Operational Guidelines for

THE USE OF COMPOSITE REPAIRS

March 2011

IMG COMPOSITES

Providing the Complete Composite Solution

Providing the Complete Composite Solution

ABOUT US

IMG Composites is:

- ISO 9001:2000 Registered
- First Point Assessment (FPAL) Registered
- A member of the Joint Industry Composite Working Group funded by the world's major oil companies and organised by ESR Technology
- A member of ACORES (Association of Composite Repair Suppliers) which promotes competence in the design and application of Composite Repairs. ACORES carry out independent audits of the systems and processes used by IMG Composites to ensure that it meets all the requirements of the current International and Industry standards.

IMG Composites Manufacture, Supply, Design and Install the CompoSol range of repair systems which are extensively used for:

- Engineered pressure retaining pipeline and pipework repairs
- Engineered pressure retaining vessel repairs
- Engineered stub encapsulations
- Engineered structural repairs
- Vessel and tank internal repairs and coatings
- Specialist epoxy and resin systems
- Anti slip systems

All CompoSol external repairs are certified to BS 476 Parts 6 & 7, Class "O" Standard for Fire Propagation and Class 1 for Spread of Flame Resistance.

IMG Composites Ltd Composite Repairs comply with the following International and Industry recognised standards:

ISO 24817	Petroleum, Petrochemical and Natural Gas Industries Composite Repairs for Pipework Qualification and Design, Installation Testing and Inspection Qualified for both Type A and Type B Defects
ASME PCC-2	Non-Metallic Composite Repair Systems for Pipelines and Pipework Article 4.1: High Risk Applications Article 4.2: Low Risk Applications
AEAT 57711	Design of Composite Repair Specification
AEAT 57756	Installation Procedures for Composite Repair Specification
HSE 2001/038	Temporary/Permanent Pipe Repair Guidelines

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1 ACORES

ACORES is a trade association (Association of COmposite REpair Suppliers) and has been established to:

- Promote competency & compliance within the industry
- Be a forum for current generic technical issues
- Provide a focus for coordinating industrial requirements relating to composite repairs

All accredited members of ACORES are independently audited, at regular intervals, to ensure their continued compliance to the relevant International Standards. Each supplier will be able to provide a certificate indicating the audit date and level of competence, including defect and component types that the supplier can repair.

The ACORES audit process covers the following issues with regard to qualification, design, installer training and installation practices:

DESIGN CONSIDERATIONS AND METHODOLOGY

- Provide evidence of Datasheets
- Types of Defects repaired
- Loading Geometry
- Design Calculations
- Risk Assessment

QUALIFICATION DATA

- Repair Laminates
- Substrate interface
- For Defect Type A and/or B
- Performance Tests

METHOD STATEMENTS

- Risk assessment/Work Conditions (Owner Supplied)
- Installer training/Qualification
- Design Information
- Plant Operating Conditions
- Repair Design Materials

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ACORES (Association of COmposite REpair Suppliers)

HEALTH & SAFETY

- MSDS Sheets
- National Safety Regulations
- Details of Personnel Protective Equipment
- Hazards

QUALITY ASSURANCE

- Documentation
- Design Records
- Evidence of Cure
- Materials
- Batch Numbers
- Hydro-test Results
- Independent Inspection Data

TRAINING RECORDS

- Installer Qualification
- Training Records
- Certificates
- Validity

JOB RECORDS

- Repair System Details
- Repair Reference Numbers
- Tg & Indenter (Barcol/Shore) Data

OTHER COMMENTS

- Service Inspection Intervals
- Repair Condition
- Other Relevant Details
- Examples of Recent Projects

2 STANDARDS

The relevant, applicable standard for composite repair systems is ISO/TS 24817 - Composite repairs for piping. The scope of ISO/TS 24817 covers the following components;

- Pipelines
- Pipework including straights, elbows, tees, flanges, reducers, valve bodies
- Tanks and vessels including nozzles and attachments

The content of ISO/TS 24817 includes details on;

- Qualification requirements; tests suppliers are required to perform to conform to the standard
- Design details; how to design a repair
- Installation guidance; what are the critical issues, e.g. surface preparation and applicator training requirements
- Monitoring guidance; how to inspect the repair system

No other reference standard or guideline is required to complete the composite repair.

