INSTALLATION QUALITY CONTROL FORM

This ECR Quality Control document is intended to provide the means of recording the relevant information from the installation of an ECR System to ensure all critical hold points are identified and the installation process is properly executed resulting in an acceptable and successful composite repair installation. Any deviation from the specified installation steps or in the design/site conditions for a specified ECR System should be noted and a ***work-stop*** issued until the client can accept and sign off on any change in process or scope. This document shall not be considered complete or valid unless signed by both the installation technician/supervisor and the asset owner/operator. Each of the following identified sections must be completed:

1. Design Verification
2. Material Verification
3. Site Conditions
4. Installation Controls
5. Curing Protocols
6. Final Repair Inspection

Client / Facility Name	
Contact Name	
Phone	

	DESIGN VERIFICATION	DATA / VALUES	INITIALS
1	Engineering Specification #		
2	ECR System Name Specified		
3	Diameter of Pipe		
4	Pipe Grade & Schedule		
5	Line ID (if given)		
6	Repair Location Geometry		
7	Design Repair Type		
8	Defect Type & Size		
9	Total # Layers		
10	Total Repair Length		

	MATERIAL VERIFICATION*	DATA / VALUES		INITIALS
11	Material Quantities	Material quantities on hand meet minimum values estimated for full job scope completion (volume of polymers and square footage of composite wrap).		
		Lot #(s)	*Expiration Date(s)*	
12	Filler (as required**) *Must be the filler qualified with the ECR System*			

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13	Primer *Must be the Primer qualified with the ECR System*			
14	Saturant (as required**) *Must be the Saturant qualified with the ECR System*			
15	Composite Wrap *Must be the Composite Wrap qualified with the ECR System*			
	*Record all individual Lot #'s and Expiration Dates separately. If multiple items have same Lot #, they only need to be recorded once. **If no filler (such as for internal corrosion) or no saturant (such as in pre-impregnated material) is required, leave these sections blank. *If additional room is required, use additional sheets to record all data.*			

	SITE CONDITIONS	DATA / VALUES	INITIALS
16	Environmental Temperature[1]		
	[1]*If tent/enclosure required on site for environmental protection, then record temperature in enclosed area*		
17	Pipe Surface Temperature	Pipe surface temperature must be 5°F (3°C) above dew point. Pipe Surface Temperature: _____	
18	Weather Conditions (rain, snow, etc.)		
19	Humidity	Relative humidity during installation of epoxy-based systems should be 85% or less. Measured Humidity Level: _____	
20	Defect is within design limits as calculated and specified	Defect type & size used in design: _____ Defect type & size confirmed at site: _____	
21	If Type B defect, no active leak is present and zero (0) pressure in pipe	No pressure or vacuum is present in the event the leak is not sealed by some other means prior to wrapping. If pipe shut down or blocked, ensure no pressure leak is present in block valve; and ensure that no head pressure exists from remaining fluid in pipe even if section is not pressurized by the system.	
22	Repair Length specified is within limits and available on site	Repair Length specified in design: _____ Repair Length available at site: _____	

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23	Surface Preparation Length	Length of prepared surface is at least two (2) inches (50mm) longer than the calculated and specified Repair Length to allow for primer to extend beyond the Repair Length by one (1) inch (25mm) on each end of the repair area.	
24	Surface Preparation	Reference industry standards for acceptable means of performing surface preparation: *SSPC-SP-10 / NACE 2* "Near White Metal Blast" or *SSPC-SP-11* "Power Tool Cleaning" at minimum *Method/Tool Used for Surface Prep:* _____ *If grit blast used, provide media type*: _____	
25	Surface Profile Measurement	Minimum profile of 1 mil (25.4 microns) required. Record data below and to right.	
	When using Testex or similar replica tape tool for surface profile measuring, reference: *NACE RP0287 "Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape"* *SSPC-PA 17 "Procedure for determining conformance to steel profile/surface roughness/peak count requirements"* (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) (Affix Press-O-Film tape here) *If additional room is required, use additional sheets to record all data.*		Surface Profile Average: _____

	INSTALLATION CONTROLS	DATA / VALUES	INITIALS
26	Filler Material Installation	Filler material mixed in correct ratios as specified on product packaging and fully mixed with no streaking or marbling visible, and in a manner which limits air pockets being "whipped" into the mixture. Filler Name: _____	
27		Mixed filler material installed fully into defect, or over transitional areas, as required with proper fairing to reduce sharp angles and no air pockets left within.	

