Before Modification

Original Wheelbase:	195.0	*inches*
Cab to Axle/Trunion:	120.0	*inches*
Number of Original Rear Axle(s):	2	

	Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)	
Base Chassis Weights	7,116	6,789	13,905	**Note: The accuracy of these calculations depends on the accuracy of the input data.**

New Wheelbase and/or Additional Axle(s)

	New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)
Data for Original Rear Axle(s):	195.0	5,000	34,000	40,000
Additional Axles				
Axle Number 1:				
Axle Number 2:				
Axle Number 3:				
Axle Number 4:				
Axle Number 5:				

Added Components

Component	Horizontal CG (inches)	Vertical CG (inches)	Weight (lbs.)
CHASSIS	95.2		13,905
Driver/Passenger	65.0		300
14 Yd. Dump Body	180.0		6,500
Tarp	75.0		85
DESIRED PAYLOAD	180.0		35,000
		Total Weight:	**55,790**

Horizontal CG:	**158.1"**
Vertical CG:	**0.0"**

Rear Axles Proportioned for Capacity

Front Weight (lbs.):	**10,561**	% Weight on Front:	18.9%
Total Rear Weight (lbs.):	**45,229**	% Weight on All Rear:	81.1%

Original Rear Axle(s) Wt. (lbs.)	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
45,229	**0**	**0**	**0**	**0**	**0**

Warning-Axle Overload!

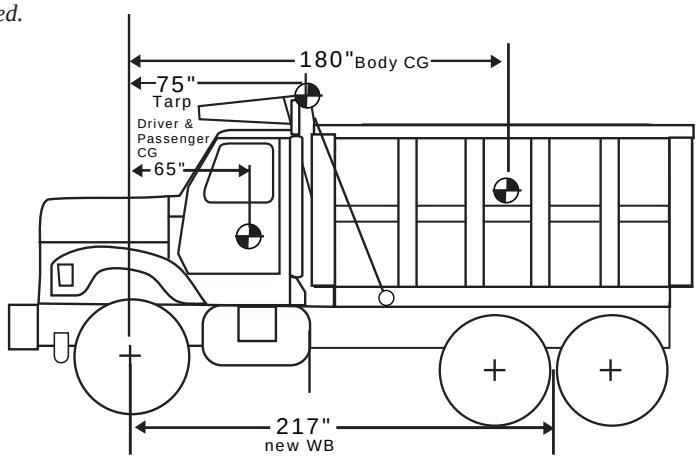
Note: The accuracy of these calculations depends on the accuracy of the input data.

B4 Front GAWR: 16,000 lbs.
C4 Rear GAWR: 40,000 lbs.
D4 GVWR: 56,000 lbs.
B7 Original WB: 195 in.
B8 Original CA: 120 in.
B9 # of original rear axles: 2
B12 Base Chassis Weight (front): 7,116 lbs.
C12 Base Chassis Weight (rear): 6,789 lbs.
B16 New Chassis WB: 195 in.
(same as original if unchanged)
C16 Weight of Chassis Rear Axles: 5,000 lbs.
D16 Desired Axle Load (rear): 34,000 lbs.
E16 GAWR (rear): 40,000 lbs.
B19 Additional Axle #1 WB: _____ in.
C19 Additional Axle #1 wt: _____ lbs.
D19 Additional Axle #1 Desired Load: _____ lbs.
E19 Additional Axle #1 GAWR: _____ lbs.
B20 Additional Axle #2 WB: _____ in.
C20 Additional Axle #2 wt: _____ lbs.
D20 Additional Axle #2 Desired Load: _____ lbs.
E20 Additional Axle #2 GAWR: _____ lbs.
B21 Additional Axle #3 WB: _____ in.
C21 Additional Axle #3 wt: _____ lbs.
D21 Additional Axle #3 Desired Load: _____ lbs.
E21 Additional Axle #3 GAWR: _____ lbs.
B22 Additional Axle #4 WB: _____ in.
C22 Additional Axle #4 wt: _____ lbs.
D22 Additional Axle #4 Desired Load: _____ lbs.
E22 Additional Axle #4 GAWR: _____ lbs.
B23 Additional Axle #5 WB: _____ in.
C23 Additional Axle #5 wt: _____ lbs.
D23 Additional Axle #5 Desired Load: _____ lbs.
E23 Additional Axle #5 GAWR: _____ lbs.
C27 Chassis Vert-GC: _____ in.
B28 Added Component Hor-CG: 65 in.
C28 Added Component Vert-CG: _____ in.
D28 Added Component wt: 300 lbs.
B29 Added Component Hor-CG: 180 in.
C29 Added Component Vert-CG: _____ in.
D29 Added Component wt: 6,500 lbs.
B30 Added Component Hor-CG: 75 in.
C30 Added Component Vert-CG: _____ in.
D30 Added Component wt: 85 lbs.
B31 Added Component Hor-CG: _____ in.
C31 Added Component Vert-CG: _____ in.
D31 Added Component wt: _____ lbs.
B32 Added Component Hor-CG: _____ in.
C32 Added Component Vert-CG: _____ in.
D32 Added Component wt: _____ lbs.
B33-45 Added Component Hor-CG: _____ in.
C33-45 Added Component Vert-CG: _____ in.
D33-45 Added Component wt: _____ lbs.
B46 Payload Hor-CG: 180 in.
C46 Payload Vert-CG: _____ in.
D46 Payload wt: 35,000 lbs.

Example 3B

B4 Front GAWR: 16,000 lbs.
C4 Rear GAWR: 40,000 lbs.
D4 GVWR: 56,000 lbs.
B7 Original WB: 195 in.
B8 Original CA: 120 in.
B9 # of original rear axles: 2
B12 Base Chassis Weight (front): 7,116 lbs.
C12 Base Chassis Weight (rear): 6,789 lbs.
B16 New Chassis WB: 195 in.
(same as original if unchanged)
C16 Weight of Chassis Rear Axles: 5,000 lbs.
D16 Desired Axle Load (rear): 34,000 lbs.
E16 GAWR (rear): 40,000 lbs.
B19 Additional Axle #1 WB: _____ in.
C19 Additional Axle #1 wt: _____ lbs.
D19 Additional Axle #1 Desired Load: _____ lbs.
E19 Additional Axle #1 GAWR: _____ lbs.
B20 Additional Axle #2 WB: _____ in.
C20 Additional Axle #2 wt: _____ lbs.
D20 Additional Axle #2 Desired Load: _____ lbs.
E20 Additional Axle #2 GAWR: _____ lbs.
B21 Additional Axle #3 WB: _____ in.
C21 Additional Axle #3 wt: _____ lbs.
D21 Additional Axle #3 Desired Load: _____ lbs.
E21 Additional Axle #3 GAWR: _____ lbs.
B22 Additional Axle #4 WB: _____ in.
C22 Additional Axle #4 wt: _____ lbs.
D22 Additional Axle #4 Desired Load: _____ lbs.
E22 Additional Axle #4 GAWR: _____ lbs.
B23 Additional Axle #5 WB: _____ in.
C23 Additional Axle #5 wt: _____ lbs.
D23 Additional Axle #5 Desired Load: _____ lbs.
E23 Additional Axle #5 GAWR: _____ lbs.
C27 Chassis Vert-GC: _____ in.
B28 Added Component Hor-CG: 65 in.
C28 Added Component Vert-CG: _____ in.
D28 Added Component wt: 300 lbs.
B29 Added Component Hor-CG: 180 in.
C29 Added Component Vert-CG: _____ in.
D29 Added Component wt: 6,500 lbs.
B30 Added Component Hor-CG: 75 in.
C30 Added Component Vert-CG: _____ in.
D30 Added Component wt: 85 lbs.
B31 Added Component Hor-CG: _____ in.
C31 Added Component Vert-CG: _____ in.
D31 Added Component wt: _____ lbs.
B32 Added Component Hor-CG: _____ in.
C32 Added Component Vert-CG: _____ in.
D32 Added Component wt: _____ lbs.
B33-45 Added Component Hor-CG: _____ in.
C33-45 Added Component Vert-CG: _____ in.
D33-45 Added Component wt: _____ lbs.
B46 Payload Hor-CG: 180 in.
C46 Payload Vert-CG: _____ in.
D46 Payload wt: 35,000 lbs.

This example, in four parts, shows a completed weight distribution spreadsheet for a 14 yd. dump body added to a chassis cab, with a lift axle and a wheelbase change. Example 3B shows the wheelbase changed to 217", with the rear axle still overloaded.

