

HIGHWAY/RAIL COMPATABILITY ISSUES:
INTERMODAL STRATEGY AND OPERATIONS
IN A CHANGING ENVIRONMENT

by

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Presented at the Second International Symposium
on Heavy Vehicle Weights and Dimensions
Kelowna, B.C.
June, 1989

INTRODUCTION

Truck-competitive traffic accounts for about a third of CN Rail's revenue. While much of that can still be handled in conventional railway equipment, a large part is moved in containers or trailers on the intermodal system. There are a number of physical constraints at the interface between the road unit and the rail system, which tend to be overlooked when changes are contemplated in highway weight and dimension regulations. Some of these can be very difficult to overcome, particularly when major capital items are involved. Both fixed railway assets and rolling stock tend to have long physical lives, which must usually be fully utilized if the investment is to make economic sense.

While this paper will not dwell on the past, CN has been in the modern intermodal business since the early 1950's. During that time we have seen trailer sizes move from 36 feet to 48 feet, and now 53 feet in western Canada. Pup sizes have increased from 20 feet to 31 feet - in fact some of the large trailers of thirty years ago would pass as pups today. Railway car fleets have been modified and juggled and replaced over the years to keep up with the changes to the road vehicles.

To put this in perspective, in 1959 CN owned 109 intermodal trailers, varying in length from 20 to 36 feet. Today we own or lease some 3500 trailers ranging in length from 40 to 48 feet (Table 1), and also have over 1600 containers for domestic service. To carry our own and other people's trailers in 1959, we operated 706 flatcars (and they really were flat in those days). Today our car fleet numbers over 2000 to handle trailers, plus another 2000 for containers (Table 2). The cars are far different and many of them cannot really be called flatcars any more - better to call them intermodal cars.

While we think we have generally been successful in adapting to the changing dimensions of road vehicles, and indeed to the accompanying changes in weights, the pace of change has increased in the last few years. The RTAC decision and the parallel ones in the individual provinces will not only result in a substantial upset in the relative economics of the two modes, but they will also create some new compatibility problems for our intermodal system.

Whether it will be economic for us to make all of the investments necessary to maintain compatibility remains to be seen. Certainly the fact that 53 foot trailers cannot operate in the east is of great importance to us since so much of the intermodal traffic runs between the east coast ports and Ontario. However, even the introduction of 31 foot units will cause us major headaches.

The following sections will review the problem areas and what CN is doing to address them, with particular focus on the latest cars designed to simultaneously provide good economics and flexibility.

WIDTH LIMITATIONS

Overall trailer width poses no real problem for the railway. The 102 inch box has been around for some time and fits readily on to the width of the railcar. However there were substantial difficulties when trailers with 102 inch tracks started showing up. Many of the older cars had guide rails on the deck designed to accommodate a 96 inch track. When a wider axle was placed on them, tire damage often resulted. CN still operates some 759 cars, about a third of the piggyback fleet, with the narrow guide rails, but generally we can match them with 96 inch axles.

The introduction of 102 inch wide containers will also necessitate some car modifications to accommodate the different location of tie-down points, but this could be regarded as a minor glitch compared with some of the other compatibility problems which have previously surfaced.

HEIGHT LIMITATIONS

With some exceptions, trailer height has not created any serious problems on CN. A trailer at the usual highway height limit of 13'6", placed on a conventional intermodal flatcar, gives an overall height above the rails of 17 feet, which is within the clearances of virtually all mainlines in Canada. The two exceptions are the Windsor-Detroit and Sarnia-Port Huron rail tunnels. Unfortunately, these are on two of the most important routes for piggyback movements, carrying traffic from Toronto and Montreal into Detroit and Chicago.

The height limit in the Windsor-Detroit tunnel is 15'8" at the normal width of a trailer, and for the Sarnia-Port Huron tunnel, the clearance is only 15 feet. The problem is therefore not susceptible to the usual expedient of lowering the rails a few inches! The possibility of enlarging the Windsor tunnel has been studied recently, but this would be an extremely expensive proposition and the economic returns would be questionable. At the moment, CN does not provide an intermodal service into Detroit, partly because of the difficulty in connecting with other railroads on the American side.

CN does operate intermodal trains through Sarnia into Chicago, using what we call "well-cars." These carry the trailers in a well between the rail wheels, on a platform only 18 inches above the rail. This compares with a platform height of 42 inches on a conventional flatcar. There are other advantages to this type of low-slung car, including an ability to carry greater loads due to the lower centre of gravity, and it now accounts for some 20 percent of our piggyback fleet, or over 400 cars.

The usual type of container movement is obviously free of any of the height constraints encountered with trailers. However when containers move in double-stack, as is now in vogue in the U.S., clearance problems are very much in evidence.

