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History of the S38 Engine

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The History of the S38 engine

This article goes a bit deeper into the engine of our beloved E34 ///M5. Like you may have heard or read before, this engine is the result of an almost 20 year evolution of engine development at BMW ///M GmbH. But let's go a bit further into detail about its history. The intention of the article is not to explain the technical differences, but to give an overview of the evolution and to describe the legacy of the S38 engine.

It all started in 1973 when BMW needed a more powerful engine for the competition CSL's to compete with the Ford Capri's. Until then, BMW via Schnitzer and Alpina raced the CSL's with the M38 and M52 engines. These SOHC engines where based on the M06 engine from 1968. The M06 is the first version of the legendary engine family, which we all now know as the M30 big six.

Linking the M30 with the M06 may seem confusing, but it is not. In the early 1980's, BMW switched to a new system of coding their engines. Before then, an engine was designated by a three character long code and if applicable followed by a version (for example M90 or M49/1). The new engine coding used a six character long code and if applicable followed by one or more characters for engine specifics. The new engine code allowed BMW to specify its source (regular BMW or BMW Motorsport), the engine family and the displacement. Examples of the new engine codex are M30B35 and S62B50. The M06 engine from 1968 is coded according to the old coding system, while the M30B35 from 1985 is coded according to the new system. Some common engines with an 'old' ID code also received 'new' engine code. For instance the M06 is also know as the M30B25V with the V meaning "Vergasser" or Carburetor.

The M52 racing engine family created a base for the new 24-valve race engine coded M49. This new engine was developed by a new division lead by Jochen Neerpasch. Today we know that division as BMW Motorsport. Jochen Neerpasch managed to create a team with amongst others Paul Rosche, also known as "nocken Paul". The cylinder head of the M49 engine is almost similar to the M12/2 formula II engine. This means that the camshafts are driven by directly by gear train. This gear train was driven by a single timing chain via an intermediate shaft. Theoretically this allowed the head to rev over 9000RPM. But since the crankshaft is larger than the four-cylinder Formula II engine, 9000RPM was the limit for the group 5 engine. The M49 equipped E9 CSL won it's first race in the European ETC series on the Salzburgrung in March 1974. A remarkable success, especially because it was also it's racing debut. The oil crisis of 1973 and the commercial lack of interest for high performance cars (the E20 2002 turbo being a good example) slowed down the development of the E9 CSL's. Four E9 CSL's with M49 engines entered the American IMSA series in 1975. Also in 1976, BMW participated in the American IMSA series. During these two years, BMW won 7 races.

In Europe, there was hardly any real competition and when plans for a group 5 class for the 1975 season did not materialize, the European E9 CSL's with M49 engines where sold of. Alpina bought at least one and about two years ago one of these cars showed up for sale in the Netherlands for about US$25000.

For the 1976 season, the oil crises was a few years back and BMW decided to enter the newly created group 5 series. By request of the factory, Josef Schnitzer further developed the M49 engine so it could be used for vertical installation in the CSL's engine bay. Vertical installation allowed the use of larger exhaust headers, a more optimized inlet system and the installation of a more efficient cooling system. This engine was named M49/3 and yielded 465hp @ 8500RPM.

But compared top the Porsche 935 turbo, the E9 CSL with the atmospheric M49/3 engine did not have a chance to compete. That is why in a later stage, twin turbo chargers where added. This was the fifth evolution of the M49 engine and was called M49/4. The M49/4 had a 300cc smaller displacement. With a bore of 94,0mm, the M49/3 only had 6,0 mm gap between the cylinders. For the non-turbo charged engines, this was enough, but turbo-charged engines produce much more heat, which has to be removed efficiently. Reducing the bore is one of the ways to achieve this. Even today, reducing the bore is a common practice to create a larger gap between the cylinder walls to create larger cooling channels within turbo charged engines. The four-valve M49/4 engine allowed a relatively low turbo pressure. Usually, a boost of 1,3bar was used to yield a neat 750hp @ 9000RPM. This high power output came with a relatively high reliability of the engine. Although the CSL gearbox was not designed for such a power, it held up rather well during the races. The practical experiences with the M49/4 engine provided a basis for the development of the later E26 ///M1.