There are also two ASME composite repair standards;

- ASME PCC-2 Article 4.1 : Non-metallic composite repair systems for pipelines and pipework: High risk applications
- ASME PCC-2 Article 4.2 : Non-metallic composite repair systems for pipelines and pipework: Low risk applications

The scope of these ASME PCC-2 standards includes pipelines and pipework but not tanks and vessels. The content of the three composite repair standards mentioned is comparable and not contradictory. These standards cover pressure containment applications including pipelines, pipework and vessels also including risers. However, there is no current standard that covers structural strengthening of primary (or secondary) members. For this application of composite repairs, each application must be treated on its own merit and designed specifically for the intended application.

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3 ALLOWABLE DEFECT TYPES

The types of defects that are covered by ISO/TS 24817 include:

- External corrosion, e.g. general wall loss, where the defect is or is not through wall. In this case the application of a repair system will usually arrest further deterioration - Defect type A
- External damage such as dents, gouges and fretting e.g. at supports - Defect type A
- Internal corrosion or erosion, e.g. general wall loss or pitting corrosion, where the defect is or is not through wall. In this case corrosion and/or erosion may continue after application of a repair system and therefore the design of the repair system should take this into account, i.e. the defect may continue to grow and become through wall (if not already through wall) - Defect type B

In the above description of the types of defects, growth can be in either, or both, the axial and hoop direction.

Crack like defects are not covered by ISO/TS 24817, although, if it can be demonstrated in the defect assessment procedure that the crack will not grow, a composite repair can be applied to strengthen the defect affected region. Also, composite repairs may be applied to surface breaking cracks where the intention is to prevent leakage. This application will in most cases be short term as the repair will not prevent either further crack formation or crack growth. In general the repair of crack like defects using composites will not stop crack growth. However, composite repairs may be used as a short term solution until an alternative repair or replacement option is available.

Leaking defects cannot be directly repaired. The leak needs to be stopped before the appropriate surface preparation procedure for the repair system can be applied.

ISO/TS 24817 does not define what is an acceptable defect to repair, but assumes that a decision has been made to repair a given defect, under the relevant code, using a composite repair. The decision of what constitutes an acceptable defect for repair is beyond the remit of ISO/TS 24817.

4 APPLICATIONS

ISO/TS 24817 defines the range of potential applications in terms of Classes. Simply, these Classes can be considered as a simplified risk assessment grouping in terms of application. Table 1 lists the definition of Class with example applications. Class 1 refers to low risk applications, with higher Class numbers referring to higher risk applications.

The class of repair (from Table 1) will determine the detail of the design method to be carried out, design margin or safety factor, together with the requirements for supporting documentation.

In general all substrates (i.e. pipe or piping materials) can be repaired. To qualify the repair system for each substrate material in question, the appropriate qualification tests (as defined in ISO/TS 24817, Section 8.2) must be performed.

In general, composite repair systems can be applied to the following applications:

- Above ground and buried pipelines
- Piping
- Tanks and vessels
- Splash zones
- Jetties

Repair Class	Typical Service	Pressure	Temperature
Class 1	Low specification duties, e.g. static head, drains cooling medium, sea (service) water, non-leaking utility hydrocarbons	< 10 bar g	-20^0 to 40^0C
Class 2	Fire water/deluge systems	< 20 bar g	-20^0 to 100^0C
Class 3	Produced water and hydrocarbons, flammable fluids, gas systems. Class 3 also covers operating conditions more onerous than described.	Qualified upper limit	-50^0C to qualified upper limit

Table 1: Repair Classes

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Repair systems can be applied to the following substrates:

- Carbon steel
- Cast iron
- 316 stainless steel
- Duplex
- Super Duplex
- 6 Moly
- Titanium
- Cunifer
- FRP - Fibre Reinforced Plastic (e.g. glass reinforced epoxy, vinyl ester or polyester) pipe. In general composite repairs can be applied to FRP where the P is a thermo-setting resin but cannot be applied to thermoplastic systems, e.g. Polyethylene or Polypropylene.