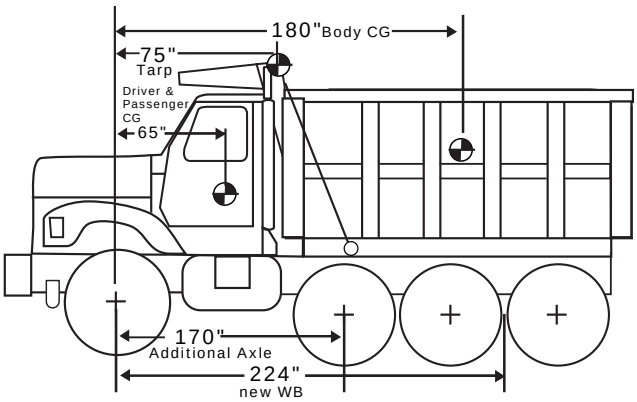


	A	B	C	D	E	F
2	**CENTER OF GRAVITY AND WEIGHT DISTRIBUTION**					5/10/02
	WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION				**(C) Copyright Toner Associates 2002**	
3	VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)		
4	2003 International 7400 Reg Cab 6x4	16,000	40,000	56,000	**GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.**	
5						
6	**Chassis Components Before Modification**					
7	Original Wheelbase:	195.0 *inches*				
8	Cab to Axle/Trunion:	120.0 *inches*				
9	Number of Original Rear Axle(s):	2				
10						
11		Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)	**Note: The accuracy of these calculations depends on the accuracy of the input data.**	
12	Base Chassis Weights	7,116	6,789	13,905		
13						
14	**New Wheelbase and/or Additional Axle(s)**					
15		New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)	
16	Data for Original Rear Axle(s):	217.0	5,000	34,000	40,000	
17						
18	Additional Axles					
19	Axle Number 1:					
20	Axle Number 2:					
21	Axle Number 3:					
22	Axle Number 4:					
23	Axle Number 5:					
24						
25	**Added Components**	Horizontal CG				
26	Component	(inches)	Vertical CG (inches)	Weight (lbs.)		
27	CHASSIS	103.1		13,905		
28	Driver/Passenger	65.0		300		
29	14 Yd. Dump Body	180.0		6,500		
30	Tarp	75.0		85		
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46	DESIRED PAYLOAD	180.0		35,000		
47				Total Weight:	**55,790**	
48	Horizontal CG:	**160.1"**				
49	Vertical CG:	**0.0"**				
50	Rear Axles Proportioned for Capacity			% of Total Vehicle Weight		
51	Front Weight (lbs.):	**14,639**		% Weight on Front:	26.2%	
52	Total Rear Weight (lbs.):	**41,151**		% Weight on All Rear:	73.8%	
53						
54	*Original Rear Axle(s) Wt. (lbs.)*	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
55	**41,151**	**0**	**0**	**0**	**0**	**0**
56	**Warning-Axle Overload!**					
57						

Note: The accuracy of these calculations depends on the accuracy of the input data.

Example 3C

This example, in four parts, shows a completed weight distribution spreadsheet for a 14 yd. dump body added to a chassis cab, with a lift axle and a wheelbase change. Example 3C shows the addition of a 13,000-lb. lift axle with a desired axle load of 10,000 lbs. and a weight of 1,700 lb. Also the wheelbase needed to be changed to 224" because of the additional axle, but the total vehicle weight now exceeds the GVWR by 1,490 lbs.



CENTER OF GRAVITY AND WEIGHT DISTRIBUTION — 5/13/02
WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION — (C) Copyright Toner Associates 2002

VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)
2003 International 7400 Reg Cab 6x4	16,000	40,000	56,000

GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.

Chassis Components Before Modification

Original Wheelbase:	195.0	*inches*
Cab to Axle/Trunion:	120.0	*inches*
Number of Original Rear Axle(s):	2	

	Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)
Base Chassis Weights	7,116	6,789	13,905

Note: The accuracy of these calculations depends on the accuracy of the input data.

New Wheelbase and/or Additional Axle(s)

	New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)
Data for Original Rear Axle(s):	224.0	5,000	34,000	40,000
Additional Axles				
Axle Number 1:	170.0	1,700	10,000	13,000
Axle Number 2:				
Axle Number 3:				
Axle Number 4:				
Axle Number 5:				

Added Components

Component	Horizontal CG (inches)	Vertical CG (inches)	Weight (lbs.)
CHASSIS	112.6		15,605
Driver/Passenger	65.0		300
14 Yd. Dump Body	180.0		6,500
Tarp	75.0		85
DESIRED PAYLOAD	180.0		35,000

Total Weight: **57,490** **Warning-Vehicle Overload!**

Horizontal CG: **161.0"**
Vertical CG: **0.0"**

Rear Axles Proportioned for Capacity

Front Weight (lbs.): **13,784**
Total Rear Weight (lbs.): **43,706**

% of Total Vehicle Weight

% Weight on Front: 24.0%
% Weight on All Rear: 76.0%

Original Rear Axle(s) Wt. (lbs.)	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
33,773	**9,933**	**0**	**0**	**0**	**0**

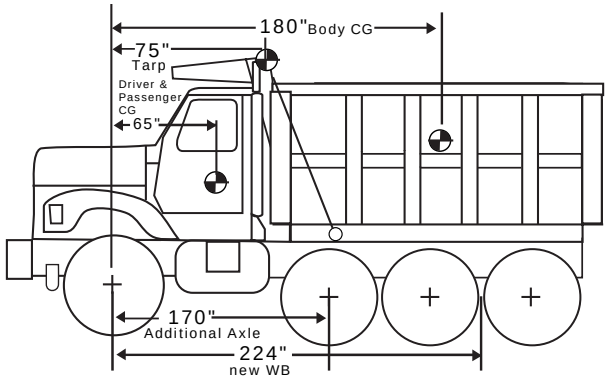
Note: The accuracy of these calculations depends on the accuracy of the input data.

B4 Front GAWR: 16,000 lbs.
C4 Rear GAWR: 40,000 lbs.
D4 GVWR: 56,000 lbs.
B7 Original WB: 195 in.
B8 Original CA: 120 in.
B9 # of original rear axles: 2
B12 Base Chassis Weight (front): 7,116 lbs.
C12 Base Chassis Weight (rear): 6,789 lbs.
B16 New Chassis WB: 195 in.
(same as original if unchanged)
C16 Weight of Chassis Rear Axles: 5,000 lbs.
D16 Desired Axle Load (rear): 34,000 lbs.
E16 GAWR (rear): 40,000 lbs.
B19 Additional Axle #1 WB: 170 in.
C19 Additional Axle #1 wt: 1,700 lbs.
D19 Additional Axle #1 Desired Load: 10,000 lbs.
E19 Additional Axle #1 GAWR: 13,000 lbs.
B20 Additional Axle #2 WB: _____ in.
C20 Additional Axle #2 wt: _____ lbs.
D20 Additional Axle #2 Desired Load: _____ lbs.
E20 Additional Axle #2 GAWR: _____ lbs.
B21 Additional Axle #3 WB: _____ in.
C21 Additional Axle #3 wt: _____ lbs.
D21 Additional Axle #3 Desired Load: _____ lbs.
E21 Additional Axle #3 GAWR: _____ lbs.
B22 Additional Axle #4 WB: _____ in.
C22 Additional Axle #4 wt: _____ lbs.
D22 Additional Axle #4 Desired Load: _____ lbs.
E22 Additional Axle #4 GAWR: _____ lbs.
B23 Additional Axle #5 WB: _____ in.
C23 Additional Axle #5 wt: _____ lbs.
D23 Additional Axle #5 Desired Load: _____ lbs.
E23 Additional Axle #5 GAWR: _____ lbs.
C27 Chassis Vert-GC: _____ in.
B28 Added Component Hor-CG: _____ in.
C28 Added Component Vert-CG: _____ in.
D28 Added Component wt: _____ lbs.
B29 Added Component Hor-CG: _____ in.
C29 Added Component Vert-CG: 65 in.
D29 Added Component wt: _____ lbs.
B30 Added Component Hor-CG: 300 in.
C30 Added Component Vert-CG: 180 in.
D30 Added Component wt: _____ lbs.
B31 Added Component Hor-CG: 6,500 in.
C31 Added Component Vert-CG: 75 in.
D31 Added Component wt: _____ lbs.
B32 Added Component Hor-CG: 85 in.
C32 Added Component Vert-CG: _____ in.
D32 Added Component wt: _____ lbs.
B33-45 Added Component Hor-CG: _____ in.
C33-45 Added Component Vert-CG: _____ in.
D33-45 Added Component wt: _____ lbs.
B46 Payload Hor-CG: 180 in.
C46 Payload Vert-CG: _____ in.
D46 Payload wt: 35,000 lbs.

Example 3D

B4 Front GAWR: 16,000 lbs.
C4 Rear GAWR: 40,000 lbs.
D4 GVWR: 56,000 lbs.
B7 Original WB: 195 in.
B8 Original CA: 120 in.
B9 # of original rear axles: 2
B12 Base Chassis Weight (front): 7,116 lbs.
C12 Base Chassis Weight (rear): 6,789 lbs.
B16 New Chassis WB: 224 in.
(same as original if unchanged)
C16 Weight of Chassis Rear Axles: 5,000 lbs.
D16 Desired Axle Load (rear): 34,000 lbs.
E16 GAWR (rear): 40,000 lbs.
B19 Additional Axle #1 WB: 170 in.
C19 Additional Axle #1 wt: 1,700 lbs.
D19 Additional Axle #1 Desired Load: 10,000 lbs.
E19 Additional Axle #1 GAWR: 13,000 lbs.
B20 Additional Axle #2 WB: in.
C20 Additional Axle #2 wt: lbs.
D20 Additional Axle #2 Desired Load: lbs.
E20 Additional Axle #2 GAWR: lbs.
B21 Additional Axle #3 WB: in.
C21 Additional Axle #3 wt: lbs.
D21 Additional Axle #3 Desired Load: lbs.
E21 Additional Axle #3 GAWR: lbs.
B22 Additional Axle #4 WB: in.
C22 Additional Axle #4 wt: lbs.
D22 Additional Axle #4 Desired Load: lbs.
E22 Additional Axle #4 GAWR: lbs.
B23 Additional Axle #5 WB: in.
C23 Additional Axle #5 wt: lbs.
D23 Additional Axle #5 Desired Load: lbs.
E23 Additional Axle #5 GAWR: lbs.
C27 Chassis Vert-GC: in.
B28 Added Component Hor-CG: in.
C28 Added Component Vert-CG: in.
D28 Added Component wt: lbs.
B29 Added Component Hor-CG: in.
C29 Added Component Vert-CG: 65 in.
D29 Added Component wt: lbs.
B30 Added Component Hor-CG: 300 in.
C30 Added Component Vert-CG: 180 in.
D30 Added Component wt: lbs.
B31 Added Component Hor-CG: 6,500 in.
C31 Added Component Vert-CG: 75 in.
D31 Added Component wt: lbs.
B32 Added Component Hor-CG: 85 in.
C32 Added Component Vert-CG: in.
D32 Added Component wt: lbs.
B33-45 Added Component Hor-CG: in.
C33-45 Added Component Vert-CG: in.
D33-45 Added Component wt: lbs.
B46 Payload Hor-CG: 180 in.
C46 Payload Vert-CG: in.
D46 Payload wt: 33,500 lbs.

