Fike

ASSOCIAZIONE TERMOTECNICA ITALIANA

Associazione Italiana Strumentisti

ISA Italy Section

BECAUSE SO MUCH IS AT STAKE™

DISCHI DI ROTTURA – dalla progettazione all’installazione

Fike Italia - Amos.Cavalera@fike.com

FIKE – chi siamo:

- Rupture (Bursting) Discs

- Explosion Protection

Dal 1945 Fike progetta e costruisce soluzioni per la sicurezza delle persone e degli impianti industriali

- Oilfield Products

- Fire Protection & Alarm

FIKE – dove siamo

Head Quarter: Blue Springs MO - USA

Uffici e siti operativi: 12 paesi nei 6 continenti

Persone: circa 800 dipendenti

Copertura globale

- EU Pressure Equipment Directive (EN ISO 4126)
- ASME Section VIII, Division I - UD stamp
- Canadian Registration Number - Canada
- CT - Chinese Safety Quality License
- GOST - Russian Safety Equipment GOST-R ora TR-CU
- KOSHA -
- AD Merkblatt A1 – TüV
- 94/9/CE - ATEX ***AT****mosphères* ed ***EX****plosibles*
- NFPA – National Fire Protection Association
- EHEDG - European Hygienic Engineering & Design Group
- 3A Sanitary Standards
- FDA - Food & Drug Administration
- etc etc

Codici di progetto

American Society of Mechanical Engineers – Sec. VIII, Div. 1

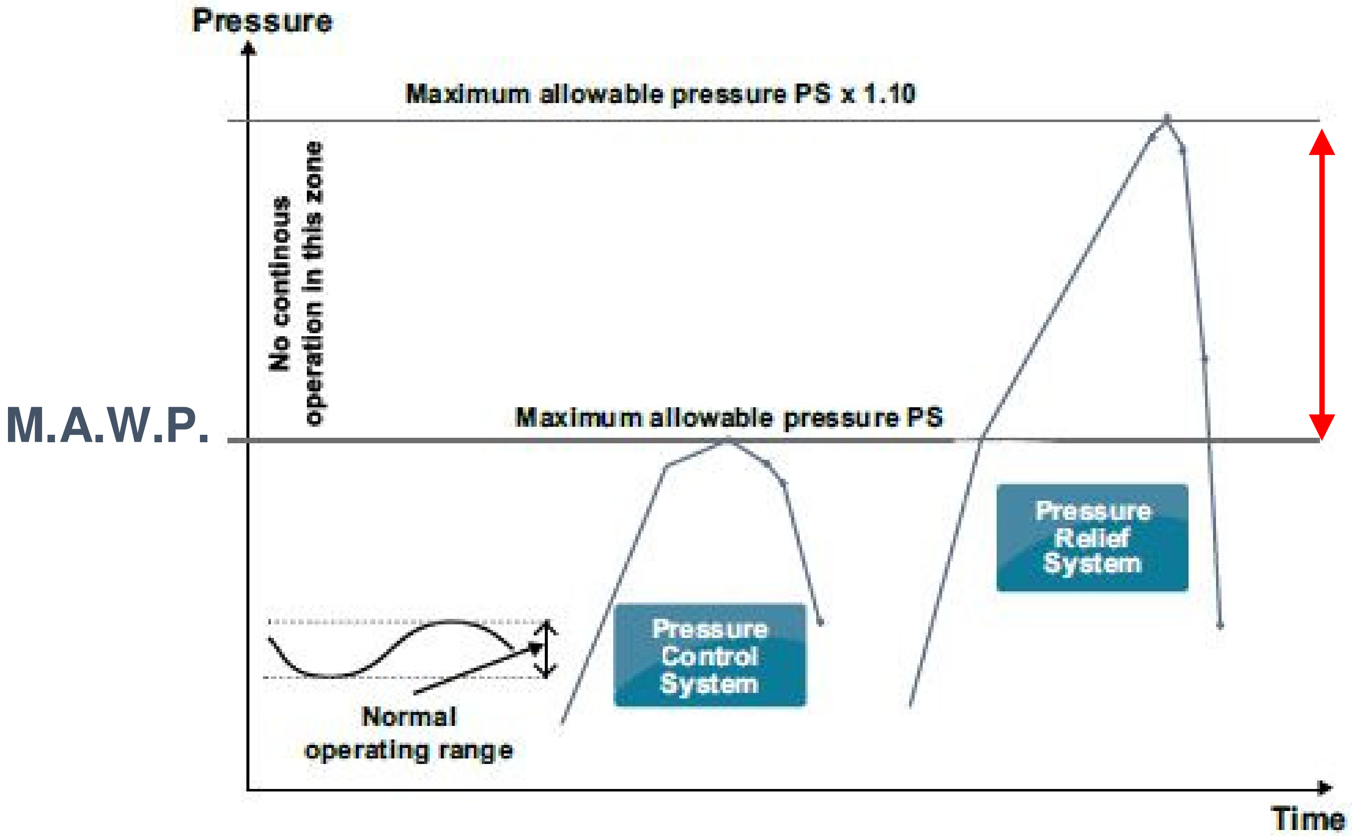
American Petroleum Institute – RP520

Pressure Equipment Directive – 97/23/EC

EN 4126 Safety Devices for protection against excessive pressure – Part. 6

ISO 6718:1991 Bursting Disc Devices

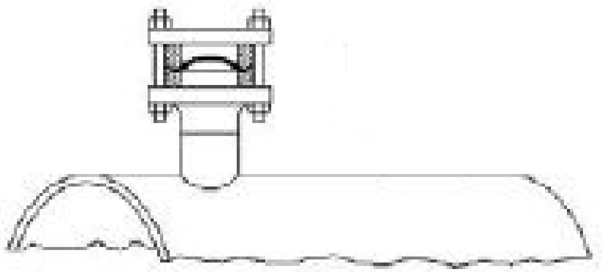
Codici di progetto



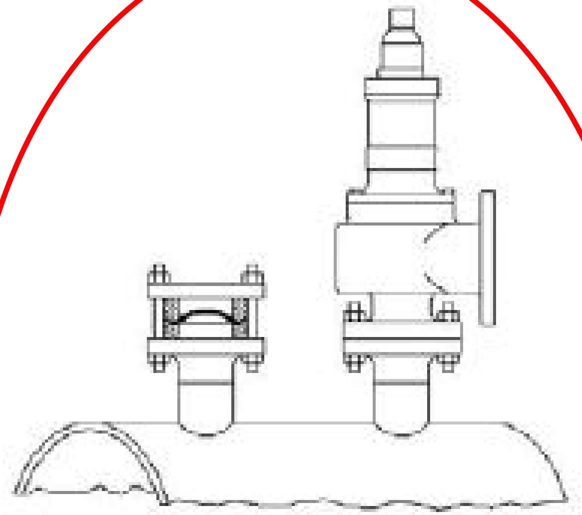
- *ASME Section VIII*
- *EN ISO 4126-6*
- *API RP520*

OVERPRESSURE CONSENTITA 10%

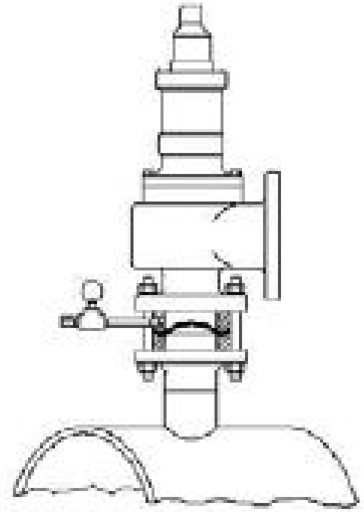
Applicazioni tipiche



Scarico primario



Scarico secondario



Scarico combinato

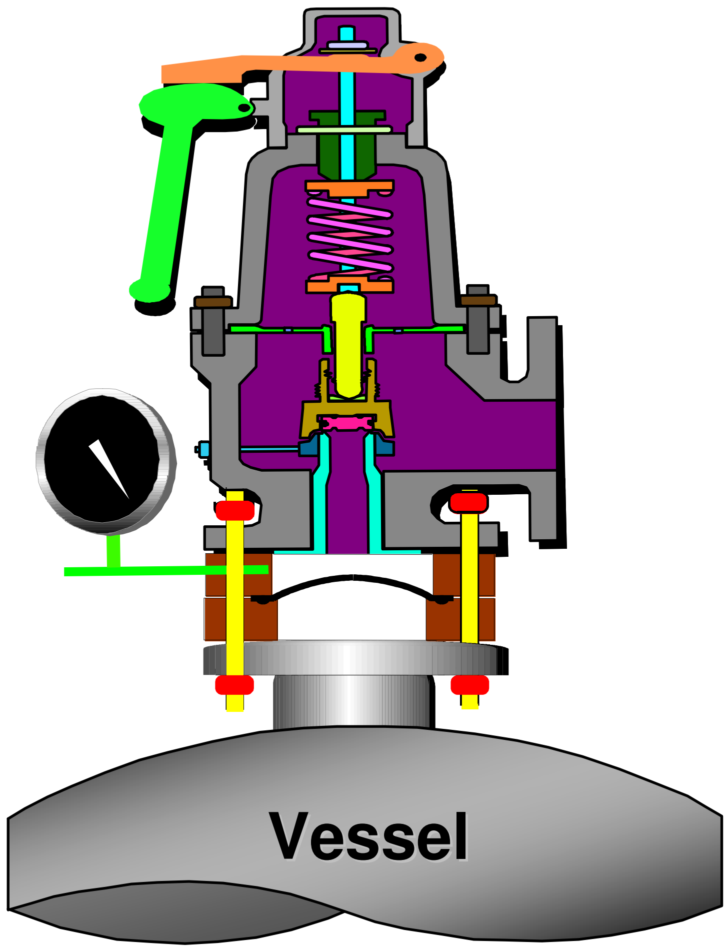
ASME Section VIII: *non superiore al 16% della M.A.W.P.*

