



ATEX

Guidance to Engineers on ATEX Components and Machinery Elements.



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ENVIRONMENTAL TECHNOLOGY

Guidance to Engineers on ATEX components and Machinery Elements.

1. Introduction. This document has been produced to provide the necessary explanation of the recent clarification issued by the Health and Safety executive (see paragraph 2) with regard to Mechanical seals and the ATEX 94/9/EC regulations. The major Pump and Seal companies of Europe have collectively agreed to the clarification document and its contents. AESSEAL plc has therefore amended its processes in line with the Industry standard approach. A series of Documents will appear in this text from third party sources as well as AESSEAL plc.

2. The British Pump Manufacturers Association (BPMA) Guidance.

Under the auspices of the BPMA, UK pump and seal companies were represented at a meeting in Frankfurt on December 2004. The other bodies present included the UK HSE(Health and Safety executive), European pump association, European Pump and seal manufacturers. Their latest communication on the matter is included below:-

**ATEX (EXPLOSIVE ATMOSPHERES)
94/9/EC**

At the ATEX Standing Committee meeting in July 2004, no conclusion was reached regarding the Mechanical Seal issue and it was proposed that industry experts from the UK, France, Germany and Denmark should meet to formulate a clarification sheet that could be used by industry.

The BPMA Technical Director and Technical staff from Flowserve, John Crane and AESSEAL attended this meeting which resulted in a compromise and an appropriate clarification note was developed and duly circulated within the EUROPEAN Commission EU Atex Standing Commission. It as now been confirmed that industry can work to the clarification sheet .The BPMA again would like to take this opportunity to thank those members involved in achieving this result.

BPMA members who wish to receive a copy of the clarification sheet should contact S Schofield at the BPMA.

3. The HSE Guidance.

The Text below was created and agreed during the December 2004 Frankfurt meeting and a subsequent submission to the ATEX standing Committee by the UK HSE. It is available for viewing on the European Commission website europa.eu.int.

When a Mechanical Seal¹ is a Machinery Element and when an ATEX-Component

DEFINITION:

A mechanical seal is a device which prevents leakage of fluids along rotating shafts. Primary seal function is at right angles to the axis of rotation between one stationary ring and one rotating ring.

MACHINERY ELEMENT:

These are parts of machinery not defined within 94/9/EC.

Most mechanical seals are machinery elements. Typically these seals are:

- Catalogue mechanical seals and their parts, selected by the equipment manufacturer alone or with assistance from the mechanical seal manufacturer.
- mechanical seals stocked by the equipment manufacturer or end user for general applications
- mechanical seals used for applications where the service conditions are not closely specified
- non cartridge-seals and parts
- standard cartridge-seals.

Mechanical seals will also be machinery elements if a risk assessment by the mechanical seal or equipment manufacturer shows that the seal is not expected to be an ignition source even in the event of fault conditions.

ATEX COMPONENT:

The following definition is taken from the European Commission ATEX Guideline (Second edition):

The two defining elements for components are that they,

- ***are essential to the safe functioning of equipment and protective systems with respect to explosion protection (otherwise they would not need to be subject to the directive);***
- ***with no autonomous function (see 3.8) (otherwise they would have to be regarded either as equipment, protective system or as device according to Article 1.2).***

Engineered mechanical seals maybe classified and sold as ATEX components. Typical examples are:

¹ This clarification-sheet does not consider mechanical seal control systems

- Mechanical seals for specific applications where close co-operation between mechanical seal manufacturer and equipment manufacturer is required and will often result in a specifically designed mechanical seal.
- Mechanical seals for some category 1 equipment

In this case the mechanical seal manufacturer shall supply sufficient information about the performance of the seal so that the equipment manufacturer does not need to repeat unnecessary efforts such as tests or calculations concerning the mechanical seal in order to ensure that the equipment complies with ATEX requirements. The equipment manufacturer shall supply sufficient information about the intended application and equipment.

