



# The NStar Chronicle

## Merlin Musings

**Ninth in a series**

*Ted Devey*

### North Star Engine Restoration

North Stars were powered by four Rolls-Royce Merlin 622 Engines. The 600 series were produced following WWII and were the last Merlins built. Rolls-Royce was on a roll developing jet engines for new aircraft designs. The Merlin 622 was produced specifically for long haul service by airliners and transport aircraft. The Project North Star aircraft RCAF #17515 is the only known surviving North Star made under licence to Douglas by Canadair in Montreal. The DC-4 was the pressurized passenger version used by airlines and the C54 was the transport version used by the RCAF for carrying freight and personnel. The 600 series were the only Merlins to be fuel injected into the eye of the supercharger.

The CAvM North Star was flown to the Museum at Rockliffe in 1966 and remained outdoors without protection for 39 years until moved into the new Storage Hangar in 2005. The engines were not treated to prevent corrosion

A transport stand was fabricated using Museum resources, #1 engine (port outer) was removed from the airplane as a complete nacelle assembly (called a power pack) and fastened to this stand for transfer to the shop. A second rotatable stand was needed for mounting the core engine for ready access to all parts

of the engine. One was found in the warehouse and modified to accept the engine.



Figure 1: Power plant #1 on way to shop

The engine was broken down into sub-assemblies which were stored on shelving to await cleaning, overhaul and made ready for return to the engine.

Rolls-Royce originally supplied tool sets to commercial overhaul shops to facilitate work on the engine. Search as we might, no sets were available to us. So, we had to improvise with available tools, and make special tools in the machine shop as needed for removing special nuts in various sections of the engine. Chain hoists suspended from an A frame were used for removal of cylinder blocks (a story in itself

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to be detailed in the next article of this series). Heavy items, such as the reduction gear, wheelcase and supercharger were handled using the hoist.

Internal components were coated in lubricating oil which can best be described as blacker than black. This was removed in a varsol tank. The most difficult part to clean was the upper crankcase where steam cleaning was used plus detail work on the heavily webbed interior. An industrial grade parts washer was installed. It operates on the same principle as a dishwasher, using a solvent solution at near boiling point temperatures. This proved to be a valuable time and labour saver. External surfaces of the sub-assemblies were glass beaded and clear coated resulting in a satin finish on aluminum surfaces. North Star Merlins were not painted or finish coated.

The Merlin crew comprised Ted Devey, Crew Chief, Peter Houston and Ed Hogan as regulars, ably assisted by a number of members of the North Star restoration team. Progress has been slow as all lacked experience on Merlins. For this reason the first engine has been dubbed "Merlin 101". The engine has taken so long to overhaul due to several factors: internal corrosion due to 39 years of exposure to the elements; team member inexperience (the dif-

ficult we do immediately, the impossible takes a wee bit longer); lack of specialized tooling; and, overhaul manuals worded for experienced Merlin mechanics.

Mike Irvin, Project Manager, keeps the project on the rails. An AME qualified conservationist of the first order, he provides encouragement and guidance: "it will come apart" and "it will go back together". He has been absolutely right so far. At the time of writing, the work on the engine is complete up to the wheelcase. The supercharger drive, the intercooler and supercharger/fuel system are being worked on.

The next instalment will describe the work done on various engine parts in some detail. The Merlin Engine is a very complex machine, superbly built and finished in the tradition of Rolls-Royce. Some numbers:

- Weight of Power Pack - 3,000 lbs
- Weight of engine - 1700 lbs
- Displacement - 1650 cu. In.
- Rated power - 1760 HP

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## One Second in the Life of a Racer

*Tom Fey*

The Unlimiteds go flashing through the racecourse, engines howling, air shearing, heat waves streaming. Four hundred eighty miles an hour is 8 miles a minute, and the elite racers take about 70 seconds to cover the 9.1 mile Reno course. If you could take a souped P-51 racer flying the circuit at Reno, show time down, and examine just one second, what would you find?

In that one second, the V-12 Rolls-Royce Merlin engine would have gone through 60 revolutions, with each of the 48 valves slamming open and closed 30 times. The twenty-four spark plugs have fired 720 times. Each piston has traveled a total of 60 feet in linear distance at an average speed of 41 miles per hour, with the direction of movement reversing 180 deg. after every 6 inches. Three hundred and sixty power pulses have been transmitted to the crankshaft, making 360 sonic booms as the exhaust gas is expelled from the cylinder with a velocity exceeding the speed of sound.. The water pump impeller has spun 90 revolutions sending 4 gallons of coolant surging through the engine and radiators.

The oil pumps have forced 47 fluid ounces, roughly, one-third gallon, oil through the engine, oil coolant, and oil tank, scavenging heat and lubricating the flailing machinery. The supercharger rotor has completed 348 revolutions, its rim spinning at Mach 1, forcing 4.2 pounds or 55 ft<sup>3</sup> of ambient air into the combustion chambers under 3 atmospheres of boost pressure. Around 9 fluid ounces of high octane aviation fuel, 7843 BTU's worth of energy, has been injected into the carburetor along with 5.3 fluid ounces of methanol/water anti-detonant injection fluid. Perhaps, 1/8 fluid ounce of engine oil has been either combusted or blown overboard via the crankcase breather tube. Over 1.65 million foot pounds of work have been done, the equivalent of lifting a station wagon to the top of the Statue of Liberty.

In that one second, the hard-running Merlin has turned the propeller through 25 complete revolutions, with each of the blade tips having arced through a distance of 884 feet at a rotational velocity of 0.8 Mach. Fifteen fluid ounces of spray bar water has been atomized and spread across the face of the radiator to accelerate the transfer of waste heat from the cooling system to the atmosphere.

