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# One lump or two?

**If 'Necessity is the mother of Invention' then legislation and safety are its twin daughters. With basic crane designs well and truly established, developments seem to revolve increasingly around enforced legislative changes or safety improvements.**

Terex Explorer 5800


Grove GMK6400

**Liebherr's Variable Supporting Base (see page 20) is a logical and sensible development, but most likely spurred on by changing legislation in the USA and Europe. This change will improve safety but for Liebherr it also has the beneficial spin-off of improved lift capacities. Legislation reducing engine emissions has also focussed the designers' minds on the problem of fuel, resulting not only in improved engine emissions but efficiency and reduced fuel consumption offering owners some significant savings in fuel costs.**

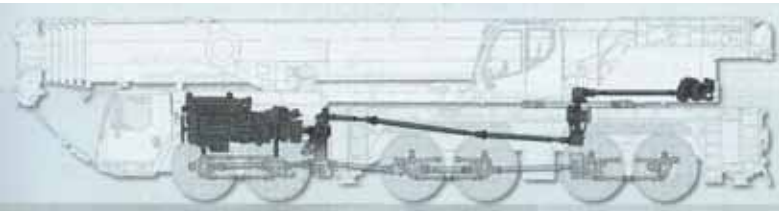
Whatever the equipment, weight is generally a problem, the reduction of which can have many benefits. Smaller capacity mobile cranes have employed a single engine for many years, but buyers have always insisted on two engines for larger road going cranes - a carrier engine specifically for moving the crane on the road and a smaller engine to power the superstructure on site.

## Single engine

One way of reducing the weight of a crane is using a single engine which powers both the carrier and crane superstructure. One of the first larger cranes to move to a single engine was the P&H Alpha Liftcraft - a five axle, 40 metre main boom, 100 ton truck mounted crane of 1981. With massive swing out outriggers it used a carrier mounted Detroit Diesel engine with a mechanical shaft to power the superstructure. Obviously a crane way ahead of its time but this crane didn't catch on and it never sold well. Since then there have been very few, if any, single-engined large road cranes (Rough Terrains have almost always used one engine). However the concept appears to be making a comeback - or rather its time may have finally come - driven more by reduced weight and therefore increased performance for a specific axle configuration. The first of the more recent 'single engine' All Terrains was the 400 tonne Grove GMK 6400, initially shown at Bauma 2010 but only recently moving to full production.

The Grove uses a single engine to save weight, space and cost. Removing the superstructure's engine also removes the exhaust after-treatment system, an important part of EUROMOT 3B and EUROMOT 4 emission regulations, thus saving even more weight.

Using a single engine on a large capacity crane presents several challenges, on the GMK6400 that involved delivering around 200kW of power to the superstructure. It manages this through a hydrostatic system with a single large pump on the carrier engine powering a large hydraulic motor in the superstructure which in turn drives the regular hydraulics. The main engine is also run at very low RPM and apparently in this mode its fuel consumption is hardly any greater than a smaller engine running at higher RPM. The PTO driven pump is also used to power wheel motors on the carrier, providing a sort of hybrid drive - Megadrive - which accelerates the crane up to 20kph before the main transmission takes over. One of the key advantages is a reduction in the cranes weight by around 600kg when compared to a two engine crane of the same size - weight which can then go into the structure or counterweight.



*Liebherr LTM 1300-6.2 shaft driven superstructure.*

## New Terex and Liebherr

Staying with the one engine concept are two other recent launches - the 220 tonne class Terex Explorer 5800 and the 300 tonne Liebherr LTM 1300-6.2. The LTM 1300 - the successor to the 250 tonne LTM 1250-6.1- features a six metre longer boom (at 78 metres) and increased capacities. However the only way to achieve this was by saving weight elsewhere - with a single engine. The carrier engine is an eight-cylinder Liebherr diesel which develops 450 kW at 1,900 rpm, it powers a mechanical shaft to the superstructure. Gear shafts are routed from the distributor gear in the chassis via two mitre gears running through the centre of the slew ring to the pump distributor gear in the superstructure. The mechanical shaft provides higher efficiency levels and combined with low engine speed ensures good fuel consumption. Liebherr says that consumption is very low overall, at least equivalent if not slightly better than having two separate engines.

