Cable & Flowline Protection

Vortex Induced Vibration (VIV) Suppression

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VIV is caused by the regular shedding of vortices in the wake behind riser and flowline pipes in steady current. The flow naturally "locks in" to shed these vortices in the same pattern at the same frequency along a significant length of pipe. This "lock in" is measured by the spanwise coherence and can cause the pipe to vibrate.

VIV causes accelerated fatigue damage and can give rise to problems such as pipe girth weld failure or premature pipe failure. Steel Catenary Riser (SCRs) and rigid steel flowlines unsupported over free spans are prone to this phenomenon.

To suppress the damaging vibration forces to an acceptable level Trelleborg Offshore developed a comprehensive analytical design and engineering package complete with a number of highly successful VIV suppression products.

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Computational Fluid Dynamics

Computational Fluid Dynamics software is an invaluable tool during the fine tuning of a VIV system design.

To assist in the optimisation of a solution to any given project, we have invested heavily in specialised Computational Fluid Dynamics software based on the industry standard Fluid 30 system to obtain a comprehensive understanding of the required geometry and calculated the best strake geometry for a VIV suppression system.

The software is an invaluable tool during the fine tuning of a VIV system design. It provides the optimal balance of drag and vortex suppression utilising the given environment data for specific projects and ensures optimum performance in any given set of environmental conditions.

We will also verify or comply with customers own strake designers to produce a bespoke system.

The analysis has been supported by wet tank and model testing including comparison with a smooth cylinder in steady current, with the behaviour test results, and forms part of a continuous programme of product development.

Our VIV suppression system function by introducing three-dimensionality into the flow. This disrupts the spanswise coherence of vortices that might be shed, leaving the wake stable and steady.
Our VIV suppression strakes combine the impact and abrasion protection benefits of Uraduct with an effective helical strake profile.

To reduce the effects of VIV, we have developed a range of cost effective VIV suppression systems to suit various installation and pipeline scenarios including pipeline free spans, top tensioned risers (TTRs) and tendons.

Our VIV suppression strakes combine the impact and abrasion protection benefits of Uraduct with an effective helical strake profile. The system consists of overlapping and interlocking easy to handle mouldings typically 1.5 to 2.0m long and incorporates 3 start helical strakes with either a triangular or trapezoidal profile. The mouldings are manufactured as a single split line moulding in a range of marine grade polyurethane and polyethylene elastomers including options for stinger installation and marine growth inhibition.

The mouldings are secured in place using the same corrosion resistant banding material and technique as used with the Uraduct product. The bands are pre cut to the required length and come complete with pre-formed seals. Manual or semi-automatic tensioning banding tools are available.

The entire system can be easily pre installed onshore, installed offshore simultaneously during the pipe laying operation, or alternatively, should the need arise, we have also developed an ROV retrofit system.
ROV Installable VIV Strake Covers

The strake covers are manufactured in two halves using a high performance GRP composite.

We have completed a number of high profile contracts for the design, engineering and supply of ROV installable products, all of which have unique design features including a hinge and ratchet ROR (remote operated ratchet) fastening system.

Designed to our design standards for VIV suppression strakes, our ROV installable strake covers are high performance composite covers with an attachable polymer strake profile incorporating the field proven hinge and ratchet ROR which allows the ROV to handle, open and securely close the covers around the pipeline.

The strake covers are manufactured in two halves using a high performance GRP composite, providing a lightweight high-strength structure which supports a separately moulded rigid polyurethane strake, sized to suit each design. The covers are hinged down one side and fitted with a patented moulded ROR system on the other side including connection points to accept the ROV manipulators.

The covers are designed to minimise ROV intervention and incorporate accessible handles to afford easier installation. They can be manufactured to any length and are designed to operate at any ocean depth.

All these features can be incorporated at the design stage with the co-operation of the ROV or installation contractor. The ROV VIV system is ideal for deployment on deepwater installations, for example on flowline free spans or deepwater drill risers which can also suffer from VIV.

The whole system is neutrally buoyant in sea water but can be adjusted to suit.
We manufacture thermal insulation shells incorporating a strake profile moulded into insulation shells.

On the majority of deepwater developments, for fields greater than 1000msw, thermal insulation is often required on all exposed pipeline structures including Subsea Manifold, Xmas trees and Spool Piece pipelines. As the outer diameter of the pipeline increases due to the additional insulation requirements, this also increases the risk of VIV.

We manufacture thermal insulation shells incorporating a strake profile moulded into insulation shells and the solution has been successfully used on many projects.

With the increasing number of deepwater field discoveries, it is anticipated that the requirement for integral VIV strakes will increase accordingly.

By adopting the integral strake principle with a thermal insulation requirement, we can design a dual function engineered product to the client's exact thermal and VIV suppression requirements.

Other variants are available and our experienced design department can develop project specific systems.

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Each roto moulded fairing module consists of a ‘teardrop’ shaped polyethylene moulding fixed onto the riser by a system of hinged clamps. The whole system relies on its ability to rotate around the riser in reaction to the prevailing current, i.e., the fairings rotate freely around the riser. To simplify installation and reduced deployment time frames, axial restraint is provided by the use of a single clamp located every 3 to 4 fairing modules.

