



Relentless pursuit

Set to bring eagerly anticipated new capabilities to the commercial helicopter market, Bell's 525 Relentless has already achieved its first overseas order, with the prospect of many more. By listening to and meeting customers' requirements, Bell is improving the helicopter game.

Glenn Sands spoke with those who've been involved in the development programme

There are few opportunities to bring a new era to the aviation industry, particularly in the helicopter sector. On close inspection of recent platforms, the often overused phrase, 'a clean-sheet design', doesn't always remain valid. But when this does occur, the resulting aircraft can be breath-taking, not only in performance, capability, safety and technology, but also in the whole

concept of the design process from the outset; surely leaving many other OEMs wondering why they didn't adopt a similar approach.

For Bell, this 'new approach' to helicopter design and development has proven to be a huge success, and no more so than with their 525 Relentless, a helicopter in the super-medium-lift class that's set to dominate the oil and gas market for which it is intended, but is showing every indication of being adopted by countless other sectors across the helicopter industry, based on initial customer feedback.

It's a point that Timothy Evans, 525 business development director, was keen to emphasise: "When we initially launched the product, we were coming out of a partnership with Augusta and looking at a 412 replacement. The big debate internally was whether we should relaunch a 412 medium aircraft or move into the super-medium/heavy sector.

"We decided to go with the super-medium, which we thought was a better bet. As part of this process, we established a customer advisory board, which fed into many of the design requirements, capabilities and technologies that are now on the 525 model.

"In terms of the market we foresee for the 525, probably 50% of our design requirements came from the offshore market, so it was really intended to be an offshore crew transport aircraft. Several factors that we heard very loudly during this phase were safety, reliability and crew comfort.

"Taking these on board, we knew right away that fly-by-wire, a clean-sheet design would contribute to the customer experience of the new design.

"Although offshore has been a target market, it's also been important to look at the SAR, parapublic sectors, such as state police and border agencies, and the VIP market, although we do expect these to be slightly smaller in orders. We've plans in place to address these sectors when the time is right."

"The big debate internally was whether we should relaunch a 412 medium aircraft or move into the super-medium/heavy sector"

Timothy Evans, 525 business development director, Bell



Checks and tests

The certification of the 525 has been a long time coming and is now in the final stages of meeting US Federal Aviation Administration (FAA) requirements, as Douglas Hamelwright, 525 deputy chief engineer, explained: "Where we are at in achieving test certification at present is that we had a really successful 2023 and worked through the bulk of what was left to accomplish certification in terms of testing and reporting. We got through nine TIA [Type Inspection Authorisation] events with the FAA test group, which were some of the last things we had to do.

"We're down to the last five TIA events, which we'll start in the next few weeks. After this, we have two small checks, and then the final one is our functionality and reliability [FNR] testing. After this, we'll complete all the final documentation you need to get the signature. So it's all moving along as planned, and we are preparing the 525 we selected for these tests. As soon as the four TIA events are done, it's straight to the F&R phase."

Evans added: "The F&R is the final test score with the FAA. You have to 'burn' 150 hours on the aircraft, so it's really pressure testing. It's about putting the aircraft in a real-world scenario to see how it will perform, which all falls within the Part 21 certification process."

He continued: "We completed nine TIAs last year [2023], the year before we had not been so successful by a long shot. Still, it allowed us to build a great working relationship with the FAA, which is why so many were accomplished last year. Thinking that we only have five [TIAs] to complete this year gives us a perfect line of sight for type certification. We're confident about where the 525 programme is right now."

With Bell soon to complete certification with the FAA on the 525, as far as EASA is concerned, Bell has already been talking with the aviation safety organisation regarding the Relentless, as Hamelwright explained: "We've had years of discussions with EASA on the programme for over a decade now, and I

OPPOSITE:
The four 525 Relentless aircraft completed much of the company's FAA certification process, comprising over 3,000 hours of flight and ground testing. One aircraft has already been withdrawn from flight testing and passed to Bell's training academy to assist in training maintenance crews

All images via Bell

PREVIOUS PAGES:
Once certified, the Bell 525 Relentless will be the most advanced contemporary commercial transport helicopter in the marketplace, not just for now but for many years to come

Bell 525 Relentless Specification Panel

Max cruise speed	296km/h
Max range	1,074km
Max gross weight	9,299kg
Max gross weight (external load)	9,752kg
Engines	two x GE CT7-2F1
Standard seating	two flight crew and 16 passengers
High-density seating	two flight crew and 20 passengers
Standard fuel capacity	2,426 litres
Passenger cabin height	137cm
Baggage compartment volume	3.6m³



have been over to Cologne several times in the last five years. Even before that, Bell was engaged in understanding the specific requirements EASA would want and what they'd like us to cover."