Pressure Equipment Directive 93/23/EC: *non superiore al 10% della M.A.W.P.*

Scarico combinato con PSV

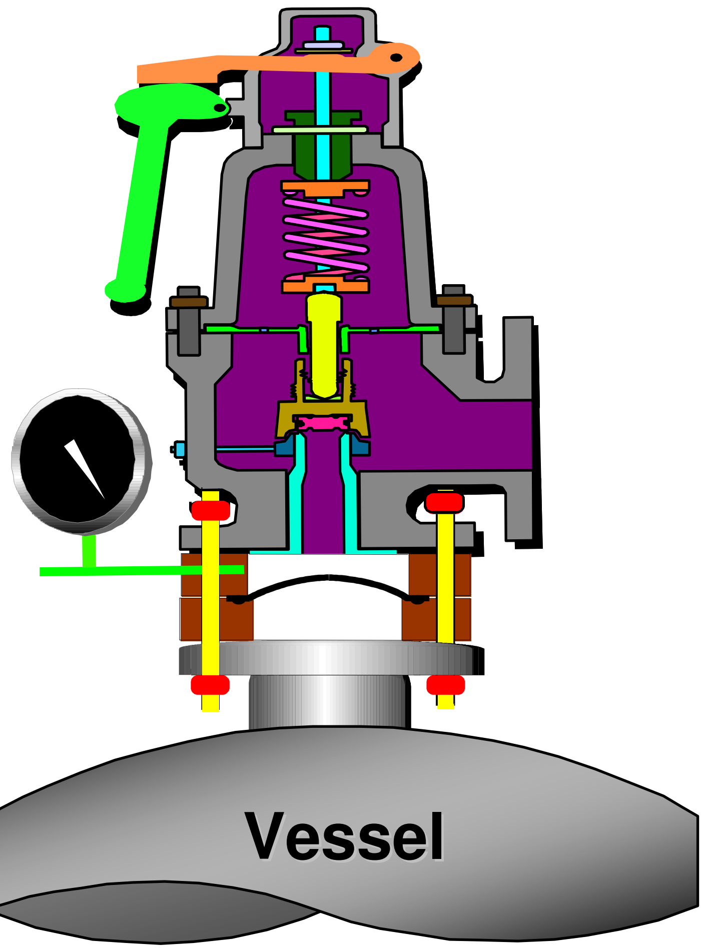
1) Il disco di rottura dev’essere capace di scaricare, come minimo, la stessa capacità della valvola

2) Le perdite di carico fino alla valvola di sicurezza devono essere contenute, alle massime condizioni di scarico, nell’ordine del 3% della pressione di set della valvola (*EN 4126-3 paragrafo 6.2)*



Scarico combinato

La capacità della valvola di sicurezza
installata dev’essere ridotta del 10%
(in accordo alla EN4126-3 e/o UG-132)
a meno che
non vi siano valori sperimentali
d’accoppiamento valvola/disco



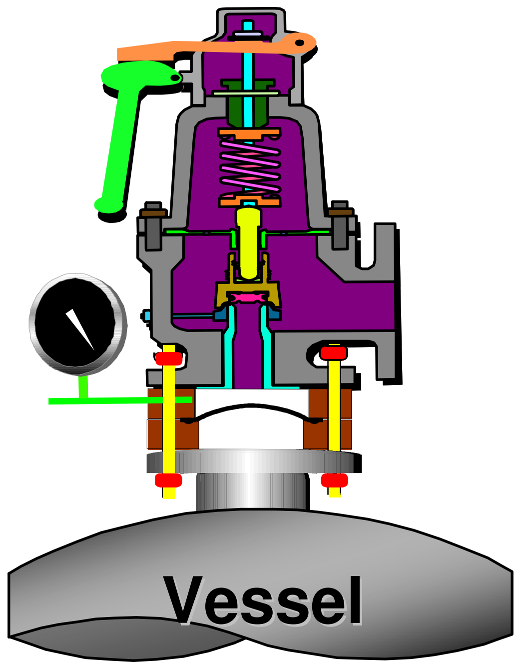
Scarico combinato

CERTIFIED COMBINATION CAPACITY FACTORS

ASME Section VIII, Division I provides guidance for the use of rupture disc devices in combination with a pressure relief valve. When a rupture disc is installed on the inlet of a pressure relief valve, the capacity of the combination is equal to the capacity of the valve times the combination capacity factor. A default combination capacity factor of 0.9 may be used or the specific disc/valve combination may be tested to arrive at a higher value. The following table lists the certified combination capacity factors for various Fike disc/valve combinations.

Rupture Disc Model	Valve Model	Minimum Size (in)	Min. Burst Pressure in Min. Size (psig)	Certified Combination Capacity Factor
Poly-SD CS	Consolidated Dresser 1900E-2, 1900-30E-2	1	125	.989
Poly-SD DH		1	32	.989
SRL		1	27	.994
SRX		1	95	.978
Poly-SD	Consolidated Dresser 1900, 1900-30, 1900-35	1	60	.992
HOV		2	25	.976
MRK		1	53	.979
Poly-SD	Consolidated Dresser 3900	2	55	.989
HOV		2	30	.985
Poly-SD CS	Farris 2600, 2600S	1	125	.958
Poly-SD DH		1	32	.999
Poly-SD Double Disc		2	83	.974
SRL		1	27	.996
SRX		1	95	.969
MRK		3	34	.983
MRK	Anderson Greenwood Crosby JOS-E, JBS-E	1	60	.977
MRK	Anderson Greenwood Crosby 223/423/623/923	1	88	.991
MRK	Anderson Greenwood Crosby 273/473/576/673/973	1.5	62	.988
SRX	Fukui RE Series	1.5	85	.972

Technical Bulletin



704 S. 10th Street · P.O. Box 610 · Blue Springs, Missouri 64013-0610 U.S.A. · (816) 229-3405 · (816) 229-4615 · www.fike.com

Scarico combinato – ulteriori considerazioni

1) Lo spazio tra valvola e disco deve prevedere una connessione atta a **prevenire o rilevare** un'inaccettabile crescita della contropressione (*EN 4126-3 paragrafo 5.5)*

2) Il disco di rottura deve essere **non frammentabile** (no grafite)

3) I petali del disco **non devono protrudere** all'interno della valvola (*EN 4126-3 paragrafo 5.6)*

4) Il DN del disco di rottura deve essere **non inferiore** al diametro nominale d'ingresso della valvola (*EN 4126-3 paragrafo 5.8)*

SET PRESSURE - con scarico combinato

La pressione di set deve essere scelta in accordo alle direttive e linee guida:

- *ASME Section VIII Div.1 UG-127 nota 52:* "….result in opening of the valve coincident with the bursting of the rupture disk." For combination capacity testing, ASME UG-132(a)(4)(a) says: "The marked burst pressure **shall be between 90% and 100% of the marked set pressure** of the valve."

STESSA PRESSIONE DI SET

- *API RP520 paragrafo 2.3.2.2.2:* "…the specified burst pressure and set pressure **should be the same nominal value**."
- *EN ISO4126-3 paragrafo 7.2:* "The **maximum limit** of bursting pressure…**shall not exceed 110%** of the…set pressure or a gauge pressure of 0.1 bar, whichever is greater…" and "The **minimum limit**…should **not be less than 90%** of the…set pressure."