All in all, the M49 engine and the E9 CSL where very successful in the Group 2 European Touring Car (ETC) series. From 1973-1976, BMW won the championship in these series. Although the last CSL's where made in 1974 and the last E9 coupe's left the factory in December 1975, BMW Motorsport continued to support it in 1976, but could continue that in 1977 because it was an obsolete model. This was a logic consequence of the introduction of the E24 6 series and using the CSL longer would not benefit the sales of the new coupe. Private teams continued to use the E9 CSL until 1978 and even managed to win the European Touring car Championship (ETC in 1977 and 1978. The following table shows an overview of the M49 engines which where used in racing.

Car's	E9 CSL	E9 CSL	E9 CSL	E9 CSL (Group 5)	E9 CSL (Group 5)
Development	BMW Motorsport	BMW Motorsport	BMW Motorsport	Schnitzer	Schnitzer
Old engine code	M49	M49/1	M49/2	M49/3	M49/4
New engine Code	N/A	N/A	N/A	N/A	N/A
Engine Capacity (cc)	3153	3340	3498	3498	3200
Stroke (mm)	84	84,0	84,0	84,0	
Bore (mm)	89,3	92,5	94,0	94,0	
Max Power (DIN hp)	415 @ 9000RPM	430 @ 8750RPM	440 @ 8500RPM	465 @ 8500RPM	Up to 950 @ 9000RPM (at 1,6 atu)
Max torque (nm.)				40,5mkg	
Max torque (lb./ft)					

Compression ratio				11,0:1	
Fuel management	Kugelfisher mech.	Kugelfisher mech.	Kugelfisher mech.	Kugelfisher mech.	Kugelfisher mech.
Engine type	Normal Aspirated	Normal Aspirated	Normal Aspirated	Normal Aspirated	2 KKK turbo chargers
Lubrication	Dry sump	Dry sump	Dry sump	Dry sump	Dry sump
Year(s)	1973	1974	1974	1976	1977

Table 1, M49 engine family

For the group 5 series, Jochen Neerpasch wanted a mid engined racing car. The development of the E26 ///M1 started in 1976. The idea was to develop a racecar first and a road car second. Since BMW did not have the capacity or the expertise to build a tube framed car, BMW Motorsport contacted Lamborghini to help with the development and the production of the chassis. But Lamborghini came into financial troubles and was not able to fulfill its commitments to BMW. This delayed the production of the E26 ///M1 with more than a year and by the time the production of the ///M1 started, the rules for the group 5 touring car championship where changed and ruled out mid engined sports cars. At that time, Jochen Neerpasch had his new racecar, but could not use it. Max Mosley of the FIA came up with a brilliant idea. A new race class was established specially for the ///M1. This new race class, the Group 4 Pro Car series was scheduled to take place before a Formula 1 race with a few formula 1 drivers and privateers.

The engine for the ///M1 was an evolution of the M49 engine of which the development stopped in 1977. However the new M88 was spend with significant changes to allow also to be used as a production engine for road cars. This was necessary to sell the E26 ///M1 as a road car, a requirement for the group 4 regulations. The Group 4 rules required that 400 units of that same car would be made within one year. The direct drive of the camshafts by a gear train was abandoned for a direct chain drive to reduce the interior noise. Like the M49, the M88 engine also used a Kugelfisher mechanical fuel injection system. The cylinder head of the M88 consisted of two pieces. The lower piece contained the intake and exhaust ports, the valves and the spark plugs. The upper piece contains the buckets, shims, camshafts and bearings

Compared to the M49/3, the M88 had a slightly smaller displacement (3453cc). This was achieved by reducing the bore slightly to 93,4mm. However the stroke of the engine remained the same (84,0mm). To test if the M88 engine would be reliable for a production engine, BMW placed the existing SOHC drive train on the M88 cylinder block. This engine, called M90 used a regular Bosch L-Jetronic (predecessor of the Motronic) fuel injection system and yielded 218hp.

The road going ///M1 used the M88 engine. The M88 yields 277hp @ 6500RPM and 330nm @ 5500RPM. This was more then enough to propel the 1418kg sports car in a little more than 20sec to the 200km/h mark.

Since the E26 ///M1 was designed for racing first, the M88 engine was heavily modified. For road use, the M88 is tuned to offer a good compromise between tractability, engine longevity and performance. Engine longevity is not that important for racing and for group 4 and 5 Procar races a lot more than 277hp was required. New camshafts, larger valves, reshaped ports,

throttle slides instead of butterflies, forged pistons and a completely different exhaust system helped to increase the power to almost 500bhp. For Group 5 purposes, two turbo chargers where added. This version is known as the M88/2. Depending on the boost pressure, the power output was between 850bhp and 950bhp.