The LTM 1300 includes an ECO mode - an add-on programme within the LICCON2 crane control - developed for the new single engine concept. Using the ECO mode the complete pump drive is automatically disconnected when the engine is idling and then reconnected by the intelligent controller in a matter of seconds when it is required. This ECO mode is also being made available on other mobile cranes to reduce fuel consumption and noise emissions. Crane operators do not know the

*The 180 tonne Tadano ATF180G-5 at Bauma*

perfect engine speed for the required work, resulting in many operating at higher engine speeds than necessary, particularly when certain movements - luffing the boom down or lowering the hoist - only require idling speed and increased revs do not produce significantly faster speeds. In ECO mode the driver sets the required working speed and the LICCON2 then calculates the perfect engine speed. The result is an average reduction of 10 percent in fuel consumption. This will be available in the future for ATs up to 130 tonne capacity. A similar mode is already available on the LTM 1300-6.2 and the LTM 1750-9.1.

## New Terex Explorer

The latest 220 tonne class Terex Explorer 5800 is another single engine crane and can be configured to meet axle loads from under 9.1 tonnes to 16.5 tonnes for operation in every market around the world. The five axle AT has 2.44 metre axle spacing, a short 1.2 metre front overhang and has optional boom-off solution or dolly to meet the most stringent road regulations. The 13.2 metre long carrier and all-wheel steering make it highly manoeuvrable. Standard is the 70 metre main boom and 103 metre system length with a maximum load moment of 660 tonne metres. It has a 15 tonne capacity while telescoping, 9.9 tonnes cable pull requiring less reeving for shorter rigging times and increased performance.

The single Euromot IV/Tier 4 diesel engine operates both the driveline and superstructure by hydraulics through a rotary joint. A controller automatically senses demand on the engine to offer the power required and fuel economy. Engine and gearbox maintenance points are positioned in a centralised area to reduce service time. The Explorer 5800 features the latest Terex operator's cab which has a variable tilt operator cab up to 20 degrees helping to improve visibility up the boom. It comes with the standard IC-1 control system which stores all load charts and offers easy configuration based on load and radius input and can be quickly custom configured by operators

## Tadano ATF180G-5

The latest launch from Tadano Faun is the more traditional two engine 180 tonne, five axle ATF180G-5. Although several have already been delivered to customers in North America, it had its European launch at Bauma and included a number of improvements and upgrades, including a switch to Mercedes Bluetec engines. Featuring a 60 metre main boom plus a 13.2 metre swingaway extension, the crane also has the option of a hydraulic telescopic luffing jib up to 22.8 metres long.

The ATF180 can be specified with Tadano's Lift Adjuster safety device which is said to cure the problem of a swinging load caused by boom deflection. Operating with a full 60 metre boom at an angle of 70 degrees, the load could move by up to four metres after being lifted. The Lift Adjuster - activated by a switch in the cab - minimises the pendulum effect using the Automatic Moment Limiter programme which detects boom length and angle as well as the weight of the load to be lifted. It then adjusts (increases) the boom angle to automatically minimise the change in the working radius once the boom is loaded.

# Higher capacities and greater safety

**Perhaps the most revolutionary development in the mobile crane sector at Bauma was the least publicised. Tucked away on the Liebherr stand was an information board outlining the improved safety and increased lifting capacity with its new Variable Supporting Base. Surrounded by new cranes such as the 1,000 tonne LR 11000 and the 750 tonne LTM 1750-9.1 it was easily missed, however it is arguably the biggest safety development in mobile cranes for many years.**

**In a nutshell, the system calculates the maximum lifting envelope based on the actual positions of the outriggers and the amount of on-board ballast. Currently incorrect outrigger positioning - either not being used at all or being in different positions than those specified by the operator possibly over-riding the system - is one of the main factors causing crane accidents.**

In the United States the OSHA US Crane & Derricks in Construction Final Rule standard states that by next year manufacturers must have a horizontal outrigger position sensor to ensure that the position of the stabiliser is entered into the system is correct. In Europe there are major revisions planned to European standard EN13000 over the next few years similar to the OSHA requirements which will include the monitoring of outrigger positions and at a later date a system that prevents the crane from operating if the outriggers are not deployed correctly.

## Liebherr solution

Liebherr's new Variable Supporting Base would appear to more than satisfy both the OSHA and future EN13000 requirements and will be available for customers to try out later in the year. The system however goes a lot further than the changes to the standards in that it has an infinitely variable monitoring system which works whatever the position of the outriggers and also monitors the total system weight including the ballast.