RESPONSIBILITIES:

A) Mechanical seal manufacturer:

Case 1: Mechanical Seals supplied as Machinery Element

It is normal practice that the manufacturer of mechanical seals supplied as Machinery Element provides complete documentation for safe use of his product i.e.: instruction manual for incorporation into equipment, which shall include safety aspects and limits of operation.

Case 2: Mechanical Seals supplied as ATEX Components

Mechanical seals shall comply with article 8.3 of 94/9/EC Atex Directive.

An ATEX component mechanical seal shall be supplied at least with the following information:

- all information/documentation given for case 1
- results of relevant calculations and/or tests that have been carried out
- a temperature rating as far as possible
- an indication of the category
- a list of ATEX essential safety requirements that the mechanical seal complies with
- what fault conditions have been considered for category 1 or 2 mechanical seal
- a close specification for intended use, for example gas group
- a certificate of conformity
- marking for components in accordance with the latest ATEX Guidelines

B) Equipment Manufacturer:

In all cases the equipment manufacturer is responsible for the entire package within his scope of supply and therefore it will be required to comply with article 8.1 of 94/9/EC ATEX Directive.

4. European Contacts responsible for ATEX implementation.

The following details are contacts published in edition 1 (May 2000) of the ATEX guidelines, they may be useful in obtaining translations of the above Clarification of Mechanical seals document.

Germany – H. Mattes Bundesministerium fur arbeit und sozialordnung – 49 228 5272955 – ha.mattes@bma.bund.de

Spain – J J Portero Sanchez – Ministerio de Ciencia y tecnologia – 34 91 3494063 – joseportero@myct.es

France – R Estival – Secretariat d’etat a l’industrie – 33 1 43195142
Robert.estival@industrie.gouv.fr

Italy – E Federici – Ministero dell’industria – 39 06 47887951
celeste@minindustria.it

Netherlands – R Ferns – Ministerie van sociale Zaken en werkgelegenhedn- 31 70 3335507 - rferns@minszw.nl

E V Lopes – direccao de servucos de energia electrica – 351 1 7922700 – energia@mail.telepac.pt

Sweden – B andersson – National Electric Safety Board – 46 55015510 – bertil.andersson@elsak.se

Denmark – A Mortensen Arbejdstilsynet Risksecretariat – 45 46 350236 – amo@arbejdstilsynet.dk

Finland – T Koivumaki – Ministry of trade and industry – 358 9 1603722 – tapani.koivumaki@ktm.vn.fi

5. AESSEAL plc ATEX guidance.

The text below is included to acquaint the reader with the general requirements of the ATEX directive.

What is ATEX?

The ATEX Directive (94/9/EC) is one in a series of measures introduced under article 100a of the Treaty of Rome. Its aim is to provide a level playing field with regards the safety standards and the supply of equipment for use in potentially explosive atmospheres. In essence, it is in 2 parts

94/9/EC	-	Equipment Directive	} With regards explosive atmospheres
1999/92/EC	-	Worker directive	

What does ATEX stand for?

ATEX is derived from the French **AT**mospheres **Exp**losives (no explanation necessary).

What does it Cover?

The directive extends the previous limitations on electrical equipment intended for use in flammable atmospheres to now include mechanical devices which are to be used in a potentially explosive atmosphere. It should

be noted that the directive is effectively a commercial harmonisation, which also consolidates the safety regulations throughout the European Union.

What is an Explosive atmosphere?

An explosive or flammable atmosphere is one where a flammable substance either in the form of a gas mist or dust, when placed in a 'mixture' with air under atmospheric conditions will rapidly combust, following ignition, until all the product is burned.

What do they mean by atmospheric Conditions?

There are no real guidelines for atmospheric conditions given. However, it is widely accepted that this is taken as:

Temperature - -20°C to 40°C
Pressure - 0.8 to 1.01 Bara

Is every piece of Equipment covered?

Most equipment is covered. However, Medical equipment, personal equipment, domestic gas appliances and equipment for the manufacturer's own use are not required to comply.

When is the directive due to come into force?

