HEAVY EQUIPMENT VEHICLE COMBINATIONS
AND
TRANSPORT WEIGHT RESTRICTIONS
ON
OREGON STATE HIGHWAYS
AND
FOREST ROADS

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Introduction:

Various types and configurations of heavy equipment must be transported on forest roads in the support or various forest operations. These operations include logging, road building, oil, and mineral extraction. Transport vehicle configurations, gross vehicle weight (GVW), and wheel loading **are** of concern for five major reasons:

1. Dimensions of vehicle configurations for road geometry deign.
2. Transport of heavy equipment on existing transportation facilities.
3. Vehicle axle weights for aggregate and paved road surface design.
4. Legal haul weight limits for road surface management.
5. Cost of equipment transport for logging and road construction cost estimates.

All states have restrictions on the movement of heavy equipment on state and county highways. Federal agencies also have **similar** restrictions on forest roads. Vehicle weight regulations for the state of Oregon will be **used** as an example.

Heavy Equipment Transport Configuration Computations:

There are several low **boy** axle configurations. The general nomenclature is illustrated in Figure 1 and the various combinations **are** described in Figure **2.**

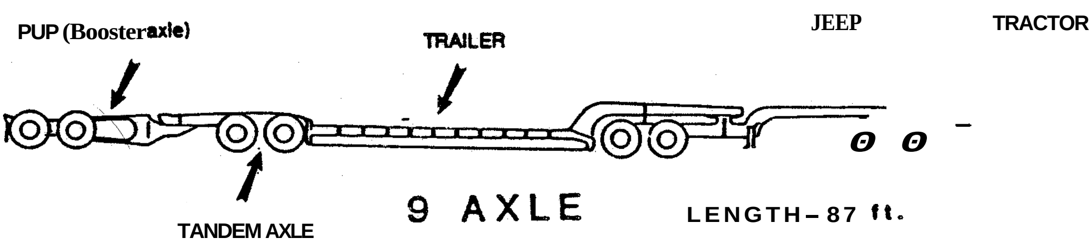

Figure **1. Low** boy Component Nomenclature

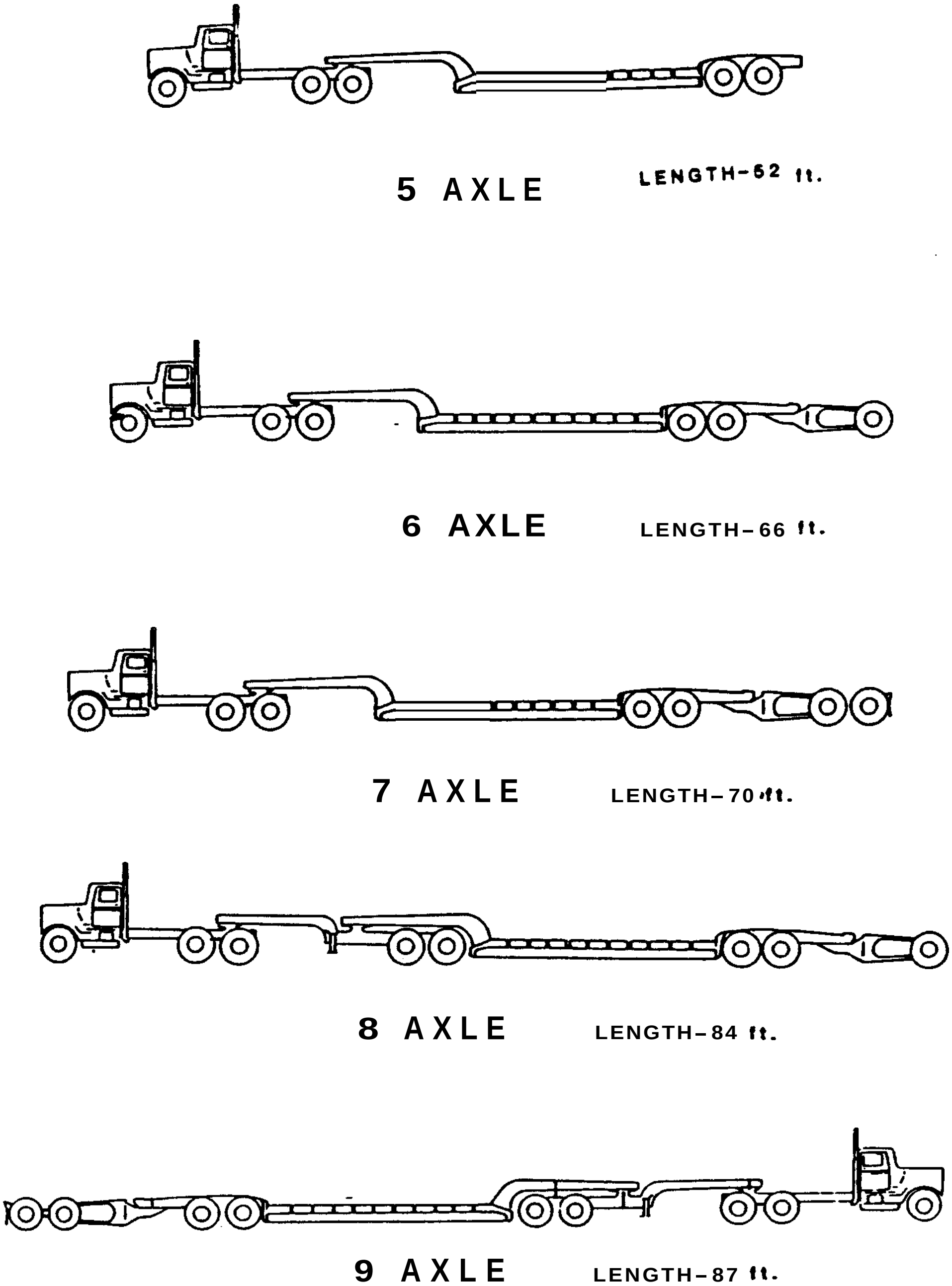

Figure **2.** **Low** boy Axle Combinations

Oregon state law requires a breakdown at a payload weight of 130,000 pounds, with certain exceptions. Further information can be obtained from the "Oregon State Department **of** Transportation Highway Division Vehicle Size and Weight Laws Handbook".

