

PER and PSM hazard model



Danger
Highly flammable



Caution
Harmful chemicals





Brief overview of requirements

- Pressure Equipment Regulations (R.734 15 July 2009)
- Occupational Health and Safety Act (Act 85 of 1993)
- Hazardous Chemical Substances Regs (R.1179 25 Aug 1995)
- Major Hazard Installation Regs (R.60 16 Jan 1998)
- SANS 347 (Categorization), SANS 10228 (ID & Classification)
- Sasol PSM Standard S1.2 Process Safety Information
- ASME B31.3 (Code for pressure piping)
- NFPA 49 (Hazchem data), 325 (*) and 704 (Hazard ID)





Brief overview of the PER

- For pressure equipment higher than 50kPa.
- Exclusions include piping for water distribution below its boiling point, aerosol dispensers, PE on road and rail vehicles, open metal making pots, blast furnaces, car tyres, fixed hot water storage geysers and more....
- It applies to the duties of persons who manufactures, repairs, import, offers and supplies, installs and use PE.
- All PE shall be categorized according to SANS 347.
- SANS 347 references the requirements of SANS 10228.



Duties of the users of PE

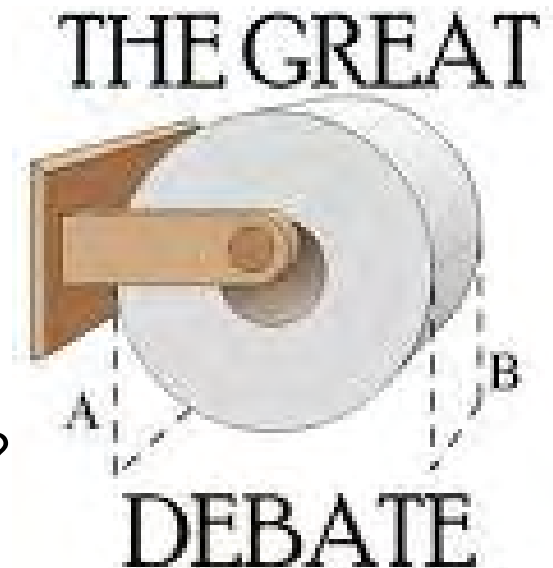
- Provide relevant parties with comprehensive information on operating conditions, fluid characteristics and operating conditions of connected equipment.
- Ensure that PE has a certificate issued by the manufacturer or repairer and signed by an approved inspection authority.
- PE has AIA certificate to be in place before commissioning.
- Gas system has valid certificate.
- Have records ready for inspection the certificate and results of any tests, inspections etc performed on the PE.
- Some requirements for portable gas containers and fire extinguishers.



To be or not 2B. ...



- Mechanical engineers need to classify PE.
- The rest of us in the chemical industry knows more about chemicals and we also have a job to do !!



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- Group 1 or Group 2 chemicals / fluids?
 - The role of PSM critical containment ?

SANS 347 – characteristic key words

SANS 347, requires the classification of pressurised systems according to the type of fluid.

[Group 1 fluids are as classified as per SANS10228.](#)

Fluids are classified as dangerous substances (in accordance with SANS 10228 or Council Directive 67/548/EEC/, for example, fluids that are:

- a) explosive,
- b) extremely flammable,
- c) highly flammable,



SANS 347 – more detail

- d) flammable (where the maximum allowable temperature is above flashpoint),
- e) corrosive,
- f) toxic,
- g) oxidizing and
- h) saturated or superheated steam.

Group 2 fluids comprise fluids other than those in fluid Group 1, including water below its boiling point at atmospheric pressure.





SANS 10228 – so much information

- SANS 10228 contains an extensive list of Group 1 fluids in its Annex C titled as “Alphabetical list of dangerous goods”.
- Based on the criteria discussed, the list of Group 1 fluids is considered an extensive list of hazardous chemicals.
- The exclusions to this group are considered a faster check to identify Group 1 fluids, i.e. if the chemical substance is not a Group 2 fluid, then it is classified as a Group 1 fluid.
- The next table provides an approach to consider Group 2 fluids:



Group 2 fluids – our own interpretation

Chemical substance	Physical status
Water	Liquid below its boiling point at atmospheric pressure.
Inert, non toxic asphyxiates (Nitrogen, Helium, Neon, Argon, Krypton and Xenon)	Gases (liquid forms may cause damage to human tissue). Although these compressed gasses are listed in Annex C of SANS 10228, they are not explosive, flammable, toxic, corrosive or oxidizing, nor steam.
All chemical substances with a NFPA rating for Health = 0, Fire ≤ 2 (temperature below flash point), Reactivity/Instability = 0 and no special hazards (OX, COR, W or others)	Gas or liquid as verified against Annex C of SANS 10228.





