3X ENGINEERING

STOPKiT®

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR

Emergency Pipeline Repair System (EPRS)

OIL & GAS ONSHORE /OFFSHORE

OIL & GAS SUBSEA

DOC MKT 011 – D2 – ENG – LC – 12/2022

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1. PRODUCT BROCHURE

3XENGINEERING
OIL & GAS
ONSHORE /OFFSHORE

3XENGINEERING
OIL & GAS
SUBSEA

3X ENGINEERING

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR

Many pipe geometries | 2" to 56" pipe diameters | Up to 150 bars | -20°C to +150°C | Oil | Gas | Water

STOPKiT®

World leading leak sealing system

OIL & GAS
ONSHORE / OFFSHORE

OIL & GAS
SUBSEA

INNOVATIVE REPAIR SOLUTIONS FOR YOUR INSTALLATIONS

STOPKiT® is a world leading repair system able to seal a leak online in few minutes.

3X ENGINEERING OIL & GAS ONSHORE / OFFSHORE

3X ENGINEERING OIL & GAS SUBSEA

This emergency and temporary solution is available under various references to cover a wide range of applications.

STOPKiT® is a patented concept made of rubber patch and tightening system. By compressing the patch over the leaking defect, the rubber seals the leakage.

STOPKiT® RANGE FROM 2" TO 56"

ONSHORE	STOPKiT® SD	STOPKiT® 50	STOPKiT® 100
	Pipe temperature **-20°C to +150°C** (-4°F / +302°F)		
	Pipe diameter **2" and 3"**	Pipe diameter **From 4" to 56"**	Pipe diameter **From 4" to 56"**
	Maximum pressure **150 bars** (2175 psi)	Maximum pressure **120 bars** (1740 psi)	Maximum pressure **50 bars** (725 psi)
	according to pipe diameter and temperature (see Technical Data Sheet)		
	Maximum hole Ø **20mm**	Maximum hole Ø **25mm**	Maximum hole Ø **50mm**
			

OFFSHORE / SUBSEA	STOPKiT® SD	STOPKiT® 50	STOPKiT® 100
	Pipe temperature **-20°C to +150°C** (-4°F / +302°F)		
	Pipe diameter **2" and 3"**	Pipe diameter **From 4" to 56"**	Pipe diameter **From 4" to 56"**
	Maximum pressure **150 bars** (2175 psi)	Maximum pressure **120 bars** (1740 psi)	Maximum pressure **50 bars** (725 psi)
	according to pipe diameter and temperature (see Technical Data Sheet)		
	Maximum hole Ø **20mm**	Maximum hole Ø **25mm**	Maximum hole Ø **50mm**
			

STOPKiT® MAIN FEATURES & BENEFITS

- Emergency pipeline repair system (EPRS)
- Online sealing (no shutdown or de-pressurization required)
- Temporary system (for long-term solution, refer to REINFORCEKiT® product)
- Large range of performance (can stop a leak up to 150 bars, on pipe operating up to 150°C, from 2" to 56" diameters, in onshore, offshore and subsea environments)
- Yellow belt dedicated to onshore environment
- Specific red belt dedicated to offshore and subsea environments
- Suitable for oval pipe, elbow, weld ...
- Light product, no additional load on pipe
- Easy to store and ready to use
- 5-year shelf life
- Quick and easy installation (can be performed by a single person in 5 mn)
- Installation by trained and certified applicators only

STOPKiT® 50 & 100 IMPLEMENTATION (using STOPKiT® Positioner device)


1 Set-up the 1st part of the positioner


2 Install the STOPKiT® and slide it over the leak


3 Set-up the 2nd part of the positioner


4 Tighten until leak is sealed 40 N.m max.


5 Remove the positioner

DOC.MKT.021 - C - ENG - IC - 04/2022

3X ENGINEERING

ISO 9001:2015 CERTIFIED

9, avenue Albert II - 98 000 MONACO
+ 377 92 05 79 81
info@3xeng.com
www.3xeng.com

2. TECHNICAL DATA SHEET

STOPKiT®

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

OIL & GAS ONSHORE / OFFSHORE

OIL & GAS SUBSEA

TECHNICAL DATA SHEET

STOPKiT® DESCRIPTION

Considered as an emergency repair, STOPKiT® is a stop leak solution for pipe. It is the most efficient repair system applicable under pressure. This unique and revolutionary concept, patented by 3X ENGINEERING (3X), allows to fix high pressure leaks by tightening. Installation can be done without shutting down the line pressure.

Different sizes of STOPKiT® are proposed to be suitable with pipe diameters from 4 to 56-inch (114 – 1422 mm).

STOPKiT® technology is suitable for various applications and environments. It can be used for several fluids (oil, gas, water…) according to the strap and the technical patch (special applications on demand). STOPKiT® is available for: Onshore, Offshore/Subsea.

STOPKiT® product can be used from –20°C to +150°C (-4°F to + 302°F).

Pressure up to 120 bars (1 740 psi) can be stopped for hole diameter inferior to 25 mm (patch size: 50 x 100 mm). STOPKiT® can fix leaks for most hole shapes. In case of hole diameter up to 50 mm, leaks can be sealed up to 50 bars (725 psi) (patch size: 100 x 100 mm).

STOPKiT® is a product without special specifications for the storage. STOPKiT® is lightweight and does not add any mechanical stress to the pipe, unlike metal clamps. It is sold in ready-to-use kit.

STOPKiT® can be used on elbows and even on oval diameter pipes. The pipe surface must be without sharp edges but the system can be applied on irregularity like welding wire or corrosion cankers, so it's the best system to repair damaged and leaking pipes.

To ensure the effectiveness of the STOPKiT® technology, the product must be properly installed. STOPKiT® installers have to be trained by an authorized 3X Trainer. 3X Company and its agents should be contracted for all non-standard repairs.

STOPKiT® FEATURES

USES

- Suitable on welds, elbows, ovalised pipes
- Compatible with most common fluids and gas
- Stop leak up to 120 bars (1740 psi)
- Hole diameter up to 50 mm
- Pipe diameters from 4 to 56-inch
- Temperature from –20°C to +150°C (-4°F to + 302°F)

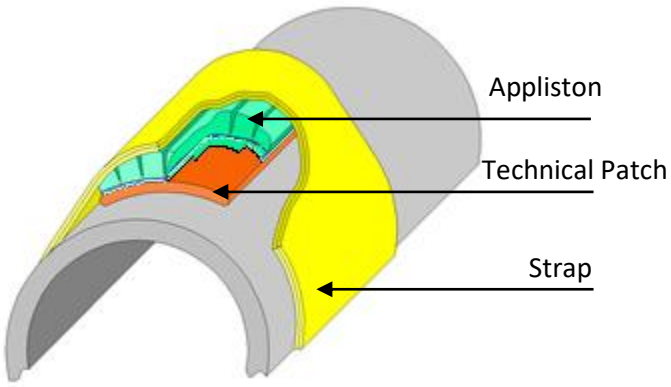
BENEFITS

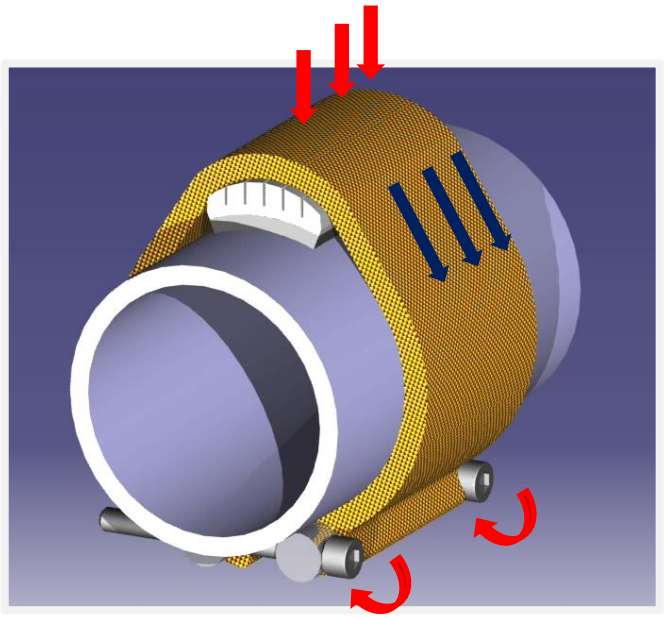
- Installation in less than 5 minutes
- Light product
- No additional load on pipe
- Online sealing / No shutdown required
- Easy to store product
- Shelf-life: 5 years

STOPKiT® CONCEPT

The system operates by concentrating all the needed stress in the pipe at the defect location. The hoop stress needed to stop the leak is brought by the technical strap and the screws. The strong fibers of the strap are temperature and stress resistant.

STOPKiT® patented concept:

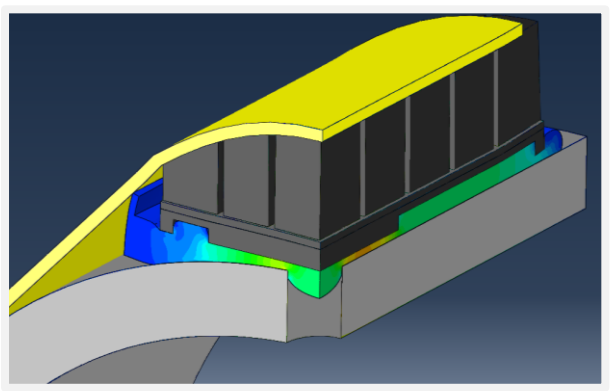




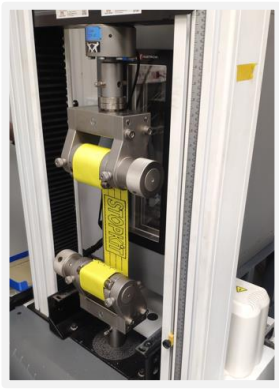
When the screws are tightened, the strap transfers the strain to the technical rubber patch in order to get the imperviousness. In fact, tightening the screws will induce a tension force in the belt, and this will perform the radial force on the leak point via the applicator. The applicator adds a tension force component to the radial force, then the distributor increases the pressure locally with the ribs and the containment grooves, as a stress concentrator, on the sealing pad.

STOPKiT® study:

3X ENGINEERING has spent intensive effort to develop the latest generation of STOPKiT®.
The design has been optimized using FEA, relying on a strong knowledge of involved materials and their constitutive equations, as well as mastery of non-linear behavior. As a result, 3X is able to predict the behavior of its STOPKiT® for each new configuration.



AFTER TIGHTENING: LEAK SEALED



BELT TESTING

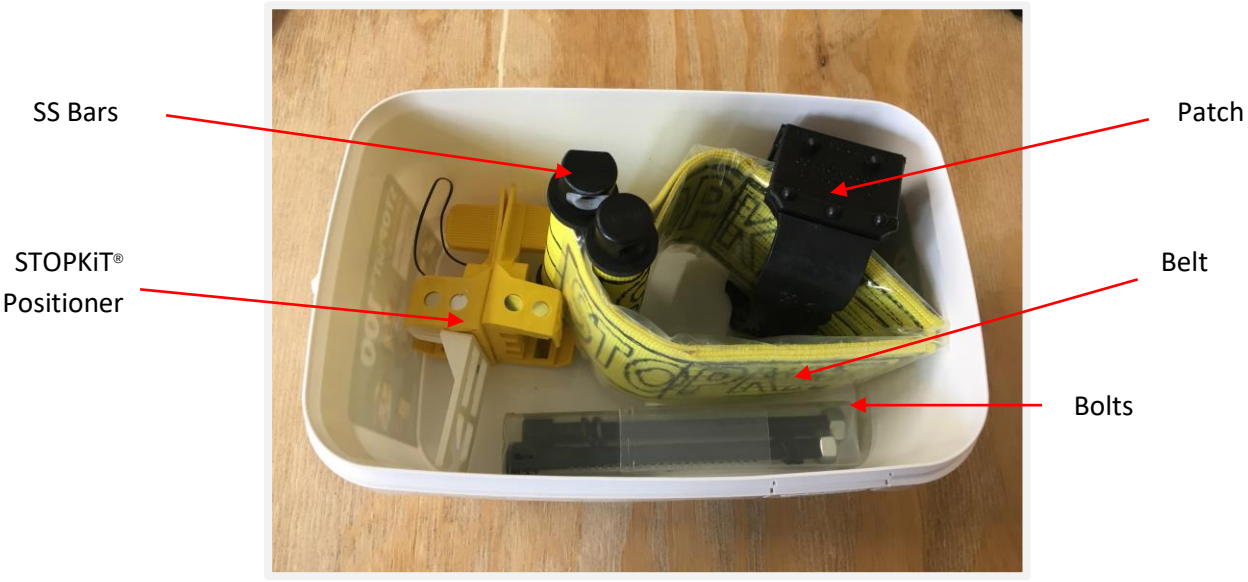
WITNESSED PRESSURE TEST

STOPKiT® has been thoroughly tested with active leakage to confirm that the experimental values are similar to FEA.

