



Truck, Trailer, and Hitch Components

Making Sure the Numbers Add Up

Truck, Trailer, and Hitch Components Making Sure the Numbers Add Up

Fred Whitford, Coordinator, Purdue Pesticide Programs
Steve Hawkins, Assistant Director, Purdue Agricultural Centers
Mark Purschwitz, Extension Agricultural Engineering, University of Kentucky
John Earnest, Jr., Collision Reconstructionist, Princeton Kentucky Police Department
David Hynes, Clark County Extension Educator, Purdue University
Kevin Smith, Editor, Purdue University (not until the end)

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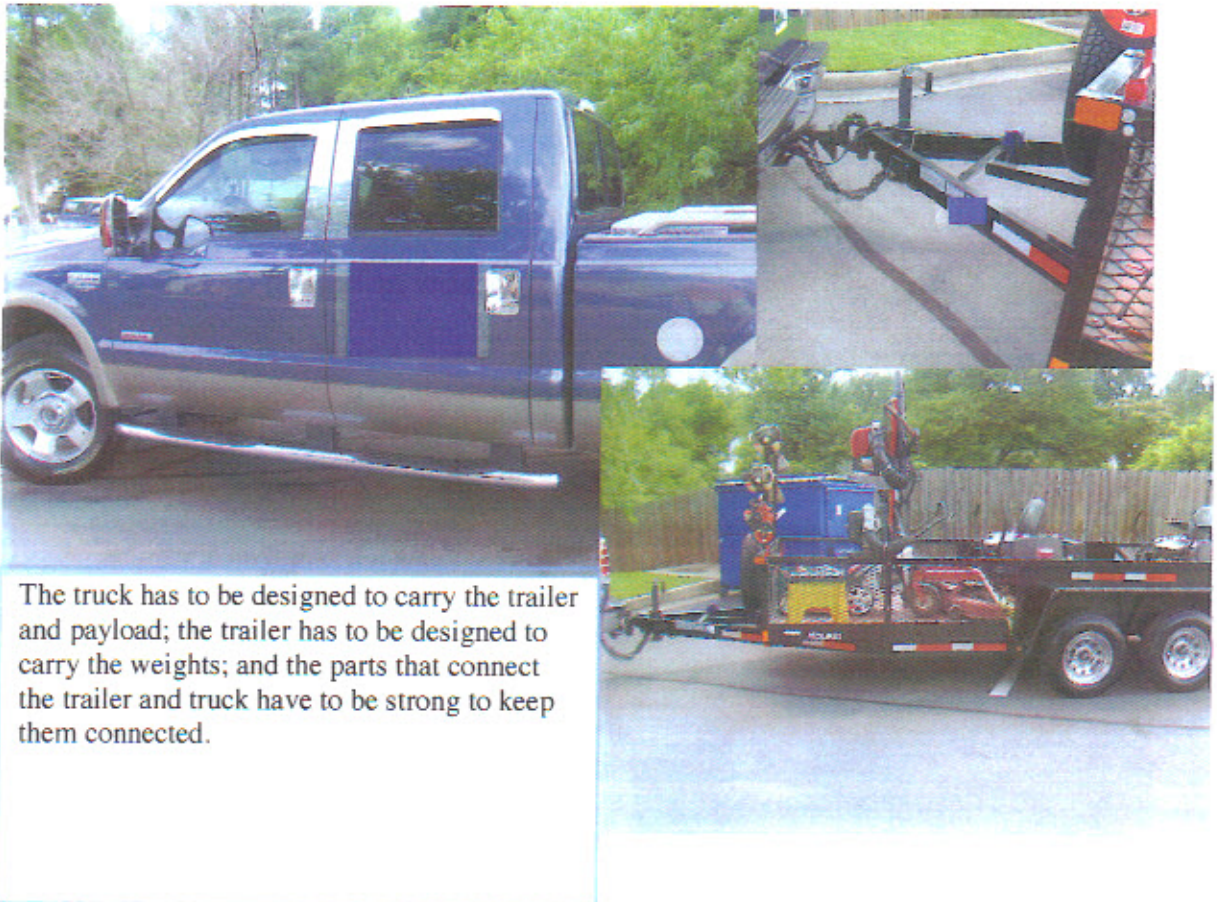
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Disclaimer

Coupling a trailer to a truck is analogous to building an office, home, or shop. A safe and functional building doesn't materialize by luck alone; it happens when there is a detailed set of plans that match the structure with dozens of individually-rated systems such as heating, cooling, electrical, and plumbing. It then takes competent builders and craftsmen to follow those blueprints to ensure that the sum of the parts work together in the new building.

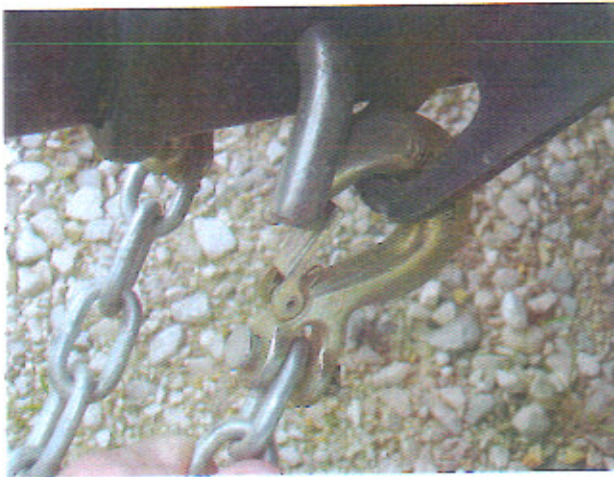


The truck has to be designed to carry the trailer and payload; the trailer has to be designed to carry the weights; and the parts that connect the trailer and truck have to be strong to keep them connected.

A truck and trailer combination has thousands of individual parts working to keep the truck moving and the trailer operating. Truck and trailer designers develop a mechanical and electrical blueprint that require parts which meet or exceed a very exact set of specifications.

Each part must work in concert with other parts to allow the truck and trailer to efficiently and safely operate on and off highways.

Most often, we incorrectly consider the trailer and the truck separately in most of our situations when we connect the two together for use on the job or at home. Actually, connectors such as hitches, inserts, balls, and chains are purposefully attached to meld two independently designed systems into a single 'super vehicle'. The person linking the truck and trailer with the



connectors must understand how all the parts fit together so the truck can pull the trailer safely, just like the architect must specify correctly rated systems in a building.

Transportation accidents provide clear and convincing evidence that undersized or mismatched components can lead to significant mishaps with disastrous

consequences to human life and the environment. The purpose of this publication, *Truck, Trailer, and Hitch Components: Making Sure the Numbers Add Up*, is to guide the reader in understanding how to critically analyze the ratings of their 'super vehicles' to

determine if the components is properly matched or to pinpoint deficiencies which need remediation.



