



# The NStar Chronicle

## Merlin Musings

Tenth in a series

*Ted Devey*

### The Rolls-Royce Merlin 622

The figure provides a schematic portrayal of the Merlin engine, a 60 degree V-12 with 12 cylinders, (bore - 5.4" and stroke - 6") having a displacement of about 1650 cubic inches. The Upper Crankcase supports two cylinder banks of 6 cylinders each, with an angle of 60 degree separation which provides even firing for 12 cylinders every 720 degrees of rotation (2 revolutions). The cylinder banks are of cast aluminum with steel cylinder liners. The cylinder heads are also of cast aluminum with four valves for each cylinder (2 intake, 2 exhaust). Valve seats are steel inserts pressed into the aluminum casting. Each cylinder head carries a single camshaft which operates both the intake and sodium-cooled exhaust valves.

The Upper Crankcase provides the foundation for the engine so that when cylinder banks and heads are securely bolted to the crankcase the assembly is immensely rigid. The Crankshaft is carried by the Crankcase by seven main bearings which are fastened by conventional bearing caps additionally secured to the Crankcase with two horizontal bolts passing from one side of the Crankcase, through the bearing caps to the other side for each bearing. This provides additional strength and rigidity to the

whole assembly.

To the front of the crankcase is bolted the reduction gear which carries the propeller. It has a reduction ratio of about 2.5 to 1 and takes the full propeller thrust. The rear of the Crankshaft carries the Wheelcase which provides drives to various components of the engine.

The Wheelcase drives the two camshafts, the two magnetos (One fires the intake spark plugs and the other fires the exhaust plugs), coolant pumps, the Supercharger and the Fuel Injection pump. (The 600 and 700 series were the only Merlins that were fuel injected). The Supercharger is driven by a 2-speed clutch-drive which is fastened to the Wheelcase and the Supercharger in turn is also fastened to the Wheelcase.

The 622 is the ultimate engine of the Merlin Series being rated at 1760 HP and generally run at about  $\frac{1}{2}$  of this rated value for many hours and thousands of miles of piston-pounding service continuously. It was used in both passenger (TCA, CPA and BOAC) service, and for hauling cargo and some personnel (RCAF, -USA to Japan via the Aleutian Islands and return via Hawaii on the Korean run. It was beefed up to provide highly reliable operation in the Transport Service.

Fighter planes powered by Merlins in WWII were aloft for brief periods of about an hour for Spitfires and Hurricanes and several hours for the Mustang. Bombers, such as the Lancaster, Halifax and Mosquito involved heavier service, but for the post-

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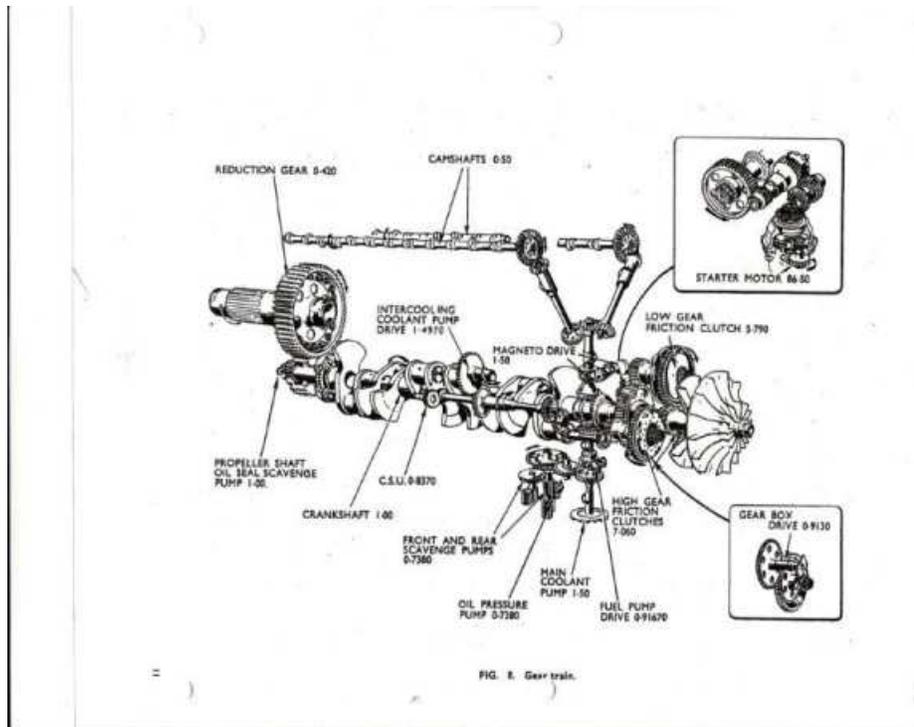