STOPKiT® COMPOSITION

STOPKiT® is made of:

- 1 patch 50mm x 100mm (STOPKiT® 50) or 100mm x 100mm (STOPKiT® 100)
- Belt(s) (number of belts varies according to pipe diameter)
- Carbon Steel Bars (number of bars varies according to pipe diameter)
- Stainless Steel Bolts 17mm and Carbon Steel HSHC Screw 8 (number of bolts and screws varies according to pipe diameter)
- 1 STOPKiT® Positioner (special device for STOPKiT® implementation)



Depending on pipe diameter, the number of belts and the packaging are subject to change. Do not modify the composition of the STOPKiT® for quality purpose. Do not try to adapt a STOPKiT® on another pipe diameter than mentioned on the packaging.

PACKAGING FOR SIZE 4'' UP TO 10'

PACKAGING FOR SIZE 12'' UP TO 30''

PACKAGING FOR SIZE 32'' UP TO 56''

STOPKiT® versions can be used in most environments: Onshore, Offshore and Subsea. Because the environment is more aggressive in subsea and offshore conditions, the composition of the belt is slightly different to make it more resistant.

STOPKiT®

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

TECHNICAL SPECIFICATIONS FOR STOPKiT® ONSHORE

STOPKiT® ONSHORE version is dedicated for onshore environment such as refinery or inland pipeline.

The color of the belt is yellow.

DENOMINATION	STON50			STON100		
USE	ONSHORE ENVIRONMENT – EMERGENCY REPAIR					
PIPE DIAMETER	From 4'' to 56''					
MIN. TEMPERATURE	-20°C / -4°F					
MAX. TEMPERATURE	+150°C / +302°F					
PATCH SIZE	50x100mm			100x100mm		
MAXIMUM DEFECT SIZE	Ø≤ 25mm			Ø≤ 50mm		
MAXIMUM PRESSURE*	Pipe diameter	-20°C <T< +80°C	+80°C<T<+150°C	Pipe diameter	-20°C <T < +80°C	+80°C<T<+150°C
	Ø ≤ 6''	120 Bars	40 bars	Ø ≤ 6''	40 bars	15 bars
	6'' < Ø ≤ 12''	90 bars	30 bars	6'' < Ø ≤ 12''	32 bars	10 bars
	12'' < Ø ≤ 24''	60 bars	20 bars	12'' < Ø ≤ 24''	25 bars	8 bars
	24'' < Ø ≤ 56''	45 bars	15 bars	24'' < Ø ≤ 56''	20 bars	6 bars

*Values given for information as each leaking configuration is specific.

STOPKiT®

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

TECHNICAL SPECIFICATIONS FOR STOPKiT® OFFSHORE

STOPKiT® OFFSHORE version is dedicated for offshore environment such as platform or subsea conditions.

The color of the offshore belt is red. The belt has been designed specifically for harsh environments. The belt of this STOPKiT® is not only lighter and more flexible but is also very resistant underwater. It will definitely improve the long-term product efficiency.

DENOMINATION	STOF50			STOF100		
USE	OFFSHORE AND SUBSEA ENVIRONMENTS – EMERGENCY REPAIR					
PIPE DIAMETER	From 4'' to 56''					
MIN. TEMPERATURE	-20°C / -4°F					
MAX. TEMPERATURE	+150°C / +302°F					
PATCH SIZE	50x100mm			100x100mm		
MAXIMUM DEFECT SIZE	Ø≤ 25mm			Ø≤ 50mm		
MAXIMUM PRESSURE*	Pipe diameter	-20°C <T< +80°C	+80°C<T<+150°C	Pipe diameter	-20°C <T < +80°C	+80°C<T<+150°C
	Ø ≤ 6''	120 Bars	40 bars	Ø ≤ 6''	40 bars	15 bars
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	24'' < Ø ≤ 56''	45 bars	15 bars	24'' < Ø ≤ 56''	20 bars	6 bars

*Values given for information as each leaking configuration is specific.

MATERIAL SPECIFICATIONS

Part	Material
Belt	PES / aramid
Nut	ISO 4035 04 CLASS – Zinc plated
Screw	CS 42CD4 + Zinc-Nickel
O-ring spacer	Nitrile
E bar	CS 42CD4 + Zinc-Nickel
S bar	CS 42CD4 + Zinc-Nickel
Applicator	PA 66
Patch	HNBR
Anti friction sleeve	LDPE

CORROSION RESISTANT

Metallic material parts are corrosion resistant.

Two elastomeric O-ring spacers are mounted grooves at the extremity of the two bars to avoid the contact between stainless steel bars and the surface of the steel pipe.

A specific grease is used to lubricate the threads to ensure an easy bolting to the necessary torque.

TEMPERATURE EFFECT

STOPKiT® delivers optimal performance for temperature inferior to +80°C.

It is possible to seal leakage up to +150°C with degraded pressure performance. Indeed, the temperature may affect the components because of patch softening or belt and reduce product lifetime from months to few weeks.

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ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

CHEMICAL RESISTANCE

CHEMICAL	STOPKIT PATCH		CHEMICAL	STOPKIT PATCH
Acetic Acid	C		Hydrogen, Gas	A
Acetone	U		Iso-Butane	A
Acetylene Gas	A		Jet Fuel JP3	A
Aerozene 50 (50%Hydrazine, 50% UDMH)	U		Jet Fuel JP4	A
Alcohol (Methanol)	B		Jet Fuel JP5	A
Aluminum Hydroxide Solution	A		Jet Fuel JP6	A
Amines, primary (such as Methyl, Ethyl, Propyl)	U		JP3 (Fuel)	A
Ammonia (gas)	A		JP4 (Fuel)	A
Ammonia (liquid)	B		JP5 (Fuel)	A
Argon Gas	A		JP6 (Fuel)	A
Aromatic Fuels (up to 50% Aromatic)	A		JPX (Fuel)	A
Aromatic Hydrocarbons (100% Aromatic)	U		Kerosene	A
Asphalt, Emulsion	B		Machinery Oil (mineral)	A
ASTM Test Fuel A	A		Methane	A
ASTM Test Fuel B	A		Methanol	B
ASTM Test Fuel C	B		Mineral Oil	A/B
ASTM-Oil IRM 902	A		Muriatic Acid (HCl), diluted	B
ASTM-Oil IRM 903	A		Natural Gas	A
ASTM-Oil No.1	A		Neon Gas	A
ATM-Brake Fluid (Glycol based)	U		Nitrogen Gas	A
Automatic-Transmission Fluid	A		Octane	B
Automotive Gasoline	A		Olefin, crude	A
Battery Acid (Sulfuric Acid diluted)	U		Oleic Acid	A
Benzine (Gasoline)	A		Paraffin	A
Benzine 80/Benzene 20	B		Paraffin Oil	A
Benzol (Benzene)	U		Petroleum	A
Brake Fluids (based on mineraloil)	A		Petroleum Ether	A
Butane	A		Phenol	U
Chloric Acid	U		Phosphoric Acid 45%	B
Citric Acid	A		Potassium Hydroxide (Solution 50%)	B
Copper Sulfate (Blue Vitriol) Solution	A		Potassium Hypochlorite (Javelle water)	B
Crude Oil	B		Propane	A
Cyclohexane	A		Propanol	B
Diesel Fuel	A		2-Propanone (Acetone)	U
Diesel Oil	A		Sea Water	A
Domestic Fuel Oils	A		Silcone grease	A
Ethane	A		Silicone Oil	A
Ethylene Glycol	A		Silver Nitrate	B
Freon 11	A		Sodium Bicarbonate Solution	A
Freon 112	B		Sodium Chloride (Common Salt)	A
Gas Oil	A		Sodium Hydroxide, Caustic Soda	B
Gasoline/Alcohol Mix	B		Sulfur Dioxide (SO2)	U
Gasoline, 130 Octane	A		Sulfur Hexafluoride (SF6)	B
Gasoline, aromatic	A		Sulfuric Acid, diluted	B
Gasoline, Ethyl and Regular	A		Toluene (Toluol)	U
Gasoline, Refined	A		Transformer Oil	B
Gasoline, Sour	A		Waste Gas (cont. Carbon Dioxide)	A
Gasoline, with Mercaptan	A		Waste Gas (cont. Carbon Monoxide)	A
Generator Gas	A		Waste Gas (cont. Hydrogen Chloride)	B
Glycerol	A		Waste Gas (cont. Hydrogen Fluoride)	A
HEF-3	B		Waste Gas (cont. Sulfur Dioxide)	B
Helium Gas	A		Waste Gas (cont. Sulfuric Acid)	U
Heptane	A		Water to +150 °C / +302 °F	B
Hydrochlorique Acid (Muriatic Acid) 37%	U			

A Very good suitability and resistance. Elastomer shows little or no effect from exposure. Little effect on performance and physical properties.

B Good suitability. Some effects from exposure with some loss of physical properties. Some chemical swelling

C Limited suitability. Significant swell and loss of physical properties after exposure. Additional tests should be done.

U The elastomer is unsuitable for application in this media.

3X ENGINEERING - 9 avenue Albert II – 98000 MONACO - ☏: +377.92.05.79.81 - Fax: +377.92.05.72.71 – 3x@3xeng.com – www.3xeng.com

STOPKiT®

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

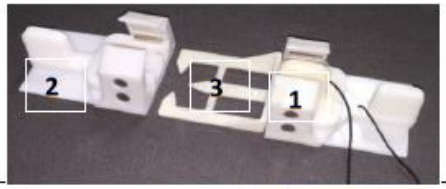
INSTALLATION PROCEDURE

Scan this QR code to watch STOPKiT® installation video

0 – WEAR APPROPRIATE PPE

•Perform risk assessment prior job – spill and spatter hazards
•Select and wear suitable PPE according to HSE regulations on site and operational hazards (chemical, temperature, pressure, access, handling)

1 – STOPKiT POSITIONER PRESENTATION



•Magnetic positioner 1st (1)
•Magnetic positioner 2nd (2)
•Removable centring (3)

2 – SETTING UP ON THE PIPE

•Clean the pipe
•Avoid any burrs or sharp edges around the hole
•Centre the pin hole aligned on the 3 arrowheads

•Stitch down the two ears
•Check the centering

•Draw a line on each side of the frame located at the back of the positioner

•Remove the centring and lay it on the pipe under the positioner

Materials:
- PPE
- File
- Rags and acetone
- White marker

3 – SETTING UP OF THE STOPKIT ON THE PIPE

•Insert the screws in the entrance bar first.
Attention! The screw heads and the washers must be in contact with the flat spots of the entrance bar
•Note the presence of the anti-loss washers.
•Tight the screws into the threaded bar.

Materials:
- PPE

STOPKiT®

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
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4 – POSITIONING OF THE STOPKiT

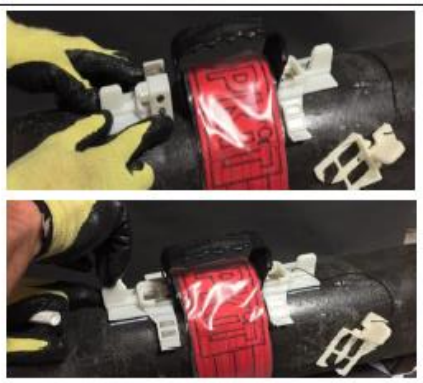
•Beyond 10 inch the STOPKiT is composed of several belts
•Centre the rubber patch on the smallest belt
•Position the STOPKiT next to the leak and tight softly to let a free sliding capacity
•Slide the STOPKiT over the leak and insert the ergots of the patch into the notches of the positioner

Materials:
- PPE
- Tightening tool (key ratchet Allen 8)

5 – SETTING UP OF THE SECOND POSITIONER

•Rubber patch must be perfectly centred on the leak
•Set up the second positioner next to the rubber patch and slide it up to touch, insert the ergots of the patch into the notches of the positioner.
•Stitch down the two ears
•Draw a line on each side of the frame.