In that one second, the aircraft itself has traveled 704 feet, close to 1/8 mile, or roughly, 1.5% of a sin-

gle lap. The pilot's heart has taken 1.5 beats, pumping 5.4 fluid ounces of blood through his body at a peak pressure of 4.7 inches of mercury over ambient pressure. Our pilot happened to inspire during our measured second, inhaling approximately 30 cubic inches (0.5 liter) of oxygen from the on-board system, and 2.4 million, yes, million, new red blood cells have been formed in the pilot's bone marrow.

In just one second, an amazing sequence of events

have taken place beneath those polished cowlings and visored helmets. It's the world's fastest motor-sport. Don't blink.

*Editor's note* The North Star Rolls Royce Merlin 622 engines, have been used extensively in unlimited racers. Rated at 1760 hp for transport operations, they have been souped up to deliver almost twice the power in racers.

Aircraft Engine Historical Society. Reprinted with permission.

## PNSAC Salvage Millard Air DC54C Aircraft

*Jim Riddoch*

Wayne Millard called the Canada Aviation Museum in August this year to advise he was parting out his last DC54C aircraft and would the North Star Project be interested in any parts of this aircraft. Mike Irvin, CAVM North Star Project Manager advised PNSAC volunteers of this opportunity and would we be interested in following up this offer. Some discussion followed re the interchangeability of parts with the North Star and it was decided a visit to Millard Air could be worthwhile. Accordingly, on 27 August four volunteers, namely Jim Riddoch, Bruce Gemmell, Bill Tate and Ted Devey drove to Pearson International Airport, Millard Air Hangar to inspect for potential salvage items that could be used in the North Star restoration.

We found the aircraft parked outside the hangar with all four engines removed and considerable amount of equipment already removed. We learned that Berlin Air Lift had already acquired many of these items. However we identified several items of interest, including landing gears, flap actuators and mounting brackets, access doors, phenolic cable pulley assemblies, astral compass equipment and antennae, cargo bay lights and various other parts and pieces. We made a list of these components and requested Wayne to save them for the North Star Project, a restoration effort that he firmly supports. The same day we returned to Ottawa confident we could recover these items on a subsequent return visit with suitable tooling and salvage equipment.

On our return to CAVM we discussed our findings with Mike Irvin and asked for his support in recovering these parts. Although heavily involved in other work at the museum, Mike was unable to participate in a return visit but did get approval for CAVM to cover our subsequent trip costs. With this

approval PNSAC funded the acquisition of heavy cutting equipment to remove the desired parts from the aircraft (excluding landing gears).

On 8th September, four volunteers, namely Jim Riddoch, Bill Tate, Rolf Geiger and Tec Devey set off in a four-by-four cab with suitable equipment and tools on a return four day visit to Millard Air hangar at Pearson International Airport. We met up with Steve and Peter, mechanics working for Wayne Millard who assisted us in setting up electrical power for cutting wheel and reciprocating saw and other support equipment.

The next three (3) days were spent cutting and removing various parts from the aircraft. These included cable assembly pulleys, doors and hinges, antennae, tail skid actuator, cockpit astral canopy, lights, electrical equipment and various odd items. The attached pictures depicts some activity during this period along with the odd break period for meals.



Figure 1: Bill Tate escaping from the cockpit



Figure 2: Rolf, Bill, Jim and Ted taking a break

We marked out areas for the cutting of the landing gears and flap actuators as these could only be done when the aircraft was moved inside and the demolition contractors took over. Unfortunately, this proved to be too expensive by the contractors and so were cancelled by PNS and CAVM. On Thursday, we packed most of the items we could accommodate in the four- by- four cab and returned to Ottawa, arriving back around 8.00pm. All together, a successful salvage of parts useable on the North Star restoration.

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# Miscellany

## Photographs

*Photos in figures 2 to 7 by Chris Payne.*



Figure 2: Nice shine



Figure 1: Co-conspirators just before sentencing. (Thanks to Hope Aero)



Figure 3: Jim consorting with the Luftwaffe



Figure 4: How's the patient doing?



Figure 5: Metal shaped by Ted Slack for spinner fix



Figure 6: Rebuilding the radiator door



Figure 7: Featherdusters in full flight

## Newsletter distribution

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

## Member's Meeting

PNSAC Members and guests are invited to attend the Meeting which will be held in the Bush Theatre at the Canada Aviation Museum on Saturday, December 6, 2008, starting at 10:30 am. The agenda will include updates on Project North Star and other items of interest to members.

## Canada Aviation Museum re-opens

The Museum re-opened to the public on November 19th after a two and one half month closure for re-configuration of the displays. The new displays, when they are completed in December or perhaps January, will be interactive and organized in pods based on aviation themes such as the pioneer era, bush flying, World War II and development since the war.

## Product Bar Coding

This will be of interest for those who want to know where goods originate. The first three digits of the barcode identify the country where the product was made. Some examples: USA and Canada 000-013; France 030-037; Japan 049; UK 050; Philippines 480; China 690-695 and Central America 740-745.

## Coffee Time

Canadians consume 4 kg of coffee per person per year, 25th place in world consumption, just behind the United States at 4.2 kg. Finland tops the list at 11.4 kg per person per year. Brazil produces the most coffee, over two million metric tons. Vietnam is next with over one million metric tons and Columbia is third with 774,000 metric tons.

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<sup>1</sup>This newsletter is typeset using L<sup>A</sup>T<sub>E</sub>X<sup>2</sup>. The style package used for the newsletter (PNSAC.sty) is a modification of GRASSnews.sty belonging to the Geographic Analysis Resources Support System (GRASS). The modification was made possible by kind permission of the Editor-in-Chief of GRASS-News.