TF-51D MUSTANG

DAVE UNWIN DESCRIBES FLYING ONE OF THE WORLD'S GREATEST FIGHTERS – THE MIGHTY MUSTANG.

(PAUL BOWEN)

It was a moment to be savoured. There I was, thundering through the sky at the controls of one of the most famous fighters ever made – North American's immortal P-51 Mustang – and there was another P-51 in identical markings just off the starboard wing! No, I hadn't travelled back in time – I was flying with the world's premier P-51 flight training organisation, Stallion 51, and we'd just joined up with the company's other TF-51. As we soared above the scattered clouds in perfect formation, with the sunlight flashing and sparkling off the fuselage and the roar of a mighty V-12 thundering in my ears, the thought flashed across my mind – do I really get paid for doing this?

When photographer Duncan Cubitt and I arrived at Stallion 51's Kissimmee base, my mount for the morning mission, Crazy Horse^2, was standing out on the ramp with the original Crazy Horse, a Spitfire and another Mustang! If you like big, piston-powered warbirds, you'd find Kissimmee a magical place, and it undoubtedly is. The Mustang is indisputably one of the world's most iconic aircraft, and Crazy Horse^2 looked absolutely fantastic in the warm Florida sun. Needless to say, I was itching to get behind the controls of this famous fighter. However, long before going anywhere near it I sat down in the briefing room with Eric Huppert, one of Chief Pilot Lee Lauderback's instructors, who gave me a detailed, yet easily assimilated, briefing. Indeed, I didn't realise just how much information Eric had imparted until later, when I realised that practically every question I usually asked after a flight had already been answered! Stallion 51 has built up an impressive reputation for Mustang training, and I was rapidly beginning to see why. Although the term is used rather too freely these days, the only way to describe the entire operation is that it is – in every sense of the word – outstanding.

THIS IS ONE EXCITING MACHINE!

Briefing over, Eric and I changed into our flying suits and walked out to the waiting Mustang. Crazy Horse^2 is Stallion 51's second TF-51 (see box) and as we walked up to it my initial reaction was "I can't believe this thing's 60 years old!" Honestly, readers, it is absolutely immaculate – indeed I'd be

prepared to bet that it is in even better condition now than when it was brand-new. The amount of care lavished upon these Mustangs must be seen to be believed. As we began to move around the aircraft, Eric pointed out the important points to check during the pre-flight, along with other interesting features, such as the infinitely variable outlet for the cooling system, which played a pivotal role in the Mustang's success. (see box)

Another interesting feature is the large dorsal fin ahead of the main fin, which was added after the original canopy had been replaced in the D model with a bubble canopy. Although this modification greatly increased visibility, it reduced directional stability and could also produce the dangerous condition of 'rudder overbalance'. Installing the dorsal fin cured this.

By now I was practically salivating at the chance of flying this beautiful machine, and eagerly looking forward to the forthcoming flight.

Although there's a bit of climb up to the cockpit, it is not too difficult, as there are several well-designed handholds and steps. Before climbing into the rear cockpit I had a good look in the front. At first glance the cockpit looks a bit cluttered, but closer inspection shows that it is actually very well-designed, with the various systems and sub-systems all laid out logically.

I have been fortunate enough to fly some other famous aircraft from the North American stable, including the T-6 Texan and T- 28 Trojan, and the family resemblance was obvious.

