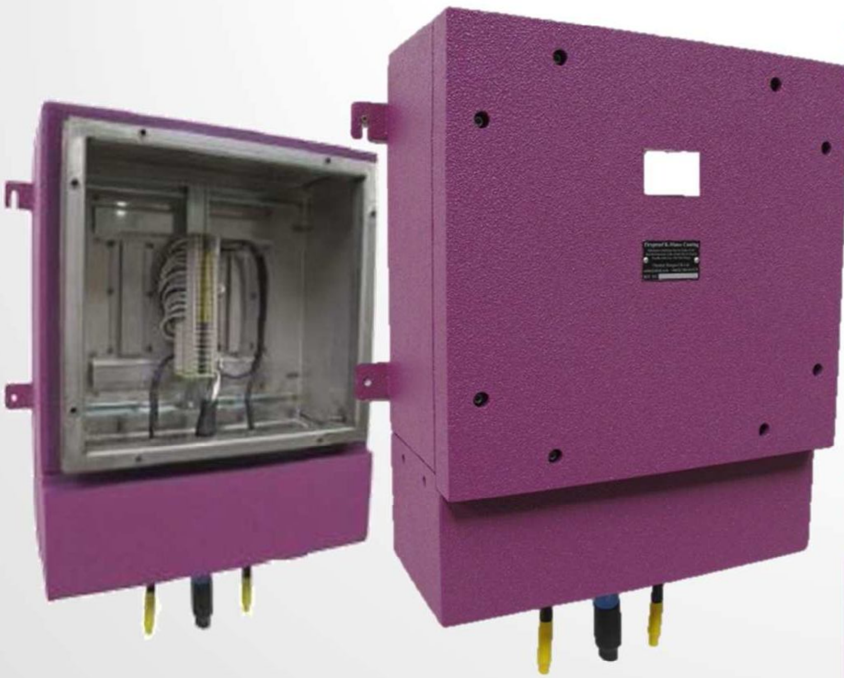
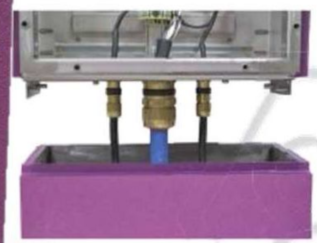
K-Mass® ATEX junction boxes

Thermal Designs UK LTD in partnership with Hawke International has produced a unique range of ATEX junction boxes fireproofed an tested to UL1709.



Technical Data

- Increased Safety Ⓔ II 2 GD Exe II ExtD.
- Apparatus Certificate No's: Baseefa08ATEX0208X and IECEx BAS 08.0065X.
- Suitable for use in: Zone 1, Zone 2, Zone 21 and Zone 22.
- Construction and Test Standards: IEC/EN 60079-0, IEC/EN 60079-7, IEC/EN 61241-0 and IEC/EN 61241-1.
- Ingress Protection: IP66 to IEC/EN 60529.
- Deluge Protection to DTS01.
- Operating Temperature Range: -60°C to +80°C. Temperature Class and Ambient: T6 40°C, optional T5 with ambients up to 65°C.
- 160mm, 210mm and 300mm deep options available.
- Suitable for critical low current Control and Instrumentation applications.



- K-Mass® can be added to Hawke Enclosures with minimal increase to the overall footprint.
- Adding K-Mass® to a Hawke Enclosure does not affect the certification, or the functionality of the enclosure. Not only is the enclosure protected, the glands are encased as well to ensure maximum protection and safety.
- All Hawke enclosures are tested and certified to the latest standards to ensure we are constantly providing a safe product to the hazardous area industry.

- K-Mass® can be moulded to any of the Hawke Stainless Steel Enclosures without interfering with the easy access to terminals and cable glands for maintenance and/or inspection purposes.
- Moulding K-Mass® to the Hawke Enclosure means that the fire protection cannot be omitted.
- Robust 316 Stainless Steel construction **with 3mm thick gland plates.**
- K-Mass® protection does not insulate like other forms of fire protection and will only be activated during a fire.

- Rigid slotted external mounting feet allow the enclosure to be mounted on most structures.
- Internal / External Earth.
- Superior one piece silicone sponge gasket providing IP66 and DTS01 protection.
- Terminal and entry configuration to suit customer requirements.
- Single gland plate can be specified on Face C.

ORDERING INFORMATION

The SK Range is available as an option to our standard S Range of Enclosures.

Ordering Examples:

SK6 = Size 6 with K-Mass® coating

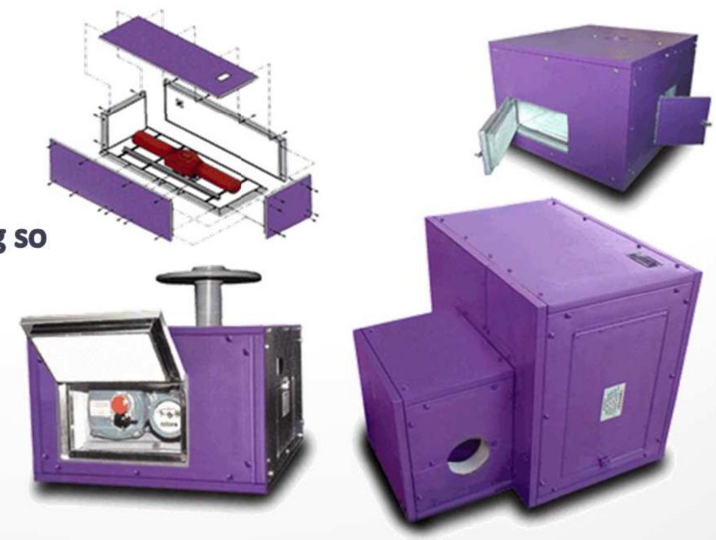
SK2L = Size 2L with K-Mass® coating

Please contact our Sales Department for further information.

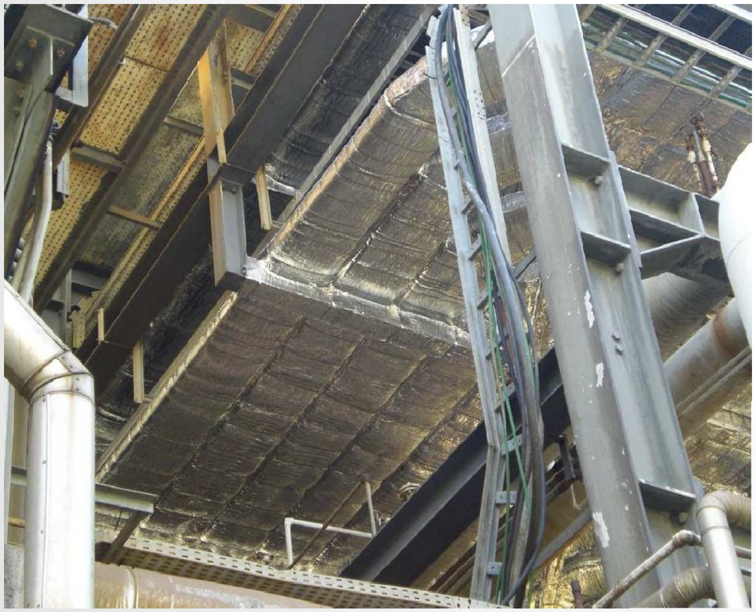
K-Mass Lite® enclosure

This is a new product introduced by Thermal Designs where customers insists on an enclosure or when retro fitting on installed equipment.

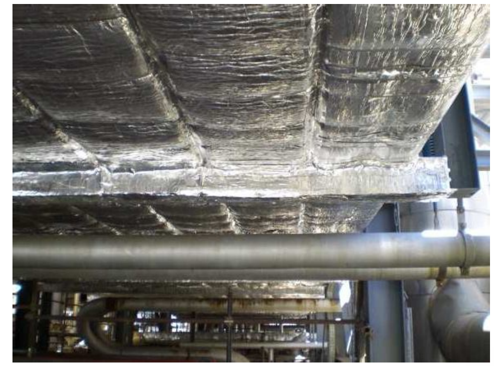
- **Enclosures are inherently not people proof.**
- **All panels are independently removable so access for maintenance is greatly simplified.**
- **K-Mass Lite® enclosures are designed to be self supporting so no additional support structure is required.**
- **Tested and certified by Thermal Designs to meet UL1709.**
- **Unlike traditional fire boxes K-Mass Lite® can be drilled anywhere on the enclosure for pipes and tubes. All that is required is for any penetration to be sealed with mastic.**
- **If required K-Mass Lite® can be vented to prevent build up from stem leaks.**

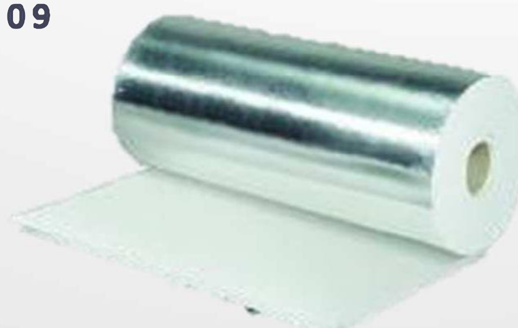


Thermal Designs UK LTD
Fire Protection Specialists



Cable tray protection to UL1709 (1hour)





3M

Thermal Designs UK LTD

Thank you for your time

May we take this opportunity on behalf of Thermal Designs UK and myself to thank you for your time and attention.

We would welcome any questions

PYRO ELECTRIC®
An ISO 9001:2008 Certified Company

ASME PTC 19.3 TW -2010

A manufacturers perspective

Pyro Electric Instruments Goa Pvt. Ltd. www.pyro-electric.in
G/B, Hill Crown, College Road, Mapuca, GOA – INDIA 403507. **Tel.:** 91-832-2264391 / 2252719, **Fax.:** 91-832-2263294. **Email:** pyroadmin@pyro-electric.in

Temperature Pressure Flow

THERMOWELL LEGACY :

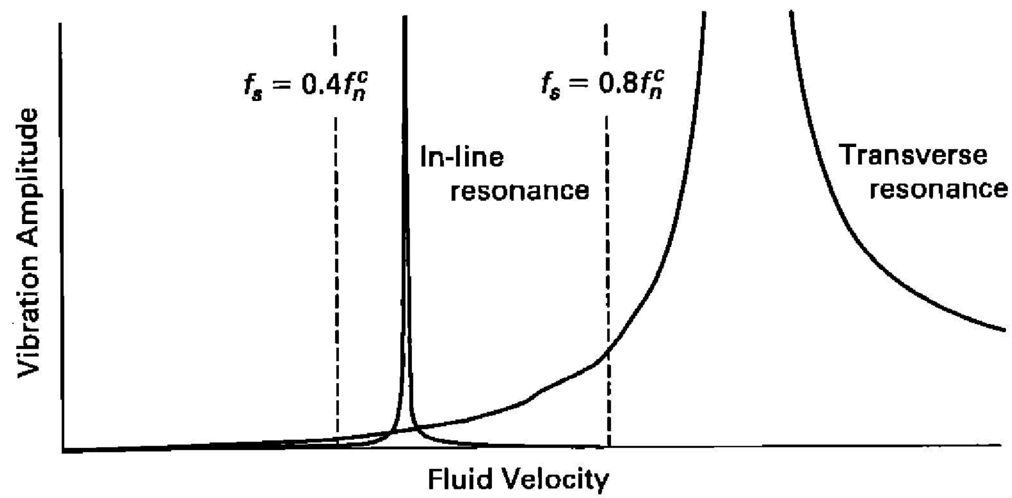
- Thermowell as an instrumentation 'bulk' item
- Dimensional specifications provided during MR
- Engineering carried out at post-order stage
- 'No deviation' philosophy at MR stage
- Safe design frequency and stress analysis awareness
- Design change costs during approval phase remain contentious
- Execution delays.

WHAT THE NEW STANDARD SAYS :

- **Evaluate natural frequency fn with corrections**
- **Evaluate Strouhal frequency fs with Strouhal number which is dynamic**
- **Calculate Scruton number and Reynolds number and eliminate low density media and low velocity cases**
- **Check for in-line frequency resonance first, double check with cyclic stress (steady state and oscillating)**
- **Place the thermowell in safe zone with appropriate ratio**
- **Check for design pressure compliance as well.**

Pyro Electric Instruments Goa Pvt. Ltd. www.pyro-electric.in
G/B, Hill Crown, College Road, Mapuca, GOA – INDIA 403507. Tel.: 91-832-2264391 / 2252719, Fax.: 91-832-2263294. Email: pyroadmin@pyro-electric.in

Fig. 6-8.1-2 Schematic Showing the Amplitude Response of a Thermowell Subjected to Fluid-Induced Forces as Solid Lines, for In-Line and Transverse Excitation Modes



GENERAL NOTE: The frequency limits discussed in paras. 6-8.2 to 6-8.4 are shown as dotted lines. The figure ignores lock-in effects, which can shift the locations of the resonances, as shown in Fig. 6-8.1-1.

