can-am

motorcycles

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Looking back fifty years
Chapter seven 1976 the last chapter
David McLean 1971 to 1976

This year would be a dramatic one, for Bombardier Ltd. and its involvement with motorcycles. With the motocross success of Gary Jones and Jimmy Ellis in 1974 and early 1975 and the enduro success in 1973 and 1974 there were high expectations for the number of MX and TNT motorcycles that could be sold in 1975. With the benefit of hindsight it can be said that the numbers predicted were overly optimistic. Too many complete motorcycles were made and too many parts were made to make even more. As a result of this, there would be no 1976 MX or TNT models and the improvements planned for the 1976 models were shelved for the 1977 models.

However, there would be one new model for 1976. This was the fourth year of can-am production and a ready to use Enduro motorcycle had yet to be made. Customers were expected to modify their TNT or MX machines. The new complete enduro motorcycle would be the 175 O/R [off road]. In 1975 there was an effort to help customers modify their machines with enduro kits. These kits were production items that were copied from the hand made items from Jeff Smith's competition department.

The first was a lighting kit which consisted of a small diameter head light with horizontal bars protecting the lens, a low profile tail light and licence plate holder mounted on a flexible rubber base and a wiring harness with a voltage regulator to ensure no light bulb failures.

The second was a speedometer/odometer kit which consisted of the can-am speedometer, mounted on a new bracket which curved downwards at the front to hold a front number plate with a cut out for the head light. Also included was a speedo cable and a stronger cable guide, clamped to the Betor fork boot. All can-am front hubs had three tapped holes for the speedo drive, so a MX bike could use the TNT speedo drive.

The third was a thick leather tool bag to be mounted on top of the rear fender just behind the seat. With early prototypes of this bag, it was found that if the leather was saturated with water it became very pliable and unable to hold its contents. The final version had an internal aluminium base plate, three large flaps and three straps with large buckles to hold on to those tools securely.

All three of these kits would now be used on the new 175 O/R, along with Magura control levers and throttle. There was one more part that needed a change. By this time there were a number of States and Provinces that required a spark arrestor, approved by the U.S. Forest Service for off-road motorcycles on public land. The spark arrestor in common use at this time was the Krizman centrifugal design. Much effort was spent back in 1972 designing and developing the muffler for the TNT. The low, triangular shape was fully tucked in, relatively lightweight and made no contact with the rider. However, there was no interior space to fit the Krizman spark arrestor design and so this good design had to be abandoned for a more conventional high pipe design, that went straight back from the expansion chamber. Rotax designed a new muffler with the Krizman spark arrestor at the end, the end cap was removable to clean out any carbon particles. This was the fourth year of 175cc can-am production and most of the details of this design had been taken care of. It would be truthful to say that this enduro bike was as" bullet-proof "as it gets for enduro bikes of this era.

For 1976 motocross, the effort would again concentrate on the American Motorcycle Association professional MX series. Jimmy Ellis would ride the whole series and Mike Runyard and Buck Murphy would again be supported. This was the era of ever increasing suspension travel and the competition departments bikes would follow this trend. The front suspension travel increased from 7 ½" to 8 ¾" with the new Marzocchi forks and the rear increased a similar amount with the Gabriel dampers mounted in a laid-down position as on last year's bike. The engines would remain the same 37 bhp @ 8500 rpm, these Rotax engines had a peak power advantage in 1974-5 and probably still had an advantage in 1976. This was the third year of Jimmy Ellis racing this bike with this engine's power band, he had raced on many different race courses under different conditions [wet/dry]. The peak horsepower was an advantage at times but the steep strong torque curve meant that there was a poor relationship between throttle position and what was happening at the rear tire contact patch. This meant that it was difficult to find traction under poor surface conditions [wet/mud]. Ellis, on his own initiative , tried to improve this problem. " Banke " was a company that produced aftermarket exhaust systems for MX bikes, and they were known for providing a wide usable power band. An exhaust system was obtained for a 250 MX can-am, and Ellis liked the change in power delivery. Back at the can-am R&D we were questioning how an aftermarket exhaust could be better than the Rotax designed expansion chamber exhaust. Eventually we received a Banke pipe and put it on the 250 MX dyno engine. Franco Baroni was one of the dyno operators at this time, verifying the performance of the hand made MX exhaust pipes, and testing better performing enduro exhaust pipes. When testing the Banke pipe, it was found that the high rpm torque peak was considerably reduced and that the over-rev capability was extended by 500 rpm. This effectively flattened the torque curve and allowed the rider to stay in a given gear a little longer. This was an indication of where future development of the 250 MX torque curve should be. With the loss of this peak torque, there was a loss of peak horsepower, down to 33 bhp, midway between the 37bhp of the MX and the 29 bhp of the TNT and Enduro bikes. During the course of the season it is not known when the 33 or the 37 exhaust pipe was used.

