SIST

SLOVENSKI STANDARD
SIST EN 13597:2004

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Železniške naprave – Vzmetni elementi iz elastomerov – Membrane iz elastomerov za zračne, nosilne vzmeti

Railway applications - Rubber suspension components - Rubber diaphragms for pneumatic suspension springs

Bahnanwendungen - Federungselemente aus Elastomer - Membranen aus Elastomer für pneumatische Tragfedern

Applications ferroviaires - Pieces de suspension a base d'élastomere - Membranes a base d'élastomere pour ressorts pneumatiques de suspension

Ta slovenski standard je istoveten z: EN 13597:2003

ICS:

21.160	Vzmeti	Springs
45.040	Materiali in deli za železniško tehniko	Materials and components for railway engineering

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Railway applications - Rubber suspension components - Rubber diaphragms for pneumatic suspension springs

Applications ferroviaires - Pièces de suspension à base d'élastomère - Membranes à base d'élastomère pour ressorts pneumatiques de suspension

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Contents

Foreword

This document (EN 13597:2003) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2003, and conflicting national standards shall be withdrawn at the latest by August 2003.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association:

— Council Directive 96/48/EEC of 23 July 1996 on interoperability of the European high-speed train network [1)];

— Council Directive 93/38/EEC of 14 June 1993 coordinating the procurement procedures of entities operating in the water, energy, transport and telecommunications sectors [2)];

— Council Directive 91/440/EEC of 29 July 1991 on the development of the community's railways. [3)]

The annexes B and D are normative.

The annexes A and C and E are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1) Official Journal of the European Communities N° L 235 of 17.09.96

2) Official Journal of the European Communities N° L 199 of 09.08.93

3) Official Journal of the European Communities N° L 237 of 24.08.91

Introduction

Designing a suspension diaphragm requires knowledge of the mechanical system of which it forms part. Specific characteristics are therefore needed for each case, which only the customer can specify.

The requirements of the European Standard should operate in conjunction with the conditions for the supply of air spring suspension diaphragms.

This European Standard is the result of studies and research to improve the performances and quality of rubber diaphragms for pneumatic suspension springs in order to meet the requirements of railway rolling stock.

This European Standard is designed for the railway operators, the manufacturers and equipment suppliers of the railway industry as well as for the suppliers of rubber diaphragms for pneumatic suspensions springs.

1 Scope

This European Standard specifies:

- characteristics that suspension diaphragms achieves, together with applicable inspection and test methods to be carried out for verification;
- approval procedure to be implemented by the customer;
- guidelines for qualification of the product with specified requirements;
- quality monitoring of diaphragms in manufacture;
- supply requirements.

This European Standard applies to suspension diaphragms designed to be fitted on railway vehicles and similar vehicles running on dedicated tracks with permanent guide systems, whatever the type of rail and the running surface.

The European Standard does not detail the other components of pneumatic suspension assemblies or control systems such as air reservoirs, frames, stiffeners, emergency suspension systems or elastic supports (such as series springs), etc., which will affect the diaphragm performance.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 45020, *Standardization and related activities – General vocabulary (ISO/IEC Guide 2:1996).*

ISO 31-1, *Quantities and units – Part 1: Space and time.*

ISO 31-3, *Quantities and units – Part 3: Mechanics.*

ISO 36, *Rubber, vulcanized or thermoplastic – Determination of adhesion to textile fabric.*

ISO 48, *Rubber, vulcanized or thermoplastic – Determination of hardness (hardness between 10 IRHD and 100 IRHD [4]).*

ISO 471, *Rubber – Temperatures, humidities and times for conditioning and testing.*

ISO 1382, *Rubber – Vocabulary.*

ISO 1431-2, Rubber, *vulcanized or thermoplastic – Resistance to ozone cracking – Part 2: Dynamic strain test.*

ISO 1817, *Rubber, vulcanized – Determination of the effect of liquids.*

ISO 2781, *Rubber, vulcanized – Determination of density.*

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[4] IRHD : International Rubber Hardness Degrees

ISO 2921, *Rubber, vulcanized – Determination of low-temperature characteristics – Temperature – Retraction procedure (TR test).*

ISO 4649, *Rubber, vulcanized or thermoplastic – Determination of abrasion resistance using a rotating cylindrical drum device.*

ISO 10209-1, *Technical product documentation – Vocabulary – Part 1: Terms relating to technical drawings: general and types of drawings.*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this European Standard, the terms and definitions in ISO 1382 together with the following apply.