Using Your Eyes Leaves You Blind to the Facts

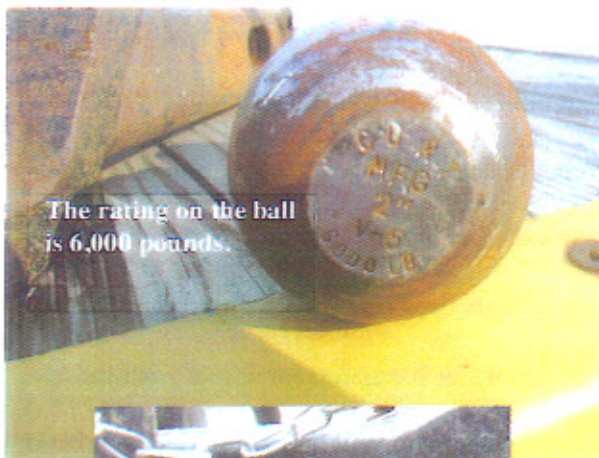
Can you imagine if buildings were constructed with the installer telling the job site foreman, "I think this cooling unit is big enough and will work" without having looked at the exact cooling output of the air conditioner. It might work this time like it did at the previous job site. But at other times, the same unit might be considerably undersized and cannot keep the building cool in the middle of the summer, or is overrated for a smaller building and incurs

unnecessary capital and operating costs. Each make and model of air conditioner has a set of performance ratings used to match the right unit to the heat load and volume of air to be cooled.

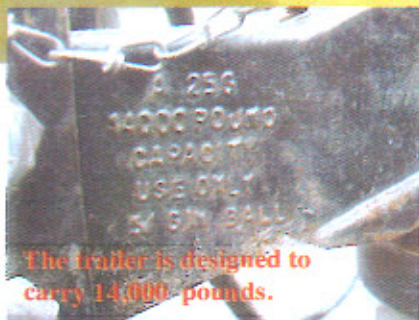
It's really no different with trucks, trailers, and connectors: Several 'invisible' ratings must be of the appropriate capacity so

as to fit together into a safe and cohesive unit. Many of those ratings are found stamped or tagged on the equipment or are written in the owner's manual. Others,

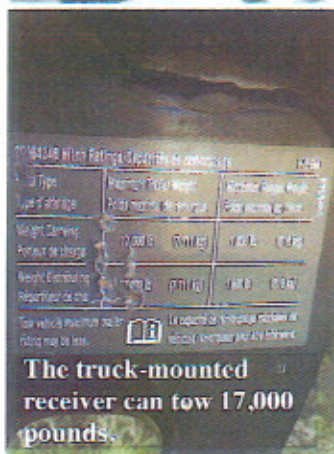
such as the actual weights of the loads carried in the truck bed or on the trailer, will have to be determined by weighing the truck and trailer both empty and loaded.



The rating on the ball is 6,000 pounds.



The trailer is designed to carry 14,000 pounds.



The truck-mounted receiver can tow 17,000 pounds.

Can you see the problem if these three components were assembled together? The amount that could be towed would be based on the 6,000 pound ball, not what the trailer or hitch are rated for.

The bottom line is that you cannot accurately gauge the adequacy and safety of a truck, trailer, or connector based on the 'eye' test. With a little time devoted to understanding and examining ratings, much of this mystery of the ratings can be dispelled and actually put to use.

A Lot is Riding on the Ratings

Anyone managing a farm or business knows there are never enough hours in the day to get the work done. Some may question why they should take time away from an already overcommitted work schedule to conduct a review of the ratings of their 'super vehicles'. It's a good question to ask.

A few of the more important reasons why a ratings review of the 'super vehicle' should take on a higher priority include the following:



- It allows a detailed snapshot of the ratings associated with the truck, trailer, and connectors. It will give you a better understanding of what the 'super vehicle' can do, and more importantly, what it cannot do. You will learn which trucks and trailers

not to combine; equipment that must be retrofitted; parts that need to be scrapped; and which trailers have more capacity than you thought.

- You don't want to send employees out with faulty equipment that could cause a serious or fatal



traffic accident. With employees being our most valuable resource, losing a seasoned employee means being without those skills for an extended period of time or forever. And you don't want to hurt or kill an innocent party.



You want to make sure when a collision reconstructionist is asked to recreate the accident, they will not report the cause of the accident was an undersized or worn out component from the truck, trailer and connector.

While insurance is a contract that binds one party to another, it's worth pointing out all insurance policies have statements that say the policy will not cover illegal acts. It's important to consider whether using a vehicle with underrated components is an illegal activity.

For instance, if an undersized truck is pushed through a stop sign by an



overloaded trailer into another car, is the insurance legally obligated to cover the cost of the accident, pending lawsuits, and judgments awarded by jurors?

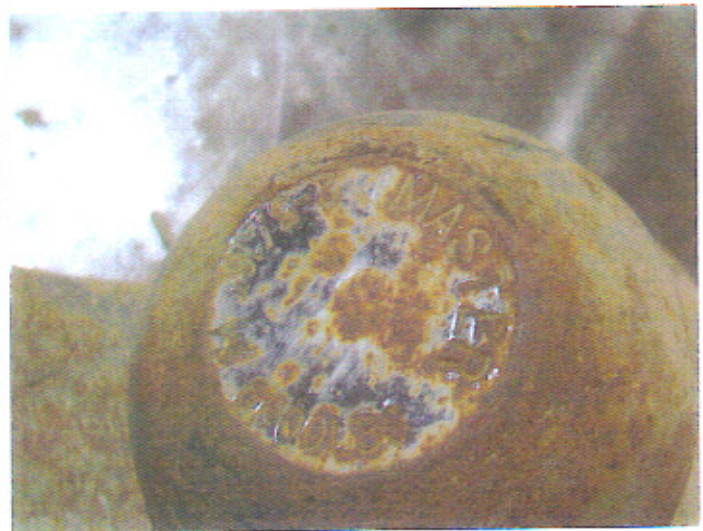
- While most accidents are preventable, they are still common enough to expose you to liability. Your attorney is always better able to defend your actions in a legal claim when you have documents that show your equipment was



being operated safely and within the manufacturer's guidelines. Even if you are guilty of causing the accident, your legal team can argue that the accident was not based on your negligence or a willful disregard for public safety, and that you made a good faith effort to prevent it. Winning such an argument is important when a jury is considering how much to compensate accident victims for the injuries caused by one of your trucks or trailers.



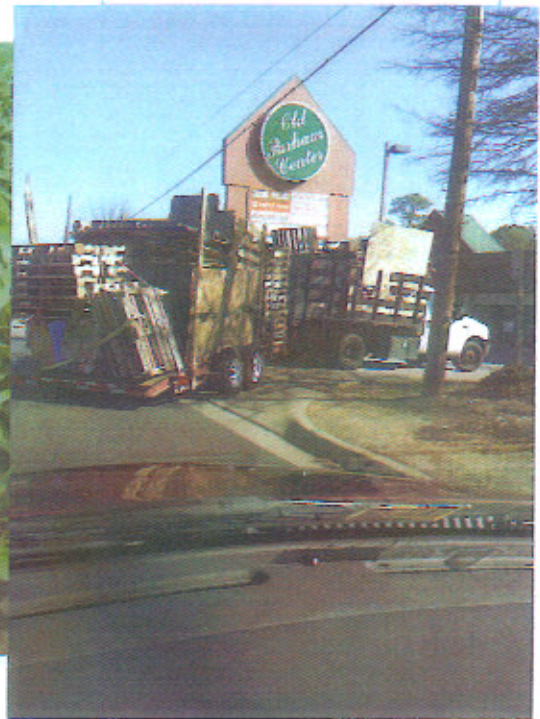
- Tags attached to equipment will be damaged or fall off, information stamped into metal over time will wear away, or owner's manuals will become lost. To capture important information before it is lost, consider making a permanent record of the ratings and weights as suggested later on in this publication.



