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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Development of specifications for heavy-duty tractor trucks in Canada and the United States

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1. Introduction

In the heavy-duty trucking industry, fleets and owner-operators often have the ability to customize a wide variety of design features in the truck, including engine size and power rating, transmission type, axle configuration, gear ratios, tire sizing and type, aerodynamic features, and countless other parameters. Different combinations of design choices can result in thousands of unique specifications for the same truck model. With Canada and the United States both having finalized regulations that will affect truck designs and the options available, it is important that policymakers are familiar with the process by which fleets make these choices as well as the information available from dealerships and manufacturers to support specification decisions.

The motivation for this collaborative study between the International Council on Clean Transportation (ICCT) and the North American Council for Freight Efficiency (NACFE) is to gain a deeper understanding of the process of how the features of Class 7 and 8[1] tractor trucks are specified for purchase in Canada and the United States. The primary objectives of this paper are to:

- Gain a better understanding of the overall process for specifying and purchasing new Class 7 and 8 tractor trucks;
- Interview a diverse cross section of trucking fleets, including carriers of various sizes, geographic locations, and operating profiles;
- Glean insights into how fuel-saving technologies are marketed in North America and how fleets make decisions about adopting these technologies; and
- Synthesize the findings from the interviews into information that is relevant for policymakers.

1 Class 7 trucks have a gross vehicle weight rating (GVWR) of between 26,000 and 33,000 pounds; Class 8 trucks have a GVWR heavier than 33,000 pounds.

The paper is organized as follows. In Section 2, we describe the two most common pathways for specifying tractor trucks in Canada and the United States, as well as characteristics of the specification process that the authors have gleaned from interactions with thousands of fleets, manufacturers, and suppliers in their combined 30-plus years of experience in the field. Section 3 outlines the methodology of the fleet survey that was carried out for this project and discusses the findings from the interviews by four major topic areas: 1) trusted sources of information during the specification process, 2) specifying fuel-saving technologies and packages, 3) differences in the specification process in Canada and the United States, and 4) macro forces in the trucking industry, including driver shortages and turnover as well as emerging trends toward electrification and automation. In Section 4, we outline several key insights from the study and highlight areas for future work.

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2. Overview of truck specification process

This section provides an overview of the truck specification process in Canada and the United States. In the following three subsections, we discuss three factors that have a significant impact on the process in which trucks are specified, as well as the technologies and features that end up on those trucks. These factors are the size of the trucking fleet, the type of fleet—whether for-hire or private, and secondary markets.

2.1. FLEET SIZE

Typically, the process for purchasing and specifying a new truck depends on the size of the fleet. Small and medium-sized fleets tend to acquire trucks via a dealership, whereas large fleets buying 100 or more trucks a year have assigned account managers from truck original equipment manufacturers (OEMs) to facilitate purchases. Figure 1 illustrates the key features and decision points of the truck specification process for smaller and medium fleets compared with larger ones. Each pathway is discussed in more detail in Sections 2.1.1 and 2.1.2.

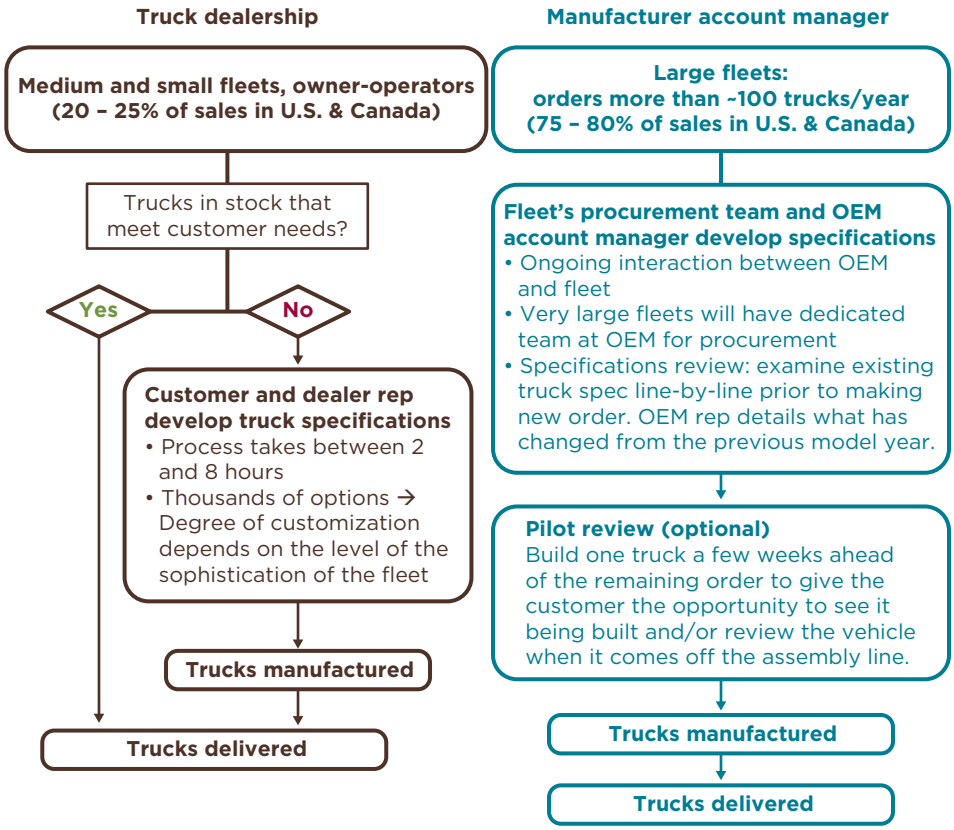

Figure 1. Two primary pathways for purchasing and specifying a tractor truck

2.1.1. Owner-operators and small to medium-sized fleets: truck dealerships

Truck dealerships tend to know their local customers well, as they closely track the operating profiles of existing and potential customers. The buyer may start the discussions on new truck purchases based on existing specifications or ask another fleet to use its specifications as a starting point. The dealer's sales person will most likely visit the fleet location and develop one or more proposals to meet the fleet's needs based on what the sales person has learned about operations, challenges, and desires. This typically involves just one or two dealership employees and one or two representatives from the fleet or the owner-operator directly. The specification sheet is typically created at the customer's facility, and the process can take anywhere from a few hours to a full work day. An example specification sheet from an actual truck order is provided in Appendix B.

2.1.2. Medium and large fleets: national account managers

Large fleets may have one or more direct points of support from the OEM such as sales, parts, warranty, and training, depending on the situation. Virtually all have a national accounts manager to oversee the relationship. They may also have more than one base set of specifications if their businesses require different applications. For example, the need for different base specs can reflect variations in:

- Type of operation: such as dry van versus refrigerated freight versus flatbed transport.
- Differences in gross combined weight allowed in various provinces or states.
- Length of haul: for example, day cab versus single driver sleeper versus teams with double bunk sleeper cabs.
- Merged fleets: It is often the case that large fleets are involved in an acquisition or merger with another fleet, which frequently brings different types of tractor and trailer equipment together into one operation.

Setting the specifications for the next order may involve multiple people within the fleet to represent areas such as maintenance, driver recruitment/training, warranty, and finance. With medium and large fleets, there is a good chance that there will be several OEM representatives involved from different departments, such as engineering, used trucks, and reliability. The most common OEM point of contact for the fleet is the sales/applications engineer, as he or she works as a technical liaison between sales and engineering/manufacturing. The sales/applications engineer is typically responsible for an application or model family, or multiple applications or families. This puts them in position to have considerable knowledge of standard features, published options, unpublished options, and unusual customer requirements that may even need to be completed after the production line. Their position helps them know what is changing in model options as well as how the industry is adapting to new or updated technologies.

Meetings with medium and large fleets may occur at the customer's facility to allow the OEM to see the customer's vehicles, but they can also take place at one of the OEM's facilities to allow various experts from within the OEM's operations to join for a portion of the meeting. Many times there will be one or more "specification reviews" and once the specification are finalized and vehicles purchased, there may be a "pilot review" at the vehicle assembly plant well ahead of the start of the full order to determine whether there are any issues or quality problems to be addressed before mass production.

As compared with the process for small fleets, specification development for larger carriers involves a much larger group of people and may occur at various places over several days or weeks.

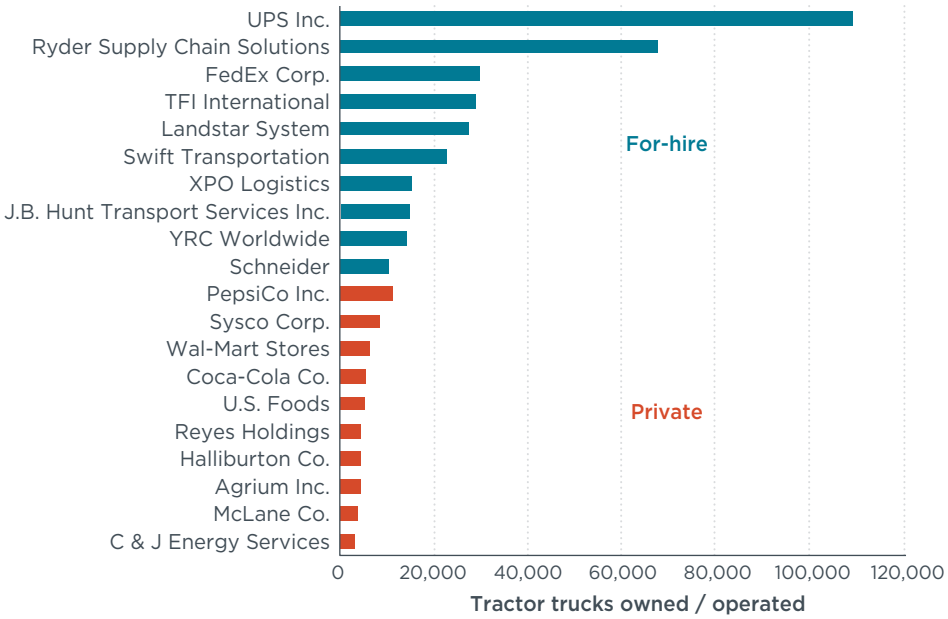

Figure 2. Ten largest for-hire and private trucking fleets in North America in 2017

2.2. FOR-HIRE VERSUS PRIVATE FLEETS

Another important criterion is whether the fleet is a for-hire or a private fleet. For-hire fleets contract out trucking services as their primary business and generally dominant source of income. Companies that take the responsibility for transporting their products create private fleets of their own tractor-trailers. For these companies, the primary business is selling products such as food, retail goods, and agricultural commodities, not transportation services.