3.1.1
bead
end feature of the diaphragm which enables it to be secured and sealed to the surrounding structure

NOTE A diaphragm has two beads.

3.1.2
bead core
reinforcing core, vulcanized in at both ends of the carcass

NOTE It assures permanent seating on a conical or other specifically shaped mounting part.

3.1.3
carcass
structure of reinforcing material, typically consisting of heavy duty fabric plies arranged crosswise, embedded in the elastomer for flexible force transmission

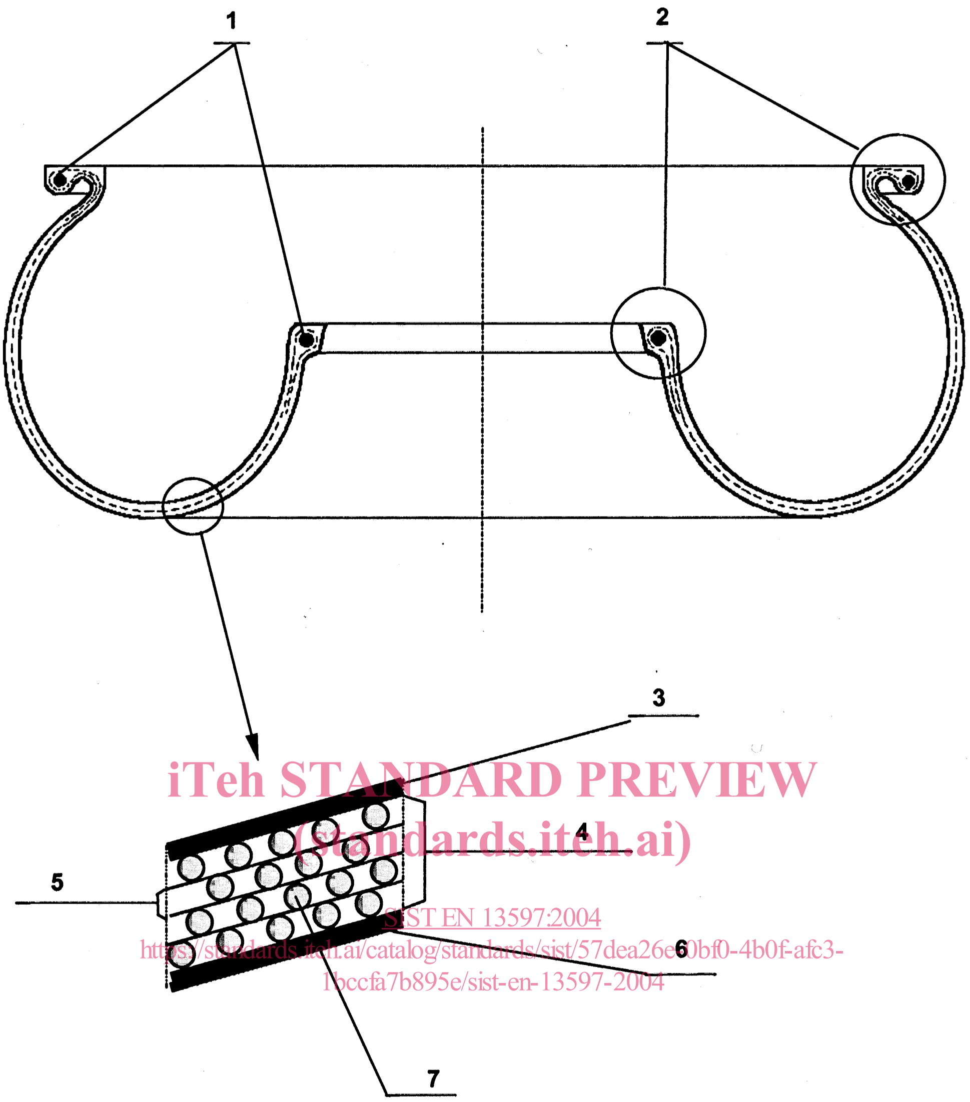
3.1.4
diaphragm
the term "diaphragm" herein applies to the finished product, comprising of carcass and beads for use as part of pneumatic suspension system