As long as the outriggers are deployed correctly with the pads in contact with good ground the system does not prevent the crane from operating, it simply modifies the lifting chart so that it can operate safely with the outrigger and ballast configuration that it detects. For example, if the crane is working alongside a wall or in one lane of an open road preventing outriggers on one side from being deployed, the system calculates the safe working envelope for the outrigger pattern and the installed ballast. In the case of the LTM 1130-5.1 in this configuration (see Figure 1) that still allows an eight tonne lift at almost 10 metres and two tonnes to about 18 metres on the side where outriggers are not deployed. Figure 2 shows a similar chart with just one of the outriggers unable to be deployed because of a nearby building and the resulting increased working envelope.


***Figure 1***

*When working alongside the open lane of a road, preventing the outriggers on one side from being extended, the Variable Support Base automatically calculates the safe working envelope.*

## Laser measurement

The system uses a specially developed Liebherr laser mounted at the chassis end within each outrigger beam. The laser beam is fired onto a target at the jack end of the outrigger, measuring the exact distance that each leg has been extended. This information is then fed into Liebherr's load moment limiter within the LICCON control together with the forces from sensors in each vertical outrigger jack to calculate the maximum safe load and working envelope of the crane in that configuration, taking into account all other crane factors including the counterweight. The system is designed to give the maximum possible lifting duty, whether the outrigger is at a pinned position or not.

The operator can also use the Lift Planner software on the screen in the cab and set up a possible theoretical lift specifying the position of each outrigger, the boom position and boom angle and this will then reveal the load for a specific radius or load at various radii with all calculations done in real time.

There is also no way to override the system. The outrigger footprint can be precisely determined whatever their relative positions, the system also knows the total weight of the jacked machine, without weighing the actual ballast. So even if the operator has left part of the counterweight on the deck so that the total machine weight is as expected, the crane knows if it is stowed or in position, because when it slews it will give an incorrect reading on one of the outriggers. Should the system fail there is a way of resetting the crane to operate under a fully manual method.

The basics of this idea have been around for a while and are increasingly applied to loader cranes and truck mounted platforms but these have always worked on fixed outrigger points - fully in, half out fully out - rather than fully variable and used cable reels to measure beam extension.

Although a simple idea, the crane software and outrigger monitoring has until now not been sophisticated enough to cater for the infinitely variable calculations, not to mention getting an accurate measurement of the force through the outrigger. While full details have not been disclosed, the Liebherr method does not measure the hydraulic pressure in the outrigger cylinder, but rather a method more akin to a strain gauge measuring the vertical force through the cylinder for greater accuracy.

One area that it does not have any control over is ground conditions and so it assumes that the crane has been set up on solid ground. Because it measures the force through the outrigger cylinder this would remain the same whatever the size of the outrigger mat which then spreads the load to the ground. It also does not use a tilt sensor to detect if the crane becomes out of level when lifting a load which is available on certain loader cranes.

## Increased lifting capacity

The improved safety aspect is just one benefit of the new system the other is an increase in the lift capacity for the same crane. For example, on most cranes the lift capacity is shown in a circle around the machine. This identifies the worst case lift and does not take into account if you are lifting directly over an outrigger where the performance could be significantly higher. Figure 3 shows the 360 degree (yellow) and the new Variable Support Base (blue) load charts. It can clearly be seen that when lifting over the outrigger supports the maximum load capacity increases as well as benefitting from small gains when lifting over the front and rear.

When a crane is used with part ballast the increase in lifting capacity and working radius is even more pronounced with the new system than when operating with full counterweight.

In the case of a Liebherr LTM 1130-5.1, it can lift a tonne at around 43 metres, rather than 33 metres without the Variable Support Base - a gain of almost 10 metres radius. This could offer numerous cost savings, such as avoiding the need to send a ballast truck for a particular lift. The new 300 tonne LTM 1300 will be the first crane to be fitted with the system later this year. Other cranes - some but not all of the three, four and five axle machines - will have it available as an option during 2014.