So, in terms of European requirements, Bell is already ahead of the game with the 525. Hamelwright continued: "We did put a brief pause on these requirements while focusing on FAA certification, but as this is now in the final stages, we're re-engaging with EASA and looking to make some good gains in what we've learnt."

With the primary focus 525 market being offshore, where the weather can be at its worst, operating a helicopter

requires a substantial series of icing tests as part of the certification sign-off; the 525 Relentless is about to undergo this phase of testing shortly. As the company lead for this phase, Hamelwright explained: "For any aircraft that will be operating North Sea and around Canada in the offshore oil and gas market, you must have an anti-icing configured aircraft. So, I have spoken with EASA regarding their certification process and requirements, as this will be an essential part of having the 525 ready to operate in that region of the world.

"Our icing certification is one that we have been planning in the background around the other type certification



The Relentless is the first commercial helicopter to incorporate the Garmin 5000H, a touchscreen avionics suite. The Bell 525's standard configuration G5000H Flight Deck includes the HSVT (helicopter synthetic vision technology) that gives the pilots a 3D depiction of terrain, obstacles, traffic and more in any visibility condition

activities and now, with that almost complete, we're ready to go because it's in our interest in getting the aircraft launched on the North Sea routes.

"We've been working on the certification requirements for several years, and development in this area started when the programme first began.

"The final ice testing and certification process was ongoing in 2023 when we took the aircraft to Marquette, Michigan, and went through our first round of testing behind the HISS [helicopter icing spray system] tanker. That's when you put the systems through the rigours of understanding exactly where your ice shapes build up and how effective your heater elements are in shedding ice or preventing its build-up on critical surfaces. We've now proven how good and efficient the electrical system is

and what the supporting systems are like. The final showing of compliance for these electrical systems will begin in the autumn of 2025.

"On the 525, we have an inlet barrier filter to the engine to prevent ice from being ingested into the engines, so these tests offer the chance to demonstrate to the authorities how well this works. It's the opportunity to test and demonstrate all these systems. We're ready to enter the final test phase with the FAA."

The icing tests in the autumn will see the FAA accompanying the Bell engineers for several months, at which point the 525 will already be fully certified by the administration, meaning all present at Marquette are able to focus on the icing tests. Providing Bell engineers with all the correct natural icing conditions in Michigan and successful tests will be the

final certification that allows the aircraft to operate on regular North Sea flights.

Vast potential

There's a lot of anticipation across the helicopter industry, which has waited patiently for the 525 Relentless to enter the market finally. The sheer wealth of technology that this one helicopter is bringing to the industry, particularly towards the offshore sector – with multiple operators needing to replace ageing platforms within the next three to five years – means the potential for Bell is vast and, as Evans said, has been well worth the investment:

"What we heard loud and clear from the market was, 'We want a different aircraft, something that is fundamentally different from what we've seen over the last 75 years of helicopters'. The only way

to achieve the levels of safety that you see in the fixed-wing industry was to put fly-by-wire [FBW] into the 525. The way to think of FBW is that it's the baseline enabling technology that will grow. In a very real sense, you can automate this aircraft to a point where it effectively could be a drone; you can programme it to that level. You can't do that with a standard mechanical 'push-pull-rod' type of helicopter."

This capability means the Relentless platform has a head start over the super-mediums that is already out there, and has the technology to grow, Evans said: "Over the next 20 to 30 years, we'll continue to invest and pour technology into this platform – you're going to see further improvements. The gross weight will increase; the automation that the market demands will be added as a software upload, as a type of SD card. So, the 525 is at the foundation stage today, but has years, if not decades, of growth."