NOTE Different types of diaphragms are illustrated in annex A.

3.1.4.1
new diaphragm
diaphragm in new condition and never yet used

3.1.4.2
grown diaphragm
diaphragm which has been in use and, as a result, has changed dimensionally

3.1.5
ply
layer typically made up of rubberized fabric



Key

1 Bead cores
2 Beads
3 Inner layer of rubber
4 Carcass
5 Ply
6 Outer layer of rubber
7 Rubberized fabric

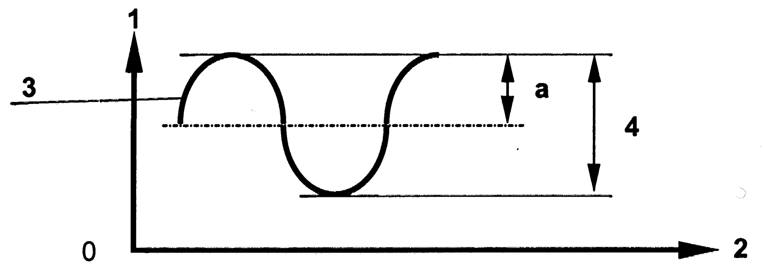
Figure 1 — Different parts of a diaphragm

3.2 Symbols and abbreviations

The majority of the symbols, used in this standard and defined in this sub-clause, are in accordance with ISO 31-1 and ISO 31-3.

Decimal multiples and submultiples of units defined in Table 1 can be used.

Table 1 — Symbols and abbreviations

Symbol Abbreviation	Unit	Explanation
A_e	m^2	Effective area of the diaphragm, with: — $A_e = F / p$ — $\Delta A_e / \Delta d$: Variation of the effective area in function of axial displacement. $\Delta A_e / \Delta d = ((F_{(j+1)} - F_j) / p) / (d_{(j+1)} - d_j)$
a	m or rad	Amplitude of the movement, with $a = \Delta d / 2$ or $a = \Delta \Theta / 2$.  **Key** 1 Displacement (*d* or *Θ*) 2 Time (*t*) 3 *d* (*t*) or *Θ* (*t*) 4 Δ*d* or Δ*Θ* **Figure 2 — Amplitude definition**
D	m	Outer diameter of diaphragm (see Figures 5, A.1, A.2, A.3 and A.4), with: D_{pj} : Outer diameter of diaphragm for a given internal pressure (see explanation symbol *p*).
d	m	Linear displacement, with: d_M : Maximum operational displacement; Δd : Difference between peak movements measured on the "force versus linear displacement" diagram (see Figures 2 and 14). NOTE The above symbols state the direction of the displacement (see 3.3). For example, d_{Mx} corresponding to a maximum displacement parallel to axis O_x.
e	m	Thickness of test sample for verification of low temperature resistance (see 7.2.1).
F	N	Static force applied on the diaphragm, with: F_J : Various operational forces (F_1, F_2, F_3,.etc.), with : $0 \leq F_0 < F_j < F_M$; F_0 : Minimum operational force; F_M :Maximum operational force; ΔF : Difference between peak forces measured on the "force versus linear displacement" diagram (see Figure 14). NOTE The above symbols state the direction of the force (see 3.3). For example, F_{z0} corresponding to the minimum operational force applied on the diaphragm along axis O_z.