The economics of double-stack are entirely different in Canada compared with the United States, mainly because of the much lower traffic density and higher container weights north of the border. As a result, the Canadian railways have reviewed the prospects for double-stack rather cautiously. From CN's perspective, it is only now, as new car designs become available and terminals are replaced or modified, that the concept appears economically feasible in Canada. We have test-marketed a limited number of double-stack cars on the Vancouver-Toronto route, and will have double-stack capability on the new multi-purpose cars now being designed. However it is unlikely we shall ever see large numbers of solid trains of containers stacked two high in Canada. They are likely to operate mainly as a few cars in a train full of more conventional intermodal equipment.

A double-stack of 8'6" high containers on one of the cars now in service stands 18'7" above the rails. With a new car design this might be reduced to 18'4" while still retaining the ability to handle 48 or 49 feet containers. Lowering the platform any further on such long cars would result in loss of bottom clearance on vertical curves. This configuration could operate over all of CN's mainlines with comparatively minor changes to the infrastructure.

If a 9'6" container is stacked with an 8'6", giving a total height of 19'4", more serious clearance problems arise. This arrangement could operate east of Edmonton, but only if speed were reduced past certain obstructions to reduce sway. In the west, it could not be used without major track modifications. Even speed restrictions would probably be unacceptable for a regular service due to the traffic disruption they would cause.

To be completely flexible, a double-stack system should be able to handle two 9'6" high containers, with an overall height for an optimally designed car of 20'4". CN may provide adequate clearances for such a combination on the entire Vancouver-Halifax mainline, but this step will cost several tens of millions of dollars and will only be taken if the economics justify it.

LENGTH LIMITATIONS

CN's present car fleet is designed to handle trailers up to 48 feet long and pups up to 28 or 29 feet. Any step beyond 48 feet would have major implications for the existing cars. For example, only about 270 out of 2100 cars could handle 53 foot trailers at about the same cost as 48's. The rest are either too small overall to accommodate a 53 foot unit, or would lose the ability to carry two trailers if a 53 foot trailer were carried. Obviously in this latter case, the rate that could be charged would not be sufficient to offset the large drop in productivity of the car.

Likewise the 31 foot pups being introduced as a result of the RTAC decision cannot be economically handled on any of CN's existing equipment.

The difficulties of longer trailers really boil down to two types. Either the trailer is longer than the car, or it would cover two hitches instead of one. If the trailer overhangs the end of the car, it creates safety problems and may interfere with the lading on the next car. In the hustle and bustle of a real intermodal terminal, there is no time to treat such situations individually, and such an arrangement is considered unacceptable. In practice, any car with a deck length less than about 54 feet would be unsuitable for general use with 53 foot trailers, since the normal range of kingpin settings would result in a large percentage of trailers overhanging the end of the car.

About 900 cars, or 40 percent of our piggyback fleet, exceed a 54 foot deck length. However some 300 of those are designed to handle two pups per car, and their use for 53 foot trailers would undermine our ability to handle pup traffic. Another 325 are equipped for either two or three 40 to 48 foot trailers per car, and could handle 53's only by occupying the space required for two smaller trailers. This would be uneconomic.

The net result is that only some 270 cars of our present fleet would be able to handle 53 foot trailers economically. This represents 13 percent of the piggyback fleet, which is too small a fraction to ensure consistent, large volume movements of such trailers.

For 31 foot trailers, a similar situation exists. We have some 300 cars designed to handle two 28 foot trailers each. A 31 foot trailer would make it impossible to use the second hitch, thereby slashing the productivity of the car. It would, of course, be possible to move 31's on cars designed for longer trailers, but again the loss of productivity makes this a losing proposition. In effect, we have no cars in our current fleet capable of handling 31 foot trailers on a consistent and economic basis.

This is not to say that small numbers of 53 or 31 foot units cannot be moved by rail on an exception basis. If a suitable car is available and is not required for a more productive purpose such as moving two 45's or two 28's, then it may be practical to accept the larger vehicles. However CN cannot at the moment accomodate any large scale change over to these longer trailers.

WEIGHT LIMITATIONS

The main constraint on trailer weight for a traditional piggyback flatcar is the height of the centre of gravity of the combined car and trailer. This cannot be higher than 8'2" above the rails, and to ensure this is satisfied, the trailer weight is limited to 70,000 lb for long trailers and 50,000 lb each for pups. Other components of the railcar are sometimes regarded as independent constraints on trailer weight, such as the strength of the hitch and the load carrying capacity of the rail wheels, but in fact these are designed to accomodate whatever loads result from the centre of gravity criterion.

Under the new RTAC limits, a tridem trailer can easily gross over 80,000 lb and a tandem pup can reach 65,000 lb or more. Such heavy trailers clearly cannot be carried on the conventional intermodal cars.

