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REF: Oiling & Lubrication

Understanding Oil Filters

Having cleaner oil is better for the reliability of the engine. [1)]
There's an old saying that oil doesn't wear out; it just gets dirty.
Although there is some validity to the idea that dirtier oil will "age" quicker than clean oil,
The engine oil will have a finite life. It will need to be changed eventually no matter how clean you keep it.

Full Flow vs Bypass Flow (or part flow) Oiling Systems

Bypass or Part Flow Oil Systems

- By-pass or part flow oil filtration systems take only a small portion (about 10%) of the oil flow from the pump. [2)]
  - This small portion is borrowed from the excess oil that would ordinarily be returned to auto oil pan or inlet side of the pump through a passage-way controlled by the engine pressure regulating valve.
  - Oil flow through a bypass filter is regulated by the use of a metering orifice within the filter.
  - Oil which has been filtered is returned to the engine oil pan directly and not to the mating parts of the engine as with the full flow system.

Full Flow Oil Systems

- In a full flow oil filtering system, all of the oil from the oil pump must pass through the oil filter. [3)]
  - Filters must provide low restriction to oil flow while having a high degree of single-pass efficiency.
  - This means that a filter must remove engine damaging dirt and grit from the oil the first time around.
  - A relief valve is built into the filtering system to ensure a constant supply of oil to the engine under all conditions.
  - This filter relief valve could be located in the engine, oil filter base (attached to engine) or in the filter itself.

- Under normal operating conditions this valve is closed.
- However, this valve will open and supply oil directly to the engine whenever the filter becomes plugged with contaminants and too restrictive to oil flow.
- Manufacturers believe that it is better to supply unfiltered oil to the bearings than to burn out bearings by oil starvation.

Oil Filter Efficiency

- Filter ratings are the most often misunderstood area of contamination control. [4)]
  - A nominal rating is an arbitrary size value assigned to a filter by the manufacturer.
  - Tests have shown that particles as large as 200 microns will pass through a nominally rated 10-micron filter.
  - Because the nominal rating is arbitrary, it has no value.

Physical Size of an Oil Filter

Often limited by physical size, engine oil filters are relatively small when compared to their industrial counterparts. [5)]
This small size coincides with less filter media surface area through which to pass the lubricant.

Mounting Adapter Threads

Look for the inside diameter threading listed in the filter specs.

- Different vehicle manufacturers use either a metric (20mm) or a standard (3/4“-16) threaded filter mounting adapter.
  (the threaded spud that holds the filter onto the engine) [6)]
  - It is very important that the oil filter adapter size be verified prior to buying / installing a replacement oil filter on your bike.
  - Using a metric threaded filter on the standard threaded mounting adapter will result in loss of oil and possible engine damage.
  - You can carefully test fit an open ended wrench on the threads on the filter pad.
    1. Drain the oil and remove the existing filter.
    2. Using a quality 3/4” open-end wrench, try to slip the open end of the wrench over the adapter threads.
    3. If the 3/4” wrench fits around the threads, the thread size is 3/4“-16.
    4. If the 3/4” wrench does not fit over the threads, the thread size is 20mm.

Filter Media Construction

- Car oil filters in the United States are made by only a handful of manufacturers. [7)]

    - These include Fram, Wix (Dana), Hastings, Champion Labs and Baldwin.
    - Many of these companies supply the oil filters that bear the brands of automakers, oil companies, mass merchandisers, auto parts stores and quick-lube operators.
    - A close inspection of the can shape, construction and the base plate usually reveals its manufacturer.
        - An oil filter can be cut open and disassembled for further inspection.

Media Type

Some filter materials are lightweight steel, plastic or cardboard.
Their ability to stand up to long service intervals, repeated shock loading, vibration, thermal cycles, temperature extremes and changing motor chemistry may be marginal in certain applications and worst-case scenarios. [8)]