There was a new problem with this 1976 version MX bike. With the yearly increase in suspension travel, the centre of gravity increases and if the rider is standing, the effective centre of gravity is even greater. When accelerating through the steep portion of the torque curve with good rear wheel traction there was unpredictable front wheel lift.

This 250cc motocross bike would be the basis for the 1977 MX3 250, all of these characteristics would be inherited by this new model. This new 250, with its poorly calibrated suspension soon developed a reputation. The word used to describe it was " widow maker ", now this certainly is not a technical word, but is a short and indirect way of saying that those riders who choose to ride this motorcycle as fast as it can go, beware !

This year would be moderately successful for Jimmy Ellis. There would be six supercross/stadium races, and he would win two of them and place third overall in the series. In motocross there would be seven races, and he would win one and place eighth overall in the series. In a number of races he would finish well back of the front runners.

By 1976, the four remaining Japanese and some European motorcycle manufacturers were very serious about winning professional motocross races and seasonal championships. They were providing the resources to build the best motorcycles possible and obtain the best riders, just as can-am had done in 1974 with Gary Jones and Jimmy Ellis. In future years Honda, Yamaha, Suzuki and Kawasaki would seriously compete with each other, introducing new technologies and making major changes in a new motorcycle model, if it was not successful.

In enduro competition, this was the fourth year of participating and can-am's had earned a good reputation of a bike that could finish well. This was seen in the increasing number of can-am's entering enduro events. However, the most challenging event each year was the "International Six Day Trial". This year it would be located in Austria, the country where the Rotax engines are made and special effort would be made to represent all three displacement classes 125/175/250. A new long travel suspension chassis would be used for these bikes. These would be the prototypes of the 1977 Qualifier enduro bikes, a new name for the enduro bikes that would remain well into the future. The competition department would send a large group of riders and they would finish well.

Jeff Smith 250 Gold Medal
Ron Matthews 250 Gold Medal
Eric Neilson 250 Silver Medal
Bob Fisher 175 Silver Medal
Geoff Burgess 125 Silver Medal

Geoff Burgess was the newest member of the can-am R&D team, joining this year.
This was just the type of results needed, to promote future sales of enduro bikes.

The ½ mile oval dirt track bike project was a more modest effort, one motorcycle and one rider, David McLean. In 1975 a 250 MX-1 was modified into a dirt tracker, this was an experiment to see if a 250 can-am engine, modified to 250 MX race bike specs, would be competitive in the new 360cc class. It turned out that it was not only competitive but could win races. For 1976 a more serious effort was made to make it even more competitive. This bike would be made up from parts more suited to dirt track racing. An out of the box 250 MX-2 engine would be the heart of this bike. The exhaust port was slightly changed and the head pipe length reduced on a 250 MX race pipe dimensioned exhaust. One ft/lb of engine torque was lost but peak power was raised to 39 bhp @ 9200 rpm. This is the exact opposite as was needed on the 250 MX bikes, but a good ½ mile straight away speed was needed to be competitive with the 360 bikes. This narrowed the usable power band and made top gear, gearing critical to take advantage of increased horsepower.