This is not by any stretch of the imagination a complete list of compelling reasons why you should make checking the ratings of the equipment one of your highest priorities in the

upcoming months. It's simply that there are damning, damaging, and serious repercussions from continuing to operate these 'super vehicles' without knowing and understanding the ratings.

It's difficult enough to keep a single vehicle operating safely. Adding a trailer to a truck without understanding how things work together creates serious safety issues for the public.



Moving Beyond the 'New Smell' of A Truck

Think about the last time you bought a new truck or trailer. You found the make and



model you wanted at a dealer's lot, 'kicked' the tires,

walked around the truck, and took a test drive.

With the trailer, you liked the length, the double

axles, and the reputation of the dealer. Both the

new truck and trailer passed the 'eye test'.

But trucks and trailers are usually

purchased separately without giving much thought

to whether they will work well together to haul the

loads you are accustomed to towing. Without

looking at the ratings, did you really purchase a truck and trailer that maximize the capabilities of



both and do not overload either?

Will the truck have to work at its

upper limits to pull the trailer and

load, meaning it will not last as

long due to heavy use? Is the

braking system and weight of the

truck strong enough to stop your

fully loaded trailers? These are

important questions that cannot be

answered by merely taking a test drive, being impressed with the comfortable ride, and

appreciating all of the amenities that come with a new truck.

Obviously, you don't want to spend more than necessary for excess towing and payload capabilities for a truck or trailer that you will never use. Wasting money is one thing, but finding out after the fact that the truck is undersized for the daily tasks it is expected to perform. It's



money wasted in the first example, and dangerous operation in the second.

Consider how you would answer these two questions: First, "Is a 1/2 ton or 3/4 ton truck better equipped to pull a heavier trailer and payload?" Second, "Does the make and model of the truck such as Dodge Dakota, F150, Silverado

2500 have meaning?"

Brand names of vehicles are certainly important to the manufacturer, dealer, and those who are in the market for a replacement truck. However, the make (e.g., Ford) or model number (e.g., F150, F250, F350) provides little information in making a determination of the suitability of a truck to haul and tow. While we might think a 3/4 ton could tow more than a 1/2 ton truck or a model 2500 could tow less than a model 3500 truck, the truth is that those numbers don't really

mean much.



In many respects, every truck is uniquely built and equipped even if they carry the same designation (e.g., Chevrolet Silverado 2500).

Not every Silverado 2500 is built exactly the same. In fact, each manufactured truck is part of

a larger series, meaning that two different Chevrolet Silverado 2500 trucks may be able to tow or haul considerably different weights, even though they look exactly the same.

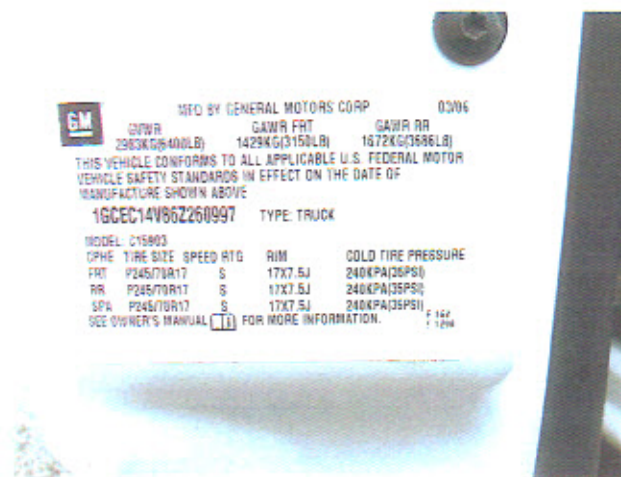
In truth, how much payload a truck can carry or tow cannot be defined by simple words, brands, or even numbers. Using, for example, the Dodge Ram 1500, 2500, or 3500 designations as the sole criteria for judging the strength of that truck to tow your trailers makes that a risky purchase at best.

Three important considerations have to do with weight:	C-3500 (2WD)		
• the weight of the trailer;	Engine (Trans.)	Axle Ratio	Max. Trailer Wt.
• the weight of the trailer tongue	5.0L (Auto.)	3.42	5,500 lbs. (2 497 kg)
• and the weight on your vehicle's tires.		3.73	6,500 lbs. (2 951 kg)
Weight of the Trailer	5.0L (Manual)	3.42	3,000 lbs. (1 362 kg)
How heavy can a trailer safely be?		3.73	4,000 lbs. (1 800 kg)
It depends on how you plan to use your rig. For example, speed, altitude, road grades, outside temperature and how much your vehicle is used to pull a trailer are all important. And, it can also depend on any special equipment that you have on your vehicle.	5.7L	3.42	6,000 lbs. (2 724 kg)
Use one of the following charts to determine how much your vehicle can weigh, based upon your vehicle model and options.		3.73	7,000 lbs. (3 178 kg)
Maximum trailer weight is calculated assuming the driver and one passenger are in the tow vehicle and it has all the required trailing equipment. The weight of additional optional equipment, passengers and cargo in the tow vehicle must be subtracted from the maximum trailer weight.	6.5L Diesel	3.42	6,500 lbs. (2 951 kg)
Above the 2,000 lbs. (908 kg) trailer rating, the engine oil cooler is required on C/K-2500 models with gas engines. Refer to the Trailering Guide for oil cooler recommendations.		3.73	7,500 lbs. (3 405 kg)
		4.10	8,500 lbs. (3 859 kg)
	7.4L	3.73	9,000 lbs. (4 086 kg)
		4.10	11,000 lbs.* (4 994 kg)
	*Fifth wheel hitch rating; weight distributing hitch rating is limited to 10,000 lbs. (4 540 kg).		

The capability of a truck to haul and tow is directly related to the spring ratings, axle ratio, engine size, engine type (gas, diesel), transmission, frame strength, tire size, and brakes all of which can be drastically different within and among a

series of trucks such as the F150 and F250. Some might find it hard to believe that trucks designated as half-tons can have more towing power than those designated as three-quarter ton trucks. It all depends on the truck.

How much a truck can tow or a trailer can haul is a question of design. Automotive



engineers are calculating payloads and towing capacities based on the ratings of the components they put into a truck and trailer. This is why basing one's purchasing decision by 'kicking the tires'

and taking a test drive around the automotive dealership will tell you little about what you really need or should want to know about that specific truck.

Once you find the truck or trailer brand you think is priced within your budget and *possibly* sized to meet the needs of the business or farm, then take a step back before signing the contracts. Those few minutes should be used in making visible those invisible ratings to see if in fact the truck or trailer is strong enough or sized properly to deal with your operation.

What will you be hauling for your business or farm? Do you know your weights? Before purchasing a new truck or trailer, is it possible to obtain the weight and size of the items you will be hauling. "Utility" trailers, whether open or enclosed provide the owner flexibility when handling loads. However, just because something fits on a trailer doesn't mean the trailer is the correct size.



The truck has to be designed to safely move, stop, and control a trailer.



Bad things happen when
equipment are not
matched to one another.



PPP-92 can help you find many of the ratings that are talked about in this publication.