Typical calculation of a drilled bar-stock flanged thermowell

Well type : Drilled barstock SS316L made from 36mm dia bar

Insertion length 'U' : 400mm

Extension length 'T' : 63mm

Shank type : Tapered from 21mm to 16mm overall

Process connection : 1.5"150#RF in F316L

Reference cost price : Rs 3300

Result of calculation : Failed due to high vortex shedding frequency

CHANGES MADE FOR ARRIVING AT A SAFE DESIGN

Insertion length 'U' : 400mm (unchanged)

Shank type : Straight 37mm overall

Process connection : 2"150#RF in F316L

Result : Passes for frequency resonance.
Design is safe as per ASME PTC 19.3 TW – 2010

CHANGE IN SPECIFICATION TO BE ADOPTED :

- Thermowell to be manufactured from 40mm diameter round bar-stock.
  (instead of 34 or 36 mm)
- Flange size changed from 1.5" to 2"
- Increased cost of thermowell : Rs 4585
- Percentage increase in cost : Approximately 38% over original price

MANUFACTURERS INVOLVEMENT IN SUCH CHANGES :

1) Approval from engineering consultant for change in piping nozzle

2) Extensive interaction with instrumentation team to get the change accepted.

3) Trade off between thermowell strength and response time of sensor – check the requirement of process.

4) Clarifying the myth about 'thumb rules' of thermowell insertion - 1/3 or 1/2

5) Educating the client about the compliances of the PTC code and its applicability for different thermowell designs

MANUFACTURERS PERSPECTIVE…

1) Classify thermowell as an 'engineered' product – similar to a flow element or a control valve

2) Allow engineering of thermowell at the MR stage & not at PR stage

3) Greater interaction during MR stage

4) Standardize few possibilities of thermowell designs over a period based on typical design conditions

THANK YOU FOR A PATIENT HEARING

ASME PTC 19.3 TW, 2010
Latest Requirements.

Rejath Jacob Thomas
TECHNIP KT India Limited

Technip
take it further®

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13. Resonance
14. Frequency ratio Limits.
15. Stress & Pressure Calculations
16. Strength Vs Response

Criticality of Thermowells

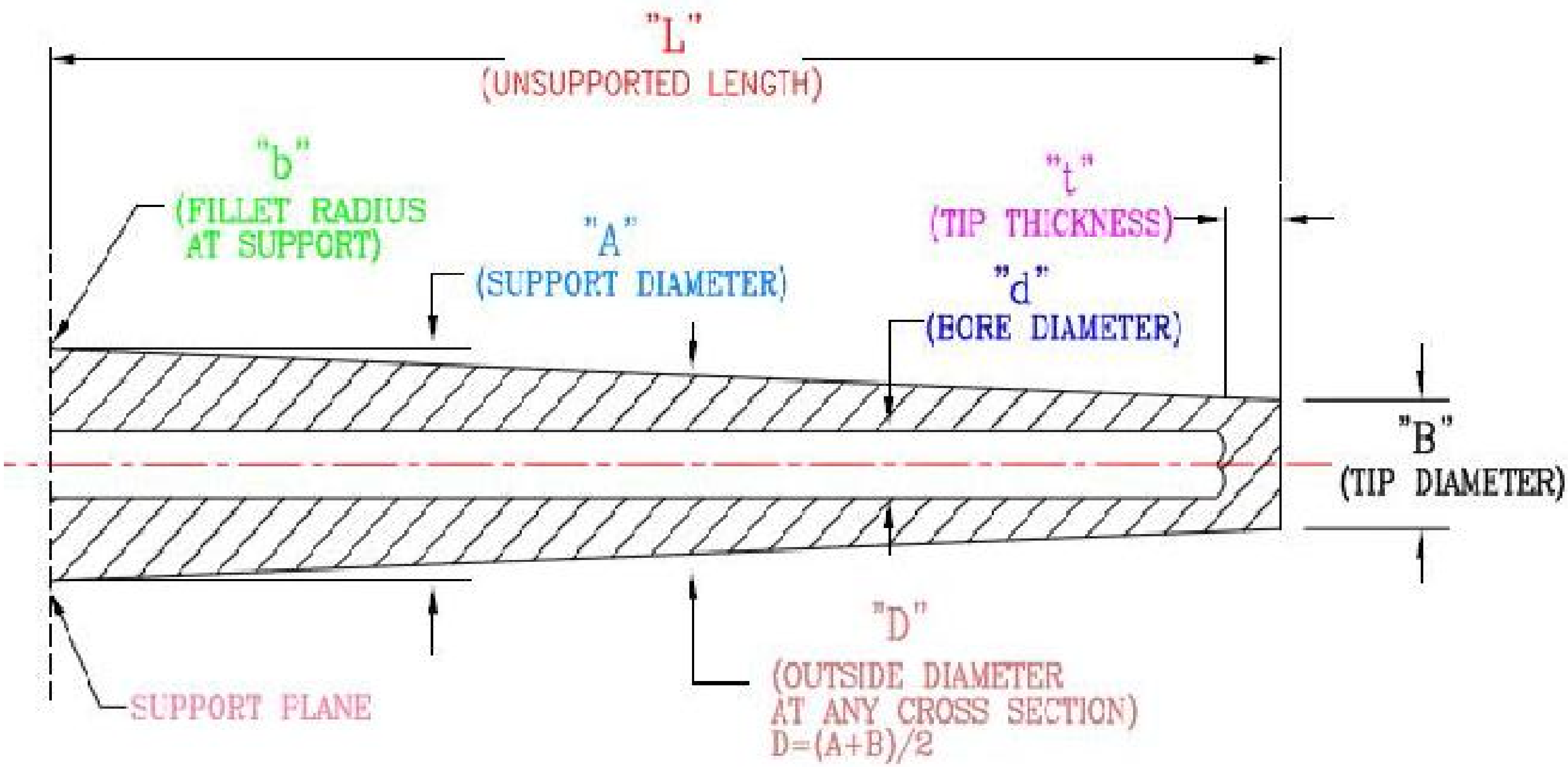
Thermowells – Why so critical / Special ?

- **The thermowell to function properly, needs to sit directly on the process or need to see the process directly .**
- **When Thermowell fails . . .**
  - **No isolation possible.**
  - **Leads to hazardous situation leading to personal and environmental consequences.**
  - **Plant shutdown warranted.**
  - **Significant loss of production and related economic loss.**

Technip

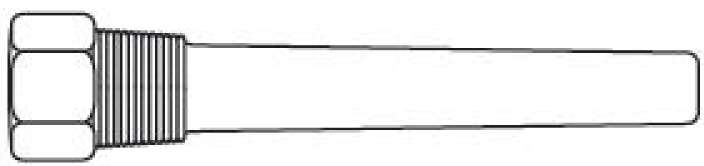
Thermowells – Terms and Defenitions

Thermowell – Terms and Definitions.

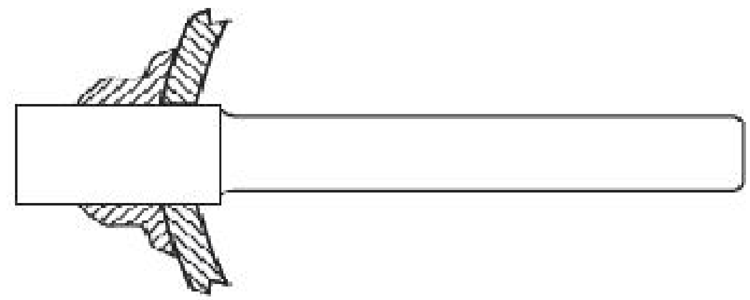


Thermowell Types

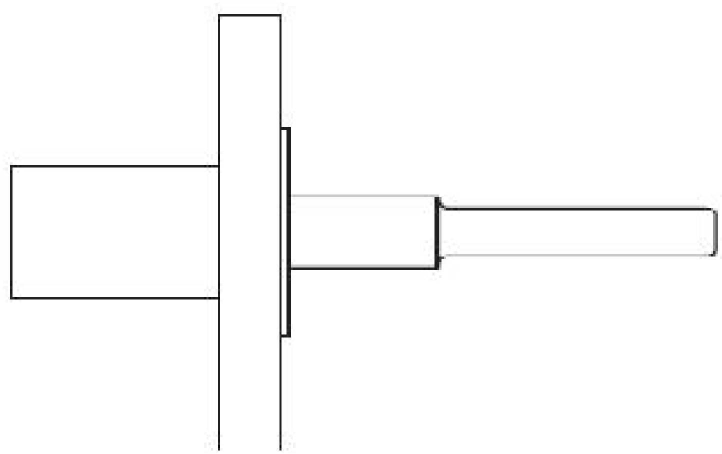
Thermowell Types



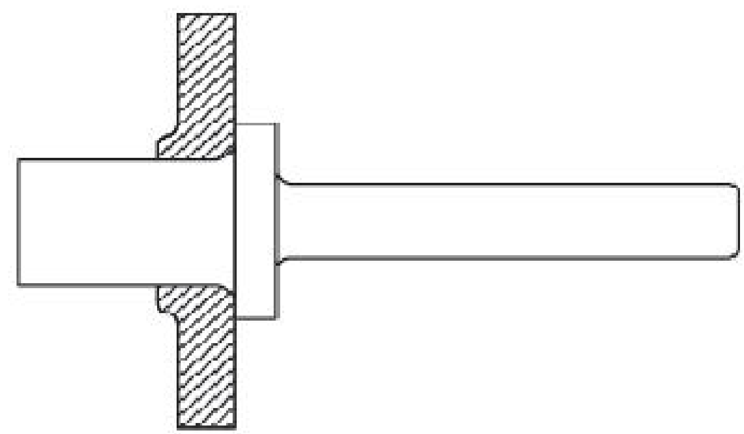
(a) Tapered-Shank Threaded Thermowell



(b) Straight-Shank Socket Weld Thermowell



(c) Step-Shank Flanged Thermowell



(d) Straight-Shank Lap-Joint (Van Stone) Thermowell

History

History

1959

In 1959 J W Murdock published a paper against a request to ASME PTC 19.3 committee for a review of the supplement on temperature measurement dealing with Thermowells - **14 pages**.

1974

On the basis of the paper published by J W Murdock, revised standard for thermowell design was prepared by the ASME committee and was accepted as ASME PTC 19.3 – 1974 (for Steam Service) - **4 pages**.

2010

ASME PTC 19.3 committee started reviewing a draft version of TW specific subsection in 1999. The review indicated major flaws and shortcomings in the standard. A completely revised standard "ASME PTC 19.3 TW 2010" was adopted in Feb-2010 and was further approved by ANSI in April-2010 - **40 pages**.

Thermowell Failure

1995 – Japan ; Monju Fast Breeder Reactor

- In 1995 a thermowell failed in the secondary coolant loop of the Monju fast breeder reactor in Japan.
- The failure closed the plant for 15 years

- The thermowell was designed to ASME PTC 19.3 1974
- The failure was found to be due to the drag resonance induced on the thermowell by the liquid sodium coolant

PTC 19.3 TW - Objective

Objective - ASME PTC 19.3 TW

- The ASME PTC 19.3 TW is a thermowell stress calculation, which serves as a mathematical proof that the material chosen and the mechanical design will not fail given the effects of the operating conditions.
- The calculation provides guidance for establishing a comparison between the vortex shedding frequency and the natural frequency of the thermowell.
- Establishes a mechanical design standard for reliable service of tapered, straight and stepped shank thermowells in a broad range of applications.
- Evaluates the forces by external pressure and the combination of static and dynamic forces resulting from fluid impingement and further, the suitability of the thermowell, against them.

A Comparison
PTC 19.3 (1974) Vs PTC 19.3 TW (2010)

Comparison : PTC 19.3 & PTC 19.3 TW

A comparison between 1974 and 2010 standards.

Sl No.	Description	PTC 19.3 (1974)	PTC19.3 TW (2010)
1	Shank/Stem Style	Tapered or Straight	Tapered, Straight or Stepped
2	Welds along the stem	Unstated	Not Allowed
3	Coating or weld deposits on stem	Unstated	Not Allowed
4	Velocity Collar	Unstated	Indicates that collars are not recommended and are outside scope
5	Installation Shielding	Not Covered	Minor reduction on the impact of stress on the well.
6	Erosion and Corrosion	Not Covered	Factors considered in calculation
7	Manufacturing Tolerances	Not Covered	Provided

Comparison . . . contd.

