

## Current limits of PTFE in sliding bearings

**Virginio QUAGLINI**

Assistant Professor  
Politecnico di Milano  
Milano, Italy  
[virginio.quaglini@polimi.it](mailto:virginio.quaglini@polimi.it)

**Charlotte TAVECCHIO**

Research Fellow  
Politecnico di Milano  
Milano, Italy  
[tavecchio@stru.polimi.it](mailto:tavecchio@stru.polimi.it)

**Paolo DUBINI**

Research Fellow  
Politecnico di Milano  
Milano, Italy  
[paolo.dubini@stru.polimi.it](mailto:paolo.dubini@stru.polimi.it)

**Daniele CUMINETTI**

Test Engineer  
Politecnico di Milano  
Milano, Italy  
[daniele.cuminetti@polimi.it](mailto:daniele.cuminetti@polimi.it)

**Daniela FERRONI**

Research Fellow  
Politecnico di Milano  
Milano, Italy  
[ferroni@stru.polimi.it](mailto:ferroni@stru.polimi.it)

### Summary

The European standard EN 1337 on bridge bearings is supported by experimental studies dating to the '70s and the '80s, which are not suitable to account for recent issues relevant to operations of steel-PTFE bridge bearings under extreme conditions, like high environment temperatures or high velocities of sliding. The investigations reported in the paper show that the strength of PTFE at high temperatures is underestimated by the standard, leading to unnecessary need for over sizing the bearings. On the other hand, increase in wear rate and reduced service life shall be carefully considered for PTFE bearings operating at high velocities. Under severe conditions in terms of high speeds and increase in temperature at the sliding interface the actual wear life of PTFE can be dramatically reduced with respect to the figure given in the standard.

**Keywords:** sliding bearing; PTFE; friction; wear; temperature; pressure; velocity.

### 1. Introduction

Sliding bearings, since their first introduction at the beginning of the '60s, are among the most popular bridge bearings thanks to their ability to support heavy loads while permitting large movements and rotations with minimum reaction forces: individual bearings can support vertical loads up to 40.000 kN, and provide displacement and rotation capacities of up to 1.500 mm and 0,04 radians [1].

Modern sliding bearings are made of materials with proved longevity and resistance to environmental deterioration and aging. Sliding occurs at the interface between a sheet of a self-lubricating polymer, such as poly-tetra-flour-ethylene (PTFE), and a highly polished metal surface made of stainless steel, or hard chromium plated steel, or aluminium alloy. This interface is usually lubricated with grease to reduce resistance to sliding and increase the service life.

In Europe the range of operation of bridge bearings is given in the scope of the European standard EN 1337, which is compulsory for CE Marking. The limits of operation of PTFE sliding bearings are set in Part 2 of the standard (Table 1).

*Table 1: Operating conditions of PTFE in sliding bridge bearings according to EN 1337 Part 2*

Characteristic	value
Compressive strength, MPa	90 MPa
Minimum effective temperature	-35° C
Maximum effective temperature	48° C
Maximum velocity of sliding	2 mm/s
Service term (accumulated path)	10242 m

In the development of the standard, theoretical support was given by investigations carried out in the '70s and '80s. A comprehensive study on the deformation and wear characteristics of PTFE sheets at low and moderate temperatures, up to +30° C, and pressures up to 60 MPa is reported by e.g. Eggert [2].

The main limitations to the performance of PTFE have been identified in the moderate wear endurance, which is restricted to about 10 km, and in the load bearing capacity,