Annex C
(informative)

Examples of ignition hazard assessment

C.1 General remarks

The following examples (see also Table C.1) are not definitive. Alternative measures can normally be applied. The most important ignition sources of non-electrical equipment are electrostatic discharges, hot surfaces and mechanical sparks. Real equipment may have different and/or further ignition sources.

It is expressly pointed out that an ignition hazard assessment is always dependent on the individual design and the specific intended use of a product. Therefore, the following ignition hazard assessment examples are neither complete nor directly applicable to real products without detailed analysis.

Table C.1 – List of examples

Clause	Example	Table
C.2	Common cases demonstrating the use of the scheme – Electrostatic discharge Common cases demonstrating the use of the scheme – Hot surfaces Common cases demonstrating the use of the scheme – Mechanical spark	C.2 C.3 C.4
C.3	Ignition hazard assessment report for a pump	C.5
C.4	Ignition hazard assessment report for an agitator	C.6

C.2 Examples for common cases demonstrating the use of the scheme

The examples in Table C.2, Table C.3 and Table C.4 show a few common cases for typical parts of non-electrical equipment to explain the use of the reporting scheme described in Annex B. The examples should be read row by row and stand alone.

A resulting EPL cannot be indicated in this case.

The examples alert to typical potential ignition hazards and their assessment. Specific importance is attached to measures applied to prevent the ignition source becoming effective. For purpose of evidence, the identification and specification of the parts causing ignition hazards and the description of the measures applied form part of the essential technical documentation.

Table C.2 – Common cases demonstrating the use of the scheme – Electrostatic discharge *(1 of 2)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description / basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	Basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
1	electrostatic discharge	parts of non metallic material with an undefined surface resistance		X			assessment is provided for by a (harmonised) standard; highly efficient charge generating mechanisms is excluded	limiting the surface resistance so it does not exceed 10^9 Ω; verification of the surface resistance of the individual materials used	7.4.2; 7.4.3; 6.7.5 a)	– specifications of the material (7.4.2; 7.4.3); – parts list, pos: … – test report according to 8.4.8				X	G a D a	
2	electrostatic discharge	parts of non metallic material with an undefined surface resistance		X			no charging during normal operation; material is an outer part of the casing; charging could be done by a person (operator)	largest area less than 2 500 mm^2	7.4.2; 7.4.3; 6.7.5 a)	– specifications of the material (7.4.2; 7.4.3); – parts list, pos: … – drawing no: …				X	G a D a	IIB
3	electrostatic discharge	examples of processes where charging can give rise to significant amount of electrostatic charging: Filling and draining of vessels, transfer of liquid, agitation	X				acknowledged rule of technology	limitation of the intended use: Only liquids with a high conductivity (> 1 000 pS/m) can be used	IEC TS 60079-32-1	– specific Conditions of Use (X) – specification of the liquid in the instructions, chapter …, Clause …				X	G a D a	yes[a]

Table C.2 *(2 of 2)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description / basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	Basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
4	electrostatic discharge	circumferential speed of a belt drive	X				acknowledged rule of technology	conductivity criteria and conditions of use for belts: limitation of the maximum speed because of the type of construction of the drive, e.g. exclusion of frequency converters to avoid overspeed	IEC TS 60079-32-1	– instructions, chapter …, clause …			X		G b D b	IIB
Resulting EPL including all existing ignition hazards:															b	b

[a] Limitation of the intended use required.

[b] A resulting EPL cannot be indicated in this case.

Table C.3 – Common cases demonstrating the use of the scheme – Hot surface *(1 of 2)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
1	hot surface	hot surface of a frictional wheel drive	X				drive has critical heating during normal operation	The maximum surface temperature under the most adverse conditions. A temperature monitoring and limiting system (ignition prevention type 1; type of protection "b1") is mounted. Limiting temperature is 120 °C.	ISO 80079-37 "b"	– test report no. .... about the thermal type test – attestation of conformity and instructions of the monitoring system (purchased from an external supplier)		X			Gc Dc	T4
2	hot surface	hot surface of a ball bearing		X			bearing has negligible heating during normal operation	The bearing is calculated according to ISO 281 for a specified lifetime. A malfunction is generally agreed as a rare incident under these conditions. The maximum surface temperature is determined under the most adverse conditions (110 °C)	ISO 80079-37 "c"	– test report no. ... about the thermal type test			X		Gb Db	T4

Table C.3 *(2 of 2)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
3	hot surface	heating of a viscosity meter (stirrer system)				X	mechanical input energy can cause heating The maximum surface temperature under the most adverse conditions. Maximum temperature rising ΔT 3 K		8.2	– test report no. … about the thermal type test				X	Ga Da	T6
Resulting EPL including all existing ignition hazards:															[b]	[b]

[a] The conformity assessment procedure for a monitoring system according to control of ignition source "b" is variable and depends on the EPL

[b] A resulting EPL cannot be indicated in this case.