Car's	Development engine for the E26	E26 ///M1	Group 4 Procar series	Group 5 Procar series	E28 ///M5 & E24 ///M635CSI
Old engine code	M49/5	M88	M88/1	M88/2	M88/3
New engine Code	N/A	S32B35	N/A	N/A	S31B35ME
Engine Capacity (cc)		3453	3453	3200	3453
Stroke (mm)		84,0	84,0		84,0
Bore (mm)		93,4	93,4		93,4
Max Power (DIN hp)		277 @ 6500RPM	490 @ 9000RPM	Up to 950 @ 8500RPM (1,6 atu)	286 @ 6500RPM
Max torque (nm.)		330 @ 5000RPM			340 @ 4500RPM
Max torque (lb./ft)		239 @ 5000RPM			250 @ 4500RPM
Compression ratio		9,0:1			10,5:1
Fuel management		Kugelfisher mech.	Kugelfisher mech.	Kugelfisher mech.	Bosch Motronic
Engine type		Normal Aspirated	Normal Aspirated	2 KKK turbo chargers	Normal Aspirated
Lubrication	Dry sump	Dry sump	Dry sump	Dry sump	Wet sump
Year(s)	1977	1978	1978	1979	1984-1989

Table 2, M88 engine family

With the cease of the group 4 and group 5 races, BMW stopped to use the M88 engine for racing purposes and concentrated on developing race cars on basis of the E21 and later the E30 3

series. But in 1983, the M88 was used one more time to power the new top model of BMW, the E24 ///M635CSI. The regular 635CSI lacked the power to compete with Porsche's 928S and the Mercedes 500SEC. For the E24 ///M635CSI, the M88 was redesigned. The bore and stroke of the M88/3 engine remained the same as the M88. Also six individual butterfly valves where used for the M88/3. However, Bosch's Motronic, the first digital controlled fuel-management system that was used in production cars, replaced the M88's Kugelfisher fuel injection system. This allowed the compression ratio to rise to 10.5:1. Thanks to these changes, the power output rose to 286hp at 6500RPM. The torque rose slightly also to 340nm at 4500RPM. This was 500RPM lower than for the original M88 engine and this helped to improve the M88/3 abilities for daily use.

At the end of 1984, the M88/3 engine was also fitted in the E28 5 series. Unlike the ///M635CSI, the E28 version was not named ///M535I as this type was already given to another E28 with the M30B35 engine. Instead, the name ///M5 was chosen. Already from September 1984 till February 1985, a small number of E28 ///M5's where hand build by BMW Motorsport for a happy few. It was not before February 1985 before the E28 ///M5 was introduced to the public. In the mid eighties, unleaded fuel and the use of catalytic converters became more and more common in Western Europe, especially in the environment oriented Swiss and Austrian market's. The M88/3 engine did not have a catalyst. BMW did not want to be accused of being insensitive to the environment and decided against the introduction of the E28 ///M5 at the important Geneva car show. Instead, BMW showed the E28 ///M5 at the Amsterdam car-show, but with no real international importance.

Despite that BMW already switched to a new engine codex in 1983, the new 24-valve engine kept the family code M88. It was not before 1986 when the S38 designation was used for the catalyst version of the M88/3. The S38 stands for, 'S' means that the engine is originated by BMW Motorsport, the '3' means that it is derived from the M30 engine family and last but not least, the '8' is chosen to make a reference to the legendary M88.

During the last century's mid eighties, the ///M635CSI and the E28 ///M5 where only available in Western Europe. In the United States, there was a small but significant demand for 'these European only' cars. This gap in the United States market was served by Grey market importing companies. BMW North America realized that very well and from 1987, the Motorsport versions of the E24 and E28 became available in the US, but their specifications where changed to meet the demands of the American market. To meet the US exhaust emission regulations of that time, the catalyst equipped S38B35 replaced the M88/3. The S38B35 kept the M88/3's bore, stroke and cylinder head, but to install a catalytic converter, the compression ratio decreased from 10,5:1 to 9,8:1. The equally tuned exhaust headers of the M88/3 where replaced by log headers. Al these changes decreased the engine performance. The S38B35 delivered 260hp and a torque of 330nm (243lb/ft) at 4500RPM. The US E28 ///M5 and E24 ///M6 where spend a lot more goodies which in Europe could only e had as an option or on special order. As a result, the US cars where noticeable heavier than the European cars and this had an impact to the car's performance. The European E28 ///M5 can do the 0-100km/h (0-62mp/h) sprint in just 6,5sec, while the US version needs 0,3sec more.