Figure 2 shows the 10 largest for-hire and private fleets in North America by tractor truck ownership (Transport Topics, 2018a and 2018b). The for-hire fleets are much larger than the private fleets, with Class 7 and 8 truck ownership ranging from about 10,000 to nearly 110,000 units. The top 10 private fleets have between roughly 3,000 and 11,000 tractor trucks.

Through conversations with several fleets of various types and sizes across North America, as well as experts from manufacturing, the authors have learned the principal differences between for-hire and private fleets. Table 1 summarizes the typical characteristics that differentiate for-hire and private fleets and how these disparities translate to different preferences for vehicle features and technologies.

The most important distinctions are differences in driver schedules, compensation, and annual turnover. From a driver's perspective, trucking jobs with private fleets are typically much more attractive for two reasons: 1) more predictable routes and scheduling and 2) better salaries and benefits. These characteristics are the primary reasons annual driver turnover is much lower for private fleets. According to the American Trucking Association, about 10% of drivers leave private fleets every year, compared with 90% in the for-hire business (Costello, 2017). "It's nice to sleep in my bed every night," one private-carrier driver said at a trucking road show. Previously working at

a for-hire fleet, he had a significant amount of time away from home, he said (Sharpe, 2017).

Truck ownership durations are different between for-hire and private fleets. In annual fleet fuel studies and technology confidence reports (North American Council for Freight Efficiency, 2018a and 2018b), NACFE consistently finds that for-hire fleets tend to own trucks for 3 to 5 years (Schaller and Roeth, 2016). Private fleets typically own them twice as long, or 6 to 10 years.

These distinctions translate to differences in technologies and features sought by the two fleet types. Driver shortages have been a top concern in recent years and affect fleets' truck-buying decisions. In for-hire trucking, the majority of drivers switch companies after less than a year, so many of these fleets are loath to invest in technologies that require additional driver training or intervention. One oft-cited example is boat tails, or trailer rear-end aerodynamic fairings, which commonly require drivers to manually open and close the systems. Expending extra resources to ensure drivers properly use the devices is seen as a poor investment because of driver turnover. For-hire fleets commonly spec out trucks giving strong consideration to driver recruitment and retention. For example, for-hire fleets may opt for cabin comforts such as nicer seats and improved amenities instead of fuel-saving technologies.

For-hire fleets tend not to have significant public-facing marketing and public relations, with the exception of the high-profile parcel delivery services UPS and FedEx. Large retailers, grocers, and food and beverage companies, however, often use private trucking divisions to promote their commitment to sustainability by deploying readily noticeable efficiency technologies such as trailer side skirts. While some for-hire fleets do invest in fuel-saving technologies, private fleets commonly have more motivation to do so.

Table 1. Typical differences between for-hire and private trucking fleets

	For-hire fleets	Private fleets
Primary business	Freight transport	Non-trucking related: retail, groceries, commodities, etc.
Driver dynamics	• Unpredictable schedules and routes • Lower salary and benefits • Very high annual driver turnover (~ 90%)	• Predictable schedule and routes; drivers more likely to be home every night • Higher salary and benefits • Low annual driver turnover (~ 10%)
Truck ownership cycles	Shorter (3-5 years)	Longer (6-10 years)
Typical fuel-saving technology preferences	• Gravitate toward technologies that do not require active driver intervention. • May opt for cabin comfort features instead of fuel-saving technologies to improve driver recruitment and retention. • Need technologies to pay back in 1.5 to 2 years.	• More likely to adopt technologies that are easily seen and can help foster a green image • More apt to adopt technologies that require driver intervention or special training. • More willing to accept payback times for efficiency technologies that are longer than 1.5 to 2 years.

Moreover, longer truck-ownership cycles make private fleets more willing to adopt a larger set of fuel-saving technologies. From Figure 2 it is clear that the largest for-hire fleets have orders of magnitude more trucks than the largest private fleets, and, in turn, for-hire fleets make up a more substantial percentage of new truck sales. As a result, product offerings from the major truck OEMs are generally tailored to the for-hire market. A typical threshold for the payback of a fuel-saving technology or package of technologies is 1.5 to 2 years, based the typical fleet ownership cycle of 3 to 5 years. Operators want to see a return on investment in the second half of the ownership cycle.

2.3. SECONDARY MARKETS

During the specification process, fleet managers are typically sensitive to the trucks' future residual value and the dynamics of secondary markets. Many fleets have commented that fuel-saving technologies do not generally increase a truck's value for secondary buyers. For example, respondents in one interview remarked that used trucks are generally "much more of a commodity" than new trucks and that fleets are typically "not looking for specific technologies but simply a reliable truck that can get the job done." By and large, used-truck prices are primarily driven by the volume of used trucks available in the market.

This phenomenon is illustrated in Figure 3. In this fictitious example, new truck sales and the average price of used trucks are shown by the blue and orange curves. As in the real world, new truck sales in this figure follow a cyclical pattern of highs and lows. The orange curve is roughly identical

to the blue curve but is shifted forward. This shows how surges in new truck sales, as in points a and c on the blue curve, lead to increased supply of used trucks 3 to 4 years later, as the first owners, which are typically large for-hire fleets, hit the end of their truck ownership cycles. The increased supply of used trucks depresses the average price of these vehicles as in points d and f. When truck residual values are low, some fleets will opt to keep vehicles longer until prices rebound. A bottoming-out of new truck sales as in point b leads to decreased availability of used trucks 3 to 4 years later and a high point for used truck prices as in point e.

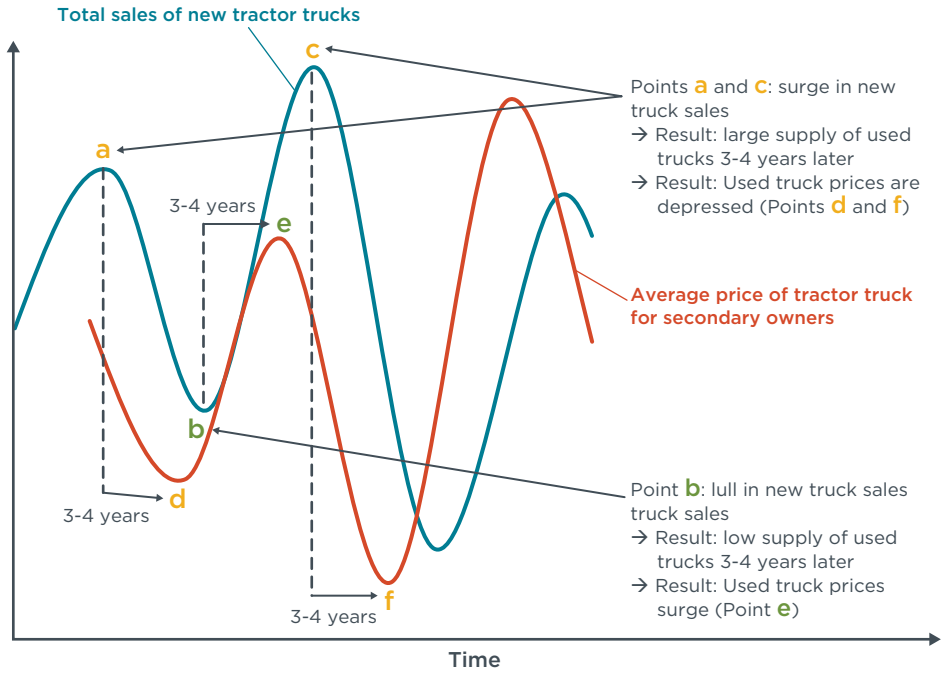

Figure 3. Average prices of used tractor trucks is dictated by the supply of trucks in the market

3. Industry stakeholder interviews: description and findings

The study team conducted in-person and telephone interviews on the truck specification process in Canada and the United States. Beforehand, we developed a questionnaire to help ensure that we covered roughly the same material with all participants.

Over two months in early 2018, the authors conducted 15 interviews with trucking fleets of various types, sizes, and geographies, as summarized in Table 2. Thirteen of the fleets are based in Canada, of which seven are small fleets with fewer than five trucks or owner-operators. Two carriers are based in the United States. The eight larger fleets varied widely in terms of size, with truck ownership ranging from 100 to 2,000 trucks. All of the company representatives and owner-operators interviewed had direct involvement and decision-making responsibilities in truck specification.

Table 2. Stakeholders interviewed

Stakeholder GROUP	Number of interviews / surveys
Canada-based trucking fleets (total)	6
Canada-based trucking fleets (private)	2
Canada-based trucking fleets (for-hire)	4
US-based trucking fleets (for-hire)	2
Canada-based owner-operators and small fleets (operating fewer than 5 trucks)	7

The survey template is included in Appendix A. We organized the responses into four categories: 1) sources of information used during truck specification, 2) specification of fuel-saving technologies and packages, 3) differences in truck specs between Canada and the United States, and 4) macro forces in the North American trucking industry, including driver shortages and turnover, as well as emerging trends in truck electrification and automation. These topics are discussed in the following four subsections.