Sl No.	Description	PTC 19.3	PTC19.3 TW
8	Velocity Range	< 300 fps	No Limits
9	Process	Steam Services	No Limits
10	Life Cycle	Unstated	10^{11} Cycles
11	Process Connections	Not Mentioned	Flanged, Weld-in, Socket weld, threaded acceptable. Ball joints, Spherical unions and Packing glands not permissible.
12	Calculation of Natural Frequency	Based on well length, modulus of elasticity and well material density.	Additionally also considers sensor mass, process fluid mass, bore size, well mass, well diameter, beam correction, shape and installation particulars.
13	Calcn of Wake Frequency	Strouhal No./tip dia ; Fixed Strouhal No. = 0.22	Strouhal No. modified with viscosity.

Comparison . . . contd.

Sl No.	Description	PTC 19.3	PTC19.3 TW
14	Resonance Calcn	Only Transverse (lift) Resonance	Both Inline (drag) and Transverse (lift) Resonance verified
15	Frequency Ratio	Limited to 0.8 of Resonance Frequency	Limitation up to 0.4 of Resonance Frequency, based on applications.
16	Stress Calcn.	Steady State Stress	Both Steady State and Dynamic Stress against fatigue limits.
17	Pressure	Tip and Stem Pressure	Additionally also considers pressure/temp ratings for flanged thermowell.

Scope

Scope

- Covers
  - Thermowells machined from barstock
  - Straight, tapered or stepped shank.
  - Threaded, flanged, van stone or welded process connection.
  - Surface finish of 32µin.Ra or better.

Scope

. . . Contd.

- Excludes
  - TW manufactured from pipe
  - TW with specially designed surfaces (eg. knurled, with spiral ridges etc.)
  - TW fabricated in piece construction (welding of the shanks in sections)
  - TW with shanks that includes flame spray, weld overlays along the shank or at the tip
  - Ceramic wells or any non-metallic or exotic metals

Scope

. . . Contd.

- Excludes
  - Standard dimensions
  - TW attachment methods
  - Parasitic vibration of sensor inside the TW
  - Thermal equilibrium of sensor with process

Thermowell - Material

Thermowell Materials

- Material Selection shall be
  - Governed by the strength requirements and possible corrosion.
  - Shall be of forged or bar stock type.
  - Shall confirm to the governing code.
  - Non ASTM, ANSI, ASME material may be used subject to
    - Agreement between designer and supplier
    - Confirm to published specification
    - Allowable stresses shall as per PTC 19.3 TW

Design Criteria

Design Criteria

Four (4) quantitative criteria in ASME PTC 19.3 TW-2010.

- **Frequency Limit :** The resonant frequency of the thermowell must be sufficiently high so that destructive oscillations are not excited by the fluid flow.

- **Dynamic Stress Limit :** The maximum primary dynamic stress must not exceed the allowable fatigue stress limit. Evaluation done for both in-line (drag) resonance and transverse (lift) resonance.

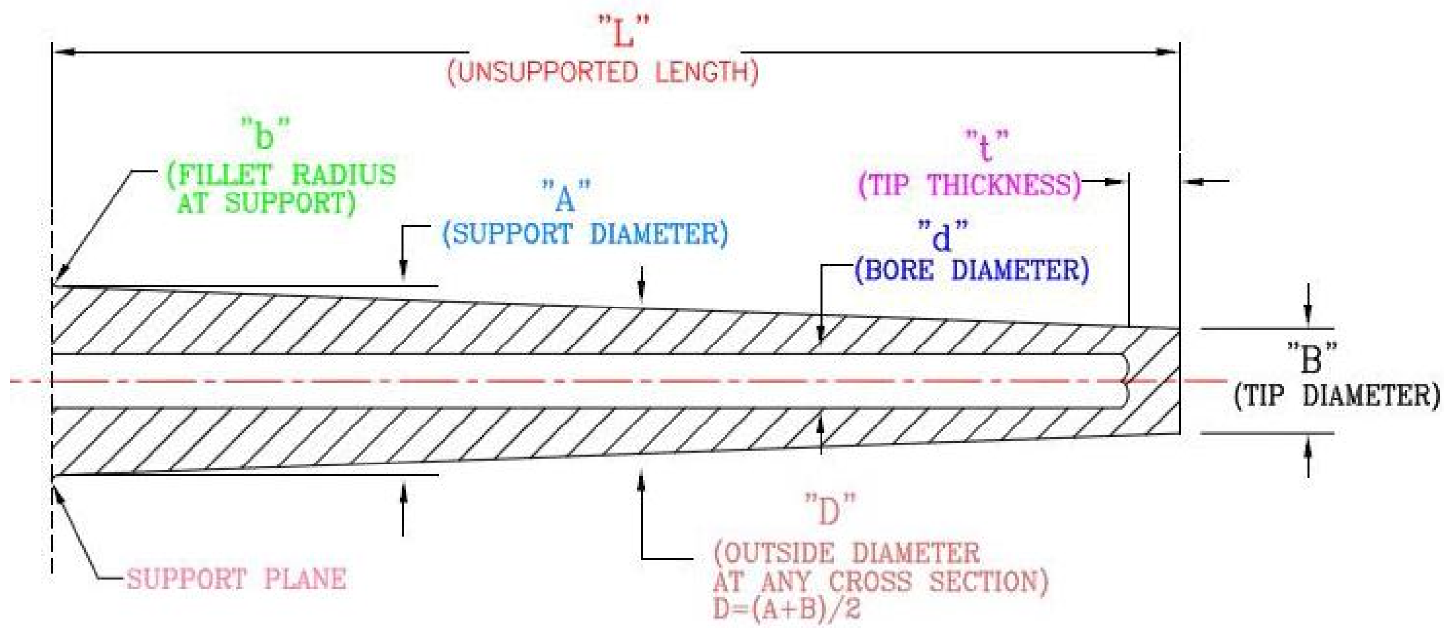
Design Criteria . . . Contd.

- **Static Stress Limit :** The maximum steady-state stress on the thermowell must not exceed the allowable stress, as determined by the Von Mises criteria.

- **Hydrostatic Pressure Limit :** The external pressure must not exceed the pressure ratings of the thermowell tip, shank and flange or threads.

Dimensional Limits

Straight and Tapered Thermowell



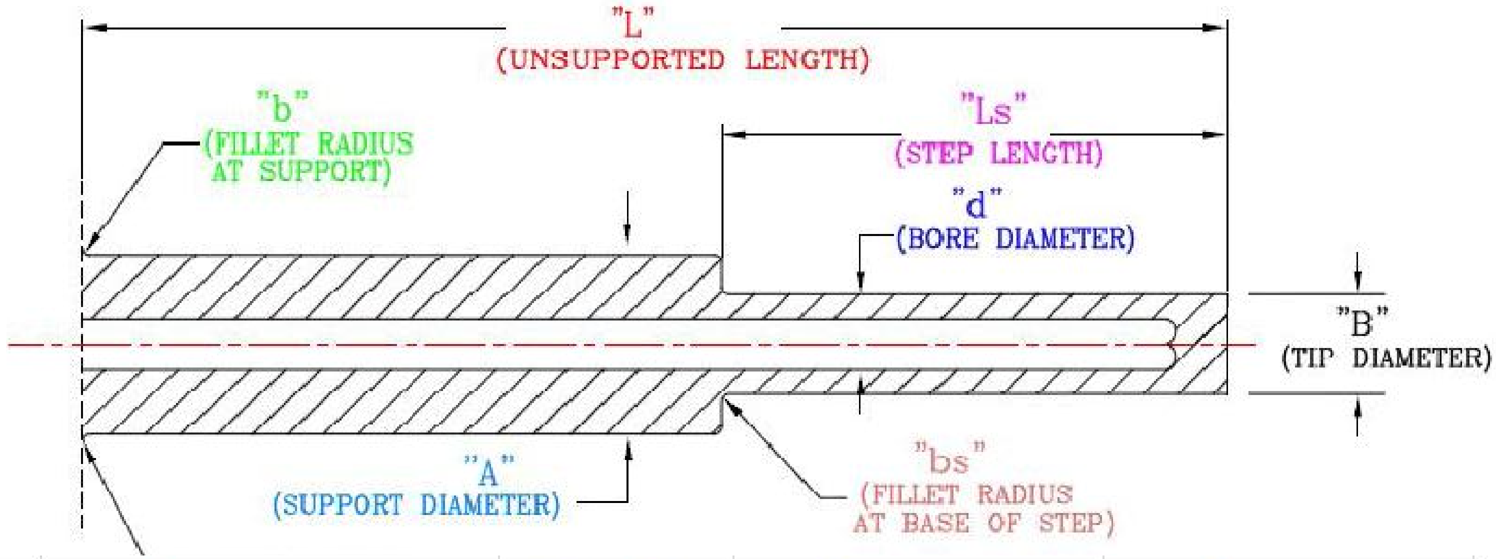
Dimension	Symbol	Minimum	Maximum
Unsupported Length	L	6.25 cm (2.5") Note-1	60.96 cm (24") Note-2
Bore Diameter	d	0.3175 cm (0.125")	2.0955 cm (0.825")
Tip Diameter	B	0.92 cm (0.36")	4.65 cm (1.83")
Taper Ratio	B/A	0.58"	1
Bore Ratio	d/B	0.16	0.71
Aspect Ratio	L/B	2	
Wall Thickness	(B-d)/2	0.30 cm (0.12")	

Notes

1 TWs of length less than the minimum specified require design methods outside the scope of this Standard

2 Maximum specified length may be exceeded, provided shanks are of single piece and drilled bar-stock

Step-Shank Thermowell



Dimension	Symbol	Minimum	Maximum
Unsupported Length	L	12.7cm (5")	60.96 cm (24")
Bore Diameter	d	0.61cm (0.24")	0.67cm (0.265")
Step Diameter Ratio, for B=1.270 cm (0.5")	B/A	0.5	0.8
Step Diameter Ratio for B= 2.223 cm (0.875")	B/A	0.583	0.875
Length Ratio	Ls/L	0	0.6
Wall Thickness	(B-d)/2	0.30 cm (0.12")	
Tip Diameter (Note-1)	B	1.270 cm (0.5") & 2.223 cm (0.875")	

Notes

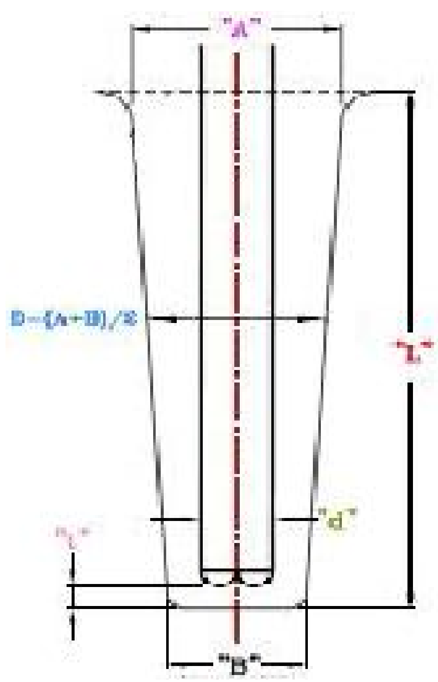
1 The methods presented in this standard apply for other tip diameters than those specified

Low Fluid Velocities

Low Fluid Velocities

At very low fluid velocities, the risk or chances of thermowell failure is greatly reduced.

The calculations of natural frequency and corresponding frequency limits, steady state stress and oscillating stress are not required to be performed provided the following criteria are met.