Materials:
- PPE
- White marker



6 – LEAK SEALING

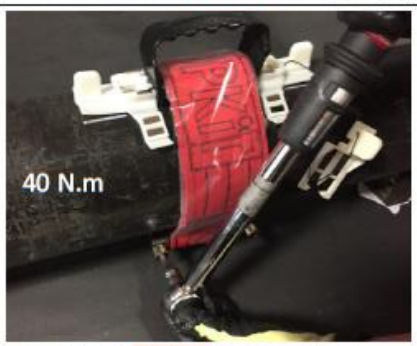
•Tight alternatively the right screw and the left screw (10 times) to keep the two bars parallel

•Repeat until **torque reaches 40 Nm for both screws**

•After 30 minutes, check the 40 Nm tightening

•Screw and block the nuts and the lock nuts

Materials:
- PPE
- Torque ratchet (Allen 8) calibrated
- 2 plate spanners N°16



7 – POSITIONERS REMOVAL

•Fold up the ears of the two positioners
•Remove the positioners by dragging the tail

Material:
- PPE

STOPKiT® must be installed only by trained and certified applicators
Contact us for training certificate. By e-mail at 3x@3xeng.com or by phone +377 92 05 79 81

STOPKiT®

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From -20°C (-4°F) to +150°C (+302°F)

OIL & GAS ONSHORE / OFFSHORE

OIL & GAS SUBSEA

APPLICATION NOTES

REQUIRED TOOLS

The following tools are required for STOPKiT® installation:

- Marker
- File
- Rags and acetone
- Tightening tool (key ratchet Allen 8)
- Torque ratchet (Allen 8) calibrated
- Plate spanners N°16

INSTRUCTION

STOPKiT® must be used only by trained and certified applicators. Contact us for training certificate.

USE

STOPKiT® is made for single use only. Do not use if packing is already open or STOPKiT® already used.

SHELF-LIFE

5 years after manufacturing date mentioned on packaging (dd/mm/yy).

SAFETY

Each applicator should read and understand the Installation Procedure before to use 3X products. Before intervention, Hazards and measures must be assessed accurately to ensure the safety of installation and applicators (pipe temperature, fluid or gas exposure, environment contamination...). Make sure the applicators wear appropriate PPE before leak sealing in accordance with risk assessment (chemical protective apparel, face shield, chemical or heat resistant gloves).

WARRANTY DISCLAIMER

Every reasonable effort is made to ensure the technical information and recommendations of this data sheet are true and accurate to the best of our knowledge at the date of issuance. However, improvements being continuously implemented to 3X products, this information is subject to change without notice. Please contact your 3X Distributor for the last updated product specifications. This 3X technical datasheet warrants the quality of this product when used according to directions. User shall determine suitability of the product for use and assumes all risk.

3X ENGINEERING

INNOVATIVE REPAIR SOLUTIONS FOR YOUR INSTALLATIONS

STOPKiT® SD

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

OIL & GAS ONSHORE / OFFSHORE

OIL & GAS SUBSEA

TECHNICAL DATA SHEET

STOPKiT® DESCRIPTION

Considered as an emergency repair, STOPKiT® is a stop leak solution for pipe. It is the most efficient repair system applicable under pressure. This unique and revolutionary concept, patented by 3X ENGINEERING (3X), allows to fix high pressure leaks. Installation can be done without shutting down the line pressure.

This document is dedicated to STOPKiT® for small diameters, ie 2 and 3-inch. (60.3 – 88.9 mm).

STOPKiT® technology is suitable for various applications and environments. It can be used for several fluids (oil, gas, water…) according to the strap and the technical patch (special applications on demand). STOPKiT® is available for Onshore, Offshore and Subsea environments.

STOPKiT® product can be used from –20°C to +150°C (-4°F to + 302°F).

Pressure up to 150 bars (2 175 psi) can be stopped for hole diameter inferior to 20 mm. STOPKiT® can fix leaks for most hole shapes.

STOPKiT® is lightweight and does not add any mechanical stress to the pipe, unlike metal clamps. It is sold in ready-to-use kit.

STOPKiT® can be used on elbows and even on oval diameter pipes. The pipe surface must be without sharp edges but the system can be applied on irregularity like welding wire or corrosion cankers, so it is the best system to deal with damaged and leaking pipes.

To ensure the effectiveness of the STOPKiT® technology, the product must be properly installed. STOPKiT® installers have to be trained by an authorized 3X Trainer. 3X Company and its agents should be contracted for all non-standard repairs.

STOPKiT® FEATURES

USES

- Suitable on welds, elbows, ovalised pipes
- Compatible with most common fluids and gas
- Stop leak up to 150 bars (2 175 psi)
- Hole diameter up to 20 mm
- Pipe diameters for 2 and 3-inch (exist up to 56-inch)
- Temperature from –20°C to +150°C (-4°F to + 302°F)

BENEFITS

- Installation in less than 5 minutes
- Light product
- No additional load on pipe
- Online sealing / No shutdown required
- Easy to store product
- Shelf-life: 5 years

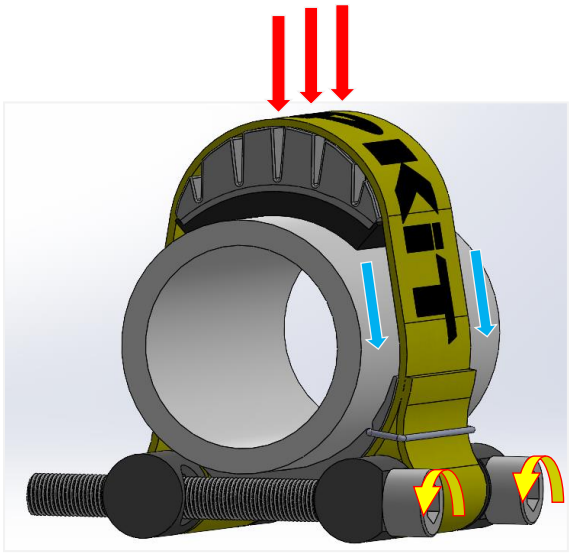
STOPKiT® SD

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

STOPKiT® CONCEPT

The system operates by concentrating all the needed stress in the pipe at the defect location. The hoop stress needed to stop the leak is brought by the technical strap and the screws. The strong fibers of the strap are temperature and stress resistant.

STOPKiT® patented concept:

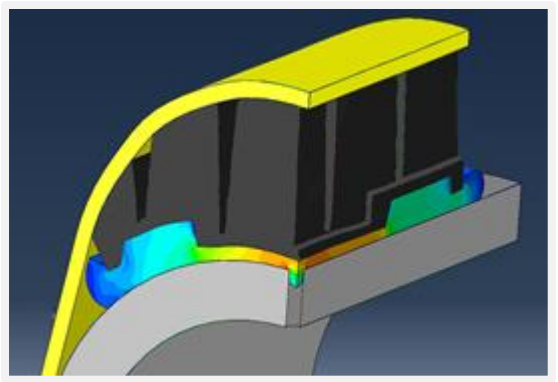


PRINCIPLE OF LEAK SEALING USING STOPKiT®

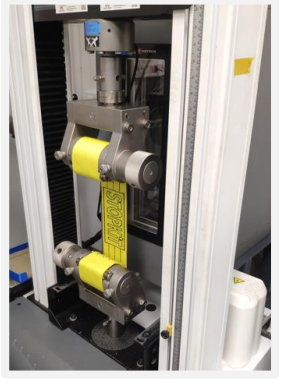
When the screws are tightened, the strap transfers the strain to the technical rubber patch in order to get the imperviousness. In fact, tightening the screws will induce a tension force in the belt, and this will perform the radial force on the leak point via the applicator. A U-tensioner is used to increase the screw stroke and reach proper tape tensioning and thus higher leak sealing capacity. Once properly compressed, the HNBR patch will be forced into the through wall defect and seal the leakage.

STOPKiT® study:

3X ENGINEERING has spent intensive effort to develop the latest generation of STOPKiT®.
The design has been optimized using FEA, relying on a strong knowledge of involved materials and their constitutive equations, as well as mastery of non-linear behavior. As a result, 3X is able to predict the behavior of its STOPKiT® for each new configuration.



AFTER TIGHTENING: LEAK SEALED



BELT TESTING

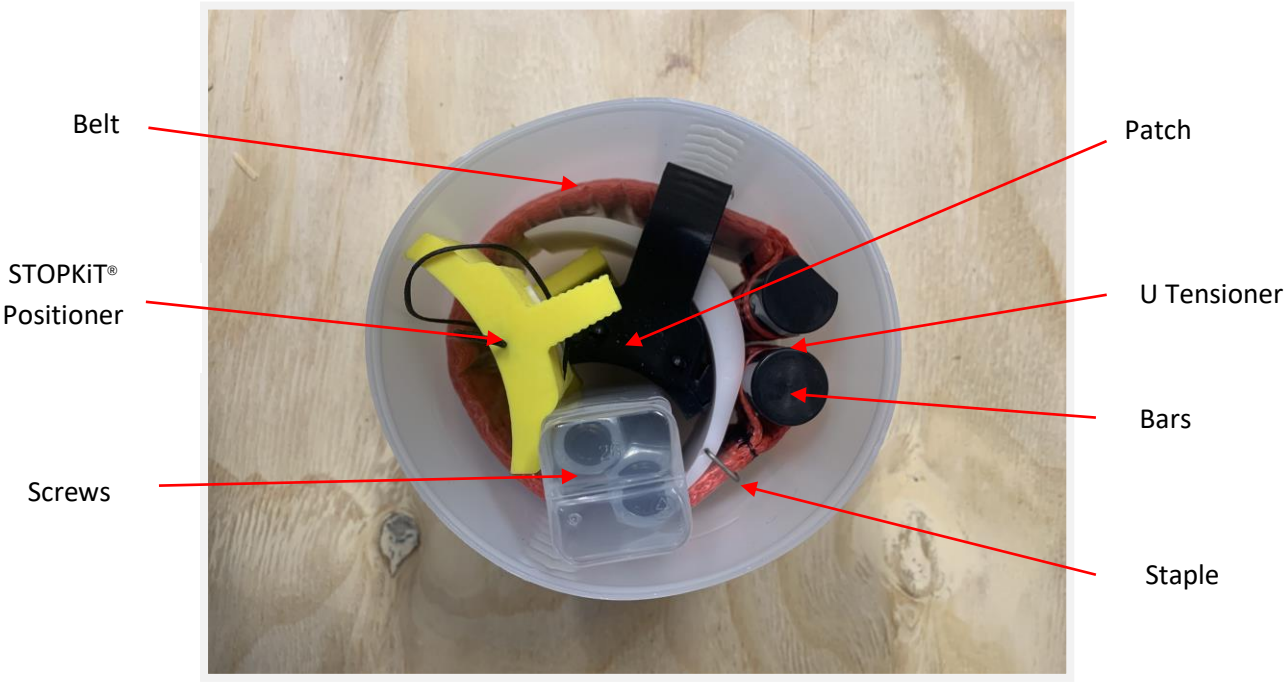
WITNESSED PRESSURE TEST

STOPKiT® has been thoroughly tested with active leakage to confirm that the experimental values are similar to FEA.

STOPKiT® COMPOSITION

STOPKiT® is made of:

- 1 patch 50mm x 50mm
- 1 Belt (specific length according to pipe diameter)
- 1 Carbon Steel Bar
- 1 Carbon Steel Bolt 16mm and 2 Carbon Steel HSHC Screws 10
- 1 STOPKiT® Positioner (special device for STOPKiT® implementation)
- 1 U Tensioner (2" or 3" inch depending on model)
- 1 Staple (combined with U Tensioner)



Do not modify the composition of the STOPKiT® for quality purpose. Do not try to adapt a STOPKiT® on another pipe diameter than mentioned on the packaging.

STOPKiT® versions can be used in most environments: Onshore, Offshore and Subsea. Because the environment is more aggressive in subsea and offshore/splash zone, the composition of the belt is slightly different to make it more resistant.

STOPKiT® SD

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

TECHNICAL SPECIFICATIONS FOR STOPKiT® ONSHORE

STOPKiT® ONSHORE version is dedicated for onshore environment such as refinery or inland piping.

The color of the belt is yellow.

DENOMINATION	STON002	STON003
USE	ONSHORE ENVIRONMENT – EMERGENCY REPAIR	
PIPE DIAMETER	2-inch	3-inch
MIN. TEMPERATURE	-20°C / -4°F	
MAX. TEMPERATURE	+150°C / +302°F	
PATCH SIZE	50x50mm	
MAXIMUM DEFECT SIZE	Ø≤ 20mm	
MAXIMUM PRESSURE	T°C < 80°C : 150 bars / 2 175 psi 80°C < T°C < 150°C : 50 bars / 725 psi	

STOPKiT® SD

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

TECHNICAL SPECIFICATIONS FOR STOPKiT® OFFSHORE

STOPKiT® OFFSHORE version is dedicated for offshore environment such as platform, splash zone or subsea conditions.

The color of the offshore belt is red. The belt has been designed specifically for harsh environments. The belt of this STOPKiT® reinforced to be resistant underwater and durable. It will definitely improve the long-term product efficiency.