3.1. SOURCES OF INFORMATION DURING THE TRUCK SPECIFICATION PROCESS

After gathering background on each fleet's business and operations, we discussed the respondents' role in truck specification. All 15 of the interviewees were directly involved in or solely responsible for truck specification. Every fleet representative and owner-operator had at least 15 years in the trucking business, and several, more than 25 years. Experience and a deep knowledge of trucking

maintenance and operations are crucial for making the hundreds of decisions on technologies and features involved in specifying new trucks. See Appendix B for examples from an actual fleet's truck order.

Nearly everyone interviewed said they depended on networks of friends and colleagues for information about new trends and technologies. A very high premium was put on conversations with trusted peers from other fleets as well as industry groups such as the Technology and Maintenance Council[2] and provincial and national trucking associations.

Respondents from the larger fleets emphasized that they were in constant communication with OEM national account managers and often with suppliers of key component such as engines, transmissions, and axles. Many of the interviewees said it's generally a good idea to vet information from manufacturers with other fleets. Small fleets and owner-operators have much less contact with manufacturers and are more dependent on truck shows, conferences, and trucking publications for information about new technologies and features.

Fleets seek to add features that will make operations more efficient without taking on added reliability risk that could lead to downtime, repairs, delivery delays and other costs. They often rely on organizations such as Performance Innovation Transport and NACFE for information on return on investment, benefits, and potential downside risks of new technology and features. Our survey found that fleets depend on OEM and dealership contacts to learn of legislated and optional changes that can help or hurt fuel economy. Fleets also communicate with other fleets, suppliers, and trucking associations and attend events such as trade shows to learn what options are most promising and which ones have the most negative effects.

"The trucking business is about trust," one of the fleet interviewees said. "I've got to believe that the OEM really has my best interest in mind. They know that [the fleets] talk to one another all the time, and I think that keeps them honest to a certain extent."

The qualitative finding from the surveys that fleets are most apt to trust fuel performance data generated by themselves or other fleets is aligned with the results from a previous ICCT study. In Roeth, Swim, Kircher, and Smith (2013), roughly 95% of the survey participants said they believed that fleets' own testing data and experience are "very important" or "important" in decision-making about fuel-saving technologies. In contrast, less than 50% said they thought that data from suppliers, manufacturers, or government were a "very important" or "important" input.

3.2. SPECIFYING FUEL-SAVING TECHNOLOGIES AND PACKAGES

We sought a better understanding of how fuel-saving technologies and packages are marketed, specified, and ultimately produced and delivered to fleets. Several technology categories are most commonly involved in improving fuel efficiency, including:

- Powertrain: engine, transmission, and axles
- Tires: types of tire and methods to ensure they stay properly inflated
- Aerodynamics: tractor, trailer, and the gap between them
- Axle ratios and configuration: for example, 6x2 versus 6x4 configurations[3]
- Idle reduction: keeping the driver comfortable and batteries charged while minimizing idle time

Respondents reported that all OEMs use some sort of proprietary computer simulation to estimate fuel consumption. For technologies that can be modeled, sales representatives typically show the fuel effects across several drive cycle and payload combinations to give customers a sense of the range of benefits in normal operations.

The survey responses suggested that there is a wide range of ways that fleet customers can engage with sales representatives and specification software. For smaller fleets and owner-operators, some respondents reported that they had no interest in the simulation outputs. On the other hand, one owner-operator said he enjoyed "seeing how new features can save me a little fuel" and that he kept the mpg numbers from the simulations in mind "so that when I get out on the road I can try to beat them."

With larger fleets that tend to have dedicated truck-procurement teams, the manufacturers' simulation outputs are often factored into a fleet's decision-making. However, fleets

2 The Technology and Maintenance Council (TMC) is one of four councils that are a part of the American Trucking Association. TMC develops best-practice recommendations for truck engineering and maintenance that are voluntarily adopted by fleets, OEMs, and component suppliers. The council also does frequent industry surveys and organizes events that help to foster cooperation between the manufacturing community and the end users who specify, purchase, and manage trucking equipment.

3 In a 6x2 axle configuration, there is one powered drive axle instead of two, which is the case in the conventional 6x4 configuration. There are weight savings associated with having one less powered axle, and this reduction in curb weight leads to fuel savings. However, one of the downsides to the 6x2 configuration is a reduction in traction in certain situations.

generally take the simulation results as an optimistic case and use more-conservative estimates for their analyses.

"If the model tells us we're looking at a 0.5 mpg improvement, I take that as a best-case scenario—good driver, nice conditions, no grade, average load," one fleet representative said. "But I have to be realistic that these best-case conditions don't happen all too often. So, in this situation, I'd probably assume that we actually see a 0.2 mpg benefit, on average."

It was clear from the interviews that there is tremendous diversity in the industry as to how efficiency technologies are advertised and offered to fleets. Technologies can be ordered as factory installations, but there are other ways to obtain them. For instance, fleets may use a customization/specialty center[4] to install a wide array of options not available in the factory. Options can also be added at a dealership or even at a fleet's facility.

We asked interviewees how they make decisions to adopt or forgo a particular technology. All 15 reported that they use some kind of return-on-investment metric. Calculating payback times is fairly universal.

We asked respondents how long they typically keep trucks and the maximum acceptable payback time for efficiency technology. The results are summarized in Figure 4. Each data point represents an interview response, with the X axis showing the typical truck ownership time and the Y axis, the maximum acceptable payback time. The size of the data points indicates the number of responses matching a given ownership duration-payback time combination. In four instances, there were identical responses for ownership

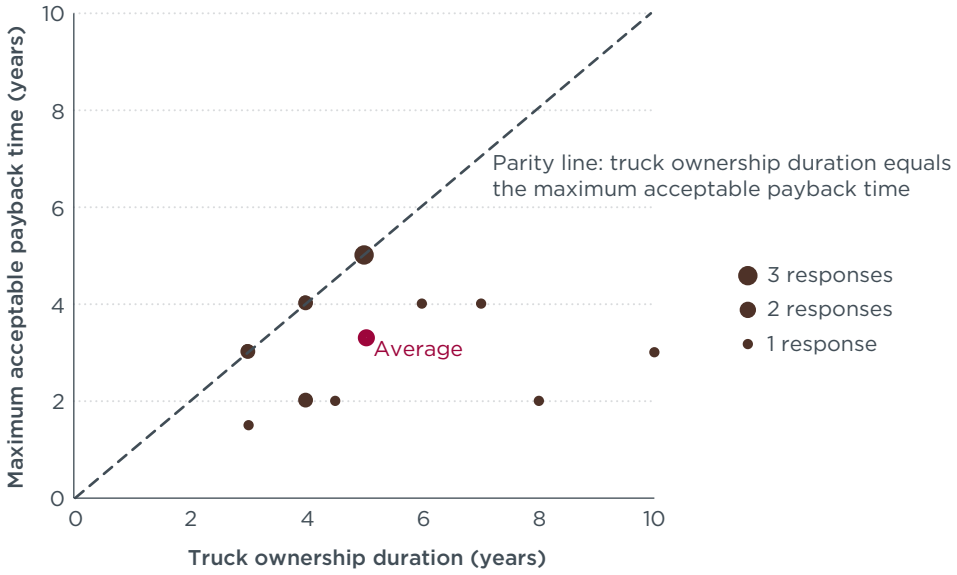

Figure 4. Survey responses on truck ownership cycles and maximum expected payback time for fuel-saving technologies

duration-payback time combination. In eight of the 15 responses, operators require that technology payback time be less than the ownership cycle. Those are the data points below the dashed parity line in the figure. For the remaining seven operators, the maximum payback time was the same as the typical ownership period. On average, the fleets interviewed kept their trucks five years with a payback threshold for just over three years. Most carriers require technology payback in half the length of the ownership cycle so that the device or feature can provide a return on investment in the second half of the truck's time with the fleet. On average, the responses from the survey are aligned with this rule-of-thumb expectation.

We broke down the fuel-savings opportunities into six broad technology categories—engine, transmission and axles, aerodynamics, tires and wheels, telematics and information technology, and weight reduction via material substitution. We then asked the respondents to rank the value to their overall business of technologies in each area. Respondents were given the liberty of defining "value" as they saw fit—whether in terms of cost-effectiveness, overall fuel and money savings, or some other parameter or combination.

Figure 5 shows the individual responses where 1 was the highest rating and 5 the lowest. Engine technologies were rated the highest, with seven fleets giving it a 1 and with an average rating of about 2. Transmission-and-axles and aerodynamics both had nearly an equal distribution of high and low scores and an average of about 3. The remaining three technology categories had a larger portion of lower ratings and an average of just over 4.

All of the technology areas had some combination of high and low ratings, underscoring the significant diversity in the trucking industry and how the benefits from a particular technology are heavily dependent on drive cycle, payload, driver behavior, and operating conditions. In fact, one fleet representative said he

4 These can be third-party companies or owned and operated by the OEM.

could easily submit several sets of technology rankings based on different trucking divisions within his company. As an example, he said the bulk transport division "looks for all the weight savings we can reasonably find" because weight limits are a major concern, but other divisions are generally volume-limited, so that "single-wide tires and material substitution isn't nearly as cost-effective."