The system is designed using materials that have a long subsea track record and have been selected to provide a lightweight solution reducing loads and stresses in the bearing surfaces. Our fairings are particularly suited for larger diameter risers (up to 36” OD). They are easily and quickly installed onto risers either during pipe lay or onshore prior to mobilisations, with stinger installable systems available. These systems are backed up by a rigorous testing programme.

As with VIV suppression strakes, fairings are used where it is necessary to minimise vortex induced vibration on subsea risers (mainly SCRs). Unlike VIV suppression strakes, fairings will reduce vibration without incurring an increased drag penalty. However, the specific environmental conditions do need to be considered as fairings will not always provide the desired effect. These systems will normally be considered and specified by engineering houses, operators and installers.
Slipstream (fairings)

We have a great deal of technical understanding of fairing geometries and effectiveness

Advantages:

- We have a great deal of technical understanding of fairing geometries and effectiveness
- The system has been verified and optimised through CFD analysis and full scale tank testing
- Slipstream is manufactured from lightweight, neutrally buoyant materials and modules are therefore man-handleable and easy to install
- As the system does not cover the whole riser, ROV inspections of the pipeline can be easily carried out.
- Alternative fairing solutions tend to encapsulate the whole riser and can be difficult to install and ROV inspections cannot be carried out.

Slipstream can be manufactured to suit risers from small diameters up to large drill riser strings (circa 36" OD). In reality, the larger diameters tend to be better suited to fairings than VIV suppression strakes.
Roto-moulded strakes

Our VIV suppression systems are analysed using computational fluid dynamics software and tested in wet tank facilities, so that we have a comprehensive understanding of the required geometry.

Our Roto-moulded VIV suppression system is manufactured from a marine grade polyethylene (PE) material. The components are full circumferential mouldings with an axial split line. The system is designed to suppress damaging vibration forces to an acceptable level. The Roto-moulding manufacturing technique uses much less material than PU versions.

As with other VIV Suppression Systems these are required on steel catenary risers or unsupported rigid steel pipelines over free spans to suppress Vortex Induced Vibration. This particular system is only suitable, however, for installation and/or operating conditions that do not exert a load onto the VIV Profile. The vertical ‘moon-pool’ installation method is acceptable but the S-lay method cannot be accommodated.

Advantages:

- Generally our VIV suppression systems have been analysed using computational fluid dynamics software and tested in wet tank facilities, so that we have a comprehensive understanding of the required geometry.
- The particular advantage of the Roto-moulded system is reduced material required = reduced product weight = reduced price compared to PU systems.
- Note that the installation technique required may preclude the use of this type of design.

VIV suppression strakes are made to order and can accommodate any likely riser/flowline diameter.

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Our Thermoformed VIV suppression system is manufactured from polyethylene (PE) sheet material. The manufacturing technique generates a curved section that incorporates hinge features so the finished component can be fitted circumferentially around the product to be protected.
Marine grade polyurethane is the industry standard material for our VIV suppression strakes.

Our VIV suppression strakes can be manufactured using a wide range of polyurethane and polyethylene elastomers, most of which have been specially developed in-house. They exhibit a wide variety of mechanical and physical properties matched to suit specific applications.

These materials have a proven track record in a marine environment and are only selected after extensive research, testing and trials to prove their optimum performance.

Marine grade polyurethane is the industry standard material for our VIV suppression strakes and offers excellent abrasion and mechanical protection and is cost effective. This material has a specific gravity of 1.15g/cm² and therefore does not add any weight to the overall installation.

The materials used in the manufacture of ROV installable strake covers require high strength combined with low weight which are generally the key requirements especially when ROV installation is required.

Syntactic and GRP composites are used by us for the manufacture of ROV installable strake covers.

We are able to call upon our vast experience in design, engineering and production of composites to deliver a total engineered solution.

All metallic materials that we use including hinges and banding are supplied in materials suitable for a long offshore life.
Testing

Our VIV suppression systems are tested both within our in-house facilities and independently at a variety of research establishments.

Our in-house testing, research and development establishments focus on giving us the enviable ability to keep the majority of our development processes within the confines of our own facilities. We also undertake extensive external R&D programmes with external testing houses. Given the numerous considerations to be made when evaluating the suitability of a design and material selections, we carry out a number of international testing programmes to ensure that the most appropriate solution is chosen for any given application.

Our VIV suppression systems are tested both within our in-house facilities and independently at a variety of research establishments and is the only system proved capable of withstanding installation loads over a stinger due to the resilience of the selected polyurethane.

We have conducted tank testing of our VIV suppression systems to verify strake heights and pitch. The remaining ongoing testing is linked to our continual improvement programme of strake design. This ensures that strake geometry not only meets the environmental criteria for VIV suppression but is also vessel friendly. This has involved research into differing vessel installation spreads for pipelay such as "J-Lay" or "S-Lay" techniques and to design and build test rigs that replicate as close as possible the loadings imparted during lay operations from the stinger roller boxes.

We developed an in-house testing facility which simulates up to 100 tonne loadings which could potentially be imparted during "S-Lay" operations.