This example, in four parts, shows a completed weight distribution spreadsheet for a 14 yd. dump body added to a chassis cab, with a lift axle and a wheelbase change. Example 3D shows the payload reduced by 1,500 lbs. to keep the total vehicle weight within the GVWR. The additional axle weight of 1,700 lbs. requires the payload to be reduced by 1,500 lbs.



CENTER OF GRAVITY AND WEIGHT DISTRIBUTION — 5/13/02
WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION
(C) Copyright Toner Associates 2002

VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)
2003 International 7400 Reg Cab 6x4	16,000	40,000	56,000

GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.

Chassis Components Before Modification

Original Wheelbase:	195.0	*inches*
Cab to Axle/Trunion:	120.0	*inches*
Number of Original Rear Axle(s):	2	

	Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)
Base Chassis Weights	7,116	6,789	13,905

Note: The accuracy of these calculations depends on the accuracy of the input data.

New Wheelbase and/or Additional Axle(s)

	New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)
Data for Original Rear Axle(s):	224.0	5,000	34,000	40,000
Additional Axles				
Axle Number 1:	170.0	1,700	10,000	13,000
Axle Number 2:				
Axle Number 3:				
Axle Number 4:				
Axle Number 5:				

Added Components

Component	Horizontal CG (inches)	Vertical CG (inches)	Weight (lbs.)
CHASSIS	112.6		15,605
Driver/Passenger	65.0		300
14 Yd. Dump Body	180.0		6,500
Tarp	75.0		85
DESIRED PAYLOAD	180.0		33,500
		Total Weight:	**55,990**

Horizontal CG:	**160.5"**
Vertical CG:	**0.0"**

Rear Axles Proportioned for Capacity

Front Weight (lbs.):	**13,559**
Total Rear Weight (lbs.):	**42,431**

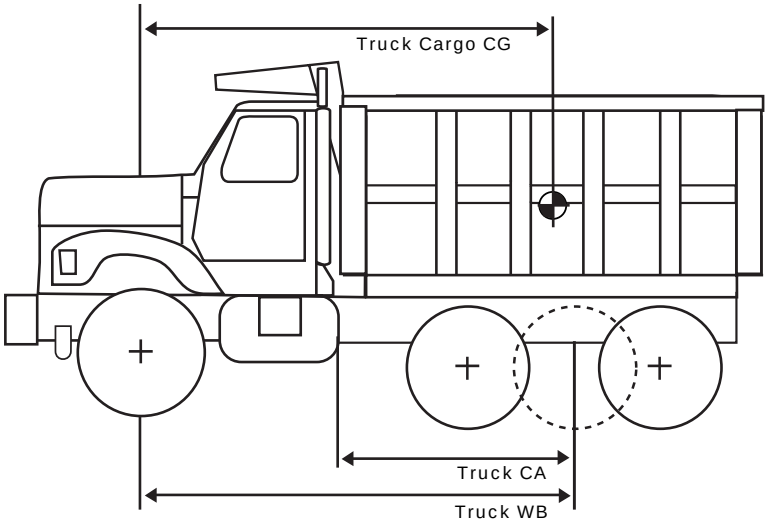
% of Total Vehicle Weight

% Weight on Front:	24.2%
% Weight on All Rear:	75.8%

Original Rear Axle(s) Wt. (lbs.)	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
32,787	**9,643**	**0**	**0**	**0**	**0**

Note: The accuracy of these calculations depends on the accuracy of the input data.

Section 6 continued



	A	B	C	D	E	F
2	**CENTER OF GRAVITY AND WEIGHT DISTRIBUTION**				**5/21/02**	
	WHEELBASE CHANGES OR AUXILIARY AXLE INSTALLATION			**(C) Copyright Toner Associates 2002**		
3	VEHICLE:	Front GAWR (lbs.)	Rear GAWR (lbs.)	GVWR (lbs.)		
4	A4-A5	B4	C4	D4	**GVWR should not be increased unless an FMVSS 121 analysis is performed. See instruction manual for additional information.**	
5						
6	**Chassis Components Before Modification**					
7	Original Wheelbase:	B7	*inches*			
8	Cab to Axle/Trunion:	B8	*inches*			
9	Number of Original Rear Axle(s):	B9				
10						
11		Front Weight (lbs.)	Rear Weight (lbs.)	Total Weight (lbs.)	**Note: The accuracy of these calculations depends on the accuracy of the input data.**	
12	Base Chassis Weights	B12	C12	0		
13						
14	**New Wheelbase and/or Additional Axle(s)**					
15		New Wheelbase, or enter original if not altering (inches)	Weight of Original Rear/Additional Axle(s) (lbs.)	Desired Axle Load for weight Proportioning (lbs.)	Gross Axle Weight Rating (lbs.)	
16	Data for Original Rear Axle(s):	B16	C16	D16	E16	
17						
18	Additional Axles					
19	Axle Number 1:	B19	C19	D19	E19	
20	Axle Number 2:	B20	C20	D20	E20	
21	Axle Number 3:	B21	C21	D21	E21	
22	Axle Number 4:	B22	C22	D22	E22	
23	Axle Number 5:	B23	C23	D23	E23	
24						
25	**Added Components**	Horizontal CG (inches)	Vertical CG (inches)	Weight (lbs.)		
26	Component					
27	CHASSIS	#VALUE!	C27	#VALUE!		
28	A28	B28	C28	D28		
29	A29	B29	C29	D29		
30	A30	B30	C30	D30		
31	A31	B31	C31	D31		
32	A32	B32	C32	D32		
33	A33	B33	C33	D33		
34	A34	B34	C34	D34		
35	A35	B35	C35	D36		
36	A36	B36	C36	D36		
37	A37	B37	C37	D37		
38	A38	B38	C38	D38		
39	A39	B39	C39	D39		
40	A40	B40	C40	D40		
41	A41	B41	C41	D41		
42	A42	B42	C42	D42		
43	A43	B43	C43	D43		
44	A44	B44	C44	D44		
45	A45	B45	C45	D45		
46	DESIRED PAYLOAD	B46	C46	D46		
47			Total Weight:	**#VALUE!**	**#VALUE!**	
48	Horizontal CG:	**#VALUE!**	*inches*			
49	Vertical CG:	**#VALUE!**	*inches*			
50	Rear Axles Proportioned for Capacity			% of Total Vehicle Weight		
51	Front Weight (lbs.):	**#VALUE!**	**#VALUE!**	% Weight on Front:	#VALUE!	
52	Total Rear Weight (lbs.):	**#VALUE!**		% Weight on All Rear:	#VALUE!	
53						
54	*Original Rear Axle(s) Wt. (lbs.)*	*Axle 1 Wt. (lbs.)*	*Axle 2 Wt. (lbs.)*	*Axle 3 Wt. (lbs.)*	*Axle 4 Wt. (lbs.)*	*Axle 5 Wt. (lbs.)*
55	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**
56	**#VALUE!**					
57		**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**
58						

Note: The accuracy of these calculations depends on the accuracy of the input data.

