Session 2
Paper(a)

TRUCK TYPES - AVAILABILITY AND SELECTION

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INTRODUCTION

Log cartage is an integral part of the process of transporting logs from the stump to the mill and makes a significant contribution to the landed cost of wood in the mill yard.

Trucking is an extremely capital intensive business and therefore utilisation of that asset is of primary importance to a profitable operation. Many external influences such as road conditions, mill demands and legislative changes will influence the efficiency of trucking.

A wide range of truck types are available for log cartage on the New Zealand market.

In selecting a truck for your operation both present and future conditions must be taken into account.

In this paper I have covered broadly the type of trucks that are available in New Zealand for logging. I have given no advice on what brand of truck to purchase, that decision is yours.

I have endeavoured to outline the process that one should go through in selecting the right truck combination for the particular job. Much of this paper is devoted to the process that my company went through to select what we believe is the best specification for our particular operation.

The Pan Pac operation utilises 470,000 tonnes of logs per year and these are transported to the mill with a fleet of 38 logging trucks of which 50% are company owned.

AVAILABILITY OF TRUCKS SUITABLE FOR LOGGING IN NEW ZEALAND

We in New Zealand can buy almost any brand of truck in the world - providing we are prepared to wait for it and can afford to pay for it.

Only a very small range of trucks suitable for logging are stocked in New Zealand and in most cases are required to be ordered from overseas. This is understandable when one considers the relatively small market due to our small population and small geographic area coupled to the high capital cost of trucks.

So delivery of your new truck can take anything from two to six months.

One could well be critical of the fact that for such a small population we have almost every brand of truck on the road. This must affect the standard of service and parts availability that some of particularly the small suppliers can provide.

During 1986 a total of 773 new Class 6 trucks were registered in New Zealand. These are trucks over 220kw and were represented by a total of 18 different makes. In comparison a 1987 listing of trucks in the same classification available in the United States lists 17 brands of truck.

Obviously not all of the 773 new trucks registered in 1986 were used for logging, but in my estimate at least 14 would be suitable for logging work.

Interestingly the top four sellers in New Zealand in 1986 were Mack (96) Isuzu (92) International (92) and Scania (71) representing 45% of the total sales.

TRUCK TYPES

There are two broad types of truck

- Conventional long nose truck

- Cabover engine truck

Almost all conventional long nosed trucks are of 6 x 4 configuration with the cabover either 6 X 4 or 8 X 4 axle configuration.

The load carrying capacity and road user charges differ between the 6 X 4 and 8 X 4 axles configuration as demonstrated below.

	6 X 4	8 X 4
Tare weight estimated	10.6	11.4
Maximum gross loading Class I	19.9	24.5
Pay load Class I	9.3	13.1
Road user charges per 1000km $	253.88	284.24
Road user charge per tonne/100km $	27.30	21.70

However a truck or tractor unit cannot carry logs on its own. Logging equipment, bolsters and trailers are needed to make up the rig. These items will contribute to approximately 20% of the on the road truck cost.

The major consideration for the design or type of logging rig required will depend on the following factors:-

(i) Size and weight of the payload to be trucked
(ii) Characterisation of the road
(iii) Loading and unloading facilities available.

SIZE AND WEIGHT OF THE PAYLOAD

Log length will determine whether a short log rig or long log rig is required.

Generally some short logs can be carried within a load of long logs. However a shorts truck and trailer are normally not capable of carting logs longer than 8 metres. There is a trend towards a greater amount of log segregation in the forest especially in pruned stands where logs are supplied to more than one customer and therefore logs are being prepared in shorter lengths. This trend has seen more predominant use of shorts units.

Our logging fleet at Pan Pac comprised all longs trucks from the start of our operations in 1973 till 1980. Shorts units were first introduced in 1980 due to a requirement to segregate sawlogs and pulplogs at the forest. Pulpwood was generally too short and of too greater volume to cart in long loads and four of our trucks were converted to shorts trucks.

Recent truck purchases have been shorts units which are proving more suitable for transporting young production thinnings that tend to sag on a standard longs unit and in some cases, the short length of logs required shortening up of the trailer pole thus limiting payload capacity.