3.3. DIFFERENCES BETWEEN CANADA AND THE UNITED STATES

Differences in regulated weight allowances and other operating parameters between the two countries can lead to differences in truck specifications. For example, most operations within the United States are limited to 80,000 pounds, but certain provinces in Canada allow fleets to haul up to 120,000 pounds with a single tractor-trailer. Canada also has more common operation of double trailers, including twin 53-foot trailers. Both differences can push a fleet to run engines with larger displacement and horsepower. It can also influence a fleet to opt for transmissions with more gears and higher rear axle ratios to facilitate acceleration of heavy loads in challenging situations. Heavier axles are needed for heavier loads, and additional axles require additional tires, wheels, and brakes.

The climate-related challenges of operating in Canada or in heavy-winter U.S. states can also change specifications. Not only are winters colder and more severe in terms of wind, snow, and ice, but also there are other challenges. Operating in sparsely populated areas means that maintenance assistance is not always nearby. Sleeper tractors must have reliable heating systems and often "arctic

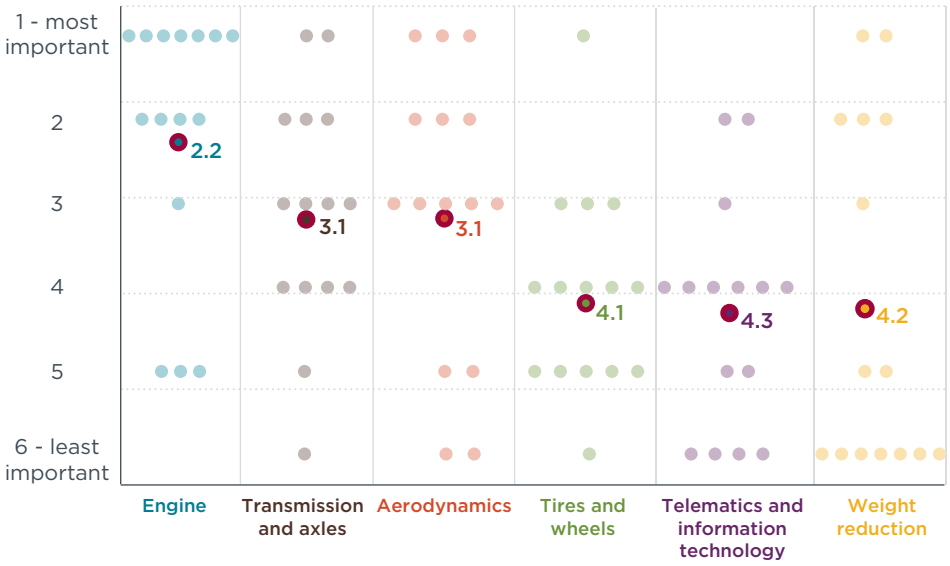

Figure 5. Interview and survey responses ranking the value of fuel-saving technology areas

package" insulation to ensure driver safety and survival in severe weather. Longer winters and more sub-freezing weather also mean more distance and time on roads that are being treated for ice. Most of these road treatments are known to cause corrosion of metal and are especially difficult on the many electrical connections on tractors and trailers.

There was considerable agreement among survey participants around the unpopularity of 6x2 axles in Canada. Several respondents commented that while 6x2 axle configurations are attractive for fuel-saving in milder climates, fleets and drivers in Canada believe they need the maximum traction of the 6x4 configuration.

Finally, two fleets reported that drivers are more likely to encounter large animals on roads in Canada. The increased likelihood of colliding with deer and moose lead many fleets to add structures to the front of their tractors to protect the headlights, hoods, aero bumpers, and cooling systems from being disabled.

3.4. MACRO TRENDS IN THE TRUCKING INDUSTRY

Driver shortages and turnover

All of the interviewees acknowledged that driver shortages are a major issue in the trucking industry. This trend is likely to worsen over the next few years as fleets struggle to find new, younger recruits to replace retiring drivers and meet the demands of a growing on-road freight sector (American Trucking Research Institute, 2017). While lack of drivers doesn't affect all of the fleets that were interviewed, all of the respondents said they thought this issue would continue to weigh heavily in fleets' specification decisions, particularly in the for-hire market.

Electrification and automated trucking

While a large majority of the survey participants said they thought trucks will eventually move toward higher levels of electrification and automation, there was a common sentiment that these ideas are being over-hyped

in the media and popular culture. Most respondents were fairly skeptical about the prospects of battery electric trucks for long-haul applications of 600 – 800 km per day, but they said they were curious to see how the first generations of such trucks perform in local and regional duty cycles.

None of the respondents said they expected to see fully driverless trucks any time before 2030, and a typical expectation for the arrival of fully automated commercial trucks was "not in my lifetime." However, most said they expected driver support and crash-avoidance technologies to become standard in the next 5 to 10 years. Also, it was a common expectation that highway platooning will be possible starting in the next few years for the select percentage of fleets that are able to make a favorable return on investment for these systems.

Fuel prices

Fuel prices are critical in the decision to adopt a particular technology or package of technologies. While we did not ask explicit questions about fuel prices, a few respondents volunteered that fleets are usually conservative when estimating fuel savings and associated cost benefits. One owner-operator said that trying to forecast fuel prices is a "fool's errand" and he can't depend on $5-a-gallon diesel for "technology choices to pan out." The few interviewees who brought up fuel prices reported that they simply use the current average price in their calculations and that trying to "guesstimate" price changes over time was not commonplace.

4. Summary and future work

The following are the key findings from the fleet interviews, and we conclude by presenting some areas of potential future work.

Table 3: Key findings regarding truck specification from this study

Topic	Key findings
Sources of information used during the specification process	• Specifying trucks requires a deep understanding of all aspects of the trucking industry and many years of hands-on experience. • The high degree of trust that fleets place in their own data and data from their peers can lead to a vicious cycle that depresses technology adoption. • Trucking is a "copycat" business, and few fleets are willing to be on the "bleeding edge" of early technology adoption.
Factors influencing technology decisions	• Fleets generally assume that fuel-saving technologies will not increase the resale value of a truck. However, particular technologies can decrease a truck's value in the secondary market such as the 6x2 axle configuration.[5] • Larger fleets with dedicated procurement staffs are typically more knowledgeable about new technologies than small fleets and owner-operators. As a result, larger fleets tend to have an advantage in developing specifications that take advantage of new and emerging technologies. • On average, for-hire fleets own their trucks for shorter durations than private fleets and require fuel-saving technologies to provide a return on investment more quickly. This results in private fleets tending to adopt a wider range of efficiency technologies. • In the for-hire business, driver turnover is high, and fleets often specify trucks in ways to attract and retain drivers. Given limited budgets, for-hire fleets may opt for features that are attractive to drivers in lieu of fuel-saving technologies. • Private fleets are more likely to specify a highly visual technology such as trailer side skirts that they can use to promote a green image. In contrast, for-hire fleets do not typically engage with the general public and do not make technology decisions based on public relations.
Specification differences between Canada and the United States	• More-severe winter conditions and more-relaxed maximum weight limits in Canada are the most significant factors that lead Canadian-based fleets to have a preference for larger engines, more transmission gears, and heavier-duty axles.

Findings. The interviewees were asked the same set of questions, with minor wording changes to reflect the nature of the company or organization that each survey participant represented. We focused on issues in three primary areas related to truck specification. Table 3 summarizes our key takeaways in each area:

The study team found that the significant variety in how trucks are specified mirrors the overall diversity that characterizes the trucking industry. Several factors impact how a fleet will approach the truck procurement process, including the type and size of the fleet, typical operating patterns, geography, and familiarity with emerging technologies.

Future work. Market forces and regulations are accelerating the development and deployment of a wide range of tractor-trailer technologies for promoting increased safety, efficiency, and driver comfort. As these technologies

5 In this study and others, fleets have reported that 6x2 tractors can be more difficult to sell in secondary markets because of their perceived lack of traction in certain situations.

are adopted by an expanding portion of the fleet in Canada and the United States, it will be important to refresh this analysis at semi-regular intervals so that government regulators and other stakeholders will have a better sense of how fleets make technology decisions for new-truck purchases and how policies and programs might be adapted to better match the industry's needs. This type of industry-focused survey will be increasingly important as we start to see the commercialization of zero-emissions and highly automated trucks.

Another knowledge gap highlighted in this study is the low value placed on fuel-saving technologies in secondary markets for Class 7 and 8 freight trucks. A data source such as Truck Blue Book that has detailed specifications, manufacturer's suggested retail price, and current prices by model year can be used to analyze how various technologies impact a truck's value over time. Moreover, this type of data source can allow for an analysis of the link between total sales in a particular market such as Canada or the United States and prices 3 to 4 years later when used trucks from the for-hire sector start to enter the used-truck market.

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Appendix A: Industry stakeholder survey template

TRUCK ORDERING AND SPECIFICATION PROCESS

The following questions focus on the process for ordering and acquiring a new Class 7 or 8 tractor truck. Question 2 is asked from two different perspectives. Depending on if you represent a **fleet or owner-operator** or a **truck dealership or manufacturer**, please answer the question that is most relevant.

1. **Please describe your role in the truck ordering and/or specification process.**

2. **What is the process in which a tractor truck is specified?**

   a. **If you are a fleet or owner-operator**, how do you go about developing a truck specification? What sources of information are most important to you or your company as you develop truck specs?

   b. **If you are a truck dealership or manufacturer**, how do you interact with customers during the specification process? How are truck specs developed for different types of fleets? What software tools or other types of models are used to develop data that informs the specification?

3. **What would you change about the truck specification process to make the experience more efficient and/or enjoyable?**

SPECIFYING FUEL-SAVING TECHNOLOGIES AND PACKAGES

The next few questions ask about how fuel-saving technologies are marketed, evaluated, and ultimately specified on a new truck. In Question 4, please answer the question that is most relevant, depending on if you are a **fleet or owner-operator** or a **truck dealership or manufacturer**.

