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# REVIEW OF MECHANICAL AND SEALING PERFORMANCE ASPECTS OF COMMERCIALLY AVAILABLE PTFE BASED GASKET MATERIALS

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## ABSTRACT

Gaskets incorporating polytetrafluoroethylene (PTFE) are one of the most common in use today where soft sealing material is needed in bolted joints. Over the years, various types of gaskets have been developed including those using skived, expanded, filled, or molded PTFE sheet. Still other PTFE gaskets have been fabricated, incorporating some type of metal insert. Although many of the key benefits (e.g., chemical resistance, application in a broad range of flange types, higher maximum temperature and stress levels than most elastomers, indefinite shelf life, etc.) remain, the performance of the gasket will vary significantly according to the type of PTFE gasket employed. These variations in accordance with PTFE gasket styles are presented and discussed with an emphasis on such criteria as relaxation, gasket tightness / leak rate, and safe reserve operating temperature. For estimating tightness and predicted leak rates, the previously reported "Fugitive Emissions Calculator" (FEC) model has been used which employs Room Temperature Testing (ROTT) data and an ASME / PVRC draft empirical equations set. Published test data have also been compiled to support conclusions concerning relative capabilities for selected PTFE gasket categories. The differences in analytical and leak rate performance criteria have been used to suggest appropriate applications for various subtypes of PTFE gaskets.

## INTRODUCTION

In 1938, Dr. Roy J. Plunkett was the first to develop polytetrafluoroethylene (PTFE). Later in 1945, this material was registered as Teflon™ by DuPont with Teflon™ products being sold commercially beginning in 1946 [1]. Eventually PTFE was used in gaskets and other fluid sealing materials due to its inertness to most solvents and other chemicals as well as the relative ease in which it can be formed into sheet material, cut, and be modified by various processes, added fillers, or metal inserts. PTFE gaskets are often used where flange face defects (e.g., scratches, gouges, etc.) are better sealed with a softer gasket material which is used to fill in the defects. Overall, PTFE gaskets have a much lower minimum stress to seal than metal and other hard gaskets. The advantages of PTFE as a gasket material are mollified by three limitations in particular: (1) the tendency for PTFE gaskets to experience creep relaxation; (2) their continuous upper temperature limitation to no more than 500 deg. F; and (3) the porosity of PTFE prior to gasket compression. Fillers were originally added to PTFE to reduce (but not eliminate) creep as well as to increase the maximum temperature limits. However, filler additions resulted in many instances to a change in overall chemical compatibility and the most effective pH range of a particular material. Inserts of various types (corrugated metal, tang core, etc.) were added to the PTFE gasket design to minimize the impact of thermal cycling while improving the gasket's ability to retain bolt load.

Several laboratory tests have been developed as quality control standards for various gasket materials which manufacturers often report for consumption by their end users. These tests include:

- ASTM F-36 Compressibility / Recovery
- ASTM F-38 Creep Relaxation
- ASTM F-152 Tensile Strength
- HOBT2-C (Hot Blowout Test)

There are many other gasket material tests both under ASTM as well as with other standard organizations such as the European Committee for Standardization (CEN). This study includes a review of the mechanical and sealing performance data for 42 different PTFE based gasket materials commercially available. To compare their mechanical properties, published ASTM data for these materials were reviewed. The above ASTM tests were selected due to: (1)



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