STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
METHODS OF TEST FOR RUBBER

AS 1683.24
RUBBER VULCANIZED—DETERMINATION OF RESISTANCE TO OZONE CRACKING—STATIC STRAIN TEST

PREFACE

At the series of meetings held by the Association's four main rubber committees in September 1982, a unanimous demand was expressed for a general method of test for resistance of vulcanized rubber to ozone cracking.

In response to their demand, this standard has been prepared by the Association's Committee on Rubber Testing.

It is technically identical with ISO 1431/1—Rubber, Vulcanized—Resistance to Ozone Cracking—Part 1: Static Strain Test.

FOREWORD

This standard is intended for use in estimating the resistance of vulcanized rubbers to cracking when exposed, under static tensile strain, to air containing a definite concentration of ozone and at a definite temperature in circumstances where the effects of direct light are excluded.

Cracks develop in rubber only on surfaces subjected to tensile strain. The pattern of cracks, and the severity of cracking, vary according to the magnitude and nature of the applied strain. The strain on an article in service will vary from a minimum at one point, which need not necessarily be zero, to a maximum at some other point. The pattern of cracks at all extensions in this range should be considered when ozone resistance is being measured.

The first criterion for describing a material as ozone resistant is total freedom from cracking. Thus, the higher the threshold strain for a given exposure period or the higher the limiting threshold strain or the longer the time before cracks appear on a test piece at a given elongation, the better is the ozone resistance.

However, an alternative criterion may be necessary when ozone cracks below a certain limit of size are permitted on the rubber over a given range of strains. This criterion is based on the concept that one vulcanizate can be described as more ozone resistant than another if the ozone cracks on it are less severe over the range of extensions encountered in service, which should be specified. The visual nature of the ozone cracks which develop in the test piece should then be reported so that the whole relationship between strain and severity of cracking is determined.

The way in which ozone cracking depends on strain is not a simple relationship. The number of cracks on a test piece is related to their size and this relationship depends on the threshold strain for a given exposure period and the elongation applied to the test piece, for any given material.

Thus no ozone cracking will occur for a given exposure period at strains between zero and the threshold (by definition). A few cracks, which will be large, will be found at strains slightly above the threshold and the cracks will become more numerous and smaller at progressively higher strains. At very high strains, the cracks may sometimes be so small as to be invisible to the naked eye.

Cracks will coalesce as the exposure increases, particularly when they are very numerous on the surface of the test piece. This will result in the length of some cracks being increased, but without a proportionate increase in depth. Coalescence is probably due to a tearing process as well as ozone attack, and will sometimes result in a number of larger cracks being scattered among the general mass of small, dense cracks which often cover the test piece surface at high strains.

Great caution is necessary in attempting to relate standard test results to service performance since the relative ozone resistance of different vulcanizates can vary markedly according to conditions, especially ozone concentration and temperature. In addition, tests are carried out on thin test pieces deformed in tension and the significance of attack for articles in service may be quite different owing to the effects of size and the type and magnitude of deformation.

METHOD

1 SCOPE. This standard sets out a method for determining the resistance of vulcanized rubbers to cracking when exposed, under static tensile strain, to air containing a definite concentration of ozone and at a definite temperature in circumstances where the effects of direct light are excluded.

2 REFERENCED DOCUMENTS. The following standards are referred to in this standard:

AS 1683 Methods of Test for Rubber
1683.20 Standard Temperatures, Humidities and Times for Conditioning and Testing Test Pieces

ISO 4661 Rubber—Preparation of Test Pieces.

3 DEFINITIONS. For the purposes of this standard, the following definitions apply:

3.1 Threshold strain—the highest tensile strain at which a vulcanizate can be exposed to air containing a given concentration of ozone without ozone cracks developing on it after a given exposure period.

Threshold strain must be distinguished from limiting threshold strain, defined in Clause 3.2.

3.2 Limiting threshold strain—the tensile strain below which the time required for the development of ozone cracks increases very markedly and can become virtually infinite.

4 PRINCIPLE. Test pieces under static tensile strain are exposed, in a closed chamber at constant temperature, to an atmosphere containing a fixed concentration of ozone and subjected to examination for cracking at certain intervals.