Figure 1.0.1: Schematic Diagram of Merlin Gear Train

war Transport Service the Merlin was built for heavy duty. Engine auxiliary systems were greatly enlarged. Three separate cooling radiators were used, the largest was for the main engine, then the inter-cooler, and finally lubricating oil which removed a lot of heat from internal engine components.

Stiffening of the Crankcase was increased in size, heavier connecting rods of the fork-and-blade configuration were fitted, and the cylinder-head-to-bank fasteners were strengthened and made longer to provide an axial-spring effect so as to accommodate the high expansion of aluminum under heat without stripping threads of the studs. The Crankshaft was stiffened to keep torsional vibration under control which was due to the heavy impact of firing im-

pulses along its length.

Such as the structural integrity of the 622 Merlin, surplus engines that became available following the scrapping of North Star airplanes were quickly snapped up by the Racing Circuit for souping up as replacements for Packard Merlins fitted to surplus Mustang fighters adapted for racing. An idea of such applications was presented in the December issue of the NStar Chronicle in the article titled "One Second in the Life of a Racer". The engine described is a Rolls-Royce merlin 622 severely modified for all-out racing in goosed-up P51 Mustangs.

Subsequent articles will describe our experiences in the overhaul of the first of the four North Star Engines.

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## Ted Slack – biography

### Part One

#### *Ted Slack*

Yeah, well to go back, I got my pilot's licence in '51. We had our own flying club at UBC. The government gave the university and each student who received

a pilot's licence \$150.00. It was \$5.00hour to rent the aircraft wet. The instructor received \$2.00hour. Thirty hours for my flying was \$180.00 – for a net cost of \$30.00 to get my pilot's licence.



Figure 2.0.1: Ted Slack

After UBC I went to work on the Quebec North Shore and Labrador Railroad. I spent eight and a half years up there. The pay and the security was good but unfortunately there was no future for an anglophone in Quebec even at that time. By now I was married with two children and working out of Sept Illes.

I decided to head for Calgary and the Southern Alberta Institute of Technology. There were only two options at the time: aerophysics at the University of Toronto, or aeronautical engineering technology. So I wound up working at the Institute of Aerospace Research (a separate branch of the NRC). I spent 26 years there and during that time I became heavily involved in amateur-built aircraft. In 1971 I started the EAA technical committee for Canada. I did that up until the mid-1990's even though I had retired well before then. After that I spent eight years working for the RCMP on the Air India investigation – working out of Ottawa most of the time. I had to create a full-scale mockup of the wreckage from photographs (most of the wreckage is still on the bottom of the ocean). We had a warehouse in Vancouver. I think I used 150 sheets of four by eight foot aluminum to build up the full mockup. At the time of the trial the court was moved to the warehouse where the judge was seated in the middle of the space. The defense agreed that there was a bomb – but the defense's case rested on the claim that the bomb-laden luggage was in Section 54 (i.e., the Toronto baggage), whereas the Vancouver luggage was in Section 52 (side-by-side compartments in the aft cargo hold). These two sections were separated by four feet. The judge didn't agree with the prosecution's witnesses and their testimony concerning the defendants' actions. See, the bomb at Marita in Japan blew up first – the police found the label from the VCR and traced it back (five VCRs were shipped to Vancouver for sale, three own-

ers were traced – leaving the two missing VCRs). They were using the timers on the VCRs.

Three were charged – one pleaded guilty. Everybody was afraid to testify. The number one witness was the editor of the local Sikh newspaper. He was shot and merely incapacitated. Some time later he was shot again and killed. Other witnesses were shot as well. It was an eye-opener for me to see the hoops they had to jump through to get a person convicted.