We see a trend towards shorts units as opposed to longs units in the future, certainly in our region.

Complete versatility can be achieved with a "bailey-bridge" truck which is capable of carting either "shorts" or "longs" however increased tare weight and road user charges due to the inability to pig-a-back the trailer are disadvantages.

Although under the transport regulations there are limits on load dimension, generally the load size on a logging truck is limited by the legal axle loading requirements.

CHARACTERISTICS OF THE ROAD

The class of road will determine the best choice of axle configuration. A high percentage of cartage on Class II roads may justify a seven axle rig. A 6 X 4 truck with 3 axle trailer configuration has a reduced payload capacity on a Class II road of 1.7 tonnes over than on a Class I road.

The grade and construction of the road will also determine the mechanical specification of the truck especially in respect to power requirement and gear ratio selection.

Traction is limited if the empty trailer has to be towed behind the truck rather than pig-a-backed.

LOADING AND UNLOADING FACILITIES.

The size of the loader at the forest may influence the size and weight of the trailer to enable it to be off loaded from the truck. Lighter 2 axle trailers may assist but may not give optimum payload carrying capacity.

I have seen this problem overcome by having bolsters on the truck that fold forward to enable the trailer to be dragged off over the tail of the truck.

THE TRUCK SELECTION PROCESS

(a) Overall objective

To transport logs from the source of supply to their destination at the lowest possible cost and within legal constraints.

(b) The Economics will be influenced by

- Capital cost
- Pay load
- Utilisation/reliability
- Maintenance costs - parts and service
- Regional conditions
- Load types
- Fuel economy
- Tyre costs
- Road user charges
- Truck turn around time
- Changes in legislation.

(c) Truck specification

I will now outline the process that my company went through to evolve a logging truck specification for our cartage operation.

LOGGING TRUCK SPECIFICATION AND SELECTION AT PAN PAC

History - Pan Pac commenced operations in 1973 with a fleet of 20 of its own trucks and 12 owner operators.

Unlike today's situation at that time there was only a small range of trucks available suitable for the large scale operation that was to be established. It was decided that we should invest in premium North American type trucks that had a proven track record in logging both on and off highway. What we purchased was basically a standard North American logging truck being conventional Kenworths with 335hp Cummins engines, 13 speed road ranger gear box and 44,000lb SSHD Rockwell differentials. These were set up with single axle load sharing dolly and 2 axle trailer.

We were generally satisfied with the performance of these trucks and when the mill was expanded in 1976 a further 18 Kenworths with similar specifications were purchased, only this time with 350hp Cummins engines and set up with 2 axle trailers, i.e., 5 axle rigs.

We soon discovered the disadvantage in operating a large fleet of trucks all of the same age. As all trucks were covering similar annual distances component failure and overhauls coincided with each other. This was of particular concern as the second major purchase coincided with the first engine overhauls with the original trucks. This caused extreme loads on our vehicle workshop, parts etc. It also had a dramatic impact on truck availability. To make matters worse the second lot of trucks first overhaul coincided with the second overhaul of the original fleet. This was about 1979, in fact I remember being at the LIRA seminar on log transport and loading in Rotorua and receiving a phone call from our workshop saying that we had experienced 3 cam shaft failures

failures on that day.

We soon came to realise that we had to commence planning a truck replacement programme. Refer to Table 1.

We identified that our long term objective must be to achieve a constant average truck age by instigating an annual replacement programme. This would even out the maintenance load and truck utilisation ensuring that production targets and costs could be predicted and met. The range of trucks suitable for log cartage had increased by this time and with the effect of the oil shock significant design improvements had been incorporated into engine technology to produce more efficient engines.

Not only was there a bigger range of truck suppliers but also a greater choice of engine option and other mechanical components.

We made a decision to completely re-assess our truck specification and maximise the advantage available due to improvments in technology.

METHOD OF SELECTION

Cummins had a computer aided truck selection programme called Vehicle Mission Simulation VMS which we had then run for us using various specifications. This firstly involved recording a profile of our cartage route between the forest and the mill. Through the use of computer technology, VMS can accurately simulate the operation of a proposed vehicle by,

- Considering various alternatives, engines, transmissions, drive axles, cab configuration, trailer types etc., over a specified route which the client uses under his operating conditions.

