Kenworth Truck Company Offers Advice on Spec'ing for Mixers

A mixer is a highly specialized piece of equipment, which is expected to put in a number of years of service. To ensure efficiency over the life of the vehicle, it's important to spec wisely.

A key consideration to spec'ing is the local length and weight regulations since these will dictate the axle spacing needed to maximize payload. Some states require compliance with the Federal Bridge Formula; others don't. This will have a big influence on how the axles are set up and spaced.

"The intent of the Federal Bridge Formula truck spec is to spread the weight over the longest wheelbase, which defines where the steer axle goes and has a direct impact on frame dimensions," says Alan Fennimore, vocational marketing manager for Kenworth Truck Company in Kirkland, Wash. "In most cases, a set-forward steer axle with a flying tag is a common mixer spec. The Kenworth W900S is an example of a chassis designed specifically to meet the Federal Bridge Formula with its set-forward front axle and 28-inch bumper setting."

Kenworth W900S

To maximize compliance with the Federal Bridge Formula, operators must keep several important measurements in mind. The truck must not exceed an overall length of 40 feet (480 inches). The measurement from the centerline of the front steer axle to the centerline of the booster axle must exceed 30-1/2 feet (427 inches or greater) to provide the maximum allowable 66,000 pounds GVW on four axles. Any length less than 427 inches reduces the maximum GVW. However, some states do allow exceptions of up to 45 feet in overall vehicle length, so check with local and state authorities.

"Since the rear mudflap is usually 25 inches from the center of the booster axle, the steer axle needs to be within 28 inches of the front bumper, which is characteristic of the Kenworth W900S," Fennimore says. "Also, be careful not to spec a permanently-mounted tow hook which extends out front, since it could make your truck over-length."

Kenworth T800 Short Hood

In states where operators aren't required to comply with the Federal Bridge Formula, mixer trucks can be specified shorter and with a setback axle to make them more maneuverable on jobsites. The Kenworth T800 short hood and the Kenworth T440 are examples of trucks that work well for these mixer applications. "You may need to spec lift axles to distribute more weight of the mixer over more axles. That's because those states often have limits on the amount of weight each axle or each wheel may carry. This may apply to both Federal Bridge and non-bridge law configurations," notes Fennimore.

Kenworth T440

Depending on the weight carried by the steer axle and the laws in your state, you may also need to spec wide-based front tires. "This would require a 425/65R22.5 tire size to get to the 20,000-pound rating on the front axle," says Fennimore.

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Kenworth T800 Twin Steer

Another option is the Kenworth T800 twin steer model, which may be more suitable for certain state weight requirements. This model is based off the set-back axle T800 with the second steer axle located 72 inches rear of the front steer axle. The maximum front GAWR is 40,000 pounds. In some cases, this configuration can operate without a pusher for up to an 80,000-pound GCW, where state regulations allow.

2010 Engines – SCR or EGR

It's especially important to understand how the 2010 federal engine emissions standards may require some changes to be made when spec'ing for new truck purchases compared to your current mixer spec, which may include a 2007 emission-compliant or older engine.

"The extent of these changes depends upon each mixer operator's choice between selective catalytic reduction (SCR) and increased exhaust gas recirculation (EGR) engine technologies, which may also affect truck performance and operating costs over its lifetime," Fennimore says.

Alan Fennimore
Kenworth Vocational Marketing Manager

SCR mixes a reductant – most commonly a solution of urea and de-ionized water known as diesel exhaust fluid (DEF) – with the oxides of nitrogen (NOx) in exhaust gases. The exhaust then passes through a catalyst, where the DEF reacts with the NOx to convert it into nitrogen and water.

Increased EGR reduces NOx by boosting the amount of exhaust gases in the engine cylinder, then slowing and cooling the combustion process inside the cylinder resulting in different and reduced pollutants. The increased heat created with the enhanced EGR approach requires greater engine cooling capacity. Increased EGR also requires more fuel to be injected into the DPF for active regenerations. The increased heat that an advanced EGR engine has to deal with will most likely affect overall engine life as well.

According to Fennimore, it is important for operators choosing SCR to consider DEF tank capacity and placement. "To support SCR system integration, Kenworth provides a range of exhaust and DEF tank sizes and locations designed for mixers. This helps mixer operators maintain their wheelbase and body configuration when spec'ing Kenworth trucks with 2010 EPA-compliant engines," Fennimore says.

"For mixers where truck frame space is often critical, Kenworth provides a 5.6-gallon DEF tank with a clear back of cab option unique to the industry. The tank provides a range of 800 to 1,200 miles between refilling with the range dependent on duty-cycle and fuel economy. When combined with an in-cab battery box and a Kenworth SCR and DPF package located under the cab access step, there's essentially no impact to the customer as far as valuable frame space compared to a pre-2010 emissions truck," he said.