4. **Fleets or owner-operators**: As you develop a truck specification, how do you learn about technologies that could be cost-effective for your fleet, given your duty cycles, typical payloads, and overall business strategy? What metrics (e.g., percent fuel savings, annual fuel cost savings, payback time) are presented to you? Are there barriers that have hindered you from specifying a specific fuel-saving technology or package?

   Dealerships or manufacturers: how do you educate customers on efficiency technologies that you believe will be cost-effective? What metrics (e.g., percent fuel savings, annual fuel cost savings, payback time) do you present to customers? Setting aside additional costs, what are the barriers you face in offering fuel-saving technologies or packages to customers?

5. **How are the Phase 1 (model year 2014 – 2017) and Phase 2 (2018 – 2027) fuel efficiency and greenhouse gas regulations for new heavy-duty vehicles in the U.S. and Canada impacting the truck specification process?**

6. Please rank the importance (1 – most important; 6 – least important) of the following fuel-saving technology areas to your business.

Engine technologies _____

Transmission and axles _____

Aerodynamics _____

Tires and wheels _____

Telematics and information technology _____

Weight reduction (e.g., alternative materials) _____

7. What is the trade cycle (lifetime in your fleet) for your new trucks? _____

8. What is the ROI time period that is your threshold for buying new features? _____

DIFFERENCES BETWEEN THE UNITED STATES AND CANADA

9. How do truck specs differ between the U.S. and Canada? Are there fuel-saving technologies or packages that are more common in the U.S. or Canada?

9. Are there differences in the tractor truck resale markets in the U.S. and Canada that impact truck specs?

MACRO TRENDS IN THE TRUCKING INDUSTRY

10. How do you expect advances in truck autonomous driving and electrification to impact the overall truck specification process?

11. How do driver shortages and high driver turnover rates impact your truck specifying process?

Appendix B: Example truck specification sheet

		Description	Weight Front	Weight Rear	
Price Level					
		NEW [truck model] PRL-15K (EFF:09/01/2016)			
Data Version					
		SPECPRO21 DATA RELEASE VER 007			
Weight Reduction Packages					
*		NO WEIGHT REDUCTION PACKAGE			
Integrated Power Train					
		6X4 FUEL ECONOMY POWER TRAIN PACKAGE			
		COMBINED OPTION PRICES OF THE SELECTED CODES FROM THE 6X4 INTEGRATED DETROIT POWER TRAIN PACKAGE			
Bright Work Packages					
		ELITE EXTERIOR APPEARANCE PACKAGE			
		COMBINED OPTION PRICES OF THE SELECTED CODES FROM THE ELITE EXTERIOR APPEARANCE PACKAGE			
Fuel Efficiency/Aero Package					
		AERO-X PACKAGE, 72 INCH RAISED ROOF SLEEPERCAB			
		COMBINED OPTION PRICES OF THE SELECTED CODES FROM THE AERO-X PACKAGE, 72 INCH RAISED ROOF SLEEPERCAB			
Vehicle Configuration					
		NEW [truck model] 126 INCH SLEEPERCAB	9,765	7,724	
		2019 MODEL YEAR SPECIFIED			
		SET BACK AXLE - TRACTOR			
		LH PRIMARY STEERING LOCATION			
General Service					
		TRACTOR/TRAILER CONFIGURATION			
		DOMICILED, USA 50 STATES (INCLUDING CALIFORNIA AND CARB OPT-IN STATES)			
		LINEHAUL/LONG HAUL SERVICE			
		GENERAL FREIGHT BUSINESS SEGMENT			
		GENERAL FREIGHT COMMODITY			
		TERRAIN/DUTY: 100% (ALL) OF THE TIME, IN TRANSIT, IS SPENT ON PAVED ROADS			
		MAXIMUM 8% EXPECTED GRADE			
		SMOOTH CONCRETE OR ASPHALT PAVEMENT - MOST SEVERE IN-TRANSIT (BETWEEN SITES) ROAD SURFACE			
		FREIGHTLINER LEVEL I WARRANTY			
		EXPECTED FRONT AXLE(S) LOAD : 12000.0 lbs			
		EXPECTED REAR DRIVE AXLE(S) LOAD : 40000.0 lbs			

		Description	Weight Front	Weight Rear	
		EXPECTED GROSS VEHICLE WEIGHT CAPACITY : 52000.0 lbs			
		EXPECTED GROSS COMBINATION WEIGHT : 80000.0 lbs			
Truck Service					
		TRACTOR ONLY WITH NO BODY UPFIT			
Tractor Service					
		VAN TRAILER			
		SINGLE (1) TRAILER			
Engine					
		DETROIT DD15 14.8L 400 HP @ 1625 RPM, 1900 GOV RPM, 1750 LB/FT @ 975 RPM			
Electronic Parameters					
		75 MPH ROAD SPEED LIMIT			
		CRUISE CONTROL SPEED LIMIT SAME AS ROAD SPEED LIMIT, WITH AUTO RESUME AFTER SHIFT			
		5 MINUTES IDLE SHUTDOWN WITH CLUTCH AND SERVICE BRAKE OVERRIDE			
		ENGINE BRAKE WITH GLOBAL CRUISE CONTROL ENABLED			
		ENABLE AUTO ENGINE RPM ELEVATE FOR EXTENDED IDLE			
*		NO FLEET SPEC FOR PARAMETERIZATION			
Engine Equipment					
		2016 ONBOARD DIAGNOSTICS/2010 EPA/ CARB/FINAL GHG17 CONFIGURATION			
		2008 CARB EMISSION CERTIFICATION - CLEAN IDLE (INCLUDES 6X4 INCH LABEL ON LOWER FORWARD CORNER OF DRIVER DOOR)			
		STANDARD OIL PAN			
		ENGINE MOUNTED OIL CHECK AND FILL			
		OIL SAMPLE TEST FITTING ON OIL FILTER MODULE			
		ONE PIECE VALVE COVER			
		DUAL SIDE OF HOOD AIR INTAKE WITH ENGINE MOUNTED AIR CLEANER			
		DR 12V 275 AMP 40-SI BRUSHLESS PAD ALTERNATOR WITH REMOTE BATTERY VOLTAGE SENSE	10		
		(4) NORTHSTAR ULTRA HIGH PERFORMANCE ABSORBED GLASS MAT NSB-AGM31, GROUP 31, 12 VOLT 4600 CCA THREADED STUD BATTERIES, OEM WARRANTY INCLUDED	43	42	
		(4) NORTHSTAR ULTRA HIGH PERFORMANCE ABSORBED GLASS MAT NSB-AGM31, GROUP 31, 12 VOLT 4600 CCA THREADED STUD AUXILIARY BATTERIES, OEM WARRANTY INCLUDED			
		STEEL BATTERY BOX WITH ENCLOSED TRAY			

		Description	Weight Front	Weight Rear	
		PLASTIC AUXILIARY BATTERY BOX MOUNTED BETWEEN RAILS	20	60	
		SINGLE BATTERY BOX FRAME MOUNTED LH SIDE UNDER CAB			
		AUXILIARY BATTERY BOX(ES) MOUNTED IN RAIL BACK OF CAB			
		WIRE GROUND RETURN FOR BATTERY CABLES WITH ADDITIONAL FRAME GROUND RETURN			
		PLASTIC BATTERY BOX COVER			
		PLASTIC AUXILIARY BATTERY BOX COVER			
		POSITIVE LOAD DISCONNECT WITH CAB MOUNTED CONTROL SWITCH MOUNTED OUTBOARD DRIVER SEAT	8		
		POSITIVE AND NEGATIVE POSTS FOR JUMPSTART LOCATED ON FRAME NEXT TO STARTER	2		
		PROGRESSIVE LOW VOLTAGE DISCONNECT AT 12.3 VOLTS FOR DESIGNATED CIRCUITS			
		DETROIT HEAVY DUTY AUTOMATED MANUAL TRANSMISSION CLUTCH			
		BW MODEL BA-921 19.0 CFM SINGLE CYLINDER AIR COMPRESSOR WITH SAFETY VALVE			
		STANDARD MECHANICAL AIR COMPRESSOR GOVERNOR			
		AIR COMPRESSOR DISCHARGE LINE			
		ELECTRONIC ENGINE INTEGRAL SHUTDOWN PROTECTION SYSTEM			
		JACOBS COMPRESSION BRAKE			
N		RH OUTBOARD UNDER STEP MOUNTED HORIZONTAL AFTERTREATMENT SYSTEM ASSEMBLY WITH RH HORIZONTAL TAILPIPE			
		ENGINE AFTERTREATMENT DEVICE, AUTOMATIC OVER THE ROAD REGENERATION AND VIRTUAL REGENERATION REQUEST SWITCH IN CLUSTER			
		STANDARD EXHAUST SYSTEM LENGTH			
		RH STANDARD HORIZONTAL TAILPIPE			
		23 GALLON DIESEL EXHAUST FLUID TANK			
		100 PERCENT DIESEL EXHAUST FLUID FILL			
N		STANDARD DIESEL EXHAUST FLUID TANK CAP			
		AIR POWERED ON/OFF ENGINE FAN CLUTCH			
		AUTOMATIC FAN CONTROL WITH DASH SWITCH AND INDICATOR LIGHT, NON ENGINE MOUNTED			
		DDC SUPPLIED ENGINE MOUNTED FUEL FILTER/FUEL WATER SEPARATOR WITH WATER-IN-FUEL INDICATOR			
		FULL FLOW OIL FILTER			