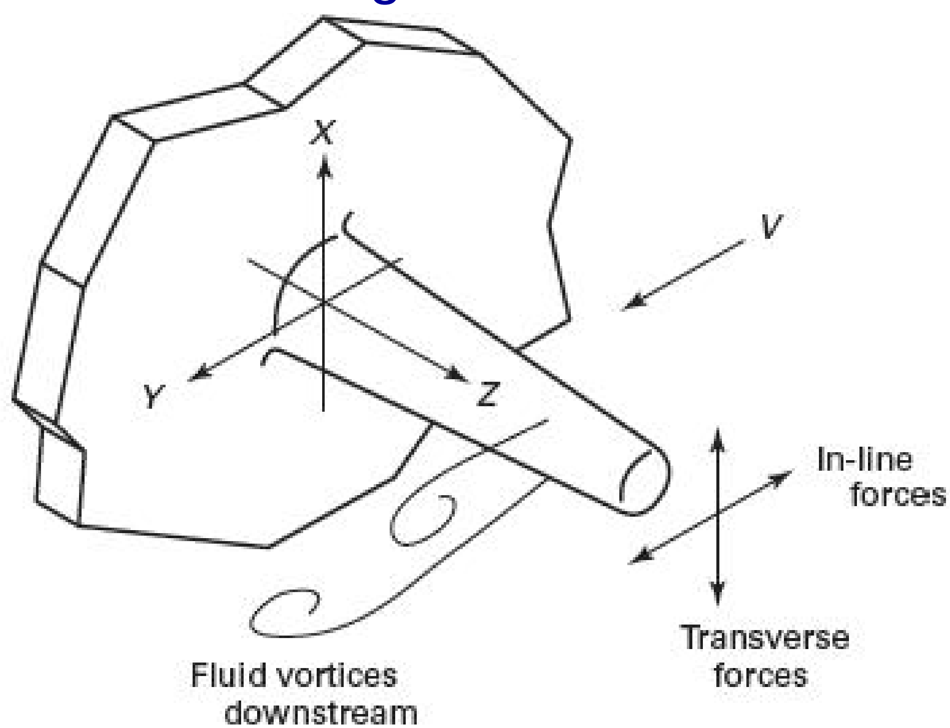


- Max process fluid velocity ≥ 0.64 m/s (2.1 ft/sec)
- The thermowell dimensions to satisfy the limits
  - A-d > 9.55 mm (0.376 in.)
  - L < 0.61 m (24 in)
  - A > B > 12.7 mm (0.5 in)
- The thermowell material satisfies S > 69 MPa (10 ksi) and Sf > 21 MPa (3 ksi)

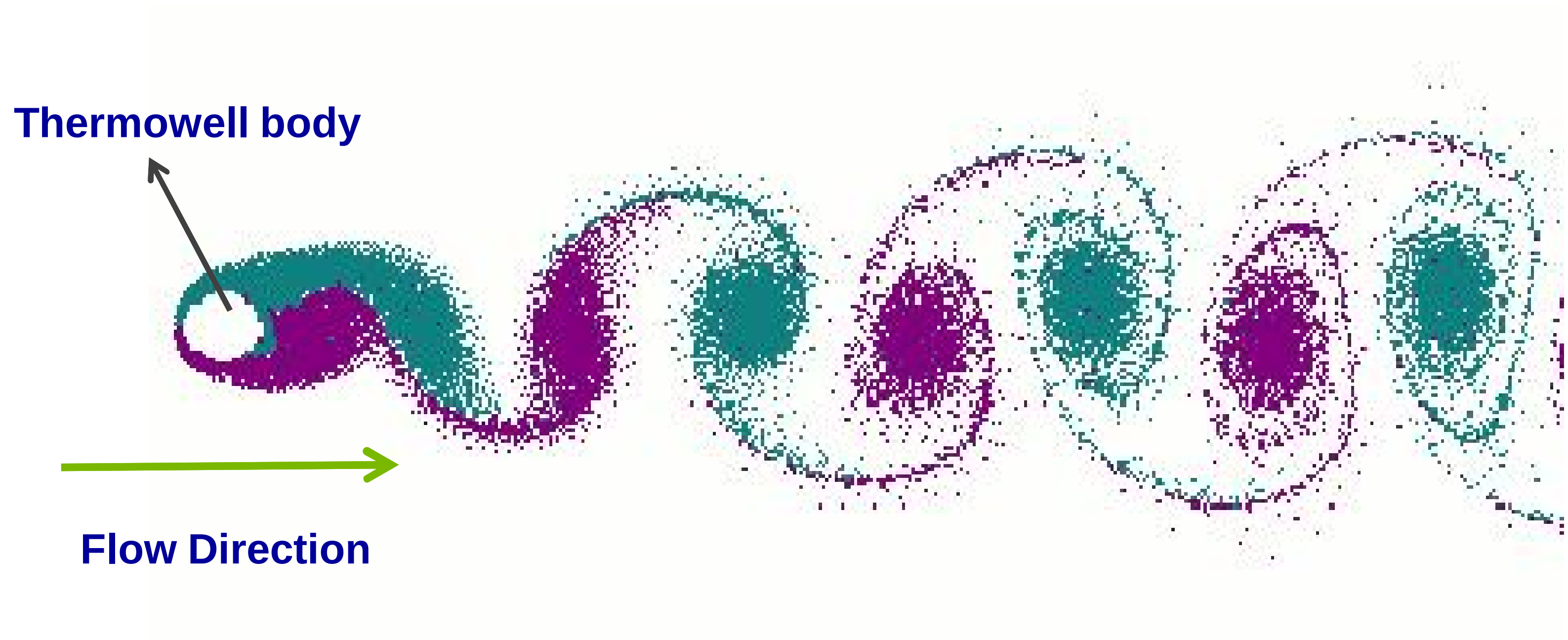
Vortex Shedding

Vortex Shedding

When a thermowell is inserted into the process line, it obstructs the flow, which leads to a pressure drop. This phenomenon creates low pressure vortices downstream of the thermowell. These vortices occur alternately at one side of the thermowell and then on the other, which is known as alternating vortex shedding also known as Von Karman Vortices.



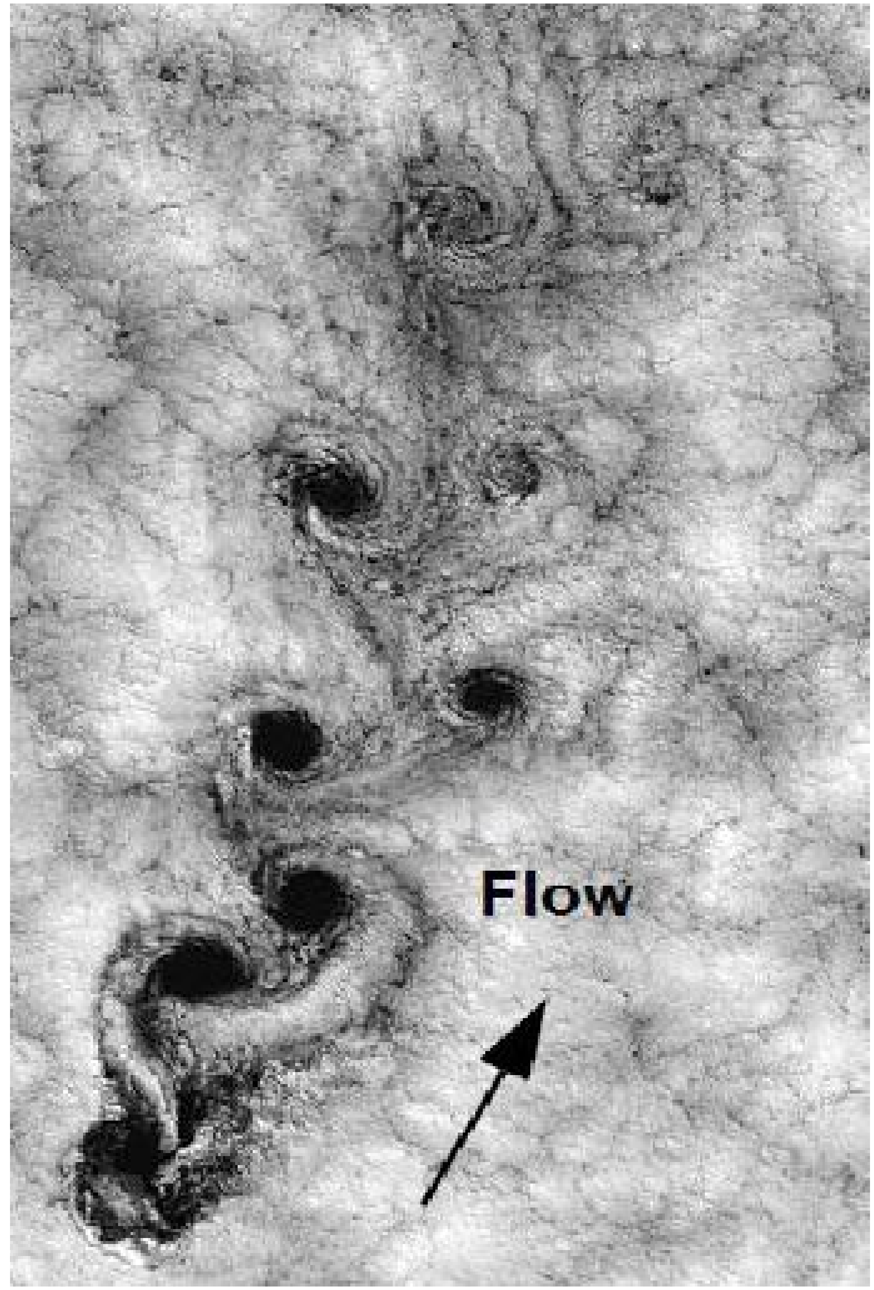
Vortex Shedding



An animated presentation of vortices created due to flowing fluid across a cylindrical body (thermowell).

Vortex Shedding

**A real image of a
Von Karman Vortex Street
formed among the clouds,
when passing a mountain.**



Vortex Shedding

The effect of vortices can be seen in the example of flag poles creating ripples on the flags when the wind flows across the poles.

Vortex Shedding - Strouhal Number

The Strouhal number is a key component of the wake frequency calculation. It describes oscillating flow and varies depending on flow conditions.

The frequency of Vortex shedding f_s is related to the fluid velocity by a dimensionless number *"Strouhal Number – N_s"*

$$f_s = N_s * V / B$$

- f_s – **Vortex Shedding Rate**
- N_s – **Strouhal Number**
- V – **Fluid Velocity**
- B – **Tip Diameter of the Thermowell**

Vortex Shedding - Strouhal Number

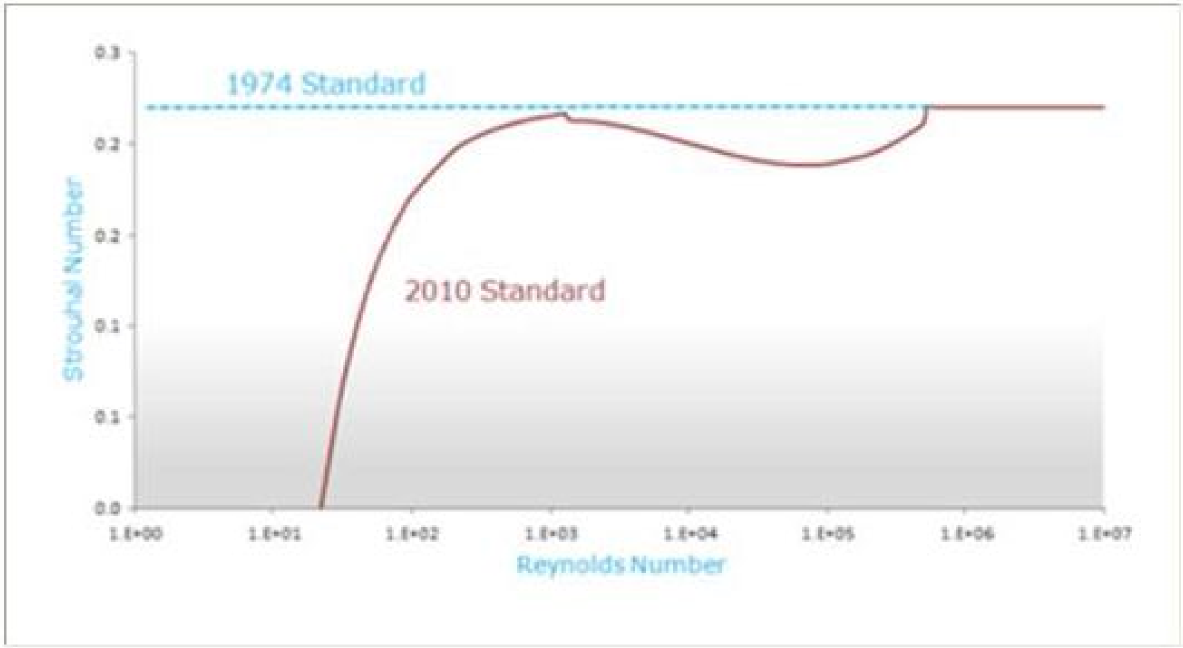
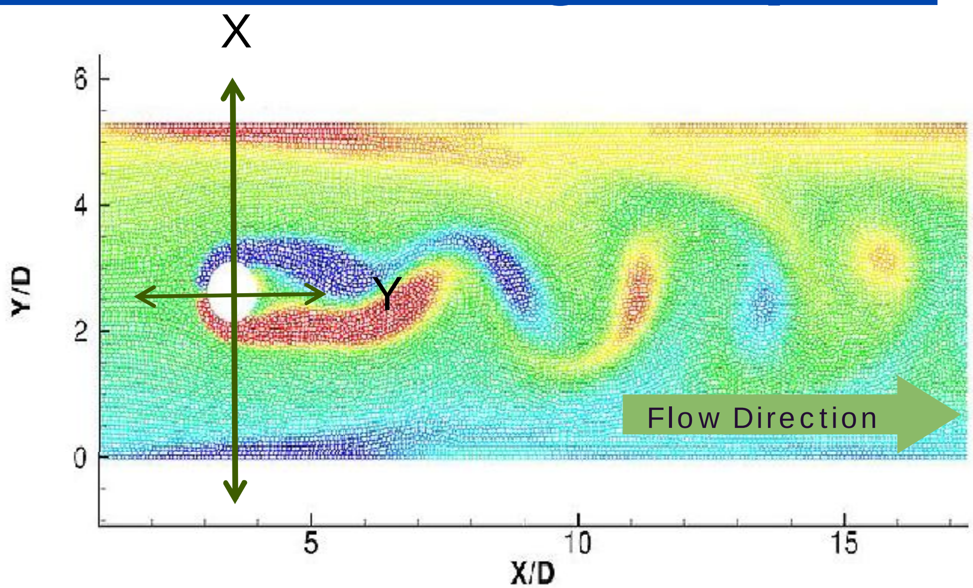