- The oil filter media is the actual material used to capture contaminants in a filter element. [9)]
    - Whatever media is used, it usually starts out in sheet form and is then folded or pleated to expose more surface area to oil flow.
    - This is done to increase contaminant carrying capacity and to reduce the pressure differential across the filter.
- The most common media: [10)]
  (synthetic media will appear white and felt-like while cellulose will look like orange-brown colored cardboard) [11)]
    - **Wire mesh**: constructed of either standard or stainless steel in a woven mesh.
      Because of the limitations in wire size and construction techniques, they are not available in very fine micron ratings.
    - **Cellulose**: made from wood pulp.
      The “paper” used for cellulose filters isn’t much more sophisticated than the paper used for writing.
      They are however cheap.
      The downside of this type of media is that it is not very efficient nor do they have a high dirt holding capacity. Cellulose also absorbs water, which may or may not be a benefit.
      They can be used to remove water from the system, however if this is not the desired effect and there is water in the system, the filter element will still absorb water.
      The pressure differential will increase and the filter will appear clogged.
    - **Fiberglass**: a type of synthetic filter media.
      In general, synthetic media performs considerably better than cellulose media because the fibers can be manufactured in a more uniform size distribution and thinner than cellulose media.
      Multiple layers of differing quality can be used to create a medium that is both extremely efficient and offers great dirt holding capacity.

Pore Size

- The media pore size is the major determinant in how efficient and how small of particles the filter can remove. [12)]
    - The physical size of the filter is usually determined by the other components around it.

The flow rate must be high enough to feed all the lubricated components.
This means you can't make the pore size too small or it will raise the pressure differential and the bypass valve will open, effectively rendering the filter useless.

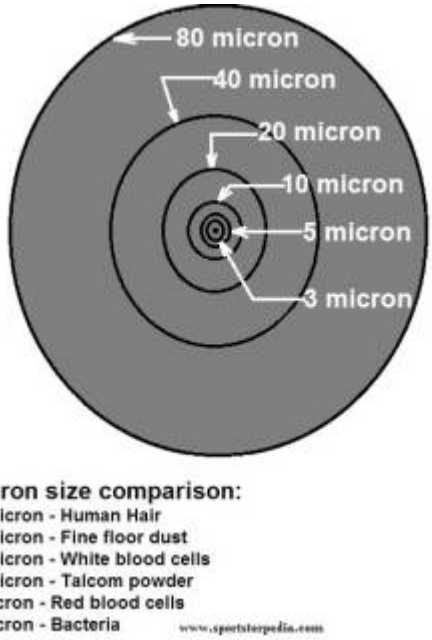
- In a case study performed by General Motors and published by the Society of Automotive Engineers (SAE);
  It was determined that engine service life could be extended eight times when 5-micron filtration is implemented vs. the standard 40-micron filtration.

Advertised Filtration Efficiency

Micron Ratings

In a case study performed by General Motors and published by the Society of Automotive Engineers (SAE);
It was determined that engine service life could be extended eight times when 5-micron filtration is implemented vs. the standard 40-micron filtration. [13)]

- A micron is another name for micro-meter. (1 millionth of a meter or 39 millionths of an inch).
- Micron ratings were used initially by various filter manufacturers to evaluate the relating porosity of flat sheets of media used in making filter elements.
  (intended purpose to indicate the relative freeness or tightness of a sheet of filter media)



Micron comparison [14)]

- However, the micron rating is also now falsely used as a widespread measure of filtration efficiency.
  (unintended purpose)
  Here are some of the reasons why a micron rating is totally inappropriate for this use: [15)]
  1. The test is not repeatable at different labs.
     - Each manufacturer has its own test procedures.

        - Although the test is a valid comparison of one paper to another within a given company,
        - The micron rating does not lend comparison of filters made by different manufacturers.
        - While one manufacturer may give a paper a nominal micron rating of 10,
        - Another may rate it a 2.
        - A third manufacturer may rate the same paper a 15.
        - There is no across the board basis for comparison.
    2. There is no consistent relationship between micron rating and actual filtration efficiency.
        - The relative porosity of a sheet of filter media is only one of the factors which determines the efficiency of a filter.
        - The physical construction of the media, filter, element and the types of contaminants to be encountered, are also very important factors.
        - The entire filter needs to be tested, not just the paper.
    3. The micron rating does not show what happens to a filter over time.
        - The performance of a liquid filter may deteriorate with use.
        - The micron rating is a one-pass test done on a new sample of filter paper.
        (which provides no information about how a filter will stand up under continued use)
        - The inadequacies of micron ratings have been readily apparent to the vast majority of OEMs.
- Changes in testing procedures may eventually come around.
    - Many have established their own rigid, repeatable, performance criteria which a filter must meet to qualify as acceptable for a particular vehicle.
    - Others are calling for the standardized multi-pass test and its resultant unit of measure (the B ratio).
        - SAE is currently moving toward adopting the multi-pass test as a standard procedure.
    - Unfortunately, reliance on micron ratings is still wide-spread at the user level.
    - Filter manufacturers reluctantly provide micron ratings to fleets who are still insistent on having this information.
    (even though it serves more to confuse than to clarify)