		Description	Weight Front	Weight Rear	
		1400 SQUARE INCH FUEL ECONOMY RADIATOR			
		ANTIFREEZE TO -34F, OAT (NITRITE AND SILICATE FREE) EXTENDED LIFE COOLANT			
		GATES BLUE STRIPE COOLANT HOSES OR EQUIVALENT			
		CONSTANT TENSION HOSE CLAMPS FOR COOLANT HOSES			
		HDEP VARIABLE SPEED COOLANT PUMP AND RADIATOR DRAIN VALVE			
		LOWER RADIATOR GUARD			
		ALUMINUM FLYWHEEL HOUSING			
N		DELCO 12V MOD 3.175-39MT+ OCP STARTER WITH THERMAL PROTECTION AND INTEGRATED MAGNETIC SWITCH			
Transmission					
		DT12-1750-DH1 HEAVY DUTY 12-SPEED DIRECT DRIVE AUTOMATED MANUAL TRANSMISSION			
Transmission Equipment					
		DT12 PERFORMANCE PACKAGE: PERFORMANCE ONLY, WITH ICU CONTROL MENUS, WITH KICKDOWN			
		REVERSE GEAR RANGE LIMITED TO 2ND GEAR			
		NO PTO TRANSMISSION RANGE			
		ALUMINUM CLUTCH HOUSING			
		MAGNETIC PLUGS, ENGINE DRAIN, TRANSMISSION FILL AND DRAIN, AXLE(S) FILL AND DRAIN, ALL YELLOW			
		HEAVY DUTY ELECTRONIC TRANSMISSION SHIFT CONTROL, COLUMN MOUNTED			
		AIR TO OIL TRANSMISSION COOLER			
		SYNTHETIC TRANSMISSION LUBE			
Front Axle and Equipment					
		DETROIT DA-F-13.3-3 13,300# FF1 71.5 KPI/3.74 DROP SINGLE FRONT AXLE			
*		BENDIX ADB22X-V AIR DISC FRONT BRAKES			
		2011/2013-FMVSS 121 RSD FRONT BRAKE LINING			
N		FRONT DISC BRAKE ROTORS			
*		SKF SCOTSEAL PLUS XL FRONT OIL SEALS			
		VENTED FRONT HUB CAPS WITH WINDOW, CENTER AND SIDE PLUGS - OIL			
		STANDARD SPINDLE NUTS FOR ALL AXLES			
N		FRONT AIR DISC BRAKE INTERNAL ADJUSTERS			
		TRW THP-60 POWER STEERING			
		POWER STEERING PUMP			

		Description	Weight Front	Weight Rear	
		2 QUART SEE THROUGH POWER STEERING RESERVOIR			
		ROADRANGER SYNTHETIC FE 75W-90 FRONT AXLE LUBE			
Front Suspension					
		13,300# TAPERLEAF FRONT SUSPENSION	10		
		MAINTENANCE FREE RUBBER BUSHINGS - FRONT SUSPENSION			
		FRONT SHOCK ABSORBERS			
Rear Axle and Equipment					
N		DETROIT DA-RT-40.0-4T HH 40,000# R-SERIES 74-77 INCH INTERMEDIATE TRACK TANDEM REAR AXLE WITH AXLE LUBE MANAGEMENT(ALM)			
		2.16 REAR AXLE RATIO			
		IRON REAR AXLE CARRIER WITH OPTIONAL HEAVY DUTY AXLE HOUSING		40	
		RPL35 MERITOR MAIN DRIVELINE	15	15	
		RPL25 MERITOR INTERAXLE DRIVELINE		20	
		(1) INTERAXLE LOCK VALVE FOR TANDEM OR TRIDEM DRIVE AXLES			
		INDICATOR LIGHT FOR EACH INTERAXLE LOCKOUT SWITCH WITH IAD FEEDBACK			
*		BENDIX ADB22X-V AIR DISC REAR BRAKES			
		2011/2013-FMVSS 121 RSD REAR BRAKE LININGS			
		STANDARD BRAKE CHAMBER LOCATION			
N		REAR DISC BRAKE ROTORS			
N		REAR BRAKE DUST SHIELDS		5	
*		SKF SCOTSEAL PLUS XL REAR OIL SEALS			
N		AIR DISC LONGSTROKE 2-DRIVE AXLES SPRING PARKING CHAMBERS			
N		REAR AIR DISC BRAKE INTERNAL ADJUSTERS			
		FE 75W-85 REAR AXLE LUBE			
		STANDARD REAR AXLE BREATHER(S)			
Rear Suspension					
		AIRLINER 40,000# REAR SUSPENSION			
		AIRLINER HIGH POSITION RIDE HEIGHT			
		RESTRAINED AXLE SEATS IN AXLE CLAMP GROUP			
		51 INCH AXLE SPACING			
		MANUAL DUMP VALVE FOR AIR SUSPENSION WITH GAUGE			
		INDICATOR LIGHT AND BUZZER FOR EACH REAR SUSPENSION CONTROL SWITCH			
		SINGLE AIR REAR SUSPENSION LEVELING VALVE			

		Description	Weight Front	Weight Rear	
		TRANSVERSE CONTROL RODS			
		REAR SHOCK ABSORBERS - TWO AXLES (TANDEM) (AIR RIDE SUSPENSION)			
Brake System					
		WABCO 6S/6M ABS WITH HILL START AID AND AUTOMATIC TRACTION CONTROL WITH ATC SHUT OFF SWITCH			
		REINFORCED NYLON, FABRIC BRAID AND WIRE BRAID CHASSIS AIR LINES			
		FIBER BRAID PARKING BRAKE HOSE			
		STANDARD BRAKE SYSTEM VALVES			
		STD U.S. FRONT BRAKE VALVE			
		RELAY VALVE WITH 5-8 PSI CRACK PRESSURE, NO REAR PROPORTIONING VALVE			
		WABCO SS-1200 PLUS AIR DRYER WITH INTEGRAL AIR GOVERNOR AND HEATER			
		WABCO OIL COALESCING FILTER FOR AIR DRYER			
		AIR DRYER FRAME MOUNTED			
		STEEL AIR BRAKE RESERVOIRS			
		(1) 700 CUBIC INCH ALUMINUM TRANSMISSION AIR TANK, INLET CHECK VALVE			
		PULL CABLES ON ALL AIR RESERVOIR(S)			
		QUICK DISCONNECT FITTING WITH TIRE INFLATION KIT	2		
Trailer Connections					
		12 FOOT STRAIGHT TRAILER AIR HOSE			
		36 INCH STAINLESS STEEL SLIDE BAR WITH SPRING TYPE AIR HOSE HANGER			
		COMBINATION DUMMY GLAD HANDS AND LIGHT PLUG HOLDER MOUNTED LH BACK OF CAB WITH GROUND ACCESS			
		PRIMARY CONNECTOR/RECEPTACLE WIRED FOR SEPARATE STOP/TURN, ABS CENTER PIN POWERED THROUGH IGNITION			
		SAE J560 7-WAY PRIMARY TRAILER CABLE RECEPTACLE MOUNTED LOWER LH BACK OF CAB			
*		SIGNAL DETECTION AND ACTUATION MODULE			
		12 FOOT DETACHABLE STRAIGHT PRIMARY TRAILER ELECTRICAL CABLE WITH SAE J560 CONNECTOR			
Wheelbase & Frame					
N		5675MM (223 INCH) WHEELBASE			
		7.0MM X 88.0MM X 279.0MM STEEL FRAME (0.28X3.46X10.98 INCH) 120 KSI			
		1450MM (57 INCH) REAR FRAME OVERHANG			
		FRAME OVERHANG RANGE: 51 INCH TO 60 INCH			

		Description	Weight Front	Weight Rear	
		CALC'D BACK OF CAB TO REAR SUSP C/L (CA) : 85.01 in			
		CALCULATED EFFECTIVE BACK OF CAB TO REAR SUSPENSION C/L (CA) : 79.42 in			
		CALC'D FRAME LENGTH - OVERALL : 312.97			
		CALC'D SPACE AVAILABLE FOR DECKPLATE : 48.99 in			
N		CALCULATED FRAME SPACE LH SIDE : -2.33 in			
		CALCULATED FRAME SPACE RH SIDE : 56.78 in			
*		UNDER OR OVERSLUNG CROSSMEMBER			
		FLANGED TAPERED END OF FRAME			
		FRONT CLOSING CROSSMEMBER			
		LIGHTWEIGHT HEAVY DUTY ALUMINUM ENGINE CROSSMEMBER			
		STANDARD MIDSHIP #1 CROSSMEMBER(S)			
		STANDARD REARMOST CROSSMEMBER			
		STANDARD SUSPENSION CROSSMEMBER			
Chassis Equipment					
		LH BACK OF CAB ACCESS, GRAB HANDLES WITH SINGLE RUBBER INSERT			
		21 INCH (525MM) DECK PLATE FLUSH MOUNTED BETWEEN RAILS	3	2	
		PAINTED AERODYNAMIC BUMPER WITH CHROME OVERLAY AND ENHANCED AERODYNAMIC DEVICES	32		
		REMOVABLE FRONT TOW HOOKS STORED ON THE CHASSIS FRAME	25		
		BUMPER MOUNTING FOR (3) LICENSE PLATES			
		NO MUDFLAP BRACKETS		-15	
		BLACK MUDFLAPS			
		FRONT ANTI-SPRAY CAB MOUNTED MUDFLAPS			
		HUCK-SPIN ROUND COLLAR CHASSIS FASTENERS EXCLUDING FIFTH WHEEL			
		PLASTIC QUARTER FENDERS WITHOUT LOGO WITH AERODYNAMIC SPOILER		25	
		FACTORY INSTALLED BENDIX SMARTIRE TIRE PRESSURE MONITORING SYSTEM WITH WHEEL RIM MOUNTED SENSORS AND INTEGRATED IN DASH	6	6	
		DEDICATED PATHWAY, HIGH COMPLEXITY ROUTING AND CLIPPING			
Fifth Wheel					
		HOLLAND FWAL ILS LOW-LUBE 24.0 INCH AIR SLIDE FIFTH WHEEL WITH ALUMINUM TOP PLATE - 2 INCH SLIDE INCREMENTS		-30	
		FIFTH WHEEL 356MM (14.0 INCHES) AHEAD OF SUSPENSION CENTERLINE			
		187MM (7.38 INCH) FIFTH WHEEL HEIGHT			