For the US and Japanese markets, The ///M635CSI was renamed to ///M6, while in Europe the ///M635CSI designation remained. The distinction between the ///M6 and ///M635CSI is the engine. The ///M6 always contains the S38B35 engine, while the ///M635CSI can have both. Despite the catalyst, the majority of the E28 ///M5's and E24 ///M635CSI in Europe where equipped with the M88/3 engine, thus no catalyst.

The production of the last E28's ceased at the end of 1987 after which the E34 succeed it. It was without any doubt that soon after the introduction of the E34, also a Motorsport version became available. The E34 ///M5 was available for the German market in September 1988. The engine which powered the E34 ///M5 is a further evolution of the S38B35 engine which powered the

catalyst versions of both the E28 ///M5 and E24 ///M635CSI. The E24 ///M635CSI remained in production until it's demise in spring 1989. During that time, the M88/3 and S38B35 engine where by BMW Motorsport alongside the S38B36. This was of benefit for the last E24 ///M635CSI's because in their last production months, both the M88/3 and S38B35 engines received the duplex timing chain of the S38B36.

Car's	E24 ///M635CSI, E28 ///M5	E24 ///M6, E28 ///M5	E34 ///M5 3.6	E34 ///M5 3.8
Old engine code	M88/3	N/A	N/A	N/A
New engine Code	S31B35ME	S38B35	S38B36	S38B38
Engine Capacity (cc)	3453	3453	3535	3795
Stroke (mm)	84	84	86	90
Bore (mm)	93,4	93,4	93,4	94,6
Max Power (DIN hp)	286 @ 6500RPM	260 @ 6500RPM	315 @ 6900RPM	347 @ 6900RPM
Max torque (nm.)	340 @ 4500RPM	330 @ 4500RPM	360 @ 4750RPM	409 @ 4750RPM
Max torque (lb./ft)	250 @ 4500RPM	243 @ 4500RPM	266 @ 4750RPM	295 @ 4750RPM
Compression ratio	10,5:1	9,8:1	10,0:1	10,5:1
Fuel Management	Bosch Motronic	Bosch Motronic	Bosch Motronic 1.2	Bosch Motronic 3.3
Engine type	Normal Aspirated	Normal Aspirated	Normal Aspirated	Normal Aspirated
Lubrication	Wet sump	Wet sump	Wet sump	Wet sump
Catalytic Converter	No	Yes	Yes	Yes
Year(s)	1984-1989	1986-1989	1988-1993	1992-1995

S38 engine family

To create the S38B36, the S38B35 was stroked from 84,0mm to 86,0mm, the same as the M30B35 engine. The bore remained 93,4mm. This all increased the displacement to 3535cc. Actually, this is 3,5 liter's and not 3,6 as the type designation indicates. However to make a distinction with the S38B35, the S38B36 engine was marked as a 3,6 liter engine. Not only the stroke was changed. Also the Compression ration increased from 9,8:1 to 10,0:1. The S38B36 delivered 315hp @ 6900RPM and 360nm (269lb/ft) at 4750RPM.

The intake received an electronically controlled RAM induction system to boost up the torque. A changeover valve varies the effective length of the induction system depending on load and engine speed. The changeover valve operates when the engine speed is below 4120RPM and full throttle or the engine speed is above 6720RPM and full throttle. The engine management remained the Bosch Motronic system, but instead of measuring the airflow with a valve, the S38B36 received an airflow measurement system based on a hat-wire sensor. In contrary to a conventional sensor with an air-valve and potentiometer, hot-wire sensors measures the mass of the air and since it is only a very thin wire, the air can flow to the intake-plenum without restrictions and thus reducing the flow resonance's and noises.