Come dimensionare un disco di rottura

Fike DisCalc+ → media monofase

DisCalc+ esegue il calcolo di dimensionamento in accordo a diversi **enti e norme riconosciute** utilizzando il Coefficient of Discharge Method - Kd

- ***ASME Section VIII***
- ***EN ISO 4126-6***
- ***API RP520***

Come dimensionare un disco di rottura

Fike DisCalc+ ➔ media reattivo bifase

Alcuni metodi di calcolo riconosciuti:

- Homogenous Equilibrium Method (HEM –method)
- Omega method
- Leung method
- ***Fauske method***

Come dimensionare un disco di rottura

SIZING RUPTURE DISKS (RDs) FOR TWO-PHASE FLOW

Hans K. Fauske
Fauske & Associates, Inc., Burr Ridge, Illinois

SUMMARY

An easy and accurate method for estimating two-phase flow through RDs is outlined. Given information about stagnation conditions the model can handle gas-liquid, vapor-liquid and hybrid flows including subcooled flashing flows. Examples are provided illustrating sizing of RDs for gas-liquid, vapor-liquid, hybrid and flashing flows. The examples illustrate the importance of considering two-phase flows when sizing rupture disks.

INTRODUCTION

RDs are extensively used for overpressure protection in the chemical process industries and sizing methods for all liquid and all gas flows are well established and easy to use (see Fike Metal Products catalog). In comparison, two-phase flow methods proposed over the years have been far more complex and difficult to use than the single-phase flow methods. Here we introduce an equally easy to use two-phase flow method with accuracy equal to or better than that provided by the more complex models (Fauske, 1998).

The RD size is obtained by assuring a balance between the required venting rate, W (kg/s) and the discharge rate

$$W = K_d\, A\, G \qquad (1)$$

where K_d (0.62) is the rupture disk flow coefficient given in the ASME Boiler and Pressure Vessel Code (1983), A (m^2) is the vent area, and G (kg/m^2-s) is the two-phase mass flux given by

$$G = \left[\frac{1-x_o}{G^2_{x_o=0}} + \frac{x_o}{G^2_{x_o=1.0}}\right]^{-1/2} \qquad (2)$$

where x_o is the stagnation gas and/or vapor quality.

GAS-LIQUID FLOWS

For two-compartment two-phase flows such as air-water flows, $G_{x_o=0}$ is determined

$$G_{x_o} = \sqrt{2(P_o - P_b)\rho_{\ell,o}} \qquad (3)$$

where P_o (Pa) is the stagnation pressure, P_b (Pa) is the back pressure, and $\rho_{\ell,o}$ (kg/m^3) is the liquid density. For critical flows $G_{x_o=1.0}$ is given by

$$G_{x_o=1.0} = P_o\left(\frac{M_w}{R\,T_o}\right)^{1/2}\left[k\left(\frac{2}{k+1}\right)^{(k+1)/(k-1)}\right]^{1/2} \qquad (4)$$

and for subcritical flows by

$$G_{x_o=1.0} = P_o\left(\frac{M_w}{R\,T_o}\right)^{1/2}\left\{\left(\frac{2\,k}{k-1}\right)\left[\left(\frac{P_b}{P_o}\right)^{2/k} - \left(\frac{P_b}{P_o}\right)^{(k+1)/k}\right]\right\}^{1/2} \qquad (5)$$

where M_w is the molecular weight, R (8314 Pa-m^3/K-kg-mole) is the gas constant, and k is the isentropic coefficient (see Table 3, Fike Metal Products Catalog, for values of k).

VAPOR-LIQUID FLOWS

For one-component two-phase flows, such as steam-water flows, $G_{x_o=0}$ can be estimated from

$$G_{x_o=0} = \rho_{v,o}\,\lambda_o\,(T_o\,c_o)^{-1/2} \qquad (6)$$

where $\rho_{v,o}$ (kg/m^3) is the stagnation vapor density, λ_o (J/kg) is the latent heat of vaporization, T_o (K) is the stagnation temperature and c_o (J/kg-K) is the liquid specific heat. Similar to two-component two-phase flows $G_{x_o=1.0}$ is given either by Equation (4) or Equation (5).

HYBRID GAS-VAPOR-LIQUID FLOWS

For hybrid two-phase flows such as air-steam-water flows $G_{x_o=0}$ is determined from

$$G_{x_o=0} = \left[2\,P_{g,o}\,\rho_{\ell,o} + \lambda_o^2\,\rho_v^2 / T_o\,c_o\right]^{1/2} \qquad (7)$$

where $P_{g,o}$ (Pa) is the stagnation gas partial pressure and $G_{x_o=1.0}$ is again given by either Equation 4 or Equation 5 with the molecular weight M_w given by

$$M_w = M_{w,g}\left(P_{g,o}/P_o\right) + M_{w,v}\left(P_{v,o}/P_o\right) \qquad (8)$$

where $P_{v,o}$ (Pa) is the vapor pressure corresponding to the stagnation temperature T_o. The value of the isentropic coefficient k can be estimated in a similar manner.

ALL LIQUID FLASHING FLOWS

For all liquid initial conditions, Equation 2 reduces to $G = G_{x_o=0}$. In case of saturated inlet or stagnation conditions, G is determined from

$$G = \rho_{v,o}\,\lambda\,(T_o\,c_o)^{-1/2} \qquad (9)$$

and for subcooled inlet conditions the expression is the same as that for hybrid vapor-gas-liquid flows with $x_o = 0$

$$G = \left[2\,P_{g,o}\,\rho_{\ell,o} + \lambda_{v,o}^2 / T_o\,c_o\right]^{1/2} \qquad (10)$$

EXAMPLE 1 - SIZING FOR GAS-LIQUID FLOWS

What size rupture disk is required to relieve an air-water mixture under the following conditions:

$W = 50$ kg/s, $x_o = 0.01$, $P_o = 7 \cdot 10^5$ Pa,
$P_b = 10^5$ Pa, $T_o = 300$ K, and $\rho_{\ell,o} = 10^3$ kg/m^3.

$$G_{x_o=0} = \sqrt{2\left(7 \cdot 10^5\right)1000} = 3.46 \cdot 10^4\ kg/m^2-s$$

$^+$

$$G_{x_o=1.0} = 7 \cdot 10^5\left(\frac{29}{8314 \cdot 300}\right)^{1/2}\left[1.4\left(\frac{2}{1.4+1}\right)^{\frac{(1.4+1)}{(1.4-1)}}\right]^{1/2}$$
$$= 1.63 \cdot 10^3\ kg/m^2-s$$

$$G = \left[\frac{0.99}{\left(3.46 \cdot 10^4\right)^2} + \frac{0.01}{\left(1.63 \cdot 10^3\right)^2}\right]^{-1/2}$$
$$= 1.48 \cdot 10^4\ kg/m^2-s$$

$$A = 50/\left(1.48 \cdot 10^4 \cdot 0.62\right)$$
$$= 5.44 \cdot 10^{-3}\ \ or\ \ 8.44\ in^2$$

Answer: 4 inch diameter rupture disk.

What size rupture disk is required to relieve only the gas portion of the above air-water mixture, all other conditions remaining the same.

$$A = \frac{W\ x_o}{K_d\ G_{x_o=1.0}} = \frac{50 \cdot 0.01}{0.62 \cdot 1.63 \cdot 10^3}$$
$$= 4.95 \cdot 10^{-4}\ m^2\ \ or\ \ 0.77\ in^2$$

Answer: 1 inch diameter rupture disk, i.e., in case of no liquid entrainment the required rupture disk size is much smaller.

EXAMPLE 2 - SIZING FOR VAPOR-LIQUID FLOWS

What size rupture disk is required to relieve a vapor-liquid ethylene mixture under the following conditions:

$W = 300$ kg/s, $x_o = 0.01$, $P_o = 2 \cdot 10^6$ Pa,
$P_b = 10^5$ Pa, $T_o = 245$ K.
Other physical properties: $\rho_{v,o} = 38.5$ kg/m^3,
$\lambda_o = 3.2 \cdot 10^5$ J/kg, $c_o = 3050$ J/kg-K, $M_w = 28$,
and k= 1.26.

$$G_{x_o=0} = 38.5 \cdot 3.2 \cdot 10^5(245 \cdot 3050)^{-1/2}$$
$$= 1.43 \cdot 10^4\ kg/m^2-s$$

$^+$ Critical flow condition is used: $P_b/P_o = 0.143 < P_c/P_o = \left(\frac{2}{K+1}\right)^{k/(k-1)} = 0.53$, where P_c is the critical pressure.