Simple decision guidance rules are presented in Appendix 1 to help decide if a composite repair is feasible for the intended application. These rules should be used as a guide only. There will be situations where a generic guide such as this is not appropriate but the aim is to provide some initial guidance as to whether a repair using a composite solution is practical.

5 CHEMICAL COMPATIBILITY

The following service fluids are considered acceptable for the application of composite repair systems:

- water, sea-water
- produced hydrocarbons, both liquids, gas and gas condensate including alkanes and cyclo-alkanes
- utility fluids including diesel, air

To assess the chemical compatibility of a repair system to either the internal or external environment the following approach is adopted by ISO/TS 24817; qualification tests (Section 8.2) demonstrate that the repair system is compatible with aqueous environments at the qualification test temperature and aqueous environments are relatively aggressive towards thermoset resins. In general, thermoset resins (e.g. epoxies, vinyl esters) are compatible with a wide range of environments but in environments which are strongly acidic (pH<3.5), strongly alkaline (pH>11) or contain a strong, polar solvent (e.g. methanol, toluene) in concentration greater than 25%, then guidance on compatibility should be confirmed with the repair supplier. Resistance to UV degradation and weathering is not a concern for repair systems as all commercial resin systems have UV stabilisers added.

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6 APPLICATION ENVELOPE

The application envelope of a specific composite repair system can be defined in terms of an upper pressure and temperature limit and also a lower temperature limit.

UPPER PRESSURE LIMIT OF A QUALIFIED REPAIR SYSTEM

The upper pressure of a repair system is a function of the type of defect under consideration and the thickness of the repair laminate. A specific pressure cannot be defined until these application parameters are given.

UPPER TEMPERATURE LIMIT OF A QUALIFIED REPAIR SYSTEM

The upper service temperature of a repair system is a function of the glass transition temperature (Tg), or heat distortion temperature (HDT) of the resin system. The following table summarises the maximum temperature limits.

Temperature measurement	Defect type B	Defect type A
Tg	Tg-30°C	Tg-20°C
HDT	HDT-20°C	HD-15°C

Table 2: Upper Service Temperature Limit

LOWER TEMPERATURE LIMIT OF A QUALIFIED REPAIR SYSTEM

There is no material limitation on the lower service temperature limit of a composite repair. From ambient temperatures down to -45^{0}C both the modulus and strength remain approximately constant. However, the thermal expansion (contraction) mismatch between the composite repair and the substrate places a mechanical limit on the lower temperature of application. Typically this value of lower temperature performance ranges from -50 to -100^{0}C, depending on the repair material and substrate. At temperatures lower than -45^{0}C a detailed design calculation must be performed to demonstrate that the strains developed within the repair laminate (both axial and circumferential) through thermal mismatch are less than the design allowables.

7 QUALIFICATION DATA

The purpose of qualification of a repair system is to demonstrate that the repair system is appropriate for the intended application and also to provide the relevant mechanical data for the design of the repair. The qualification data for the repair system should be contained within the technical specification of the repair system supplier. This specification should not only contain the data but should also state the test method used to obtain that data.

The required qualification test data as defined by ISO/TS 24817 is:

	Material Property	Test Method
Mechanical properties	Young's modulus	ISO 527 or ASTM D3039
	Poisson's ratio	ISO 527 or ASTM D3039
	Shear modulus	ASTM D5379
	Thermal expansion coefficient	ISO 11359 or ASTM D696
	Glass transition temperature of resin or heat distortion temperature of resin	ISO 11357-2 or ISO 75, ASTM D6604, ASTM E1640, ASTM E831, ASTM E2092
	Barcol or Shore hardness	BS EN 59 or ISO 868 or ASTM D2583
Adhesion strength	Lap shear	BS EN 1465 or ASTM D3165
Optional performance data	Long-term strength	ISO 24817 Annex E, ASME PCC-2 Annex 5
Defect type A only	Short-term pipe spool survival test	ISO 24817 Annex C, ASME PCC-2 Annex 3
Defect type A and B	Energy release rate test	ISO 24817 Annex D, ASME PCC-2 Annex 4
	Impact test	ISO 24817 Annex F, ASME PCC-2 Annex 6

Table 3: Repair system qualification test requirements

Appendix 2 presents a summary diagram on repair supplier selection for the range of defect types and service conditions considered in ISO/TS 24817.