B4 Front GAWR: _____ lbs.
C4 Rear GAWR: _____ lbs.
D4 GVWR: _____ lbs.
B7 Original WB: _____ in.
B8 Original CA: _____ in.
B9 # of original rear axles: _____
B12 Base Chassis Weight (front): _____ lbs.
C12 Base Chassis Weight (rear): _____ lbs.
B16 New Chassis WB: _____ in.
(same as original if unchanged)
C16 Weight of Chassis Rear Axles: _____ lbs.
D16 Desired Axle Load (rear): _____ lbs.
E16 GAWR (rear): _____ lbs.
B19 Additional Axle #1 WB: _____ in.
C19 Additional Axle #1 wt: _____ lbs.
D19 Additional Axle #1 Desired Load: _____ lbs.
E19 Additional Axle #1 GAWR: _____ lbs.
B20 Additional Axle #2 WB: _____ in.
C20 Additional Axle #2 wt: _____ lbs.
D20 Additional Axle #2 Desired Load: _____ lbs.
E20 Additional Axle #2 GAWR: _____ lbs.
B21 Additional Axle #3 WB: _____ in.
C21 Additional Axle #3 wt: _____ lbs.
D21 Additional Axle #3 Desired Load: _____ lbs.
E21 Additional Axle #3 GAWR: _____ lbs.
B22 Additional Axle #4 WB: _____ in.
C22 Additional Axle #4 wt: _____ lbs.
D22 Additional Axle #4 Desired Load: _____ lbs.
E22 Additional Axle #4 GAWR: _____ lbs.
B23 Additional Axle #5 WB: _____ in.
C23 Additional Axle #5 wt: _____ lbs.
D23 Additional Axle #5 Desired Load: _____ lbs.
E23 Additional Axle #5 GAWR: _____ lbs.
C27 Chassis Vert-GC: _____ in.
B28 Added Component Hor-CG: _____ in.
C28 Added Component Vert-CG: _____ in.
D28 Added Component wt: _____ lbs.
B29 Added Component Hor-CG: _____ in.
C29 Added Component Vert-CG: _____ in.
D29 Added Component wt: _____ lbs.
B30 Added Component Hor-CG: _____ in.
C30 Added Component Vert-CG: _____ in.
D30 Added Component wt: _____ lbs.
B31 Added Component Hor-CG: _____ in.
C31 Added Component Vert-CG: _____ in.
D31 Added Component wt: _____ lbs.
B32 Added Component Hor-CG: _____ in.
C32 Added Component Vert-CG: _____ in.
D32 Added Component wt: _____ lbs.
B33-45 Added Component Hor-CG: _____ in.
C33-45 Added Component Vert-CG: _____ in.
D33-45 Added Component wt: _____ lbs.
B46 Payload Hor-CG: _____ in.
C46 Payload Vert-CG: _____ in.
D46 Payload wt: _____ lbs.

Glossary

AF (Axle-to-Frame) — The distance from center of rear axle(s) to end of frame. See *Chassis Dimensions.*

Above-cab Carrier — A platform above the cab that can be in a fixed or hydraulically adjustable position for transporting vehicles.

Air Dam — Flexible air deflecting panel usually located below the radiator support.

Air Resistance — A measure of the "drag" on a vehicle moving through air. Air resistance increases as a square of the speed, thus power requirements increase much faster than vehicle speed.

Ambient Temperature — Surrounding air temperature.

Anchor Bar — Part of the tow sling or tow hitch that is placed under or against a vehicle to be towed. It must be fastened to the vehicle with two tow chains.

Approach Angle — (1) Ramp clearance angle for the front of a vehicle, measured from the forward edge of the front tire contact patch to the lowest part of the vehicle forward of the tire; (2) An angle made between the plane of the platform and the ground plane on a carrier body.

Auxiliary Equipment — Any equipment, in addition to the basic chassis, that is required for a piece of equipment/vehicle to perform its functions. For example, a winch would be auxiliary equipment for a tow truck.

Auxiliary Fuel Tanks — Fuel tanks installed in addition to the standard equipment tank.

Auxiliary Towing Lights — Stop, tail and turn-signal lights attached to the trailing end of the towed vehicle operated as part of the towing vehicle lighting system.

Auxiliary Transmission — A transmission with a limited number of speeds (usually two, three or four) that is mounted immediately in back of the main transmission. The auxiliary has its own control in the cab, and by using both transmissions the driver can get several times the number of forward speeds possible with just the main transmission. A five-speed main transmission with a three-speed auxiliary would give the driver 15 forward speeds.

Axle-*Dead* — A means of support for the wheels at each end. This is contrasted to a Live Axle, which is connected to the wheels and rotates with the wheels.

Axle-*Drive* — The axle that is connected to the truck engine and propels the truck.

Axle-*Full Floating* — A type of drive axle in which the axle "floats" in the axle housing with all the truck weight and stress of the wheels on the housing, not the axle shaft.

Axle-*Live* — A means of support for the wheels at each end that connects the wheels with members that rotate with the wheels.

Axle-*Semifloating* — A type of drive axle in which the weight of the truck, with consequent load and wheel stress, is supported by the axle shaft.

Axle-*Tandem Drive* — Both axles of the tandem are driven by the vehicle engine.

Axle Rating — See *Gross Axle Weight Rating.*

BA — The distance from the foremost point on the front bumper to the center line of the front axle. See *Chassis Dimensions.*

BBC — The distance from the foremost point on the front bumper to the back of the cab. See *Chassis Dimensions.*

BHP — Abbreviation for Brake Horsepower. See *Horsepower.*

BL (Body Length) — The distance from the foremost point of the body to the rearmost point of the body. See *Chassis Dimensions.*

Baffle — A plate or shield used for deflecting, checking or regulating the flow of liquids or gases.

Barrel — The cylindrical component of the hydraulic cylinder.

Battery — An electro-chemical device for storing electrical energy.

Bending Moment — The force times the distance from the support to the point the force is applied causing bending.

Bevel Gear — Gear that will transmit power at an angle.

Blower — A tank vehicle accessory (which may be either tractor-mounted or trailer-mounted) used in the transfer by air of dry bulk products at pressures normally below 5 psi.

Body — The structure or that portion of the vehicle which carries the load or cargo.

Body Extension Over Cab — A body overhang commonly found in furniture vans. Also referred to as *Attic, Boot, Bullnose, Chair Deck, Peak or Poop Deck.*

Body Hinge — The attachment mechanism connecting a tilting body to the stationary frame about which the body rotates into the tilt position.

Body Subframe — Another term for *Body Understructure* or *Mounting Subframe.*

Body Understructure — Crossmembers and longitudinal members under the body floor.

Body Weight — Unmounted weight of a body with applicable options.

Bogie — A *Tandem Axle.*

Bolsters — The transverse members commonly used to define the horizontal support for the diagonal braces of a vertical mast.

Glossary continued

Boom — A member extending from a mast, base or frame to hold, extend or lift a load.

Bore and Stroke — Bore is the diameter of the engine cylinder. Stroke is the maximum distance the piston moves.

Brakes-*Engine* — The engine's compression pressure used for retarding the truck.

Brakes-*Emergency* — An independently actuated secondary brake system used for parking or in an emergency when the service brake is inoperative.

Brakes-*Service* — Mechanism for retarding and stopping the truck.

Bridge Formula — A formula used by certain states to compute the maximum allowable weight for vehicles. Total weight, number of axles and location of axles are factors in this formula.

Bumper-*Dock* — A bumper attached to the rearmost portion of the body (often called *Platform Floor Extension*).

Bumper-*DOT* — A bumper designed to provide rear-end protection that meets requirements of FMCSR 393.86. Previously called *ICC Bumper, ICC Drop Bumper or Step Bumper.*

Bumper-*Step* — A light-truck bumper with a flat-top surface to provide a step for entry into a truck body.

CA (Cab to Axle) — The distance from the back of the truck cab to the center of the rear axle. Clear or *effective* CA is the distance from the rear surface of any obstruction behind the cab to the center of the rear axle. On a tandem-axle truck this dimension is from the back of the cab to a point midway between the two rear axles. See *Chassis Dimensions.*

CB (Cab to Body) — The distance between truck cab and body. See *Chassis Dimensions.*

CE (Cab to End of Frame) — The dimension from the back of the cab to the rear of the standard frame. Used primarily to determine size of body that may be used. See *Chassis Dimensions.*

CT (Cab to Tandem) — The distance from the back of the cab to a point midway between the tandem axles. Clear or *effective* CT is the distance from the rear surface of any obstruction behind the cab to the center of the rear axles.

Cab — The driver / passenger-carrying compartment of a chassis cab.

Cab Control Levers — Handles to control action of power take-off and hydraulic valve, usually located in truck cab convenient to driver's hand.

Cab Forward — See *Forward Control.*

Cab Over Engine (COE) — Cab design where driver is actually as far forward as possible. Engine is directly under cab.

Cab Protector — Metal shield over the cab as protection from cargo such as coal, stone, etc. being loaded into a dump body.

Cable — Steel wire rope used for pulling or supporting.

Camber — The angle a front wheel makes with a vertical line. Outward lean on the top of a wheel is "positive camber."

Cargo Weight Rating — The value specified by the manufacturer as the cargo-carrying capacity, in pounds, of a vehicle, exclusive of the weight of the occupants (computed at 150 lbs. times the number of designated seating positions).

Carrier — A platform body with a winch for loading.

Caster — The angle a front-wheel spindle pivot makes with a vertical line. Tilting the top of the pivot to the rear of the vehicle is "positive caster."

Center of Gravity (CG) — The point at which the weight of the chassis, body / equipment and payload, if collectively or individually supported, would balance vertically, horizontally, and laterally. (This engineering concept finds the center of the mass of an object.) The three measurements necessary to determine the CG of an object are defined as follows:

***Horizontal* (HCG)** — measured fore and aft from a reference plane
***Lateral* (LCG)** — measured from center line of the vehicle to the side
***Vertical* (VCG)** — measured up or down from a reference plane.

Certification Label — A label, required by Public Law 89-563, that states (certifies) that a motor vehicle or item of motor vehicle equipment complies to all applicable Federal Motor Vehicle Safety Standards (FMVSS) in effect on the date of manufacture.

Cetane — Rating of diesel fuel similar to octane for gasoline.

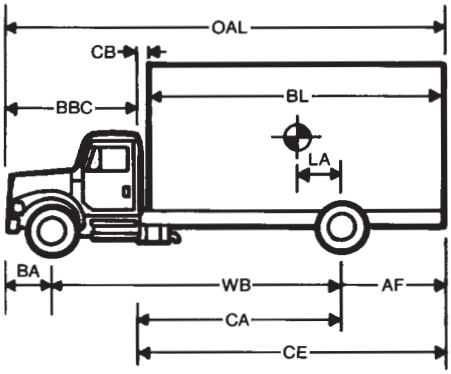
Chain Assemblies — Chain with all hardware and coupling devices.