		Description	Weight Front	Weight Rear	
		OUTBOARD ANGLE - FIFTH WHEEL MOUNTING			
		DASH MOUNTED CONTROL VALVE AND PLUMBING FOR FIFTH WHEEL			
		LH FIFTH WHEEL RELEASE			
Fuel Tanks					
		120 GALLON/453 LITER ALUMINUM FUEL TANK - RH	5	5	
		120 GALLON/453 LITER ALUMINUM FUEL TANK - LH	10		
		25 INCH DIAMETER FUEL TANK(S)			
		PLAIN ALUMINUM/PAINTED STEEL FUEL/ HYDRAULIC TANK(S) WITH PAINTED BANDS			
		FUEL TANK(S) AFT			
		30 GALLONS ADDITIONAL FUEL			
		POLISHED STEP FINISH			
		CHROME LOCKING FUEL TANK CAP(S), ALL UNITS KEYED ALIKE			
		DETROIT FUEL/WATER SEPARATOR WITH BYPASS AND 12 VOLT PREHEATER	10		
		EQUIFLO INBOARD FUEL SYSTEM			
		NO NATURAL GAS VEHICLE FUEL TANK VENT LINE/STACK			
		HIGH TEMPERATURE REINFORCED NYLON FUEL LINE			
Tires					
		MICHELIN X LINE ENERGY Z 275/80R22.5 16 PLY RADIAL FRONT TIRES	4		
		MICHELIN X-ONE LINE ENERGY D 445/50R22.5 20 PLY RADIAL REAR TIRES		-184	
Hubs					
*		CONMET PRESET PLUS ALUMINUM FRONT HUBS			
*		CONMET PRESET PLUS ALUMINUM REAR HUBS			
Wheels					
		ALCOA ULTRA ONE ULTRAX 22.5X8.25 10-HUB PILOT 5.79 INSET ALUMINUM DISC FRONT WHEELS	-60		
		ALCOA ULTRA ONE 84U60X 22.5X14.00 10-HUB PILOT 0.00 OUTSET 10-HAND ALUMINUM REAR WHEELS		-352	
		POLISHED DISC SIDE FRONT WHEELS WITH DURA-BRIGHT FINISH			
N		POLISHED OUTER (DISHED SIDE) REAR WHEELS WITH OUTER ONLY DURA-BRIGHT FINISH			
		FLOW BELOW MOLD IN COLOR GRANITE GRAY AERODYNAMIC REAR AXLE WHEEL COVERS		16	

		Description	Weight Front	Weight Rear	
		BENDIX SMARTIRE TIRE PRESSURE MONITORING SYSTEM WHEEL/RIM MOUNTED SENSORS, TIRE MOUNTER INSTALLED	8	64	
		FRONT WHEEL MOUNTING NUTS			
		REAR WHEEL MOUNTING NUTS			
		WHEEL STUDS FOR CUSTOMER INSTALLED HUB PILOTED DUALED ALUMINUM WHEELS, ALL AND NYLON FRONT WHEEL GUARDS			
Cab Exterior					
		126 INCH BBC ALUMINUM CONVENTIONAL CAB			
		RH CAB DOOR(S) WITH 70 DEGREE DOOR STOP			
		LH CAB DOOR(S) WITH 70 DEGREE DOOR STOP			
		72 INCH RAISED ROOF SLEEPERCAB			
		RAISED ROOF AERODYNAMIC SPOILER			
		24 INCH CAB/SLEEPERCAB SIDE EXTENDERS WITH BLACK FLEXIBLE ENDS AND CHASSIS FAIRING GAP FILLER PANEL	25	25	
		UNDER CAB VANITY PANELS			
		PAINTED FRAME SIDE FAIRINGS TO BACK OF SIDE EXTENDERS	125	85	
		LATCHED FRONT LEFT SIDE FAIRING PANEL FOR BATTERY ACCESS			
		AERODYNAMIC SKIRT FOR CHASSIS FAIRINGS			
		AERODYNAMIC DRIVE WHEEL FAIRINGS		80	
		LH AND RH BAGGAGE DOORS			
		AIR CAB MOUNTING			
		NONREMOVABLE BUGSCREEN MOUNTED BEHIND GRILLE			
		LH AND RH SLEEPER DOORS	20	10	
		INTERIOR GRAB HANDLES WITH ADDED LOWER LH AND RH A PILLAR GRAB HANDLES			
		CHROME GRILLE WITH INTEGRAL SURROUND			
		BLACK HOOD MOUNTED AIR INTAKE GRILLE WITH BRIGHT ACCENT			
		AERODYNAMIC HOOD			
		INTEGRATED DETROIT POWER TRAIN BADGE FOR NEW [truck model] ONLY			
		SINGLE AIR HORN UNDER LH DECK			
		SINGLE ELECTRIC HORN			
		DOOR LOCKS AND IGNITION SWITCH KEYED THE SAME			
		REAR LICENSE PLATE MOUNT END OF FRAME			
		LED LOW BEAM AND HIGH BEAM HEADLIGHTS			
		ROOF MOUNTED LED MARKER LIGHTS			
		LED FOG LIGHTS	6		

		Description	Weight Front	Weight Rear	
		HEADLIGHTS ON WITH WIPERS, WITH DAYTIME RUNNING LIGHTS			
		TRUCK-LITE SERIES 60 LED STOP/TAIL WITH SEPARATE BACKUP LIGHTS			
		LED SIDE TURN SIGNAL			
		(2) FLUSH LED UTILITY LIGHTS MOUNTED BACK OF CAB/SLEEPER			
		DUAL BRIGHT FINISH HEATED AERODYNAMIC MIRRORS WITH INTEGRAL CONVEX AND LH AND RH REMOTE			
		DOOR MOUNTED MIRRORS			
*		102 INCH EQUIPMENT WIDTH			
		RH DOWN VIEW MIRROR			
		STANDARD SIDE/REAR REFLECTORS			
		REAR REFLECTIVE DEVICE			
		ELECTRIC HORN WARNING SYSTEM FOR PARK BRAKE NOT SET WITH DOOR OPEN AND ALL IGNITION KEY POSITIONS			
		NO SLEEPER VENT	-10		
		SOLAR TINTED DOOR GLASS LH AND RH WITH TINTED FORWARD SIDE GLASS			
		RH AND LH ELECTRIC POWERED WINDOWS			
		LH AND RH SOLAR TINTED AND SCREENED CRANK OUT SLEEPER CAP WINDOWS			
		LH AND RH TINTED AND SCREENED SLIDING WINDOWS	4	4	
		1-PIECE TINTED ROPED-IN WINDSHIELD			
		8 LITER WINDSHIELD WASHER RESERVOIR, CAB MOUNTED, WITH FLUID LEVEL INDICATOR			
Cab Interior					
		SADDLE TAN UP LEVEL INTERIOR			
		SADDLE TAN WITH OREGON ASH WOODGRAIN HARD TRIM			
		STANDARD LH DOOR TRIM			
		STANDARD RH DOOR TRIM			
		BLACK MATS			
		BLACK MAT IN SLEEPER AREA			
		BLACK MATS IN BAGGAGE COMPARTMENT			
		(3) DASH MOUNTED POWER OUTLETS AND COIN TRAY			
		SLEEPER TALL CLOSET WITH UPPER STORAGE			
		MICROWAVE SHELF WITH UPPER STORAGE AND FACTORY INSTALLED REFRIGERATOR			
		FORWARD ROOF MOUNTED CONSOLE WITH DOORS RH AND LH	2		
		LH AND RH DOOR STORAGE POCKETS INTEGRATED INTO MOLDED DOOR PANELS			

		Description	Weight Front	Weight Rear	
		STORAGE POCKET(S) MOUNTED INSIDE CABINET DOOR(S)			
N		DRIVER LOFT; MURPHY BED WITH FOLDABLE SEATS AND TABLE	65	65	
		FOLDABLE UPPER BUNK			
		BUNK RESTRAINT FOR UPPER BUNK, TENT STYLE RESTRAINT FOR LOWER BUNK			
		DIGITAL ALARM CLOCK IN DRIVER DISPLAY			
		WING DASH WITH E-VAULT			
N		5 LB. FIRE EXTINGUISHER MOUNTED IN LH BAGGAGE COMPARTMENT	10		
		FIRST AID KIT	2		
		HEATER, DEFROSTER AND AIR CONDITIONER WITH CONSTANT OUTLET TEMPERATURE CONTROL			
		HVAC DUCTING WITH MAIN FRESH AIR FILTER			
		MAIN HVAC CONTROLS WITH RECIRCULATION SWITCH			
*		PARKSMART PARKED HVAC SYSTEM WITH OPTIMI ZED IDLE			
		STANDARD HEATER PLUMBING WITH BALL SHUTOFF VALVES AT SUPPLY LINES ONLY			
*		AUXILIARY HEATER PLUMBING			
		DENSO HEAVY DUTY AIR CONDITIONER COMPRESSOR			
		RADIATOR MOUNTED AIR CONDITIONER CONDENSER			
		BINARY CONTROL, R-134A			
		PREMIUM INSULATION			
		SOLID-STATE CIRCUIT PROTECTION AND FUSES			
		12V NEGATIVE GROUND ELECTRICAL SYSTEM			
		DOOR AND BUNK ACTIVATED LH AND RH BUNK MOUNTED LED BAGGAGE COMPARTMENT LIGHTS			
		PREMIUM LED CAB LIGHTING			
		PREMIUM LED SLEEPER LIGHTING			
		LH AND RH ELECTRIC DOOR LOCKS			
		BRIGHT DOOR HANDLES			
		QUILTED SPRING MATTRESS IN LOWER BUNK AND SPRING MATTRESS IN UPPER BUNK	30	30	
		(3) 12 VOLT POWER OUTLETS IN BUNK AREA			
		AC 120 VOLT CAB WIRING AND AC OUTLET, WITH SHORE POWER AND XANTREX 1500 WATT MODIFIED SINE WAVE INVERTER/ CHARGER SYSTEM	50		
		CAB PRIVACY CURTAIN	5		
		BUILT-IN REFRIGERATOR	20	20	