Back in 1973 Jeff Smith’s competition department was tasked with making a competitive 125 MX race bike. The engine power of 20 bhp was already excellent , but the engine and chassis were designed to be suitable for 125/175/250 engine sizes. This meant that the 125 was an overweight motorcycle. Way back in the 1960’s when Jeff was racing unit construction 250 to 500cc BSA motorcycles, he was well aware of the importance of reducing the weight of racing motorcycles. Sometimes using extremely costly parts to achieve this. Now it was time to lose weight again. A small number of aluminium main frames were made, exact copies of the production steel frames, aluminium 6061 T6 [weight 12lbs.]. The production frames were steel 1015/1018 [weight 23 lbs.]. One MX bike was built and tested, however it proved not to be durable enough for MX use. This was an experiment ,and all experiments don’t produce the results one hopes for. This resulted in a return to a more conventional racing frame material, 4130 N chrome/moly alloy steel, one gauge thinner than the production frames [weight 19 lbs.]
The spare aluminium frames were put in storage, perhaps to be used for a future project, such as a Trials bike. By the end of 1975 these frames had still not found a use, so it was decided to experiment again and see if they were durable enough for much less demanding oval dirt track use [and this time the experiment was successful, the frames were durable for many years of use]. The 125, one gauge thinner 4130 N swing arm was used to complete the frame. Cerriani 35mm road racing fork legs were used to reduce weight and lightweight inverted Girling suspension units were used to support the rear. Numerous other small weight savings were found in the engine and chassis. The starting line weight of this year's dirt tracker was now 180 lbs. compared to the 1975 version of 200 lbs. This motorcycle was again very competitive but did not have any advantage over a well prepared 360cc dirt tracker.

I am going off on tangent for a few paragraphs here:

In 1963 the USA congress enacted the Clean Air Act. After more than a century of population and industrial growth, numerous areas of America were suffering from severely polluted air. The most seriously polluted and most publicised for many years, was the unique situation in the greater Los Angeles area of California. For most of the 20th century poor air quality had been a serious problem in what is now named the Los Angeles Basin. By the late 1940’s an Air Pollution Agency had been formed to control the ever increasing pollution from population and industrial growth. In particular industrial smoke and fumes and the widespread use of burning all garbage. This improved the air quality somewhat, but by the 1960’s with the continued fast growth of population [8 million] and industry, the pollution was even more severe. This polluted air would interfere with vegetation and crop growth,attack paint, plastics, rubber and even concrete. Even more important was the effect on the health of those who lived here, watery eyes and many respiratory problems, sometimes severe.This had become a very serious problem and something had to be done! Many years previously it had been determined what the pollutants were and the condition necessary to produce this brown tinged dense smog.

Hydrocarbons [HC] - unburned and partially burned fuel

Carbon Monoxide [CO] - incomplete combustion

Nitrogen Oxides [NOx] - high peak combustion temp. [mostly in 4 cycle engines]

These three pollutants in combination with a warm, sunny climate [no problem for southern California] would interact to produce toxic smog.

This combination could be found in other industrial population centres, but the Los Angeles location is unique. This area is mostly surrounded by mountains and high hills, effectively putting it in a basin. To the west is the Pacific Ocean which typically produces light to nil on shore winds. These winds are not strong enough to disperse the polluted air, but hold this air in a stagnant position against the mountains and hills. It requires a major wind event or storm to remove this polluted air from this area, and then this pollution cycle begins again.
Although industry and electric power generation continued to add a significant amount of pollutants it was now determined that private vehicle transportation was now the major source of pollution. The greater Los Angeles area could be characterised as urban sprawl with a well developed road network. This results in high private vehicle use, long commutes to work and being stalled in rush hour traffic. Other cities in California also had similar air pollution problems and so the State of California enacted its own regulations, limiting the amount of the pollutants coming from new light duty vehicles [automobiles and small trucks]. This was the first light duty emission standard and would apply to all new vehicles sold in California, starting in 1966.