Filter Fitment

In April of 1995, the MoCo issued a Tech Tip stating: [16)]
When replacing oil filters during service intervals;
Check that the oil filter adapter has a sufficient amount of threads protruding to properly engage the filter.
The correct thread length should be 0.45”-0.52“

The MoCo issued a Tech Tip on Oil Filter Fitment[17)]
Remember to check the oil filter adapter to ensure that it is tight.
Any loose adapters should be removed, cleaned, threads coated with 242 Loctite and installed to correct thread height (as above)

In September of 1995, the MoCo issued a Tech Tip on oil filter fitment. [18)]

All OEM filters are interchangeable between the models (spin-ons).
(however we recommend that you use the appropriate filter for the model)
But, there are some things to be aware of if filters are swapped between models.

1. Although Dyna models can use the short filter in place of the long filter,
   The oiling system capacity would be reduced.
2. Long filters cannot be used on EFI models because of the contact with the crankshaft position sensor.
3. Eagle Iron oil filters are 1/4” longer than the stock filter.

On some models, you may run into a fitment problem.

Filter Height

- Same thing as length.
- Tall filters have more media than shorter ones and should filter more oil for a longer period of time.
- One main concern for this dimension is space available for the filter in autos.
- A half clogged taller filter can still pass more oil than a half clogged shorter one.

Filter Outside Diameter (O.D.)

- Again, available space is a big factor in some engine configurations.
- A wider O.D filter will have more volume to collect oil as will a taller one.
- However, the filter media and condition thereof is an important factor also when measuring volume passed.

Anti-Drainback Valve

- Some oil filter mountings may allow oil to drain out of the filter when the engine is stopped. [19)]
  - When the engine is next started, oil must refill the filter before full oil pressure reaches the engine.
  - The anti-drain valve (included in some filters) prevents oil from draining out of the filter.
  - Some filter designs incorporate a combination anti-drain and relief valve with an integrated unit construction.

On some car engines the filter is mounted in a position which allows the oil in the filter to drain back to the crankcase when the engine is stopped. [20)]
This would be the case where the filter is horizontal and is above the level of the oil in the crankcase.
Since a filter holds up to a quart of oil, it takes about 5 seconds for the pump to fill the filter after the engine has been started.
During which time the warning light will remain on.

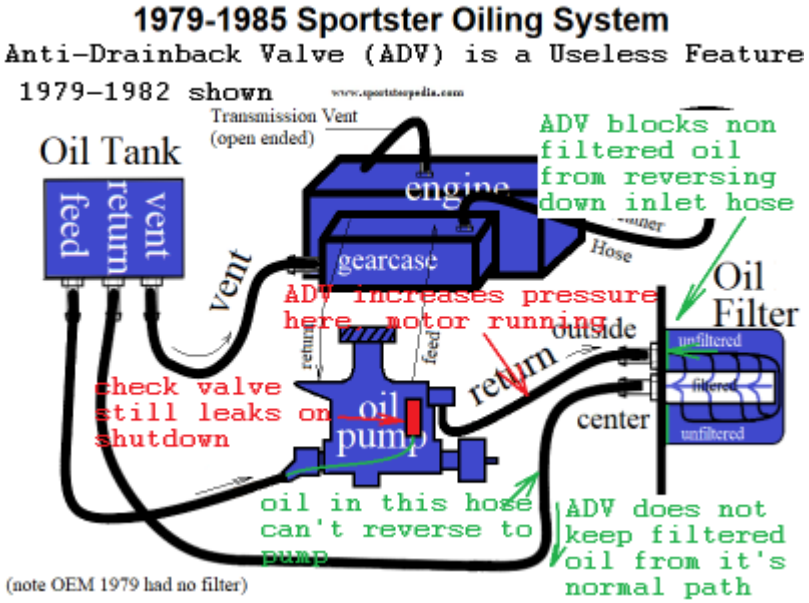
To prevent the engine from operating without oil pressure for this period of time after startup,
Some filters are designed for these special mounting positions to contain an anti-drain back valve.