			
BALL 3,500	INSERT 5,000	RECEIVER 7,500	TRUCK 12,400
TRAILER			
GVWR 7,000	EMPTY WEIGHT 2,400	USABLE PAYLOAD 4,600	



Find the component which is the weakest link and base towing capacity from that. A truck and trailer may look large enough to get the job done. However, notice that the 20' trailer can only have 1,100 pounds loaded on it. Can you see why? While the truck can pull 12,400 pounds, the 3,500 pound ball has the lowest rating. Pulling a trailer that weights 2,400 pounds only leaves 1,110 pound load capacity. This is why it is important to know ratings.

'Super Vehicle' Consist of Truck, Trailer, and Connectors With Ratings

When pulling a trailer, you are actually creating one 'super vehicle' from three distinct systems. It's the ratings of the truck, trailer, and connectors that must be aligned



to create a single unit which can operate safely on the highway. Having those numbers in front of you will allow you to objectively compare and empirically contrast your 'super vehicle' to point out problems which could *potentially* lead to

missteps, miscues and mishaps.

Potentially means you have time to make assessments and modifications before something bad happens. By making some changes in your operation or equipment, you can turn those potential miscues and mishaps into unlikely events. It's just that simple!

- Gross Combined Vehicle Weight Rating**—This number represents the maximum total

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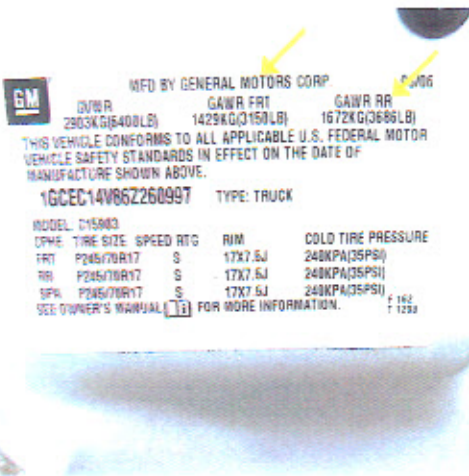
weight of the 'super vehicle' system. It includes the tow vehicle, trailer, passengers, load on the trailer, load on the tow vehicle, tools, fuel, etc. It is found in the owner's manual.



- **Curb Weight**—the weight of an empty truck with a full tank of fuel. You will have to weigh the truck to get this

number or call the dealer that you purchased the vehicle from to see if they have it.

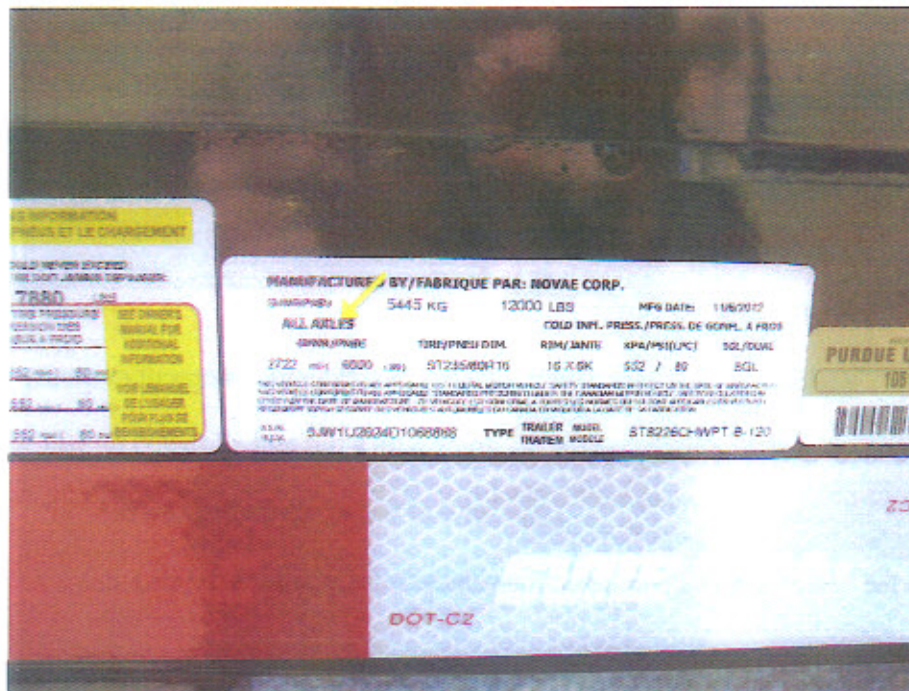
• Gross Axle Weight Rating (GAWR)—the maximum weight the axle is manufactured to carry. These ratings are found on the door jamb of the vehicle. In this



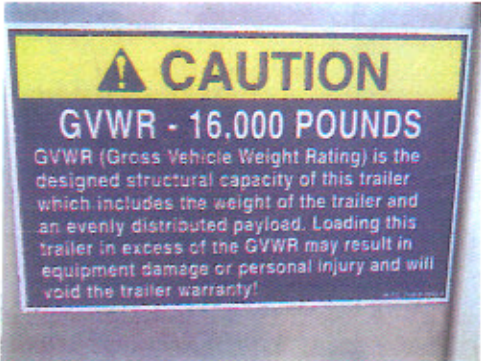
example, the front axle GAWR is 3,150 pounds and the rear is 3,686 pounds.

Most newer trailers will have the axle rating on a tag mounted near the tongue of the trailer. If the tag is missing or is not marked, you can check to see if a tag or stamp is on the

axle. In the photograph below, each axle on the trailer is rated for 6,000 pounds. If not, contact the manufacturer of the trailer to get the exact number.



• Gross Vehicle Weight Rating (GVWR)—The GVWR represents the maximum loaded weight of the individual truck or trailer as certified by the manufacturer; i.e., the maximum weight, including the vehicle itself, that the truck or trailer can safely carry. The GVWR takes into consideration the suspension, tires, frame, and overall manufactured design strength of the vehicle and trailer.



CAUTION
GVWR - 16,000 POUNDS
GVWR (Gross Vehicle Weight Rating) is the designed structural capacity of this trailer which includes the weight of the trailer and an evenly distributed payload. Loading this trailer in excess of the GVWR may result in equipment damage or personal injury and will void the trailer warranty!

GM INFO BY GENERAL MOTORS LLC 08/11

GVWR	GVWR FRT	GVWR RR
4300 KG	2177 KG	2812 KG
9500 LB	4800 LB	6200 LB

THIS VEHICLE CONFORMS TO ALL APPLICABLE U.S. FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

1GC1KKCG98F244732 TYPE: TRUCK
MODEL: K20743

KBFK	TIRE SIZE	SPEED RTG	PRM	COLD TIRE PRESSURE
FRT	LT285/70R17E	Q	17X7.5J	420KPA(60PSI)
RR	LT285/70R17E	Q	17X7.5J	520KPA(75PSI)
SPR	LT265/70R17E	Q	17X7.5J	650KPA(90PSI)

SEE OWNER'S MANUAL FOR MORE INFORMATION.

CORN PRO

DATE OF MANUFACTURE
DATE DE SA FABRICATION

MANUFACTURED BY:
FABRIQUE PAR: CORNELIUS MANUFACTURING INC.
ELMORA, IN.