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FIKE EUROPE

BURSTING DISC CALCULATION TOOL

MINIMUM REQUIRED RELIEF AREA PER EN-ISO 4126-6

Fike

FIKE EUROPE

Date :	4/05/2010	Project :	
Calculated by :		Reference :	

MINIMUM REQUIRED RELIEF AREA FOR TWO-PHASE FLOW

Choose medium :

GAS - LIQUID — Two-component two-phase flow (ex. Air - Water)

OR

VAPOR - LIQUID — One-component two-phase flow (ex. vapor - liquid Ethylene)

GAS // VAPOUR

DRY & SUPERH. STEAM

WET STEAM

LIQUIDS

TWO-PHASES FLOW

GAS - LIQUID FLOW

The minimum required relief area for gas - liquid flows can be calculated by adding the following requested information :

Add data for capacity calculation

Q =	15000	kg / hr	
Po =	12	bara	
Pb =	1,5	bar	
α =	0,62		
$\rho_{l,o}$ =	900	kg/m³	
x_o =	0,01	Stagnation gas quality	
M =	29	Kg / kmol if necessary see GASES - LIST or WEBSITE.	
k =	1,39	see also in the GASES -LIST or WEBSITE	
R =	8314,47	Pa.m³/K kg mol	
T_o =	101	C	
The flow is	**Critical**		
$G_{xo=1,0}$ =	2502,559		
$G_{xo=0}$	43474,13		(No viscosity correction)
G =	21715,85	kg/m²s	two-phase mass flux

Solo 8 parametri per calcolare il flusso della massa e l'area richiesta

From the above given data we can calculate the min. required relief area of the bursting disc.

A_o =	309,47	mm² =	**0,48**	in² (calculated relief area)

Use this value to find the most suitable bursting disc in the minimum net flow area table.

Diameter =	19,85	mm =	0,78	inch (= min. diameter of disc)

NOMENCLATURE :

A_o = required flow area in mm² or in²

α = coëfficiënt of discharge

C = isentropic coëfficiënt at the inlet conditions

c_0 = liquid specific heat in J/kgK

F= reaction force @ the point of discharge to the atmosphere

$G_{x0=0}$ =mass flux 0% gas

$G_{x1,0=0}$ =mass flux 100% gas

G = two phase mass flux
k = ratio of specific heats : k=Cp/Cv
Cp= heat capacity @ const. pressure(1,013 bar and 15°C

Cv = heat capacity @ const. volume (1,013 bar and 15°C)

K_v = Viscosity Correction factor

λ_0 = latent heat of vaporizationin kJ/kg

M = molecular mass in kg/kmol

P_o = absolute bursting pressure

ΔP = Bursting Pressure - Reverse Pressure in bar or kpascal

ρ = density in kg/m³

$\rho_{l,0}$ = density in kg/m³ liquid medium

$\rho_{v,0}$ = density vapor in kg/m³

Q = discharge mass Flow

R = gasconstante

To = inlet Temperature in °C, K or F

v = volumetric mass in m³/kg

x= gives a value to the dryness of wet steam.

x_0 = stagnation gas quality; (value between 0 and 1)

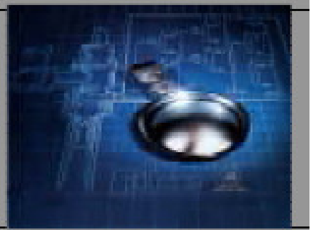
Zo = compressibility factor (if unknown Zo=1)

Come dimensionare un disco di rottura

FIKE EUROPE

BURSTING DISC CALCULATION TOOL

MINIMUM REQUIRED RELIEF AREA PER EN-ISO 4126-6



IMPORTANT GENERAL RULES (5) :

x MARK "x"

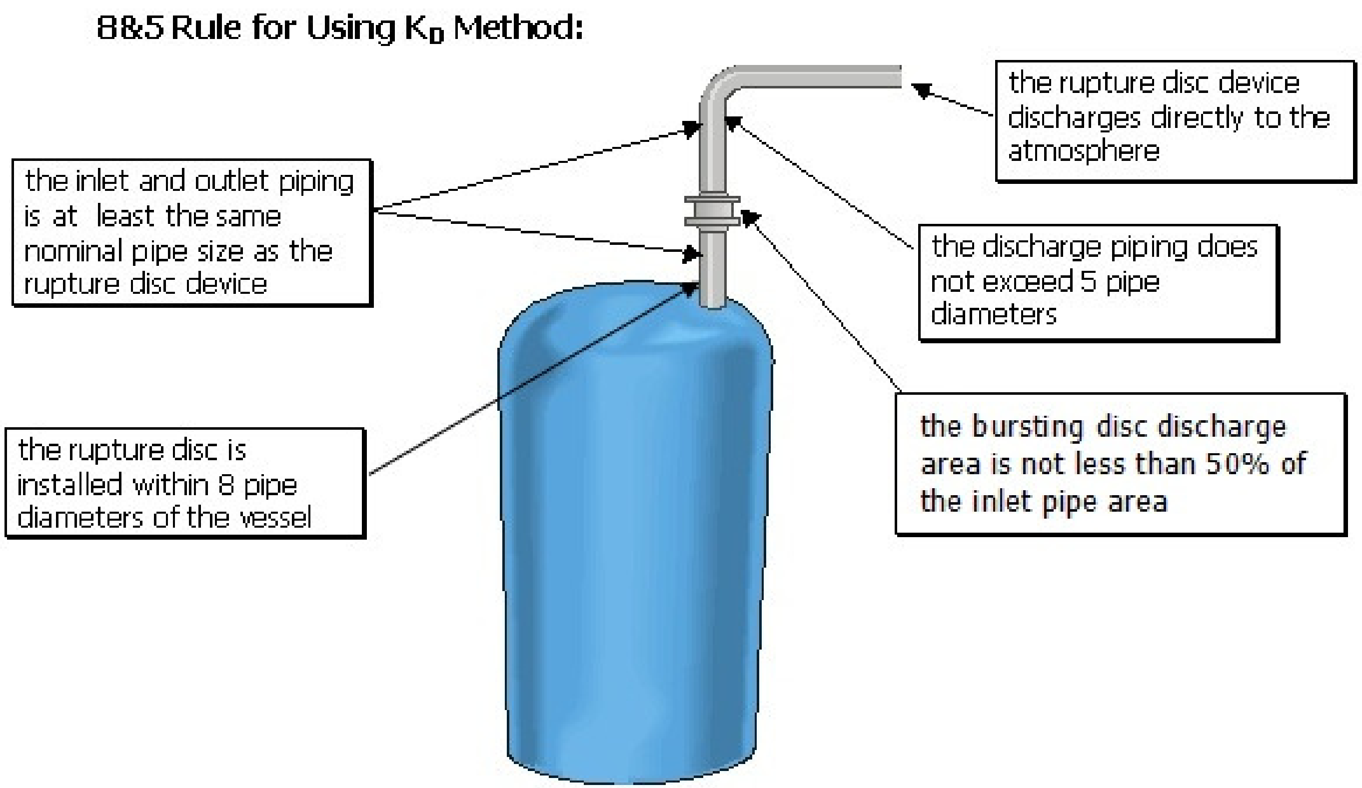
x	The bursting disc discharges directly to atmosphere.	true	PICTURE RULE 1
x	The bursting disc is installed within 8 pipe diameters from the entry to the equipment nozzle.	true	PICTURE RULE 2
x	The bursting disc device discharge area is not less than 50% of the inlet pipe area.	true	PICTURE RULE 3
x	The length of the discharge pipe following the bursting disc does not exceed 5 pipe diameters	true	PICTURE RULE 4
x	The nominal pipe diameter of the inlet and discharge piping are equal to, or greater than the nominal size of the burst disc .	true	PICTURE RULE 5

ONLY when 5 Times "true" => This method is appropriate and you can use Fike Europe Discalc. 5

Come dimensionare un disco di rottura

Coefficient of Discharge Method (Kd) o Simplified approach

Restrizioni per l'uso (*EN 4126-6 Annex C*)

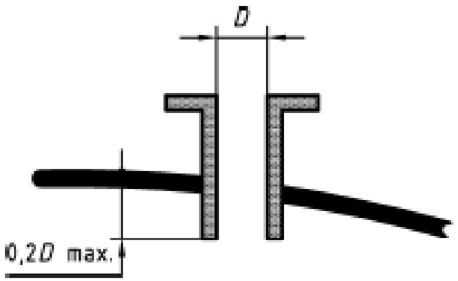
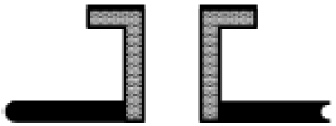
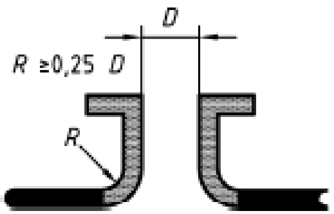


Tutte le condizioni sopra riportate devono essere verificate. Se anche solo una di esse non fosse soddisfatta, bisogna analizzare l'intero sistema di scarico con il metodo Kr (Resistance to Flow Method)

Selezionare l'appropriato Discharge Coefficient

EN ISO 4126-6 Gas & Vapore

Table C.1 — Discharge coefficients α

Number	Branch/nozzle type		Discharge coefficient, α
1		In the case of an internally protruding branch/nozzle	0,68
2		In the case of a flush branch/nozzle or a block flange whose inlets are not of hydrodynamic configuration	0,73
3		In the case of a branch/nozzle or a block flange of hydrodynamic configuration, e.g. with rounded or chamfered inlets	0,80

EN ISO 4216-6 Liquidi

ASME & API

tutti i media

α= 0,62

Come dimensionare un disco di rottura

Resistance to Flow (K_r) Method o Comprehensive approach

Analizzare la **capacità** del flusso **dell'intero sistema di scarico**. L'analisi terrà in considerazione **tutte le perdite di carico esistenti**. I calcoli verranno eseguiti utilizzando le pratiche ingegneristiche per il fluido determinato come l'equazione di Bernoulli per liquidi ed equazioni di flusso isotermico o adiabatico per vapore/gas.