DENOMINATION	STOF002	STOF003
USE	OFFSHORE / SUBSEA ENVIRONMENT – EMERGENCY REPAIR	
PIPE DIAMETER	2-inch	3-inch
MIN. TEMPERATURE	-20°C / -4°F	
MAX. TEMPERATURE	+150°C / +302°F	
PATCH SIZE	50x50mm	
MAXIMUM DEFECT SIZE	Ø≤ 20mm	
MAXIMUM PRESSURE	T°C < 80°C : 150 bars / 2 175 psi 80°C < T°C < 150°C : 50 bars / 725 psi	

MATERIAL SPECIFICATIONS

Part	Material
Belt	PES
Nut	ISO 4032 Steel 8 Class
Screw	ISO 4762 – DIN 912 Steel 12.9 Class
E bar	CS 42CD4 + Zinc-Nickel
S bar	CS 42CD4 + Zinc-Nickel
Applicator/Distributor	PA 66
U-tensioner	POM
Patch	HNBR
Anti friction sleeve	LDPE

CORROSION RESISTANT

Metallic material parts are corrosion resistant.

A specific marine grease is used to lubricate the threads to ensure an easy bolting to the necessary torque.

TEMPERATURE EFFECT

STOPKiT® delivers optimal performance for temperature inferior to +80°C.

It is possible to seal leakage up to +150°C with degraded pressure performance. Indeed, the temperature may affect the components because of patch softening or belt and reduce product lifetime from months to few weeks.

STOPKiT® SD

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

CHEMICAL RESISTANCE

CHEMICAL	STOPKIT PATCH		CHEMICAL	STOPKIT PATCH
Acetic Acid	C		Hydrogen, Gas	A
Acetone	U		Iso-Butane	A
Acetylene Gas	A		Jet Fuel JP3	A
Aerozene 50 (50%Hydrazine, 50% UDMH)	U		Jet Fuel JP4	A
Alcohol (Methanol)	B		Jet Fuel JP5	A
Aluminum Hydroxide Solution	A		Jet Fuel JP6	A
Amines, primary (such as Methyl, Ethyl, Propyl)	U		JP3 (Fuel)	A
Ammonia (gas)	A		JP4 (Fuel)	A
Ammonia (liquid)	B		JP5 (Fuel)	A
Argon Gas	A		JP6 (Fuel)	A
Aromatic Fuels (up to 50% Aromatic)	A		JPX (Fuel)	A
Aromatic Hydrocarbons (100% Aromatic)	U		Kerosene	A
Asphalt, Emulsion	B		Machinery Oil (mineral)	A
ASTM Test Fuel A	A		Methane	A
ASTM Test Fuel B	A		Methanol	B
ASTM Test Fuel C	B		Mineral Oil	A/B
ASTM-Oil IRM 902	A		Muriatic Acid (HCl), diluted	B
ASTM-Oil IRM 903	A		Natural Gas	A
ASTM-Oil No.1	A		Neon Gas	A
ATM-Brake Fluid (Glycol based)	U		Nitrogen Gas	A
Automatic-Transmission Fluid	A		Octane	B
Automotive Gasoline	A		Olefin, crude	A
Battery Acid (Sulfuric Acid diluted)	U		Oleic Acid	A
Benzine (Gasoline)	A		Paraffin	A
Benzine 80/Benzene 20	B		Paraffin Oil	A
Benzol (Benzene)	U		Petroleum	A
Brake Fluids (based on mineraloil)	A		Petroleum Ether	A
Butane	A		Phenol	U
Chloric Acid	U		Phosphoric Acid 45%	B
Citric Acid	A		Potassium Hydroxide (Solution 50%)	B
Copper Sulfate (Blue Vitriol) Solution	A		Potassium Hypochlorite (Javelle water)	B
Crude Oil	B		Propane	A
Cyclohexane	A		Propanol	B
Diesel Fuel	A		2-Propanone (Acetone)	U
Diesel Oil	A		Sea Water	A
Domestic Fuel Oils	A		Silcone grease	A
Ethane	A		Silicone Oil	A
Ethylene Glycol	A		Silver Nitrate	B
Freon 11	A		Sodium Bicarbonate Solution	A
Freon 112	B		Sodium Chloride (Common Salt)	A
Gas Oil	A		Sodium Hydroxide, Caustic Soda	B
Gasoline/Alcohol Mix	B		Sulfur Dioxide (SO2)	U
Gasoline, 130 Octane	A		Sulfur Hexafluoride (SF6)	B
Gasoline, aromatic	A		Sulfuric Acid, diluted	B
Gasoline, Ethyl and Regular	A		Toluene (Toluol)	U
Gasoline, Refined	A		Transformer Oil	B
Gasoline, Sour	A		Waste Gas (cont. Carbon Dioxide)	A
Gasoline, with Mercaptan	A		Waste Gas (cont. Carbon Monoxide)	A
Generator Gas	A		Waste Gas (cont. Hydrogen Chloride)	B
Glycerol	A		Waste Gas (cont. Hydrogen Fluoride)	A
HEF-3	B		Waste Gas (cont. Sulfur Dioxide)	B
Helium Gas	A		Waste Gas (cont. Sulfuric Acid)	U
Heptane	A		Water to +80 °C / +176 °F	B
Hydrochlorique Acid (Muriatic Acid) 37%	U			

A Very good suitability and resistance. Elastomer shows little or no effect from exposure. Little effect on performance and physical properties.

B Good suitability. Some effects from exposure with some loss of physical properties. Some chemical swelling

C Limited suitability. Significant swell and loss of physical properties after exposure. Additional tests should be done.

U The elastomer is unsuitable for application in this media.

3X ENGINEERING - 9 avenue Albert II – 98000 MONACO - ☏: +377.92.05.79.81 - Fax: +377.92.05.72.71 – 3x@3xeng.com – www.3xeng.com

STOPKiT® SD

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

INSTALLATION PROCEDURE

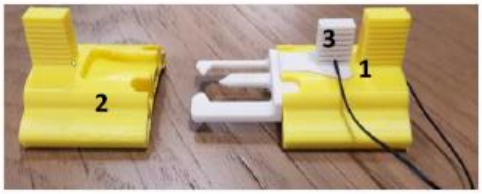
Scan this QR code to watch STOPKiT® SD installation video

0 – WEAR APPROPRIATE PPE

•Perform risk assessment prior job – spill and spatter hazards
•Select and wear suitable PPE according to HSE regulations on site and operational hazards (chemical, temperature, pressure, access, handling)

1 – STOPKiT POSITIONER PRESENTATION

•Magnetic positioner 1st (1)
•Magnetic positioner 2nd (2)
•Removable centring (3)



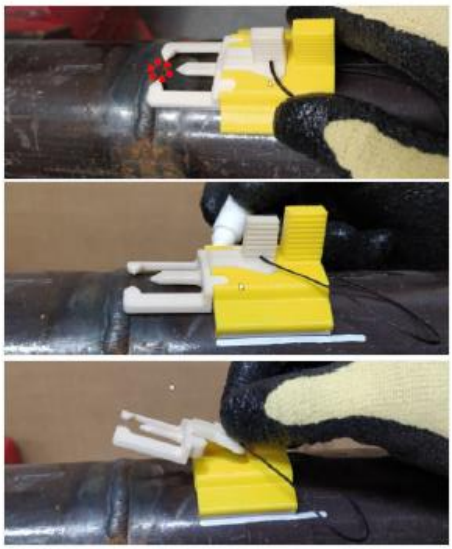
2 – SETTING UP ON THE PIPE

•Clean the pipe
•Avoid any burrs or sharp edges around the hole
•Centre the pin hole aligned on the 3 arrowheads

•Check the centering
•Draw a line on each side of the frame located at the back of the positioner

•Remove the centring part and let it hang.

Materials:
- PPE
- File
- Rags and acetone
- White marker

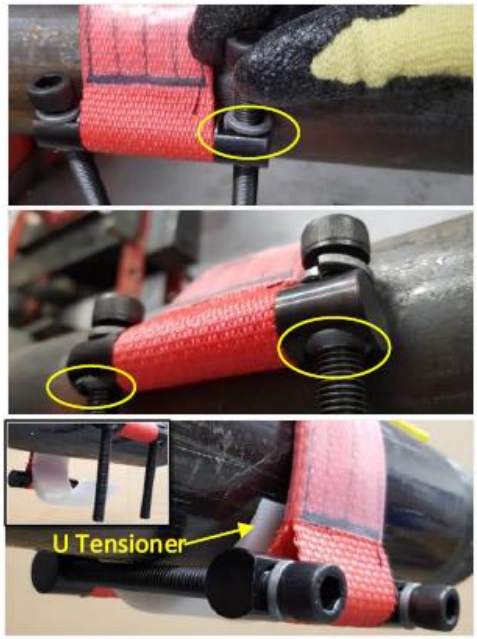


3 – SETTING UP OF THE STOPKIT ON THE PIPE

•Insert the screws in the entrance bar first.
Attention! The screw heads and the washers must be in contact with the flat spots of the entrance bar
•Note the presence of the anti-loss washers.
•The rubber patch must be centred on the belt as much as possible.
•Position the STOPKiT next to the leak (5 cm).
•Tight the softly the screws into the threaded bar to let a free sliding capacity.
•Position the U tensioner at the opposite of the patch, centred between the two bars.

If the geometry (Elbow) or if a too prominent weld hinders the installation, remove the U tensioner (For Max pressure 50 bar).

Materials:
- PPE



4 – POSITIONING OF THE STOPKiT

•Slide the STOPKiT over the leak and insert the ergots of the patch into the noto of the positioner.

Materials:
- PPE
- Tightening tool (key ratchet Allen 8)

5 – SETTING UP OF THE SECOND POSITIONER

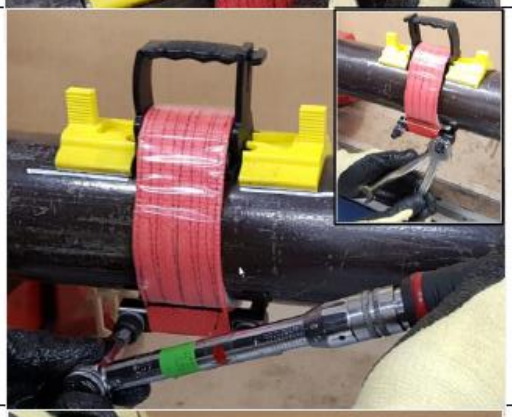
•Rubber patch must be perfectly centred on the leak
•Set up the second positioner next to the rubber patch and slide it up to touch, insert the ergots of the patch into the notches of the positic

Materials:
- PPE
- White marker

6 – LEAK SEALING

•Tight alternatively the right screw and the left screw (10 times) to keep the two bars parallel
•Repeat until the leak is fixed, maximum torque 20Nm for both screws
•After 30 minutes, check, if it is still leaking, tight more with 2 turns or more if it is necessary maximum torque 20 Nm.
•Screw and block the nuts and the lock nuts

Materials:
- PPE
- Torque ratchet (Allen 8) calibrated
- 2 plate spanners N°16



7 – POSITIONERS REMOVAL

•Remove the positioners by dragging the tail

Material:
- PPE

STOPKiT® SD must be installed only by trained and certified applicators
Contact us for training certificate. By e-mail at 3x@3xeng.com or by phone +377 92 05 79 81

STOPKiT® SD

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR
From -20°C (-4°F) to +150°C (+302°F)

APPLICATION NOTES

REQUIRED TOOLS

The following tools are required for STOPKiT® installation:

- Marker
- File
- Rags and acetone
- Tightening tool (key ratchet Allen 8)
- Torque ratchet (Allen 8) calibrated
- Plate spanners N°16

INSTRUCTION

STOPKiT® must be used only by trained and certified applicators. Contact us for training certificate.

USE

STOPKiT® is made for single use only. Do not use if packing is already open or STOPKiT® already used.

SHELF-LIFE

5 years after manufacturing date mentioned on packaging (dd/mm/yy).

SAFETY

Each applicator should read and understand the Installation Procedure before to use 3X products. Before intervention, Hazards and measures must be assessed accurately to ensure the safety of installation and applicators (pipe temperature, fluid or gas exposure, environment contamination...). Make sure the applicators wear appropriate PPE before leak sealing in accordance with risk assessment (chemical protective apparel, face shield, chemical or heat resistant gloves).

WARRANTY DISCLAIMER

Every reasonable effort is made to Ensure the technical information and recommendations of this data sheet are true and accurate to the best of our knowledge at the date of issuance. However, improvements being continuously implemented to 3X products, this information is subject to change without notice. Please contact your 3X Distributor for the last updated product specifications. This 3X technical datasheet warrants the quality of this product when used according to directions. User shall determine suitability of the product for use and assumes all risk.