to follow

Table 1 *(continued)*

Symbol Abbreviation	Unit	Explanation
f	Hz	Frequency
H	m	Height of the diaphragm (see Figures 5, 6, A.1, A.2, A.3 and A.4), with: H_1 : Maximum overall dimension of the diaphragm in relation to its upper surface (supporting face of the upper bead) when the diaphragm is submitted to a radial displacement. H_2 : Minimum overall dimension of the diaphragm in relation to its upper surface (supporting face of the upper bead) when the diaphragm is submitted to a radial displacement. H_{pj} : Height of the diaphragm for a given internal pressure (see explanation symbol *p*).
h_N	m	Height of levelling of the diaphragm. Distance between the thrust surfaces of the diaphragm beads (see Figures 5, 6, A.1, A.2, A.3 and A.4). This dimension is essential when setting the height of pneumatic springs and shall be specified in the definition documents.
ks	N/m	Stiffness at constant velocity. Stiffness of the diaphragm measured along an axis, at constant velocity. NOTE 1 The above symbol states the direction of the characteristic (see 3.3). For example, ks_y corresponding to constant velocity stiffness measured about axis O_y. NOTE 2 It is permitted to define a flexibility at constant velocity instead of a stiffness at constant velocity, where flexibility is the inverse of stiffness (1/ks).
$k\Theta s$	N·m/rad	Rotational stiffness at constant velocity. Stiffness of the diaphragm measured around an axis, at constant velocity. NOTE 1 The above symbol states the direction of the characteristic (see 3.3). For example, $k\Theta s_z$ corresponding to rotational stiffness at constant velocity measured around axis O_z. NOTE 2 It is permitted to define a rotational flexibility at constant velocity instead of a rotational stiffness at constant velocity, where flexibility is the inverse of stiffness ($1/k\Theta s$).
kdyn	N/m	Stiffness under sinusoidal motion. Stiffness of the diaphragm measured along an axis, under a sinusoidal motion. NOTE 1 The above symbol states the direction of the characteristic (see 3.3). For example, $kdyn_z$ corresponding to stiffness measured about axis O_z under a sinusoidal motion. NOTE 2 It is permitted to define a flexibility under a sinusoidal motion instead of a stiffness under a sinusoidal motion, where flexibility is the inverse of stiffness (1/*kdyn*).