Table C.4 – Common cases demonstrating the use of the scheme – Mechanical spark *(1 of 2)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
1	mechanical spark	breakdown of the bearing of an EPL Gb equipment (gear) could cause grinding of a stirrer in a vessel (zone 0); the distance between the stirrer and the vessel may be unacceptably reduced			X		A breakdown of the bearing needs to be considered as a rare malfunction (for EPL Ga equipment), because this is not considered in EPL Gb equipment. Therefore, mechanical grinding cannot be excluded inside the vessel.	The shaft feed through is designed with an additional emergency bearing to avoid contact between stirrer and vessel (sleeve bearing in EPL 2 part; EPL of the gear remains unchanged) In addition the failure of the bearing will be controlled by a temperature monitoring and limiting system (ignition prevention type "b1"). Limiting temperature < 155 °C.	Clause 5, ISO 80079-37:—, 6.1 and 8.1	– test report no. … about the thermal type test – Instructions of the monitoring system (purchased from an external supplier)				X	Ga Da	T3
2	mechanical spark	mechanical generated sparks due to a grinding fan		X			mechanical grinding cannot be excluded. Assessment is provided by a (harmonised European) standard.	The minimum clearance between rotating elements and the casing is defined.	EN 14986: 2005, 4.15	– constructional measures design according to drawing no. …			X		Gb Db	

Table C.4 *(2 of 2)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
3	mechanical spark	mechanical generated sparks due to a grinding roots pump rotor at dry run conditions			X		mechanical grinding of a the rotor and particulate material	A shock pressure resistant casing and mounting of an autonomous protective system (flame arresters to avoid flame transmission into the inlet and outlet)	ISO 16852	– test report no. ... about the thermal type test – Attestation of conformity and instructions of the autonomous protective system (purchased from an external supplier) and test report of flame transmission test of combination of pump and flame arrester				X	Ga Da	
4																
Resulting EPL including all existing ignition hazards:															[a]	[a]

[a] A resulting EPL cannot be indicated in this case.

C.3 Example of an ignition hazard assessment for a pump

Table C.5 gives an (incomplete) example of how a manufacturer could record the ignition hazard assessment for a pump. This example is not definitive and alternative measures could be applied. The EPL of the pump is the outcome at the end of the assessment table. It is assumed that the pump is located in zone 1 and is intended to pump flammable liquid from a storage tank to a reactor.

Aspects of normal operation (EPL Gc) are heating during continuous operation with maximum load at the highest ambient temperature. The fluid pressure at the inlet and the outlet should be considered as well as corrosion and the temperature of the fluid conveyed. If the maximum surface temperature depends not on the pump itself, but mainly on the heated fluid conveyed, the temperature class cannot be determined by the manufacturer. It shall be determined by the user in accordance to the information provided by the manufacturer in the instructions (see Clause 10).

In the event of expected disturbances or equipment malfunctions which normally have to be taken into account (EPL Gb) attention should be paid to: continues operation at maximum pressure with low feed rate, failure of parts and components because of the operating conditions and the dimensioning, suction of contaminants, loosening of mechanical fasteners or stress because of impacts or friction.

Rare malfunctions (EPL Ga; not dealt with in Table C.5) may be the operation with closed pressure line (closed outlet), the failure of an ignition control device or a newly-created ignition hazard in consequence of any combination of two expected malfunctions.