To fulfill the exhaust emission regulations, a ceramic catalytic converter has been added to the exhaust system. To control the emissions at cold-engine start up an air injection feature for the exhaust has been added. This system injects air into the exhaust system to convert carbon monoxide into carbon dioxide and hydrogen's into water. For Tropical regions, for instance the Middle East and south East Asia got a slightly different version of the S38B36. For these markets the compression ratio reduced to 9,2:1.

In 1991, the E34 ///M5 got competition by the Mercedes Benz 500E and of lesser importance, the Opel Lotus Omega and the BMW-Alpina B10 Biturbo. Neither the Opel nor the Mercedes could match the ///M5 in character and driving abilities, but they where more powerful. The Opel Lotus Omega has a twin turbocharged 3,6 litre 24-valve engine and was (a cheaper) competitor for Alpina's B10 Biturbo. The 500E however was directly positioned as a competitor to the ///M5. Compared to the E34 ///M5, the 500E's strength was torque. It's 5,0 liter 32-valve V8 produced 480nm of torque. Despite that the 500E is approximately 100kg heavier than the E34 ///M5, it was the better autobahn performer. On all other disciplines, the E34 ///M5 with it's much better balance chassis is the better car. Nevertheless, BMW Motorsport redesigned the S38 to gain back the "fastest 4 door saloon" title.

The bore and stroke where increased one more time. As a result the displacement grew to 3795cc. Another significant change is the compression ratio that was increased to 10,5:1. The intake and exhaust ports increased in size also and each spark plug got it's own HV coil which eliminated the distributor rotor and the high voltage wiring. A smaller and lighter Emitec metallic type replaced the ceramic catalytic converter. The main advantage of the Emitec metallic converter is that it increases the flow of the exhaust gasses. The Bosch Motronic 1.2 fuel management system was changed for the Motronic 3.3 system of the same manufacturer that also includes the resonance flap control. This feature is the same as on the S38B36, but with an extra switch-point at 2480RPM.

The S38B38 was the last evolution within the S38 engine family and delivered 347hp @ 6900RPM and 409nm torque at 4750RPM. All these changes stretched the S38 to its limits. The web spacing between two cylinders with 5,4mm is extremely narrow. This is 0,6mm less that the M49/3 racing engine. The S38B38 engine remained in production until the summer of 1995 when the last E34 ///M5's left the production facility in Garching.

For the Swiss and Austrian market, the S38B38's where fitted with Ceramic catalytic converter and the smaller exhaust manifolds (80mm vs. 90mm) of the S38B36 engine. As a result, the

Austrian and Swiss version did not deliver 347hp, but 327hp.

Post S38 period

S50B30, S50B32, S50B30 US and S52B32

In 1992, BMW introduced the E36 ///M3 coupe with the S50B30 engine. The S50B30 is based on the smaller M50 engine family, but had a completely new developed 24-valve head. All in the /// M tradition, this engine also has 6 individual butterfly valves. Completely new was the VANOS system to vary the intake camshaft and thus the timing of the intake valves. This means more torque at lower revs. The S50B30 engine measured 2990cc and delivered 286bhp @ 7000RPM and 320nm @ 3700RPM. The US did not get this expensive engine. Instead, BMW skipped the 6 throttle bodies and the expensive head construction. This resulted in an overall power loss of 46hp. Generally, the S50B30 US is just a bored and stroked M50B25 with VANOS.

In 1995, the S50B30 was bored and stroked one more time to 3201cc. Other significant changes are that the DME was now a system developed by BMW and Siemens. Also the exhaust camshaft timing is controlled by VANOS. Power rose to 321hp at a staggering high 7600RPM. The US again got a detuned version without the S50B32's expensive cylinder head and intake system. Compared to the S50B30 US, the S52B32 delivered the same power, but more torque at lower revs. For the E46 ///M3 of 2000, this engine was completely redesigned and thus called S54B32. Like the S38B38, this engine is completely stretched to its limits.