Well, I spent part of my childhood living in railroad stations. My father retired at age 65 with 51 years service with the C.P.R. During the Depression years railroaders operated on seniority. From 1939 on we lived in a CPR station in Barrie. Later, my father took a position at Camp Borden. We stayed at Craighurst and my mother became the station manager. When I was about 10 or 11 (1940-41) during the weekends they would keep the locomotives going so I would spend a lot of time with the fireman on duty. He would operate the track switches in the yard while I ran the locomotives. In the summertime I would go up the track with the welding gangs (several miles from the station) and just before lunch they would give me a push on the speeder – and I would return to their boarding cars to pick up the lunches.

I always loved things mechanical. One year Dad bought a new Ford. I was forever tinkering with the car. One day I took apart the fuel pump. A friend came by and we went off somewhere. My mother hopped in the car, and of course it wouldn't start. She called the local garage and they towed it back and soon called to tell her the fuel pump was AWOL.

We used to go island hopping in the Caribbean. Our twelve aircraft – all privately owned – would roam as far south as Columbia, and spend two or three days on each island. We would meet in Florida and then fly as a group. Accommodations were pre-booked. The airports at that time were not used to small aircraft; They would insist on three minutes separation, and with twelve aircraft that would mean 36 minutes from leader to tail-end Charlie. We got around that by putting a Maple Leaf flag with a number on each tail. Now our flight planning was done as a fleet of twelve. We all had our set takeoff position, with the fastest in the lead (Ted was the flight leader -ed.)

We flew the length of Cuba twice. That was '85 and '91. The people of Cuba were excellent. The government tried to generate jobs for everyone – they have five or six times as many customs people as most other countries.

The first time I flew in the Caribbean was the mid-70's in our Mooney. You have to have a "General Declaration" (GD.) form which states what you have on board. On the first trip down there, when we landed in the Dominican Republic, I had three copies of the GD. The first person I met wanted three copies, the

next person another three, and so on. I handed out nine copies, yet others demanded more. Animated negotiations ensued but I didn't speak any Spanish. Once in Haiti I gave the customs clerk a copy of the GD in red ink and he went off the deep end. (I discovered later that red ink was reserved for officials only.)

We always used to go to the Bahama Islands, then the Turk and Caicos, and then head to Puerto Rico or the Dominican Republic. We had a bit of a problem coming back from Cuba via the U.S. since one of our passengers was an American. I had advised him to get pre-clearance and this eased his re-entry. (We were briefed by the RCMP about what to do or not do while in Cuba.)

Coming back from the islands only two or three customs ports of entry were designated. Key West

was one of these. Coming from Cuba direct we were met by customs at Key West and immediately informed we had to clear at another airport to the North. We were ordered to: "Get back in your planes!" – no refueling, no rest stops, nothing. This was late in the day, thunderstorms were all around, and we had pilots that were not IFR rated, When we did land near Fort Pierce it was raining and the customs agent didn't even look at our planes, just stamped our passports and handed them back.

We discovered that in Cuba every one of our planes was given a motorcycle escort on takeoff! A motorcycle with a rifle-wielding soldier in a sidecar would follow each plane down the runway until the plane wheels left the ground. We used to take hundreds of Canadian flag lapel pins and hand them out to the people we met in Cuba. (...to be continued)

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## Project North Star Restoration Progress

*Jim Riddoch*

Presently the Number 1 Engine and Mounting Frame have been completely disassembled, cleaned, inspected, repaired to original standard and almost completely re-assembled. This has been a long arduous task, a great learning curve and a source of pride of accomplishment by all the volunteers involved. Currently the engine awaits the completion of the fuel injection pump and the second stage intercooler before being mounted on the engine and then the engine can be removed from its rotating jig and re-installed in the main ground engine frame where the rest of the Quick Engine Change assembly has been installed. The latter includes the mounting frame, all accessories including intake flap assemblies, fire suppression system, oil and coolant system, radiators, electrical power systems, hydraulic systems and various other components. The supercharger and the auxiliary gearbox assembly remain to be cleaned and refurbished before the engine can be re-mounted on the airframe bulkhead. The latter will need to be cleaned and stencils redone prior to attaching Nr1 engine. All of this should occur in the coming months and hopefully the engine re-mounting can occur later this year probably in summer months.