Table C.5 – Ignition hazard assessment report for a pump *(1 of 3)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	A	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description / basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
1	hot surface	losses dissipate into heat	X				The pump has a maximum temperature during normal operation	The maximum surface temperature is determined under the most adverse conditions (ΔT 45 K). A bypass (overflow) is installed to insure the minimum flow rate. The minimum residual volume of the storage tank is specified	8.2	– test report no. ... about the thermal type test			X		Gb	T4
2	hot surface	dissipation of mechanical energy into heat		X			external valve closed upstream	The maximum surface temperature is determined under the most adverse conditions. A temperature monitoring and limiting system (IPL 1; type of protection "b1") is mounted. Limiting temperature is 100 °C.	8.2 and ISO 80079-37 "b"	– test report no. ... about the thermal type test – Attestation of conformity) and instructions of the monitoring system (purchased from an external supplier) for the use in explosive atmosphere and the use as a monitoring device for control of ignition source "b" (ignition prevention type b1)			X		Gb	$T4_a$

Table C.5 *(2 of 3)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	A	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description / basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
3	hot surface	friction of the clutch plate		X			The clutch starts to slip and generates heat.	The maximum surface temperature (ΔT 30K) is determined under the most adverse conditions. The coupling time and max. torque is specified. The overload is limited and switched off before reaching the temperature class limit.	ISO 80079-37 "c"	– test report no. … about the thermal type test			X		Gb	T5
4	electrical equipment	electric motor inside the assembly		X			Electrical equipment is a possible ignition source.	Only electrical equipment with certification of conformity is used.	IEC 60079 series	– Certificate and instructions			X		Gb	IIB T3 Gb
5	mechanical spark	a grinding rotor at dry run conditions		X			Mechanical grinding of the rotor cannot be excluded. A breakdown of a bearing shall be considered.	The bearing is calculated according to ISO 281 for a specified lifetime. A malfunction is generally agreed as a rare incident under these conditions.	Clause 5 and ISO 80079-37 "c"	– description and calculation no. …, drawing no. … about the design			X		Gb	

Table C.5 *(3 of 3)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	A	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description / basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
6	electrostatic discharge	transfer of non-conductive liquid causes electrostatic charge	X				The conductivity of the liquid is not defined	limitation of the intended use: Only liquids with a high conductivity (> 1000 pS/m) can be used. Only a conductive liquid is foreseen. Ethanol is a conductive liquid. Proper earthing of the equipment is required.	IEC TS 60079-32-1	– instructions chapter …, clause …: WARNING in the instruction: pump operation involves the risk of producing an electrostatic charge in flowing liquids. The user should take measures according to IEC TS 60079-32-1				X	Ga	
7	…	further ignition sources					…									
Resulting EPL including all existing ignition hazards:															Gb	T3

[a] Limitation of the intended use required.

C.4 Example of an ignition hazard assessment for an agitator

Table C.6 gives an (incomplete) example of how a manufacturer could record the ignition hazard assessment for an agitator which is assumed to be inside of EPL Ga and outside of EPL Gb. This example is only for the EPL Ga part of the agitator. It is not definitive and alternative measures could be applied.

Potential ignition hazards by hot surfaces, mechanical sparks and electrostatic charging, e.g. in the stirrer vessel, are assessed by the manufacturer. Mechanical sparks can be generated by grinding contacts of stirrer elements with the vessel wall or by foreign solid particles between stirrer elements and the vessel wall. Other possibilities for grinding contact are vibrations of the stirrer shaft because of critical revolution speed, external oscillation or in consequence of a bearing failure.

The agitator is designed and manufactured so that it fulfils its safe function within the limits of the operating conditions stipulated by the manufacturer. If a stirrer is e.g. combined with a movable vessel it cannot be expected that the mould alignment is satisfactory only by use of the instructions. The safe centring between the moving parts is considered ensured by the conceptual design. This could be achieved by a mechanical clamping unit and a safety circuit. Stirrer designs should not support misuse. Stirrers are designed to be not mountable on vessels where it is not intended (e.g. on Intermediate Bulk Containers – IBCs).

EPL Gc equipment does not create effective ignition sources during normal operation. An example is the charging due to agitation of chargeable suspensions and fluids. This ignition hazard cannot be avoided by the equipment design only. In such case the explosive atmosphere should be avoided which is a restriction of the intended use. The choice of materials, an adequate dimensioning and minimum distances between moving parts and fixed parts are also meant to avoid mechanical sparks and hot surfaces.

To meet the requirements of EPL Gb apparatus expected malfunctions, e.g. defect of a fluid lubricated slide ring seal because of the absence of lubrication, are avoided. A monitoring of the fluid level including an actuation switch-off is regarded as adequate. Further examples for expected malfunctions are mechanical wear, exceeded service life of the lubrication or corrosion.