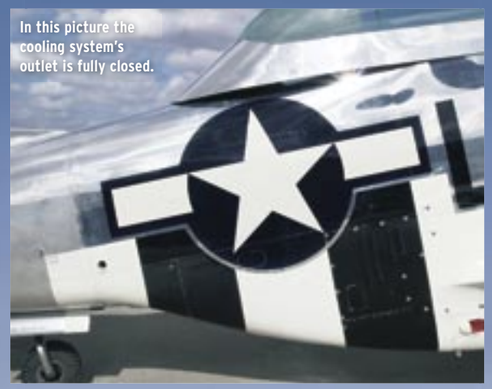
Securely strapped down on the rear seat, I began to study the orientation of the instruments and location of the controls. The stick and throttle both fell nicely to hand, while the rudder pedals adjust over a wide range. However, studying the instrument panel I noticed a curious anomaly. It would be no exaggeration to say that America has not exactly grasped the metric system, so I was surprised to see that the temperatures for both the oil and the coolant were indicated in degrees Centigrade. (I noticed a similar anomaly in the engine instrumentation of the Spitfire I flew several months earlier, and wondered if this could have been down to the fact that the engine was of British origin. Nevertheless, even this is slightly odd as in the 1940s Britain was still firmly wedded to the Fahrenheit system). However, even this assumption proved to be false as – my curiosity piqued – I subsequently looked in the POH for both the Corsair and Hellcat. Intriguingly, the oil and cylinder head temperatures of these American-designed aircraft, which also feature American air-cooled engines, were indicated in Centigrade!

It was also interesting to note that the primary flying instruments had been rearranged into the classic 'sacred six' arrangement, for as delivered from the factory the instruments were far from standard. (On stock aircraft the ASI was top left, the DG top centre and the horizon top right; with the altimeter bottom left, turn and slip bottom centre and VSI bottom right.) I also noted that warning lights for coolant temperature, fuel pressure and oil pressure were mounted quite prominently to the right of the MP gauge and tachometer.

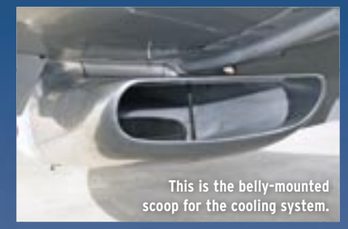
Having ascertained that I was ready, Eric ran through the pre-start checks and energised the starter. The giant propeller began to revolve and the engine suddenly burst into life, instantly shredding the ribbons of smoke that had begun to drift back from the 12 stub exhausts.

With the massive Merlin grumbling contentedly to itself, Eric completed the post-start check and we began to taxi.

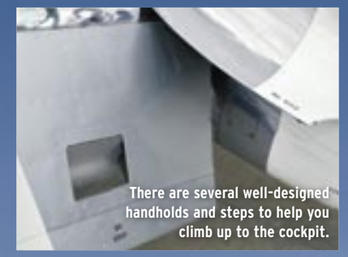
By varying the outlet of the cooling system and forcing excess air through it at high speed, substantial backpressure built up behind the radiator and generated thrust. Here the outlet is fully opened.



In this picture the cooling system's outlet is fully closed.



This is the belly-mounted scoop for the cooling system.



There are several well-designed handholds and steps to help you climb up to the cockpit.

THE TF-51

Although North American built more than 15,000 P-51s, only ten of these were dual control TP-51s.

As many foreign air forces operated Mustangs in the 1950s the requirement for a dual control trainer grew, and in 1951, TEMCO aircraft converted 15 P-51Ds to TF's. (The difference in designation from 'P' to 'F' is that the term 'pursuit' was changed to 'fighter' after World War Two.)

During the 1970s Trans Florida Aviation converted several P-51Ds into TF-51s. These aircraft were referred to as 'Cavalier' Mustangs.

Converting a Mustang into 'TF' configuration is a lot of work. The fuselage tank has to be removed to allow installation of a second seat, controls and instruments, the canopy is enlarged and the fin and rudder is noticeably taller. Both Crazy Horse and Crazy Horse^2 were originally P-51Ds.

Above The hydraulically actuated flaps are huge. (All KEY – Duncan Cubitt unless stated)

Far Left As the mainwheels retract inwards, the undercarriage track is relatively wide.

Left The undercarriage retracts hydraulically.

The primary flying instruments have been rearranged into the classic 'sacred six' arrangement. Note the warning lights for coolant temperature, fuel pressure and oil pressure mounted to the right of the MP gauge and tachometer.

Taxiing out was 'interesting', as the view forwards from the back seat is practically non-existent. This makes 'S-turning' absolutely essential. The tailwheel steers through the rudder pedals up to 6° either side if the stick is held back past the neutral position. Differential braking can be used for tighter turns.