This approach enables the client to quickly compare the results and select the best combination for his specific job. As paper (c) of this session will deal with truck simulation packages, I will not go into any further detail on this model.

Table 2 is a print out of the results using the truck specifications we had simulated in the model.

In the final analysis we had to make a decision on which was the best specification for our application.

Basically this decision required balancing fuel economy against durability and drivability.

It can be seen from the simulation results that the specification giving the best fuel economy required a high number of gear shifts.

I was not with 100% confidence that we decided to try the lower RPM Formula 350 Cummins engine which developed its maximum horespower at 1900RPM, coupled to a RT12515 roadranger gear box and running a 3.90 differential ratio.

TABLE 1

PROPOSED LOGGING TRUCK REPLACEMENT PROGRAMME

MAKE-UP OF FLEET	1980/81 YEAR I	1981/82 YEAR II	1982/83 YEAR III	1983/84 YEAR IV	1984/85 YEAR V	1985/86 YEAR VI	1986/87 YEAR VII	1987/88 YEAR VIII
1973 truck	9 @ 8yr	Nil	Nil	NIl	Nil			
1976 truck	7 @ 5yr	Nil	Nil	Nil	Nil			
1976 truck 3 axle trailer	8 @ 5yr	15 @ 6yr	10 @ 7yr	5 @ 8yr	Nil			
New trucks	9 new	9 new	5 new	5 new	5 new	5 new	5 new	5 new
New truck-1 yr		9 @ 1yr	9 @ 1yr	5 @ 1yr	5 @ 1yr	5 @ 1yr	5 @ 1yr	5 @ 1yr
= 2yr			9 @ 2yr	9 @ 2yr	5 @ 2yr	5 @ 2yr	5 @ 2yr	5 @ 2yr
" 3 yr				9 @ 3yr	9 @ 3yr	5 @ 3yr	5 @ 3yr	5 @ 3yr
" 4yr					9 @ 4yr	9 @ 4yr	5 @ 4yr	5 @ 4 yr
" 5 yr						4 @ 5yr	8 @ 5yr	5 @ 5yr
" 6yr								
No trucks	33	33	33	33	33	33	33	30
per tonne	$10.68	$10.48	$10.30	$10.12	$9.93	$9.75	$9.56	$9.38
per truck age	4.46	3 years	2.94	2.73	2.36	2.61	2.73	2.5

NOTE: Present average truck age = 5.58 years old (1979)

TABLE 2

SUMMARY OF VMS STUDY CONDUCTED BY CUMMINS DIESEL (AUSTRALIA).

VMS REFERENCE NUMBER.	2	3	4	5	6	7	8	9	6A (320 hp)
SPECIFICATION	350 2,100. RT12515 4.11	350 2,100 RT12515 4.33	F350 1,900 RT12513 3.90	F350 1,900 RTO12513 4.44	F350 1,900 RT12515 3.90	F350 1,900 RTO12515 4.88	400 2,100 RT12515 4.11	400 2,100 RT12515 4.33	350 1,900 RT12515 3.90
* LOADED AND EMPTY RANGITAIKI TO NAPIER RETURN									
G.C.W. (LBS)	92,400	92,400	92,400	92,400	92,400	92,400	92,400	92,400	92,400
DISTANCE (MILES)	139.9	139.9	139.9	139.9	139.9	139.9	139.9	139.9	139.9
DRIVING TIME (HRS)	3.61	3.63	3.71	3.74	3.67	3.66	3.54	3.53	3.72
IDLE TIME (MIN/SEC)	.34	.34	.34	.34	.34	.34	.34	.34	.34
AVG. SPEED (MPH)	38.8	38.6	37.7	37.4	38.2	38.2	39.6	39.6	37.6
FUEL USED (GAL) IMP.	27.6	26.2	26.6	26.4	25.7	25.8	27.9	26.5	25.7
U.S.	33.1	31.5	31.9	31.7	30.9	31.0	33.5	31.8	30.9
FUEL MILEAGE (MPG) IMP.	5.06	5.32	5.25	5.29	5.43	5.42	5.01	5.28	5.43
U.S.	4.22	4.44	4.38	4.41	4.53	4.52	4.18	4.40	4.53
TIME AT FULL THROTTLE %	33.1	34.7	35.7	35.8	36.5	36.2	28.1	29.5	38.9
AVG. ENGINE SPEED (REVS/MILE)	3,036	2,735	2,810	2,805	2,539	2,543	3,014	2,689	2,582
ENGINE LOAD FACTOR %	51	48	48	47	47	47	46	44	46
TOTAL GEAR SHIFTS	205	270	302	300	305	311	203	242	325
TIME ON BRAKES (MIN)	31.7	33.4	32.8	32.4	33.9	34.2	31.5	33.5	34.3
TIME OVER 2100/1900	37.6	5.9	9.7	11.5	8.2	9.1	41.0	6.3	7.7
TIME IN TOP GEAR 12	5.4	61.0	6.3	5.6	58.5	55.9	5.6	64.0	56.5
TIME IN TOP GEAR 11	64.7	10.3	56.3	56.1	11.4	13.9	67.1	9.7	12.2