Parallel with this work is the complete overall of Nr1 and Nr2 Propeller assemblies, thanks to Mike Hope and his staff at Hope Aero in Mississauga. Nr1 Prop has been re-installed in Nr2 Engine while Nr1

Engine is being overhauled. Nr 3 Propeller has been removed and shipped to Hope Aero. Nr2 Prop has been installed on Nr3 Engine, where it will remain until Nr2 Engine is overhauled and remounted on the aircraft. This work also involves considerable effort by the volunteers to remove, clean, repair and re-assemble the mating parts such as the spinner, prop frame assembly and various other attaching parts.



Figure 3.0.1: Engine Mounting Frame

Looking ahead, the next major task is the completion of the cockpit area. After the removal of instrument panels, seats and various other equipment it became obvious that nothing less than a total strip of the cockpit interior frame assembly and flooring, including insulation and windows will be required to tackle interior skin corrosion. This poses a consider-

able problem as the aircraft in its present position in the Storage Facility cannot be worked on with chemicals or other maintenance equipment. Accordingly it has been agreed to do this work with the aircraft positioned outside. This will require complete bird proofing while outside. Also a ventilation and extraction system will need to be set up to permit paint stripping and use of other chemicals. This is planned to start in Spring as soon as the weather permits but there is lots to do prior to moving the aircraft outside.



Figure 3.0.2: Engine on rotating jig

We still hope to exhibit the aircraft on Canada Day and at the Classic Air Rally but may have to limit the access to the cockpit area if not completed. Hopefully we can make some interesting arrangements in the cabin area to recall some of the service duties this aircraft was involved in and trust we will have at least one overhauled engine re-installed on the aircraft.

Although some may be disappointed with the progress to date and the non availability of weekend work, it must be borne in mind that this type of restoration is very demanding requires patience, care, skillful work and resourcefulness in detail work and in recovering and securing parts. Currently we have a small group of dedicated volunteers who regularly attend the museum and maintain continuity of work which is essential in a project of this size.

It would be remiss of us to not include the cooperation and support of the museum staff who have been patient and encouraging in their involvement, particularly Mike Irvin, the CAvM Project Manager – good job he has a good sense of humour.

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## Flight Comment

*Bill Tate*

The recent event where a US Airways A-320 ditched into the Hudson River adjacent to Manhattan has brought the topic of bird strikes and airplanes back into the forefront.

Bird strikes are common as some major airlines have over 20,000 bird strikes per year. In North America, this accounts for over \$500 million in damages that the airlines face.

Over the last twenty years, Canada has been a leader in the control of birds around airports. Some of the innovative ideas have been:

- Controlling the amount of birds eat such as keeping the grass near runways kept short so that small rodents are no longer comfortable being in that environment t as they become more exposed.
- Planting grasses that do not produce seed.
- Using timed propane cannons to help relay the

message that birds are "not welcome".

- In some hard cases using hawks are used to discourage bird flocks, to a high degree of success.
- From the pilots' perspective, we use the 'see and be seen principle of using all of our available lights whenever able – that is, landing lights and strobe lights when we are below 10,000 above ground.
- A design feature of the bullet at the front of the engine is a striped design that creates an interesting visual effect when the engine is at speed which the birds can see in daytime that helps them avoid the aircraft.

One urban legend that has been put to rest is the use of weather radar that projects a beam of energy which was thought that birds could feel.

In migration season, birds have been observed at night and in between cloud layers.

So as a pilot, what considerations should we take into account?

1. Limit your climb speed to 250 kts until above 10,000 remembering the formula = mass over velocity squared – for example, if climbing high speed in the range of 350 kts, IAS hitting a Canada Goose is close to 610,000 foot pounds of energy.
2. In migration season, ask for PIREPS (pilot reports) of birds, ask Arrival or Departure Control if birds are on radar (large birds or flocks can be detected)
3. If a bird strike is about to happen, climb above the birds as their escape manoeuvre if they see you is to dive.
4. More important, if birds are in the vicinity of an airport, report it to let others know of the danger. If you do have a bird strike report it and have your aircraft inspected.