NFPA Ratings – another form of classification



Health Hazard	
4	Very short exposure could cause death or serious residual injury even though prompt medical attention was given.
3	Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.
2	Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.
1	Exposure could cause irritation but only minor residual injury even if no treatment is given.
0	Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.





NFPA Ratings – another form of classification



Flammability

4	Will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.
3	Liquids and solids that can be ignited under almost all ambient conditions.
2	Must be moderately heated or exposed to relatively high temperature before ignition can occur.
1	Must be preheated before ignition can occur.
0	Materials that will not burn.





NFPA Ratings – another form of classification



Instability	
4	Readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.
3	Capable of detonation or explosive reaction , but requires a strong initiating source or must be heated under confinement before initiation, or reacts explosively with water.
2	Normally unstable and readily undergo violent decomposition but do not detonate. Also: may react violently with water or may form potentially explosive mixtures with water.
1	Normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy , but not violently.
0	Normally stable , even under fire exposure conditions, and are not reactive with water.





NFPA Ratings – another form of classification

Special Hazards	The white "special notice" area can contain several symbols. The following symbols are defined by the NFPA 704 standard.
W	Reacts with water in an unusual or dangerous manner (e.g., caesium, sodium, sulfuric acid)
OXY	Oxidizer (e.g. potassium perchlorate, ammonium nitrate, hydrogen peroxide)
SA	Simple asphyxiant gas (includes nitrogen, helium, neon, argon, krypton and xenon)

Non NFPA

COR: Corrosive; strong acid or base (e.g. sulfuric acid, potassium hydroxide ; also **ACID and ALK**

BIO: Biological hazard (e.g. smallpox virus)

POI: Poisonous (e.g. strychnine),

Radioactive): is radioactive (e.g. plutonium, uranium)

CYL or CRYO: Cryogenic (e.g. liquid nitrogen)



Project – UCT 4th year – the chemicals



Chemical	Health	Flammability	Instability	Special
Copper sulphide (values should be close to sulphate)	2	0	1	Do not use water !!
SO ₂	3	0	0	
Sulphuric acid (98% or less – diff values)	3	0	2	No Water , OX
Kerosene	2	2	0	
Iron dust	2	1	2	May damage lungs
Cobalt dust	3	0	0	May damage lungs

<http://cameochemicals.noaa.gov/chemical/960>





Application - SANS 347 – PE categories

- In order to determine how the statutory regulations will apply to specific items of PE, a manufacturer shall classify the equipment into one of five hazard categories:
 - a) sound engineering practice (category 0),
 - b) category I,
 - c) category II,
 - d) category III, and
 - e) category IV.





SANS 347 – Map to PE classification figures

Table 1 — Product classifications and relevant figures

1	2	3	4	5	6	7	8	9	10
Equipment type	Vessels^a				Steam generator	Piping^b			
State of contents	Gas		Liquid^c			Gas		Liquid^c	
Fluid group^d	1	2	1	2		1	2	1	2
Refer to figure	1	2	3	4	5	6	7	8	9
For two-phase flow, the equipment should be categorized to the higher risk.									
<p>^a For portable gas containers and tanks (see SANS 10019), see figure 10.</p> <p>^b Design and construction requirements for piping shall be as given in annex B.</p> <p>^c No pockets of gas may form above the liquid in the equipment, including steam.</p> <p>^d Fluid group 1 = dangerous; fluid group 2 = not dangerous (see 4.3.1).</p>									





