



## PIPING FABRICATION PLAN

Rev #	Date of Issue	Status Description	Originator	Reviewer	Approver
R0	28 May, 2023	Issued for Construction	A. Asuquo	D. Abalaka	



## TABLE OF CONTENTS

### Contents

TABLE OF CONTENTS.....	2
1.0 INTRODUCTION.....	3
2.0 SCOPE OF WORK.....	3
3.0 REFERENCE DOCUMENTS.....	3
3.1 CODE AND STANDARDS.....	3
4.0 DEFINITION AND ABBREVIATIONS.....	3
5.0 FABRICATION ORGANIZATION STRUCTURE.....	4
5.1 PRODUCTION ENGINEERING AND METHOD (PEMT).....	4
5.2 WORKSHOP SUPERINTENDENT.....	4
5.3 QUALITY CONTROL.....	4
5.4 HSE OFFICER.....	4
6.0 PIPING FABRICATION PROCEDURE.....	5
6.1 GENERAL.....	5
6.2 MATERIAL PREPARATION.....	5
6.3 CUTTING AND MARKING.....	5
6.4 MACHINING (BEVELING, TRIMMING, THREADING, DRILLING).....	5
6.5 FIT UP/ASSEMBLY.....	6
6.6 DIMENSIONAL CONTROL/FIT UP INSPECTION.....	6
6.7 WELDING AND VISUAL WELD CONTROL.....	7
7.0 NON DESTRUCTIVE TESTING (X-RAY).....	7
7.1 POST WELD HEAT TREATMENT (IF REQUIRED).....	7
7.2 HARDNESS TEST (IF REQUIRED).....	8
7.3 HYDROSTATIC TEST.....	8
7.4 PIPELINE EXTERNAL COATING.....	8
7.5 OTHER TREATMENT (IF REQUIRED).....	8
7.5.1.1 MECHANICAL CLEANING.....	8
7.6 STORAGE OF FABRICATED PIPE.....	9
7.7 HANDLING OF PIPES.....	9
7.8 HSE REQUIREMENT FOR FABRICATION WORKS.....	9
7.9 WORKSHOP PREPARATION, STORAGE AND HANDLING.....	11
7.10 NON DESTRUCTIVE TESTING (X-RAY).....	11
7.11 PWHT AND HARDNESS TEST.....	12
7.12 HYDROSTATIC TEST.....	12
7.13 PRESERVATION.....	12



## **1.0 INTRODUCTION**

This detailed Fabrication Plan is written to minimize on-site fabrication, testing and commissioning of piping for construction projects to be executed by Kojis Global Services Nigeria Limited.

## **2.0 SCOPE OF WORK**

The scope of work includes verification of the FEED package, Detailed Engineering Design, testing of materials and equipment, construction and installation, pre-commissioning, commissioning and handover of all the facilities. Kojis Global Services Nigeria Limited shall also prepare as-built drawings and documents that are required for the operation and maintenance of the completed WORK. The fabrication works shall be carried out in line with relevant design and engineering specifications, drawings, etc.

This plan covers the basis for material traceability and fabrication work for pipes prefabricated in the workshop provided with pipe drawing. The plan is to provide guidelines on general working procedure and operative method for conducting piping fabrication work.

## **3.0 REFERENCE DOCUMENTS**

### **3.1 CODE AND STANDARDS**

Piping fabrication shall be in accordance with latest edition of the following international codes and standards:

ASME B16.5	Pipes Flange and Flanged Fittings
ASME B16.9	Factory – Made Wrought Butt-welding Fittings
ASME B31.3	ASME Code for Process Piping
DEP 31.38.01.31-Gen.	Shop and Field Fabrication of Piping
DEP 30.10.60.18-Gen.	Welding of Metals (Amendment/Supplements to API RP 582)
DEP 31.40.30.31-Gen.	Pipeline External Coating.

## **4.0 DEFINITION AND ABBREVIATIONS**

NDE/NDT	Non Destructive Examination/Non Destructive Testing
PEMT	Production Engineering and Method
PWHT	Post Weld Heat Treatment
ISO Drawing	A drawing used for pipes fabrication, detailed with all information necessary or all fabrication works.
WPS	Welding Procedure Specification



## **5.0 FABRICATION ORGANIZATION STRUCTURE**

### **5.1 PRODUCTION ENGINEERING AND METHOD (PEMT)**

PEMT is responsible to verify the completeness and correctness of the piping isometrics drawings and the pipe drawing which shall be used as a reference for the fabrication operation. PEMT also responsible to issue out material take off for material preparation purpose.