3X ENGINEERING

INNOVATIVE REPAIR SOLUTIONS FOR YOUR INSTALLATIONS

3. PRODUCT APPLICATIONS

STOPKiT®

SUITABLE FOR VARIOUS PIPE CHARACTERISTICS & CONFIGURATIONS

➲ ENVIRONMENT

ONSHORE – OFFSHORE / SUBSEA

➲ PIPE DIAMETER

FROM 2’’ TO 56’’

➲ PIPE PRESSURE

UP TO 150 BARS (ACCORDING TO PIPE DIAMETER AND TEMPERATURE)

➲ PIPE TEMPERATURE

FROM -20°C TO +150°C (-4°F TO +302°F)

➲ PIPE GEOMETRY

STRAIGHT PIPE - ELBOW – OVAL PIPE
WELD INCLUDING

➲ FLUID TRANSPORTATION

OIL – GAS - WATER

BEFORE (HIGH PRESSURE LEAK)

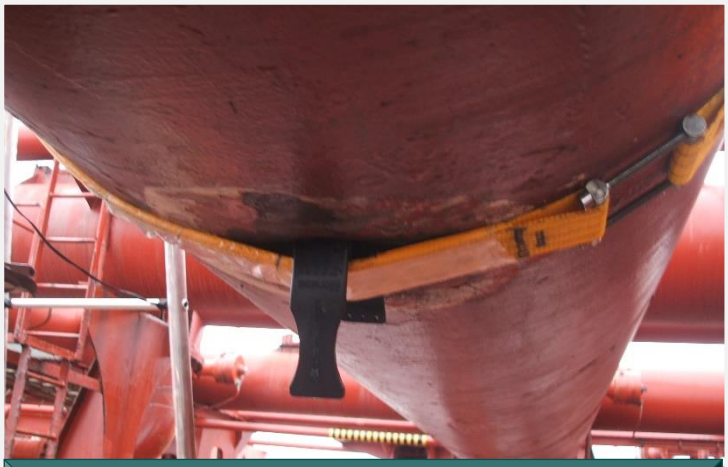
AFTER (STOPKiT® INSTALLED)

COMPLICATED CONFIGURATION (SHORT SPACE BETWEEN TEE AND FLANGE)

LARGE-DIAMETER PIPE

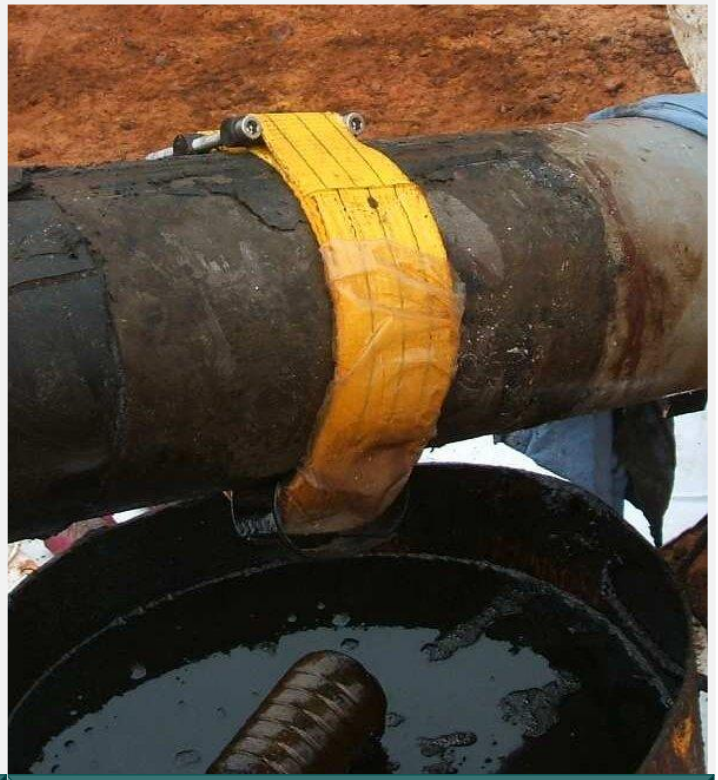
ELBOW

CLOSE STOPKiT®



ON FPSO

PIPE TRANSPORTING OIL WITH LEAK



PIPE TRANSPORTING OIL REPAIRED WITH STOPKiT®

SUBSEA – STRAIGHT PIPE

SUBSEA – ON WELD

SUBSEA – ELBOW

4. CASE STUDIES

3X ENGINEERING

INNOVATIVE REPAIR SOLUTION FOR YOUR INSTALLATIONS

OIL & GAS
ONSHORE /OFFSHORE

ONLINE LEAK SEALING SOLUTION FOR EMERGENCY PIPE REPAIR

DEFECT TYPES	**Leakage**
DETAILS	**20" gas pipeline, pressure 26 bars**
LOCATION	**Croatia, Onshore**
3X SOLUTION	**STOPKiT®**

Fig. 1: STOPKiT® packaging and components

Fig. 2: Detecting the exact location of the leakage before sliding the STOPKiT®

Fig. 3: STOPKiT® installed (side view)

Fig. 4: STOPKiT® installed (other side view)

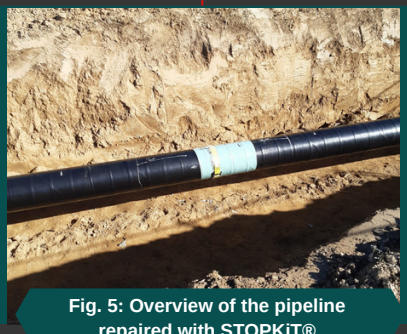


Fig. 5: Overview of the pipeline repaired with STOPKiT®

OVERVIEW

The objective of the repair, performed in February 2022 by **3X ENGINEERING (3X)** local distributor **FEROMIHIN** was to seal online a gas leak on a 20" pipeline.

The leakage was discovered during the reconstruction of the pipeline and application of new corrosion protection system when workers discovered bubbles under new layer of protective tape. To carry out the repair, it was decided to use 3X emergency leak sealing system **STOPKiT®.**

SCOPE OF WORK

The leakage, almost microscopic, was situated on spiral weld at 5 o'clock. A gas detector foam was used to detect the exact location of the leakage.

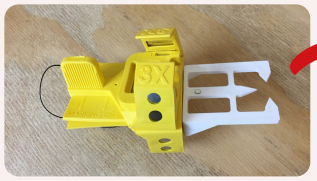
The repair was performed according to 3X installation procedure described below using **STOPKiT®** reference STON020 (suitable reference for a 20" pipe in onshore environment):

1/ **STOPKiT®** was positioned next to the leakage using specific positioner device.

2/ **STOPKiT®** was then slided and the rubber patch perfectly centred over the leakage.

3/ Once positioned over the leakage, **STOPKiT®** right and left screws were tightened alternatively to keep the two bars parallel. It was repeated until torque reached 40Nm for both screws.

4/ **STOPKiT®** positioner device was removed and the leakage sealed.



STOPKIT® POSITIONER

RESULTS

This job was successfully managed by our trained and certified distributor and the leakage was stopped within few minutes thanks to our emergency pipe repair system **STOPKiT®**. This product is easy to store, ready to use and will avoid a disaster, affecting the integrity of your assets.

info@3xeng.com www.3xeng.com

INNOVATIVE REPAIR SOLUTIONS FOR YOUR INSTALLATIONS

JOB DETAILS	**Online leak sealing system installation in bank data centre with refrigeration system**
LOCATION	**COLOMBIA**
3X SOLUTION	**STOPKiT®**

New intervention area

Fig. 1: Data center (illustrative photo)

JOB OVERVIEW

The objective of this job, performed in March 2021 by 3X ENGINEERING (3X) distributor in Colombia – C.P.S, was to train onsite technical team of a bank data center to install our **STOPKiT®** solution (emergency online leak sealing system, patented by 3X) in case of leakage in their refrigeration system that could affect the integrity of the installation.

ENVIRONMENT & TRAINING PROGRAM

Fig. 2: Refrigeration system made of several pipes

A data centre is the department in an enterprise that houses and maintains back-end IT systems and data stores — its mainframes, servers and databases. These data centres are vital for the continuity of daily operations. Consequently, the security and the reliability of these installations are a top-priority. This is the reason why CPS was consulted by the client to analyse and propose a suitable end efficient solution to avoid any problem in their assets. The data centre has a refrigeration system made of several pipes of different diameters that cannot be stopped in case of leak.

3X distributor naturally proposed our **STOPKiT®** product to solve this potential problem including a training of their technical team to be able to repair quickly in case of emergency.

STOPKiT® is an online leaking repair solution, ready to be used, that can be stored easily in your premises to respond very quicky to emergency issue.

Below are the different steps of **STOPKiT®** training program:

1/ Theoretical training: product presentation with its components and benefits
➔ **emergency stop leak solution applicable without shutdown (EPRS)**
➔ **large range of performance** (pipe from 2'' to 56 '', pipe temp. up to 80°C, with hole diameter of 50mm and max. pressure of 80 bars – available for onshore/offshore and subsea environments)
➔ **user-friendly product** (ready to use and easy to store, quick and easy to install).

Fig. 3: STOPKiT® installation training on progress

2/ Practical training: **STOPKiT®** implementation steps in real-life working conditions (installation in few minutes by a single person using **STOPKiT®** positioner device).

3/ Evaluation with training certificate delivered based on applicator's ability.

Fig. 4: Technical team successfully trained

CONCLUSION

The client is now equipped with **STOPKiT®** and trained to install it in case of leaking pipe. This way they are prepared in case of emergency situation. Having this **STOPKiT®** solution ready to install is the key to avoid a disaster.

INNOVATIVE REPAIR SOLUTIONS FOR YOUR INSTALLATIONS

DEFECT TYPE	**Leak**
PIPE DETAILS	**10" oil line – design pressure 250 psi – op. max. pressure 150 psi – temperature 49°C**
LOCATION	**COLOMBIA**
3X SOLUTION	**STOPKiT® recovered with REINFORCEKiT® 4D**

Figure 1: STOPKiT® installed

OVERVIEW

The objective of this job, performed in May 2020 by 3X ENGINEERING (3X) distributor in Colombia – C.P.S, was to seal online an oil leak on 10" straight line. To perform the repair, it was decided to use 3X emergency leak sealing system **STOPKiT®** and then secure it as long-term solution by overwrapping the **STOPKiT®** with the composite repair **REINFORCEKiT® 4D.**

SCOPE OF WORK

The repair procedure was performed following two main steps.

➔ **STOPKiT®** installation: emergency online leak sealing system, patented by 3X.

➔ **REINFORCEKiT® 4D** application according to ASME PCC-2 and 3X repair calculation: composite reinforcement system.

Below are the different stages of the procedure:

❶ **STOPKiT®** was installed in few minutes on the defect to stop the leak following 3X installation procedure.

❷ Surface preparation was then performed on both sides of the **STOPKiT®** using manual and mechanical tools to eliminate corrosion and coating residues and get a good surface roughness (superior to 60µm) to ensure a good bonding between the pipe and the composite. Hygrometric conditions were checked and the surface was cleaned and degreased with ethanol.

❸ **F3X8 filler** was used to level the surface and smooth irregular edges and geometries between the **STOPKiT®** and the pipe.

❹ **REINFORCEKiT® 4D** composite wrapping over the **STOPKiT®** was completed using Kevlar® tape impregnated with **R3X5 resin** ➔ 14 layers for a total repair length of 1500mm.

❺ Final layer of **R3X5 resin** was applied on the whole repair to ensure good wetting and improve the visual aspect. **Reference plate** was finally installed for traceability purpose.

Samples of filler and resin were taken during the various stages of the repair for quality control.

Figure 2: F3X8 filler application

Figure 3: Composite wrapping on progress

Figure 4: View of the repair completed

RESULTS

The leak was quickly stopped thanks to our **STOPKiT®** and the composite reinforcement system application was performed successfully using **REINFORCEKiT® 4D.** The measurement of the resin hardness was made after 72 hours of curing, exceeding the minimum values required.