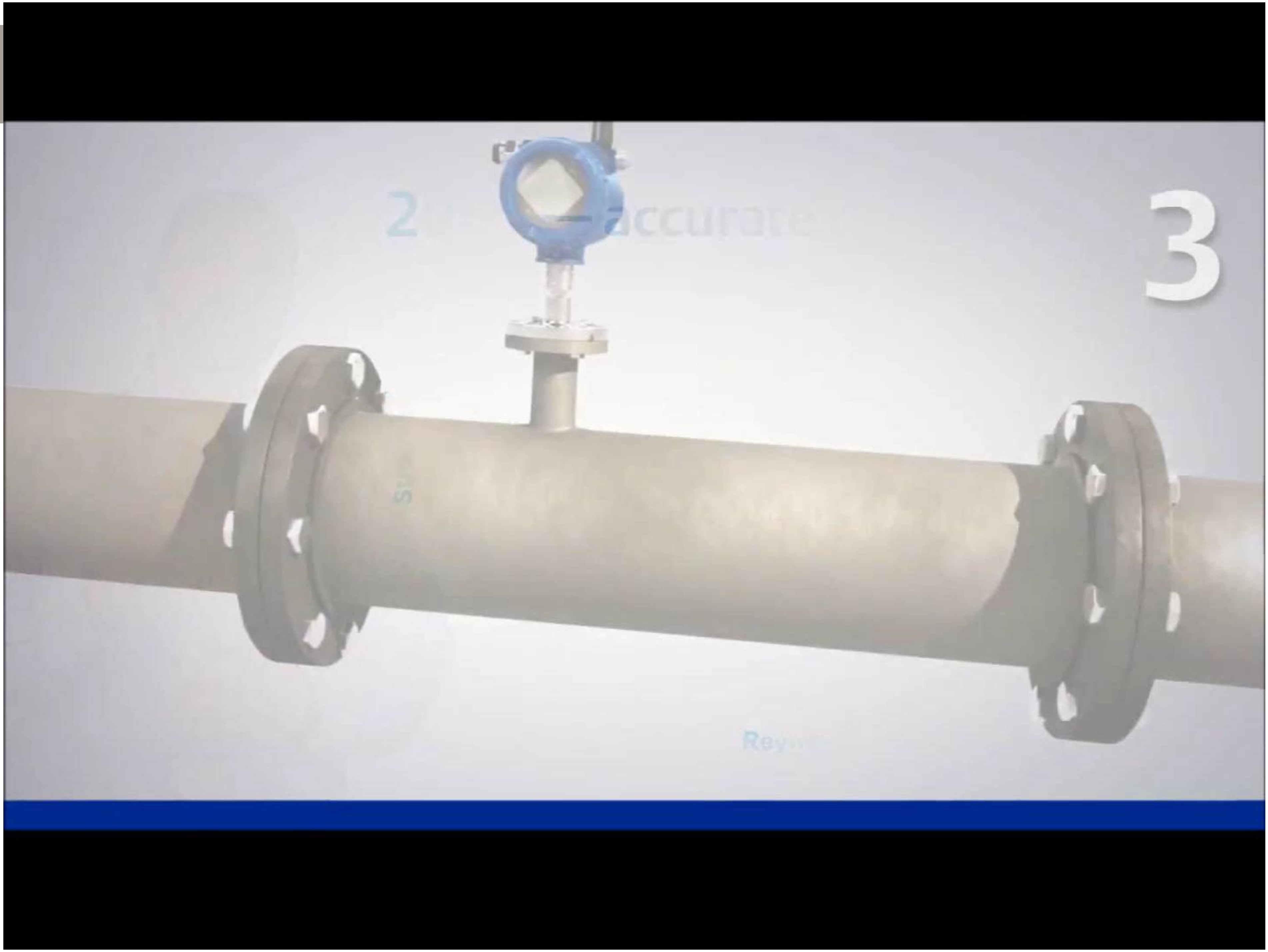
Figure 2. *Strouhal number in relation to Reynolds number for ASME thermowells*

Comparison of Strouhal Number calculated based 1974 standard and 2010 standard.

Vortex Shedding - Impact



- **Vortex shedding causes the thermowell to vibrate.**
- **The vortices produces two types of forces on the thermowell**
  1. **Forces created in the Y plane (in-line with flow) are called drag at frequency,** (f_s)
  2. **Forces created in the X plane (transverse to flow) are called lift at frequency,** ($2f_s$)
- **As the velocity of the fluid flow increases the rate of shedding increases linearly, while the magnitude of forces increases with the square of the fluid velocity.**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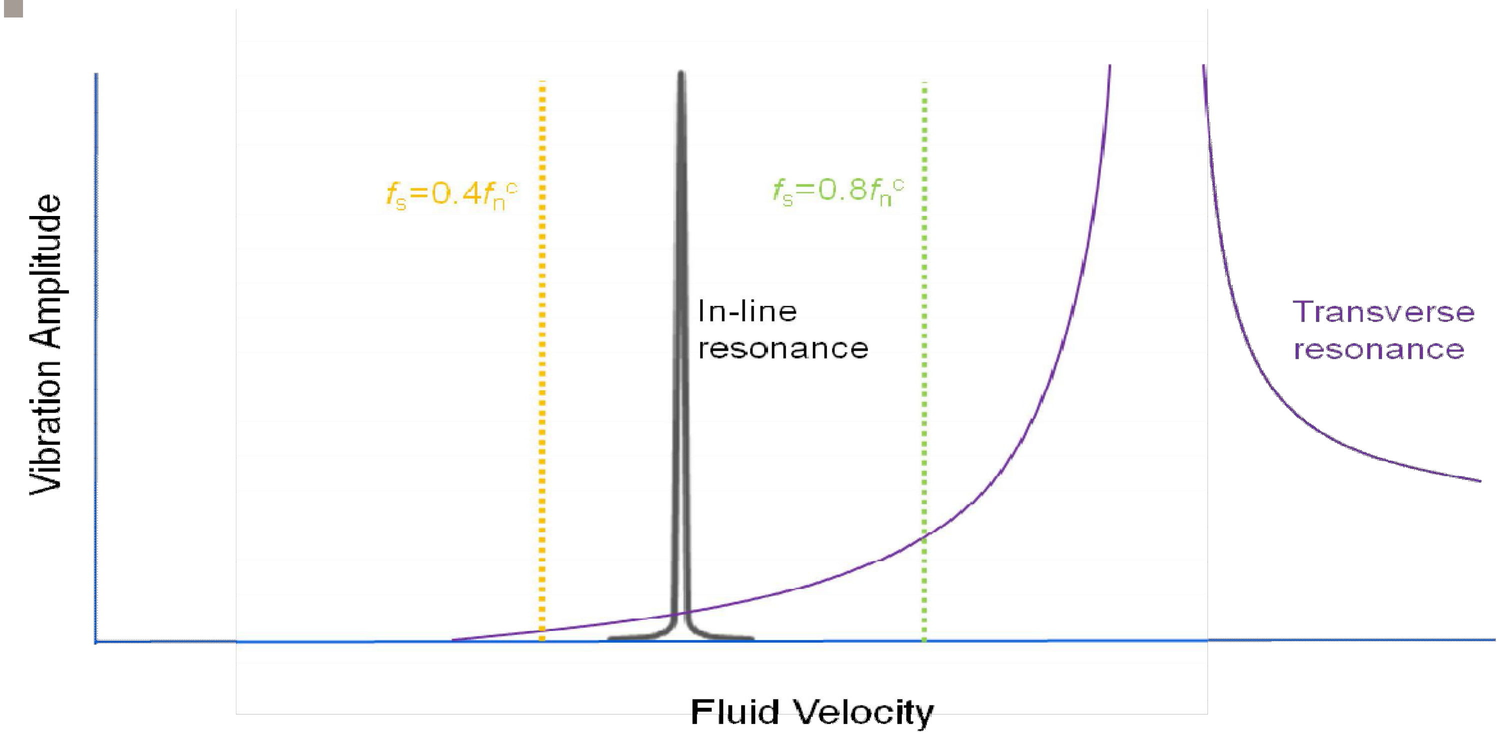
accurate

Vortex Shedding - Impact



- If this vortex shedding rate (fs) coincides with the natural frequency (fnc) of the thermowell, resonance occurs, and dynamic bending stress on the thermowell increases dramatically and thereby the amplitude of vibration also increase phenomenally.

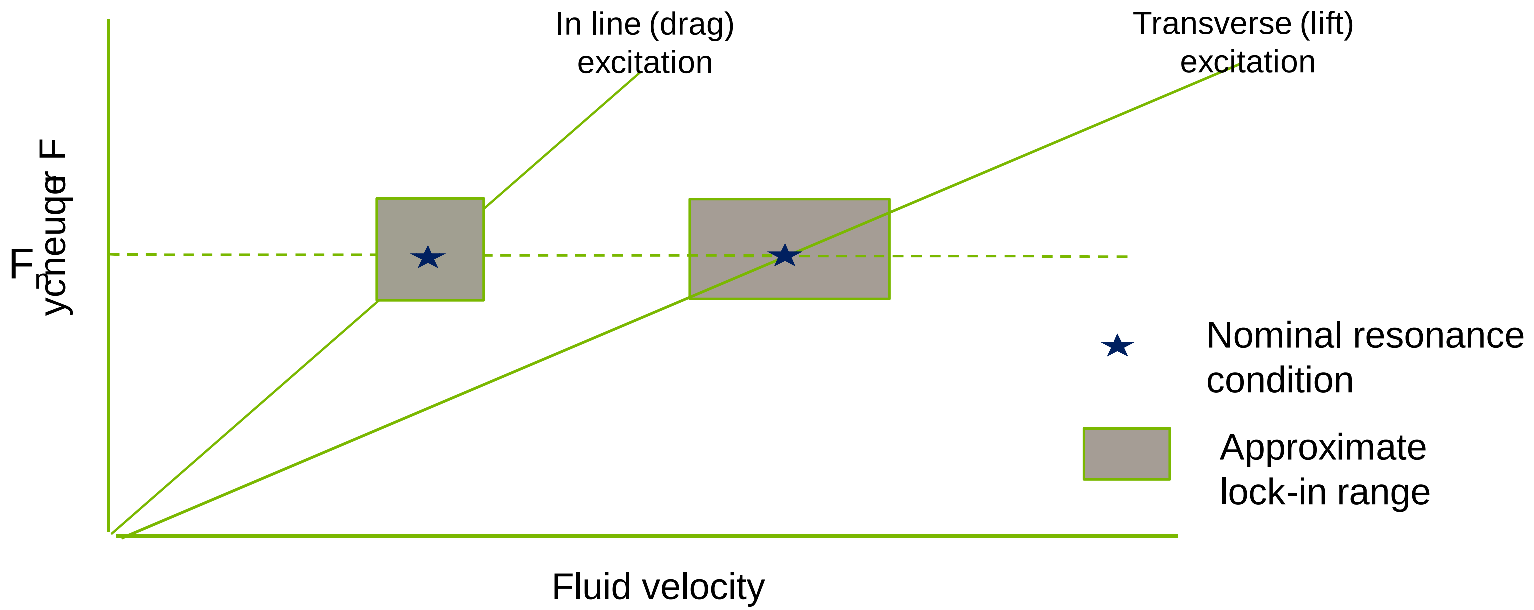
Vortex Shedding - Impact

- **The velocity critical for in-line resonance is approximately one-half that required for the lift resonance. In other words, the in-line resonance occurs at half the fluid velocity of the transverse resonance.**

- **The drag forces are generally weaker than the lift forces, but tend to become critical, when the thermowell is lowly damped.**

Resonance Lock-In

Resonance “lock in”



- The elastic response of the thermowell and the vortex shedding process are so closely coupled, because of which lift / drag frequency tends to change and further get “locked in” on the natural frequency.
- Can cause fatigue on thermowells when exposed to a single start-up operation, even if the vortex shedding rate does not coincide the natural frequency for steady state conditions.
- The low damping of thermowells exaggerates this effect