to follow

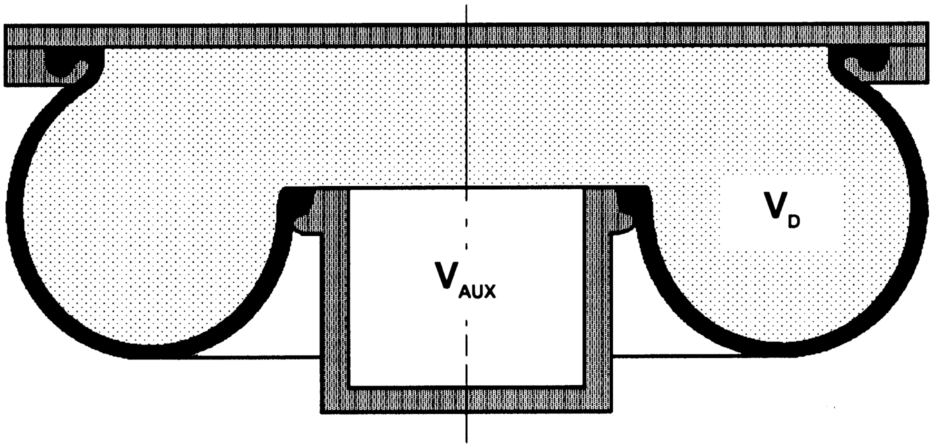
Table 1 *(continued)*

Symbol Abbreviation	Unit	Explanation
$k\Theta dyn$	N·m/rad	Rotational stiffness under sinusoidal motion. Stiffness of the diaphragm measured around an axis, under a sinusoidal motion. NOTE 1 The above symbol states the direction of the characteristic (see 3.3). For example, $k\Theta dyn_z$ corresponding to rotational stiffness measured around axis O_z under a sinusoidal motion. NOTE 2 It is permitted to define a rotational flexibility under a sinusoidal motion instead of a rotational stiffness under a sinusoidal motion, where flexibility is the inverse of stiffness ($1/k\Theta dyn$).
L_B	m	Half of the distance between the bogie pivots of the vehicle to which the diaphragm is fitted.
L_b	m	Distance from the diaphragm centre line to the bogie pivot.
l_0	m	Reference length of test piece for verification of low temperature resistance (see 7.2.1).
M	N·m	Moment applied around an axis of the diaphragm, with: M_J : Various operational moments (M_1, M_2, M_3,.etc.), with : $0 < M_j < M_M$. M_M : Maximum operational moment corresponding to a maximum angular displacement Θ_M. ΔM : Difference between peak moments measured on the "moment versus angular displacement" diagram (see Figure 14). NOTE The above symbols state the axis of rotation (see 3.3). For example, M_{Mz} corresponding to the maximum moment applied around axis O_z.
p	Pa	Diaphragm relative internal pressure (above atmospheric pressure), with: p_j : Various internal pressures (p_1, p_2, etc.) when diaphragm is submitted to an axial static force F_j, with: $0 \leq p_0 < p_j < p_M$. p_0 : Internal pressure when diaphragm is submitted to the minimum axial static force F_0. p_M : Internal pressure when diaphragm is submitted to the maximum axial static force F_M. p_B: Diaphragm bursting pressure. NOTE 1 1 Pa = 1 N/m² ; 1 bar = 100 kPa. NOTE 2 Use of this symbol as a suffix indicates a parameter which varies with internal pressure (which should be defined according to the above definitions).
R_1	m	Maximum overall dimension of the diaphragm in relation to the axis of the fixed section of the diaphragm when radially displaced (see Figure 6).
R_2	m	Minimum overall dimension of the diaphragm in relation to the axis of the fixed section of the diaphragm when radially displaced (see Figure 6).
R_c	m	Radius of the track curve.
r	%	Percentage of retraction of test piece for verification of low temperature resistance (see 6.2.1).