The time scale for the Equipment part of the directive is 1 July 2003. All new goods supplied after this date must comply with the requirements of the directive. Failure to do so could result in a three-month imprisonment and/or a £5000 fine.

These are covered by UK law under statutory instruments SI 1996/192 & SI 2001/3776.

The worker directive, which is concerned with the working conditions in potentially explosive environments, comes into effect in 2006.

How does this affect UK companies?

As part of their worker directive, companies must provide suitable zone classification to their manufacturing facilities. In addition to this, as of 1 July 2003, they must only specify new equipment suitable for operating in those designated zones and purchase such equipment accordingly.

Is there any flexibility in this?

No

The HSE has given UK companies until 2006 to classify older areas of plant. However, any new areas currently being installed or scheduled for installation must adhere to the directive deadline of July 1st 2003.

What are the zones?

Whilst the directive does not implicitly state the methodology for zoning it does use the flammable area zone and sub-category classification system. This is as follows:

Zone	Conditions
0	Effectively a continuously explosive atmosphere >1000hrs/year
1	Explosive atmosphere present some of the time > 10hrs/yr <1000hrs/year
2	Explosive atmosphere may be present, but very rarely (e.g. fault conditions) <10hrs/yr

Table 1- Flammable Zones

The above zones can be sub-categorised further into the following groups and categories. With the exception of items with an intended use underground in Mines.

Group	Category	Typical Location	Correspond to	Exposure
I	M1	Mines (underground)	N/A	N/A
I	M2	Mines (underground)	N/A	N/A
II	1	Other	Zone 0	>1000hrs/year
II	2	Other	Zone 1	10-1000hrs/yr
II	3	Other	Zone 2	<10hrs/yr

Table 2 – Group Sub-categorisation (DTI Classification)

Effectively, with the exception of mines, the most stringent application area is that of zone 0 where stringent anti-explosion measures are usually in operation.

What about the Fluids?

Fluids for use in explosive atmospheres can be categorised depending upon their flammability, the categories applicable being dependent upon their operating conditions and the effects on the fluid should there be a release.

Fluid Category	Description
A	Flammable liquid that on release can vaporise rapidly and substantially
B	Flammable liquid not in Category A which can be released above its boiling point
C	Flammable liquid that can be released above its flash point as either a spray or mist.
G(i)	Typical Methane rich natural gas
G(ii)	Refinery Hydrogen

Table 3 Fluid Categories (Institute of Petroleum)

What are the Temperature Classes?

Gases and fluids are given a class depending upon the temperature at which it will auto-ignite. See the table below.

Temperature Class	Maximum Surface temperature(°C)
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Table 4 – Temperature Class

It should also be noted that for the sake of testing the fluids the maximum ambient temperature is assumed to be 40°C as per IEC 60079-0.

What about the threat from Sparks?

To reduce the risk of sparking the use of light metals is not advised. Below are the limits as set out by EN 13463 as % by mass of the overall seal.

Equipment Group	Category	Aluminium, Magnesium, Titanium & Zirconium	Magnesium, Titanium & Zirconium
I	M1 & M2	15% Max	7.5% Max
II	Category 1	10% Max	7.5% Max
II	Category 2	<7.5% Magnesium only	-
II	Category 3	No requirement	No requirement

Where the risk assessment shows no risk of incendive friction (sparking) then the above does not apply.

Table 6 – Light metals

What about Electro-static sparks?

Again, as with light metals, the amount of plastic used on equipment in explosive areas is severely limited. Irrespective of the quantity, it is inadvisable to clean any plastic in these areas with dry cloths. The act of rubbing the plastic is similar to that of rubbing a balloon, whereby a static charge is induced into the material. This could then lead to a spark being generated should another body come close to it. Wet damp cloths are much better.

What do the markings mean?

All equipment suitable for ATEX compliance has the requirement for marking. This is also true of mechanical seals and systems.