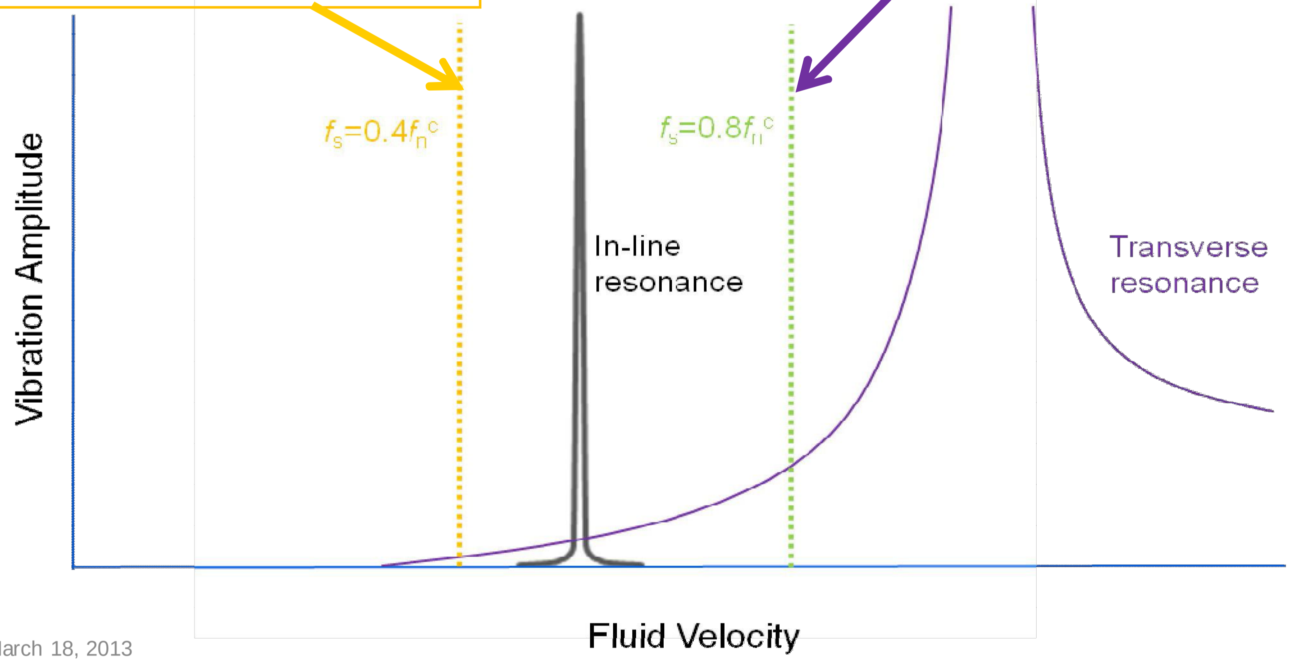
Frequency Ratio Limits

Frequency Ratio Limit

- **The frequency ratio (fs / fnc) is the ratio between the vortex shedding rate and the installed natural frequency of the thermowell.**

Following the inclusion of the in-line (drag) forces, a second resonance band with 0.4 limit may also need to be avoided

The transverse resonance band is above the 0.8 limit



Frequency Ratio Limit

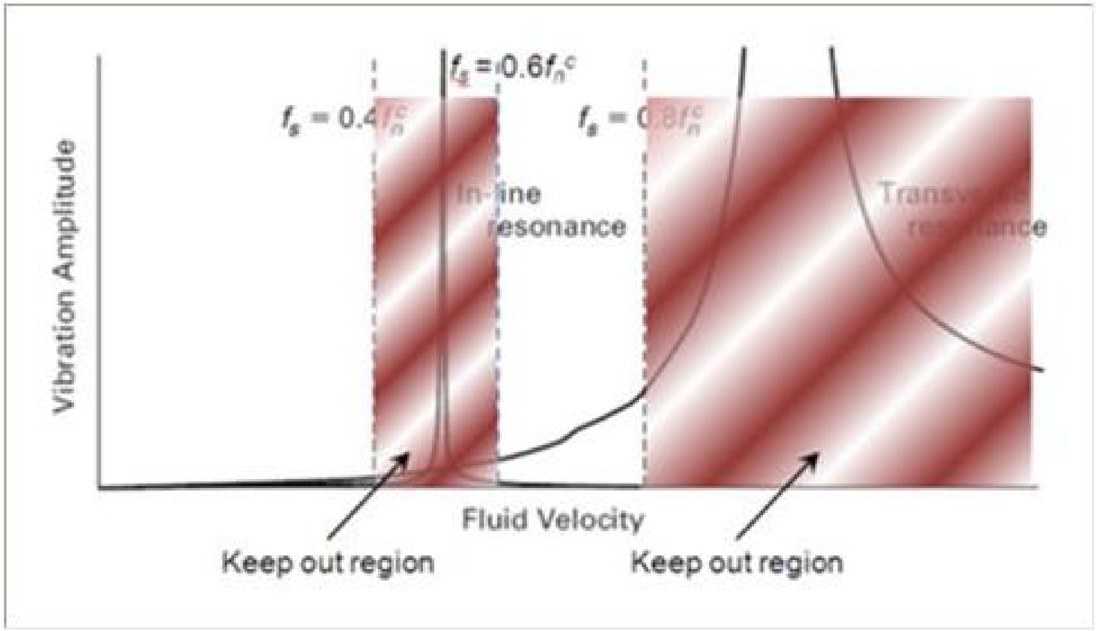


Figure 1. New in-line resonance region for ASME thermowells

- **For gases, the area between the two resonance conditions (0.6<ratio<0.8) is considered acceptable, provided the stresses experienced by the thermowell as it passes through the in-line resonance region are lower than the fatigue endurance limit of the thermowell.**

Mass Damping Factor (Scruton Number)

The mass damping factor, or the Scruton number (N_{Sc}) is calculated as below

$$N_{Sc} = \pi^2 \zeta (\rho_m / \rho)[1 - (d/B)^2]$$

N_{Sc}	-	**Scruton Number or Mass Damping Factor**
ζ	-	**Intrinsic damping factor**
ρ_m	-	**Mass Density of the Thermowell Material (kg/m3)**
ρ	-	**Fluid Density (kg/m3)**
d	-	**Bore Diameter of Thermowell**
B	-	**Tip Diameter of Thermowell**

Frequency Ratio Limit

The frequency limit ratio is set at either 0.4 or 0.8. The criteria for which limit to use is defined in ASME PTC 19.3 TW-2010 and the theory is simplified below. This is the theory used in the calculation and should not be estimated without carrying out the full evaluation.

Is the in-line resonance suppressed ?
For fluids of sufficiently low density and with Re < 10^5 the intrinsic damping of the thermowell sufficiently suppresses the inline vibrations.
Is N_{sc} > 2.5 and Re < 10^5

YES → **Freq Ratio Limit = 0.8**

NO ↓

Does the thermowell pass the cyclic stress condition ?
The cyclic drag stress is evaluated at the in-line resonance condition, arriving at a value for combined stress. The cyclic lift stress is neglected. If the combined stress calculated is less than the fatigue stress limit of the thermowell material.

YES → **Freq Ratio Limit = 0.8**

NO → **Freq Ratio Limit = 0.4**

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Stress & Pressure Calculations

Steady State Stress Limits

The steady state loading includes both Hydrostatic Fluid Pressure and Non-oscillating drag on the thermowell.

$$S_{\max} = S_D + S_a$$

$S_{\max}$ - **Maximum Allowable Stress of the Material**

S_D - **Steady State Drag Stress due to fluid impingement Pa (psi)**

S_a - **Axial Pressure Stress Pa (psi)**

Steady State Stress Limits

Using the Von Mises criteria for failure, the applied stresses S_{max}, S_r, and S_t should satisfy

$$\sqrt{\frac{(S_{max}-S_r)^2+(S_{max}-S_t)^2+(S_t-S_r)^2}{2}} \leq 1.5S$$

- S - **Maximum Allowable Stress of the Material**
- S_{max} - **Maximum Stress**
- S_r - **Radial Pressure Stress, Pa (psi)**
- S_t - **Tangential Pressure Stress, Pa (psi)**

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Dynamic Stress Limits

The dynamic stresses are due to the periodic drag and lift forces. The peak oscillatory bending stress amplitude shall not exceed the fatigue-endurance limit, adjusted for temperature and environmental effects.

$$S_{o,\max} < F_T \cdot F_E \cdot S_f$$

- $S_{o,\max}$ - **Peak Oscillatory Bending Stress Amplitude.**
- S_f - **Allowable Fatigue-Stress Amplitude Limit.**
- F_E - **Environmental Correction Factor ($F_E \leq 1$)**
- F_T - **Temperature Correction Factor**

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Pressure Limits

The pressure rating of the STEM/SHANK, pressure rating of TIP and FLANGE rating limits shall be calculated.

The allowable external pressure with respect to the STEM is calculated as

$$P_c = 0.66S\left[\frac{2.167}{2B/(B-d)} - 0.0833\right]$$

S **- Maximum allowable Stress of the governing code.**

The allowable pressure with respect to the TIP is calculated as

$$P_t = \frac{S}{0.13}\left(\frac{t}{d}\right)^2$$

t **- Tip Thickness**

d **- Bore Diameter**

S **- Maximum allowable Stress**

Check the FLANGE pressure rating for flanged thermowells in accordance with ASME 16.5.

Strength Vs Response

Thermowell : Strength Vs Response

Conflicting Requirements for Design

Factors which tend to increase thermowell strength include

- **Shortening the thermowell**
- **Increasing the thermowells root diameter**
- **Increasing the thermowells tip diameters**
- **Increasing the thermowell stem thickness**

However, these same factors increase stem conduction error and response time, making the thermowell less effective.

?

It is the design engineer's responsibility to properly manage these opposing interests and strike the right balance between the two requirements.

Thank you!

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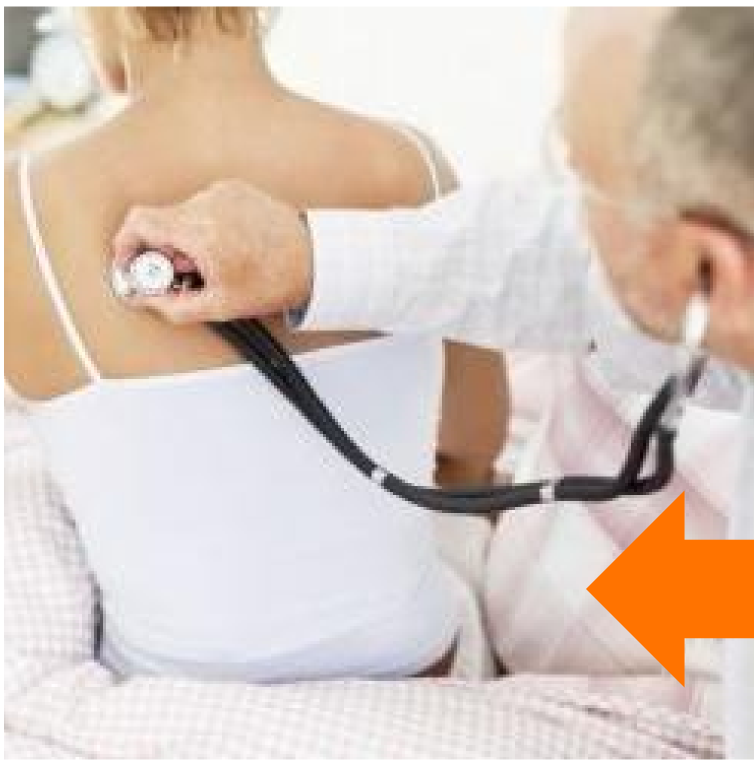
take it further®

Hazardous area remote I/O with enhanced diagnostics features acc. to NAMUR NE 107