### **5.2 WORKSHOP SUPERINTENDENT**

Workshop Superintendent is responsible to ensure that all the piping fabrication activity are conducted as per approved procedure, achieve desired quality as per required by spec/client expectation. Prepare and execute detailed schedule and manpower planning to achieve master schedule by Project Management Team.

### **5.3 QUALITY CONTROL**

Welding Inspector is responsible to check correctness of the assembled pipe pipes against the ISO drawings dimensionally, to ensure the end result of weld joint is within acceptance range of the specification, to arrange for Client Inspection (if required) and arranging NDT work. Welding Inspector responsible to arrange any kind of test/examination as per required by spec/code such as PMI (Positive Material Identification), etc.

### **5.4 HSE OFFICER**

- He shall cascade and ensure that all HSE requirements in the construction HSE plan is being followed in the fabrication workshop.
- Cascade the Client's life saving rules to the work force.
- Conduct regular inspections inside the fabrication workshop.
- Ensure that the Toolbox Talk and JSA processes are being carried out correctly.
- Be familiar with and ensure that Project HSE Requirements and Work Permit Procedures are followed.
- Monitors and reports all Safety/environmental concerns on their job sites
- Conducts daily inspections of each job site assigned to them.
- Monitors subcontractors' safety and environmental activities for project compliance especially in consistent use of PPE and proper housekeeping.
- Maintains and monitors employees log register in the workshop.
- Carries out random safety/environmental inspections
- Assists in investigation and reports.
- Stops any unsafe or environmentally non-compliant act observed
- Have the right to intervene and stop any unsafe work condition and disseminate information to Site HSE Supervisor or HSE Manager when required.



## **6.0 PIPING FABRICATION PROCEDURE**

### **6.1 GENERAL**

The pipe fabrication drawing may be used to record all QA/QC requirements (eg material traceability, heat number, NDT, Weld Map, welder/fitter identification etc) and accompany the pipe along the entire fabrication process.

Method for workshop progress tracking and material traceability other than above can be used, such as using a Work Progress Sheet and/or Welding Follow up Sheet. Final record of workshop progress reporting has to be compiled using dedicated software.

Carbon Steel piping material will be fabricated in dedicated piping workshop. The installed concrete coating shall meet the specifications in the DEP on Concrete Coating.

### **6.2 MATERIAL PREPARATION**

All pipe fittings shall be prepared according to material take off as shown on pipe drawing, exact quantity to be released from material store. Material specification shall follow approved pipedrawing. Below are the standard check list for pipe and fittings:

- Check the sizes, obtain nominal diameter and schedule number (pipe, elbow, tee, etc).
- Check the bend radius (elbow)
- Check the pressure rating and flange facing (flange)
- Record down the heat number (pipe)
- Check for any defect: pitting, corrosion, buckling, flattening, ovality, etc.

### **6.3 CUTTING AND MARKING**

Cutting process may be performed by a bandsaw cutting machine and/or oxy-acetylene cutting machine for carbon steel piping. The work flow will be:

1. Pipe fitter chooses pipes as per pipe drawing on the pipe rack.
2. A crane lift up the selected pipe from pipe rack outside workshop to the conveyor
3. Cut pipes using the cutting machine as per pipe drawing's required cut length.
4. Dimensional control on the cut pipes.
5. After cutting the Pipe fitter shall transfer identification mark shown on the pipe with a marker, with the ISO number, pipe number, heat number etc.
6. To maintain material traceability, heat number of each material shall be written from the ISO drawing on each pipe and fitting.
7. The ISO drawing shall follow these material to the next step of fabrication.
8. Pipe fitters fill the workshop progress sheet.

### **6.4 MACHINING (BEVELING, TRIMMING, THREADING, DRILLING)**

Machining, beveling and/or trimming of pipe and fitting will be done in area near the cutting machine area.

On this beveling area will be placed work tables for bevelling operation. Bevelling process shall use a portable machine. Other type of machining such as trimming, threading, drilling and etc; will be done



as per required.