Come dimensionare un disco di rottura

Resistance to Flow Method (Kr):

- I componenti che generano perdite di carico sono gli ugelli di ingresso ed uscita, gomiti, T, riduzioni, valvole, dischi di rottura (da notare che il disco di rottura e il suo holder sono considerati un'unica unità)

- In questo modo il disco di rottura è considerato niente di meno che un altro componente della tubatura di scarico. Quindi il disco di rottura contribuisce attivamente a generare una perdita di carico che deve essere determinata.

Come dimensionare un disco di rottura

Resistance to Flow (K_r) Method o Comprehensive approach

- Questo giustifica nome “K_r”, che risulta essere analogo al valore K delle altre componenti della tubatura di scarico.

- **K_r viene determinato sperimentalmente** in laboratori di flusso direttamente dal costruttore dei dischi di rottura e certificato secondo ASME Section VIII Division 1/EN ISO 4126-6.

- E’ una **misura della resistenza del flusso** attraverso il disco di rottura e dipende dalle caratteristiche del modello di disco utilizzato.

Certified K_R and MNFA Values

Design codes like EN 4126-6 and ASME Section VIII, Division 1 provide guidance for the use of a bursting disc device in a pressure relieving system. Two of the basic methodologies for sizing bursting disc devices are the resistance to flow and the coefficient of discharge methods. The coefficient of discharge method, K_D, is used for simple systems. This method uses the minimum net flow area (MNFA, cm²) to calculate the appropriate capacity of the system. The resistance to flow method represents the velocity head loss due to the bursting disc device. This head loss is included in the overall system loss calculations to determine the size of the relief system. See technical bulletin "8.0100.00.0 Bursting Disc Sizing" for guidance in selecting the applicable method for bursting disc sizing.

The resistance of the bursting disc is denoted by a dimensionless K_R value established by testing during the certification process. Due to the variation in the opening characteristics of the bursting disc between compressible vapour and incompressible liquid, there are certified K_R values that are denoted by the applicable service media.

- K_{RG} : Use K_{RG} when the media is a gas or vapour, or when the media is liquid but there is a significant vapour volume directly in contact with the disc at the time of rupture
- K_{RL} : Use K_{RL} when the media is liquid and the liquid against the disc at the time of rupture
- K_{RGL}: Use K_{RGL} for any service conditions

The values shown have been certified by the National Board of Pressure Vessel Inspectors and are published in NB-18.

Type of disc		AXIUS Low Pressure	AXIUS High Pressure	ATLAS	SRL	SRX	POLY-SD DH	POLY-SD DH	POLY-SD DH	POLY-SD SH	POLY-SD SH	POLY-SD CS	POLY-SD CS
K_{RG}		-	0.45	0.65	0.43	0.99	-	-	3.04	-	-	0.99	2.39 (1)
K_{RL}		-	1.25	1.50	-	-	-	-	5.30	-	-	1.10	5.71 (1)
K_{RGL}		0.45	-	-	0.59	-	0.34	0.65	-	0.34	0.90	-	-
Holder		BT	BT	BT	BT	BT	BT	BT	BT	BT	BT	BT	BT
DN	Inch		Minimum Net Flow Area (cm²)										
15	0.5	-	-	-	-	-	-	-	1.26	-	-	-	1.26 (1)
20	0.75	-	-	-	-	-	-	2.85	-	-	2.85	2.85	-
25	1	5.57	5.57	4.52	5.57	5.57	5.06	-	-	5.06	-	5.06	-
40	1.5	13.16	13.16	11.61	10.77	9.93	11.42	-	-	11.42	-	11.42	-
50	2	21.68	21.68	18.90	21.68	21.68	21.68	-	-	21.68	-	21.68	-
80	3	47.68	47.68	40.96	47.68	47.68	47.68	-	-	47.68	-	47.68	-
100	4	81.93	81.29	70.31	81.93	81.93	81.93	-	-	81.93	-	81.93	-
150	6	151.61	139.35	-	162.58	163.22	186.45	-	-	186.45	-	186.45	-
200	8	269.68	247.74	-	289.03	279.35	-	-	-	-	-	322.58	-
250	10	418.71	383.87	-	-	449.03	-	-	-	-	-	509.03	-
300	12	607.74	557.42	-	-	658.06	-	-	-	-	-	729.03	-
350	14		-	-	-	890.32	-	-	-	-	-	890.32	-
400	16		-	-	-	1180.64	-	-	-	-	-	1180.64	-
450	18		-	-	-	1509.67	-	-	-	-	-	1509.67	-
500	20		-	-	-	1877.42	-	-	-	-	-	1877.42	-
600	24		-	-	-	2741.93	-	-	-	-	-	2741.93	-

(1) Some models may have higher K_R or lower MNFA values for Teflon liners.
(2) MNFA slightly less for liquid service.
(3) MNFA for 1034 barg holder is 0.96 cm².

Technical Bulletin

Laboratorio di Flusso Certificato

Laboratorio di Flusso Fike è certificato ASME dagli ispettori del National Board of Pressure Vessel

Laboratorio di Flusso Certificato

Large Zero-Velocity Vessel w/ 4” Flow Rig Attached

Typical Flow Rig Installations

Altri TEST disponibili

- UT - Ultrasonic Test
- Dye Penetrant
- MPI - Magnetic Particle Inspection (solo CS)

Sia ***ASME*** che ***PED*** impongono che uno di questi sia eseguito se il contenitore e ottenuto da fusione (tutti i nostri holder sono forgiati)

- PMI - Positive Material Identification
- Hydrostatic Test
- Hardeness test
- Impact Test
- Radiographic Test
- Leakage Test

Ulteriori possibilità - R&D

Laboratorio di metallurgia

***N**ational **A**ssociation of **C**orrosion **E**ngineers*

NACE INTERNATIONAL

- ***NACE MR0175/ISO 15156*** (oilfield - onshore & off shore) – creata nel 1975

- ***NACE MR0103*** (refinery) – creata nel 2003

NACE – Materiali approvati

Bursting disc approved materials:

- Stainless steel 304, 316
- Nickel based alloys
  - Monel, Hastelloy C276, Inconel **625**
- **(Inconel 600 excluded)**

Bursting disc HOLDER approved materials:

- Stainless steel 304, 316
- Nickel based alloys
  - Monel, Hastelloy C276, Inconel **625**
- Carbon Steel

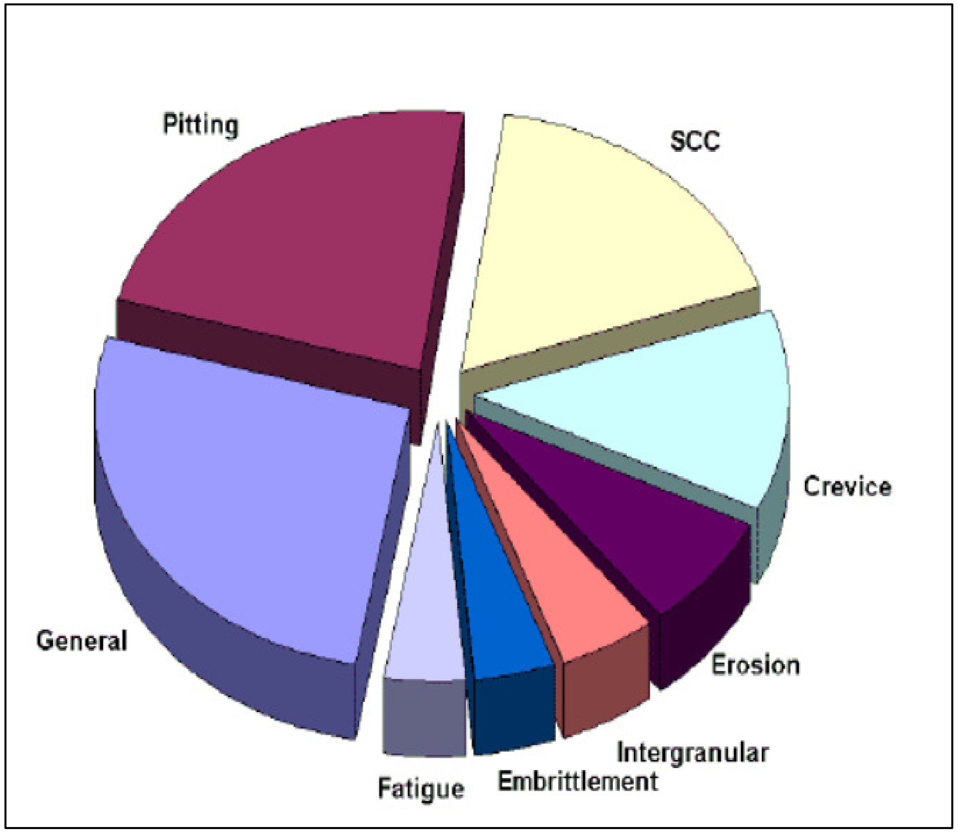
Studs & nuts approved materials:

- Stainless steel 304, 316
- Alloy steel

Steel Type	Grades Included	Comments
Ferritic	405,430, 409, 434, 436, 442, 444, 445, 446, 447, 448	Hardness up to 22 HRC
Martensitic	410, 420	Hardness up to 22 HRC
Martensitic	F6NM	Hardness up to 23 HRC
Martensitic	S41425	Hardness up to 28 HRC
Austenitic	201, 202, 302, 304, 304L, 305, 309, 310, 316, 316L, 317, 321, 347, S31254 (254SMO), N08904(904L), N08926(1925hMo)	Solution annealed, no cold work to enhance properties, hardness up to 22 HRC
Austenitic	S20910	Hardness up to 35 HRC
Duplex	S31803 (1.4462), S32520 (UR 52N+), S32750 (2507), S32760 (Zeron 100), S32550(Ferralium 255)	PREN ≥30 solution annealed condition, ferrite content 35% to 65%, or 30 to 70% in welds. Note that the general restriction of 28 HRC in previous editions is not found in this latest edition of the standard. There is a specific restriction on HIP'd S31803 to 25HRC. For some applications cold worked material is allowed up to 36HRC
Precipitation Hardening	17-4 PH	33 HRC Age hardening at 620 deg C
Precipitation Hardening	S45000	31 HRC Age hardening at 620 deg C
Precipitation Hardening	S66286	35 HRC

Cosa valutiamo e perchè?

- **General** attack corrosion
- **Localized** corrosion: Pitting
- **Environmental cracking**
  Stress corrosion cracking (SCC)
  Hydrogen-induced cracking
- **Intergranular** corrosion (IGC)
- **High-temperature** corrosion



Cosa valutiamo e perchè?

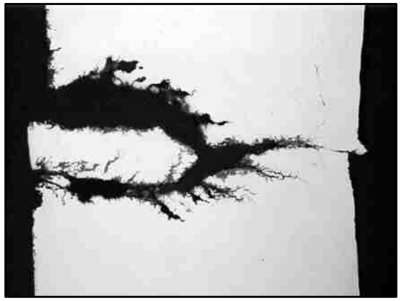
Stress corrosion cracking (SCC)

- Corrosione
- Stress
- Suscettibilità del materiale

SCC con corrosione che segue il bordo del grano

Sulfide stress cracking

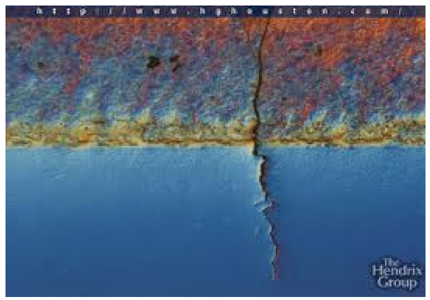
- Giusta combinazione di H_2S, P e T
- Catastrofica perchè non prevedibile



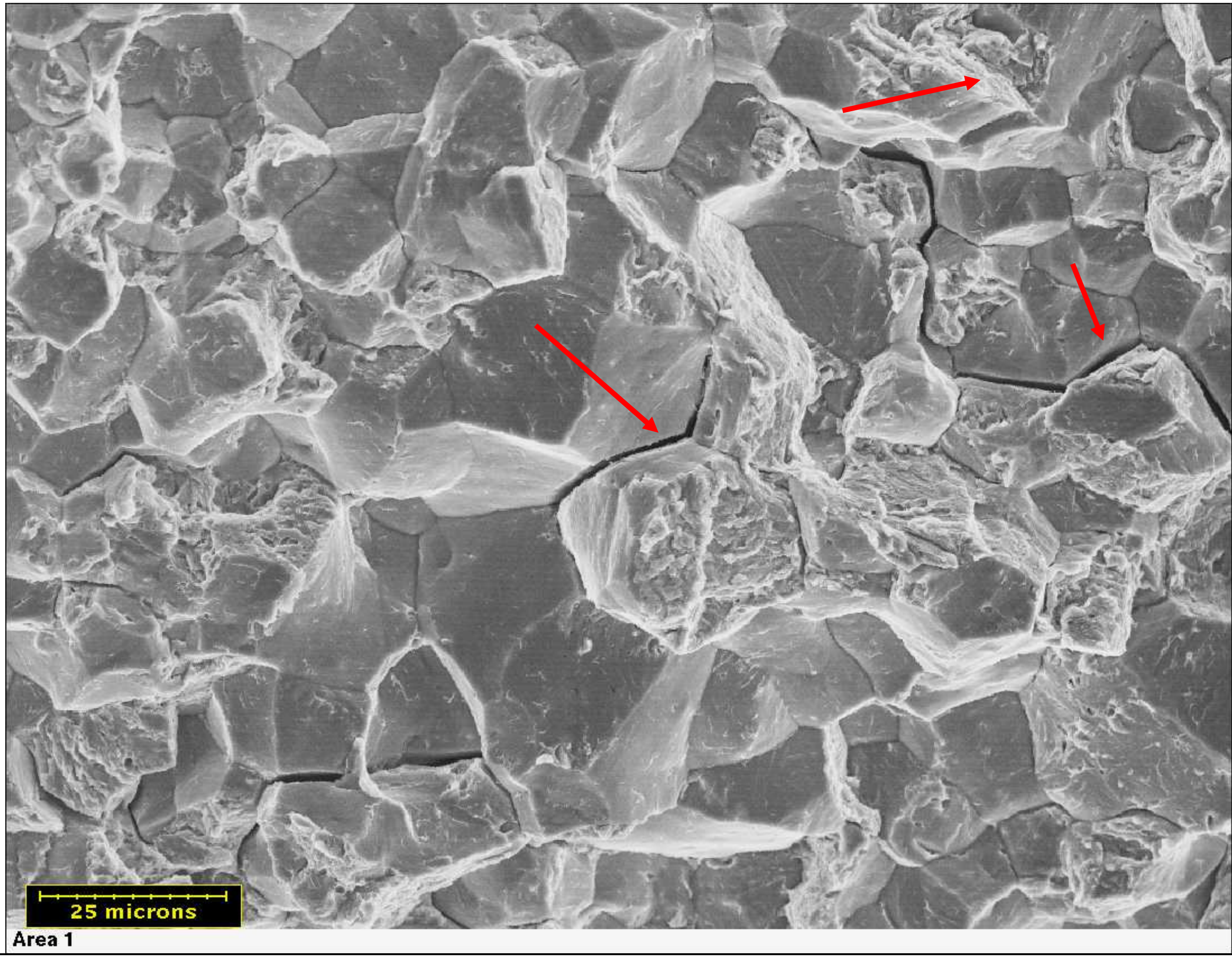
Sulfide stress cracking

Hydrogen embrittlement (infragilimento da H_2)

- Lavora a bordo grano per l'esposizione a H_2
- Favorita dalle elevate T
- Crea pressioni/stress interni al materiale



Hydrogen embrittlement



Hydrogen embrittled Carbon Steel (intergranular with secondary cracking)