S62B50

When the E39 succeeded the E34 in 1996, it took almost three years before it was succeeded by the E39 ///M5. Originally, BMW did not plan a Motorsport version of the E39 as it felt that the E39 540I and the E36 ///M3 4 door would fulfill the demands of the E34 ///M5 owners. However the ///M5 customers did not buy that, probably since neither the E36 ///M3 or the E39 540I are really exclusive cars. In 1997 BMW realized that and started to develop the third generation of the E39 ///M5. The first prototype was shown to journalists on the IAA car-show of 1997, but it was not before December 1998 that the first E39 ///M5's where delivered to their customers. Instead of an inline six, BMW used the M62 V8 engine as basis for the S62B50 power plant with 400bhp. The E39 ///M5 turned out as a very successful car, especially in the USA. Already in the summer of 2001, BMW had manufactured more E39 ///M5's than E34 ///M5's in a seven-year period! Unlike the E28 and E34 ///M5's, the E39 ///M's are not hand build in Garching anymore, but manufactured on the E39 production line in Dingolfing. Thanks to this, the German MSRP of DM140000 for the E39 ///M5 in 1998 was almost the same as the customer cost for the last E34 ///M5's in 1995.

Developments related the S38

M90

The M90 was the first road going BMW engine with 3.5 liters displacement. Originally this engine was used to test if the M88 engine was reliable with the narrow web spacing of 6,6mm. This means that this engine has exactly the same bore and stroke as the M88 and is directly related. However instead of a DOHC cylinder head with 24 valves, BMW used the SOHC cylinder head with 12 valves. The use of an electronically controlled fuel management system (Bosch LE-Jetronic) allowed a slightly higher compression of 9,3:1. Strictly, the M90 engine is not an M production engine although the E12 ///M535I in which it is used is a real M car. Until 1981, the M90 engine was used for the early 635CSI's and the very rare and delectable E12 ///M535I from 1980.

In 1981 and 1982, Alpina used the last batch of the M90 engine to power the last versions of the

B7 turbo versions of the E12 sedan and E24 coupe. For the B7S turbo, the M90 has been modified extensively to allow the use of a turbo charger. The B7S delivered 330hp @ 5800RPM and 500nm @3000RPM. During 1981 and 1982, Alpina only made 60 E12 sedans and 30 E24 coupe's in the B7S version.

M30B35

To improve the reliability for road use, BMW redesigned the M90 engine in 1981. This engine, called M30B35 was slightly different. Compared to the M90, the M30B35 has a larger stroke (86,0mm), but a smaller bore (92,5mm). The use of a digital controlled fuel management system (DME) allowed to increase the compression ratio from 9,1:1 to 10,0:1. Although the engine capacity decreased slightly (3430cc vs. 3453cc), power and torque remained almost the same. The M30B35 remained in production for almost 13 years and in the late 1980's, catalyst versions where developed and offered for sale also. The M30B35 has been used in the E23 735I, the E24/1 635CSI, the E28 535I, the E28 M535I, the E32 735I and the E34 535I.

This engine was also used a lot by tuners and the tuners with a manufacturer status such as Hartge and Alpina. Alpina examples are the E28 B7 turbo, the E24/1 B7 turbo, the E28 B9, the E30 B6(S), the E28 B10 3.5, and the E34 B10 3.5 and last but not least the E34 B10 Biturbo. In 1993, the last 50 M30B35 engines where delivered to Alpina for the last 50 B10 Biturbo's.

Car's	E26 ///M1	E12 ///M535I and E24 635CSI (<1981)	See Note #1
Old engine code	M88	M90	N/A
New engine Code	S32B35	S30B35LE	M30B35 (without CAT)
Engine Capacity (cc)	3453	3453	3430
Stroke (mm)	84,0	84,0	86,0
Bore (mm)	93,4	93,4	92,5
Max Power (DIN hp)	277 @ 6500RPM	218 @ 5200RPM	218 @ 5200RPM
Max torque (nm.)	330 @ 5000RPM		
Max torque (lb./ft)	239 @ 5000RPM	228 @ 4000RPM	229 @ 4000RPM
Compression ratio	9,0:1	9,3:1	10,0:1
Fuel management	Kugelfisher mech.	Bosch L-Jetronic	Bosch Motronic
Engine type	Normal Aspirated	Normal Aspirated	Normal Aspirated

Lubrication	Dry sump	Wet sump	Wet sump
Year(s)	1978	1977-1982	1982-1993

Table 4, M88 engine derivates.