This valve is usually in the form of a rubber gasket which allows the free flow of oil through the filter in the normal direction.
But when the engine is shut down, it prevents the oil in the filter from draining back to the crankcase (oil pump in the case of Sportsters).

There is no need to install a filter with an anti-drainback valve on a Sportster.
The oil tank sits higher than the oil filter housing. So if any oil could drain back, oil can't run uphill by itself.
Sportsters have an inherent problem with oil gravity draining into the engine when the engine is shut off and it sits for a while (sit-sumping).
This is due to either a worn check valve or worn clearances in the oil pump.
So, oil in a Sportster will be pushed against the filter at all times without a drainback valve in the filter.
Oil will also be pushed against the filter at all times with a drainback valve in the filter.
The only thing a drainback filter will do is add restriction / raise pressure on the hose feeding the oil filter.
An anti-drainback valve will not stop or even slow “sit-sumping” as we know it with the engine shut down.
When the ADV rubber flap closes in the filter, it just keeps oil that is in the non filtered side from coming back down the inlet hose to the filter.
It does not stop oil from seeping or otherwise entering the inlet side of the filter (just from leaving /reversing out the inlet hose).
Any oil that has made it thru the filter media is not affected by the rubber flap (not stopped from flowing or seeping out).
With the filter on the feed side (86-up), gravity will push oil down the feed hose from tank, past the oil pump, past the ADV flap and into the filter.
With filter on return side (85-down), the only oil that can get back to motor from filter is what is present between filter inlet (before ADV) and motor.
The oil check ball / valve is suppose to stop any oil from leaving the filtered side from getting into the motor.
The ADV has no relation to wetsumping on a Sportster. Oil drainback from the return side through the pump should be minimal at best.

- On 1979-1985 Sportsters, the only thing an ADV will prevent is oil coming back down the return line from the tank to filter (only what's in that portion of hose on shutdown).
  So what oil may be stored on shutdown between the filter and the tank isblocked from re-entering the motor back through the pump.
  (whether a short section of hose or hosing and oil cooler content if applicable)

This is from a HD Parts and Accessories Bulletin (PAB-398) dated 11-1-1988. Low restriction oil filter (63806-83) has been obsoleted.
It was originally offered as a low restriction filter to insure proper return of oil to the oil tank.
This filter did not have a drain-back valve (**which is not required in Harley-Davidson applications**) to reduce restriction.
Recently, the drain-back valve was removed from oil filters 63796-77 (chrome) and 63805-80 (black) to reduce oil filter restriction.
The part numbers were changed to 63796-77A and 63805-80A to reflect this change.
Either of these oil filters can be used in place of 63806-83.



[21)]

Relief (Bypass) Valve

- The pressure differential is the change in pressure from the inlet to the outlet side of the filter. [22)]
  - If the pressure differential is too high, a valve will open, allowing the oil to bypass the filter.
  - All engine oil filters or heads are equipped with a bypass valve.
  - This valve is needed so the engine does not become starved of oil as the filter clogs with debris.
- The higher the bypass pressure setting, the more oil is forced through the filter. [23)]
- In a full flow oil system, all the oil passes through the filter to reach the engine. [24)]

- If the filter clogs, an alternative route to the engine must be provided for the oil.
(or the bearings and other internal parts may fail due to oil starvation)
- A relief (or bypass) valve is used to allow unfiltered oil to lubricate the engine.
  - Unfiltered oil is far better than no oil at all.
- This relief valve is built into some engine cases.
- Otherwise, the relief valve is a component of the oil filter itself.
- Under normal conditions, the valve remains closed.
- When there is sufficient contaminant in the oil filter to reach a preset level of restriction to oil flow,
  - The pressure on the relief valve causes it to open.
- This condition can occur when the oil filter has become clogged or when the weather is cold and the oil is thick and flows slowly.

Bypass Valve Malfunctions

- The malfunction of by-pass valves and regulating valves has been traced to: [25)]
  - Sticky surfaces caused by cold, highly viscous oil.
  - Oil contaminated by excessive condensation, coolant, or oxidation.
  - Neglect – extended oil drain and filter change intervals.
  - Carbon grit that temporarily jams a valve.

    - Sudden acceleration of the engine with any of the above conditions.
- Discovery of a collapsed filter calls for inspection of;
    - The filter by-pass valve.
    - The pressure regulator valve.
    - And a review of the engine and its performance and maintenance history.

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1) , 5) , 12) , 13) , 22)
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