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	Does ECR System require base fiberglass layer as part of Primer? Yes = Complete Primer Checks 28-30 and skip Primer Checks 31-32. No = Complete Primer Checks 31-32 and skip Primer Checks 28-30. *Refer to specified ECR System Detailed Installation Guide for information on specific requirements of Primer to be used, and complete only the relevant checks for the Primer type as defined below.*		
28	Fiberglass Primer Material Installation	Primer material mixed in correct ratios as specified on product packaging and fully mixed with no streaking or marbling visible. Primer Name: _____	
29		100% of the fiberglass saturated using the mixed Primer polymer to ensure no dry spots remain. Use of NRI's Resinator™ tool is highly recommended for saturating fibers on site.	
30		Saturated Fiberglass Primer material installed at a two (2) layer thickness as specified to completely cover the specified Repair Length plus two (2) inches (50mm), ensuring coverage over entire repair area. # layers achieved during installation: _____	
31	Primer Material Installation	Primer material mixed in correct ratios as specified on product packaging and fully mixed with no streaking or marbling visible, and in a manner which limits air pockets being "whipped" into the mixture. Primer Name: _____	
32		Mixed primer material installed 360° around the circumference of the pipe at a thickness specified in installation guide to completely cover the specified Repair Length plus two (2) inches (50mm), ensuring coverage over entire repair area. Thickness specified for ECR System Primer: _____ Thickness achieved during installation: _____	
	What is the specific type of ECR System being installed? Refer to specified ECR System Detailed Installation Guide for information on specific requirements of the composite wrap, and complete only the relevant checks for the composite wrap type as defined below. Contact NRI (customerservice@neptuneresearch.com) to obtain necessary documents if needed. Pre-Impregnated Moisture Cured Urethane (MCU) = Complete MCU Checks 33-36. Field Saturated Epoxy (FSE) = Complete FSE Checks 37-41. Pre-Impregnated Heat Cured Epoxy (HCE) = Complete HCE Checks 42-44.		
33	MCU Composite Wrap Installation • *Syntho-Glass® XT* • *Viper-Skin®* • *Steel-Wrap® MCU*	100% of the wrap was activated with clean water during the wrapping of the material.	
34		The wrapping start point was one (1) inch (25mm) from the edge of the Primer material and end point was one (1) inch (25mm) from the end of the Primer material.	

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35	MCU Composite Wrap Installation • *Syntho-Glass® XT* • *Viper-Skin®* • *Steel-Wrap® MCU*	Total number of layers installed is at least the required as stated in the calculation/design documentation (more layers is acceptable, less is not). Total # MCU Layers Installed = _____	
36		4 layers of compression film was installed over the entire repair area landing on the outside area beyond the composite wrap, and fully perforated within 5 minutes of completing the composite wrapping.	
37	FSE Composite Wrap Installation • *Thermo-Wrap™* • *Thermo-Wrap™ Inspectable* • *Thermo-Wrap™ CF* • *Acid-Shield™* • *Steel-Wrap® E* • *Trans-Wrap™ APEX*	Saturant polymer mixed per specified mix ratio, and fully mixed/agitated until uniform in color with no streaking/marbling visible.	
38		100% of the composite wrap dry fabric saturated using the mixed saturant polymer to ensure no dry spots remain but was not over-saturated which could cause potential sagging. Use of NRI's Resinator™ tool is required for saturating fibers on site and ensuring the proper resin to fiber ratio is achieved.	
39		The wrapping start point was one (1) inch (25mm) from the edge of the Primer material and end point was one (1) inch (25mm) from the end of the Primer material.	
40		Total number of layers installed is at least the required as stated in the calculation/design documentation (more layers is acceptable, less is not). Total # FSE Layers Installed = _____	
41		4 layers of compression film was installed over the entire repair area landing on the outside area beyond the composite wrap within 5 minutes of completing the composite wrapping.	
42	HCE Composite Wrap Installation • *Thermo-Wrap™ 500*	The wrapping start point was one (1) inch (25mm) from the edge of the Primer material and end point was one (1) inch (25mm) from the end of the Primer material.	
43		Total number of layers installed is at least the required as stated in the calculation/design documentation (more layers is acceptable, less is not). Total # HCE Layers Installed = _____	
44		4 layers of heat resistant, compression film was installed over the entire repair area landing on the outside area beyond the composite wrap to prepare for heat curing process.	
45	ILI Smart Marker Installation	Were ILI Smart Markers installed correctly on each end of the composite repair? -- *This is primarily used in pipeline applications.* ☐ No If Yes, indicate marker type: ☐ Magnets ☐ Steel Banding	