Example - PE classification figure

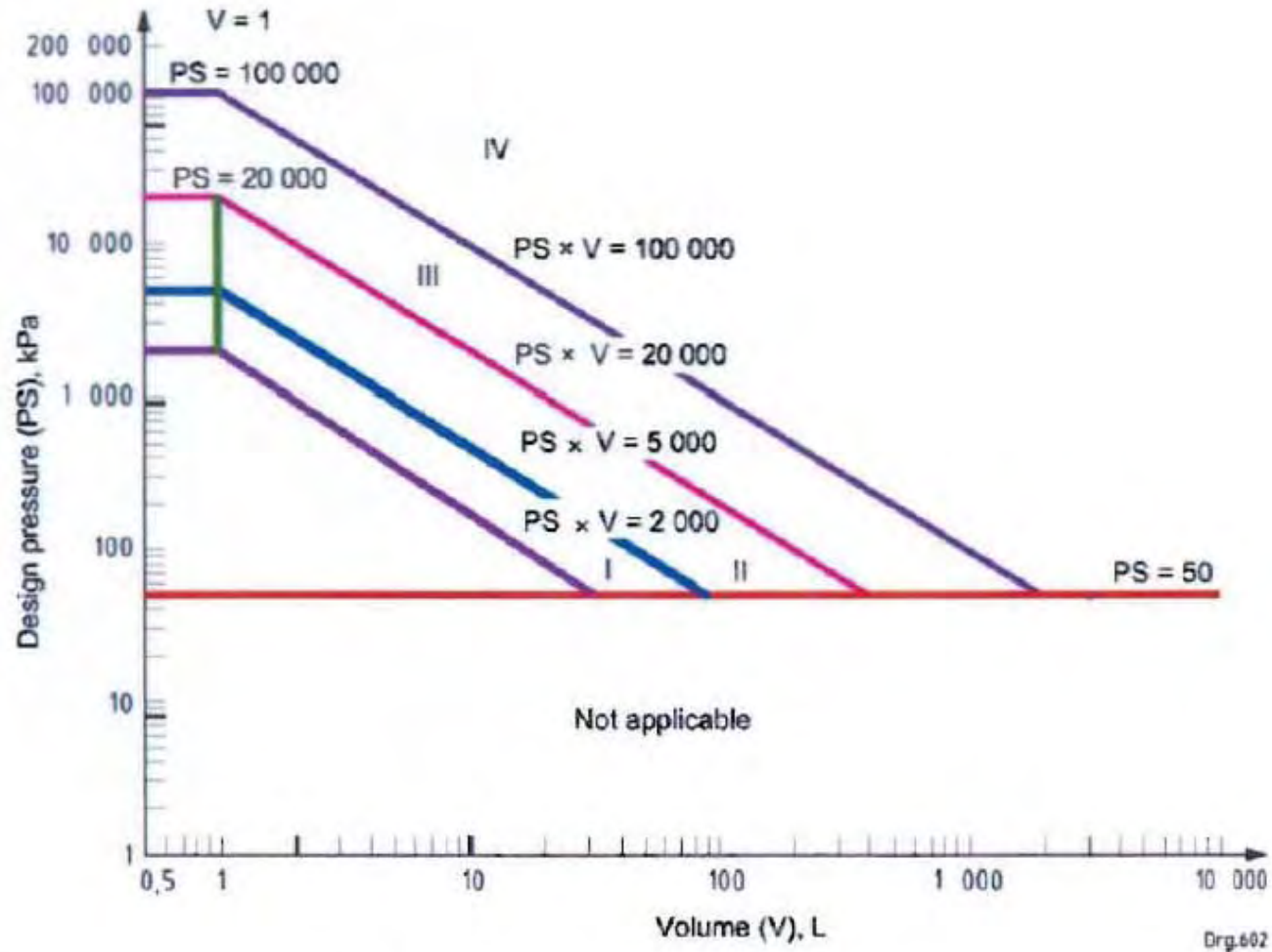


Figure 1 — Graph for vessels — Dangerous gas



Our view on hazardous chemicals that requires PSM critical containment

Explosive	Substances which may react exothermically without atmospheric oxygen, thereby quickly evolving gases, and which under defined test conditions detonate, quickly deflagrate or upon heating explode when partially confined.
Oxidizing	Substances and preparations which give rise to a highly exothermic reaction in contact with other substances, particularly flammable substances.
Pyrophoric	Substances which can ignite spontaneously when in contact with air.
Flammable	Flammable substances stored or handled at temperatures above its atmospheric pressure boiling point.
Toxic	Chemicals with an NFPA health rating of 3 or greater . . These are substances which in low quantities cause death, acute or chronic damage to health when inhaled swallowed or absorbed via the skin or are corrosive to the skin.



Conclusion

- The PER brings new classification requirements within a known environment.
- The approach is relatively simple, but requires an knowledge of chemicals and their characteristics.
- Group 1 chemicals seems to be a very long list and may result in more cost for the process industry. Experience will tell.
- We need to consider those chemicals that requires critical containment based on the properties of the chemicals and the operating conditions and take responsible care with their management.
- The PE classification we will leave to competent MEs !!





It is good to review your chemical classification on site !!



Questions and positive builds