Work flow for bevelling activity will be:

1. Pipe fitter does the cutting and bevelling works, in any case where different pipe fitters perform these activities, the pipe fitter doing bevelling shall verify the informations in 6.3.5 above.
2. If original material identification marking is to be cut or material divided into two or more pieces, the heat number and pipe item code number shall be transferred to each of the pieces prior to cutting.
3. Do bevelling work with the help of machine devices. Use grinder (disc and straight) if necessary. Bevel parameters shall follow and as per required by the WPS for correct root and edge facing. For carbon steel pipes end result shall be bright metal finish.
4. Pipe fitter shall trim the unequal wall thickness on the higher thickness of pipes and fittings for weld joint component, inside surfaces of component at ends to be joint in girth or miter groove welds shall be aligned within the dimensional tolerance. If the external surfaces of the component are not aligned the weld shall be tapered between them.
5. Bevelled pipes and fittings shall be moved to assembly/fit up box.
6. Pipe fitters fill the workshop progress sheet.

#### **6.5 FIT UP/ASSEMBLY**

Assembly work (fit up work) will be done in the assembly area near the beveling area. This assembly box may use plastic or metal panel as a partition with adjacent boxes. Fit up work may be done on pipe jacks as pipe support. Alignment work shall be done with three or more points pipe clamp.

Work flow assembly work will be:

1. Pipe fitter does the cutting and bevelling works, in any case where different pipe fitters perform these activities, the pipe fitter doing bevelling shall verify the informations in 6.3.5 above.
2. Place the pipes/fittings in the pipes jack, assemble other pipes/fittings as per ISO drawings.
3. Align the pipes and fittings using pipe clamps.
4. Check the alignment result with welding gauge for misalignment, root gap etc.
5. Tack weld on the pipes if necessary as per applicable tack weld procedure.
6. Clean the pipes weld joint preparation.
7. Pipe fitters fill the workshop progress sheet.

#### **6.6 DIMENSIONAL CONTROL/FIT UP INSPECTION**

A dimensional control inspection shall be carried out by quality control department to ensure the assembled pipe pipes are fabricated as per approved pipe drawing.

This step may be done in the same assembly box where the pipes being assembled. In case anyfault/discrepancies, comments for repair work shall be directly given to the pipe fitter team.

Parameters need to be checked and acceptance criteria shall follow QC inspection procedure.

Pipe Fitters/Piping Supervisor needs to check parameters internally before workshop superintendent raise Request for Inspection to QC Dept.



## **6.7 WELDING AND VISUAL WELD CONTROL**

Welding shall be done in the same assembly box where the assembly work took place. The welding work shall be carried out as per approved WPS. Pipe welder has to be a Qualified welder.

During the welding process, Welder foreman shall constantly monitor the welding process to ensure application of WPS on the welding process.

After welding, a visual weld inspection shall be carried out to verify the quality of weld result. The visual weld examination shall be carried out by Welding Inspector. Procedure for inspection, acceptance criteria and others requirement for welding inspection shall follow QC's Procedures.

1. Workshop Superintendent request for visual welding inspection from QC Dept .
2. The inspection may be conducted in the welding area.
3. Welding inspector performs the visual weld inspection.
4. If any weld defect found, Welding inspector shall mark and inform the welding team immediately.
5. Perform weld repair work (if any) as per weld repair procedure.
6. In case of un-repairable weld defect, Welding team shall coordinate with fitting team to reassembly the defected weld joint.
7. After successful inspection, pipe welders shall fill workshop progress sheet and welding follow up sheet.

## **7.0 NON DESTRUCTIVE TESTING (X-RAY)**

The NDT shall be carried out to ensure that only accepted weld joints will continue through the Post Weld Heat Treatment process.

The requirement of NDT shall follow approved procedure. X-Ray will be carried out in the NDT Bunker outside or inside the Piping Workshop.

## **7.1 POST WELD HEAT TREATMENT (IF REQUIRED)**

PWHT will be done in an area inside or outside the workshop as per designated later. Work flow for PWHT work as follow:

1. Pipe from NDT Bunker or temporary storage area will be send to PWHT area using forklift.
2. Arrange pipe for PWHT preparation.
3. Prepare the PWHT equipment.
4. Conduct PWHT as per required by WPS/PWHT Procedure.
5. Remove the PWHT equipment.
6. Fill up the workshop progress sheet.
7. Let the pipe on PWHT area for hardness test.



## **7.2 HARDNESS TEST (IF REQUIRED)**

Hardness test will be done in the Post Weld Heat Treatment area by Qualified NDT Personnel. If any failures on the hardness test, the PWHT process shall be re-done directly.