Chassis Cab — An incomplete vehicle consisting of a chassis upon which is mounted a completed occupant compartment. The vehicle is capable of performing work by the addition of a body / load-carrying structure.

Chassis Dimensions — Designations commonly used to describe a truck and its components. *See Illustration on page 18.*

Classification of Trucks by Ground Contact — Trucks are classified by the number of wheels and the number of driving wheels. If a truck is designated as a 4x2, it has four wheels and two driving wheels. A 4x4 truck has four wheels and four driving wheels. A 6x4 truck has six wheels and four driving wheels.

Glossary continued



AF = Axle to End of Frame
BA = Bumper to Axle
BBC = Bumper to Back of Cab
BL = Body Length
CA = Cab to Axle
CB = Cab to Body
CE = Cab to End of Frame
FH = Frame Height
LA = Load to Axle
OAL = Overall Length
WB = Wheelbase

Clearance Lights — Lighting to indicate the overall width of the vehicle.

Common Carrier — A trucking firm that hauls for hire.

Completed Vehicle — A vehicle that requires no further manufacturing operations to perform its intended function, other than the addition of readily attachable components such as mirrors or tires and rim assemblies, or minor finishing operations such as painting.

Compression Pressure — The force in pounds per square inch exerted by the compressed charge in the combustion chamber space when the piston is at the top of the compression stroke.

Compression Ratio — The cylinder and head volume (piston displacement plus combustion chamber volume) when the piston is at the bottom of the stroke divided by the combustion chamber volume when the piston is at the top of the stroke.

Contract Carrier — A trucking firm that has a hauling contract with a certain company or companies.

Control Lever — A device for imparting motion into control linkage.

Cowl — The front part of an automotive cab or body directly below the base of the windshield between fire wall and dashboard (instrument panel). Used to indicate the complete vehicle (less body) when produced by a factory to include the cowl but not the remainder of the cab or body.

Crossmembers — General term applied to transverse members in the understructure or on a truck frame.

Cube — The inside dimensions of a truck body or trailer expressed in cubic feet. So-called "high-cube" equipment is designed to offer the maximum interior load space for its exterior length and width.

Curbside — The right or passenger side of the vehicle when viewed from the rear, opposite side from *Roadside*.

Curb Weight — The weight of a motor vehicle with all permanently mounted equipment and maximum capacity of engine fuel, oil and coolant. Same as *Tare Weight*.

Cylinder — A hydraulic cylinder assembly complete.

Cylinder Base — End of hydraulic cylinder opposite to header or rod end.

Cylinder Head — End of a hydraulic cylinder through which the piston rod extends. Also called *Header*.

DOT — Abbreviation for *Department of Transportation*, the agency composed of several federal agencies dealing with regulations concerning both the manufacture and operation of motor vehicles and motor vehicle equipment.

Deflection Rate — Used in rating springs to determine the number of pounds necessary to deflect a spring one inch. For torsion bars it is a one-inch deflection of the control arm.

Differential — The gear assembly on the drive axle that permits one wheel to turn slower or faster than the other when going around corners.

Differential-*No Slip* or *Limited Slip* — This type of differential will not allow one wheel to spin while the other is motionless, such as when a truck is stuck on ice or in mud. Torque is transmitted to both drive wheels for better traction. This type of differential is available on almost all cars and trucks today as an option, standard equipment on some.

Displacement — The displacement of an engine is the volume through which the head of the piston moves multiplied by the number of pistons in the engine.

Diverter Valve — Auxiliary valve to provide hydraulic power from the hydraulic pump by switching the oil flow from its usual passageways into additional pieces of equipment such as snowplows or other lifting cylinders. Also called *Diversion* or *Selector Valve*.

Dolly (Towing) — A four-wheel carriage often used in towing to support the trailing end of a vehicle.

Double-bottom Trailer — A combination consisting of a tractor pulling a semitrailer with a full trailer in back. Also called *Tandem Trailer*.

Driveline — The total system drive shaft consisting of universal joints, slip yokes and flanges between the transmission and axle(s).

EPA — Abbreviation for *Environmental Protection Agency*, the Federal agency which establishes and enforces regulations to protect the environment. These regulations include pollution of the air and water, as well as pollution from fuel and/or noise emissions.

Glossary continued

Elevating Gate — A form of endgate used in conjunction with a hydraulic or mechanical hoisting mechanism to allow the gate to descend to ground level. Power elevation allows a gate to be used to raise freight to truck floor level for loading. Also referred to as a *Lift Gate, Load Gate, Power Gate* or *Tailgate Lift.*

FH (Frame Height) — The distance from the top of the frame to the ground. See *Chassis Dimensions.*

Fifth Wheel — A coupling device mounted on a tractor which contains a provision for accepting and holding the kingpin of a semitrailer.

Final-stage Manufacturer — A manufacturer that performs such manufacturing operations on an incomplete vehicle that it becomes a complete vehicle and road-ready for its intended purpose.

FMCSR — Abbreviation for *Federal Motor Carrier Safety Regulation*, regulations enforced by the Office of Motor Carrier Safety. See *OMCS*.

FMVSS — Abbreviation for *Federal Motor Vehicle Safety Standard.* These regulations promulgated by the National Highway Traffic Safety Administration (NHTSA) under Public Law 89-563 are mandatory and must be complied with when motor vehicles or items of motor vehicle equipment are manufactured and certified thereto.

Forks — A device attached to the lift bar for lifting a vehicle by an axle, frame or structural member.

Forward Control — A configuration in which more than half of the engine length is rearward of the foremost point of the windshield base and the steering wheel hub is in the forward quarter of the vehicle length.

Frame Cutoff — The standard frame on most models extends behind the rear axle, far enough to support a body mounted on the vehicle. For special-purpose bodies that may be unusually short for the wheelbase of the vehicle on which it is mounted or in most tractor operations, this frame extension behind the rear axle may be shortened. The shortest allowable extension for each vehicle is referred to as *Maximum Frame Cutoff.*

Frame Section Modulus — The engineering term that indicates the relative strength of frames as it relates to shape. It takes into account frame depth, flange width and material thickness. All other things being equal, the frame with the largest section modulus will have the greatest strength and stiffness (i.e., the ability to more effectively resist sagging under loads).

Full Air Brakes — Compressed air is used to provide the force required to expand the brake shoes by cam or wedge against the brake drums. Air pressure is supplied direct to chambers at the wheel position.

Full Trailer — A trailing load-carrying vehicle that is entirely supported by its own suspension system. The powered unit merely tows this type of trailer and does not directly support any of its weight. Sometimes referred to as a *Pup* when towed behind a truck with a mounted body or behind a tractor-semitrailer combination. Tractor-semitrailer / full-trailer combinations are often referred to as *Doubles* or *Double Bottoms.*

FW (Frame Width) — The overall width of the chassis frame measured outside to outside behind the cab.

GAWR — Abbreviation for *Gross Axle Weight Rating.* The value specified by the vehicle manufacturer as the load-carrying capacity of a single axle system, as measured at the tire-ground interfaces.

GCWR — Abbreviation for *Gross Combination Weight Rating.* Represents the entire weight of a vehicle at the ground with a trailer or trailers including vehicle, equipment, driver, fuel and payload (everything that moves with the vehicle.)

Gear Ratio — The number of revolutions a driving gear requires to turn a driven gear through one complete revolution. For a pair of gears the ratio is found by dividing the number of teeth on the driven gear by the number of teeth on the driving gear.

Geared Speed — The theoretical vehicle speed based on engine RPM, transmission gear ratio, rear axle ratio and tire size.

Glad Hand — The air brake connector between a tractor and trailer.

Grab Hook — Device for use with safety chains and some tow hookups.

Gradeability — Ability of a truck to negotiate a given grade at a specified Gross Vehicle Weight (GVW) or Gross Combination Weight (GCW).

GVWR — Abbreviation for *Gross Vehicle Weight Rating.* The maximum total vehicle weight, measured at the tire-ground interfaces, for which the vehicle possesses components adequately rated to safely carry. It cannot exceed the sum of all GAWRs.

Helical Gears — Gears with slanted teeth, usually used in transmissions. The teeth are positioned diagonally across the face of the gear.

Hoist — Mechanism for elevating bodies, either level or tilting.

Hold-over Plates — Plate coils containing a refrigerant that are mounted on the walls of a truck or trailer. When "charged," these plate coils hold the temperature down to the desired point for milk delivery and many other low-temperature trucking operations.

Horizontal Center of Gravity (HCG) — The point at which half of the gross weight is forward and half is aft. See *Center of Gravity.*

Horsepower — The rate of doing work equal to lifting 33,000 lbs. one foot in one minute; the amount of work done by a certain torque developed by an engine on a per-minute basis.

Glossary continued

Horsepower-*Brake* (or *Actual Delivered Horsepower*) — A measure of the rate at which engine power is produced — the time rate of doing work, as measured by a Prony brake or an electric dynamometer. In other words, the amount of work done by a certain torque being exerted over a definite space of time. Brake horsepower is expressed as the torque in pound-feet times the number of revolutions per minute divided by the constant 5,252.

$$\text{Brake HP} = \frac{\text{Torque x Engine Speed}}{5{,}252} = \frac{\text{T x RPM}}{5{,}252}$$

Horsepower-*Gross* — Obtained by dynamometer test of an engine with water pump(s) operating and air cleaner, but without generator, fan and muffler.