8 DESIGN

The design process of a composite repair system answers the following questions;

- Is the composite repair system strong enough to carry the applied loads in both axial and hoop directions? (termed the strength calculation)
- Will the repair laminate remain bonded to the surface, for through wall defects (defect type B) only, for the design life of the repair? (termed the strength of bond calculation)
- Is the extent of the repair laminate sufficient to ensure load transfer between repair and substrate? (termed the axial extent calculation)

All these questions require answering for any repair application. The outputs of the design calculation for the repair system are;

- Thickness of the repair laminate (expressed in terms of the number of wraps)
- Total axial repair length (it is assumed the repair covers the full circumference of the substrate)

The repair design should follow ISO/TS 24817. The input for the design calculation requires a definition of all possible loads, both short-term and long-term that could act on the repair. These loads include hoop, axial, bending, torsion and shear. The design rules convert these applied loads into equivalent axial and hoop applied loads and it is these two equivalent loads that are used in the repair laminate strength calculation.

8.1 REPAIR LIFETIME

The lifetime of a composite repair system is often termed permanent or temporary. These two definitions have been removed due to the vagueness of their definition. Instead repair lifetime (up to 20 years in some cases) should be specified as part of the design input information that is provided to the repair supplier. Within ISO/TS 24817 a minimum default lifetime of 2 years is specified.

8.2 DESIGN TEMPERATURE

The influence of design temperature is accounted for in the design calculation. Repair suppliers perform their qualification tests at a set test temperature. If the design temperature is greater than the qualification test temperature, but less than the maximum temperature limits (as defined in Table 2 above), then temperature de-rating factors are provided within ISO/TS 24817.

8.3 AXIAL EXTENT OF REPAIR

The overlap length (axial extent) of the repair is defined as the axial length of the repair from the edge of the defect to the edge of the repair. The minimum required overlap length is a function of the defect type. Formulas are provided in ISO/TS 24817 for determining this axial length. It is always recommended to taper the repair especially when axial loads are present. The (axial) taper length is additional to the overlap length and should be at least 5 times the repair thickness.

8.4 PIPING COMPONENTS, TANKS AND VESSELS

The previous discussion has implicitly assumed that the substrate is a straight pipe section. The repair design procedure for other components (e.g. bends, tees, nozzles etc.) is a comparative approach based on an equivalent straight pipe component. This procedure is comparable to other piping system design procedures. The design procedure is first to calculate the thickness of the repair for an equivalent straight pipe section followed by a further calculation of a multiplicative factor, called the repair thickness increase factor, which accounts for the stress intensification due to the geometry of the component. The design repair thickness for the component is given by the product of the repair thickness increase factor times the repair thickness for the equivalent straight pipe section. ISO/TS 24817 (Section 5) presents repair thickness increase factors for each component listed.

8.5 REPAIR DATA DESIGN SHEET

Appendix 3 presents a data sheet which the Owner should complete to enable the repair supplier to perform the design of the repair. It is important that as much information as possible is provided to the repair supplier to enable an accurate repair design to be performed.

9 INSTALLATION

The application of a composite repair system requires either;

- the combination of a fibrous reinforcement and a thermosetting polymer matrix that is subsequently subject to a chemical curing process or
- the adhesion of a pre-engineered roll

This implies that the load carrying material is formed or cured as or immediately after the repair is applied. The final properties of the repair are significantly influenced by the method of application, the details of the lay-up, the form of reinforcement used and the curing of the resin or adhesive. These points emphasise the need for installation procedures to be fully controlled, to ensure that the repair achieved on site is the same from a technical point of view as that previously qualified by the repair system supplier. Appendix 4 contains an installation check list which contains guidance on how to ensure that a repair system has been correctly installed.