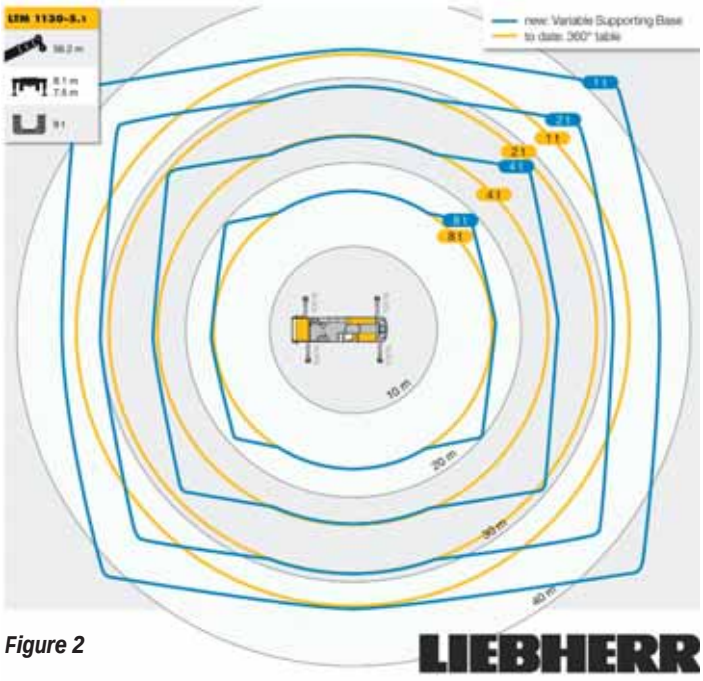



*Figure 2*

*The system also allows increased lifting capacities and a larger working range. The largest gains are when operating directly over an outrigger jack, but it also provides improvements to 360 degree charts when lifting over the front or the rear.*

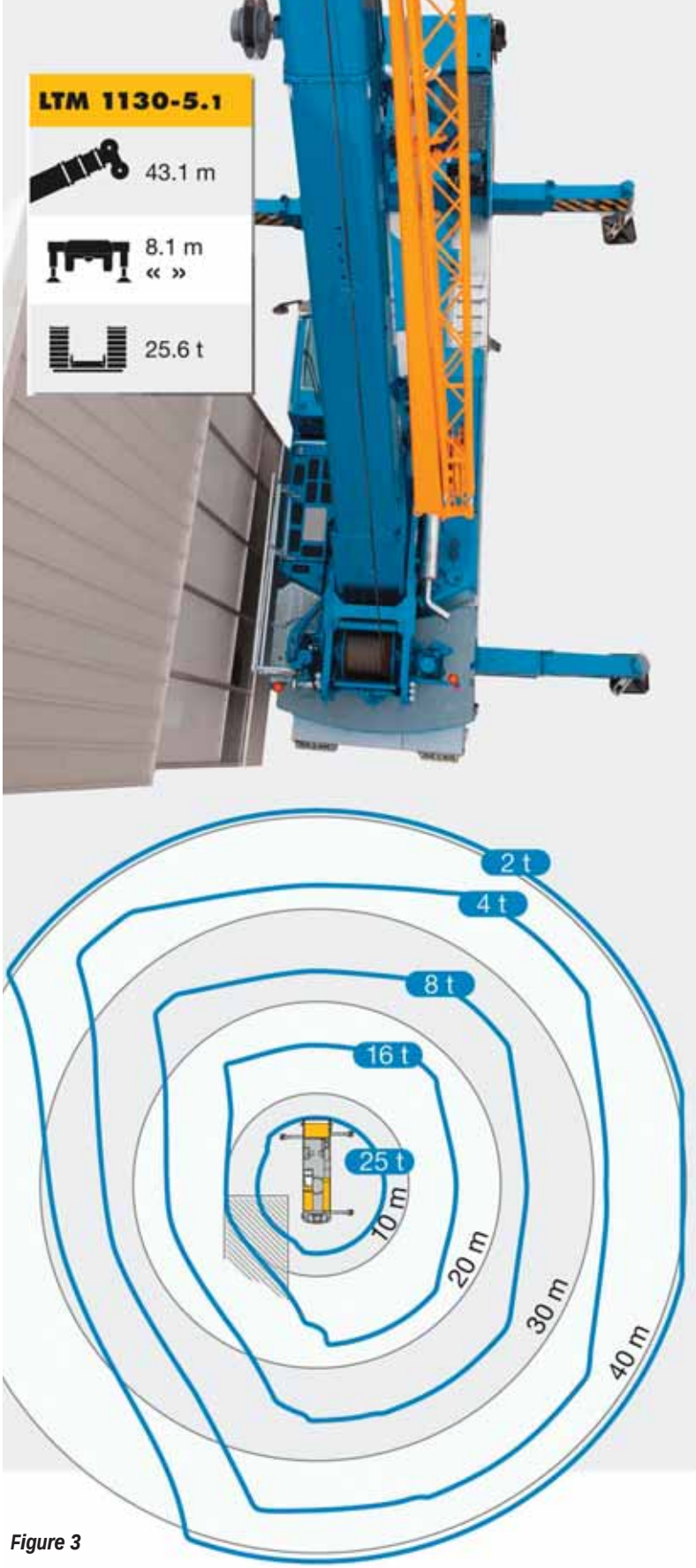



*Figure 3*

*The Variable Support Base in operation when one outrigger is unable to be deployed.*