Three alternative evaluation procedures are described for selected values of ozone concentration and exposure temperature:

(a) Determination of the presence or absence of cracks after exposure for a fixed period of time at a given strain.

(b) Determination of time to the first appearance of cracks at any given strain.

(c) Determination of the threshold strain for any given exposure period.

5 APPARATUS (see Fig. 1). The following items of apparatus are required:

5.1 Test chamber. The test chamber shall be a closed, non-illuminated chamber, thermostatically controlled to within ±2°C of the test temperature, lined with, or constructed of, a material (for example aluminium) that does not readily decompose ozone. Dimensions shall be such that the requirements of Clause 5.5 are complied with. The chamber may be provided with a window through which the surface of the test pieces can be observed.

5.2 Source of ozonized air. The source for ozonized air shall be either of the following:

(a) An ultraviolet lamp.

(b) A silent discharge tube.

The use of oxygen is necessary when using the discharge tube in order to avoid the formation of nitrogen oxides. The ozonized oxygen or air may be diluted with air to attain the required ozone concentration. Air used for generation of ozone or dilution shall first be purified by passing it over activated charcoal and shall be free

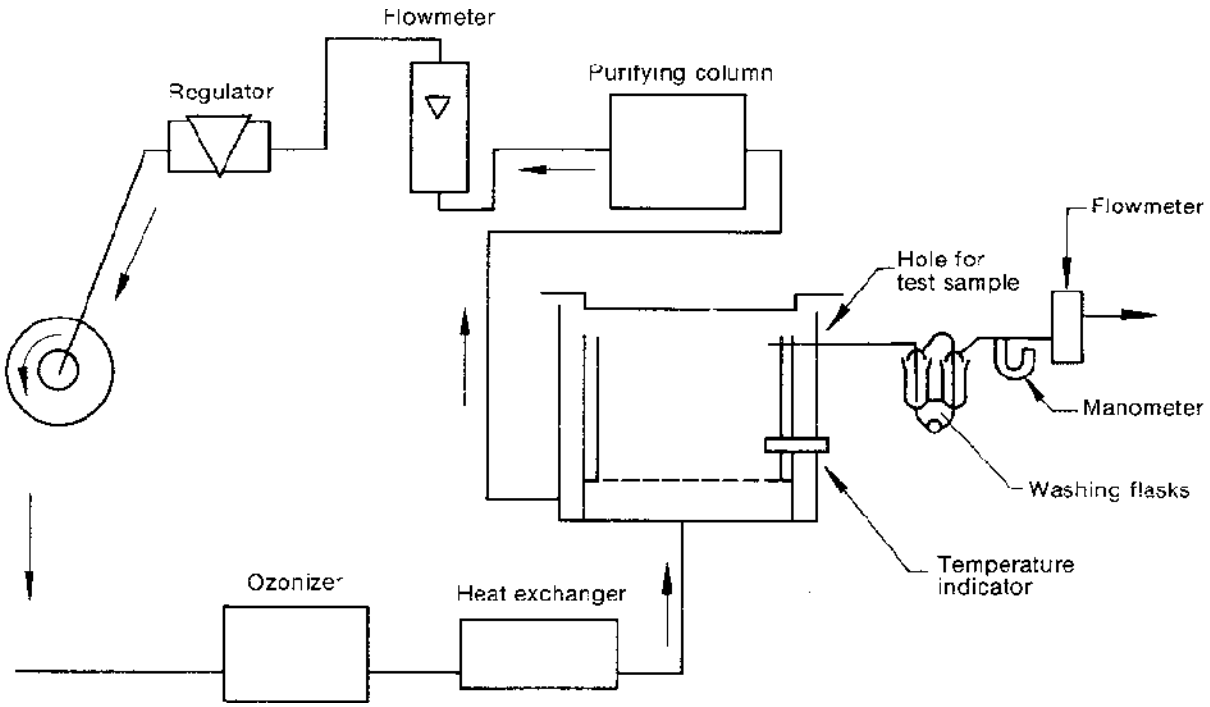

Fig. 1. SCHEMATIC DIAGRAM OF THE APPARATUS