As one who is relatively high time in A-320's (7,000 hours +), I can only put my interpretation of the events: during climb, it was reported that the aircraft lost power in both engines, yet it would appear that the one or both engines were still developing enough power to keep electrics and hydraulics on line.



Figure 4.0.1: Captain Bill Tate at the controls of an Air Canada Boeing 767 ER

Failing that, the APU (auxiliary power unit – a small gas turbine engine that supplies air for pneumatics for air conditioning or starting engines and electrical power via its generator) was running which kept hydraulics powered via two independent electrical pumps and a P.T.U. (power transfer unit – a hydraulic powered pump that can pressurize either one or the other hydraulic systems that it is part of).

However, if the aircraft was powered by the RAT (RAM Air Turbine that also deploys on loss of electrics, the R.A.T. is a small propeller which powers a generator for emergency electrics and hydraulic pump that powers emergency hydraulics in one hydraulic system) the work load becomes very intense in this situation.

From one picture I have seen, it appears that the RAT was not deployed and the aircraft would appear to have either partial power on one or both engines or that the A.P.U. was the sole power source as the flaps appeared to be in Configuration #3 which would be called for in the ditching checklist because on RAT, flaps could not be lowered as they are blocked in this emergency configuration and only the SLATS (high lift devices) are deployable with the R.A.T..

An item to be considered is if speed drops below 145 kts, the RAT will stall out, leaving the aircraft on battery power only with no emergency hydraulics.

Further, not widely known outside of the airline community is the fact that the engines are designed to shear off on landing to protect the integrity of the aircraft so that it can float to aid in a successful evacuation.

In summary, the crew did a fantastic job in ditching successfully in the Hudson considering the ditching procedure calls for a "nose up" attitude of 11 degrees and minimum vertical speed on impact with water. It is miraculous that all 155 passengers and crew managed to escape safely from the downed aircraft.

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## Miscellany

### Photographs

*All photos, except figure 3.0.1, by Chris Payne.*



Figure 5.0.1: John Tasseron and restored channel-steel air inlet frame



Figure 5.0.2: Coolant tank



Figure 5.0.3: Bill Tate, Spinner Specialist 1st Class

## Certificates of Appreciation

The first PNSAC Certificates of Appreciation, for five years of service to the Association, were presented at the Member's Meeting on December 6, 2008. The recipients were: Dorothy Barker, Richard Lodge and Drew Hodge. In making the presentations, the President, Tim Timmins, noted that Dorothy Barker had a long association with the Project and had served as a Board Member for five years. Richard Lodge has served as Treasurer since the inception of the Project and Drew Hodge is the author of a Restoration Primer published on the PNS website. He also prepares the NStar Chronicle for publication. Tim thanked them for their contributions to Project North Star.



Figure 5.0.4: Certificate recipients

## Newsletter distribution

The NStar Chronicle is delivered to members by e-mail or by regular post to members not having e-mail addresses.

## PNSAC Member's Meeting

The next PNSAC Member's Meeting will be held in the Bush Theatre at the Canada Aviation Museum on April 11, 2009 starting at 10:30 am. New date.

## Canada Day

It is expected that Canada Day celebrations at the Canada Aviation Museum will include North Star 17515.

## Classic Air Ralleye

The Flight Works 2009 Classic Air Ralleye will be held at the Canada Aviation Museum 23, 24 August. It is expected that North Star 17515 will be on display during the Ralleye. Both PNSAC and Flight Works will be looking for volunteers.

## CFB Trenton, 4-5 July 2009

Come-Commemorate-Celebrate: 100th Anniversary of Powered Flight in Canada, 85th Anniversary of the Royal Canadian Air Force, 60th Anniversary of the Memorial Gates and the 25th Anniversary of the National Air force Museum. *Web site:* [www.cfbtrenton.com](http://www.cfbtrenton.com)

## Vintage Wings Gatneau Airport

Vintage Wings is holding two open houses at Gatneau Airport this year, on 7 June and 30 September, from 10 am until 2 pm.. See their *Web site:* [www.vintagewingscanada.ca](http://www.vintagewingscanada.ca) for details of their flight operations.

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