9.1 INSTALLER QUALIFICATION

Personnel involved in the installation of composite repairs should be appropriately trained and be qualified in the repair method to be undertaken. The minimum training and knowledge requirements of both installers and supervisors are detailed in ISO/TS 24817. This should include the handling of composite materials, surface preparation, lay-up techniques, quality control procedures, and health and safety issues. It is important that the training given provides sufficient technical background to allow personnel to obtain a good understanding as to why key operations such as surface preparation, material handling and lay-up technique are so important. It should also be noted that using trained installers and supervisors is an essential element of a successful repair. Training in one repair option does not necessarily qualify personnel for alternative methods.

Installers should be the subject of a continuing review of competency with a log book kept of experience in the application of repairs. ISO/TS 24817 defines a minimum of 10 composite repairs in one year as a sufficient number of repair applications to demonstrate continued competency. This is important as the levels of competence and experience achieved by an individual installer should also be considered in the context of repair activities. For example, working in confined spaces or applying material around complicated geometries can pose additional difficulties that should be taken in to account.

Supervisors should be trained in the relevant technique and ideally should have had a period during which they were engaged in the application of repairs. Supervisors should also be the subject of a continuing review of competency, as defined in ISO/TS 24817.

9.2 INSTALLATION GUIDANCE

The repair system supplier should provide full installation instructions. The guidance given in the following sections is intended to complement that given by the repair system supplier and to emphasise the key operations necessary for a successful repair.

Full instructions for each repair system application should be included in the repair method statement.

Surface Preparation

Surface preparation is the single most important operation in the achievement of a successful repair.

The surface preparation should extend over the whole surface onto which the composite repair is to be applied, i.e. the total axial extent of the repair.

Laminate Lay-up

The details of the lay-up procedure vary according to the repair system to be used and these should be fully specified by the repair system supplier.

Cure

The cure of a repair laminate is strongly influenced by temperature and the correct mixing of resin constituents prior to application. It is important that the prevailing temperature conditions are considered when resin catalyst levels are being assessed. On no account, however, should the limits set by repair system supplier be exceeded without recourse to further information. It should be noted that for curing in extreme ambient conditions there may be special resin formulations that may be required.

Key Hold Points

The key hold points to be observed during repair installation are given below:

Hold Point	Checked by
Method statement	Installer
Risk assessment	Supervisor
Materials preparation - reinforcement, resin	Installer
Surface preparation - inspection, mechanical test	Supervisor
Filler profile	Installer
Stage check on reinforcement	Installer
Tests on repair laminate - cure, thickness, dimensions, external inspection	Supervisor
(Hydro) Pressure Test (if required by the Technical Authority)	Inspection Authority

Table 4: Key Hold Points During Installation

Appendix 1

REPAIR DECISION GUIDANCE

Defect Type	Pressure Diameter (units bar.mm)	Maximum Pressure (bar)	Maximum Temper-ature (^{0}C)	Enviroment (in contact with repair)	Comment
External	<20,000	200	250	Water, air, soil with 4<pH<11	Generally lifetime of repair can be up to 20 years
Internal and/or through wall	<15,000	100	150	Hydrocarbon, gas, water with 4<pH<11	Repair will not halt degradation process so an indication on rate is required for the intended lifetime of the repair. The repair must be designed with the defect size estimated at end of life.
Structural strength-ening	N/A	Max. strain in composite 0.0025	250	Water, air, soil with 4<pH<11	

The above limits should be seen solely as a guide. Not all repair systems supplied can meet these limits, so caution is required in interpretation.

For higher temperatures, greater than 40^{0}C, care should be taken that the environment does not limit the application and lifetime of the repair. If in doubt about the compatibility of the environment with the repair laminate, contact the repair supplier.