to follow

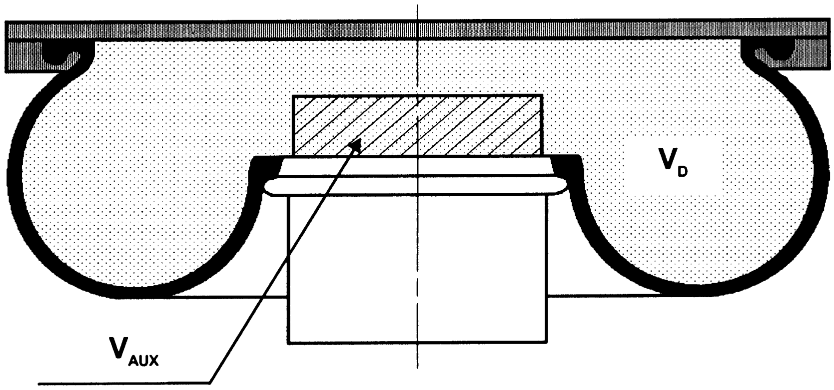
Table 1 *(concluded)*

Symbol Abbreviation	Unit	Explanation
t	s	Time, with: Δt : Period of oscillation ($1/f$).
V_D	m^3	Diaphragm air volume. Volume defined by the shell of the inner carcass surface and the two parallel planes formed by the inner edge of the beads (see Figures 3 and 4).
V_{AUX}	m^3	Auxiliary air volume. Any volume increase or reduction of V_D for testing (see Figures 3 and 4).
V_T	m^3	Total air volume Volume applied for testing, with: $V_T = V_D + V_{AUX}$ (see Figures 3 and 4).
Δm_A	g/m²	Variation in weight by surface unit of test piece for verification of oil and petroleum product resistance (see 6.2.3).
Θ	rad	Angle of displacement in a plane around an axis of the diaphragm, with: Θ_M : Maximum operational angular displacement around a clearly defined axis. $\Delta\Theta$: The difference between peak movements measured on the "moment versus angle of displacement" diagram (see Figures 2 and 14). NOTE 1 The above symbols state the axis of rotation (see 3.3). For example, Θ_{Mz} corresponding to a maximum angular displacement around axis O_z. NOTE 2 It is permissible to use angular units of degrees instead of radians.



$$V_T = V_D + V_{AUX}$$

Figure 3 — Definition of air volumes (example with positive auxiliary air volume)



$$V_T = V_D - V_{AUX}$$

Figure 4 — Definition of air volumes (example with negative auxiliary air volume)

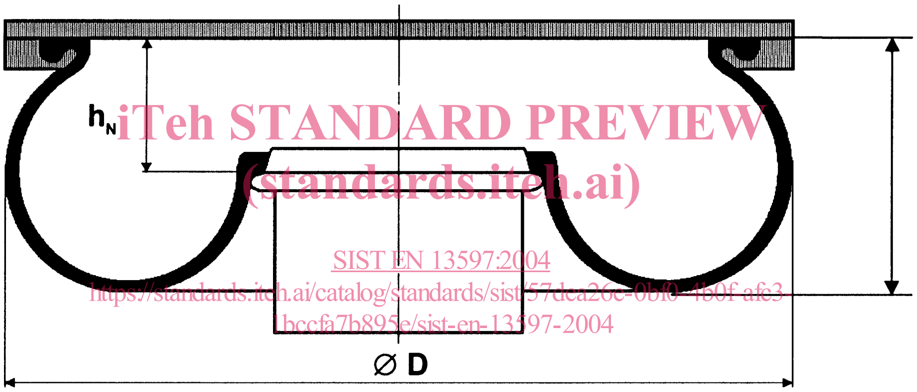
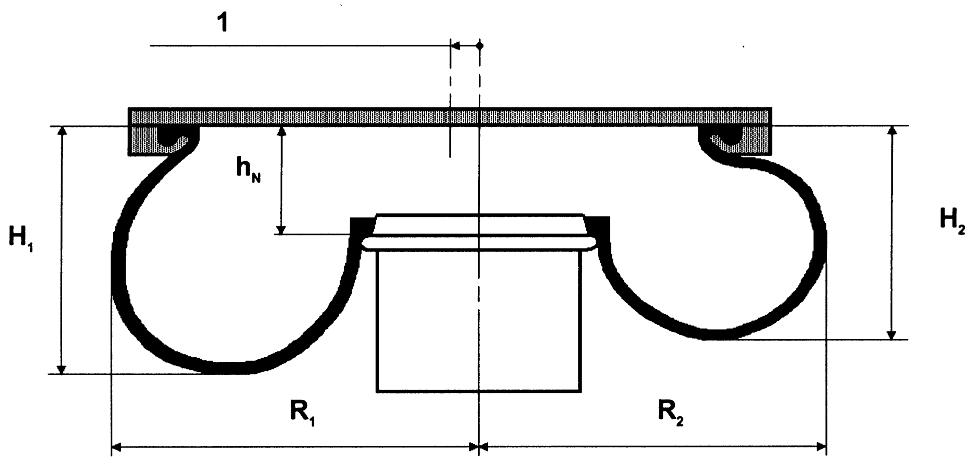


Figure 5 — Main dimensions when diaphragm is in a centred position



Key

1 Setting over

Figure 6 — Main dimensions when diaphragm is radially displaced