Not all SCR technology engines are the same, however. "An aftertreatment catalyst using copper zeolite is more efficient than one with iron zeolite at reducing NOx at normal engine operating temperatures," says Fennimore. "That's why engines using copper zeolite may offer better fuel economy than engines using iron zeolite." PACCAR engines and Cummins engines both use copper zeolite.

PACCAR MX Engine

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A Green Option: Natural Gas

A green option is natural gas. While it does not have the high energy density of diesel fuel, it does provide a cleaner burning fuel without the need for complex emission reduction technology. Natural gas is domestically produced, so it reduces reliance on foreign oil. The drawback can be a higher initial engine and fuel storage system cost. However, an estimated $2-plus savings per gallon on natural gas compared to diesel makes the ROI very attractive, Fennimore says.

Some state and local air quality control agencies may offer grant programs to help offset the additional cost of the alternative fuel engine technology and fueling stations. Plus, by deleting the additional weight associated with the SCR or EGR emission control systems, a natural gas-powered mixer may be able to carry more payload over a comparable diesel engine.

Kenworth W900S Natural Gas

Natural gas-powered engines, such as the Cummins Westport ISL G engine, are available for heavy duty Class 8 trucks, including the W900S and T440. The ISL G, which is rated at 320 hp and 1,000 lb-ft of torque, uses a maintenance-free, three-way catalyst and is 2010 EPA- and CARB-compliant without the use of SCR technology or a DPF. The ISL G is available with an Allison 3000 or 4000 series transmission.

Kenworth T440 Natural Gas

It's important to work with your truck salesperson and mixer body builder to assess which fuel storage system – compressed natural gas (CNG) or liquefied natural gas (LNG) – will work best for you. "Your decision may be determined by the availability of CNG or LNG fuel in your area," Fennimore says. "Currently, CNG is the preferred fuel storage system for mixer applications."

The Drivetrain

Whether operators choose natural gas- or diesel fuel-powered engines, big horsepower is generally not a requirement for mixer applications. "You should get just enough horsepower to do the job," says Kenworth's Fennimore. "Engines with 320 to 350 hp should be plenty for most applications. Extra horsepower just uses more fuel, puts more strain on the rest of the drivetrain, costs more and adds weight."

Kenworth T470

Truck models with the versatility to span class 7 and class 8 ratings, such as the set-back axle Kenworth T440 and T470, can offer operators the widest array of choices to build mixers that will meet their operational needs, Fennimore says.

"With the Kenworth T440, for example, operators have a choice of front axle ratings from 12,000 to 22,000 pounds, rear axles from 21,000-pound single to 46,000-pound dual drives and three frame rail sizes to match strength and weight requirements," he adds. "Plus, the T440 can be spec'd with the PACCAR PX-8, which offers a range of power choices from 260 to 350 hp and from 600 to 1,000 lb-ft of torque."

PACCAR PX-8 Engine

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In cases where additional power and payload is required, the Cummins ISL9 is available with ratings up to 380 hp and 1300 lb-ft of torque. When additional power is required for a larger mixing drum, or where weight is not as much an issue, a PACCAR MX 12.9-liter or Cummins ISX11.9 engine offers excellent performance. In addition, the larger engines will last longer. These medium displacement engines are available in the set-forward W900S and the set-back T800 short hood.

Kenworth W900S

Kenworth T800 Short Hood

According to Fennimore, the rear axle ratios should be evenly matched with the transmission so that engine speed is around 1,600 rpm at highway speeds. "You should also be able to go as slow as 1.5 mph at 1,400 or more rpm," he says. "A 4.30:1 ratio with 11R22.5 tires and the -9ALL transmission works well. With a 6-speed automatic transmission, use a 4.88:1 or lower ratio."

Automatic or Manual Transmission

The transmission you put behind the engine needs a wide ratio range to have good startability and gradability around jobsites and on the highway. "The Eaton 9ALL is a common transmission spec for mixers. It has a really low ratio for crawling while pouring curbs or other continuous pours. But there's also a high enough top end for traveling at highway speeds," he says.

In addition to the standard manual transmission, Eaton offers the vocational series of UltraShift® Plus available specifically designed for mixer usage. This automated manual includes the following vocational specific features: Hill Hold and Creep Modes.

"We're seeing more automatic and automated manual transmissions being spec'd for mixer use," Fennimore notes. "With the electronic controls on the newer automatics, the shifting is very smooth and responsive. They're easier on drivers and reduce stress on the drivetrain, and the truck can keep up in traffic much easier."