Work flow for hardness test as below:

1. Pipe is still in the PWHT area. Arrange pipe for safe conduct of hardness test.
2. Take the hardness test using portable hardness tester.
3. Obtain the result.
4. In case of unsatisfactory result, do preparation for 2<sup>nd</sup> PWHT.
5. Fill the workshop progress sheet.

## **7.3 HYDROSTATIC TEST**

Hydrostatic test on workshop after fabrication completed is to ensure the welding integrity from any leak. This hydrostatic test shall be conducted after NDT has been completed and any heat treatment require.

This hydrotest applicable for pipe with flange joint only, for others the hydrotest will be carried on erection area.

Work flow for hydrotest work as follow.

1. Bring the pipe from NDT Bunker to piping workshop hydrotest area.
2. Layup pipe on the hydrotest area.
3. Prepare the blind flange and other hydrotest equipment.
4. Conduct hydrotest work as per Pressure Testing Procedures.
5. Obtain the hydrotest result.
6. Depressurize the water and clean the water inside pipes with compressed air blow.
7. Collect the pipes and prepare for transport to the next step.

## **7.4 PIPELINE EXTERNAL COATING**

Pipe will be sent to coating workshop as required by Spec. For carbon steel pipes material will have painting work, necessary arrangement shall be made on the field weld joint for protection using adhesive tape after the blasting process. Passivation/preservation will be done after hydrotest.

## **7.5 OTHER TREATMENT (IF REQUIRED)**

Other treatment mentioned in here are passivation and acid cleaning of CS pipe materials. These activities will only be conducted if required by design/code/spec.

### **7.5.1.1 MECHANICAL CLEANING**

Oxidation may be removed by mechanical means. The surface shall be polished with a grinder and a smooth transition to the unpolished base material surface shall be made. The final surface roughness, Ra, shall be less than 12.5 micrometers.





## **7.6 STORAGE OF FABRICATED PIPE**

Fabricated pipe shall be stored in good environment to maintain material quality of pipes. End of pipe shall be blanked using suitable material to avoid any dirt/garbage put inside the pipe. This wooden material or polythene can be tightened either using wire or rope.

Prevent direct contact between pipes with dirt by using wood support. Pipe shall be stored with grid basis. This grid basis is a storage system that divides the pipes based on installation sequence by pipe material, location of installation, isometric drawing number and pipe drawing number.

## **7.7 HANDLING OF PIPES**

Handling of pipes shall not cause any damage on the materials. Few methods to handle the piping materials and pipes are:

1. Forklift, use for taking out pipe from rack, lifting materials and transfer materials. Special protection for the fork shall be used for CS materials.
2. Gantry Crane/Overhead Crane/Lifting Jib use nylon slings, for CS materials separate set of slings shall be used for each type of materials.
3. Belleli 90T and Trailers.

## **7.8 HSE REQUIREMENT FOR FABRICATION WORKS**

- Ensure that fabrication workshop is built to standard with all safety features like escape routes/fire extinguisher plans to be in place and standard workbench.
- Ensure that the electrical system is in line with the international standards and inspected by competent electrician;
- Ensure adequate HSE personnel are being mobilized to manage all activities to reduce all risk factors to acceptable limits.
- Ensure adequate risk assessment is developed to cover all activities during the fabrication.
- Prepare structural protection to separate areas where grinding and cutting operation is ongoing from the walkway.
- Ascertain the type of steel quality/ electrode and welding procedure is appropriate (via worksheets, drawings, etc.);
- Ensure that all combustible material are cleared away from the workshop area before hot work is commenced;
- Ensure that a Fire watch is present when hot work is in progress.
- Ensure that a valid Permit to Work has been issued for activities to be performed.
- Ensure that all welding equipment/hand power tools and machines are correctly used



and properly maintained in good working condition. This includes all personal protective equipment.

- Ensure proper housekeeping around the work location, before, during and after the activity.
- Welding trailing cables shall be adequately arranged and managed to avoid tripping hazard. Adequate cable hanger and trays shall be used respectively.
- All welding equipment must have undergone and passed company pre-mob inspection (PATest) and the validity shall be well maintained
- Standard scaffolds shall be erected for all height works
- Fire blankets shall be used to contain all welding sparks while working at height.
- Ensure proper exclusion zone for NDT and Hydrotest activities;
- Ensure that all MSDS and Shock card of Dangerous Material is present at site;

The minimum PPE requirement for the welders and welders mate, pipefitters (helpers) are listed below.