Horsepower-*Net* — Obtained by dynamometer test of a complete engine with all standard accessories including water pump(s), generators and fan operating, air cleaner and muffler.

Horsepower-*Taxable* — The NACC (National Automobile Chamber of Commerce) adopted an arbitrary formula for estimating horsepower to enable comparison of engines on a uniform basis. It assumes that engines deliver their rated power at a piston speed of 1,000 feet per minute and that mechanical efficiency will average 75%. Advancements in engine design since this formula was developed have obsoleted the formula completely as a basis of estimating true engine output. The formula is still used in some states for licensing purposes, however.

$$\text{Tax HP} = \frac{(\text{Dia. of Bore})^2 \text{ x No. of Cylinders}}{2.5} = \frac{D^2 \text{ x } N}{2.5}$$

Hotchkiss Drive — A term applied to that type of chassis design where the rear springs are mounted at the forward end in a stationary bracket (not shackled as at the read end) and all driving and braking forces are cushioned by the springs and transferred directly to the frame side members. Open-type universal joints and propeller shafts are used in this design.

Hydraulic Hose — Flexible oil lines used to transmit fluid.

Hydraulic Oil — Fluid used to transmit power for operation for hydraulic systems.

Hydraulic Control Valve — A mechanical device to divert or control the flow of fluid in a hydraulic circuit.

Hydraulic Relief Valve — A mechanical device used to limit the pressure in a hydraulic circuit.

ICC — Abbreviation for *Interstate Commerce Commission*, the former federal agency that regulated entry, rates, services and insurance requirements for motor carriers, railroads, bus lines, freight forwarders, brokers and waterway operators.

Identification Lights — Lighting cluster to indicate type of motor vehicle.

Incomplete Vehicle — An assemblage consisting, as a minimum, of frame and chassis structure, power train, steering system, suspension system and braking system, to the extent that those systems are to be part of the completed vehicle that requires further manufacturing operations other than the addition of readily attachable components, such as mirrors or tire and rim assemblies or minor finishing operations such as painting, to become a complete vehicle.

Incomplete Vehicle Manufacturer — A manufacturer that produces an incomplete vehicle (chassis) by assembling components none of which, if taken separately, constitutes an incomplete vehicle.

Inside Height — Unobstructed inside loading height measured at the side of a van body.

Inside Safety Release — A device mounted on the inside of a door to allow emergency exit if the door is accidentally locked from the outside.

Inside Width — Unobstructed inside loading width of a van body.

Insulated Van Body — A van body designed primarily for transportation of commodities at controlled temperatures. See *Reefer.*

Inter-axle Differential — Sometimes called a *Torque Divider Differential*, this device is located between two driving axles of a tandem-axle-drive truck or tractor. The power from the engine is divided between the two driving axles when this device is in the unlocked position. One axle can actually turn faster, or at a different speed, than the other, which is an advantage in certain types of truck use. This device can be locked, under which condition both axles turn at exactly the same speed, getting approximately 50% of the power to each.

Intermediate Manufacturer — A manufacturer, other than the Incomplete Vehicle Manufacturer or the Final-stage Manufacturer, who performs manufacturing operations on an incomplete vehicle.

J-Hook — Attachment device used for towing/recovery.

JIC — Abbreviation for *Joint Industry Committee*, an organization set up to standardize hydraulic fittings specifications and symbols.

Kingpin-*For Front Axle* — Pin that connects the front axle and steering spindle, about which the spindle pivots.

Kingpin-*For Semitrailer* — Pin that is locked into the fifth wheel on a tractor to effect coupling of a trailer with the tractor.

LA (Load to Axle) — The distance from the center of gravity (CG) of the body and/or payload to the center line of the rear axle(s). See *Chassis Dimensions.*

Landing Gear — A structure used to support the front of a semitrailer when detached from a tractor.

Glossary continued

Lease — A financial arrangement that merely provides the vehicles; the fleet company must provide maintenance and insurance and pay for depreciation.

Lessee — A company that has obtained vehicles by leasing them.

Lessor — A leasing company.

Lift Bar — A transverse horizontally pivoting member attached to the boom of a wheel lift or an underlift for attaching frame or wheel-lift devices. Also called *Cross Bar.*

Lift Gate — See *Elevating Gate.*

Lift-tow Rating — Rating of a wrecker or recovery vehicle that gives the maximum weight of a vehicle to be towed.

Light Bar — An array of lamps used in accordance with local ordinances.

Light Pylon — Structure upon which a light and/or light bar is mounted.

Lightly Loaded Vehicle Weight — (1) For vehicles with a GVWR of 10,000 lbs. or less, unloaded vehicle weight plus 300 lbs. (including driver and instrumentation); (2) For vehicles with a GVWR greater than 10,000 lbs., unloaded vehicle weight plus 500 lbs. (including driver and instrumentation). This weight is used for EPA testing and compliance.

Light-truck Tire — A tire designated by its manufacturer as primarily intended for use on lightweight trucks or multipurpose passenger vehicles.

Lights — See *Clearance Lights, Identification Lights* and *Marker Lights.* (For compliance with federal regulations see *Federal Lighting Standard,* pages 68–76.)

Load Cell — A device used to measure a load.

Longitudinal — Body members attached to and running the length of an underframe. Also called *Longrails, Longsills, Risers* or *Stringers.*

Longrails — See *Longitudinal.*

Lower Rail — Lower framing member of front, sides and occasional rear sections of a van body.

Maintenance Lease — Sometimes called *Fix Cost Leasing.* The leasing company provides insurance and all maintenance and covers depreciation.

Manufacturer — Individual/company engaged in the manufacturing or assembling of motor vehicles or motor vehicle equipment, including any party importing same, for resale as defined by the DOT for vehicle certification.

Marker Lights — Amber and red lights attached to the vehicle body that indicate overall length.

Maximum Load Rating — The load rating at the maximum permissible inflation pressure for that tire.

Maximum Loaded Vehicle Weight — The sum of curb weight, passengers and cargo.

Maximum Permissible Inflation Pressure — The maximum cold inflation pressure to which a tire may be inflated.

Maximum Rolling Grade (Gradeability) — Greatest grade a vehicle is able to climb while under motion.

Maximum Speed — The speed attainable by accelerating at maximum rate from a standing start for one mile.

Maximum Starting Grade (Gradeability) — Greatest grade on which a vehicle is able to start from a complete stop. Approximately 9/10ths of *Rolling Gradeability.*

Maximum Sustained Vehicle Speed — Highest speed a vehicle can maintain under full load conditions on level ground.

Monocoque Construction — A lightweight type of construction, commonly utilized in van-type semitrailers, where the sides of the vehicle bear a substantial part of the load in shear which is transmitted to the upper coupler and undercarriage assemblies through side rails, crossmembers and end structures.

Mounting Devices — Usually U-bolts, tie-down clamps and/or straps to secure a van body to a chassis cab. Also referred to as *Mounting Brackets, Mounting Clamps, Angles* or *Bars.*

Mounting Height — Distance from top of chassis cab frame to bottom of body floor.

Mounting Subframe — Subframe members securely affixed to a truck chassis frame.

Mud Flap — Deflecting shield at rear of wheels, required by regulation. Also called *Splash Guard.*

NHTSA — Abbreviation for *National Highway Traffic Safety Administration,* the federal agency responsible for promulgating and ensuring compliance of regulations dealing with the manufacture and certification of motor vehicles. See *DOT.*

Nominal Rating — An arbitrary classification of truck capacity in tons, such as: half ton, three-quarter ton, one ton, ton and a half, two tons, five tons, etc.

NTEA — Abbreviation for *National Truck Equipment Association,* the trade organization representing the commercial truck and transportation equipment industry. Established in 1964.

OAL — Overall length of a vehicle. See *Chassis Dimensions.*

OMCS — Abbreviation for *Office of Motor Carrier Safety,* an office of the Federal Highway Administration (FHWA) within the Department of Transportation (DOT). Responsible for developing and implementing national motor carrier standards and intermodal hazardous materials regulations and issuing interpretations and reviewing state laws and regulations.

Glossary continued

OSHA — Abbreviation for *Occupational Safety and Health Administration,* the federal agency that promulgates and ensures compliance of regulations dealing with on-the-job safety and health. Some motor vehicle regulations are included that apply to vehicles used in off-highway job sites. Compliance is the responsibility of the vehicle owner.

Odometer — A mileage counter that registers total miles traveled. Located on the dial section of most speedometers.

Off-Road — Slow-speed operations over uneven surfaces such as lumbering operations, oil field work, geological surveying, operations at mining sites, road construction and other major construction sites.

On/Off-Road — Operations mostly on hard-surfaced or graded roads with some work over unprepared surfaces. This category includes most highway units not operated over regular routes such as farm trucks, dump trucks, concrete mixers, lumber delivery trucks, etc.

Open Top — A body without a permanent top assembly.

Outriggers — Folding or sliding leg devices attached to trucks to give additional support down to the ground for maximum stability.

Overall Vehicle Height — Distance from the ground to the highest point on the vehicle.