The USA Federal government would enact similar regulations, starting in 1968.

In 1970 the USA congress and President Nixon created the independent Environmental Protection Agency [EPA] to set and enforce national pollution control standards. This was to consolidate federal government pollution programs under one new agency. They would be responsible for air, land and water quality.

The first efforts of the EPA were to set pollution limits for the largest polluters. One of these were gasoline, light duty vehicles [automobiles and small trucks] driven on the public roads of America. The EPA spent considerable time understanding the scope of this problem and investigating the technologies needed to greatly reduce the pollution. It soon set greatly reduced emission standards that required the mandatory use of catalytic converters in the exhaust system. This would become effective in the 1975 model year. Periodically in the next 50 years there would be new lower emission standards, each time giving years of advance notice to develop new technologies and put them into production. By 2022, the HC,CO,NOx pollutants have been reduced by 98 to 99% and along the way Lead has been eliminated,and Sulphur greatly reduced. Also Particulate Matter from the exhaust, which affects short and long term lung function. Another added benefit is that light duty vehicles now consume only half as much fuel as pre-emission vehicles, reduced engine size and vehicle weight combined with better aerodynamics also contribute.

To achieve all of this, requires much investigation into new technologies such as; reformulated gasoline, several redesigns of the 4 cycle gasoline engine, many sensors on or near the engine, 3 way catalytic converter and a sophisticated computer to take over control of the engine and automatic transmission under all operating conditions. This is expensive, this is complex, but this has resulted in considerably improved air quality in high population areas in the USA. Over the past 50 years the US economy has grown, the population has grown, industry has grown, vehicle population and use has grown and still the environment is livable for now.

Now back to motorcycles.

Once the EPA had set the emission standards for light duty vehicles using the public roads of America, it turned its attention to other vehicles using these roads. One of those would be motorcycles. At this time motorcycles made up 1% of the light duty vehicle population and contributed less than 1% of the pollutants. However this pollution was not evenly distributed throughout the USA. The northern part of the USA has a winter season with snow and cold temperatures, greatly restricting their overall yearly use. While the southern part of the USA has a climate warm enough to ride motorcycles all year long. An individual could have a motorcycle as one's primary vehicle and commute daily to work.

In this era, 40% of the on road motorcycles were 2 cycle engines and the other 60% 4 cycle engines. The simple 2 cycle gasoline engine is very fuel inefficient, of the fuel consumed a large portion never reaches combustion to power the engine. In the typical engine, the air, fuel,oil mixture in the crankcase when transferred into the cylinder, loses 25% or more out of the opened exhaust port. This results in very high HC emissions from the exhaust pipe. A few % of these emissions are from the lubricating oil in the mixture. However, this oil when burned either by combustion in the cylinder or the hot exhaust pipe, produces a very visible smoke. Again in a typical on road motorcycle, the interior walls of the exhaust pipe and the baffle system of the muffler are coated with a film of oil. When the throttle is opened fully and the engine rpm's rise a large volume of hot, fast moving exhaust gases burns some of this film and creates an even larger volume of very visible smoke. If a motorcycle design such as this, is ridden in an already polluted environment [such as the Los Angeles example], this motorcycle becomes a target vehicle in need of emissions reduction.

At the beginning of 1974 the EPA put out an advance notice that motorcycle emission regulations would be coming soon. Before the end of 1974, tentative emission standards and the 1976 starting date was published. The emission standards level was reasonable, considerably more pollutants were allowed than automobiles and small trucks of this era. This, even though motorcycles have smaller engines and weigh less.