- Fire retardant coverall
- Safety Shoe (S3)
- Welders Shoe Protector
- Rain boot
- Hard Hat
- Rain coat
- Welder's Knee Protector
- Welder's Leather apron
- Dark Safety Glass
- Plain Face shield
- Welding Glove
- Welder's sleeves
- Ear muff
- Welding nose mask (FFP2 or FFP3) or respirator;

The minimum PPE requirement for grinders) are listed below.



- Fire retardant coverall
- Safety Shoe (S3)
- Rain boot
- Hard Hat
- Rain coat
- Welder's Leather apron
- Dark Safety Glass
- Plain Face shield
- Ear muff
- Dust nose mask;

#### **7.9 WORKSHOP PREPARATION, STORAGE AND HANDLING**

Ferrous contamination on stainless steel and duplex shall be avoided. Carbon Steel subsequently rusts in a moist or humid environment and can initiate corrosion on the stainless steel surface. Only stainless steel tools, wire brushes, clamp and grinding wheels shall be used on stainless steel pipes.

To minimized ferrous contamination, the following preparation shall be taken for CS material pipe shop:

- All handling equipment, such as sling of crane, fork of lift truck, hook of chain block etc shall be a nonmetallic material or protected by clean wood, cloth or plastic buffer to avoid iron contact with CS pipe material surfaces.
- All working bench, working tools and working consumables such as machine vices, pipe clamps, grinding disc etc shall be a non carbon steel material or be isolated with rubber, wood or stainless steel plate etc.
- Each equipment and tools as described above shall be used for one type of material only.  
Storage area of equipment and tools shall be segregated. An identification code system shall be established for above segregation.
- Each pipe, pipe fittings, assembled pipe, welded pipe shall not be stored directly on the ground. These items shall be stored on wooden bar at least 150 mm from the ground or on a surface fully covered with wood.
- Walking, stepping or placing any item on CS piping items is strictly prohibited.
- Before starting any new work in CS pipes shop, inspection will be conducted to ensure the carbon decontamination.

#### **7.10 NON DESTRUCTIVE TESTING (X-RAY)**

As per carbon steel material, the NDT (X-Ray) may be done in the NDT bunker outside pipes workshop. These NDT bunker will differ from CS NDT bunker. Special precautions shall be taken during lifting and transporting the pipes from welding box to NDT bunker.



Work flow for the X-Ray work:

1. When transporting pipe pipes with forklift, the fork has to be protected by wooden pallet or similar protection.
2. Since the NDT bunker located outside the CS pipe material workshop, cover the pipe pipes with plastic canvas during transportation of pipe pipes.
3. Carried out X-Ray as per procedure.
4. After X-ray activities, the NDT personnel or appointed personnel shall install back protection cover to the pipe pipes.
5. Relay results to workshop superintendent.
6. Workshop superintendent will arrange to send back pipe to the hydrotest area.

### **7.11 PWHT AND HARDNESS TEST**

For CS pipes material preheat and stress relieving (PWHT) is not needed and likely to be harmful since it will cause a loss of toughness and corrosion resistance. Any heat treatment work related to duplex stainless steel shall be stated clearly in the WPS.

### **7.12 HYDROSTATIC TEST**

Conduct hydrotest as per arrangement mentioned on previous section if hydrotest is required.

When the hydrotest is not required, the pipe shall be sent to passivation area directly after X-Ray. When conducting hydrotest, pipes are not allowed to be laid down on the ground. Use wooden block for support. All hydrotest equipment and fluid shall be nonferrous contaminant.

### **7.13 PRESERVATION**

To maintain the quality of anticorrosion properties of CS pipes material and to prevent the deterioration of pipes surface finish, a special care shall be given during pipe storage and handling after fabrication.

1. All the pipes opening shall be sealed with air tight closures after passivation process.
2. End closures shall be durables and securely attached to the pipes such they will remain intact and in position during transfer, handling and storage.
3. Pipe end connection can be sealed by blinds secured using wire. Unflanged pipe end connection can be sealed by end cap from plastic (or similar) and wrapped with protecting tape 50mm around the pipe-cap joint. Threaded end connection, whenever possible, shall be sealed by means of threaded plastic (or similar materials) so that the pipe thread will be protected.
4. Pipe to be stored on wooden supports and not on the ground