Overall Vehicle Width — Refers to the nominal design dimension of the widest part of the vehicle, exclusive of signal lamps, outside rearview mirrors, flexible fender extensions and mud flaps, determined with doors and windows closed and the wheels in the straight-ahead position.

Overhang — (1) The horizontal distance from the center line of the hinge to the rear of the body on a tilting body; (2) The distance from the center of the rear axle(s) to the rearmost surface of the truck body. Usually applies to non-tilting bodies.

Parallel Batteries — All batteries have their positive terminals connected on a separate wire and all negative terminals on another separate wire. This means that four six-volt batteries (some trucks carry four batteries) will still produce only six volts, but will have four times the energy potential.

Payload — The weight of the commodity being hauled. Payload capacity is computed by subtracting the completed weight of the vehicle (including driver and passengers) from the GVWR.

Payload & Body Allowance — The payload capacity of the truck with allowance for the weight of a truck body.

Peddle Truck or Shuttle Truck — Terms for the city delivery trucks owned by a long-distance hauler. They distinguish between the big "rigs" and the small city trucks.

Percent of Grade — The figure used in computing the power requirements of a truck. Usually taken at the steepest grade a truck will be required to climb on its route. Percent of grade is determined by dividing the height of a hill by its length.

Pintle Hook — Hook mounted on a truck or semitrailer used to couple a full trailer.

Pitch Line Velocity (PLV) — The circumference in feet at the pitch line of a gear multiplied by the RPM of that gear at 1,000 engine RPM. A small PTO driving gear in the transmission gives a low pitch line velocity; a larger gear gives a correspondingly higher pitch line velocity.

Platform/Flatbed — Load-carrying bed with or without removable sides. May be equipped with hydraulic cylinders to tilt and slide platform.

Ply Rating — A standard unit of tire casing strength, based on the strength of cotton plies. This term is used to indicate the load-carrying ability of a given tire. It is an index of tire strength and does not necessarily represent the number of cord plies in the tire.

Pole Trailer — A motor vehicle without motive power designed to be drawn by another motor vehicle and attached to the towing vehicle by means of a reach or pole, or by being boomed or otherwise secured to the towing vehicle. Used for transporting long or irregularly shaped loads such as poles, pipes or structural members generally capable of sustaining themselves as beams between the supporting connections.

Power Curve — A graphic illustration of maximum output of horsepower and torque at all operating speeds. These curves are established from data obtained by running a sample engine on an engine dynamometer. Curves are established using both bare operable engine and with standard accessories. Net power figures (those using standard accessories) are used in vehicle performance calculations.

Power Divider — Usually a small auxiliary gear box or chain-driven device to allow distribution of drive shaft power to several different mechanical devices mounted on the same truck.

Power Take-off (PTO) — A mechanical device used to transmit engine power to auxiliary equipment. Power take-offs can be mounted on either a main or auxiliary transmission. Front-mounted and flywheel-mounted power take-offs are also used in various applications.

Power Train — All the components that handle the engine power from the truck engine to the driving wheels. This includes transmissions, drive shafts, as well as differentials and driving axles.

Private Fleet — A truck fleet owned for a company's own use.

Push Bumper — Device used to push a vehicle, sometimes equipped with a rubber face.

Pusher Axle — An auxiliary axle installed in conjunction with the rear axle(s) of a truck chassis. A pusher axle is installed ahead of the drive axles, thus shortening the length of the wheelbase.

Glossary continued

Radius Rod — Found in several automotive applications, most commonly for keeping the rear axle in correct position when starting and stopping.

Rear Axle Ratio — The numerical ratio of the drive shaft speed to the speed of the rear axle.

Recovery Vehicle/Wrecker — Vehicle used to retrieve and lift/tow other vehicles.

Reefer — Slang for insulated van body equipped with refrigeration for controlling temperatures.

Reflectors — Glass or plastic prism lenses which reflect light.

Regrooved Tire — A tire, either original tread or retread, on which the tread pattern has been renewed or a new tread has been produced by cutting into the tread of a worn tire to a depth equal to or deeper than the molded original groove depth.

Resisting Bending Moment (RBM) — A calculation used to compare frames of different section modulus and of different material. It is the product of the section modulus times the yield strength of the frame material. The formula is expressed as:

RBM = Section Modulus x Yield Strength

It is readily apparent from the above formula that the yield strength of a frame is as important as the section modulus. The RBM should, therefore, be taken into account whenever frames of unlike material and section modulus are being compared. See *Yield Strength.*

Ridge Pole — Member that can be located in center longitudinally on an open-top van body to support a tarpaulin in a tent-like manner.

Rim Pull — See *Tractive Effort.*

Riser — Steel or wood section between chassis frame and van body underframe to give proper tire clearance and/or required ground-to-floor height.

Road Rolling Resistance — A measure of the retarding effect of the road surface to forward movement of the vehicle. Varies with the type and condition of the road as different road surfaces offer various resistances to the wheels of a truck. A concrete surface offers 12.5 lbs. of rolling resistance per thousand pounds of gross weight; gravel, 25 lbs.; and sand, 75 lbs. This is a vital factor in determining power and power train requirements.

Roadside — The left or driver's side of the vehicle when viewed from the rear, opposite side from *Curbside.*

Rolling Radius — Height measured from center of axle to the ground.

Roof Bow — Transverse member in roof of body.

Roof Rail — Member running longitudinally that connects the roof to the side of a body.

Rope Ties — Rings, hooks, cleats or knobs attached to body wall frame members for use with lashing either inside or outside; liner slats or bars attached to wall frame members for lashing.

Rub Rail — Member running longitudinally providing rub surface on the side of a body.

SAE — Abbreviation for *Society of Automotive Engineers.*

Safety Chains — Chain assemblies used to connect the towing and towed vehicles as a secondary coupling system.

School Bus — A bus that is sold or introduced in interstate commerce for purposes that include carrying students to and from school or related events. Does not include a bus designed and sold for operation as a common carrier in urban transportation.

School Bus Passenger Seat — A seat in a school bus other than the driver's seat.

Serial Number — A number stamped on a metal plate by the manufacturer and placed on a component or the vehicle for identification purposes. See *Vehicle Identification Number (VIN).*

Set-back Front Axle — The front steering axle is normally as close to the front of the vehicle as the design and wheel and tire size permit. When the front axle is purposely located farther toward the rear, it is referred to as being "set back." Center line of front axle to front of front bumper is normally from 28" to 37" on regular models and 48" or more on set-back front-axle models. The purpose of moving the axle rearward is to increase loads applied to the front axle and increase maneuverability. Standard type front-axle setting generally enables more economical cab construction and meets axle spread requirements of states using the Bridge Formula.

Semitrailer — A trailing unit that is supported in the rear by its own suspension system and at the front by the towing vehicle. This type of unit is sometimes supported by a separate suspension unit with towing provisions (thus becoming a full trailer). An exception is the utility-type trailer, house trailer, etc. which is towed by a ball coupling (referred to simply as a trailer and is not designed as semi- or full trailer).

Shipping Weight — The dry weight of a complete truck with all standard equipment including grease and oil but without any fuel or coolant.

Short Chain — Method of attaching a tow sling to a towed vehicle so that the tow chains support the entire load.

Side Rails — Upper or lower extensions of the body sides that run longitudinally, front to back.

Single & Double Reduction Gears — Generally rear-axle terminology. Standard rear-axle gearing is single reduction, (i.e., one step of speed reduction through the rear-axle gearing). In certain heavy-duty applications a double reduction is desirable. This permits a greater gear reduction in a smaller gear case, thus allowing better road clearance and more compact design.

Glossary continued

Slideback Cylinder — A hydraulic cylinder, usually a long stroke, mounted horizontally at front of body used to slide body forward or rearward.

Snatch Block — A single or multiple pulley used to reduce cable load or change cable direction.

Spacer — Steel or wood section between chassis frame and body underframe to give proper tire clearance and/or required ground-to-floor height.

Spacer Block — Used in conjunction with 4x4 wood beam to provide additional clearance between the tow bar, chains and body of the vehicle.

Spade — One or more hydraulically operated ground-penetrating feet designed primarily to resist rearward movement.

Speedability — The speed a vehicle will attain based on engine power, gross weight, power train efficiency, air resistance, grade resistance and road type.

Splash Guard — *See Mud Flap.*

Spring Capacity — (1) Capacity at Pad: The total weight that the spring can support in its maximum position; (2) Capacity at Ground: The total weight that the spring can support in its maximum position plus a portion of the weight not supported by the springs.

Stabilizers — Hydraulic or manually operated leg devices attached to trucks to give additional support down to the ground for improved stability. Examples are outboard legs, outriggers and jack legs.

Stake Pockets — Apertures in the floor or sides of bodies for the reception of stakes.

Stakes — Metal or wood posts by means of which sides are attached to platforms; when used alone stakes are a means of retaining loads on flat deck platforms.

Steering Wheel Lock — Independent device used to secure the steering wheel of a towed vehicle.

Stopping Distance — The distance traveled by a vehicle from the point of application of force to the brake control to the point at which the vehicle reaches a full stop.

Stroke — (1) In engines, the distance traveled by a piston from top dead center to bottom dead center; (2) Maximum distance traveled by the piston in an air or hydraulic cylinder.

Sub Pan — Horizontal surface installed either between or above crossmembers prior to insulation and installation of flooring in reefers.

Suction Line — A tubular connection between a reservoir or tank and the inlet of a hydraulic pump.