MANUFACTURER'S AXLE RATING
CAPACITÉ DE L'ESSEU DU MANUFACTURIER: 5454 KG (12000 LBS)

V.I.N.: 4N00E1B24T038953

5454 KG (12000 LBS)

ESSEU (AXLE)	PNEU (GVWR)	PNEU (TIRE)	JANTE (RIM)	KPA (PSI) FROID/COLD	PNEU (GVWR) WITH LT285/85R16 (E)
AVANT FRONT	3721 KG (8200 LBS)	LT235/85R16(E)	16 X 6 K	550 KPA (80 PSI) Single	5454 KG (12000 LBS)
INT	KG				
ARRIÈRE REAR	2721 KG (6000 LBS)	LT235/85R16(E)	16 X 6 K	550 KPA (80 PSI) Single	


THIS VEHICLE CONFORMS TO ALL APPLICABLE STANDARDS PRESCRIBED UNDER THE CANADIAN MOTOR VEHICLE SAFETY REGULATIONS IN EFFECT ON THE DATE OF MANUFACTURE.

THIS VEHICLE CONFORMS TO ALL U.S. FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE.

CE VÉHICULE EST CONFORME À TOUTES LES NORMES QUI LUI SONT APPLICABLES EN VERTU DU RÈGLEMENT SUR LA SÉCURITÉ DES VÉHICULES AUTOMOBILES DU CANADA EN VIGUEUR À LA DATE DE SA FABRICATION.

TYPE OF VEHICLE: TRK
TYPE DE VÉHICULE: REM

- **Receiver Rating**— The receiver is mounted to the truck and should state the maximum trailer weight based on whether a weight carrying or weight distributing type of hitch is used. This tag is normally attached on the receiver. If it is not there, contact the



Hitch Type Type d'attelage	Maximum Trailer Weight Poids maximal de remorque	Maximum Tongue Weight Poids maximal au timon
Weight Carrying Porteur de charge	13 000 lb (5 897 kg)	1 500 lb (680 kg)
Weight Distributing Répartiteur de charge	13 000 lb (5 897 kg)	1 500 lb (680 kg)

* Vehicle maximum trailer weight applies here. / La capacité de remorquage maximale du véhicule remorqueur peut être inférieure.

truck manufacturer to see what the receiver is rated for.

- **Weight Carrying Hitch**



- **Weight Distributing Hitch**





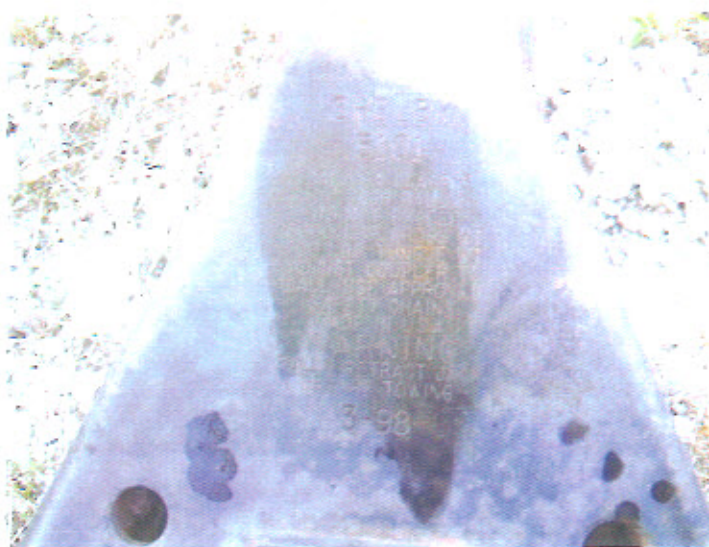
Insert Rating—The ratings on the insert may be on a tag or engraved into the steel. In both cases, these receivers are designed to pull up to 6,000 pounds.

Ball Hitch Rating—The ratings for the ball is etched into the top of the ball. In this case the 2" ball is built to pull 10,000. The 2 5/16 ball is built to pull up to 6,000 pounds. This illustrates that you cannot assume that a larger ball can tow more.



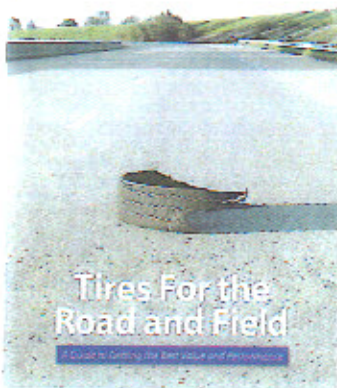


Coupler Rating—One of the more important ratings is the latch mechanism for the coupler. Sometimes the coupler is rated less than the GVWR of the trailer. Coupler ratings shown are 21,500 pounds and 6,000 pounds.

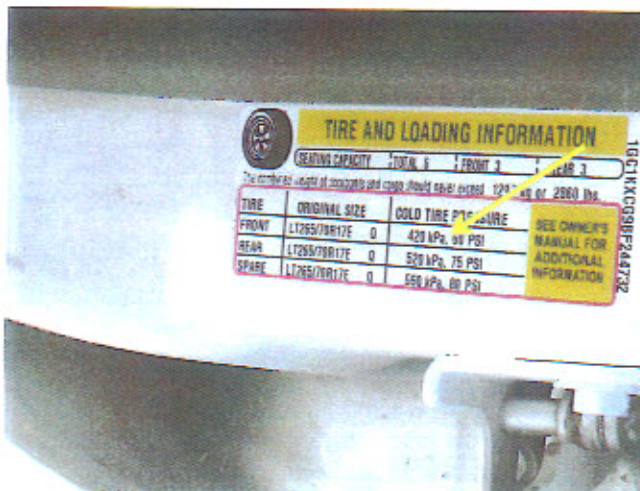




Tire Ratings: Tires are stamped with many ratings that are useful in calculating loads that can be carried by a truck or trailer. The tire on the left is a light truck tire that is 265 millimeters wide with a sidewall height that is 70% of the width. It is a radial that fits on a 17" rim. The load range E means it is equivalent to a 10 ply rating and can hold up to 80 pounds of pressure.



For detailed information about tires, download PPP-99 from http://www.ppp.purdue.edu/PPP_pubs.html





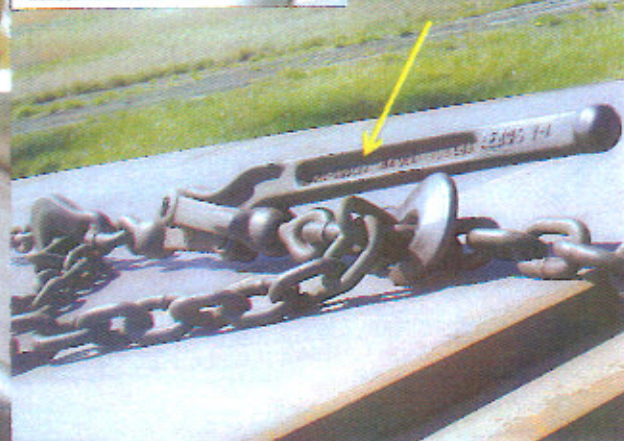
The chain, binder, and hook all have a rating which is normally stamped on them. For more information about ratings for straps and chains, PPP-75 and PPP-84 provides detailed information on the subject.

Hold it Down!
Fred O'Brien, Purdue Posthole Programs, et al.

W.I.
What's the weight of the load?
What's the weight of the hook?
What's the weight of the chain?
What's the weight of the binder?
What's the weight of the shackle?