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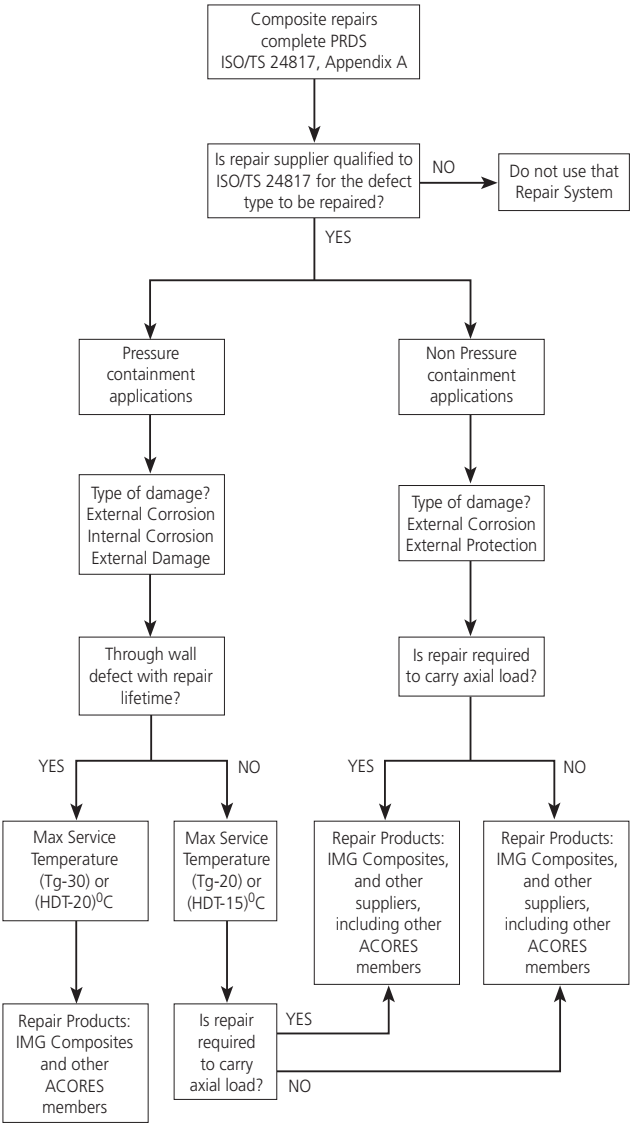
Appendix 2

REPAIR SUPPLIER SELECTION GUIDE



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Appendix 3

REPAIR DESIGN DATA SHEET

This Appendix provides an example of a design data sheet. This data sheet should form the basis of the scope of work provided by the client to the repair system supplier and be used in the preparation of the design of the repair. One sheet should be completed for each repair. In practice it may not be possible to define all the input data sheet values, e.g. all the loads acting on a piping system. In this case it is recommended to first discuss with the repair system supplier about any specific parameter and its relevance; a compromise should be reached on the actual value of this parameter to be used in the design. The boxes marked in red contain information without which it is impossible to even commence the Design Process.

Document Number:			
Project Title:			
Date of Issue:		Issue No.:	

PIPE REPAIR DATA SHEET			
Section 1.0a Onshore Contact Details		**Section 1.0b Please return to**	
Contact Name:		Contact Name:	
Company Name:		Company Name:	
Address:		Address:	
Post Code/ZIP:		Post Code/ZIP:	
Country:		Country:	
Telephone:		Telephone:	
Fax:		Fax:	
Mobile:		Mobile:	
email:		email:	
Section 1.0c Asset Contact Details			
Contact Name:		Telephone:	
Designation:		email:	
Section 2.0 Pipe Details			
Installation Name:		Location:	
Quantity:		Pipe Identification:	
Pipe Reference:		Pipe Specification:	
Material Grade:		External Diameter (ins):	
Wall Thickness (mm):		Medium:	
Operating Temperature (^{0}C):		Existing Pipe Coating:	
Section 3.0 Assessment of Repair Classification			
Repair Class:		Required Repair Lifetime:	
Other Repair Data:			

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Section 4.0 Pipe Loading:				
Please note any original design calculations or piping isometrics should be appended to this sheet and loads should be defined as "sustained" or "occasional" in the Comments box.				
	Operating	Design	Test	Comments
Pressure Rating (bar g):				
Axial Load:				
Bending Moment:				
Shear Load:				
Torsion:				
Other loads:				

Section 5.0 Details of Defect Area:
Drawings of the pipe system and inspection reports, where available, should be appended to this data sheet. Please indicate any access restrictions and proximity to other equipment. Where available, digital photographs of the defect area(s) are to be appended.