The other major constraint on intermodal trailer weight is the lifting capacity at the terminals. CN operates six major intermodal hubs, at Moncton, Montreal, Toronto, Winnipeg, Edmonton, and Vancouver. All of these with the exception of Vancouver have what we know as "top lift" capability. This can take the form of a front-end-loader type of machine, sometimes called a PiggyPacker, or various types of gantry crane. Either way, we have the ability to lift a nominal weight of 90,000 lb wherever trailers have to be lifted, and the intent is to upgrade this to 100,000 lb to provide a margin for exceptional loads and normal machine deterioration.

These top-lift machines generally handle containers and trailers interchangeably, but at a few locations such as Halifax and the Conport Terminal in Toronto, there are dedicated container operations at which the lifting capacity is 80,000 lb. This is still comfortably above the weight limit for international containers of 67,200 lb.

At the moment, Vancouver uses the older system of "circus" loading, requiring trailers to be backed on to the cars with tractors. There are obviously no lifting limitations with this arrangement, but it has many other undesirable constraints and a new terminal using top-lift is now under construction.

ONE MORE PROBLEM

Just when we thought we had a grasp on where Canadian weights and dimensions were going for the next few years, a new wrinkle has arrived. There seems to be a demand for an international container larger than 40 feet. Some 48 foot units are already moving in international service to the U.S., and of course domestic units longer than 40 feet are common. From the North American perspective, standardization at 48 feet would have been logical. The Europeans on the other hand have been leaning towards a somewhat larger metric version. The new standard is now likely to come out at 48 feet 6.875 inches or 14.8 metres.

We have not encouraged this development as it creates one more layer of complication in matching containers to flatcars. However there are 55 countries involved and Canada will have to go along with the decision reached. Apart from the car management problem, CN will be able to adapt to the new design fairly easily. About 20 percent of our 2000 container cars, with only minor modifications, will be able to carry these larger units right away, and this is likely to be adequate for several years. The new multi-purpose cars now being designed will also be able to handle the longer containers.

We expect few problems in lifting these units, since the lift points will still be at the 40 foot locations and the gross weight limit will remain at 67,200 lb, as for 40 foot units. Securement points will probably be duplicated at the corners and 40 foot locations. Height will remain at 9'6" and width at 8'6".

A RAILCAR FOR THE FUTURE

It would be right to conclude that many of the present and possible future compatibility problems cannot be solved economically by tinkering with the existing railcars. In recognition of this, CN has looked at various new car designs. In the last ten years, there has been a great deal of innovation among intermodal car designers in North America. The new designs generally have one thing in common - they try to reduce tare weight and centre of gravity height. Some of them also attempt to improve the aerodynamics of the loaded car. CN has studied all of the new cars and tested a number of the more promising. We have decided that there is nothing available off the shelf to adequately meet our needs, because the designs are aimed at the U.S. market with its lighter trailers and different traffic patterns.

The alternative was to come up with our own design and that is what we did. This is not unusual for CN; much of our existing fleet was designed in-house, and indeed a lot of it was also built in our own shops. However in this case we believe we have arrived at an exceptionally good design with a great deal of built-in flexibility

To the layman, the car looks more like five cars, since there are five platforms each supported by a two-axle wheelset at each end (Figure 1). But the platforms are "permanently" coupled together. They can be taken apart in the shop, but would not normally be split in the yard. We prefer to think of the whole thing as one car, our "5-pak, standalone, drawbar-equipped" car. The design will be built in our own facilities and we expect to have 40 of them in service by the end of 1989. That may not sound like a lot, but it represents 200 platforms, or about 7 percent of our present platform capacity. Further acquisitions will depend on traffic demand and how the cars perform.

There are a number of features worthy of note. First, unlike most of our existing cars, this one can handle containers and trailers interchangeably. That will ultimately allow us to integrate trailer and container operations, which are now segregated, improving the productivity of the expensive lifting equipment and of the yard space.

It can also carry double-stacked containers. In the bottom position, the usual options of one 40 foot or two 20 foot units can be accommodated, but it can also take up to a 49 foot container to encompass the new international standard. In the top position, a container as long as about 57 feet could be carried, though we do not envisage the need for such capability in the foreseeable future.

For trailers, all legal units up to 53 feet or 31 foot pups can be mounted and carried economically. The load carrying capacity of each platform will be 168,000 lb, more than enough for two 67,200 lb containers, an 85,000 lb trailer, or two 60,000 lb pups. Incidentally, the average tare weight per platform is only 52,000 lb, giving an excellent net to tare ratio of 3.23. Even allowing for the locomotives, the net to tare ratio of an entire train of these cars will be around 2.6. This high carrying capacity and ratio of load to empty weight is due to the use of four axles per platform, contrary to the current U.S. trend towards only two axles in the search for minimum tare weight. Lowering tare is not always a good idea if reduced payload is the result.