CHAINS
Metric and U.S. units

Link	Grade	Weight	Strength	Grade	Weight	Strength
1/2"	50	2.20	11,000	1/2"	50	11,000
3/4"	50	3.30	16,500	3/4"	50	16,500
1"	50	4.40	22,000	1"	50	22,000
1 1/4"	50	6.60	33,000	1 1/4"	50	33,000
1 1/2"	50	8.80	44,000	1 1/2"	50	44,000
2"	50	13.20	66,000	2"	50	66,000
2 1/2"	50	16.50	82,500	2 1/2"	50	82,500
3"	50	22.00	110,000	3"	50	110,000



Conducting An Analyses of Your Trucks, Trailers, and Connectors



The first step is to fill in the information in the following five tables for each truck, trailer, and connectors.

A completed report for a 2011 Ford F150 towing a 2011 Featherlite trailer with a truck-mounted hitch pictured here

is described. As you can readily see, there are many ratings involved when towing a trailer with a truck that can be used to see if the 'super vehicle' is matched.

Component 1. Truck System

- Year—2011
- Make—Ford
- Model—F150
- Cab—supercab
- Bed—8 feet
- Wheelbase—163 inches
- Engine—5.0 liter
- Fuel—gas
- Transmission—5 speed automatic
- Gross axle weight rating (rear)—4,200 pounds
- Rear axle ratio—3.73
- Tire size—LT245/70R17E
- Tire loading rating—3,120 pound
- Tire pressure—55 to 60 psi
- GVWR—8,200 pounds
- Curb/empty weight—5,780 pound
- Load Capacity—2,420 pounds
- Towing capacity—9,600 pounds

Component 2. Connector System

Truck-Mounted Hitch

- Size—2 inch
- Hitch rating for weight carrying—5,000 pounds
- Hitch tongue weight—500 pounds
- Hitch rating for weight distribution hitch—10,500 pounds
- Insert size—2 inch
- Insert rating—5,000 pounds
- Ball size—2 inch
- Ball rating—5,000
- Coupler size—2 inch
- Coupler rating—5,000 pounds
- Coupler tongue weight rating—not indicated
- Safety chain grade—43
- Safety chain size—0.25
- Safety chain breaking strength—
- Safety chain hook grade—unknown
- Safety chain hook—grade 30, 1/4 diameter

Gooseneck Hitch System

- Not available

Component 3. Trailer System

- Year—2011
- Brand—Featherlite
- Model—6.7 x 10 feet
- Type—conventional
- Electric Emergency Brake—none
- Axles—single
- Axle rating—3,500 pounds
- Single/dual tires—single
- GVWR—2,990 pounds
- Curb weight—1,590 pounds
- Payload weight—1,400 pounds
- Tire size—ST 205/75R15
- Tire loading rating—1,820
- Tire pressure—50 psi
- Chain rating—

Component 4. Combination System

- Combination Gross Vehicle Weight Rating—15,300 (from owner's manual)

Component 5. Actual Weights of Payloads

- Payload in truck: one person, no load in bed—180 pounds
- Actual load carried on trailer—Polaris ATV at 1,170 pounds

Example 1. An Evenly Matched Truck, Trailer, and Connectors

What Are the Ratings?

GVWR	2,990
Curb Weight	- 1,590
Max Payload Weight	1,400
Tire	1,820

GVWR	8,200
Curb Weight	- 5,780
Max Payload Weight	2,420
Towing	9,600
Tire	3,120
Rear axle	4,200

Hitch	5,000
Insert	5,000
Ball	5,000
Coupler	5,000
Chain	7,800

Load 1,170

What Do The Numbers Tell Us? The payload capacity was calculated at 2,420 pounds by subtracting the curb (empty) weight from the gross vehicle weight rating (GVWR). GVWR is the maximum allowable weight of a truck including its own weight, passengers, and payload. Since the only load we are carrying is a single driver, the GVWR, the tires, or the rear axle ratings are not exceeded. The trailer tires have an additive rating of 3,640 pounds and if properly inflated and maintained, this is more than sufficient for the designed GVWR of the trailer.

The truck is rated to tow a trailer not to exceed 9,600 pounds. The empty trailer weighed 1,590 pounds which means it is built to carry a payload not to exceed 1,400 pounds. The weight of the trailer and load added together accounts for a 2,760 pound payload which is well below the 9,600 pounds the truck is designed to tow. However, it is only 230 pounds short of the 2,990 pound GVWR of the trailer.

The tongue weight of the loaded trailer was 330 pounds. Most truck and trailer manufacturers recommend 10% to 15% of the total trailer weight plus its load to be transferred to the weight carrying hitch of the truck. You don't want to overload the rear GAWR nor the carrying capacity or tongue load ratings of the other components. In this case 10% to 15% of 2,790 pounds would be 279 to 418 pounds. The tongue weight in this example is within recommended limits.



General Example

Maximum Trailer: 12,000 pounds
Tongue Weight: 1,200 pounds
Percentage: 10%

Weight Distributing Bars
Maximum Trailer: 15,000 pounds
Tongue Weight: 1,500 pounds
Percentage: 10%

Weight Carrying Hitch
Maximum Trailer: 8,000 pounds
Tongue Weight: 800 pounds
Percentage: 10%

The lowest rating for the connectors was 5,000 pounds. This means that the hitch, insert, ball, chain, and trailer coupler are well within their specifications to safely tow the weight of the 2,760 pound trailer.



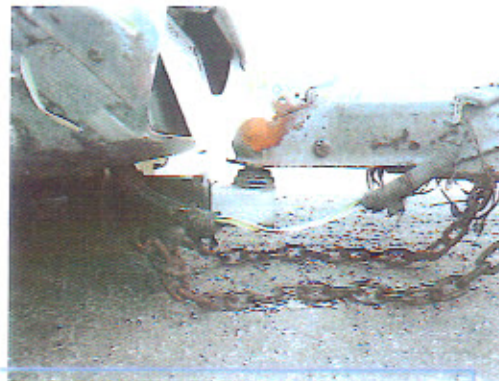
The last analyses is to compare the weight of the 'super vehicle' to the Combined Gross Vehicle Weight Rating (CGVWR) listed in the truck manual. The CGVWR is a rating designed to address how much total weight is the truck is designed to carry, pull, and stop. For this Ford truck, the owner's manual indicates that the CGVWR is 15,300 pounds. To calculate the total weight of the 'super vehicle', you will need to add up the following weights to come up with a total.

• The curb (empty) weight of the truck	5,780
• Payload in the truck bed	0
• The weight of one person	200
• The empty weight of the trailer	1,590
• The payload on the trailer	<u>1,170</u>
Actual Combined Gross Vehicle Weight Rating	8,740 pounds

The total weight of the 'super vehicle' is 8,740 pounds, which is significantly less than the 15,300 pound CGVWR listed in the truck manual. The conclusion is that the truck is equipped to safety handle, brake, and steer itself and the trailer. It also means that the truck has built in capacity to carry payloads in the bed and pull a heavier trailer. It's

also important to note the truck is not working at the upper range of its capacity which means it should last longer with proper maintenance.

What Do We Need to Do? In this specific example, there is no deficiency noted. The more salient point is that the GVWR of the Featherlite trailer *is nearly* maxed out carrying the Polaris ATV. Operators must be careful about carrying tools or other supplies on the trailer. Operators also need to be aware tools and other supplies would be best carried in the truck bed.



Too much tongue weight placed on a ball can lead to poor steering and breaking. You can see that the front of van pulling this trailer is pushed up takes the weight off of the front steer tires making driving more dangerous.