As we taxied out I'd been keeping a very careful eye on the coolant temperature gauge, as during my Spitfire flight I'd been surprised to see how quickly the coolant temperature had risen towards the danger zone.

However, the Mustang's cooling system is much better designed and the temps remained comfortably in the green for the entire flight. At the run-up point, Eric ran carefully through the pre-take-off checks, explaining what he was doing as he did so. During the briefing he'd emphasised that correct use of the rudder trim was pivotal and I reacquainted myself with its location. As I was soon to discover, he wasn't exaggerating!

As we lined up for take-off, my blood pressure was rising along with the manifold pressure, while my heart's BPM was following the rapidly rising RPM. This is one exciting machine! Eric smoothly opened the throttle and the mighty engine roared out its one-note challenge. I noted that he applied power in two distinct stages. The initial stage was only up to 40in MP and then, as the needle of the ASI swept

Below Left At first glance the front cockpit looks a bit cluttered, but closer inspection shows it to be very well-designed, with the various systems and sub-systems all laid out logically.

NORTH AMERICAN TF-51D MUSTANG

DIMENSIONS		
LENGTH	9.83m	32ft 3in
EMPTY WEIGHT	3,465kg	7,635lb
MAX AUW	5,490kg	12,100lb
USEFUL LOAD	2,025kg	4,465lb
WING LOADING	251kg/m²	51.5lb/sq ft
POWER LOADING	4.3kg/kW	7.1lb/hp
FUEL CAPACITY	681lit	150Imp gal
PERFORMANCE		
VNE (IAS)	440kts	815km/h
CRUISE (TAS)	270kts	500km/h
STALL	76kts	140km/h
CLIMB RATE	3,200ft/min	16m/sec
ENGINE		
Packard Merlin V-1650-7 super-charged liquid-cooled V-12, producing 1,695hp (1,265kW) at 3,000rpm and 61in MP		
PROPELLER		
Hamilton-Standard four-blade constant speed		
MANUFACTURER		
North American Aviation		

Right As we moved around the aircraft, Eric pointed out the important points to check during the pre-flight.

Far Right The tailwheel steers through the rudder pedals up to 6° either side if the stick is held back past the neutral position. Differential braking can be used for tighter turns.

past 45kts, he gently picked up the tailwheel before opening the throttle further. As the power increased so did the noise, becoming something more than simply sound. You can actually feel the energy, not just through your ears but through your entire body. As the airspeed rose I followed through on the controls. Acceleration was good without being exceptional, primarily due to the fact that the engine is operated at far below maximum power. In fact, a glance at the MP gauge revealed that we were pulling only 55in at take-off. Standard wartime take-off power was 61in, although specially-prepared RAF Mustang IIIs tested for their suitability as V1 chasers and fuelled with special 150-octane fuel were boosted to an incredible +25lb (approximately 80in MP) of boost! Needless to say these engines didn't last long, but this fact once again shows just how incredible the Merlin is!

Anyway, even at these greatly reduced settings the sensation of sheer power is impressive, possibly even more so when you realise just how much more 'muscle' is available should you need it.

Almost as soon as the wheels had thumped home in the wells, Eric reduced power to 46in MP and 2,700 rpm and said the magic words "You have control". Great! Needless to say, he handed over control with the aircraft perfectly trimmed, and we continued scorching skywards at 150kts with the VSI showing an impressive 3,000ft/min. Almost immediately the Mustang

ALMOST IMMEDIATELY THE MUSTANG BEGAN TO WORK ITS MAGIC ON ME.

began to work its magic on me. That big bubble canopy is great and the visibility outstanding – you almost feel as if you're sitting on top of the aircraft, not in it. And as for the engine – it's just amazing! Indeed, as we roared across the sky Crazy Horse² seemed so much more than just a disparate collection of metal, rubber and plastic. It really does feel as if you're riding a living, breathing animal, and Crazy Horse² is a very apt name!

I could feel the Mustang's powerful personality starting to make an impression, and I resolved to demonstrate, both to it and to Eric, that I could handle this powerful beast. Eric encouraged me to acquaint myself with the machine's general handling characteristics, so as we headed south I experimented with several turns of varying degrees of steepness.