Supporting the advantages that FBW brings to the Relentless, Hamelwright added: "What FBW does well simply boils down to 'Can I as a pilot focus on what's most important for the mission', and minimises as much as possible all the extra things that have to be done to keep the aircraft safely in the air. The on-board FBW computer is able to do so much for the pilots when they are operating in an austere environment such as the North Sea.

"Adding to this is the 525's cockpit layout and the simplifications that come with the Garmin 5000H, where everything is under glass.

"Sitting in the 525's cockpit – something all our potential customers have done – they're amazed at how simple it looks; there's not a million switches in front of them."

As an example of how simple the 525 cockpit layout is, if the pilot needed to reset a circuit breaker in-flight, it usually meant having to search the instrument panel or reach above their head to reset. On the Relentless, a simple press and search of one of the glass displays is all that's needed. And there's the advantage of personalising the display screens to what a particular pilot wants to see in-flight, all achieved at the press of one of the MFDs.

"With both on-board systems 'talking' to each other and giving me, as the pilot, constant feedback, it helps with the handling.

"If I am out there on a windy day in the North Sea, with big waves and gusts of wind, if it's an SAR mission and I'm trying to pick up someone from the water, it's no longer a case of moving the cyclic – let the 525's systems do it for you.

"It makes sense and simplifies the whole experience of flying the 525. It gives pilots confidence in what they

"It's no longer a case of moving the cyclic – let the 525's systems do it for you"

Douglas Hamelwright, deputy chief engineer 525, Bell





CLOCKWISE FROM ABOVE: The Bell's 525 payload and range performance, along with its spacious cabin and baggage bay volume makes it a game-changer for the energy industry, especially for deep-water missions. Norwegian operator Equinor is due to begin North Sea offshore operations in 2026

Bell has developed several internal configurations for the Relentless, including a fast first responder layout for HEMS. There has already been interest in the type from a number of parapublic organisations

The 525's flight crew share exits with the first row of passengers. Each crew seat is mounted on a J-track that allows it to be rotated, facing the instrument panel

160kts and it loses power or an engine; the on-board systems will instantly configure the 525 and altitude to the best cruise speed into a configuration that will take the aircraft down into a safe full auto-rotation without the pilot ever touching the controls. And this is instantaneous, so you've given the crews almost a third pilot that's automatically working to enable a level of safety you can't find in another helicopter."

Increasing confidence

Having such safety features available, given the offshore environment the 525s will be operating in, will only increase the confidence of those flying the Relentless in the future. Such critical flight approaches to oil and gas rigs will become the daily requirement, and easing this approach envelope has also been addressed by Bell in the 525.

Evans explained: "The 525 is designed for the North Sea environment; we understand that there will be gusts up there, and the weather conditions can deteriorate along with the ice conditions. That was our target market, and you see that our first customer [Equinor, a Norwegian-based offshore operator that has ordered ten 525s] wanted these requirements.

"The automated approach profile's ability to come into a hover, hold or shoot the approach onto the deck is desirable; to be able to shoot the approach onto the deck and have the 525 essentially dial you down to whatever altitude and hover you want – which can be as low as ten to 15 feet; the pilot then has the option to let the aircraft do it all, or take over by simply touching the controller on the cyclic to 'beep it over' and touch the helicopter down – having already accounted for anything going on in the external environment.

"It's a case of removing those variables in the difficult phases of flight. Reducing the workload level for the pilot makes for a safer pilot. It's the whole philosophy we have behind what we've designed."

Given the level of technology introduced on the Relentless, Bell has been keen to establish training programmes for both maintainers and pilots as soon as possible and has already invested heavily in facilities and simulators.