4

Payload on Trailer: Ford tractor weighs 3,000 pounds and wheat drill at 2,000 pounds

Payload in truck bed: supplies at 400 pounds

What Do The Numbers Tell Us? This Chevy truck has an empty payload of 2,745 pounds. A payload of 400 pounds plus a driver at 200 pounds is well within the GVWR. The Chevy 2500 truck with its 7,000 pound towing rating is exceeded by the 7,900 (empty CornPro trailer plus the 5,000 payload).

The truck-mounted receiver hitch is rated at 5,000 pounds as a weight carrying hitch which means that the empty trailer, the tractor and wheat drill at 7,900 pounds

exceeds the rated capacity of the truck mounted hitch unless the hitch components are changed.

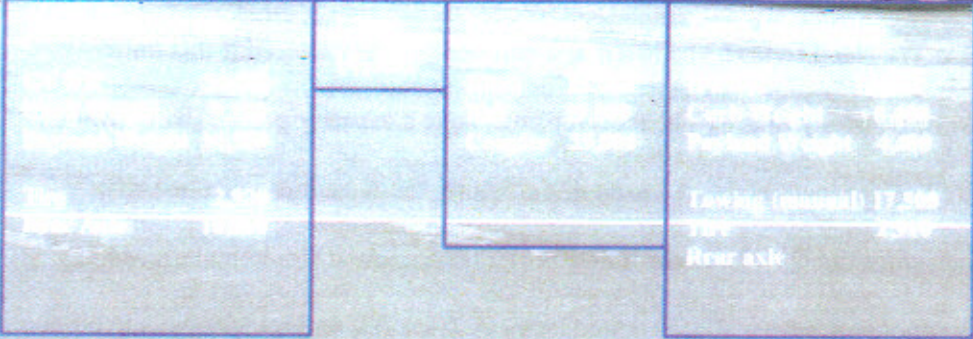
There are three different insert and ball combinations found in the bed of the truck. Combination A has an insert and ball rated at 5,000 pounds which means they and C are underrated because the ball is rated at 3,500 pounds. Combination B is underrated also.

This example is for a weight carrying application. The towing capacity of the truck and receiver hitch has been exceeded as it is currently outfitted.

The Combined Gross Vehicle Weight Rating is calculated by adding the weight of the empty truck (5,855 pounds) + payload weight (400 pounds) + driver (200 pounds) + empty trailer weight (2,100 pounds) + load on trailer (5,000 pounds) = 13,555 pounds. The truck has a CGVWR listed at 17,500 pounds indicating that the truck is equipped to handle the weights being hauled and towed if the proper components are used.

What Do We Need to Do? The insert and ball needs to be replaced if this trailer and load are the heaviest it will tow. The receiver must have a capacity greater than 7,900 pounds. And if a heavier load might be towed in the future, the capacities must be higher yet. For example, since the GVWR of the trailer is 10,000 pounds, it would make sense to have all hitch components have a 10,000 pound capacity if the full trailer capacity is to be utilized.

The Facts. A 2006 Ford F350 pulling a LoadMax trailer carrying a 7130 John Deere tractor with loader.



What Do The Numbers Tell Us? The truck is rated to tow 17,500 pounds. With the curb weight of the trailer at 9,100 pounds plus the tractor at 14,450 pounds, the total load being pulled is 23,550 pounds. This means the load being pulled is 6,050 pounds over the towing capacity of the truck. The tractor on the trailer has nearly exhausted the payload capacity of the trailer. The hitch, ball, and coupler in the truck barely can accommodate the gooseneck trailer and tractor.

The CGVWR is calculated as the weight of the truck (8,600 pounds) + weight of the empty trailer (9,100 pounds) + truck payload (200 pound driver) + weight of trailer load (14,450 pounds) makes for a total weight of 32,350 pounds.

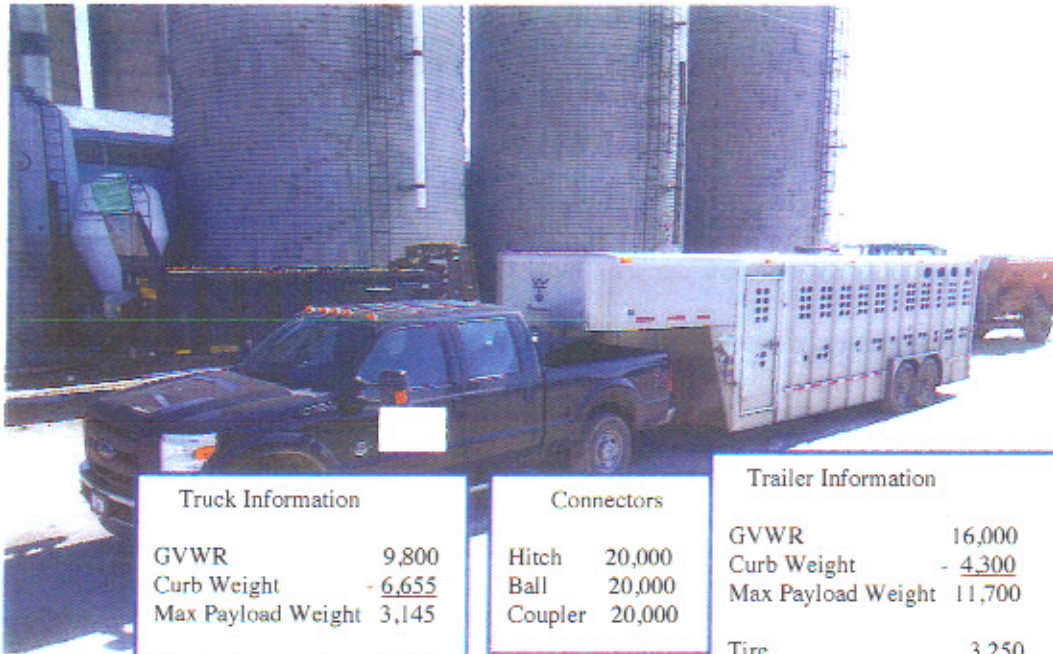
This Ford F350 Crew Cab has a CGVWR of 23,500 pounds. The current total weight as shown in this example is 32,350 pounds. This exceeds the CGVWR by 8,850 pounds.

Even though we do not know the gooseneck load on the truck, we can see that the combined capacity of the eight trailer tires is right at the limit. Thus even with the proper truck, attention must be given to the condition and inflation pressure of the trailer tires.

What Do We Need to Do? This is a dangerous situation! The truck is grossly undersized making braking, steering, and control of the truck a serious problem. Another truck needs to be hooked to this trailer and load. This is made more problematic in that the trailer and hitch components are being used near the maximum of their ratings. It would wise to have another trailer and hitch components that would be better matched to the load being carried by the trailer and towed by the truck. The bottom line is that a bigger truck is needed.

Example 4. Undersized Truck and Overloaded Trailer

The Facts. 2010 Ford 350 pulling 2010 Featherlite 8121 gooseneck livestock trailer.