- Ex - The symbol indicates equipment/component suitable for use in potentially explosive atmospheres.
- II - Indicates the equipment Group.
- 2 - Indicates the equipment/component Category.
- GD - Indicates the type of explosive atmosphere.
G = gas, vapour or mist.
D= Dust.
- c - Method of safety used (c = construction).
- T* - Temperature Classification (T1 –T6).

In addition to the above, components will also have markings (where possible) for the:

- Name and address of manufacturer (Name and Postcode).
- Series or type and the serial number (already done).
- Year of construction.
- Restricted or safety related conditions of use.

The logo for AESSEAL, featuring the word 'AESSEAL' in a stylized, bold font. The 'A' and 'E' are in a light blue color, while the 'S' and 'E' are in a light red color. A registered trademark symbol (®) is located to the right of the 'L'.

6. Machinery Elements and their implementation.

The following text is included in all AESSEAL cartridge machinery Elements sold within the European Union.

It can be used by Customers to assist them in their statutory responsibilities with respect to ATEX and DSEAR regulations.

Further assistance can be obtained by contacting the AESSEAL Technical Department.

Data for Wet Contact Machinery Element Mechanical Seals

The following addendum refers to the application, installation, operation and maintenance of wet contact AESSEAL mechanical seal Machinery ELEMENTS as defined in the ATEX clarification document accepted by European Commission February 2005. The definition of a Mechanical Seal and Machinery Element is :-

“DEFINITION:

A mechanical seal is a device which prevents leakage of fluids along rotating shafts. Primary seal function is at right angles to the axis of rotation between one stationary ring and one rotating ring.

MACHINERY ELEMENT:

These are parts of machinery not defined within 94/9/EC.

Most mechanical seals are machinery elements. Typically these seals are:

-Catalogue mechanical seals and their parts, selected by the equipment manufacturer alone or with assistance from the mechanical seal manufacturer.

-mechanical seals stocked by the equipment manufacturer or end user for general applications

-mechanical seals used for applications where the service conditions are not closely specified

-non cartridge-seals and parts

-standard cartridge-seals.

-Mechanical seals will also be machinery elements if a risk assessment by the mechanical seal or equipment manufacturer shows that the seal is not expected to be an ignition source even in the event of fault conditions. “

General

It is essential that the mechanical seal is always used within its operating limits. The material combinations of the seal faces as well as the physical and thermal properties of the quench and barrier fluids may greatly affect the heat generation of the mechanical seal. For problem free operation it is essential to choose the correct type of seal for a particular application. More information on seal selection is available through our network of sales engineers or from our website at www.aesseal.com.

Lubrication of Seal Faces

Wet contact mechanical seals are designed to operate with a thin layer of lubricating fluid between the sealing faces. It is essential that this lubricating layer is maintained at all times. The seal MUST not be allowed to operate under dry running conditions. Operation under dry running conditions will cause the seal face temperatures to increase and may provide a potential ignition source in a potentially explosive atmosphere. In order to ensure that dry running cannot occur requires that the pumped medium and, where a barrier system is fitted, the barrier fluid are monitored to determine that product and barrier fluid are always present during operation of the equipment. It is also essential to ensure that where the equipment is fitted with seal flush or other cooling arrangements that temperatures and flow rates are to specification.

Leakage

All mechanical seals leak to some extent, under normal conditions this leakage is negligible. Leakage from the mechanical seal should be monitored on a regular basis since an increase in the amount of leakage is an indication of a malfunction.

To assist the OEM and End User of AESSEAL plc Mechanical Seal Elements the table below shows the anticipated SEAL FACE temperature rise for correctly functioning seals at differing Size, Speed and Pressure Differential.

Aqueous environment Balanced Single Seal (Table 2) For oil environments multiply figures below x1.5.