RATING

FUEL ECONOMY	7	3	6	4	1	2	8	5	1
TIME LEAST AT FULL THROTTLE	3	4	5	6	8	7	1	2	9
LOWEST AVG. ENGINE SPEED	9	5	7	6	1	2	8	3	3
LOWEST ENGINE LOAD FACTOR	5	4	4	3	3	3	2	1	2
LOWEST GEAR SHIFTS	2	4	6	5	7	8	1	3	9

We had placed a high priority on fuel economy improvements. Our main concern was driver acceptance, however compared to the old small cam 350hp engines the F350 had better torque characteristics and a flatter horsepower curve.

At the same time we carried out an evaluation of other makes of engines and mechanical components.

In our fleet replacement plan we decided that we would replace 9 trucks as a first step in our overall replacement programme.

As I have said previously we had some reservations with the lower RPM engine option but were confident enough to incorporate that in three of the new trucks.

We were also keen to try an alternative make of engine and specified the remaining 6 trucks with Caterpillar 3406 engines rated at 380hp at 2100RPM.

One of our motivations in specifying Caterpillar was that our operation involves a high utilisation of the engine retarder due to the hilly nature of the road. We had previously had engine problems that we believed were at least partly due to the engine brake. Caterpillar offered a completely different approach to braking with their hydraulic brake saver which was incorporated into our truck specification.

We had previously run Roadranger RTO 12513 which is a direct control box with better suited ratios for the engines selection.

We had had virtually no problems with the Rockwell SSHD differentials fitted to our older trucks and so decided to incorporate these into our specification with ratios to suit the required maximum road speed and engine RPM. These were 3.90:1 in the case of 1900RPM engines and 4.11:1 for the 2100 RPM engines with both combination giving as close as possible the same road speeds.

Prior to making a final decision on truck purchase we invited quotations from all suppliers able to meet our broad specifications to enable an economic evaluation to be carried out. (This specification is attached Appendix I). Of a total seven suppliers that were able to meet our broad specification, four were able to offer our preferred engine choices.

In the final analysis we were able to purchase to our preferred specification without any premium in price over most other alternatives, including truck brands that did not supply a range of engine make options. We purchased White Road Boss trucks which completely conformed to our preferred specification and also offered the best deal out of all contenders.

EVALUATION OF NEW TRUCK SPECIFICATION

An analysis was carried out in 1984 after the first three years operation of the new trucks. In this analysis the two

different specification White trucks were compared with the old Kenworth fleet and the following were the results,

1 Fuel economy

During the 3 year period studied, savings were made in diesel consumption over the entire logging truck fleet of 4%. These savings were made by improved driver education and changes to radial-ply tyres. The following table shows diesel consumption for the three different specification trucks over the period expressed in litres per 100km.

