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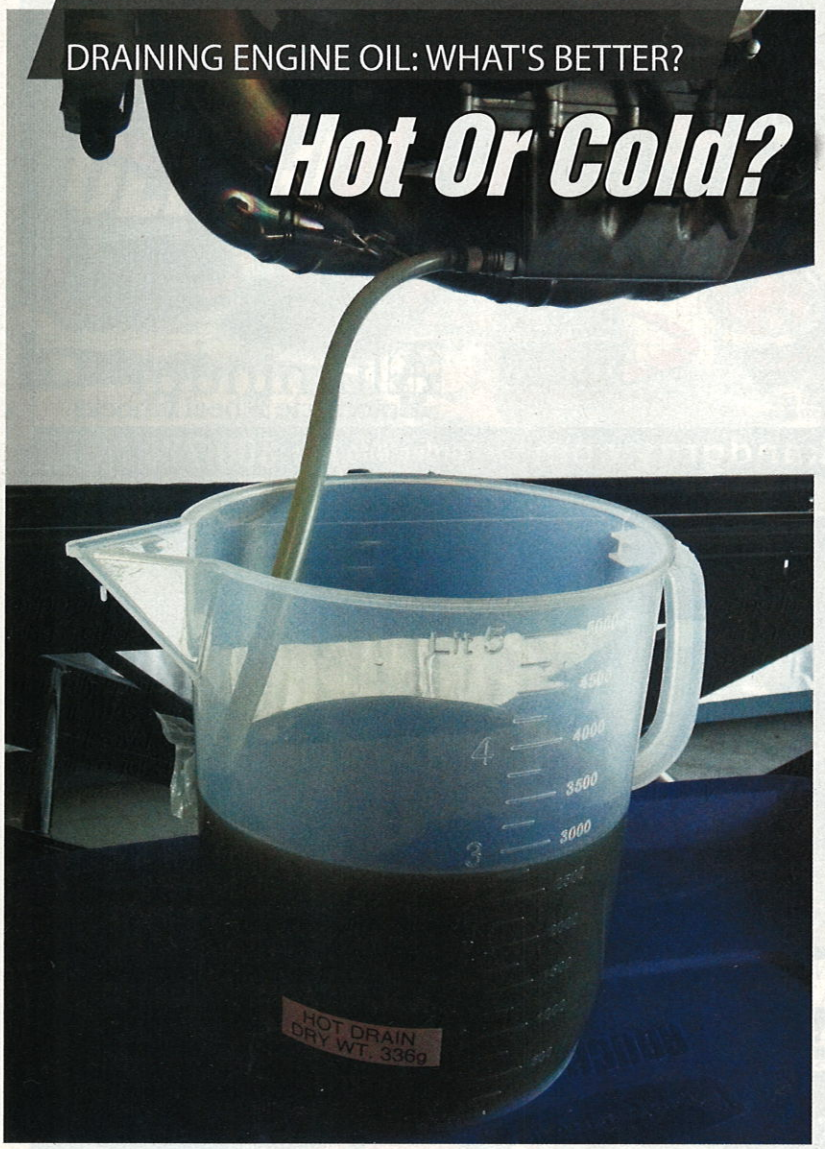
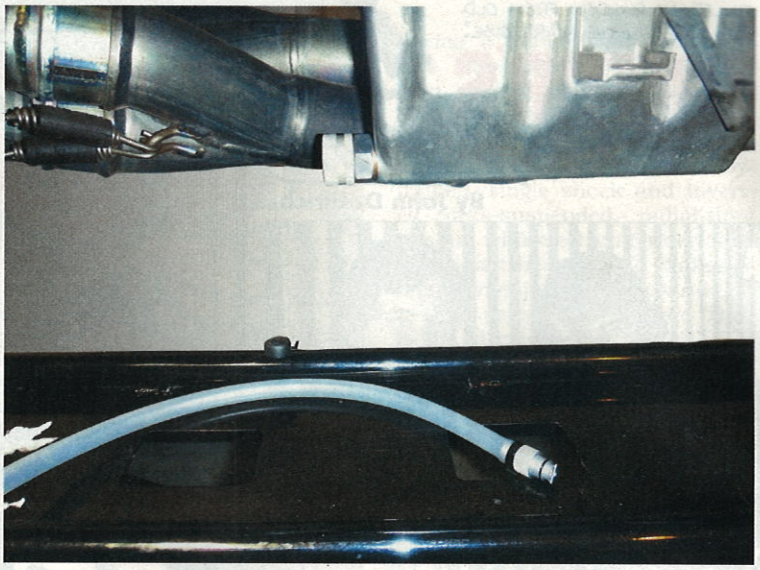
DRAINING ENGINE OIL: WHAT'S BETTER?

Hot Or Cold?





(Left) We compared how temperature affected the quantity of oil drained out of the sump (oil pan) using a quick connect/disconnect Stahlbus dry-break system. When no more oil was seen running down the clear tube, it was disconnected, automatically shutting the drain fitting in the oil pan. (Above) When the Stahlbus drain hose and quick-connect fitting aren't being used, an aluminum cap fits over drain fitting. (Below, Left) An aftermarket titanium drain bolt, with a Torx (star) drive inside the hex head. (Below, Right) Use a torque wrench to avoid over-tightening a drain bolt.

By Jason McDonnell

You may have seen or heard gurus online or at the track discuss the best way to change oil. Frequently the proclaimed best oil change method includes getting the bike good and warm, if not rocket hot. Then, while the engine is still warm, removing the drain bolt so that the maximum amount of oil can be drained out. This might sound good, but working around the hot engine and exhaust can be less than fun. What is the truth?