For EPL Ga equipment rare malfunctions as well as ignition hazards as consequence of two expected malfunctions are considered. As example, the failure of a rolling contact bearing of the shaft guiding is mentioned here. The bearings are used in zone 1 and can be assessed to meet EPL Gb requirements, but in case of a bearing failure it may create an ignition hazard in Zone 0. Appropriate action would be for example, a continuous monitoring device for the bearing including an actuator switch-off. Other examples are insufficient stability, impermissible operation at the critical rotary frequency, losing of parts, failures of safety devices or the intrusion of explosive mixtures into not adequate protected parts of the equipment because of defective sealing elements, e.g. gaskets or rotating mechanical seals.

For EPL Ga equipment, combinations of two rare malfunctions or a rare malfunction in combination with an expected malfunction can be disregarded. In these cases an ignition hazard is regarded as sufficiently improbable. Examples are on the one hand the grinding between shaft and vessel even though an adequate strength is chosen for the parts that exert influence on the move of the shaft or, on the other hand, the operation at the critical rotary frequency even though this speed shall not be possible because of the agitator's design.

Table C.6 – Ignition hazard assessment report for an agitator *(1 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
1	electro-static discharge	isolated electrical conductive parts	X				isolated conductive parts creates a capacitor, which e.g. can be charged by electrostatic induction to a hazardous static	equipotential bonding between the parts, earthing of the housing, information for installation	6.7.2	– specification of the material (7.3.2) – parts list, pos: … (or drawing no: …)				X	Ga	
2	electro-static discharge	isolating parts e.g. of non metallic material		X			no charging during normal operation; material is an outer part of the casing; charging could be done by a person (operation)	surface resistance < 1 GΩ at 50 % relative humidity	6.7.5 a), 8.4.8	– specification of the material (6.7, 7.4.2, 7.4.3) – parts list, pos: … – drawing no: …				X	Ga	
3	electro-static discharge	isolating parts e.g. of non metallic material		X			no charging during normal operation; materials is an outer part of the casing; charging could be done by a person (operator)	surface resistance < 1 GΩ at 50 % relative humidity or area < 2 500 mm^2	6.7.5 and Table 8	– specification of the material (6.7, 7.4.2, 7.4.3) – parts list, pos: … – drawing no: …				X	Ga	IIB

Table C.6 *(2 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
4	electro-static discharge	electrostatic charging of the liquid during agitation	X				use of chargeable liquids tends to static under normal operation	limitation of the intended use: only liquids with a high conductivity (> 1 000 pS/m) can be used (alternative inertisation is required)	IEC TS 60079-32-1	– Specific Conditions of Use – alert in the instructions, chapter …, Clause …				X	Ga	yes[a]
5	hot surface	grinding of the shaft in range of the casing				X	design according to the state of the art, safety factor > 3 for all parts effective the deflection	no additional measures required	ISO 800 79-37 "c"	– constructional measures, design according to drawing no. …				X	Ga	

Table C.6 *(3 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
6	hot surface	breakdown of the bearing with influence to zone 0; (the bearing is located in zone 1 near the separating plate of the vessel)			X		A breakdown of the bearing shall be considered as a rare malfunction (for EPL Ga equipment)	The malfunction of the bearing will be detected by a thermal sensor. Maximum temperature < 150 °C (Type of Protection "b")	Clause 5, ISO 80079-37 "c" and "b"	– test report no... about the thermal type test – certificate and instructions of the monitoring system (purchased from an external supplier)) for the use in explosive atmosphere and the use as a monitoring device for control of ignition source "b" (ignition prevention type b1)				X	Ga	T3

Table C.6 *(4 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
7	hot surface	breakdown of the bearing of an EPL Gb or Db equipment (gear) with influence to zone 0; (the bearing is located in zone 1 near the separating plate of the vessel)			X		frictional losses could heat up the separating plate	The failure of the bearing will be detected by a thermal sensor. Maximum temperature < 155 °C (ignition prevention type "b1")	Clause 5, ISO 800 79-37 "c" and "b"	– test report no… about the thermal type test – certificate and instructions of the monitoring system (purchased from an external supplier)) for the use in explosive atmosphere and the use as a monitoring device for control of ignition source "b" (ignition prevention type b1)				X	Ga	T3

Table C.6 *(5 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
8	hot surface	frictional heat at the wiper; relative motion of the rotating mechanical seal		X			heating < 80 % of the temperature class T4 during normal operation	The maximum surface temperature is determined under the most adverse conditions. Alternatively a temperature monitoring and limiting system (type of protection "b1") can be mounted. Limiting maximum temperature is 100 °C	Clause 5, ISO 800 79-37"b"	– test report no. … about the thermal type test – certificate and instructions of the monitoring system (purchased from an external supplier)) for the use in explosive atmosphere and the use as a monitoring device for control of ignition source "b" (ignition prevention type b1)				X	Ga	T4