Period	Caterpillar White	Cummins White	Cummins Kenworth	Fleet Total
1981/82	65.4	60.0	66.8	65.2
1982/83	62.6	57.1	65.5	63.6
1983/84	61.5	57.2	64.4	62.6
Average	63.2	58.2	65.0	63.8
Saving	6.0%	5.0%	3.6%	4.0%

The best fuel economy was with the 350HP 1900RPM Cummins powered White trucks. This improvement was due to the engine specification with maximum horsepower developed at 1900RPM as opposed to 2100RPM on the other trucks.

2 Total cost savings

Significant savings were made due to improved utilisation and maintenance cost savings.

The following table compares the performance and operating cost of the six Caterpillar powered White trucks with six randomly selected 1976 Kenworth trucks over the same period. Note there is 5 years age difference between the two types of truck.

Logging truck comparative costs 1.4.81 to 31.3.84

	White 1981	Kenworth 1976
Distance	1,793,400km	1,654,132km
Average tonnes/trip	25.26	26.09
Utilisation	90.3%	85.5%
Variable cost $/MT		
Diesel	3.124	3.087
Oil	0.091	0.081
Tyres	0.066	0.884
Road tax	1.420	1.388
Maintenance	1.617	4.151
Variable total	7.219	9.591
Fixed Cost $/MT	4.301	3.819
Total Cost $/MT	$11.52	$13.41

These results justified continuation of our logging truck replacement programme.

THE PRESENT TRUCK SPECIFICATION

We have made no significant changes in our truck specification since our first replacement trucks. We have however specified 1900RPM engines and have continued fuel consumption savings.

The following table shows diesel consumption for the year ended 31 March 1987 compared to those for year ended 31 March 1984 expressed in litres per 100km.

	White Truck Cat 3406 380HP @ 2100rpm	White Truck Cummins F350 350Hp @ 1900rpm	Kenworth Cummins Small cam 350hp @ 2100rpm	Mack Cat 3406B 350hp @ 1900rpm
1983/84	61.5	57.2	64.4	-
1986/87	59.0	56.9	59.0	54.0

The fleet total in 1986/87 was 56.1 litres/100km
Compared to 1983/84 at 62.6 litres/100km

This represents an annual diesel cost savings in 1987 dollars of $87,000 for the present Pan Pac fleet of 19 trucks.

In 1986 we once again reviewed our fleet specification requirement. We considered the proposed changes in the maximum allowable gross loading and the effect of that on our fleet.

We also considered our future likely wood suply, i.e., the roads and conditions likely to be encountered and the type of logs likely to be carted. An increase in gross vehicle loading would reduce the number of trucks required to move our present wood volume.

The likely move to forests closer to the mill would also increase the number of trips per day a truck can achieve and also reduce fleet size.

The last four trucks that were purchased were 8 x 4 twin steering axle cab-over tractor units with 3 axle trailer for short log cartage,

The increase tare weight of these trucks due to the additional axle has been partly offset by using high tensile steel and aluminium alloy in logging gear and trailer construction. These units are 130 kilograms heavier than our conventional 6 x 4 trucks with 3 axle trailers.

These new shorts trucks attract an annual road tax saving of approximately $10,000 compared to the 6 axle trucks and that more than offsets the reduced pay load due to increased tare weight. See diagram Appendix II.

CONCLUSION

Profitable log transport requires:-

* Good planning of overall system
  Including - logging
  loading
  log sorting
  unloading

* Can be affected by

Fuel prices/usage
Logging terrain/roads
Mill demands
Government regulations
Technical developments.

SPECIFICATION FOR LOGGING TRUCK TRACTOR UNIT

GENERAL

Truck will be used for transporting logs from Kaingaroa State Forest to the Whirinaki Mill site. The on highway distance being 430km per day and off highway 100km per day on a 2 trips per day basis. This is - approximately 19% off highway work. The truck must be capable of transporting an all up load of 22 tonnes and towing a trailer carrying 20 tonnes, i.e., total all up weight 42 tonnes. The maximum road speed required is 95km/hr.

CONFIGURATION

The attached sketch shows the two configurations required. In each case the wheel base should be designed to give even weight distribution in respect to legal axle loadings. Both configurations are 6 X 4.

Wheel base, frame length and approximate tare weight are to be specified.