Section 6.0 Repair Specification:					
Type of Defect:			Nature of Defect:		
Current Size, Area:	(mm^2)		Current Size, Depth:	(mm)	
Projected Size, Area:	(mm^2)		Projected Size, Depth:	(mm)	
Cause:			Effect:		
Perforated?			MAWP (API 579)		

Section 7.0 Anticipated Conditions During Implementation of Repair:					
Pipe Temperature:	min ^{0}C		Pipe Temperature:	max ^{0}C	
Ambient Temperature:	min ^{0}C		Ambient Temperature:	max ^{0}C	
Humidity:			External Environment:		
Constraints:					

Appendix 4

INSTALLATION CHECKLIST

Hold Point	Comment
Method statement	This document should contain the details of the repair, the installation procedure, installer qualifications. It should also indicate required facilities on site, e.g. enclosures etc.
Materials preparation - reinforcement, resin	Check to ensure sufficient reinforcement and resin available for the repair. Check that appropriate volumes of resin and hardener are available.
Surface preparation - inspection, mechanical test	Check that the surface preparation procedure has been performed according to the installation procedure. Procedure could include mechanical abrasion e.g. grit blasting and chemical cleaning. Ensure correct sequence of cleaning and abrasion. Surface profile (mechanical) should be measured by profile pad.
Filler profile	Check that filler has been applied according to installation procedure and smoothed to the correct profile.
Reinforcement application	Check that the appropriate number of layers or wraps have been applied. Check that the appropriate layer orientation is applied. Check that the correct axial extent of repair has been applied. Check that the taper geometry is applied.
Curing of repair	Check that the correct time for cure has elapsed before re-starting the system through hardness measurement. If post curing is required, then check that the heating blanket is set to the correct temperature.
External inspection	Check that there are no visible defects.

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Providing the Complete Composite Solution

IMG Composites Ltd supplies a range of Composite Repair products designed to restore operational integrity and to enhance the life and safe operation of existing assets in the Oil and Gas Production and Distribution sectors, which comply with International and Industry recognised standards.

CompoSol Pipework Engineered and Designed Composite Repair System for use on piping systems, including bends, "T" pieces, reducers and complex geometries suffering from either internal or external corrosion, including through wall defects or mechanical damage.

CompoSol Pipeline Engineered and Designed Composite Repair System for use on pipelines suffering from either internal or external corrosion, including through wall defects or mechanical damage

CompoSol Vessel Engineered and Designed Composite Repair System for use on vessels suffering from either internal or external corrosion, including through wall defects, which eliminates the expensive and time consuming requirement of Hydro-Testing associated with "Hot Work" type repairs.

CompoSol Encap Engineered and Designed Composite Repair System for use in encapsulating redundant and corroded off-takes, valves and stubs on pipes and pipelines which vastly reduces the weight issues surrounding "clamp type" repairs on already weakened systems.

CompoSol Flat Engineered and Designed Composite Repair System for use in reinforcing worn and holed decks, bulkheads, accommodation modules and general structures.

CompoSol GF Liner Glass flake reinforced system for use in lining vessels to provide a barrier to chemical permeation and extend service life either on its own or in conjunction with a complete refurbishment solution utilising "Composol Vessel" repairs.

All CompoSol external repairs are certified to BS 476 Parts 6 & 7, Class "O" Standard for Fire Propagation and Class 1 for Spread of Flame Resistance.

CompoSol X-Protect Engineered Composite Repair System used to prevent the spread of external corrosion.

CompoSol HT Pipe Engineered and Designed Composite Repair System for use on pipes and piping systems, including bends, tees, reducers and complex geometries, suffering from either internal or external corrosion, including through wall defects or mechanical damage. Its unique curing chemistry allows CompoSol HT Pipe to be used on repairs that operate up to 200 degrees C.

Tight n Seal Repair Kits A quick, easily applied two part temporary leak repair kit, for use in emergency situations.

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