Size mm	speed rpm	ΔT @ 5 BARG	ΔT @ 10 BARG	ΔT @ 15 BARG	ΔT @ 20 BARG
25	1500	11	14	16	19
25	3000	13	19	24	29
50	1500	13	18	23	27
50	3000	18	27	38	47
75	1500	15	21	28	35
75	3000	21	35	48	61
100	1500	18	27	37	45
100	3000	27	45	65	83

The temperatures above are empirically derived from type testing undertaken by AESSEALplc. They represent the following:-

- 1) The Surface temperature adjacent to the mechanical seal faces.
- 2) On a single seal this represent the atmospheric side of seal faces subjected to PRODUCT Pressure and temperature.
- 3) On a Double seal this represent the atmospheric side of seal faces subjected to Barrier Pressure and Barrier equilibrium temperature.

It should be noted that the effect of the clarification document is that AESSEAL plc will supply Mechanical Seal Elements which are unmarked and uncertified with respect to ATEX to Customers using the seals in hazardous environments.

The following addendum refers to the application, installation, operation and maintenance of Dry contact AESSEAL mechanical seal Machinery ELEMENTS as defined in the Atex clarification document accepted by European Commission February 2005. The definition of a Mechanical Seal and Machinery Element is :-

“DEFINITION:

A mechanical seal is a device which prevents leakage of fluids along rotating shafts. Primary seal function is at right angles to the axis of rotation between one stationary ring and one rotating ring.

MACHINERY ELEMENT:

These are parts of machinery not defined within 94/9/EC.

Most mechanical seals are machinery elements. Typically these seals are:

-Catalogue mechanical seals and their parts, selected by the equipment manufacturer alone or with assistance from the mechanical seal manufacturer.

-mechanical seals stocked by the equipment manufacturer or end user for general applications

-mechanical seals used for applications where the service conditions are not closely specified

-non cartridge-seals and parts

-standard cartridge-seals.

-Mechanical seals will also be machinery elements if a risk assessment by the mechanical seal or equipment manufacturer shows that the seal is not expected to be an ignition source even in the event of fault conditions. “

General

It is essential that the mechanical seal is always used within its operating limits. The material combinations of the seal faces as well as the physical and thermal properties of the quench and barrier fluids may greatly affect the heat generation of the mechanical seal. For problem free operation it is essential to choose the correct type of seal for a particular application. More information on seal selection is available through our network of sales engineers or from our website at www.aesseal.com.

Seal Faces

DRY contact mechanical seals are designed to operate without lubricating fluid between the sealing faces. The definition of Dry Running within the scope of this document is a NITROGEN atmosphere with less than 5 % humidity. The anticipated seal face temperature rise for variable velocity and pressure are shown in the attached table1. It should be noted that DRY Running Hard face pairs should not take place and a sacrificial Soft face is always required.

Leakage

All mechanical seals leak to some extent, under normal conditions this leakage is negligible. Leakage from the mechanical seal should be monitored on a regular basis since an increase in the amount of leakage is an indication of a malfunction.

To assist the OEM and End User of AESSEAL plc Mechanical Seal Elements the table below shows the anticipated SEAL FACE temperature rise for correctly functioning DRY Running seals at differing Size, Speed and Pressure Differential.

Nitrogen environment Balanced Single Seal with C/TC or C/SIC Face combination(Table 1).

Size mm	speed rpm	Δ T @ 1 BARG	Δ T @ 2.5 BARG	Δ T @ 5 BARG	Δ T @ 10 BARG
25	200	10	19	34	59
25	300	13	27	47	80
50	250	19	40	70	112
50	400	28	59	98	138
75	500	47	93	135	148
75	600	54	105	142	154
100	300	39	80	123	147
100	450	54	105	142	154

The Maximum PV(DRY) = 24 BarM/S.

The temperatures above are empirically derived from type testing undertaken by AESSEALplc. They represent the following:-

- 4) The Surface temperature adjacent to the mechanical seal faces.
- 5) On a single seal this represent the atmospheric side of seal faces subjected to PRODUCT Pressure and temperature.
- 6) On a Double seal this represent the atmospheric side of seal faces subjected to Barrier Pressure and Barrier equilibrium temperature.

It should be noted that the effect of the clarification document is that AESSEAL plc will supply Mechanical Seal Elements