My initial impressions were all eminently favourable. All the primary controls are powerful and although any out-of-trim condition produces control forces that are quite high, they are easily trimmed out. Control harmony appeared good, with the ailerons being the lightest primary control and the rudder the heaviest. However, and as Eric had warned, I couldn't help but notice that the slip ball needed to

Below Taxiing out was 'interesting', as the view forwards from the back seat is practically non-existent. This makes 'S-turning' absolutely essential.

Left Note the dorsal fin immediately in front of the main fin.

be monitored constantly, and that the rudder trim needed frequent adjusting.

An examination of the stick-free stability revealed the Mustang to be positively stable about all three axes, although this observation should be quantified by explaining that both Crazy Horse and Crazy Horse^2 have had their fuselage fuel tanks deleted and carry all the fuel in the wings. I suspect that setting out on a long-range escort mission in 1944 with the 323-litre fuselage fuel tank full would have probably made the aircraft longitudinally unstable, as the CG would've been a lot further aft.

One aspect of the Mustang I was particularly interested to examine was its slow flight characteristics. I've flown several aircraft fitted with laminar flow wings, and some have exhibited characteristics which can certainly be described as 'interesting'. However, the Mustang is fitted with a very early laminar flow aerofoil section (indeed, it was the first production aircraft to be fitted with a laminar flow aerofoil section – the NACA 4) and it also has a relatively high wing loading. As a result, I was keen to ascertain how well (or, more likely, how badly) it behaved at the stall. As I had expected, it soon became apparent that North American's engineers had definitely concentrated on the high-speed side of the envelope. Although the stall was preceded by some pre-stall buffet, when the wing did quit flying – it just quit! This was accompanied by a pretty abrupt wing drop, and despite the fact that it started flying again once the wing was unloaded, several hundred feet were lost in the process. Eric then took control to demonstrate an accelerated stall. This was a real eye-opener, as the Mustang flicked quite viciously – a forceful reminder that pulling hard into the buffet was likely to induce the aircraft to depart from controlled flight! Bearing this in mind, I concentrated on ensuring that I kept all my aerobatic manoeuvres smooth, and didn't pull too hard! Under Eric's expert tutelage, I started off with two wing-overs, and progressed from there through a couple of loops, some aileron and barrel rolls, a 'Cuban Eight' and a 'Reverse Cuban Eight' before trying my hand at a four-point hesitation roll. Due mainly to the quality of Eric's coaching, most of the manoeuvres went well – although try as I might, I never did get a decent four-point roll!

As I mentioned earlier, this is very much a 'rudder aeroplane' and – as expected – all its manoeuvres required plenty of rudder input. I've got an idea that the giant prop (its diameter is almost 3.5 metres and it must weigh several hundred kilograms) must produce significant amounts of gyroscopic precession. However, I'd got the idea by now, and was reasonably happy that, generally, the slip ball stayed put. Pleased with myself, I asked Eric how he thought the slip ball had been behaving – and he allowed that – so far at least – I was doing OK.

However, Eric easily taught me just how important rudder trim is. "OK, Dave," he said. "Now I want you to see just how quickly the Mustang accelerates. Look over the nose, and lower it to about 45 degrees below the horizon." I did so, and the rapidly increasing roar of the air over the canopy soon convinced me that we were indeed accelerating swiftly. A glance at the ASI confirmed that we

MUSTANGS AND MERLINS

Hidden away under the sleek cowling of Crazy Horse^2 is what is probably the world's greatest aero-engine – the immortal Merlin. This liquid-cooled 12-cylinder V-12 has a swept volume of 27 litres, and puts out up to 1,695hp at 3,000rpm and 61 inches of boost. Although the original Mustang was powered by a 1,150hp Allison V-12 engine, it was only when it was fitted with a Merlin that the aircraft became a war-winner.