While we think this car will be extremely productive and flexible, it is a compromise like all engineering designs. There are still a couple of areas where compatibility with trailer or container may give rise to problems.

For double-stacked containers, centre of gravity can obviously still be a problem, particularly if two 9'6" units are stacked together. This will require careful attention to the weights, possibly ensuring a heavy bottom unit is matched with a light one on top.

The other significant constraint will be kingpin position (Figure 2). These cars are designed to give adequate clearances between adjacent trailers with kingpin set-backs between 24 and 42 inches. Some trailers outside these limits will still be able to fit; for example a 28 foot trailer with an 18 inch set-back would create no problem, but two 31 foot units with the same short set-back would interfere with each other. Long set-backs could potentially allow interference between trailers on adjacent platforms, particularly for units equipped with nose fairings or reefers.

The RTAC limits on kingpin setting range from zero to about 60 inches. We just hope that not too many vehicles are built with the extreme set-backs.

This new car design will not solve all our intermodal problems, but it will help ensure that we can at least physically accommodate most of the trailers and containers now being built, with the flexibility to adapt to other variations that might materialize in the years ahead.

TABLE 1: CN TRAILER FLEET

1959		1989	
NO.	LENGTH	NO.	LENGTH
78	20' - 27'	55	20' - 28'
31	36'	3462	40' - 48'
<u>109</u>		<u>3517</u>	

TABLE 2: CN INTERMODAL CAR FLEET

	NO. OF CARS	
	1959	1989
FOR TRAILERS	706	2090
FOR CONTAINERS	0	2000

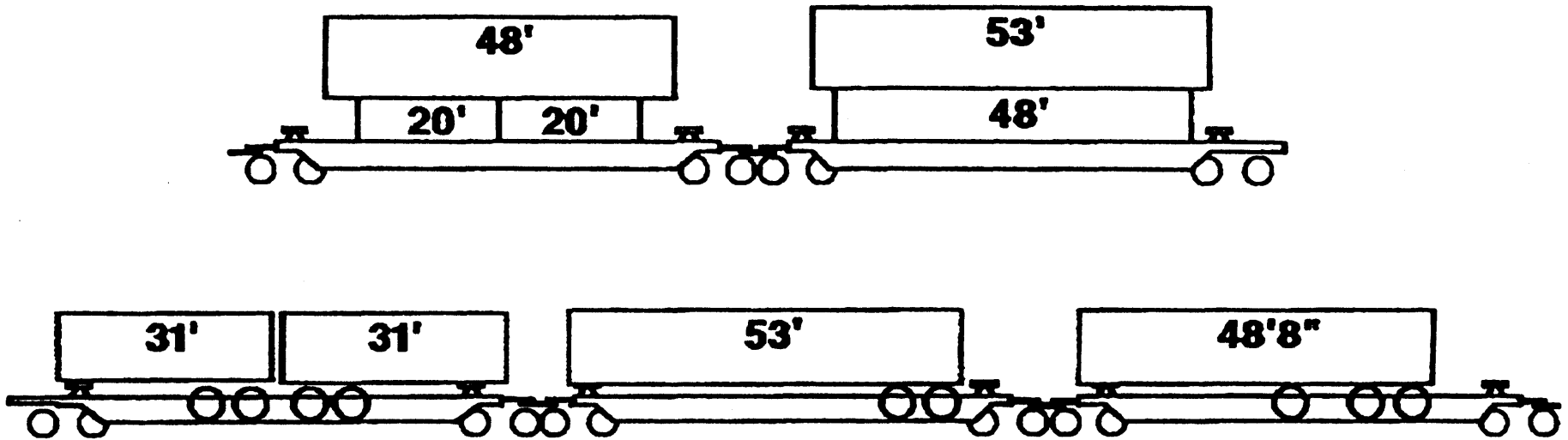


FIGURE 1 : NEW CN INTERMODAL CAR

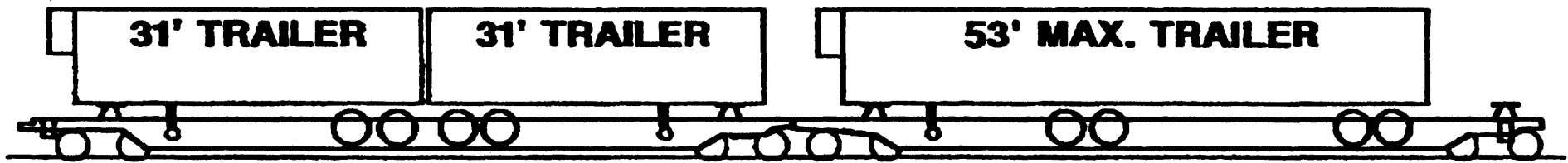


FIGURE 2 : KINGPIN SETBACK PROBLEMS