ENGINE

- Turbo charged diesel
- Minimum 250kw
- Torque minimum - 1000 ft/lb
  maximum - 1250 ft/lb
- To be fitted with temperature control cooling fan
- To be rubber mounted to chassis
- Type and make of retardation available is to be specified.
- High rise air intake system must be specified.
- Exhaust stack must be vertical.

ELECTRICAL SYSTEM

- To be 12 volt running and 24 volt starting
- Make and type of alternator are to be specified
- To be provided with battery isolation.

TRANSMISSION

Fuller Roadranger RT12515 - 15 speed direct drive. Ratios to suit engine torque with maximum road speed of 95km/hr to suit maximum engine r.p.m.

CLUTCH

Type and make to be specified.

DRIVE LINES

Details to be specified

FRONT AXLE

Rockwell FF921TW 12,000lb or equivalent fitted with 16½" x 3½" brakes with limiting valve.

APPENDIX I(Continued)

REAR AXLE

Rockwell SSHD 44,000lb with ratio to suit engine and transmission.

SUSPENSION

Front 12,200lb minimum capacity
Rear - 44,000lb minimum capacity spring and radius arm type.

STEERING

Power steering of integral power box type - make and type to be specified.

BRAKE SYSTEM

Type and make to be specified.

COLLING SYSTEM

To suit engine

WHEELS AND TYRES

20" x 7.5" cast spoke rims
Front tyres 2 only Dunlop 1000 x 20 x 14 ply
Highway major with tubes
Rear tyres 8 only Dunlop 1000 x 20 x 12 ply
Cross rib with tubes
Spare rim and tyre 1 only Dunlop 1000 x 20 x 12 ply cross rib with tube.

CAB

Long log rig to be fitted with conventional type cab.
Shorts log rig to be fitted with forward control cab with hydraulic tilt mechanism.

Both types to be fully lined and insulated against heat, noise and vibration, full length floor mats, lockable doors with continuous weather seals. Windscreen to be lightly tinted heat absorbing safety glass.

Door glass and rear window to be tempered safety glass.
To be fitted with full interior fresh air heater and demister.

Drivers sea type and make to be specified.

The following instruments to be fitted all individually lit:-

Speedometer, Ammeter, Tachometer, fuel gauge, Pyrometer, oil pressure, watertemperature, air and reservoir pressure gauges, low air pressure, low oil temperature and high water temperature warning lights, low air warning buzzer, oil temperature sending and receiving units for transmission and tandem (three).

PAINTING

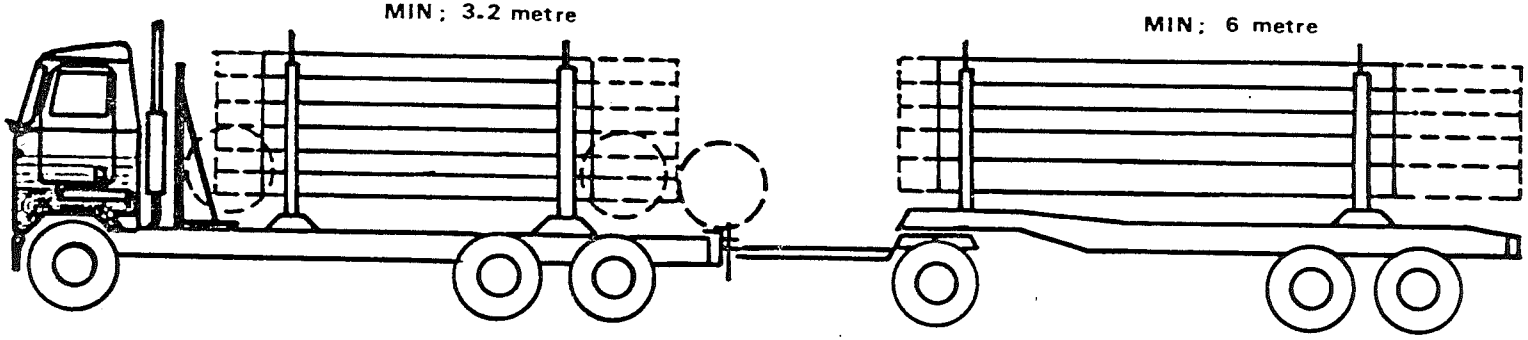
Painted and sign written to Pan Pac fleet colours.