Table C.6 *(6 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
9	mechanical spark	mechanical generated sparks due to a breaking shaft due to unacceptable vibration			X		equipment is not designed for liquid surface passage under motion, foreseeable misuse cannot be exclude	liquid level monitoring system (ignition prevention type "b1") to avoid liquid surface passage	ISO 80079-37 "b"	– certificate and instructions of the monitoring system (purchased from an external supplier)) for the use in explosive atmosphere and the use as a monitoring device for control of ignition source "b" (ignition prevention type b1)				X	Ga	

Table C.6 *(7 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
10	mechanical spark	grinding on the shaft or the stirrer in the range of the case		X			mechanical grinding cannot be excluded, if the vessel is not centred	The minimum clearance between rotating elements and the vessel is defined. The vessel clamping unit an interlock.	Clause 5 and ISO 80079-37 "b"	– constructional measures, design according to drawing no. … – certificate and instructions of the monitoring system (purchased from an external supplier)) for the use in explosive atmosphere and the use as a monitoring device for control of ignition source "b" (ignition prevention type b1)				X	Ga	
11	mechanical spark	grinding of the wiper in the vessel	X				grinding of the wiper under load during normal operation	use of capable material, static spring loaded	Clause 5, ISO 80079-37"c"	– constructional measures, design according to drawing no. …				X	Ga	

Table C.6 *(8 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
12	mechanical spark	breakdown of the bearing of the shaft guidance could cause grinding of a stirrer in a vessel (zone 0); the distance between the stirrer and the vessel may be unacceptably reduced			X		A breakdown of the bearing shall be considered as a rare malfunction (for EPL 1 equipment).	failure of the bearing will be detected by a vibration monitoring system (ignition prevention type "b1")	Clause 5 and ISO 80079-37 "b"	– certificate and instructions of the monitoring system (purchased from an external supplier)) for the use in explosive atmosphere and the use as a monitoring device for control of ignition source "b" (ignition prevention type b1)				X	Ga	
13	mechanical spark	loosening of the shaft			X		unsecured joints	force looked joints secured with an additional measure e.g. screw retention	ISO 80079-37 "c"	– test report no… about the thermal type test – constructional measures, design according to no. – instructions				X	Ga	

Table C.6 *(9 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
14	mechanical spark	unacceptable durability of parts e.g. the shaft			X		possible corrosion	adequate material selection	ISO 80079-37 "c"	– constructional measures, design according to drawing no. …				X	Ga	
15	mechanical spark	breakdown of a clutch (clutch in zone 0)			X		design according to the state of the art, safety factor > 3	only stiff in the rotational senses clutches are used	ISO 80079-37 "c"	– constructional measures, design according to drawing no. …				X	Ga	
16	mechanical spark	unacceptable vibration of the vessel causes damage of the agitator			X		internal and external sources of vibration cannot be excluded.	experimental determination and exclusion of the critical speed, limitation of the intended use	ISO 80079-37 "c"	– test report no. … about the determination of the critical speed – specific conditions for safe use – alert in the instructions, chapter …, clause … – marking of the range of the critical speed on the name plate				X	Ga	yes[a]

Table C.6 *(10 of 10)*

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to prevent the ignition source becoming effective**			**frequency of occurrence incl. measures applied**					
	a	B	a	b	c	d	e	a	b	c	a	b	c	d	e	f
No.	potential ignition source	description/basic cause *(Which conditions originate which ignition hazard?)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis *(citation of standards, technical rules, experimental results)*	technical documentation *(evidence including relevant features listed in column 1)*	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting EPL in respect of this ignition hazard	necessary restrictions
17	mechanical spark	accidental entry of metal items like tools through the manway			X		Multiple sparks formed if no liquid present	Information to user to prevent loose metal items from falling into the vessel	-	– instructions				X	Ga	
18	electrical spark	electrical equipment Gb IIB, T3 in contact with zone 0			X		shift of zone 0 in consequence of an undetected leakage	natural ventilation, constructional measures to avoid zone 0 where electrical equipment is placed	IEC 600 79-26	– constructional measures, design according to drawing no. …				X	Ga	
19	…	further ignition access					…									
Resulting EPL including all existing ignition hazards:															Ga	IIB T3[a]

[a] Limitation of the intended use required.