R. STAHL India
M.R.Kumarasamy
Customer Support

Productive Diagnostics…

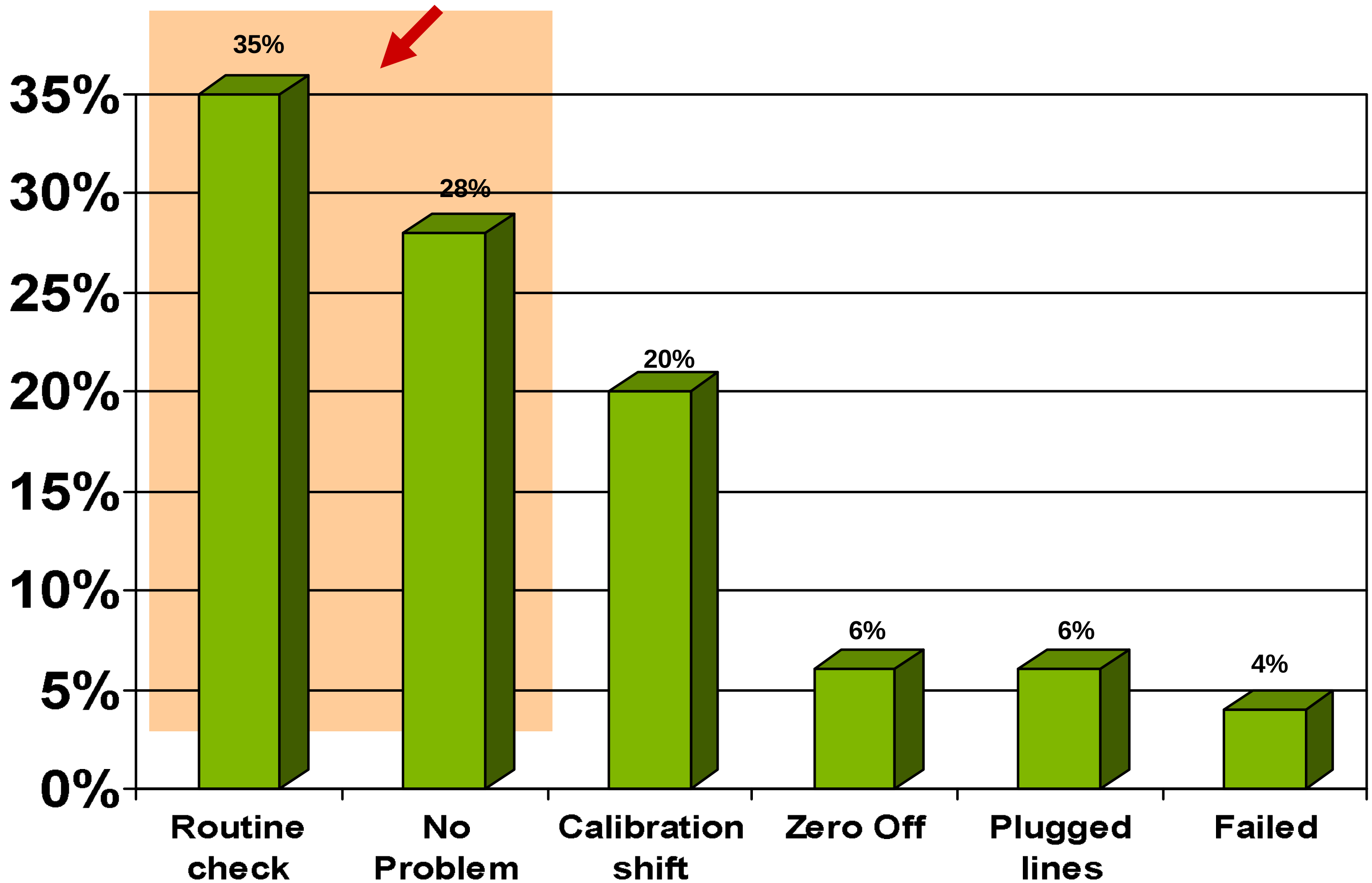
vs. forensic diagnostics



Why Diagnostics?

Source: Shell Global Solutions

63% of maintenance work is useless – but not costless!!



Different maintenance concepts

Source: Shell Global

unnecessary maintenance	• maintenance on devices without failures.
Reactive maintenance	• after the device has failed.
Preventive maintenance	• in periodic intervals
Predictive maintenance	• maintenance intervals based on experiences and statistics.
Proactive maintenance	• intervals based on integrated diagnostics.
Opportunity based maintenance	• combination of proactive maintenance with special occasions (planned shut-down etc.).

But…

Information Overload

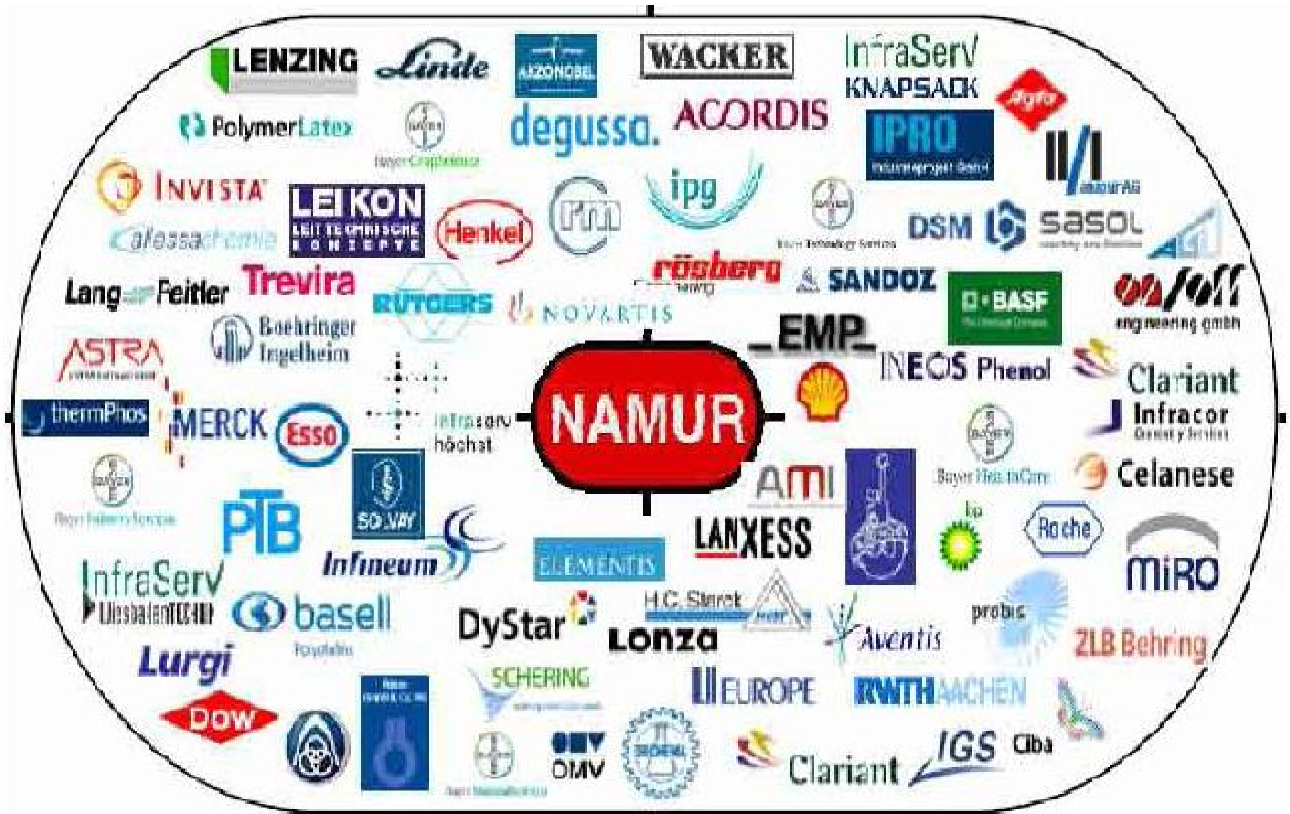
Recommendations from NAMUR

International Organisation of End Users

NAMUR represents approx. 15,000 PCS experts, of whom approx. 300 are active in 40 working groups:

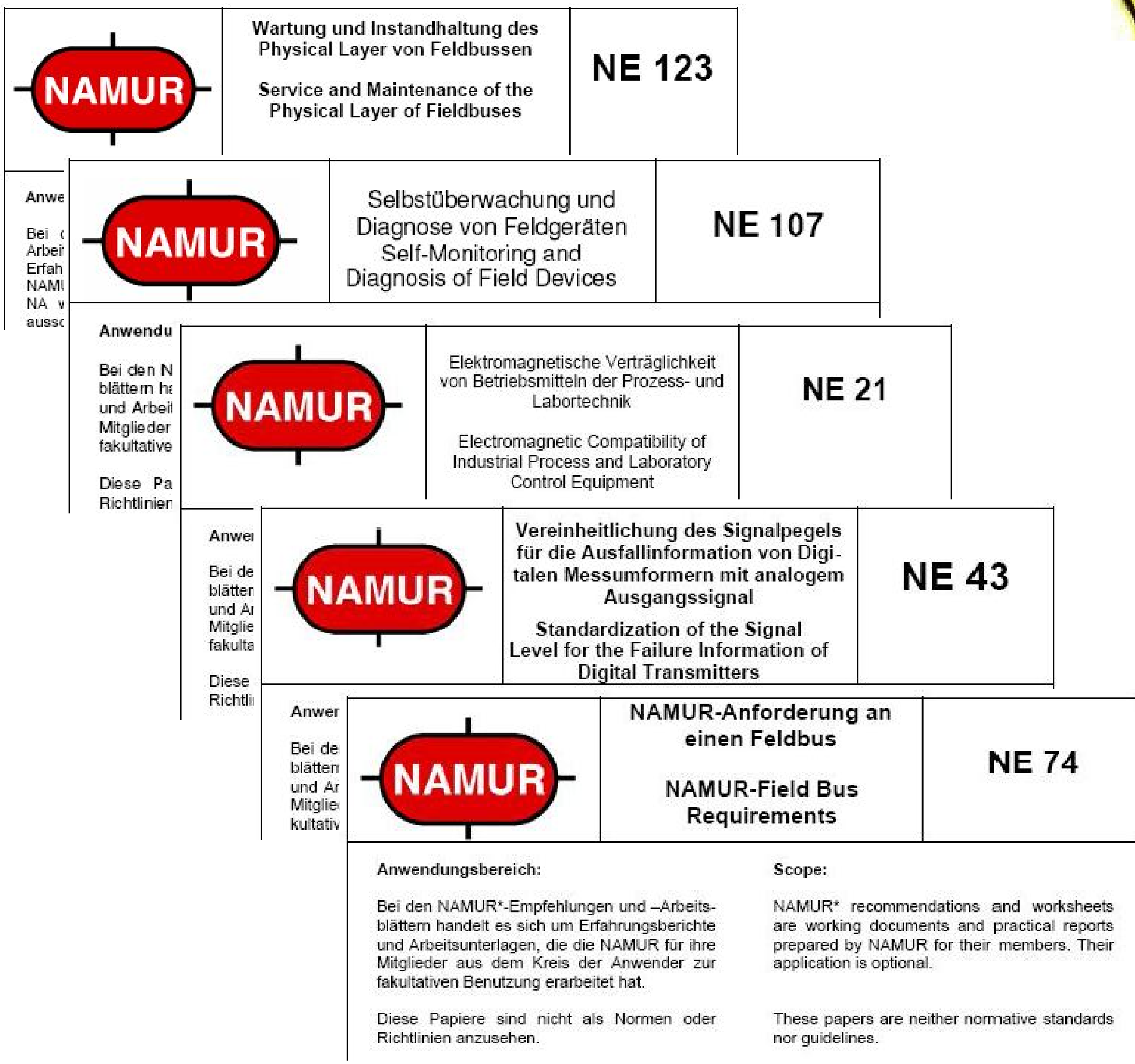
> electrical engineering over the entire life-cycle of systems, including planning, procurement, installation, operation as well as maintenance and decommissioning.
> measurement & control
> automation
> communication
> process control

Normen **A**usschuß **M**eß- **u**nd **R**egelungstechnik



The NAMUR recommendations

highly recommended for suppliers!



Wartung und Instandhaltung des Physical Layer von Feldbussen

Service and Maintenance of the Physical Layer of Fieldbuses

NE 123

Selbstüberwachung und Diagnose von Feldgeräten
Self-Monitoring and Diagnosis of Field Devices

NE 107

Elektromagnetische Verträglichkeit von Betriebsmitteln der Prozess- und Labortechnik

Electromagnetic Compatibility of Industrial Process and Laboratory Control Equipment

NE 21

Vereinheitlichung des Signalpegels für die Ausfallinformation von Digitalen Messumformern mit analogem Ausgangssignal

Standardization of the Signal Level for the Failure Information of Digital Transmitters

NE 43

NAMUR-Anforderung an einen Feldbus

NAMUR-Field Bus Requirements

NE 74

Anwendungsbereich:

Bei den NAMUR*-Empfehlungen und –Arbeitsblättern handelt es sich um Erfahrungsberichte und Arbeitsunterlagen, die die NAMUR für ihre Mitglieder aus dem Kreis der Anwender zur fakultativen Benutzung erarbeitet hat.

Diese Papiere sind nicht als Normen oder Richtlinien anzusehen.

Scope:

NAMUR* recommendations and worksheets are working documents and practical reports prepared by NAMUR for their members. Their application is optional.