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	CURING PROTOCOL	DATA / VALUES	INITIALS
46	Curing Temperature & Time Frame ****Cure time is highly sensitive to, and heavily influenced by temperature. Consult specific produce documentation for estimated time frames at expected temperatures.****	Acceptable cure temperatures and time frames vary significantly for ECR Systems and must be measured and met in order to ensure an installation will perform as designed and desired. Consult Detailed Installation Guide or Technical Data Sheets to confirm curing specifications of the ECR System being utilized. Temperature of system during cure: _____ Time of cure at given temperature above: _____ Provide verification of temperature maintained either by time vs. temperature charts or by monitoring via thermocouples depending on site capacities and availability. *Example: If curing was completed overnight, it is important to know that the temperature of the repair was maintained and did not drop to a much lower temperature than when installed, as this will slow the curing profile based on the lower temperature experienced during the curing.*	
47	Post and/or Force Curing Notes	Provide any deviation information on curing of the ECR System should it be required (such as if the installation is made on elevated temperature piping that cures the ECR System faster than typical ambient conditions, or heat added due to cold environment, etc.). Leave this section blank if typical cure schedule is met. Notes: _____ _____ _____ _____ _____	

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	FINAL REPAIR INSPECTION	DATA / VALUES / REQUIREMENTS	SITE READINGS / SIGN-OFF
	Hardness requirements must meet minimum requirements of the technical data. The ECR System's components should meet the minimum requirement of 90% of the ultimate hardness value typically published in the product's TDS to be considered ready for use as required by the ASME PCC-2 Article 4.1 and ISO-24817 standards. When using a Durometer of Type D for measuring hardness of cured composite, reference: *ASTM D2240 "Standard Test Method for Rubber Property – Durometer Hardness"* • *Testing should be performed by placing the pin on the highest point of the composite repair to insure a proper reading is taken* • *The test point shall be placed directly on a fiber and not the valley where the fibers cross as this could result in a false low reading* • *A minimum of 10 test readings shall be taken to get the average value* • *The readings shall be taken at random points along the repair to represent all areas (top of pipe, sides of pipe, bottom of pipe, etc.)* • *For fillers which may be covered by the repair system installation, place a sample of the material used on site to the side for curing in the same conditions to be hardness tested with the system* • *A "core sample" option may be used to hold out a small portion of mixed polymer and/or composite used and tested for hardness provided it has been cured under the same conditions as that on the substrate* Minimum values required for each of NRI's ECR Systems shown below (place check next to system being used and inspected by this form). Note that Compression Film *MUST* be removed to complete all following final inspection steps.		
48	Shore D Hardness: Filler Material	☐ Syntho-Steel = 74 ☐ Syntho-Poxy HC = 72 ☐ Thermo-Fill = 74 ☐ Thermo-Fill HT = 74 ☐ Thermo-Fill 500 = 74 ☐ Acid-Shield Filler = 74 ☐ Steel-Wrap Filler = 80 ☐ Trans-Wrap Filler = 78	Shored D Hardness Reading Average: _____
49	Shore D Hardness: Primer Material *(as applicable; not required if polymer in composite wrap is the same as primer)*	☐ Syntho-Subsea LV = 74	Shored D Hardness Reading Average: _____
50	Shore D Hardness: Composite Wrap	☐ Syntho-Glass XT = 68 ☐ Viper-Skin = 74 ☐ Thermo-Wrap = 78 ☐ Thermo-Wrap CF = 81 ☐ Acid-Shield = 78 ☐ Thermo-Wrap 500 = 82 ☐ Steel-Wrap E = 75 ☐ Trans-Wrap *APEX* = 78	Shored D Hardness Reading Average: _____