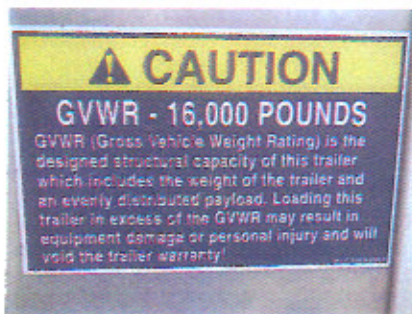


Truck Information	
GVWR	9,800
Curb Weight	- 6,655
Max Payload Weight	3,145
Towing (manual)	15,300
Tire	3,120
Rear axle	6,150

Connectors	
Hitch	20,000
Ball	20,000
Coupler	20,000

Trailer Information	
GVWR	16,000
Curb Weight	- 4,300
Max Payload Weight	11,700
Tire	3,250
14,400: 12 dairy cows each at 1,200 pounds	

What Do The Numbers Tell Us? The manual indicates that the maximum towing rating is 15,300 pounds. The total load being carried is 18,700 pounds which includes the trailer weighting (4,300 pounds) and the load at 12 dairy cows (14,400 pounds). The load being towed exceeds the maximum towing rating by 3,400 pounds. The hitch, ball, and coupler ratings at 20,000 pounds means they are adequate for keeping



the livestock trailer attached to the truck. The 14,400 pounds of payload on the trailer also exceeds the payload of 11,700.

The combined gross vehicle weight rating as established by the truck manufacturer is 19,000 pounds. The actual weight being carried is 25,555 pounds: the empty weight of the truck (6,655 pounds), empty weight of trailer (4,300 pounds), driver (200 pounds), truck payload (0 pounds), and trailer payload (14,400 pounds). This means that the CGVWR rating has been exceeded by 34%.

What Do We Need to Do? The easiest and safest but probably not practical fix is to limit the number of dairy cows to half of what is being carried. The issue is that both the trailer and truck are not rated to do the expected work. Having first checked the ratings, the owner would have purchased a larger truck and trailer.

Decision Making Spreadsheets

Three Excel spreadsheets were developed to help the operator determine if the vehicle can safely tow a trailer with or without a load, and are found at www.ppp.purdue.edu. The conventional hitch spreadsheet is for lightweight and medium weight drawbar type hookup with both weight carrying and weight distributing hitches. The gooseneck spreadsheet is for hookups using a gooseneck configuration and the fifth wheel is for fifth wheel configurations.

The operator can enter the information into the spreadsheet's corresponding entry boxes. The spreadsheet will then compare the information and display if the tow vehicle and trailer combination is safe to operate or what limits are exceeded.

When You Can't Find the Numbers

If you cannot find the specific information for a truck, the website at www.decode-this.com can provide most of the information you need such as GCWR, towing capacity, etc., provided you have the Vehicle Identification Number (VIN) and the vehicle has not been modified.



Vehicle Identification Number (VIN) on a truck dash.

Trailer manufacturers are frequently in business one day and gone the next. However, if you can determine the brand of trailer and the manufacturer is still in business, they may be able to help you determine the ratings of the trailer. You would need to provide the VIN to identify your specific trailer. If the trailer

manufacturer is out of business, but you have a valid registration, the GVWR may be noted on the registration.

Worn hitch components and missing labels should be replaced. Why guess when so much is at stake?

Safety chains and hooks without ratings are assumed to be grade 30 and capacity is then based on size.

Chain Link Diameter (inches)	Working Load Limit (pounds)				
	Unmarked or Grade 30	Grade 40	Grade 70	Grade 80	Grade 100
1/4	1,300	2,600	3,150	3,500	4,300
5/16	1,900	3,800	4,700	4,500	5,700
3/8	2,650	5,400	6,600	7,100	8,800
7/16	3,700	7,200	8,750	not available	
1/2	4,500	9,200	11,300	12,000	15,000
5/8	6,900	13,000	15,800	18,100	22,600



Not knowing the weight of a load is not an excuse. Commercial carriers and companies that ship items are all about weights. Obtaining the weight of a truck, trailer or a load can be

accomplished at a certified truck scale, grain elevator or fertilizer outlet.

Consider weighing the heaviest loads that the truck and trailer can carry. If you are within the various rating specifications, then any lighter load will also be within the

tolerance set by the truck, trailer, and connection manufacturers.

Just because it fits doesn't mean it works!

Determining Individual Numbers

- **Truck curb weight.** Empty the truck of all cargo and fill up the fuel tank. After parking the truck over the scale, exit the cab to get an accurate reading of the weight of the empty truck.



- **Trailer Curb Weight.** Drive the empty trailer over the scale and record the reading.





- **Load Weight.** Place the heaviest load including tools, supplies, and other items that will be carried with it on the trailer and reweigh the trailer. Subtracting the curb weight of the trailer from the total loaded weight will give you the load weight.



- **Tongue Weight.** Be sure scale does not have sloped ramps, or tongue weight will shift to trailer. Back the truck on the scale with only the tongue of the loaded trailer still on the scale. Take that reading. Subtract the weight of the truck from this reading to get your tongue weight.

Annual Truck and Trailer Inspections



Each 'super vehicle' should undergo an annual inspection using the criteria established by the Department of Transportation (DOT).

The form can be found at

www.fmcsa.dot.gov/documents/eta/part-396form6.pdf.

The annual inspection should be done even if you or your company is not regulated by DOT.

The purpose of the inspection is to find any problems that need to be repaired in order that accidents are prevented on the highway. In addition, doing an annual inspection will greatly assist your attorney in the event there is



an accident followed by the threat of a lawsuit.

However, the DOT walk-around inspection is required daily. In the morning, a walk-around is to



conduct a thorough visual inspection of the vehicle and trailer. At the end of the shift, a documented (written) inspection is required to list any defects noted during the day's work. Any defects are listed and if serious enough a mechanic should make the repairs before that truck or trailer is allowed to leave.

Homemade Equipment



This publication focused heavily on the use of ratings assigned by the manufacturer of the equipment. Homemade equipment used in connecting the truck to the trailer should never be used when pulling on the highway. Without

an actual rating, not to mention unknown quality of welds and materials, there is no way of knowing whether or not equipment will hold up under the stresses of highway use. It is dangerous and greatly increases your liability.



Conclusions—It's All About Weights and Ratings

Businesses and farms today use their trucks as rolling offices, well stocked and



equipped to take care of the jobs that day. The truck has connectivity back to the home base, computerized systems to access accounts, and carries a full complement of sprayers, mowers, fuel, pesticides, water, and fertilizers on a trailer. Today's trucks and trailers are nothing short of an

efficient office moving from site to site.



But the combination of the truck and trailer has serious implications—accidents involving the combination can have major repercussions. The question addressed in this publication was whether the components creating a

'super vehicle'—truck, trailer and connectors—have ratings that match to get the job done.

Being able to answer such questions as the capacity of the truck to tow a trailer loaded with spray equipment, whether the trailer can support heavy equipment or pesticide minibulks, or whether the connectors are properly rated to keep the truck and trailer attached are serious questions that need answering. We have provided a way in this



You don't want your farm or business to be the subject of an investigative reporter looking into an accident that involved your equipment.

publication to think about how to analyze individual ratings and how to look at the three components as a whole system.

The bottom line is that each major part on the truck and trailer has

been through a design, evaluation, and quality control process which defines what those parts can and can't do. Appreciate

that from the headlights on the front of the truck to the rear brake lights on the trailer, the 'super vehicle' is made up of a set of ratings which will determine the safety of the vehicle.



An accident caused when ratings are ignored can not only lead to injury (or worse), but expensive lawsuits that you will not have a chance of winning. Get ready to give your business or farm away.

If deemed grossly negligent or flagrant, a district attorney could decide to file criminal charges.



Acknowledgments

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