With an Oregon State **overload** haul permit, calculation for the low boy axle configurations are based on the weight limitations per axle in table **1.**

Table 1. Maximum GVW permit overload axle loads

12,000 lb. steering axle
21,000 lb. single axle
43,000 lb. tandem axle

The ***gross*** axle weight for a single axle load is less than one half that of a tandem axle. The reason for this is the forces of the tandem axle wheels on a pavement surfaces generate forces into the pavement structure between the dual tires that become neutral, and have no load bearing effect on the pavement structure. **This** force reduction is expressed **as** the difference between the weight limit of one tandem axle and a single axle, which is 500 lb. more allowable weight per axle on a tandem axle set.

The following information must be known in order to estimate a transport vehicle configuration used to transport a specific piece of heavy equipment :

1. Vehicle transport components.
2. Gross weight of vehicle transport components.
3. Maximum **gross** load **of** vehicle transport components.
4. **Gross** weight of equipment to be transported.

Example:

A heavy equipment transport company **owns** the following equipment in Table 2. The maximum GVW must be determined for each possible configuration. The **gross** transport component load is determined by adding the maximum **gross** overload rating per axle per component in a configuration. For example the tractor unit has one steering axle and one tandem axle **.** The steering axle can carry a maximum load **of** 12 kips and the tandem drivers 43 kips. The **gross** overload, or GVW, for **this** unit is 55 kips, column three in Table 2. The maximum weight of transport combinations and their maximum loads must be computed next. These are summarized in Table 3.

Table 2. Transport equipment

Equipment **Type**	Gross wt. **(kips)**	Max. **Gross** Load Weight (kips)
Tractor	22	55
Trailer (Low Boy)	20	43
Jeep (Tandem Axle)	**8**	43
Single Pup (Single Axle)	3.5	21
Double Pup (Tandem Axle)	5	43

Note: kip = 1,000 lb.

Table **3.** Payload Weights and Respective Number of Axles Required

(1) Transport Equipment Configuration	(2) Gross Transport Equipment **wt.** (kips)	(3) (GVW) (kips)	(4) Gross Load (kips) (3) - (2)
5 Axle	**42**	**98**	56
6 Axle	**45.5**	**119**	**73.5**
7 Axle	**47**	**141**	**94**
8 Axle	**53.5**	**162**	**108.5**
9 Axle	**55**	**184**	**128**

The transport vehicle configurations can be determined for any load to be transported with the equipment listed in Table **3.** The remaining information to be acquired **is** the gorss weight of the equipment to be transported. **This** information can be obtained from various sources, such as, equipment manufacturers, equipment sales companies, and reference books.

For example, a **D-8L** Cat tractor must be transported. The **gross** weight of a D-8L Cat with a straight dozer blade, fuel, and lub had a **gross** weight of **81,800** lb. (Ref. Caterpillar Performance Handbook, ed. **14,** pp **15.).** From Table **3** column **4,** a **six** axle transport vehicle can haul **73.5** kips load. This will not carry the **D-8L** legally. The seven axle configuration can carry a maximum legal overload weight of **94** kips. The **D-8L** must be transported in **this** configuration.

Certain types of equipment must be broken down to be legally transported. Large old growth yarders **,** rock crushing equipment, ***oil* rigs,** and **mining** equipment are in this category. The equipment break down and component weight must be known.

For example a Skagit **Bu-199** self-propelled yarder, rubber mounted, with a T-100 tower, must be broken down as follows. The yarder, jack pads, and front wheels must be removed. **A** goose neck is attached to the front of the undercarriage. The undercarriage and tower **are** transported with a tractor, tandem jeep, and tandem pup. When set up in **this** configuration the critical axles **are** the tandem set **on** the yarder undercarriage at **41.5** kips. The yarder is transported on a low boy. The number of axles required depend on the yarder weight and wether or not it carries lines and fuel during transport.

summary:

The information provided describes how to determine vehicle combinations required to transport heavy equipment in the state of Oregon. This information is required for determining equipment transport costs, transportation planning, road design, and transport operations.

Forest roads are often designed and constructed to accommodate highway legal log truck and low boy single trailer combinations (five axles). When proper coordination with harvest planners has not been accomplished, transport problems can occur.

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Problems that can occur from the above situation are: forest road curve geometry and asphalt paved or aggregate surfaced roads are designed for the maximum dimensions and legal wheel loading of a five axle low boy or log truck, but forest harvest operations often require equipment to be transported that require larger transport vehicle combinations to meet the maximum legal axle load limit. When this occurs vehicle combinations with wheel bases longer than the design vehicles are often unable to negotiate the minimum radius horizontal curves designed for the five axle vehicle combination. In this situation equipment, such as self-propelled Skagit BU-199 yarder, must be assembled and driven on the forest road to the landing. In this configuration the yarder can have 90 kips on the from tandem axles and 120 kips on the rear tandem axles. Under adverse conditions these axle loads can cause serious damage to the road surface structure and significantly reduce the design service life of the surfacing.