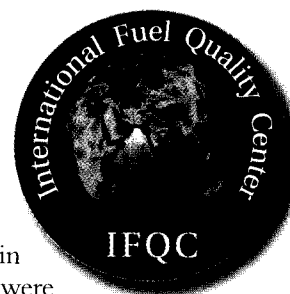


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Top-100 Countries Ranked by Standards for Gasoline Benzene Limits

The International Fuel Quality Center recently released a ranking of the top-100 countries based on the lowest benzene limits in gasoline. Colombia was at the top of the ranking with the lowest limit, followed by Canada and Luxembourg.



Benzene is a chemical found naturally in crude oil; as a result, it passes into refined products such as transportation fuels. It is a colorless or light yellow liquid at room temperature, which is highly flammable and has a sweet odor. Benzene also is a product of catalytic reforming that produces high-octane gasoline streams. The chemical is emitted into the air as a result of fuel combustion (in auto engines, for example), and also is found from other sources such as industrial emissions and tobacco smoke. Regardless of its concentration, benzene has negative environmental and health effects – the U.S. Environmental Protection Agency (EPA) has classified benzene as a Group A, known human carcinogen, which can have harmful effects on such things as bone marrow and red blood cell count (lowering the cell count, causing anemia).

Controlling benzene levels in gasoline is the most direct way to limit evaporative and exhaust emissions of benzene from vehicles. The control of benzene levels in gasoline has also been recognized as an effective way to reduce human exposure to benzene, according to the EPA. Although measures to reduce benzene levels in gasoline have not been as intensive as they have for other fuel components, such as sulfur, further

control of benzene levels has become more prevalent as emissions standards continue to become more stringent. In most of the countries included in this ranking, market quality is typically lower than the legislated amount.

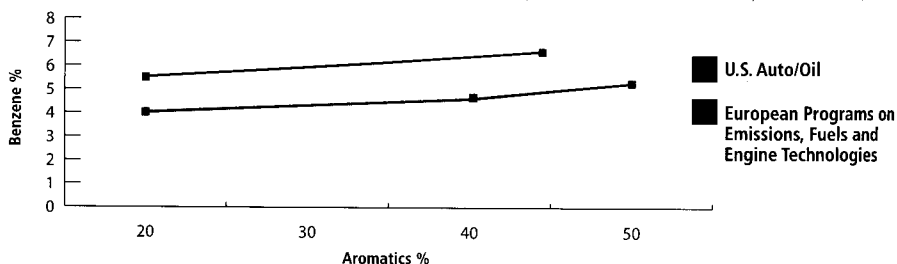
Worldwide trends show lower levels of benzene are mostly being legislated in countries that also require lower content of other harmful gasoline components, such as sulfur. Sulfur and benzene are gasoline components that must be reduced for there to be a direct impact on emissions – the reduction of these components also allows for the use of more advanced engine technologies that will further reduce emissions. Among all regions, Africa, the Middle East and the Commonwealth of Independent States (CIS) are the furthest behind in reducing benzene and sulfur limits.

Countries in this ranking were placed based on the order of the following criteria for gasoline:

- maximum benzene limits in national standards;
- maximum benzene limits in local/regional standards (such as specifications for cities/states); and by year of implementation.
- The International Fuel Quality Center focuses on legislated limits; however, market benzene levels, applied based on available data, also influenced these rankings.

It is important to note the limits for some countries are not simple maximums or averages. Producers and refiners are sometimes allowed alternate reporting mechanisms that use different limits, thus making direct comparison between countries somewhat

Fuel aromatics effect on benzene exhaust emissions.
(Data courtesy Worldwide Fuel Charter, September 2006)





Source: International Fuel Quality Center, November 2008

For more information about, and a complete list of, the "Top 100," visit www.ifqc.org and click on the "Top 100" button on the upper right.

difficult. Different grades of gasoline such as premium and regular can have different benzene limits as well.

At the top of the ranking, below first and second place Colombia and Canada were a cluster of European countries (Luxembourg in third, Belgium in fourth, nine countries tied for fifth), Ireland and Portugal tied at 14th, and Greece and Italy tied at 16th. All the European countries had a national benzene limit of 1 vol%. Market quality data was used as a criterion to further rank those countries with the same national benzene limits; market quality in these European countries varied from 0.5 vol% to 0.9 vol%, according to the EU Fuel Quality Monitoring 2006 Summary Report.

A number of Asian countries were also at the top of the ranking, right after and alongside Europe, including Hong Kong, Japan and Taiwan tied at 18th along with Iceland, Liechtenstein, Norway and Switzerland, which all had a national benzene limit of 1 vol%.

The United States came in at 67th, primarily because these rankings are based on national maximum allowance standards. Federal standards in the nation have not been updated since 1997 (another sign benzene content control has not been as pressing an issue during

the years); however, in preparation for the new limit to be enforced in 2011, refiners have been actively reducing the benzene content in the conventional gasoline. If the country's ranking were influenced by 2005 market information on conventional gasoline, the United States would have ranked 49th. The state of California could almost be considered as a country by itself, as it has the gross domestic product to place it as one of the top-10 world economies; if it were a country, California would have ranked first based on the benzene limit in gasoline. The United States actually would have ranked second if reformulated gasoline (RFG) were used in place of conventional gasoline in the ranking, as RFG has a lower benzene limit than conventional gasoline.

While the majority of countries make efforts to reduce benzene content, several nations actually do not have benzene limits nor do they require the reporting of benzene content in their gasoline pools. These countries include Malaysia, Venezuela and Peru.

There are several noticeable trends in benzene limits around the world (see map). Madagascar, for example, is ahead of the rest of the African region in its benzene limits, ranking 54th. South

Africa and Tanzania are the next African countries after Madagascar and tied at 78th. Other African countries that made the ranking include Kenya and Uganda, tied at 88th along with Jamaica, Malawi at 91st, and Cote D'Ivoire, tied at 100th with Costa Rica, Guatemala, Honduras and Nicaragua. These countries tied at 100th do not have actual benzene limits for gasoline, but producers and importers are required to report benzene content in gasoline.

The map also shows the United States (per its federal limit) has the highest in the Americas of those countries with limits in place; however, there are some nations in South America that only require reporting benzene content in gasoline. Africa and the CIS are shown as being generally behind the rest of the world in the country's benzene limits, as it ranges from 5 vol% to 7 vol% where regulated. ■

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