STANDARD SHORTS TRUCK

LICENCES – TRUCK Type 6 ; TRAILER Type 37

Log Length MAX; 4.5 metre
MIN; 3.2 metre

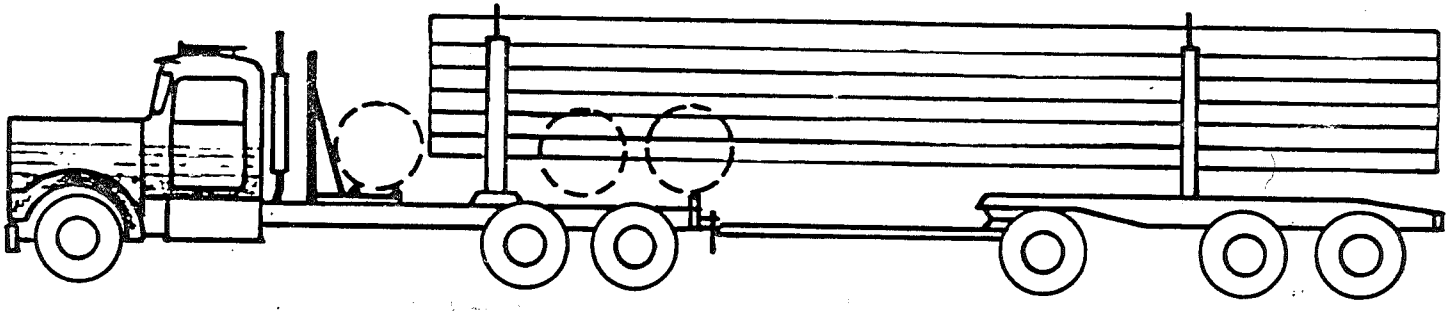
Log Length MAX; 8 metre
MIN; 6 metre



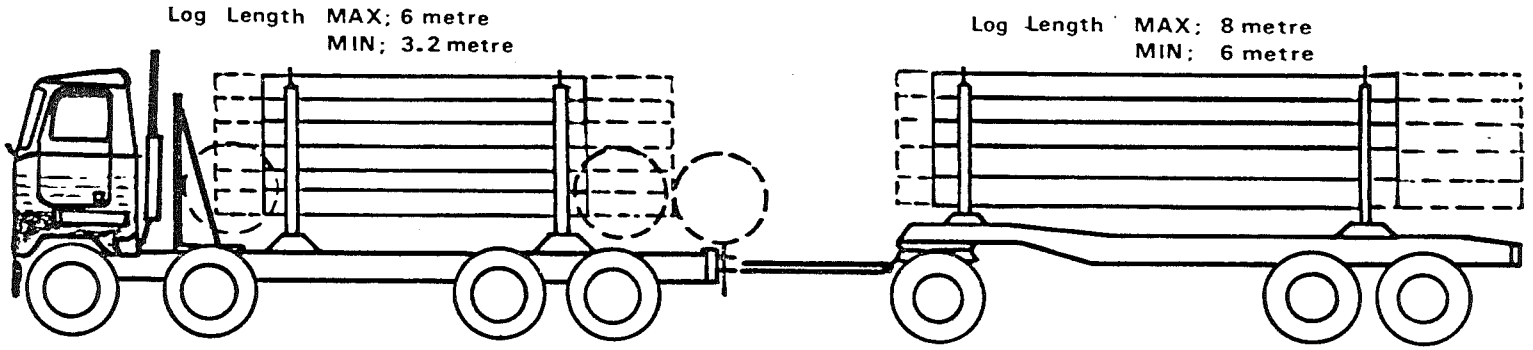
STANDARD LONG LOG TRUCK

LICENCES – TRUCK Type 6 ; TRAILER Type 33

Log Length MAX; 12.5 metre



STANDARD SHORTS TRUCK



STANDARD SHORTS TRUCK WITH EXTRA SHORT LOG TRAILER