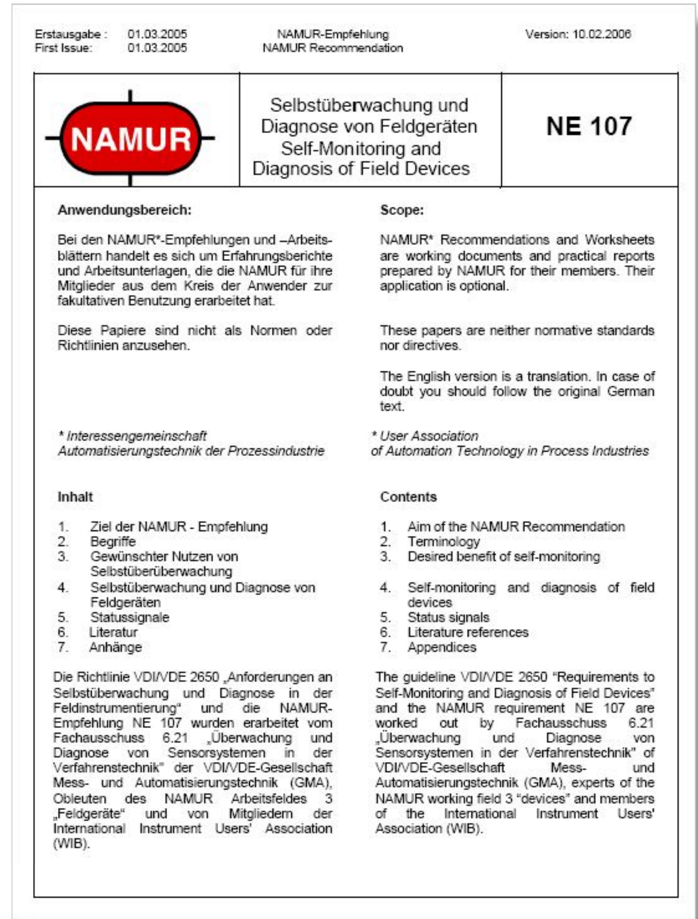
These papers are neither normative standards nor guidelines.

NAMUR **E**mpfehlung

NAMUR NE107 requirements

Self-Monitoring and Diagnosis of Field Devices

- Diagnosis results must be reliable
- Diagnosis results must always be viewed in the context of the application.
- Internal diagnosis must be categorized into 4 standard “status signals”
- Configuration must be free, as reactions will depend on the user's requirements
- Detailed information can be read out by the device specialist


Erstausgabe : 01.03.2005 | First Issue: 01.03.2005 | NAMUR-Empfehlung / NAMUR Recommendation | Version: 10.02.2006

NAMUR | Selbstüberwachung und Diagnose von Feldgeräten / Self-Monitoring and Diagnosis of Field Devices | NE 107

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** Interessengemeinschaft Automatisierungstechnik der Prozessindustrie*

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These papers are neither normative standards nor directives.

The English version is a translation. In case of doubt you should follow the original German text.

** User Association of Automation Technology in Process Industries*

Inhalt

1. Ziel der NAMUR - Empfehlung
2. Begriffe
3. Gewünschter Nutzen von Selbstüberüberwachung
4. Selbstüberwachung und Diagnose von Feldgeräten
5. Statussignale
6. Literatur
7. Anhänge

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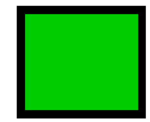
1. Aim of the NAMUR Recommendation
2. Terminology
3. Desired benefit of self-monitoring
4. Self-monitoring and diagnosis of field devices
5. Status signals
6. Literature references
7. Appendices

Die Richtlinie VDI/VDE 2650 „Anforderungen an Selbstüberwachung und Diagnose in der Feldinstrumentierung“ und die NAMUR-Empfehlung NE 107 wurden erarbeitet vom Fachausschuss 6.21 „Überwachung und Diagnose von Sensorsystemen in der Verfahrenstechnik“ der VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Obleuten des NAMUR Arbeitsfeldes 3 „Feldgeräte“ und von Mitgliedern der International Instrument Users' Association (WIB).

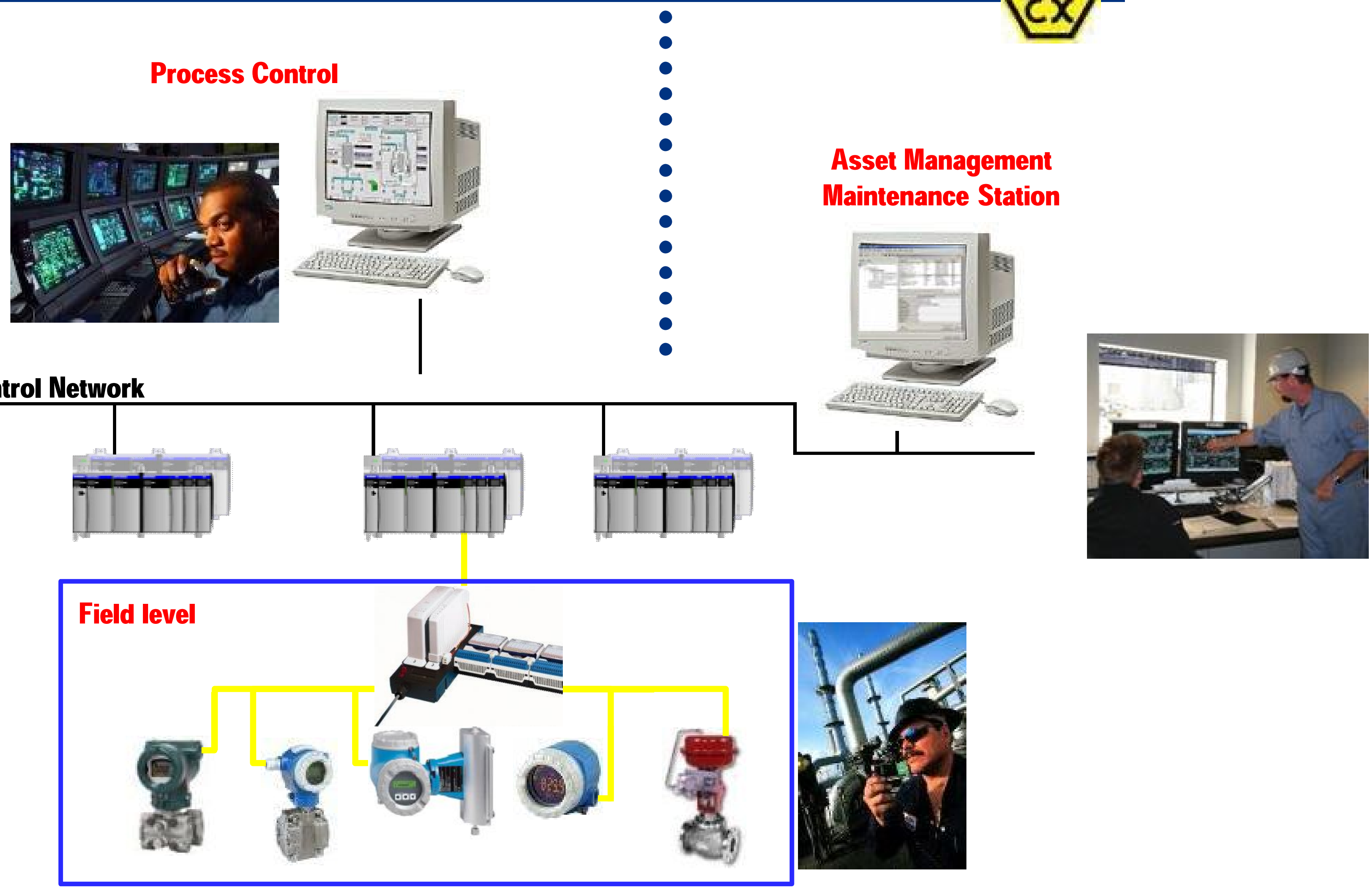
The guideline VDI/VDE 2650 “Requirements to Self-Monitoring and Diagnosis of Field Devices” and the NAMUR requirement NE 107 are worked out by Fachausschuss 6.21 „Überwachung und Diagnose von Sensorsystemen in der Verfahrenstechnik“ of VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), experts of the NAMUR working field 3 “devices” and members of the International Instrument Users' Association (WIB).

NE107 Status Informationen

4 (5) Standard indications

meaning	example	color	symbol
Normal operation: valid process value	device operating OK		
Maintenance Required: Process value still valid but maintenance required <u>soon</u>	wear-out, end of service life near		
Out Of Specification: Process value/status out of specified range, maintenance required <u>now</u>	inadmissable ambient temperature; wrong calibration		
Functional check: device is in functional check, no valid process value	local operation; simulation		
Failure: process value not valid or available	device defective		

Role based diagnostics
with NE107



Realization of the NE107

for process equipment

System	Status
DCS and PLC	partly implemented
Asset-Management Systems	mostly implemented by FDT/DTM and EDD
Fieldbusses	
PROFIBUS PA	OK (Profile 3.02)
FF H1	OK (FF-912)
PROFIBUS DP	no
HART	planned
PROFINET	OK
FF HSE / F-ROM	OK
other Ethernet protocols	no / vendor specific
Field devices	increasing *)
Remote I/O Systems	NEW *)

*) But status indication via LED not compliant to NE107 for many devices!

How to use NE107 in field devices?

many new status LED at the devices?

NE107 for Field devices & Remote I/O

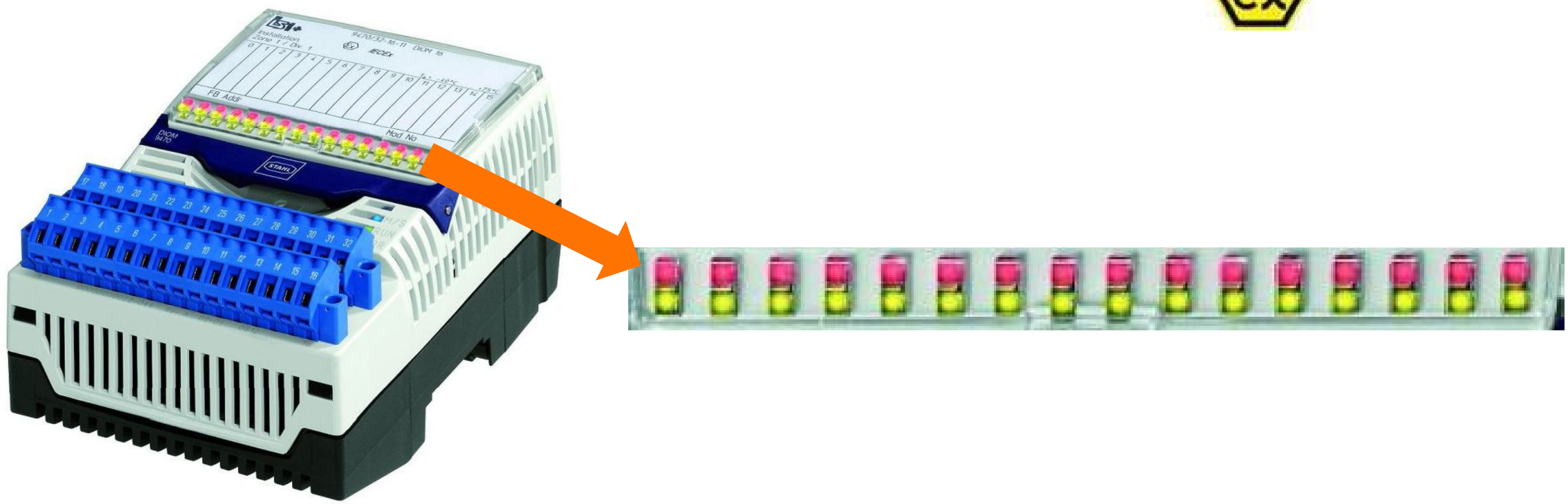
proposal for status information

Indication	today	NEW – acc. to NE107	measure:
Device related indication – as few as possible !			
green	power supply	power supply	---
red	Failure	Failure of device	Device replacement
red flashing	external failure	external failure (of connected equipment)	Check peripheries (e.g. sensor break or cable short circuit)
blue	-	Maintenance required for device	Clean/calibrate/replace device
blue flashing	-	Device is operating out of specification	Reduce ambient temperature, adjust power supply etc.
Signal related indication – no changes because „proven in use"			
red flashing	external failure	external failure (of connected equipment)	Check peripheries (e.g. sensor)
yellow **white, orange *)**	switching state	switching state	---

*) yellow, white, orange are difficult to differ for human eyes. Should be all used for same info.

Remote I/O & NE107

Signal-Status



> Red failure LED for failure per channel
  - Indication line failure for inputs/outputs: **red flashing**
  - Measure: check connected cables & devices

> Yellow status LED for discrete I/O-signals per channel
  - Indication of state ON/OFF of the inputs/outputs **yellow**
  - Information, no measure required