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# Grove GMK6300L all-terrain crane

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# 60 tonne AT sector hotting up

Grove GMK 3060

**Crane sales generally have been rising at a slow but steady rate since the global financial meltdown in 2008. While nowhere near peak numbers, manufacturers are at least now buoyed by steadily increasing sales - particularly of the larger capacity cranes – even if total shipments are down around 70 to 80 percent in some countries.**

**Focusing for a moment on the UK market, which for some time now has been a conundrum for the crane manufacturers in that it is the only market in Europe where cranes do not have to comply with the 12 tonne per axle limit. Cranes can operate at up to 16.5 tonnes per axle but manufacturers have historically shied away from producing a UK specific crane.**

With the smaller 'boom down' City cranes falling out of favour and the general move by rental companies to increase the minimum lifting capacity within their fleets, the 50 to 60 tonne class is increasingly becoming the smallest machine in a fleet. In fact the 55 tonne LTM 1055 has been one of Liebherr's top selling cranes in the UK but competition is becoming more fierce not only from the usual suspects - Grove and Terex - but also from within its own range.

Bauma saw the launch of two new cranes in the 60 tonne class - the Liebherr LTM 1060 and the Grove GMK 3060 - ready to do battle with the UK version of the Terex Challenger - the 3180, a beefed up version of the Challenger 3160 making use of the increased axle weights allowable in the UK.

Terex Challenger 3180

## How do they stack up?

So how do the LTM 1060, GMK 3060 and Challenger 3160 stack up against each other? Tadano Faun only has the three axle 50 tonne ATF 50-G3 and so this is not included.

## Most powerful three axle?

Liebherr has made its intentions very clear with the LTM 1060-3.1 calling it the most powerful three axle mobile crane in the world. The crane is the company's answer to the Terex 3180 and has been designed specifically for the UK with a 48 metre main boom and a total of 12.8 tonnes of counterweight. In comparison the Challenger has a 50 metre boom and 12.1 tonnes counterweight.

Liebherr UK predicts the LTM 1060 will become a big seller taking over from the LTM 1055 because it has eight metres more boom and more counterweight within the same dimensions.

"When the concept was first mooted the Europeans said they were not interested in a crane designed specifically for the UK," said Richard Everist, managing director of Liebherr GB. "However now they have had a chance to see it in the metal, they are very interested because of its high capacity, longer boom and various ballast options giving different configurations at 12 tonnes per axle."

At 12 tonnes an axle the LTM 1060 includes 5.5 tonnes of counterweight, 16.00 tyres, eddy current brake, 6x6 drive and a hook block. A special ballast plate configuration has been implemented in the design so depending on the crane equipment the ballast carried can be 3.7, 4.3, 4.9 or 5.5 tonnes. When the maximum 12.8 tonne counterweight is stored on board it is 15 tonnes per axle appealing to countries without the 12 tonne axle load restriction.

Other features include Liebherr's latest compact chassis technology with speed-dependent rear axle steering which is said to reduce tyre wear. The driver has five different steering programmes to suite a wide variety of driving situations. Air activated disk brakes are used for increased safety and efficiency compared to conventional drum brakes. Another advantage is that the brake linings - equipped with wear indicators - are easier to change. For those wanting a closer look, the LTM 1060 will be on show at Vertikal Days with the first UK delivery at the end of July to Liverpool-based John Sutch Crane Hire and the next two being delivered to Select Plant. The LTM 1055 will continue to be available, giving buyers an extra choice. The extra cost of LTM 1060 is about the same price as the boom extension of the LTM 1055, however this is offset by its eight metre longer main boom.

## Grove GMK 3060

The second major 60 tonne launch at Bauma was Grove's GMK 3060 which is an upgrade and replacement for the 55 tonne GMK 3055, offering improved capacity across the entire load chart thanks to an additional two tonnes of counterweight. Although the boom is shorter than the Liebherr or Terex, the Grove has good lifting capacities with a maximum of 52.62 tonnes at 2.7 metres. It also is the most compact - just - with an overall length of 11.4 metres and an outrigger spread of 6.2 metres. Other features include a new operator's cab and it is one of the first Grove mobile cranes to feature the new Crane Control System (CCS) which will eventually be used on all new Manitowoc, Potain and Grove cranes.