Back in 1970 when the EPA was started, Rotax in Gunskirchen, Austria was also starting the design of their first motorcycle engine. These engines were 125/175/250cc rotary valve 2 cycle engines that would eventually become the foundation for the can-am motorcycle. Dr. Heinz Lippitsch had just become Rotax Development Manager, and he and his team would design and develop these initial engines from 1970 to 1973. By 1973 both Bombardier and Rotax were aware of the approaching EPA emission standards for on road motorcycles. Heinz Lippitsch started to investigate the problem of reducing emissions from these 2 cycle engines and by 1974 had the equipment to measure these emissions by the EPA testing procedures. There would be no surprise that the HC levels were far above the tentative EPA standards. It was well known that 25% or more of the intake mixture was lost out of the opened exhaust port and in a high performance engine such as these new engines, the loss could be in the range of 40%. The logical solution is to inject fuel into the cylinder in such a way that none escapes out of the exhaust port. Motobecane a French manufacturer of small

2 cycle motorcycles, had an experimental electronic capacitor discharge fuel injection system, Bosch had their own system and there was a new carburetor design to test.
After two years of development there still was not a significant reduction in HC.
While direct fuel injection is a logical first step, a precise amount of atomized fuel is required for all operating conditions. As noted earlier, automobiles in the later years of lower emission standards needed many engine sensors and a computer to take over control of the engine. In the early 1970's these technologies did not exist for automobiles or motorcycles. Even if they did, it would add a considerable cost to a relatively inexpensive, small, 2 cycle motorcycle. Also if emission standards were greatly lowered in the future, could a 2 cycle engine meet those standards? And what about those HC's from the total loss lubrication system?

Earlier the EPA had realised the challenges the motorcycle industry was having, and extended the 1976 deadline. By 1976 the EPA had set a new firm date for the start of motorcycle emission controls, Jan. 1/1978. This put Bombardier and Rotax in a difficult position. From 1962 Rotax was the only provider of engines for Bombardier recreational vehicles and this would continue so into the future. Rotax had started operations in 1920 and most of the time since had produced only 2 cycle engines. Since 1962, Rotax had developed racing and sport engines for the Ski-Doo snowmobile and increased production capacity to over 200,000 engines per year. There were no foreseen emission standards for snowmobiles and these new emission standards would apply only to the can-am TNT on road models. The decision was made to stop all further development on the 125/175/250 TNT models and the 500 twin cylinder road bike, which was still in the development stage. The can-am R&D capabilities were reduced to reflect that decision. It was disappointing to lose the ability to make road models, as these motorcycles are very important to a motorcycle manufacturer. However, this was an awakening for Bombardier and Rotax, emission controls for on road vehicles now, and for off road vehicles when? How much longer would there be unrestricted freedom to pollute the air?

For the other motorcycle manufacturers of 2 cycle engine on road motorcycles, they had faced the same problem. Virtually all of them abandoned the 2 cycle engine and replaced it with new 4 cycle engine models.

Six years later in 1982, Rotax would have a 4 cycle, 500cc, air cooled engine, ready for the new can-am Sonic enduro bike. As an off road motorcycle it would not need any exhaust emissions controls but more important was the fact that it was a 4 cycle engine that could use the more than one decade of automobile emissions technologies. This engine, in various displacement sizes would go on to have a very successful two decade long run. Rotax would now turn to making many single and twin cylinder, 4 cycle engines that were emission compliant in the countries where they were sold. A number of motorcycle manufacturers took advantage of these readily available engines.

In 1988 the second generation of the Sea Doo personal watercraft [PWC] appeared, with two cylinder high performance 2 cycle engines. By 1998 EPA emission standards would start, and be phased in over a 13 year period. This would begin the phase-in of 4 cycle engines to all See Doo's.

In 1999 a new recreational vehicle would appear, the Bombardier All Terrain Vehicle [ATV]. These would be powered by 4 cycle engines, with the exception of the 2 cycle engine in the children's version. There were no emission standards for these vehicles at this time.

In 2003 there would be a company name change, Bombardier Inc. would separate its recreational division into Bombardier Recreational Products [BRP].