The question is, does the risk of burning yourself when pulling the drain plug, and removing the oil filter around the wicked hot exhaust system, actually get the most oil out of the engine? Can you avoid this risk by draining the oil when the engine is cold? Does draining the oil when it is hot get the most oil out of the engine?

To conduct the test, we used a motorcycle with a wet sump oil system to check the amount of oil that can be drained out of the engine through the drain plug. A check valve drain plug system from Stahlbus was installed, so all the oil could easily be captured into a container. The check valve assembly has clear tubing attached to make it easier to monitor the oil flow and close the valve when the oil flow has stopped. To eliminate the variable of oil filter absorption, the engine was pre-filled with oil to saturate the filter. The pre-fill also allowed the engine to be filled with a baseline level of oil. This removed the variability of oil drain volume, due to any oil left behind by the installed check valve. The oil used for this study was a 10w-40 motorcycle oil meeting the JASO standards.

To remove the factor of thermal expansion, oil weight was used to calculate the oil volume. First, six separate 500cc samples of the engine oil were weighed to calculate the oil mass-to-volume ratio. For the oil used, 500cc of oil weighs 417 grams, and 2,502g of oil was used, which equals 3.0 liters, or 3.17 quarts of oil. Each oil sample was weighed in a new and clean container. Then the same container was used to collect the same oil,

Oil Drain Data	Metric			English		
	Hot	*Warm*	*Cold*	*Hot*	*Warm*	*Cold*
Starting Volume:	3L (3,000 ml)	3L (3,000 ml)	3L (3,000 ml)	3.17 qt	3.17 qt	3.17 qt
Oil Temp (Drain):	66°C	32°C	10°C	150°F	90°F	50°F
Ending Volume:	2,865 ml	2,797 ml	2,992 ml	3.03 qt	2.96 qt	3.16 qt
Left Over Volume:	135 ml	203 ml	8 ml	4.58 oz	6.85 oz	0.28 oz
Left Over %:	4.5%	6.8%	0.3%	4.5%	6.8%	0.3%

to include any oil that was left behind in the container. To remove the variability of any oil left behind on the fill funnel, the funnel was weighed before and after to calculate the oil volume left behind. This allowed the mass of the oil that was collected to be compared to the original cold oil volume.

Three different drain scenarios were compared. The first scenario was the hot oil drain. The engine was warmed up to a water temperature of 200°F. The engine was running just seconds before draining. The oil temperature was checked while draining the hot oil and was approximately 150°F.

The second scenario was the warm oil drain. The engine was warmed up to a water temperature of 145°F. The oil temperature was checked while draining the warm oil and was approximately 90°F.

The third and final scenario was the cold oil drain. The engine was warmed up to 200°F and then allowed to sit for 12 hours in a 50°F garage.

The results showed that the cold engine drained out more oil than the hot or warm engine did. The cold engine left behind 0.3% of the engine oil, while the hot engine left behind 4.5% of the engine oil. The warm engine left behind the most oil at 6.8%.

▶ ***Why did the cold engine drain more oil?*** In two of the three conditions, the engine was running and oil was being circulated throughout the engine just prior to the oil being drained out. While oil flows better when hot, it still takes time for all the oil to return to the sump, where it can be drained out.

The warm engine oil increased the effect of the oil circulated throughout the engine. Warm oil does not drain back as quickly to the oil sump as hot oil does, so more of the oil is left in the engine in the few minutes it takes to drain the oil sump.

In the case of the cold oil drain, the engine was hot when turned off. The 12 hours of sitting allowed (almost) all the distributed oil to return to the oil pan.

▶ ***What About Particulates?*** SAE standards and research papers show that oil filters capture particles down to 10 microns. When the engine is turned off, the oil is relatively free of particles larger than 10 microns, and particles smaller than 10 microns will stay in suspension even when the oil is cold.

▶ ***What About Water and Fuel Contamination?*** In most cases, oil contamination is held in suspension. Waiting until the oil is cold will maximize the amount of contaminants that actually drain out. Running the engine before changing the oil spreads the contaminated oil throughout the engine, increasing the amount of contaminated oil that is left behind and mixes with the new, clean oil.

▶ ***What Was Drain Time?*** It took about twice as long to drain the cold oil from the sump compared to the hot oil. The warm engine oil split the difference in time between the two. But in all cases, draining the sump took less than four minutes.

▶ ***What's The Verdict?*** It's fine to drain used oil from a cold engine. This avoids dealing with scalding hot oil and working around a hot exhaust system. As a bonus, it also drains more of the dirty oil from the engine.

NOTE #1: Use a Torque Wrench

Save yourself the angst of stripped threads and grab a torque wrench when tightening the oil drain bolt. The OEM manufacturers provide a torque spec that tightens the oil drain bolt without stripping threads. Some lightweight aftermarket drain bolts are made from aluminum, and an over-torqued aluminum drain bolt may become damaged or even snap off. Most OEM drain bolts are steel and are designed for the recommended torque load. Titanium drain bolts provide a similar weight reduction as aluminum drain bolts, with the higher strength of steel bolts.

NOTE #2: Star Drive Resists Damage

In 1967, Camcar Textron developed the star drive under the brand name Torx, to reduce the cam-out action of hex-drive bolts. Cam-out is the action of the driver being pushed upwards and damaging the bolt contact surfaces. The key advantage of a star-drive oil drain plug is that the contact or drive angle between the tool and the fastener is only 15° versus 60° for a hex drive. The star drive is less prone to stripping the head of a bolt, and due to the more positive engagement, torque measurements are more accurate. ***RW***