NACE compliance or not

G2 series (AXIUS/ATLAS)*:*

Bulged dome

Senza linee d'indebolimento eseguite a freddo

***P-TYPE*:**

Convenzionali, sede piatta, senza supporto per il vuoto

Bulged, no score

ECCEZIONI

SRL, SRX, POLY-SD, SCRD FS/FSR*:*

Bulged dome con indebolimento a freddo

***HOV, P-V SERIES*:**

Bulged dome, supporti per resistenza a vuoto saldati

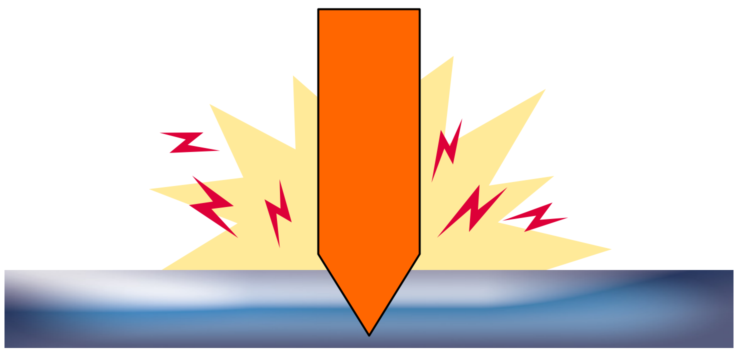
***HO*:**

Bulged compositi

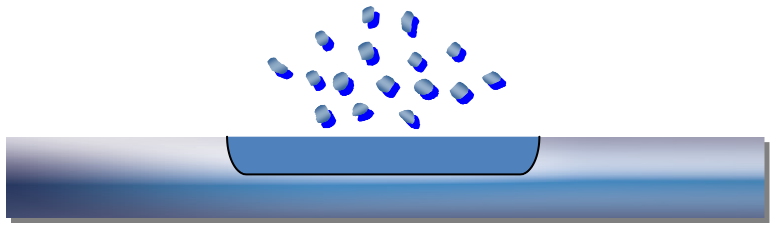
FIKE G2 Technology

G2 è un'innovativa **tecnica** costruttiva **brevettata** all'avanguardia che permette di ottenere le migliori performance perché **non utilizza la tradizionale deformazione plastica**, quindi non produce zone di stress che possono cedere a fatica

Costruzione Tradizionale
mediante azione d'indebolimento



Costruzione con G2 Technology
mediante rimozione di materiale



G2 Technology - vantaggi

- Superficie liscia senza zone di stress
- Elevate caratteristiche applicative (tol. +/-5% e O.R. 95%)
- Elevata durata ai cicli
- Alta resistenza alla contropressione

G2 Technology - vantaggi

ATLAS

- Inconel 625 (2.4856) materiale con elavata resistenza alla corrosione *(**maggior durata**)*
- Inconel 625 in accordo ai requisiti NACE MR0103 & MR0175 *(**apprezzato dall'industria – unicità: Fike Compliance Statement disponibile**)*
- Idoneo per processi che richiedono il 95% di operating ratio *(**performance di processo elevate**)*
- Non frammentabile perciò idoneo all'isolamento della PSV

Settori industriali

ATLAS

- Oil & Gas
- Processi chimici
- Seawater & Desalinizzazione
- Energia geothermica
- Carta & Cellulosa

Scrubber

Colonne di distillazione

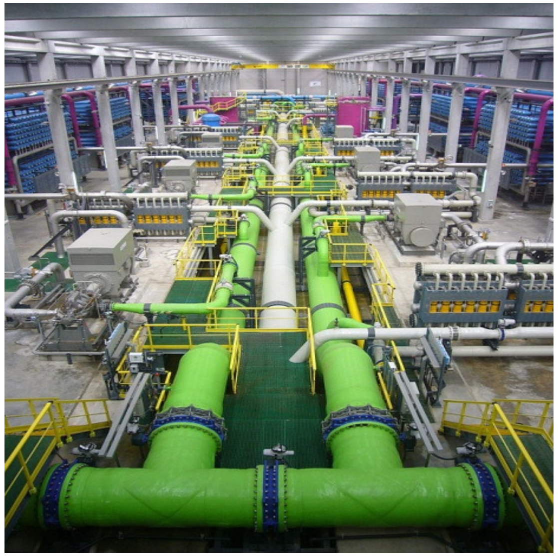
Reattori

Settori industriali

ATLAS

- Oil & Gas
- Processi chimici
- Seawater & Desalinizzazione
- Energia geothermica
- Carta & Cellulosa

Dual Media Pressure Filters



Impianti di desalinizzazione

Settori industriali

ATLAS

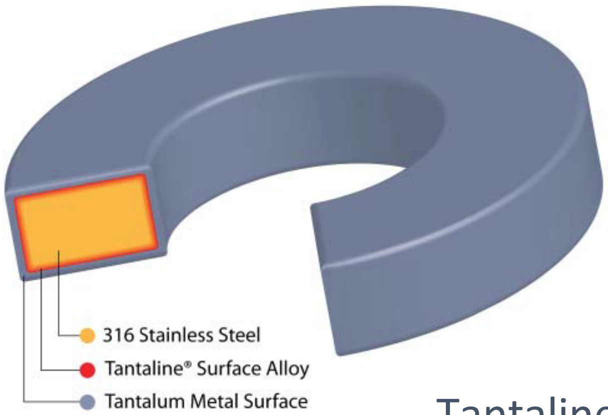
- Oil & G
- Proces
- Seawa
- Energia geothermica
- Carta & Cellulosa

Steam separator

Digester

Ulteriori possibilità

- Contenitori tantalizzati, per una migliore resistenza agli agenti corrosivi
- Soluzione meno costosa del contenitore in Tantalio
- Può offrire la copertura del 100% della superficie a contatto



Spessore di circa 50 μm

Tantaline® treated base

Guarnizioni

gaskets can be classified into two main categories:

metallic & semi-metallic gaskets

- corrugated metal gaskets
- camprofile (grooved) gaskets
- metal jacketed gaskets
- ring joints
- spiral wound gaskets
- others

non-metallic gaskets

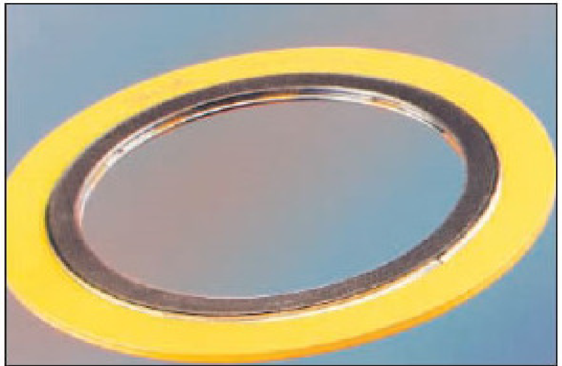
- fibre reinforced gaskets
- graphite gaskets
- PTFE gaskets
- rubber gaskets
- others

metallic or semi-metallic gaskets consists of metal or a combination of metal parts and non metal parts. these gaskets are suitable for medium and high pressure applications. metallic gaskets require a much higher quality of the sealing surface than non-metallic gaskets.

non-metallic materials are used in low to medium pressure applications usually up to nominal pressures of 40 or 63 bars on the raised face and up to 200 bars in tongue grooved flanges.

Guarnizioni spirometalliche

Flexitallic



Style CG

Style CGI

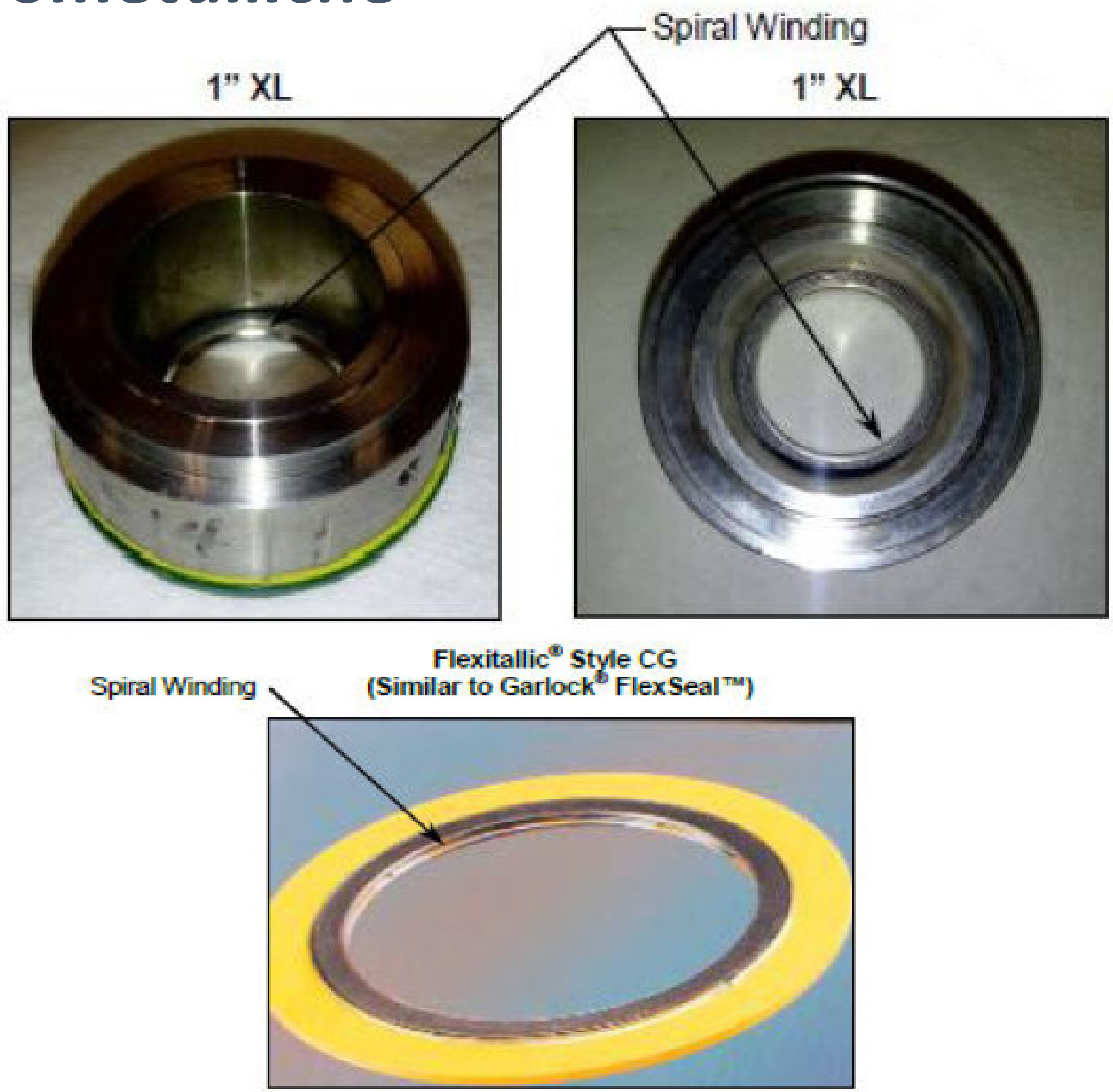
Garlock
an EnPro Industries family of companies
FLEXSEAL®