Composite Repair Specialist

DEFECT TYPE	**Pinhole – 6'' subsea gas pipeline – 30m depth**
PIPELINE DETAILS	**Bend – pressure 900 psi – temperature 30°C**
LOCATION	**INDONESIA (Client Platform)**
3X SOLUTION	**STOPKiT® Offshore (STOF006)**

Figure 1: Bend with the leak

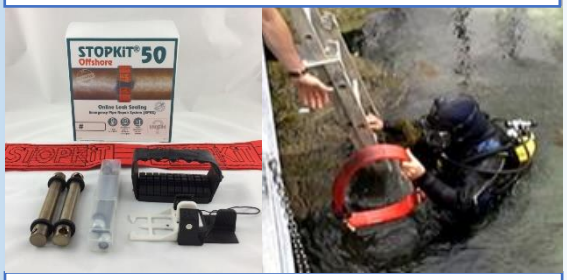


Figure 2: **STOPKiT® Offshore** Packaging
Figure 3: As per 3X technical training, client's diver is certified to install the **STOPKiT®** by himself

Figures 4 & 5: Once well positioned over the leak, both screws of **STOPKiT®** must be tightened at 40 Nm

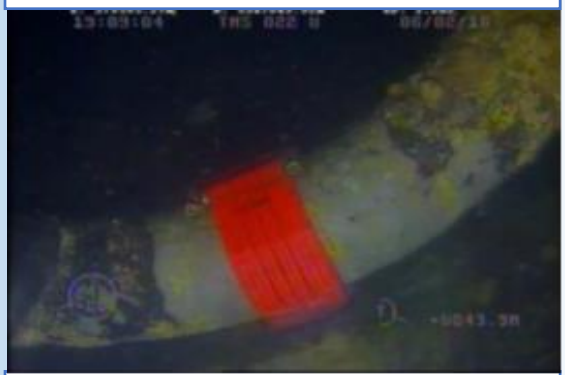


Figure 6: **STOPKiT®** successfully installed on the bend
No more gas bubbles, no more leak

OVERVIEW

The objective of the EPRS (Emergency Pipe Repair Solution), performed early 2017 by the client, was to stop an on-line gas leakage located at one of the bend of 6" susbsea line.

As per the technical training received by the client a few month ago from 3X ENGINEERING (3X) Specialist, and thanks to their safety stock located on-board, they were able to successfully install our **STOPKiT® Offshore** by themselves.

This emergency repair was conducted in-house within the hour, without any subcontractors and heavy subsea logistics.

SCOPE OF WORK

After inspection, it was decided to stop the leakage of the 6'' subsea gas line. As per their EPRS procedures, the client picked one of their several **STOPKiT® Offshore** available on the platform (no procurement delay - immediate solution available).

The repair was performed following 4 main stages:

❶ Position the **STOPKiT® Offshore** next to the leak using our **STOPKiT®** Positioner device and tight softly to let a free sliding capacity.

❷ Slide the **STOPKiT® Offshore** over the leak. Rubber patch must be perfectly centred on the leak thanks to our **STOPKiT®** Positioner device.

❸ Tight alternatively the right screw and the left screw to keep the two bars parallel. Repeat until torque reaches 40 Nm for both screws.

❹ Screw anti-vibration nuts.

RESULTS

This job has been successfully managed by the client itself within the hour, following 3X installation procedures.

The leak has been rapidly stopped despite the bend as challenging location. This proves the capabilities of our **STOPKiT®** to efficiently control on-line leakage. This solution is only temporary. It allows you to fix the emergency and schedule peacefully for permanent repairs in the upcoming weeks or months.

INNOVATIVE REPAIR SOLUTIONS FOR YOUR INSTALLATIONS

DEFECT TYPE	**Pinholes (50mm & 10mm Ø) – Hydrostatic tests**
PIPE DETAILS	**10" straight line – pressure 430 psi - 1160 psi (50mm - 10mm respectively) – temperature 30°C**
LOCATION	**BARANOA - ATLANTICO (COLOMBIA)**
3X SOLUTION	**STOPKiT®**

Figure 1: Straight line with the defect

Figure 2: STOPKiT® positioning

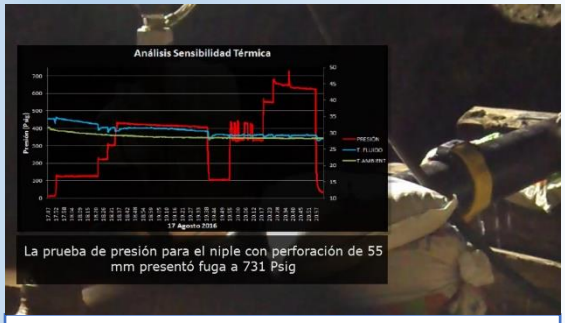


Figure 3: Pressure test for 50mm hole
➔ leaks at 731 psi

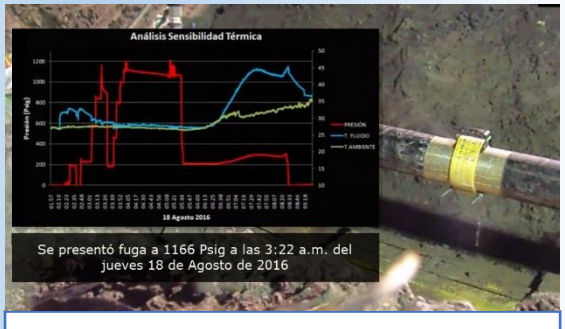


Figure 4: Pressure test for 10mm hole
➔ leaks at 1166 psi

OVERVIEW

The objective of this test, performed in 2016 in Colombia, was to contain water leaks of different diameters (50mm & 10mm) on 10" straight line.

As per the technical training given by 3X ENGINEERING specialists to the client, **STOPKiT®** were successfully installed.

Two defects were simulated, in order to test **STOPKiT® 50** (patch size 50x50mm – can fix a leakage of max. 10mm size and up to 1160 psi) and **STOPKiT® 100** (patch size 50x100mm – can fix a leakage of max. 50mm size and up to 435 psi).

SCOPE OF WORK

Hydrostatic tests were performed at different pressures for the two holes (50mm & 10mm Ø). These leaks were stopped using **STOPKiT® 100** and **STOPKiT® 50** respectively. The aim was to evaluate the performance of the product as an emergency leak sealing system.

The procedure for both leaks was performed following 4 main stages:

❶ Position the **STOPKiT®** next to the leak using **STOPKiT®** Positioner device and tight softly to let a free sliding capacity.

❷ Slide the **STOPKiT®** over the leak. Rubber patch is perfectly centered on the leak thanks to **STOPKiT®** Positioner device.

❸ Tight alternatively the right screw and the left screw to keep the two bars parallel. Repeat until torque reaches 40 Nm for both screws.

❹ Screw anti-vibration nuts. Leak sealing completed.

RESULTS

STOPKiT® 100 exceeded the pressure values specified by the manufacturer and maintained the pressure during the decrease-increase pressure cycles. **STOPKiT® 50** reached the pressure values specified by the manufacturer and maintained the pressure during the decrease-increase pressure cycles. The results of this tests proved the capabilities of **STOPKiT®** products to control efficiently on-line leakages. This is a temporary solution that allows to deal with the emergency and schedule peacefully the permanent repair in the upcoming weeks or months.

ASK US FOR THE VIDEO CORRESPONDING TO THE TEST

5. PRESS ARTICLE

PATCHWORK POWER

Olivier Marin, 3X ENGINEERING, Monaco, provides an overview of an online leak sealing solution to deal with emergency pipe repairs.

Pipelines and piping are widely used for the transportation of hydrocarbon fluids from production sites to distribution depots. Leaks in pipelines and piping networks can result in serious ecological disasters, human casualties, and financial loss. Moreover, hydrocarbon releases have a serious impact on the greenhouse effect. With increasing public awareness and concern regarding the environment and more rigorous regulations, reliable solutions to stop leakages must be available on the market.

Hydrocarbon releases have been closely monitored since the late 1990s, following major accidents. The goal was to determine leak frequencies and size breakdown for oil and gas pipework by gathering and analysing data. HSE hydrocarbon release constitutes a useful database and has been considered suitable for use in

Figure 1. STOPKiT® product installed on an elbow.

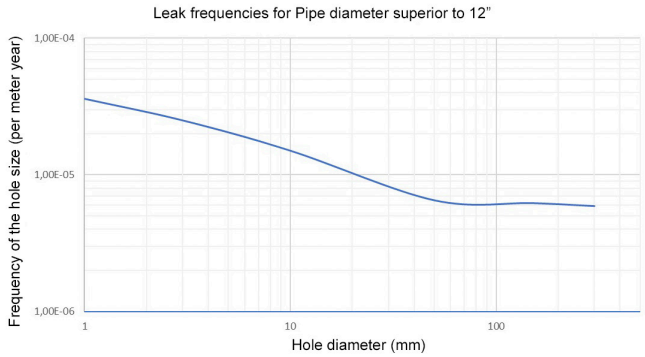


Figure 2. Leak frequency as a function of hole diameter (extrapolated from HSE hydrocarbon database 1992 - 2006).

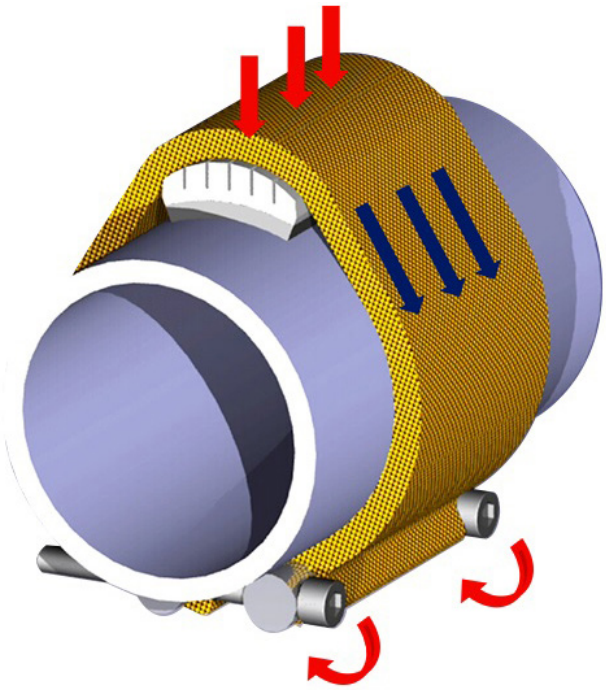


Figure 3. STOPKiT concept – by compressing the patch over the defect, the rubber can seal the leakage.

offshore as well as in onshore. It appears that the likelihood of discovering a small diameter hole is maximum.

To meet this demand, 3X ENGINEERING (3X) developed a product called STOPKiT®, which can be used as an emergency pipe repair system (EPRS). One of the main advantages of this system is its ability to stop leakage online without shutdown (within safety operations) – up to 80 bars (1160 psi) in a limited time of several minutes.

STOPKiT has a track record of more than 10 years, with a reputation established from years of experience.

Principle

STOPKiT is a patented concept, and it is made of a rubber patch and tightening system. By compressing the patch over the leaking defect, the rubber seals the leakage.

Installation

Implementation of the product requires a trained installer. After positioning the STOPKiT next to the leakage, the installer uses a magnetic positioner to target the defect (Figure 7). Next, the STOPKiT is slid over the leakage and kept firmly in position with a second magnetic positioner. The installer just needs to tighten both screws alternatively using a torque wrench until reaching the specified torque (40 Nm if the temperature is less than 40°C, otherwise 30 Nm). In only a few minutes, the active leakage is managed and stopped. The product can remain in position for several months until a long-term solution can be considered.

Many trial tests were required to determine the most suitable design and materials to achieve a high-performance product.

Material selection

The patch is made of rubber material, providing high chemical resistance to most hydrocarbon fluids and gas, as well as a large range of industrial chemicals. The rubber can offer strong shear resistance when compressed over a defect.

As it is not possible to check the belt tension on a daily basis, it is important to select the proper material to avoid belt creeping. By choosing a belt reinforced with aramid material, the strain under constraint is kept to a minimum.

The tightening system, bars and screws, are made of a combination of steels subject to surface treatment, avoiding

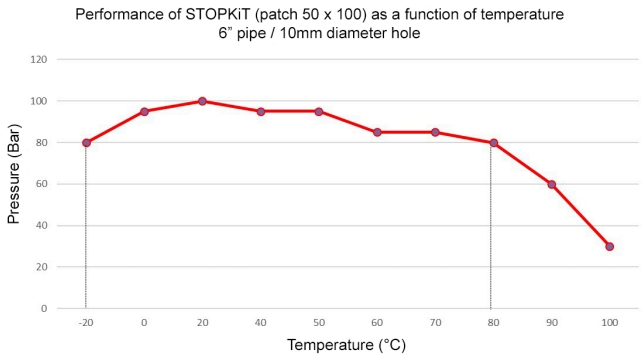


Figure 4. Performance of STOPKiT (patch 50 mm × 100 mm) as a function of temperature – 6 in. pipe/10 mm (0.4 in.) diameter hole.

Figure 5. STOPKiT recovered with 3X filler before wrapping with R4D-HT+.

Figure 6. Reinforcement completed and identity plate installed for traceability.

