

Heavy-Duty Diesel Engine Air Filter Collapse

Collapse of a heavy-duty engine air filter is defined as having permanent deformation of the element after the flow of air has stopped (engine ignition switch is off). This occurs when the pressure drop across the filter exceeds the design limit of the component.

Generally, heavy-duty air filters are designed to operate well beyond the engine manufacturers recommended air intake restriction service points. In fact, there is usually a safety factor of at least 2-3 times over the stated service point that is considered in most heavy-duty air filter designs. However, there are circumstances when filter collapse may occur. If an engine is operated with a collapsed air filter element, chances are unfiltered air is being drawn in, which could result in costly repairs. Often the failure can be attributed to poor maintenance, but operating conditions need to be considered as well.

Diesel engines typically have an intake element service point of 20"-30" H₂O or 5-7.5 kPa (restriction) of differential pressure, meaning the difference of the pressure drop between the airflow coming into the filter versus the pressure drop on the inner (clean) side of the element. As the differential pressure between the outside (dirty) portion of the filter element and the inner (clean) side increases, undue force is exerted on the outside of the element. Once this pressure difference exceeds the design parameters of the filter, the media can no longer flow air and the entire element will collapse inward. Think of drawing a vacuum through a straw; plug the end of the straw and the entire structure will draw inward and collapse.

A practical method to assess the condition of the air filter is to install an air restriction measuring device such as a mechanical air filter gauge or dash mounted electronic air pressure sensor. It is recommended that the air filter element be replaced once the service point is indicated.

Another possibility of filter collapse is sub-standard element construction or remanufacture. Generally, obtaining air filters from a reputable manufacturer will avoid this issue. Quality heavy-duty air filters are made with materials that can withstand high levels of pressure drop and resist collapse, while sub-standard elements may not.

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It is also important to inspect all filters before installation. Dented liners or end caps may result in a loss of structural integrity. Damage may be present but not markedly visible. If the filter shows any sign of damage, don't use it. This is especially critical when using cleaned elements (refer to TSB 89-4). Couple the possibility of damaged filters with weakened media (if it were washed or cleaned with too high of a pressure) and the filter may have a much lower resistance to collapse.

Operating conditions impact the service life of a filter as well. For example, high levels of soot (generally from diesel engine exhaust) can plug an air filter rapidly. This may shorten the life of a filter dramatically, and if a restriction indicating device isn't monitored closely, it can also result in extremely high pressure drop across the filter that may cause it to collapse. If high levels of soot are experienced, the cause of the ingestion should be investigated and corrected. These include (but are not limited to) proximity of the intake to the exhaust, exhaust leaks near the air intake, vehicles operating or idling in close quarters and operating in certain areas where exhaust concentrations are high can result in high levels of soot.

Extremely high levels of water ingestion can be a concern, too. Although most filters can endure a small amount of moisture with no problems, large amounts of water can weaken and plug the filter media long enough to cause collapse. However, this is an unusual situation because most vehicles that are likely to be used in these types of conditions have a water separation device installed. One possibility of excessive water ingestion often not accounted for is the introduction of high levels of moisture during washing of the vehicle. The best practice is to ensure the engine is not operating during washing and water is not sprayed directly into the engine air intake.

In summary, following the engine manufacturer's service recommendations, using quality undamaged products and using an air restriction indicating device are the best practices to prevent air filter collapse. If element collapse occurs, it is important to ascertain whether lack of maintenance caused the problem or if the vehicle is used in conditions that dramatically shorten filter life. Once the source of the collapse is identified, use appropriate measures to correct the issue to prevent further damage from occurring. For additional information about servicing heavy duty air filters refer to TSB 89-3.

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