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# Emission Factors for Oil and Gas Production Operations

STEP
*Strategies for Today's Environmental Partnership*

American
Petroleum
Institute

STEP
*Strategies for Today's Environmental Partnership*

One of the most significant long-term trends affecting the future vitality of the petroleum industry is the public's concerns about the environment. Recognizing this trend, API member companies have developed a positive, forward looking strategy called STEP: Strategies for Today's Environmental Partnership. This program aims to address public concerns by improving our industry's environmental, health and safety performance; documenting performance improvements; and communicating them to the public. The foundation of STEP is the API Environmental Mission and Guiding Environmental Principles.

## API ENVIRONMENTAL MISSION AND GUIDING ENVIRONMENTAL PRINCIPLES

The members of the American Petroleum Institute are dedicated to continuous efforts to improve the compatibility of our operations with the environment while economically developing energy resources and supplying high quality products and services to consumers. The members recognize the importance of efficiently meeting society's needs and our responsibility to work with the public, the government, and others to develop and to use natural resources in an environmentally sound manner while protecting the health and safety of our employees and the public. To meet these responsibilities, API members pledge to manage our businesses according to these principles:

- To recognize and to respond to community concerns about our raw materials, products and operations.
- To operate our plants and facilities, and to handle our raw materials and products in a manner that protects the environment, and the safety and health of our employees and the public.
- To make safety, health and environmental considerations a priority in our planning, and our development of new products and processes.
- To advise promptly, appropriate officials, employees, customers and the public of information on significant industry-related safety, health and environmental hazards, and to recommend protective measures.
- To counsel customers, transporters and others in the safe use, transportation and disposal of our raw materials, products and waste materials.
- To economically develop and produce natural resources and to conserve those resources by using energy efficiently.
- To extend knowledge by conducting or supporting research on the safety, health and environmental effects of our raw materials, products, processes and waste materials.
- To commit to reduce overall emission and waste generation.
- To work with others to resolve problems created by handling and disposal of hazardous substances from our operations.
- To participate with government and others in creating responsible laws, regulations and standards to safeguard the community, workplace and environment.
- To promote these principles and practices by sharing experiences and offering assistance to others who produce, handle, use, transport or dispose of similar raw materials, petroleum products and wastes.

# Emission Factors for Oil and Gas Operations

**Health and Environmental Sciences Departments**

API PUBLICATION NUMBER 4615

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# PREFACE

This report presents final results of an API study entitled, *Emission Factors for Oil and Gas Production Operations*. The report supplements API Publication Number 4589, published in December 1993, entitled, *Fugitive Hydrocarbon Emissions from Oil and Gas Production Operations*. Although API Publication Number 4589 contains correlation equations for several types of Exploration and Production (E&P) facilities and emission factors for those facilities, it does not contain emission factors for gas plants. This supplemental report contains emission factors for gas plants (as well as other E&P facilities) based upon the correlation equations recently published on the EPA electronic bulletin board. Emission factors for each component type were calculated by substituting screening values into the appropriate EPA correlation equation.

## ABSTRACT

In 1980, the American Petroleum Institute (API) published emission factors for fugitive hydrocarbon emissions from onshore and offshore petroleum production sites. In 1993, API published the results of a joint study with the Gas Research Institute (GRI) at 20 oil and gas production sites, including light crude, heavy crude, gas production and offshore oil and gas facilities. The current report combines the 1993 API/GRI data with data from four additional gas processing plant sites. Emission factors contained in the current report replace the existing 1980 and 1993 API factors. More than 200,000 components were screened during the two recent studies using EPA Method 21 guidelines. Mass emission rates from nearly one thousand leaks were quantified. Approximately three-fourths of the quantified leaks were speciated to determine emission rates of total hydrocarbon, volatile organic compounds, and individual air toxics (i.e., benzene, toluene, ethyl benzene, and xylenes).

Recently published EPA correlation equations were used in combination with the 200,000 instrument screening values to produce new average and Leak/no-leak emission factors for oil and gas production operations. The new factors allow operators to more accurately quantify actual emissions from their sites. This greatly improves assessment of control technologies and selection of equipment to lower fugitive hydrocarbon emissions. As the new leak definition imposed by the Clean Air Act of 1990 becomes effective, results of this study will be indispensable to operators.

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# EXECUTIVE SUMMARY

In December 1993, the American Petroleum Institute (API) published API Publication Number 4589, *Fugitive Hydrocarbon Emissions from Oil and Gas Production Operations* (Star Environmental, 1993) which contains correlation equations and emission factors developed from the screening of 184,035 components at 20 sites. In August 1994, the US EPA published new correlation equations for the petroleum industry (see Table ES-3), based in part on the data contained in the API report.

This report contains new emission factors developed from the 1993 API data using the new EPA correlation equations. The new emission factors are generally higher than the 1993 API factors, but they are lower than the SOCMI factors, refinery factors, and gas plant factors published by the EPA in *Protocol for Equipment Leak Emission Estimate* (EPA, 1993). The new emission factors are highly dependent on the EPA pegged source emission factors. This report also contains emission factors for gas plants based on the data contained in the 1993 API report appendices and data collected at four additional gas plants as a part of this study.

Average emission factors, calculated for use with component inventories, are shown in Table ES-1. These factors can be used to predict total hydrocarbon emissions when screening data is not available and only the number of components installed at a site is known.

Table ES-1. Average Emission Factors by Facility Type (lb/component-day)

| | Connection | Flange | Open End | Pump | Valve | Others |
|---|---|---|---|---|---|---|
| Light Crude | 8.66E-03 | 4.07E-03 | 6.38E-02 | 1.68E-02 | 7.00E-02 | 3.97E-01 |
| Heavy Crude | 4.22E-04 | 1.16E-03 | 8.18E-03 | no data | 6.86E-04 | 3.70E-03 |
| Gas Production | 1.70E-02 | 6.23E-03 | 3.63E-02 | 1.03E-02 | 1.39E-01 | 4.86E-01 |
| Gas Plants | 1.45E-02 | 2.32E-02 | 5.46E-02 | 6.09E-01 | 2.04E-01 | 2.57E-01 |
| Offshore | 5.70E-03 | 1.04E-02 | 5.37E-02 | 1.03E-02 | 2.72E-02 | 3.67E-01 |

"Others" category includes instruments, loading arms, pressure relief valves, stuffing boxes, compressor seals, dump lever arms, and vents.

Emission factors for connections and flanges are typically an order of magnitude lower than valve emission factors. Emission factors for onshore light crude production and onshore gas