S14B20, S14B23 and S14B25

This engine family was developed in the early 1980's for use within the E30 series where it had to power the new BMW touring car racer, the E30 ///M3. The engine block was based on the cast iron M10 engine family. The Cylinder center distance of the M10 is with 100mm the same as on the M88 so this allowed BMW Motorsport to simply cut of two cylinders of the existing M88 cylinder head. The bore (93,4mm), stroke (84,0mm) and compression ratio (10,5:1) for the S14B23 where chosen exactly the same as the M88/3. This created a displacement of 2302cc. Enough to deliver 200hp @ 6750RPM and 176lb/ft of torque at 4750RPM. With catalyst this engine delivered 195hp and 169lb/ft @ 4750RPM. In Italy, there was the 320iS, a deviation of the E30 ///M3 to avoid the huge Italian taxes for road cars above two liters. The 320iS simply used the 325iS-body style, but powered by an S14B20 engine. The S14B20 has the same bore as the S14B23, but a smaller stroke (72,6mm) resulting in a displacement of 1990cc. A compression ratio of 10,8:1 still allowed 192hp at a stunning 6900RPM.

In September 986, the first E30 ///M3's where sold to their first customers and within the first year, more than 5000 units where sold to meet the FISA Group A rules. 2396 where build in 1986 and 6396 in 1987 and thus easily satisfying the rule makers. It did not take long before the first evolution versions arrived.

For the evolution II models of 1988, BMW Motorsport fitted other pistons to increase the compression ratio to 11,0:0. The displacement and the cylinder head construction are exactly the same as the regular 2,3 liter. But now 220hp and 181lb/ft where available. In a later stage, this engine with a catalyst became available for the E30 ///M3 Cecotto and Ravaglia editions.

The last version of the S14 engine is the S14B25. An increased bore (now 95,5mm) and stroke (87,0mm) increased the displacement to 2483cc. The compression ratio remained 10,5:1. At 7000RPM this is enough for 238 hp and 177lb/ft @ 4750RPM. This engine is used for the last 600 ///M30 evolution III, the most delectable of all ///M3's.

The primary purpose for the S14 engine was to power the E30 ///M3 touring car racer which raced in different European touring car series of which the most important was the DTM (German Touring car championship). For these many engine versions where made (S14/1 till S14/7).

When the production of the E30 ///M3 ceased in March 1990, more than 17000 of these cars have been made and found their way to very happy owners. In terms of nimbleness, driving satisfaction and performance this may be the ultimate ///M car ever made. Apart from these, more than 3000 320iS cars found their way to Italian customers.

Tuner Efforts

Although the engines from the S38 and M88 have a high state of tune when they left the factory, for some this was not enough. Especially in the USA, there was a demand for even higher power output. A few enthusiastic companies served this niche in the market and offered tuning kit's

that could be acquired separately or together as a complete package. In Europe, BMW's where mostly tuned as a complete package. Good examples are companies like Alpina and Hartge. Hartge actually did tune the S38 engine family, but Alpina never touched a BMW-Motorsport engine. Although many companies actually tuned the S38, it is undoable to describe all efforts in this field.

Dinan-BMW

Steve Dinan grounded this California based company, almost 20 years ago. Unlike many European counterparts, Dinan offers their performance program as kits that can be bought seperately or as a complete package. In 1986, Dinan developed a turbocharged version of the S38B35 engine. For the E34 ///M5's S38B36, Dinan developed several tuning programs known as Stages. Dinan's program starts with a modified DME, other cam sprockets to retard the timing for more torque in the low en mid range and a stroker kit to increase the S38B36 to 3,9 liters (3880cc). Added to that, you can buy the companies modified camshafts. In the strongest program, Dinan claims 402bhp (SAE). Even today, almost 9 years after the last E34 ///M5's where officially imported into the US, Dinan still offers these programs to the owners of E34 ///M5's.

Hartge

In Europe, the S38 and M88 were less prone by tuner efforts. A Company that did was Hartge. Hartge fitted hotter cams to the M88/3 and reprogrammed the DME. erent cams and another DME program. With 330hp @ 7000RPM and 260lb/ft @ 3500RPM, this is a serious improvement. This engine was fitted in amongst others the Hartge H5SP-24, their version of the E28 M5. Hartge also used this engine for the H36, an E30 ///M3 equiped with the Hartge's modified M88/3. Only six of these beasts where ever build.

Notes:

1. The M30B35 was used in many ranges and cars. The most important are the E28 535I & ///M535I, the 635CSI after 1982, the E23 735I, the E32 735I and last but not least the E34 535I.

2. All power figures in the article are DIN. According to SAE the power is slightly smaller.

3. The torque in lb./ft can be calculated by multiplying the nm. Figure with 0,73529

References:

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