Evans said: "We're getting certification later this year, and we're concurrently working with the FAA and the flight safety board on the plan for getting the training programme approved for both the pilot and maintainer; the curriculums are developed; we've got a full motion simulator ready in the house at our training academy. It's currently a Level C because it's not certified yet. Once we get the type certification, the FAA will oversee certifying both programmes for the pilot and maintainer. ▶



CLOCKWISE FROM RIGHT:
The Relentless is powered by two General Electric CT7-2F1 gas turbo-shaft engines with a dual-channel FADEC system

With a baggage bay that accommodates 2,000lb (907kg), Bell has added 17 tie-down points for cargo which are positioned within the 128ft² (3.6m²) area

Bell's 525 Relentless will introduce many new technologies to the commercial helicopter sector, the most significant of which is perhaps introducing fly-by-wire to the helicopter market

The 525 Relentless underwent cold weather testing in Yellowknife, Canada



"The simulator will then become a Level D, although nothing physically changes, it's simply an officially recognised classification. We anticipate all this being ready for students at the end of the year or early next."

For the pilots who have been fortunate enough to fly the 525, Bell took an example on a demonstration tour in the US, complete with its different control configuration, which moves the cyclic from between the pilot's legs to a side-stick controller similar to that of a modern airliner.

What has been the feedback from commercial pilots? "During the demo tour a while back, we wanted to capture some initial raw feedback from pilots who had just

come off the aircraft after a test flight and asked if they liked the sidestick controls. Almost every pilot said they were nervous about it initially because they didn't know what to expect or be sure they'd like it. But within 15 minutes, it just felt so right. It was very intuitive in terms of flying.

"It provided us with some positive feedback," said Evans.

Speedy troubleshooting

It's not only the pilots that have been supportive in their praise for the 525; once in service, the ease of maintenance procedures for the Relentless will no doubt win similar praise from engineers, due in part to Bell adopting

a management system similar to that used on military fast jets, as Hamelwright explained: "Our integrated vehicle health management system is a well-proven and highly anticipated way to maintain an aircraft, so we're really excited to introduce it.

"It's due to the ease that it will bring in terms of the maintenance work that will have to be done, but also just being able to troubleshoot and quickly understand a fault code, discover what it means, and determine whether the 525 is still good to go. Or do I need to stop and repair the problem?"

"We want to ensure that you can quickly understand the procedure and

decide what to do next.

"All the fault code messaging systems are run through Garmin, and we intend this to be an obvious and quick way to diagnose the aircraft and understand what needs to happen next in any event."

Beyond simply fault-finding, the 525's management system also controls the flight modes of helicopters, of which there are more than five to select. Hamelwright said: "There are different flight modes based on the architecture of our system and what we anticipated and the feedback we get to make the aircraft easier to fly with an FBW system; it's about simplifying things for the pilot.

"Things like an approach and automating that, holding altitude and maintaining it and not having the pilot on the controls simply to preserve this. All these modes are built into the control system and you can easily select a mode you want to fly and let the aircraft do it for you. Or, as a pilot, if you want to have more input, you have the option to dial it back. It's being able to offer a lot more 'tools' than in the past to the pilots to allow them to fly the aircraft how they want and what makes it easier."

It's clear from the enthusiasm of both Evans and Hamelwright, who have both been heavily involved in the development of the 525 Relentless at Bell, that they are keen to see the flight test programme signed off by the administrations and the aircraft in regular service with Equinor supporting the offshore industry, which is scheduled for 2026.

Both are aware of the step-change in capability that the 525 brings: "The market was demanding improvements in capability, and we believe the 525 addresses these. From a clean sheet design, we're trying to build what we

think of as a light-heavy aircraft; it's not a super-medium, but it will have the operating economics of a super-medium. The technology we are incorporating into the airframe is a game-changer; the FBW, the clean-sheet design of the main rotor gearbox, is the only one to pass the latest EASA run-dry requirements.

"The way the aircraft will be maintained and troubleshoot all of the data, is sourced back to the original engineer drawings, so the fidelity is like nothing else out there," said Evans.

Engineer Hamelwright took a more pragmatic approach: "The 525 will be certified to the new rules for fatigue damage tolerance, which were released

in 2005. So, all your key structural components, dryers, rotors and several airframe components will have this certification.

"As far as capabilities, you have a clear understanding of what the aircraft can go through, what it can withstand, and as an operator, know what kinds of damage it can take and keep going and never have to worry about it, or where exactly the 'pain points' are and these may require attention.

"It simply gives the operator a higher level of confidence in operating the aircraft and knowing that any likely damage in a harsh environment has been accounted for in the design of the 525." **AI**