RW

RWI

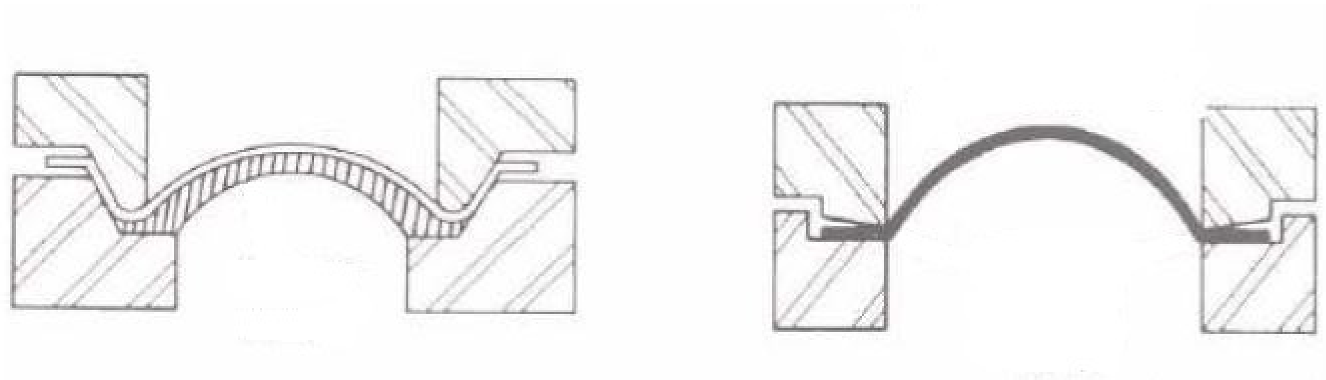
Guarnizioni spirometalliche

- Diametro interno
- Distensione



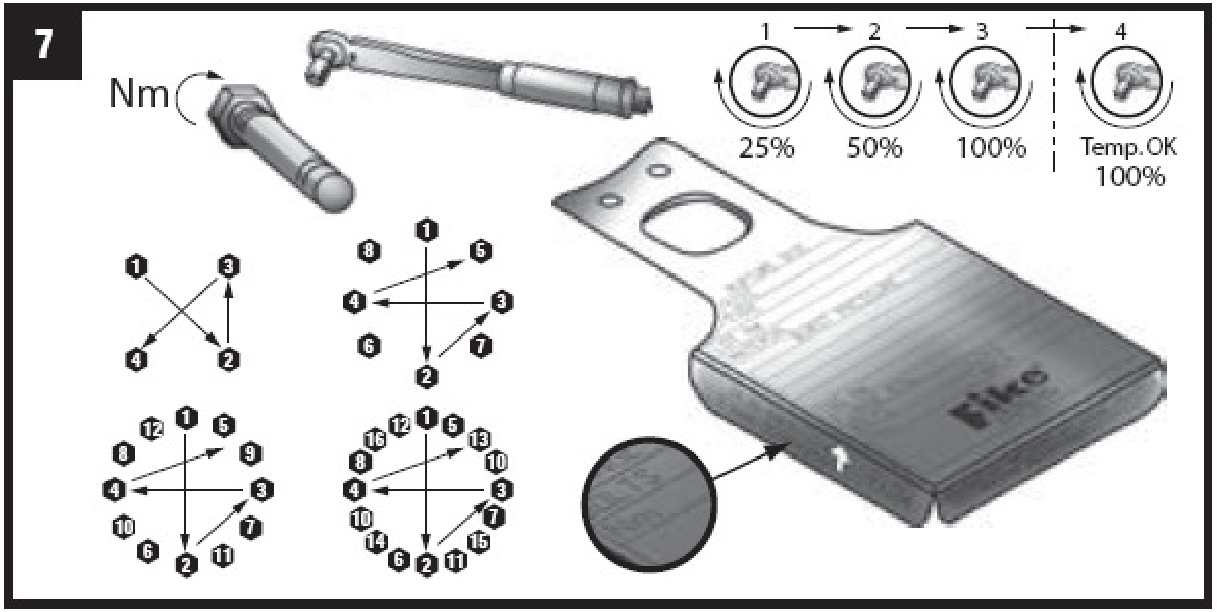
Coppia di serraggio

- Può capitare che la coppia di serraggio richiesta per i dischi di rottura sia uguale o minore della minima richiesta dalle guarnizioni spirometalliche



- I contenitori con sede a 30° sono più sensibili dei contenitori con sede piatta

Chiave dinamometrica



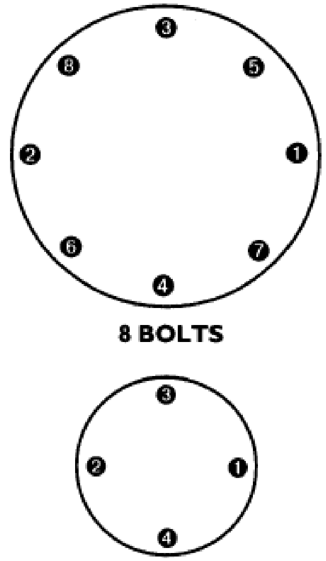


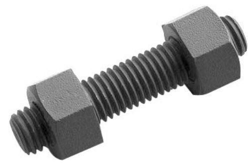
Figure 7: Bolt tigtening sequence

Table 2 – Stud Torque Values – ANSI (SRX, SRL, XL)

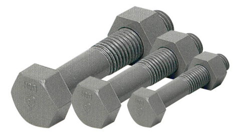
Nominal Pipe Size (in)	Torque by Flange Rating (ft-lb [N-m])					
	150 ANSI	300 ANSI	600 ANSI	900 ANSI	1500 ANSI	2500 ANSI
1"	30 [41]	60 [81]	60 [81]	160 [217]	160 [217]	160 [217]
1.5	30 [41]	100 [136]	100 [136]	245 [332]	245 [332]	355 [481]
2	60 [81]	60 [81]	60 [81]	160 [217]	160 [217]	245 [332]
3	60 [81]	100 [136]	100 [136]	160 [217]	355 [481]	500 [678]
4	60 [81]	100 [136]	160 [217]	355 [481]	500 [678]	800 [1,085]
6	100 [136]	100 [136]	245 [332]	355 [481]	680 [922]	2,200 [2,983]
8	100 [136]	160 [217]	355 [481]	680 [922]	1,100 [1,491]	2,200 [2,983]
10	160 [217]	245 [332]	500 [678]	680 [922]	2,000 [2712]	4,400 [5,966]
12	160 [217]	355 [481]	500 [678]	680 [922]	2,200 [2,983]	5,920 [8,026]
14	245 [332]	355 [481]	680 [922]	800 [1,085]	3,180 [4,312]	N/A
16	245 [332]	500 [678]	800 [1085]	1,100 [1,491]	4,400 [5,966]	N/A
18	355 [481]	500 [678]	1100 [1491]	2,000 [2712]	5,920 [8,026]	N/A
20	355 [481]	500 [678]	1100 [1491]	2,200 [2,983]	7,720 [10,467]	N/A
24	500 [678]	800 [1085]	2000 [2712]	4,400 [5,966]	11,651 [15,797]	N/A

ANSI

filetto UNC



EN



filetto metrico


QUESTIONS?

BECAUSE SO MUCH
IS AT STAKE™