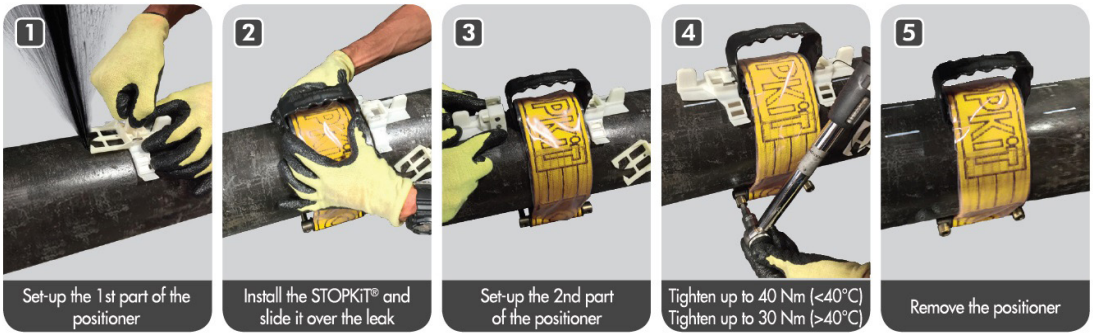


Figure 7. Implementation steps using the STOPKiT positioner device.

the issue of corrosion and strengthening the screws. A subsea version of STOPKiT has also been developed to be suitable for underwater environments.

With its design made mainly of polymeric materials, STOPKiT's weight is limited, generating no overloading when compared with alternative solutions such as metallic clamps.

Geometry

STOPKiT focuses the stress needed to stop the leak at the leaking point. In fact, tightening the screws will induce a tension force in the belt, and this will perform the radial force via the applicator. Then the distributor will increase the pressure locally with the ribs and the containment grooves, as a stress concentrator, on the sealing patch.

Even if the patch geometry seems to be basic, many trial runs were required to achieve the final product design. It was tested successfully on leaks close to welding wire up to 8 mm (0.3 in.) in height. Indeed, the patch should provide leak sealing in versatile conditions, and the flexibility of the system can also allow for applications on pitted surfaces or on bend geometries.

Size of leakage

The most common defect found on the field is a pinhole. However, in some cases, the leakage can be larger than several centimetres. 3X has developed two patches to cover a wide range of diameters.

- Patch 50 mm × 100 mm: This patch is dedicated to hole diameters up to 10 mm (0.4 in.). It can offer high performance with leak sealing up to 80 bars minimum.
- Patch 100 mm × 100 mm: This larger patch is dedicated to larger hole diameters, up to 50 mm (2 in.). However, the pressure that can be handled is 30 bars.

Temperature

Temperature is a key parameter for the behaviour of rubber. At low temperature, when approaching the glass transition of the material, the patch becomes too rigid and cannot closely fit the shape of the defected area. On the other side, at high temperature, the mechanical performance drops. As the patch is highly stressed, mostly shear mode, the rubber can fail. For this reason, the range of temperature for STOPKiT is set from -20°C to 80°C (-4°F to 176°F).

Good positioning: key to success

When sliding the STOPKiT over the leakage, it is no longer possible to locate the exact position of the defect.

Consequently, the correct positioning is essential to leak sealing success.

To assist the operator, 3X developed a solution based on a magnetic marker, which can maintain the optimal position of the patch during STOPKiT implementation.

Long-term solution

In some cases, the final user wants to secure the STOPKiT as a long-term solution. An example of this can be seen in a recent STOPKiT application in Iraq.

A 12 in. line was subject to external corrosion, leading to leakage. Process shutdown was not an option so only online repairs were considered. Several attempts were performed by a local company to seal the leakage with use of technical polymer, but there was no success.

3X proposed that the leakage should be sealed with STOPKiT online. By choosing the proper STOPKiT to suit the diameter and patch size, the leak was sealed within a few minutes.

The second part of the job was to achieve a long-term repair. Without protection, STOPKiT could be subject to ageing or external damage. As a result, it was decided that a composite repair should be applied over the STOPKiT to secure it.

The composite repair, REINFORCEKiT® 4D (R4D) provided by 3X, was designed as per ASME PCC-2 with a design pressure of 42 bars (610 psi). This composite repair is made of an epoxy matrix reinforced by bidirectional aramid fibres.

After checking the absence of leakage, the surface was prepared with the Bristle Blaster® to reach ST3 cleanliness and a roughness superior to 60 µm (Rz). The surface was then thoroughly cleaned with acetone to degrease and remove residual contaminants. The surface preparation is one of the most critical steps of composite wrapping, allowing good bonding of the polymeric system to the pipe wall.

To allow easier wrapping and encompassing of STOPKiT, the screws are cut by a bolt cutter and the patch handle removed. Filler material was then applied all around the patch to secure the defected area. It was also applied either side of the belt to create a slope and to fill in any remaining cavities.

After filler hardening, the wrapping began using the R4D-HT+ composite system. Kevlar® tape is wet lay-up impregnated and wrapped helicoidally with 50% overlapping. A total of 36 layers with a total repair length of 600 mm were required to restore the pipe integrity.

Conclusion

Keeping oil and gas assets safe is a priority for people and the environment. As leak occurrence is unpredictable, it is essential to have reliable emergency pipe repair systems available to the market. 3X Engineering's patented solution – already applied worldwide for over 10 years – aims to be efficient and provide value. Despite competitors' attempts to copy it, it remains a fast leak sealing solution.

6. REFERENCES LIST

References List

STOPKiT®

Online leak sealing

This references list includes all the products sold by 3X ENGINEERING Monaco but not the exhaustive list of the products sold by our Worldwide Distributors

LC - 12/2022

Year	Country	Client	STOPKiT Model (ONSHORE/OFFSHORE)
2022			
2022	Kazakhstan	**KPO**	ONSHORE TEMPORARY STOPKIT
2022	TURKEY	**TUPRAS**	ONSHORE TEMPORARY STOPKIT
2022	SAUDI ARABIA	**ARAMCO**	ONSHORE TEMPORARY STOPKIT
2022	TURKEY	**POLIPORT**	ONSHORE TEMPORARY STOPKIT
2022	OMAN	**CCED**	ONSHORE TEMPORARY STOPKIT
2022	QATAR	**NOC**	OFFSHORE TEMPORARY STOPKIT
2022	UAE	**ADNOC GAS PROCESSING**	ONSHORE TEMPORARY STOPKIT
2022	OMAN	**OQ**	ONSHORE TEMPORARY STOPKIT
2022	TURKEY	**TUPRAS**	ONSHORE TEMPORARY STOPKIT
2022	INDIA	**CAIRN**	ONSHORE TEMPORARY STOPKIT
2022	EQUATORIAL GUINEA	**TRIDENT ENERGY**	OFFSHORE TEMPORARY STOPKIT
2022	EGYPT	**PETROMAINT / AGIBA**	ONSHORE TEMPORARY STOPKIT
2021			
2021	RUSSIA	**Balakovskaya NPP**	ONSHORE TEMPORARY STOPKIT
2021	MALAYSIA	**hrc**	ONSHORE & OFFSHORE TEMPORARY STOPKIT
2021	MALAYSIA	**EXXON MOBIL**	ONSHORE TEMPORARY STOPKIT
2021	IVORY COAST	**SIR**	ONSHORE TEMPORARY STOPKIT
2021	EQUATORIAL GUINEA	**TRIDENT ENERGY**	OFFSHORE TEMPORARY STOPKIT
2021	GABON	**PERENCO**	ONSHORE TEMPORARY STOPKIT
2021	GABON	**MAUREL & PROM**	ONSHORE TEMPORARY STOPKIT
2021	EGYPT	**DAPETCO**	ONSHORE TEMPORARY STOPKIT
2021	EGYPT	**Alexandria Fertilizer**	ONSHORE TEMPORARY STOPKIT
2021	EGYPT	**SUMED**	OFFSHORE TEMPORARY STOPKIT
2021	ANGOLA	**TOTAL**	OFFSHORE TEMPORARY STOPKIT
2021	NIGERIA	**ESSO**	OFFSHORE TEMPORARY STOPKIT
2021	TURKEY	**TUPRAS**	ONSHORE TEMPORARY STOPKIT
2021	OMAN	**OQ**	ONSHORE TEMPORARY STOPKIT
2021	OMAN	**CCED**	ONSHORE TEMPORARY STOPKIT
2021	IRAQ	**SHELL BGC**	ONSHORE TEMPORARY STOPKIT
2021	UAE	**ADNOC GAS PROCESSING**	ONSHORE TEMPORARY STOPKIT
2021	UAE	**BOROUGE**	ONSHORE TEMPORARY STOPKIT
2021	UAE	**ADNOC GAS PROCESSING**	ONSHORE TEMPORARY STOPKIT
2021	QATAR	**TOTAL**	ONSHORE TEMPORARY STOPKIT
2021	QATAR	**NORTH OIL CORPORATION**	ONSHORE TEMPORARY STOPKIT
2021	FRANCE	**VERMILION**	ONSHORE TEMPORARY STOPKIT
2021	COLOMBIA	**ECOPETROL**	ONSHORE TEMPORARY STOPKIT
2021	COLOMBIA	**CENIT**	ONSHORE TEMPORARY STOPKIT
2021	GAMBIE	**GAMPETROLEUM**	ONSHORE TEMPORARY STOPKIT
2021	JAPAN	**TOHO GAS**	OFFSHORE TEMPORARY STOPKIT
2021	FRANCE	**TOTAL**	ONSHORE TEMPORARY STOPKIT
2021	QATAR	**NOC**	OFFSHORE TEMPORARY STOPKIT
2021	NIGERIA	**EXXON MOBIL**	OFFSHORE TEMPORARY STOPKIT
2021	PERU	**PLUSPETROL**	ONSHORE TEMPORARY STOPKIT
2020			
2020	GABON	**ADDAX**	ONSHORE TEMPORARY STOPKIT
2020	QATAR	**TOTAL E&P**	ONSHORE TEMPORARY STOPKIT
2020	CONGO	**TOTAL E&P**	ONSHORE TEMPORARY STOPKIT
2020	ANGOLA	**TOTAL E&P**	OFFSHORE TEMPORARY STOPKIT
2020	FRANCE	**COMPAGNIE INDUSTRIELLE MARITIME (CIM)**	ONSHORE TEMPORARY STOPKIT
2020	FRANCE	**SPSE**	ONSHORE TEMPORARY STOPKIT
2020	FRANCE	**NAVAL GROUP/ MARINE NATIONALE**	OFFSHORE TEMPORARY STOPKIT
2020	UK / FRANCE	**EUROTUNNEL**	ONSHORE TEMPORARY STOPKIT
2020	RUSSIA	**ROSNEFT**	ONSHORE TEMPORARY STOPKIT
2020	RUSSIA	**LUKOIL**	ONSHORE TEMPORARY STOPKIT
2020	DENMARK	**TOTAL**	OFFSHORE TEMPORARY STOPKIT
2020	FRANCE	**TOTAL**	ONSHORE TEMPORARY STOPKIT
2020	PANAMA	**INTEGRITY TECHNOLOGIES**	ONSHORE TEMPORARY STOPKIT
2020	COLOMBIA	**COMERCIAL Y SERVICIOS LARCO SAS**	ONSHORE TEMPORARY STOPKIT
2020	COLOMBIA	**METALPAR SAS**	ONSHORE TEMPORARY STOPKIT
2020	COLOMBIA	**CENIT TRANSPORTE Y LOGISTICA DE HIDROCARBUROS**	ONSHORE TEMPORARY STOPKIT
2020	GABON	**PERENCO**	ONSHORE TEMPORARY STOPKIT
2020	EQUATORIAL GUINEA	**TRIDENT ENERGY**	ONSHORE TEMPORARY STOPKIT
2020	ALGERIA	**SONATRACH**	ONSHORE TEMPORARY STOPKIT
2020	UAE	**ADNOC GAS PROCESSING**	ONSHORE TEMPORARY STOPKIT
2020	IRAQ	**SHELL BGC**	ONSHORE TEMPORARY STOPKIT