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51	Final Repair Length	Final, overall repair length must be at least the required Repair Length as specified in the design calculations. Repair Length specified in design: _____	Final Repair Length: _____
52	Repair Location	Final repair is correctly located on piping section of concern with defect located within repair length providing sufficient length wrapped beyond the defect in each direction. A longer repair length than calculated is acceptable.	
53	Final Repair Thickness	Final repair thickness must be at least the required # layers as specified in the design calculations. May be found by measuring final circumference and calculating by: *C = π x OD* *Where: C = Circumference of pipe; OD = Outside diameter* *CCP = π [OD + Primer + (2 x "#Layers" x "Thickness per Layer")]* *Where: CCP = Circumference of pipe & composite* *Final thickness = (CCP – C) / (2 * π)* # layers & repair thickness specified in design: _____	Repair Thickness: _____ # Layers: _____
	The following inspection steps shall be completed in accordance with "allowable limits" criteria as defined by the ASME PCC-2 Article 4.1 (*Table 6*) and ISO-24817 (*Table 16*) standards. Indicate either "Accepted" or "Not Accepted" based on visual inspection and stated Allowable Limits.		
	Defect Type	Allowable Limits	
54	Delamination	Tap test near ends of Repair Length. No delamination/disbonding allowed at ends of repair.	☐ Accepted ☐ Rejected
55	Cracks in Surface	None allowed.	☐ Accepted ☐ Rejected
56	Foreign Matter, Blisters, and Pits	Maximum of 0.4" (10mm) in width, and 0.1" (2.5mm) in height.	☐ Accepted ☐ Rejected
57	Wrinkles	No step changes in thickness greater than 0.1" (2.5mm) in height.	☐ Accepted ☐ Rejected
58	Pinholes/Wormholes	None deeper than outer surface, polymer-rich layer.	☐ Accepted ☐ Rejected

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59	Polymer Color	Should be uniform in color within same polymer system. *(Different polymers used such as filler/primer/saturant may be different colors, but colors within same polymer should be uniform)*	☐ Accepted ☐ Rejected
60	Dry Spots and Exposed Fibers	None allowed in composite wrap.	☐ Accepted ☐ Rejected

*** Provide photos before, during and after installation for the quality records and future inspection reference ****

Installer Technician/Supervisor Sign-off:

Name: _____ NRI Training ID #: _____ Expires On: _____

Signature: _____ Date Completed: _____

By signing the above, the installation technician/supervisor is confirming that he/she has completed the mandatory qualification training for the ECR System installed, that each step of the defined ECR process was completed per the specific detailed installation guide for the product utilized, and that all values are accurate and correct as recorded. Any deviation from the specified process was recorded and approved by the asset owner prior to proceeding with the repair. Final document may be uploaded to NRI's AEC online program (www.nriaec.com) for data storage in the technicians' profile as job records.

Additional Techs: Provide name and Training ID# for all trained techs on site for requalification records. Use additional sheets if required.

Name: _____ NRI Training ID #: _____ Expires On: _____

Name: _____ NRI Training ID #: _____ Expires On: _____

Name: _____ NRI Training ID #: _____ Expires On: _____

Name: _____ NRI Training ID #: _____ Expires On: _____

Asset Owner/Operator Sign-off^:

Name: _____ NRI CIC ID#: _____

Signature: _____ Date: _____

By signing the above, the asset owner is confirming that the pipe specifications, operational and installation parameters, repair design parameters are correct and match the design proposal for the intended repair, that the installation process was followed, and the final repair was inspected according to established standards and found to be acceptable based on requirements of the ECR System utilized.

^It is highly recommended that the representative from the asset owner have previously completed the NRI Composite Inspection Course (CIC) to fully understand the requirements of commissioning a completed ECR.

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