In 2006 the can-am name would reappear, with all ATV vehicles becoming the can-am ATV. Also this year the EPA would have emission standards for all off road vehicles.
Snowmobiles would finally have their own standards which would be phased in over a 7 year period. This would result in the majority of Ski Doo's having 4 cycle engines.
ATV's would have their own standards which would start immediately.
Motorcycles also would have their own standards which would start immediately, their standards would allow about twice the emissions of on road motorcycles.

In 2007 can-am's would be on the road again with the three wheeled can-am Spyder.
This vehicle would have a large displacement 4 cycle engine which was fully compliant with EPA on road motorcycle emission standards.

Rotax would continue on developing new 2 and 4 cycle engines. By 2022 most engines made would be 4 cycle but the 2 cycle engines would not be abandoned . There was a full line of 2 cycle Kart engines, something Rotax had been involved with since 1972 with the introduction of the engines for the can-am motorcycle. In particular the two cylinder, 2 cycle engines for racing/sport Ski Doo's had major advancements. The simple 2 cycle engine had been changed into something not so simple at all, but had become a very powerful and compact package with considerably reduced exhaust emissions. The even more complex 4 cycle engines could meet the exhaust emission regulations, but had greater external dimensions and weight and produced less power [exception being the power from the turbo charged versions].

By 2022 Rotax, a mechanical engineering company, had been in business for more than a century and had developed into a well respected maker of small internal combustion engines. One could expect quality engineered and constructed engines which were both powerful and reliable and if necessary , emissions compliant where required.

What happened to new, 2 cycle engine on road motorcycles? In countries with strict emission standards they were virtually eliminated from the market. Only 50cc 2 cycle engines with direct fuel injection and water cooling remained.

All of the previous emissions information has been centred on USA regulations, but Canada also has similar regulations. Canada has a long coast to coast border with the USA and the environment and climate is similar on both sides of this border. Rather than Canada duplicating the tremendous amount of work done by the EPA, Canada's vehicle emissions standards generally mirror those of the USA. Canada's regulations are set under the Canadian Environmental Protection Act.

Gary Robison headed the Bombardier Motorcycle Research and Development from its start in 1970, but by 1976 he had left the company. In 1971 the R&D was composed of a small group of people, and Gary and the rest of us had a goal to design and make a small engine, off road, race motorcycle. The most important part was that this motorcycle would perform better than those made by other manufacturers. This is where true research and development was needed, as no previous motorcycle existed. Many other motorcycles were researched and then the design of the chassis started. As each part of the motorcycle was being designed, the question was, is this part better or at least equal to the best of the other race bikes available?

In 1972 and early 1973 much testing and development was done, as many parts of the motorcycle failed or needed improvement. The question now was, how much time is needed to get this motorcycle right? This progress was slow, as the R&D was located in the northerly town of Valcourt, Quebec, a town with a long winter with snow and cold temperatures. This meant that most of the testing was done in various places in the southern USA. At these locations there were no facilities to maintain, repair or make modifications.
By mid 1973 we were somewhat confident to put this motorcycle into limited production.
By the end of the year, after the customers had time to ride it, we found out that this was a fairly good 125/175 competition motorcycle. Being the first year of an all new motorcycle, it was not surprising that in producing many motorcycles, there would be some flaws that needed attention. The small group in the R&D worked on these problems but in doing so,
It diluted the R&D effort to make improvements for the next models. In particular this was the era of ever increasing, well controlled suspension travel.

In attempting to make a better performing motorcycle than our competitors, it was not surprising that the cost was higher. This resulted in a higher selling price than some of our competitors. This meant that attention had to be given, to not increasing the cost of an already expensive motorcycle. In the coming years each new model that was presented to Ski Doo production had to be manufactured economically.

This is a draft of chapter seven, from one person’s perspective. Should others wish to add to this, please come forward.

David McLean

GARY ROBISON Are you out there?