The CCS hardware is a standardised set of displays, joysticks, control units and a jog dial. By using common parts Manitowoc says it will make 'maintenance easier and improve fleet management for customers'. Software is also standardised across the product lines and is directly attuned to Manitowoc Crane Care service software.

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*Liebherr LTM 1060-3.1*

The new GMK3060 also has a new boom optimisation feature, which works through the CCS system allowing operators to input basic lift parameters such as load, radius and load height, and the system automatically provides optimal boom options for performing the lift. This saves time on site and makes the set-up process much easier.

## Terex Challenger 3180

When Terex launched the Challenger 3160 it set new standards for a 'one man crane'. With a 50 metre boom it could lift up to 35.6 tonnes at a four metre radius within the 12 tonnes per axle loadings. It could also meet 10 tonne axle load requirements using its counterweight self de-rigging ability for a total vehicle weight of less than 30 tonnes. However UK buyers wanted more. So the 3180 can carry its full counterweight of 12.1 tonnes along with a 16 metre swing-away extension - giving a 66 metre tip height - at 15.5 tonnes per axle. The Challenger 3180 can also lift an extra 2.6 tonnes at four metres radius (38.2 tonnes) and can manage 800kg at 42 metres radius.

"The benefit of this model is its 50 metre full power boom on a three axle carrier which means many jobs can be reached without having to spend the time fitting a fly jib," says City Lifting's Trevor Jepson. "If we do need more reach the 16 metre swingaway can be carried on board within the UK weight limits."

The other major benefit of the Challenger series is that the design reduces the need for people to work at height. With a boom angle of minus five degrees it allows easy swingaway installation and re-reeving, further helped by the three sheave 'VarioHook' system with 18mm rope and six tonnes single line pull, reducing rigging time and weight of equipment transported. The crane is also equipped with the Terex IC-1 Control System featuring an integrated load moment indicator, real-time operation display, load charts, fault indicator, load limit indicator, LMI-load light indicator and data logger.

## Which is best?

These three cranes are very closely matched. Although the Grove has a shorter boom it makes up for it with a good maximum lift capacity when operating without restrictions - over the rear or needing special equipment etc - having the most onboard and maximum ballast. It is also the most compact (although they are all very similar) and has the best gradeability.

It was the Challengers success in the UK that forced Liebherr to rethink its 60 tonne class crane and launch the LTM 1060 and from initial feedback, Liebherr is happy with the interest shown and orders placed so far. They are all good cranes - the final choice probably comes down to your brand preference, history the manufacturers and the backup given. Price, finance and the salesman's ability will also be a factor of course.

## How the new 60 tonne cranes compare against the Challenger 3180

| | Liebherr LTM 1060-3.1 | Grove GMK 3060 | Terex Challenger 3180 |
|---|---|---|---|
| **Max capacity from load charts** | 60.0t @ 2.1m over the rear<br>42.3t @ 3m no restrictions | 52.6t @ 2.7m | 39.5t @ 3m |
| **Max lift at max radius** | 900kg @ 40 metres | 1,000kg @ 38.1 metres | 800kg @42 metres |
| **Main boom** | 48m | 43m | 50m |
| **Swingaway extension** | 9.5 – 16 m | 8.7 – 15m | 16m |
| **Max lift height** | 63m | 56.5m | 66m |
| **Axles** | 3 | 3 | 3 |
| **Swingaway offset angles** | 0, 20 and 40 degrees | 0, 20 and 40 degrees | 0, 20 and 40 degrees |
| **Max onboard ballast for 12t axle loads** | 3.7 to 5.5 tonnes | 6.6 tonnes max | 3.2 to 4.7 tonnes |
| **Additional ballast** | 7.3 tonnes | 7.0 tonnes | 7.4 tonnes |
| **Max ballast** | 12.8 tonnes | 13.6 tonnes | 12.1 tonnes |
| **Axle wt with max ballast** | 15 tonnes per axle | 14.6 tonnes | 15.5 tonnes |
| **Chassis length** | 9.44m | 9.10m | 9.33m |
| **O/A length** | 11,533mm | 11,407mm | 11,668mm |
| **O/A width** | 2.55m | 2.55m | 2.55m |
| **Outrigger width** | 6.3 m | 6.2m | 6.5m |
| **Gradeability** | 69.8% | 82% | 75% |
| **Carrier engine** | 270kW | 265kW | 240kW |
| **Minimum boom angle** | 0 degrees | -2.7 degrees | -5 degrees |