2020	JAPAN	**TOHO GAS**	ONSHORE TEMPORARY STOPKIT
2020	CHINA	**SINOPEC**	OFFSHORE TEMPORARY STOPKIT

2019

2019	GABON	**PERENCO**	ONSHORE TEMPORARY STOPKITS / OFFSHORE TEMPORARY STOPKITS
2019	COLOMBIA	**CENIT TRANSPORTE Y LOGISTICA DE HIDROCARBUROS**	ONSHORE TEMPORARY STOPKIT
2019	COLOMBIA	**ECOPETROL**	ONSHORE TEMPORARY STOPKIT
2019	UAE	**ADNOC LNG**	ONSHORE TEMPORARY STOPKIT
2019	UAE	**ADNOC GAS PROCESSING**	ONSHORE TEMPORARY STOPKIT
2019	SAUDI ARABIA	**ARAMCO**	ONSHORE TEMPORARY STOPKIT
2019	IRAQ	**SHELL BGC**	ONSHORE TEMPORARY STOPKIT
2019	UAE	**TOTAL ABK**	OFFSHORE TEMPORARY STOPKIT
2019	UAE	**BOROUGE**	ONSHORE TEMPORARY STOPKIT
2019	France	**TOTAL**	ONSHORE TEMPORARY STOPKIT
2019	France	**SFDM**	ONSHORE TEMPORARY STOPKITS
2019	Brunei	**TOTAL**	ONSHORE TEMPORARY STOPKITS
2019	India	**INDIAN OIL**	ONSHORE TEMPORARY STOPKITS
2019	Indonesia	**PERTAMINA**	ONSHORE TEMPORARY STOPKITS
2019	Viet-Nam	**PREMIER OIL**	OFFSHORE TEMPORARY STOPKITS
2019	Japan	**IWAKUNI WATERWORKS BUREAU**	ONSHORE TEMPORARY STOPKITS
2019	Japan	**BRIDGESTONE SHIMONOSEKI FACTORY**	ONSHORE TEMPORARY STOPKITS
2019	Japan	**TOHO GAS**	OFFSHORE TEMPORARY STOPKITS

2018

2018	Borneo	**TOTAL**	ONSHORE TEMPORARY STOPKITS
2018	Taiwan	**CPC**	ONSHORE TEMPORARY STOPKITS
2018	Myanmar	**TOTAL**	ONSHORE TEMPORARY STOPKITS
2018	Australia	**WOODSIDE**	ONSHORE TEMPORARY STOPKITS
2018	Hong-Kong	**CONCRETE HK**	ONSHORE TEMPORARY STOPKITS
2018	Thailand	**MUBADALA**	OFFSHORE TEMPORARY STOPKITS
2018	Brunei	**TOTAL**	ONSHORE TEMPORARY STOPKITS
2018	UAE	**TOTAL ABK**	OFFSHORE TEMPORARY STOPKITS
2018	UAE	**ADNOC GAS PROCESSING**	ONSHORE TEMPORARY STOPKITS
2018	Yemen	**PETROMASILA**	ONSHORE TEMPORARY STOPKITS
2018	Algérie	**SONATRACH**	ONSHORE TEMPORARY STOPKITS
2018	France	**Eurotunnel**	ONSHORE TEMPORARY STOPKITS
2018	France	**GRT Gaz**	ONSHORE TEMPORARY STOPKITS
2018	India	**INDIAN OIL**	ONSHORE TEMPORARY STOPKITS
2018	Japan	**TOKYO GAS**	ONSHORE TEMPORARY STOPKITS
2018	Cuba	**CUPET**	ONSHORE TEMPORARY STOPKITS
2018	UK	**CONOCO PHILLIPS**	ONSHORE TEMPORARY STOPKITS
2018	Iraq	**BASRA OIL COMPANY (BOC)**	ONSHORE TEMPORARY STOPKITS
2018	Iraq	**BP ROO**	ONSHORE TEMPORARY STOPKITS
2018	UAE	**ADNOC GAS PROCESSING**	ONSHORE TEMPORARY STOPKITS
2018	Saudi Arabia	**ARAMCO**	ONSHORE TEMPORARY STOPKITS
2018	Gabon	**PERENCO GABON**	ONSHORE TEMPORARY STOPKITS
2018	Gabon	**TOTAL GABON**	ONSHORE TEMPORARY STOPKITS / OFFSHORE TEMPORARY STOPKITS
2018	Russia	**ROSNEFT**	ONSHORE TEMPORARY STOPKITS

2017

2017	Japan	**Osaka Gas**	ONSHORE TEMPORARY STOPKITS
2017	Trinidad & Tobago	**Perenco**	ONSHORE TEMPORARY STOPKITS
2017	Oman	**CCED**	ONSHORE TEMPORARY STOPKITS
2017	Iraq	**BGC**	ONSHORE TEMPORARY STOPKITS
2017	Pakistan	**SNGPL**	ONSHORE TEMPORARY STOPKITS
2017	Irak	**BP**	ONSHORE TEMPORARY STOPKITS
2017	France	**LTS**	ONSHORE TEMPORARY STOPKITS
2017	France	**ALTEO**	ONSHORE TEMPORARY STOPKITS
2017	France	**GEOSEL**	ONSHORE TEMPORARY STOPKITS
2017	Malaysia	**Hengyuen Refinery Company (Formerly Shell Refinery Company)**	ONSHORE TEMPORARY STOPKITS
2017	Iraq	**BOC (Basra Oil Company)**	ONSHORE TEMPORARY STOPKITS
2017	Thailand	**PTTGC**	ONSHORE TEMPORARY STOPKITS
2017	Oman	**ORPIC**	ONSHORE TEMPORARY STOPKITS
2017	Angola	**CHEVRON**	OFFSHORE TEMPORARY STOPKITS
2017	Kazakhstan	**TCO (Tengizchevroil)**	ONSHORE TEMPORARY STOPKITS
2017	France	**SPSE**	ONSHORE TEMPORARY STOPKITS
2017	Japan	**KYUSHU ELECTRIC**	ONSHORE TEMPORARY STOPKIT
2017	Qatar	**TOTAL QATAR**	ONSHORE TEMPORARY STOPKITS
2017	Kuwait	**VEOLIA**	ONSHORE TEMPORARY STOPKITS
2017	Gabon	**TOTAL QATAR**	OFFSHORE LONG-TERM STOPKITS
2017	Gabon	**PERENCO**	ONSHORE TEMPORARY STOPKITS
2017	Gabon	**ADDAX**	ONSHORE TEMPORARY STOPKITS
2017	France	**TOTAL REFINERY DONGES**	ONSHORE TEMPORARY STOPKITS
2017	Belgium	**STORA ENZO**	ONSHORE TEMPORARY STOPKITS
2017	Colombia	**CPS**	ONSHORE TEMPORARY STOPKITS
2017	UK	**CONOCO PHILLIPS**	ONSHORE TEMPORARY STOPKITS

2016

2016	Iran	**NIGC**	ONSHORE LONG-TERM STOPKIT
2016	Myanmar	**Myanmar Oil & Gas Enterprise (MOGE)**	ONSHORE TEMPORARY STOPKITS
2016	Colombie	**ECOPETROL**	ONSHORE TEMPORARY STOPKITS
2016	Colombie	**EQUION**	ONSHORE TEMPORARY STOPKITS
2016	Colombie	**CONEQUIPOS**	ONSHORE TEMPORARY STOPKITS

2016	Ghana	**TULLOW**	OFFSHORE LONG-TERM STOPKITS
2016	Congo	**TOTAL**	ONSHORE TEMPORARY STOPKITS
2016	Angola	**OPS**	ONSHORE TEMPORARY STOPKITS
2016	Cameroun	**PERENCO (Rio del Rey)**	ONSHORE TEMPORARY STOPKITS
2016	Libya	**Arabian Gulf Oil Company (AGOCO)**	ONSHORE TEMPORARY STOPKITS
2016	France	**TOTAL**	ONSHORE TEMPORARY STOPKITS
2016	Iran	**IOTC**	OFFSHORE TEMPORARY STOPKITS
2016	UAE	**GASCO**	ONSHORE TEMPORARY STOPKITS
2016	UAE	**ADCO**	ONSHORE TEMPORARY STOPKITS
2016	UK	**CONOCO PHILLIPS**	ONSHORE TEMPORARY STOPKITS
2016	Gabon	**TOTAL**	OFFSHORE LONG-TERM STOPKITS
2016	Gabon	**MAUREL & PROM**	ONSHORE TEMPORARY STOPKITS
2016	Kazakhstan	**Tengizchevroil (TCO)**	ONSHORE TEMPORARY STOPKITS
2016	Indonesia	**Pertamina Hulu Energy ONWJ**	OFFSHORE TEMPORARY STOPKITS & OFFSHORE LONG-TERM STOPKITS
2015			
2015	UK	**CONOCO PHILLIPS**	ONSHORE TEMPORARY STOPKITS
2015	UK	**ONDEO SUEZ ENVIRONMENT**	ONSHORE TEMPORARY STOPKITS
2015	Gabon	**PERENCO**	OFFSHORE TEMPORARY STOPKITS & ONSHORE LONG-TERM STOPKITS & OFFSHORE LONG-TERM STOPKITS
2015	Qatar	**OXY QATAR**	ONSHORE TEMPORARY STOPKITS
2015	UAE	**ZADCO**	ONSHORE TEMPORARY STOPKITS
2015	UAE	**ADCO**	ONSHORE TEMPORARY STOPKITS
2015	UAE	**GASCO**	ONSHORE TEMPORARY STOPKITS & ONSHORE LONG-TERM STOPKITS
2015	Gabon	**TOTAL**	ONSHORE LONG-TERM STOPKITS & OFFSHORE LONG-TERM STOPKITS
2015	Arabie Saoudite	**EAST GAS**	ONSHORE TEMPORARY STOPKITS
2015	France	**CIM Le Havre**	ONSHORE TEMPORARY STOPKITS
2015	France	**TOTAL**	ONSHORE TEMPORARY STOPKITS
2015	Viet-Nam	**CUU LONG JOC**	ONSHORE TEMPORARY STOPKITS & ONSHORE LONG-TERM STOPKITS
2014			
2014	France	**VERMILLON**	ONSHORE TEMPORARY STOPKITS
2014	France	**TOTAL**	ONSHORE TEMPORARY STOPKITS
2014	UK	**CONOCO PHILLIPS**	ONSHORE TEMPORARY STOPKITS
2014	Italy	**TAL OIL**	OFFSHORE TEMPORARY STOPKITS
2014	Cameroon	**PERENCO**	ONSHORE TEMPORARY STOPKITS
2014	Yemen	**TOTAL YEMEN**	ONSHORE TEMPORARY STOPKITS
2014	Angola	**TOTAL ANGOLA**	OFFSHORE TEMPORARY STOPKITS
2014	Congo	**TOTAL E&P CONGO**	OFFSHORE TEMPORARY STOPKITS
2014	UAE	**ZADCO**	ONSHORE TEMPORARY STOPKITS
2014	UAE	**GASCO**	ONSHORE TEMPORARY STOPKITS
2014	UAE	**ELIXIER**	ONSHORE TEMPORARY STOPKITS
2014	Qatar	**OXY QATAR**	ONSHORE TEMPORARY STOPKITS
2014	Viet-Nam	**KNOC**	OFFSHORE TEMPORARY STOPKITS
2014	Viet-Nam	**CLJOC**	OFFSHORE TEMPORARY STOPKITS
2013			
2013	France	**GEOSTOCK**	ONSHORE TEMPORARY STOPKITS
2013	Italy	**TAL OIL**	OFFSHORE TEMPORARY STOPKITS
2013	Angola	**TOTAL ANGOLA**	OFFSHORE TEMPORARY STOPKITS & ONSHORE LONG-TERM STOPKITS
2013	Cameroon	**PERENCO**	ONSHORE TEMPORARY STOPKITS
2013	Gabon	**TOTAL GABON**	ONSHORE LONG-TERM STOPKITS
2013	UAE	**OASIS**	ONSHORE TEMPORARY STOPKITS
2013	UAE	**GASCO**	ONSHORE TEMPORARY STOPKITS
2012			
2012	France	**GEOSTOCK**	ONSHORE TEMPORARY STOPKITS
2012	Angola	**TOTAL ANGOLA**	OFFSHORE TEMPORARY STOPKITS
2012	Gabon	**TOTAL GABON**	ONSHORE LONG-TERM STOPKITS
2012	Gabon	**PERENCO**	ONSHORE TEMPORARY STOPKITS & ONSHORE LONG-TERM STOPKITS
2012	UAE	**GASCO**	ONSHORE TEMPORARY STOPKITS
2011			
2011	France	**GEOSTOCK**	ONSHORE TEMPORARY STOPKITS
2011	Gabon	**TOTAL GABON**	ONSHORE & OFFSHORE TEMPORARY STOPKITS - ONSHORE & OFFSHORE LONG-TERM STOPKITS
2011	Cameroon	**PERENCO**	OFFSHORE TEMPORARY STOPKITS
2011	Sudan	**GNPOC**	ONSHORE LONG-TERM STOPKITS
2011	Yemen	**TOTAL YEMEN**	ONSHORE TEMPORARY STOPKITS
2011	UAE	**GASCO**	ONSHORE TEMPORARY STOPKITS