Operators may also want to consider a transmission that can automatically select between economy and performance shift schedules based on the vehicle's actual payload and its operating grade.

"The addition of Allison's load-based shift scheduling (LBSS) can allow the mode button on the transmission's shift selector to be programmed for controlling other vehicle functions, such as body builder functions or power takeoff (PTO) operation," Fennimore says. "The economy mode is used when the truck travels on level terrain with an empty or diminishing load. The performance mode is used when the vehicle is heavily loaded or on a grade."

Operators can choose LBSS on select Allison transmissions, such as the company's 3000 and 4000 series. The Allison 3000 series is limited to a GVW of 60,000 pounds, and is available on the Kenworth T440 and W900S mixers only with the PACCAR PX-8 or Cummins ISL9 engines.

One additional Allison transmission gaining popularity in mixer applications is the 4700 RDS, which offers a 7.63 to 1 low first gear and optional second reverse. This helps give drivers extra control while pouring curb or backing down that steep incline to pour a footing. Another 4700 RDS feature is a converter lockup mode in first gear, which reduces excess heat being returned to the cooling system from a slipping torque converter without this feature.

Front Engine or Rear Engine PTO

The PTO must come directly from the engine in order to provide enough power for the mixer system. Whether you use front engine or a rear engine PTO depends on the chassis configuration. Fennimore recommends a rear engine PTO any time you can make it fit.

But in those areas where the front pedestal must be mounted immediately back of cab, a front engine PTO is the only alternative. "A front-mounted PTO makes sense in states like Florida, where the weight laws give you an incentive to get more load on the steer axle," he says. The Kenworth T470 – with its full parent rails front frame configuration – is an excellent model for FEPTO applications.

Kenworth T470

Kenworth T470

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"With 2010 engines rejecting more heat, a larger radiator is needed to cool the same horsepower, especially if you choose an engine that uses increased EGR technology to reduce emissions. In cases where high horsepower is required, both the Kenworth T800 FEPTO and the Kenworth C500 models offer great cooling capacity," Fennimore says.

"If you spec an automatic transmission, you'll definitely want a rear-engine PTO because it will provide 30 percent higher output speed due to the gearing at the flywheel," he says. "This allows much less slip in the torque converter when you are crawling along and want to keep the drum speed up to pour the concrete. Too much slip in the torque converter can lead to overheating the transmission or the engine's cooling system."

For high PTO torque requirements, the PACCAR MX offers 612 lb-ft of output torque from the rear engine PTO.

Location Issues

Kenworth W900S and Kenworth T800

Mixer specifications are also influenced by the type of delivery locations for the concrete. The heavier the load and the rougher the terrain, the more the chassis and suspension need to be beefed up.

"If your mixer chassis needs to get into some pretty rough jobsites," says Fennimore, "be sure to spec a suspension with a lot of articulation." Good examples are the Chalmers 854 series and the Hendrickson HAULMAAX® tandem suspensions, which both offer good off-road articulation and durability.

The frame rail specs are impacted by the type of mixer barrel used. "If the barrel has a subframe welded to the chassis rails that is approved by the OEM, a single 11-5/8-inch frame is fine," says Fennimore. "You'll want a transition plate bolted to the frame at back of the cab which goes as far forward as possible. This help ease stresses on the rails.

"But if the mixer pedestals are mounted directly to the frame rails, you'll need an inserted frame of at least 10-3/4 inches," he says. "Remember, it's not just strength you're looking for, but stiffness, too. And, if you have more than one pusher axle, an inserted rail is recommended to help withstand the higher side loads."

Kenworth W900S

Some of Kenworth's mixer-specific options from the factory are fully huck-bolted frames, factory installation of up to three pushers, and pre-punched holes in the frame rails to assist body builders with installation, among other options.

Another thing to remember about the frame: mixer manufacturers often request crossmembers in specific locations. It's a good idea to check with them before the truck is built. Kenworth offers a custom frame layout option that keep specific areas of the back of cab clear for customer-installed options.

The type of construction sites typically visited by your mixers will affect the amount of traction required. "I always recommend side-to-side differential locks in both rear axles for traction off the pavement," says Fennimore. "In areas with sandy soil, such as Florida, we've seen operators spec'ing a 6x4 configuration with active tire-pressure control systems (such as Eaton's central tire inflation system or CTIS), which allow the driver to reduce tire pressure when off-road to obtain the needed traction in the sand."