After World War Two ended, Merlins were used on many transport aircraft, including the Canadair Argonaut (essentially a licence-built DC-4). Of course, the requirements for a good engine for a transport are almost diametrically opposite to those of a fighter, and the engine was developed still further to make it more reliable. Interestingly, the cylinder heads of the Merlins used on the Argonaut (known as 'transport heads') are considerably more robust than those on the engines originally fitted to fighters, and are the preferred cylinder heads of most Mustang operators today.

Below The amount of care lavished upon these Mustangs must be seen to be believed.

STALLION 51

Stallion 51 is renowned as the world's premier P-51 training outfit, and can provide training for pilots at all levels of experience, from orientation flights to full check-outs. Like all quality services it is not cheap, but with the current exchange rate at $1.84 to £1 it is certainly a bargain! For more information call 001 407 846 4400 or go to www.stallion51.com.

There I was, thundering through the sky at the controls of a P-51 Mustang – and there was another P-51 in identical markings just off the starboard wing! **(Paul Bowen)**

This is the original Crazy Horse, flown by Lee Lauderback.

were rapidly approaching 310kts IAS! "Pretty impressive, eh?" he chuckled, adding: "Oh, how's that slip ball look now?" To my mortification, it was right out to the side! I quickly applied some corrective rudder, trimmed it out and replied, somewhat ruefully: "I see what you mean!" The incredible rate of acceleration had also caught my eye, and I could readily see that a steep dive at altitude could soon put the aircraft into 'compressibility'.

All too soon it was time to 'RTB'. We'd been up nearly an hour, and the minutes had flowed by as swiftly as fuel to the engine – not just metaphorically but literally, as on average the thirsty Merlin is gulping a gallon a minute. As we raced back towards Kissimmee, Eric took control, advising me to 'follow through' on the landing. The 'run and break' was especially exhilarating, and as we pulled up I could feel Eric putting some 'g' on the aircraft to wash the speed off. As we turned downwind, he set the prop to 2,700rpm, dropped 20° of flap, waited until the speed dropped below 150kts and then lowered the undercarriage.

WE WERE RAPIDLY APPROACHING 310KTS IAS.

As the wheels locked into place, the three small lights glowed a reassuring green. On base leg another 10° of flap was extended, while the speed bled back to 130kts. As we turned onto final, the flaps went down to 50° and the speed steadily reduced to 120. Even from the back the view was good, and the aircraft had a real 'rock-steady' feel as we sank towards the waiting runway. As we flashed over the fence I glanced at the ASI, and saw exactly 100kts.

Eric fully closed the throttle, and with the Merlin popping and crackling, held the aircraft just above the runway. The tail sank slightly, there was a pause – and then the mainwheels touched, followed by the tailwheel. It was an interesting landing – neither a 'wheeler' nor a 'three-pointer'. (During the debrief, Eric explained that this is the best method of consistently achieving good landings in a P-51. A full-on 'wheeler' means a faster touchdown speed, while a 'three-pointer' can be fraught due to the stall characteristics of the laminar flow wing. He likened the procedure to "an old man sitting down in a chair" and I saw immediately what he meant.)

Back at Stallion 51 Eric set 1,000rpm, ran swiftly through the pre-shut-down checks and then drew the mixture back to idle/cut off, and the sound of the Merlin died away. What an amazing aircraft! One thing's for sure – when I'm rich enough to buy myself a P-51 I definitely know where I'm going for my training!

WHY WAS THE MUSTANG SO GOOD?

The Mustang is a truly remarkable fighter, possessing excellent handling, speed and firepower. However, so do many other fighters. What sets this aircraft apart is that it also has tremendous range. The reasons for this are three-fold. Firstly, clever engineering gave the Mustang considerable internal fuel capacity (more than twice that of a Spitfire). Secondly, it was the first production aircraft to be fitted with a laminar flow aerofoil section (the NACA-4), which greatly reduced drag. Finally, the coolant system was designed to make the best use of a phenomenon known as the 'Meredith Effect'. A detailed explanation of the 'Meredith Effect' is outside the scope of this article, but in very simple terms, by varying the outlet of the cooling system and forcing excess air through it at high speed, substantial back pressure built up behind the radiator and thrust was generated. This helped offset the drag caused by the radiator.

BELOW What an amazing aircraft!