Supply Tank — An oil reservoir used in the hydraulic system.

Swing Axle — A drive axle arrangement found on some passenger cars and some light-duty trucks. The differential is mounted rigidly on the vehicle frame and the axle shafts are allowed to "swing" as the vehicle moves up and down while running. Lower unsprung weight is one advantage of this system. Universal joints are required on each half of the drive axle to accommodate the vertical motion.

Synchronized or Synchromesh Transmission — A truck transmission with built-in devices to automatically match the rotating speeds of the transmission gears. With this type of transmission, "double clutching" is not necessary.

Tachometer — An instrument that indicates the revolutions per minute (RPM) of the engine.

Tag Axle — An auxiliary axle installed in conjunction with the rear axle(s) of a truck chassis. A tag axle is installed behind the rearmost axle, thus extending the length of the wheelbase. See *Tandem Axle.*

Tail Plate — Rearmost part of the towing or recovery vehicle body.

Tandem Axle — Two axles mounted as a group (three axles placed together are often referred to as a *Tri-axle Tandem*). There are three tandem-axle drive types: (1) *Dual-drive Tandem,* both axles have drive mechanisms and are connected to the engine power unit; (2) *Pusher Tandem,* only the rearmost axle is a driving type and forward unit is free rolling (load-carrying only), commonly called *Dead Axle;* (3) *Trailing Axle Tandem (Tag Axle),* forward unit of tandem is a driving type while rear unit is freely rolling. Two trailer axles are also called tandem axles.

Tare Weight — The total weight of an empty vehicle in a condition ready to receive payload. Same as *Curb Weight.*

Thermal Efficiency — The efficiency of an engine in converting heat energy from combustion of fuel into mechanical work.

T-Hook — Attachment device used for towing.

Tiedown Assemblies — Device(s) used to restrain cargo. Also called *Cargo Control* or *Restraint Equipment.*

Tilt Cab — Vehicle designed with engine beneath cab and having provision for tilting cab forward on a pivot near front bumper to provide easy access to engine.

Tilt Cylinder — Cylinders used to change the attitude of a structure or body.

Tire Clearance — Space between tires and nearest part of the body or under-construction.

Tire Loaded Radius — The distance from the center of the wheel to the road with tire loaded to rated capacity. Static radius applies when vehicle is at rest; rolling radius for a vehicle when in motion. The latter dimension is usually slightly greater than the static radius and is the figure used in determining the tire revolutions per mile.

Glossary continued

Torque — The rotating or twisting force developed by the truck engine. This is one of the two factors in figuring horsepower and is always expressed in pound-feet. At a given RPM, the higher the torque, the greater the horsepower. The higher the torque rating of a truck engine, the greater its ability to climb hills and increase speeds. A high-torque truck engine eliminates a lot of gear shifting for the driver.

Torque Converter — Used in truck and car automatic transmissions. Torque is multiplied by the action of various turbine-like elements on a fluid.

Torque Multiplication — The truck transmission as well as rear-axle gears multiplies the engine's torque. This is done by reducing engine speed through gears, thus increasing torque by reducing revolutions per minute.

Tow Bar — A device for positioning a towed vehicle behind a recovery vehicle.

Tow Chains — Chain assemblies used as a primary coupling between towing and towed vehicles (not the same as *Safety Chain*).

Tow Sling — A device used for lifting and towing vehicles with the load supported on rubber belts and chains.

Tow Vehicle — Vehicle used to lift / tow other vehicles.

Tractive Effort — The force available at the road surface contacting the driving wheels of the truck. Determined by engine torque, transmission ratio, axle ratio, tire size and frictional losses in the driveline. Also called *Rim Pull.*

Tractive Factor or Performance Factor — This is tractive effort per thousand pounds of gross vehicle weight. A means of measuring the performance potential of a truck or tractor.

Tractor — A truck of comparatively short wheelbase used for pulling a semitrailer.

Tractor Breakaway Valve — Coupled between the tractor and trailer emergency brake system, the tractor breakaway valve provides an air supply to the trailer emergency system for normal operating conditions. In case of trailer brake system failure, the breakaway valve automatically seals off the flow of air pressure from the tractor to the trailer preventing the loss of air pressure from the tractor braking systems and activates the trailer emergency brake. In conjunction with a breakaway valve, a dash-mounted manual control valve is located in the cab. This manual control is used to charge the trailer brake system reservoir for normal operation. In the event of loss of air pressure in the normal braking system, this manual control can be used to seal off the tractor brake system.

Trailer — A motor vehicle with or without motive power, designed for carrying persons or property and for being drawn by another motor vehicle.

Trailer Converter Dolly — A trailer chassis equipped with one or more axles, a lower half of a fifth wheel and a drawbar.

Transmission — A gear reduction device that contains an assembly of gears and associated parts that transmits power from the engine to the driving axle(s). A transmission contains a number of gears that when a connection is made between a specific set provides a choice of ratio. Connection is made by sliding the teeth of one gear into mesh with another, or by engaging a tooth-type clutch that has one part fastened to a gear already meshed to another and the other part splined to a shaft. Synchromesh transmissions use gear-speed synchronizers to ease engagement.

Tread — (1) The distance between the centers of tires on the same axle at the points where they contact the road surface. Duals are measured from the center of dual wheels; (2) That portion of a tire which comes into contact with the road.

Tread Rib — A tread section running circumferentially around a tire.

Tread Separation — Pulling away of the tread from the tire carcass.

Truck — A motor vehicle with motive power, except a trailer, designed primarily for the transportation of property or special purpose equipment.

Truck Hitch — A device for positioning and supporting one end of a towed vehicle behind a recovery vehicle.

Truck Tractor — A truck designed primarily for pulling a semitrailer and not so constructed as to carry a load other than a part of the weight of the semitrailer. See *Tractor.*

Trunnion — The axis, pivot point or center point between axles. A *Trunnion Bar* is used in single-point tandem suspensions.

Turning Radius — The shortest distance in feet required for a given truck to negotiate a U-turn or make a 180-degree turn. The smaller the turning radius of the truck, the greater its maneuverability and consequent ability to handle well in heavy traffic or congested areas.

Twin Screw — Slang term for *Tandem Drive.*

Two-Speed Axle — A rear axle arrangement whereby the driver can select one of two ratios. A truck with a two-speed axle and a five-speed transmission would have 10 forward speeds.

Underlift — A device used for towing vehicles by lifting one end of the towed vehicle from under the axle or structural member.

Universal Joint — Truck drive shafts have universal joints to allow for vertical motion of drive axle and change of angle due to truck loading. Universal joints are used wherever a drive or control shaft must have a change of angle along its axis.

Unloaded Vehicle Weight — The weight of a vehicle with maximum capacity of all fluids necessary for operation of the vehicle, but without cargo or occupants.

Glossary continued

Unsprung Weight — All the vehicle weight that is not supported by the truck's springs, including wheels, tires, brakes, axles and drive shaft. The objective of design engineers is to reduce unsprung weight to a practical minimum.

VCG — Abbreviation for *Vertical Center of Gravity,* the point at which half of the gross weight is above and half is below. See *Center of Gravity.*

Vehicle Equipment Safety Commission — The Commission established pursuant to the joint resolution of the U.S. Congress relating to highway traffic safety, approved Aug. 20, 1958 (72 Stat. 635), or as it may be hereafter reconstituted by law.

Vehicle Identification Number (VIN) — A 17-character number consisting of arabic numerals, roman letters, or both, that the manufacturer assigns to a vehicle for identification purposes, as required by 49 CFR Part 565.

Vehicle Maximum Load on the Tire — That load on an individual tire that is determined by distribution to each axle its share of the maximum loaded vehicle weight and dividing by two.

Volumetric Efficiency — The ratio of air inducted per cycle to the total displacement of the engine. Commonly referred to as the engine's ability to "breathe."

Walking Beam Suspension — Term used to describe a type of tandem suspension that has equalizing beams connecting the two axles. In a parallelogram design such as this, wheels "walk" over irregularities in the road surface.

Weight Distribution — The distribution of the total gross vehicle weight imposed on the ground at each axle (measured in units of weight or as a percent of total truck weight).

Weight-*Sprung* — The weight of those things supported by the springs, such as frame, engine, body, payload, etc.

Wheel Arm — A device that attaches to the lift bar for engaging the tires of a towed vehicle.

Wheel Lift — A device used for towing vehicles by lifting one end of the towed vehicle from under the tires.

Wheel Straps — Used to tie down wheels when using wheel-lift or dolly tow equipment.

Wheelbase (WB) — Horizontal dimension from the center line of the front axle to the center line of the rear axle on a single-rear-axle truck chassis; measured from the center line of the front axle to the center line mid-way between the axles on a tandem-rear-axle truck chassis. See *Chassis Dimensions.*

Wheelhousing — Housing over wheels replacing floor area to obtain lower floor loading height or lower mounting height.

Wheelwell — Housings in body floor to allow clearance over tires.

Winch — A device for winding and unwinding a cable under power.

Working Limit — Minimum breaking strength divided by the factor of safety for cable or chain.

Wrecker — Truck equipped with winch or winches and boom(s) used for recovering and towing vehicles. Term may be used also to mean only the equipment not including the truck chassis.

Yield Strength — The inherent strength of a material by indicating the maximum load that can be applied to that material before permanent deformation occurs. This means, in effect, the maximum load that will allow the material to return to its original shape when the load is removed.