		Description	Weight Front	Weight Rear	
		PREMIUM 2.0 HIGH BACK AIR SUSPENSION DRIVER SEAT WITH 2 AIR LUMBAR, INTEGRATED CUSHION EXTENSION, TILT AND ADJUSTABLE SHOCK			
		PREMIUM 2.0 HIGH BACK AIR SUSPENSION PASSENGER SEAT WITH 2 AIR LUMBAR, INTEGRATED CUSHION EXTENSION, TILT AND ADJUSTABLE SHOCK			
		BLACK SUSPENSION COVER FOR DRIVER AND PASSENGER SEATS	4		
		DUAL DRIVER AND PASSENGER SEAT ARMRESTS	8		
		VINYL WITH VINYL INSERT DRIVER SEAT			
		VINYL WITH VINYL INSERT PASSENGER SEAT			
		3 POINT ADJUSTABLE D-RING RETRACTOR DRIVER AND FIXED D-RING RETRACTOR PASSENGER SEAT BELTS WITH DRIVER SEAT BELT STATUS INDICATOR LIGHT AND AUDIBLE ALARM			
		SLEEPER CURTAIN			
		ADJUSTABLE TILT AND TELESCOPING STEERING COLUMN			
		4-SPOKE 18 INCH (450MM) LEATHER WRAPPED STEERING WHEEL WITH CHROME SWITCH BEZELS			
N		STEEL STEERING SHAFT			
		DRIVER AND PASSENGER INTERIOR SUN VISORS WITH ILLUMINATED VANITY MIRRORS			
Instruments & Controls					
		ELECTRONIC ACCELERATOR CONTROL WITH KICKDOWN FEATURE			
		STANDARD CENTER INSTRUMENT PANEL			
		BLACK GAUGE BEZELS			
		LOW AIR PRESSURE INDICATOR LIGHT AND AUDIBLE ALARM			
		(1) TRACTOR AND (1) TRAILER BRAKE APPLICATION AIR GAUGE			
		DUAL NEEDLE PRIMARY AND SECONDARY AIR PRESSURE GAUGE			
		DASH MOUNTED AIR RESTRICTION INDICATOR WITH GRADUATIONS	2		
		ELECTRONIC CRUISE CONTROL WITH INTELLIGENT POWERTRAIN MANAGEMENT AND CONTROLS ON STEERING WHEEL SPOKES			
		KEY OPERATED IGNITION SWITCH AND INTEGRAL START POSITION WITH DDC OPTIMIZED IDLE SYSTEM			
		PREMIUM INSTRUMENT CLUSTER WITH 5.0 INCH TFT COLOR DISPLAY			

		Description	Weight Front	Weight Rear	
		DIGITAL PANEL LAMP DIMMER SWITCH IN DRIVER DISPLAY			
		HEAVY DUTY ONBOARD DIAGNOSTICS INTERFACE CONNECTOR LOCATED BELOW LH DASH			
		2 INCH ELECTRIC FUEL GAUGE			
		FUEL FILTER RESTRICTION INDICATOR			
		EMISSIONS LIMITED IDLE ADJUST			
		DIGITAL DUAL REAR AXLE TEMPERATURE IN DRIVER DISPLAY WITH SENSOR SHIELDS			
		ELECTRICAL ENGINE COOLANT TEMPERATURE GAUGE			
		DIGITAL ENGINE OIL TEMPERATURE IN DRIVER DISPLAY			
		DIGITAL TRANSMISSION OIL TEMPERATURE IN DRIVER DISPLAY			
		ELECTRONIC OUTSIDE TEMPERATURE SENSOR DISPLAY IN DRIVER MESSAGE CENTER			
		ENGINE AND TRIP HOUR METERS INTEGRAL WITHIN DRIVER DISPLAY			
		DETROIT ASSURANCE COLLISION WARNING, ADAPTIVE CRUISE CONTROL AND ACTIVE BRAKE ASSIST 4 WITH ADJUSTABLE HEADWAY CONTROL	20		
		ELECTRONIC STABILITY CONTROL			
*		DETROIT ASSURANCE LANE DEPARTURE WARNING SYSTEM WITH ON/OFF DASH SWITCH AND DROWSY DRIVER			
		ELECTRIC ENGINE OIL PRESSURE GAUGE			
		GENERIC TELEMATICS PREWIRE (CONSTANT BATTERY POWER/IGNITION/GROUND/J1939); RP1226 TYPE CONNECTOR AT PASSENGER SIDE OF DASH END			
		AM/FM/WB WORLD TUNER RADIO WITH SIRIUS XM, CD PLAYER, BLUETOOTH, IPOD INTERFACE AND USB AND AUXILIARY INPUTS, J1939	10		
		DASH MOUNTED RADIO			
		STANDARD SPEAKER SYSTEM			
		AM/FM/WB INTEGRATED AERO-ROOF ANTENNA			
		COBRA 29NW LTD CLASSIC FACTORY INSTALLED CB RADIO	5		
		ROOF/OVERHEAD CONSOLE CB RADIO PROVISION			
		INTEGRATED AERO-ROOF CB ANTENNA			
		INTEROPERABLE SDAR ANTENNA			
		FLAT SCREEN TV MOUNT WITH TV ANTENNA	20		

		Description	Weight Front	Weight Rear	
		ELECTRONIC MPH SPEEDOMETER WITH SECONDARY KPH SCALE, WITHOUT ODOMETER			
		STANDARD VEHICLE SPEED SENSOR			
		ELECTRONIC 2500 RPM TACHOMETER			
N		DETROIT CONNECT PLATFORM HARDWARE (CUSTOM SERVICE ENABLED)			
		5 YEARS DETROIT CONNECT BASE PACKAGE (VIRTUAL TECHNICIAN, REMOTE UPDATES, DETROIT CONNECT PORTAL ACCESS) DETROIT CONNECT PLATFORM			
		IDLE LIMITER, ELECTRONIC ENGINE, PARK BRAKE ACTIVATED			
		TWO ON/OFF ROCKER SWITCHES IN THE DASH WITH INDICATOR LIGHTS AND WIRE ROUTED TO CHASSIS AT BACK OF CAB, LABEL OPT			
		PRE-TRIP INSPECTION FEATURE FOR EXTERIOR LAMPS ONLY			
		STEERING WHEEL MOUNTED ELECTRIC HORN CONTROL			
		BW TRACTOR PROTECTION VALVE			
		TRAILER HAND CONTROL BRAKE VALVE			
		DIGITAL TURBO AIR PRESSURE IN DRIVER DISPLAY			
		DIGITAL VOLTAGE DISPLAY INTEGRAL WITH DRIVER DISPLAY			
		SINGLE ELECTRIC WINDSHIELD WIPER MOTOR WITH DELAY			
		ROTARY HEADLAMP SWITCH, MARKER LIGHTS/HEADLIGHTS SWITCH WITH PULL OUT FOR OPTIONAL FOG/ROAD LAMPS			
		TWO VALVE PARKING BRAKE SYSTEM WITH DASH VALVE CONTROL AUTONEUTRAL AND WARNING INDICATOR			
		SELF CANCELING TURN SIGNAL SWITCH WITH DIMMER, HEADLAMP FLASH, WASH/WIPE/ INTERMITTENT			
		INTEGRAL ELECTRONIC TURN SIGNAL FLASHER WITH 40 AMP (20 AMP PER SIDE) TRAILER LAMP CAPACITY			
		PDI INSTALLED AIR-WEIGH TRUCK SCALE, 5801, DUAL AIR DRIVE, CALC STEER - 2A5801B1B1A0A0A			
Design					
		PAINT: ONE SOLID COLOR			
Color					
		CAB COLOR A: L0228EB MED RICH BLUE MET ELITE BC			
		BLACK, HIGH SOLIDS POLYURETHANE CHASSIS PAINT			

		Description	Weight Front	Weight Rear	
		CHASSIS SIDE FAIRINGS PAINTED SAME AS LOWER CAB SECTION OR FENDER			
		BUMPER PAINT: L0228EB MED RICH BLUE MET ELITE BC			
Certification / Compliance					
		U.S. AND CANADA (DUAL CERTIFICATION), EXCEPT SALES CABS AND GLIDER KITS			
		SMARTWAY EPA CERTIFICATION LABEL			
Secondary Factory Options					
*		CORPORATE PDI CENTER IN-SERVICE AND OPTI ON INSTALLATION/MODIFICATION			
	CENTRAMATIC WHEEL BALANCERS				
*		PDI PERFORMED INITIAL FEDERAL FMCSR 396 DOT INSPECTION			
	LEAVE LABEL LOOSE IN CAB				
		SHIP TO CLEVELAND PDI CENTER FOR MODIFICATIONS PRIOR TO DELIVERY			