The 2010-compliant emissions engines used in the U.S. mixer market typically use an engine-mounted air cleaner, which does not require a pre-cleaner. But in dusty conditions, a Filter Minder® air restriction gauge mounted on the air cleaner should be ordered and checked on a regular basis. Another option is to order the optional Filter Minder gauge in the dash to monitor the air cleaner performance from inside the cab. Kenworth is standard with a pop-up gauge on the air cleaner under the hood.

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Weight Watching

Weight is an issue with mixers, but you have to save a lot to be able to haul an extra half yard of concrete, or about 2,000 pounds. The cost of lightweight components has to be considered.

You can slim down by spec'ing components – such as wheels, air tanks, and clutch housings – in aluminum rather than steel. "Use the smallest fuel tank you can get away with," Fennimore adds. "Most mixer applications burn about 4 to 4-1/2 gallons per hour. So, a 56- to 75-gallon tank is usually plenty of fuel for one shift."

Fennimore suggests engines such as the Cummins ISL9 to save up to 800 pounds compared with a 13-liter block in areas that do not require long runs away from the batch plant or have minimal steep grades. "With 350 horsepower and 1,250 lb-ft of torque, these 9-liter engines offer the power most operators will need." Also, the ISL engines can be mated to the Allison 3000 series automatics which will save an additional 250 pounds over the Allison 4000 series transmissions. One of the limitations of the 3000 series is reduced payload capacity of up to 62,000 pounds GVW in a mixer application.

Another option for saving additional weight, though more expensive, is spec'ing disc brakes on the steer and drive axles. This option can reduce another 100-150 pounds off the chassis weight as well as dramatically reducing stopping distances and annual maintenance costs compared to drum brakes.

Going with an in-cab battery box, which Kenworth offers, and a deleted passenger seat can eliminate between 90 and 150 pounds, depending on selecting either a 2- or 3-battery option. The 3-battery option is recommended in colder climates.

Valuable pounds can also be saved in your suspension selection. "The difference can be as high as 400 pounds," Fennimore says of the different suspension options. "You can leave shock absorbers off the rear because the weight of the mixer means you will never be running light."

Using wide-base "super single" tires instead of duals on the rear can save hundreds of pounds in wheel and tire weight. "The trade-off is that you get a narrower track if you stick with standard track axles," he says. "You can go with a wider track axle, but then you may not have the option to go back to duals later because the dual configuration will now be over width."

Driver Performance Items

With more trucking companies vying for good drivers, operators can't afford to neglect driver comfort and driver performance-related items, Fennimore says.

Kenworth W900S with Kenworth DayLite door

When it comes to visibility, Fennimore says try to spec as many windows as possible. "In addition to the standard Kenworth DayLite® doors, consider rear corner windows behind the doors," he says. "It's a good idea to mount the tailpipe behind the cab rather than at the side to keep out of the way of the corner windows.

"I suggest picking low-replacement cost windshields when they're available," he adds. "Most mixer fleets replace at least one windshield side per truck per year. Two-piece flat-glass windshields with roped-in seals can be replaced in half an hour for a typical total cost of under a hundred dollars. This can save thousands of dollars over the life of the truck." For a different look and more aerodynamics, select the two-piece curved glass option (one piece is also available).

To make mixers with lift axles easier to drive, it's smart to get a six-channel ABS system. "Lift axles, especially steerable ones, are normally over-braked for the load," Fennimore says. "By including them in the ABS system, it's much easier for the driver to avoid locking them up and flat spotting the tires." The Bendix® ESP* (Electronic Stability Program) system is available with both the bridge formula mixer configuration and with the standard mixer bodies.

Kenworth W900S Mixers

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To offer drivers the best turn performance and road feel, Fennimore recommends dual steering gears, rather than a large single steering gear with a steering assist ram. The dual system usually requires less maintenance than a single system with assist. Assist cylinders tend to be high maintenance and are typically more prone to leak or fail. The Kenworth W900S comes standard with dual steering gears, he noted.

Two additional driver performance items that Fennimore recommends are the Kenworth Extended Day Cab and Kenworth QuietCab® package.

Kenworth W900S Extended Day Cab

"The spacious Kenworth Extended Day Cab enhances driver comfort with an additional 6 inches of length and 5 inches of cab height compared to Kenworth's traditional day cab. It also has 2 more inches behind the wheel, additional leg room, up to 21 degrees of driver' seat recline, and 2 extra cubic feet of storage behind the driver's seat," he said. "The Kenworth QuietCab option helps to significantly reduce in-cab noise by two decibels, or by almost 50 percent, compared to Kenworth's standard cab. These options may help to reduce driver fatigue, enhance productivity, and aid driver retention," concluded Fennimore.

Something to consider when spec'ing your next mixers.

Kenworth's Alan Fennimore in the field