



RP 32-1

INSPECTION AND TESTING OF NEW EQUIPMENT IN MANUFACTURE

July 1992

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BP Group Engineering Standards Forum**

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SCOPE AND PURPOSE This Recommended Practice gives general guidance on the inspection and testing of new equipment in manufacture. Its purpose is to define organisational responsibilities and provide Inspection and Test procedures to ensure that the design of manufactured equipment is not compromised. Authority for carrying out the activities described in this practice should be clearly delegated by BP according to particular Project or Operations requirements.											
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FOREWORD

Introduction to BP Group Recommended Practice and Specifications for Engineering

The Introductory volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Practice

This Recommended Practice identifies recommended inspection and testing procedures to be applied to new equipment during and at completion of its manufacture to ensure that the equipment arrives at site fit for its intended purpose and complete with any required documentation.

This Recommended Practice is both bespoke and original - there being no other representative document.

Application

This Recommended Practice is intended to be a practical guide to inspection and test requirements for new equipment in manufacture.

Such inspection activities may be carried out by whomsoever the purchaser deems competent, the manufacturer, supplier, themselves or an agency acting on their behalf.

There are occasions when it is necessary to review and specify inspection and test activities, together with responsibilities, due to operational constraints, expediency, concerns over supplier competence or previous poor performance in manufacture. This document is based on experience gained in projects and operations engineering and procurement. It provided, along with relevant national standards, a basis range for a review of these conditions. Requirements are indicated for a range of criticality assessments to allow for different levels of equipment importance.

IT IS EMPHASISED THAT THE LEVEL OF CRITICALITY, AND THE EXTENT TO WHICH THESE GUIDELINES ARE USED, ARE ENTIRELY AT THE DISCRETION OF THE PURCHASER.

It should also be recognised that the level and extent of inspection and test may be influenced by specific cultural and legislative requirements, which, because of their variety, cannot be addressed in this document. Nonetheless, the importance of these influences must not be underestimated.



It may be in the interests of purchasers to reduce intervention, relying on the proven competence of suppliers to meet specific requirements. In all cases, methods of monitoring supplier performance should be clearly defined. Auditing or surveillance of suppliers will always be necessary to maintain assurance of their competence to satisfy the purchasers requirements.

Principal Changes from Previous Edition

CP 51 (now RP 32-1) has been expanded to include general principles on inspection and testing, a guide to the determination of criticality ratings, sampling inspection and documentation requirements.

Various new sections have been added and some sections deleted.

Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.

For feedback and further information, please contact Standards Group, BP Engineering or the Custodian. See Quarterly Status List for contacts.



1. INTRODUCTION

1.1 Scope

This Recommended Practice gives general guidance on the inspection and testing of new equipment in manufacture.

It defines organisational responsibilities, procedures for co-ordination, types of inspection, reporting, recording, inspection and testing requirements for new equipment in manufacture.

The level of assurance of quality as well as depending on the purchaser's quality programme, will also depend on supplier competence. It is the responsibility of the purchaser to decide who should perform these inspections to give the required level of assurance, i.e. an Inspector independent of the supplier, agreed or appointed by the purchaser, or the supplier's Inspector.

The Inspection Procedures contained in Part 2 detail the minimum inspection requirements recommended for new equipment. The narrative section of each procedure covers all activities for Criticality 1 items. Recommended inspection requirements for criticality 2, 3 & 4 items are detailed in the 'Guide to Purchaser' Inspection Requirements against Criticality Ratings' attached to each procedure.

Check lists are also provided as an aide to develop inspection programmes for specific items of equipment.

Other BP Group Recommended Practices and Specifications are quoted, although where these documents call on or impose other standards and codes, these are also quoted.

UK legislation is quoted where applicable and may be used for guidance in those countries where similar legislation does not exist. Alternatively, users may substitute other national regulations where appropriate.

It is emphasised that specific quality programmes should be developed for equipment for particular service applications by qualified and experienced job engineers and quality engineers. This means that the recommendations contained in this Recommended Practice could be varied, in order to ensure fitness for purpose.

1.2 Quality Assurance

Various options for the provision of Quality Assurance are given in the Introductory Volume to BP Group Recommended Practices and Specifications for Engineering.



2. GENERAL PRINCIPLES TO BE EMPLOYED BY THE PURCHASER

2.1 Introduction

This code cannot provide detailed inspection and testing requirements for all equipment, because of the diversity of equipment and manufacturers, however it lays out principles and procedures for establishing these requirements.

The inspection and testing of equipment must be given adequate consideration and coverage at all stages from initial design, through manufacture to delivery and acceptance by the end user or purchaser, as well as the supplier. The delivery of equipment to site however, is not the end of the inspection and testing activity and to ensure that all user requirements are met it is essential that the purchasers quality programme is designed so that procurement, site inspection, and documentation requirements are properly integrated.

2.2 Organisation

The organisation utilised for procurement inspection may be similar to that described by the organisation chart in figure 2.1 - (Typical Purchasing and Inspection Organisation).

2.3 Responsibilities

It is the responsibility of the supplier to:-

- (a) Ensure that inspections are carried out in accordance with approved orders, specifications, standards and quality plans.
- (b) Ensure that the design of new equipment is not compromised and that any changes or deviations are documented and validated by relevant technical authorities so that the equipment meets the specified technical requirements.
- (c) Ensure compliance with statutory regulations and codes applicable to design, operations, inspection, test and certification of equipment.

2.4 Purchase Orders

In general it is assumed by this recommended practice that all new equipment is procured by means of a purchase order. It is therefore necessary to ensure that any specific purchaser inspection, test and certification requirements for new equipment are clearly identified within the purchase order documentation.

Proforma check lists are useful in specifying quality requirements and documentation/certification requirements (see 6.6 and 6.7 of Part 1).



For criticality 1 and 2 and orders with complex documentation/certification requirements, it is often advisable to have the supplier submit a document index, based on the purchasers documentation requirements. This allows the supplier to:-

- (a) Demonstrate his understanding/agreement with the purchasers documentation requirements.
- (b) To itemise generic documents e.g. weld procedures and drawings.
- (c) To propose submittal dates for documents based upon the manufacturing programme requirements.

See 6.5 and 6.1 of part 1 for example of Supplier Document Index and Typical Document Transmittal Note.

It should be noted that where the words 'approve' or 'agree' are used this does not absolve the supplier from any responsibility and this should be stated in purchase order documentation.

2.5 Design

2.5.1 General

One of the main purposes of inspection and testing is to ensure that the design of manufactured equipment is not compromised. The purchaser should consider whether or not the supplier's design needs to be independently verified and authorised in writing prior to the commencement of the manufacturing process, and that any deviations are accepted and/or corrected before the next stage of inspection is commenced.

The supplier should ensure that the Quality Plan for new manufactured equipment identifies each stage of design and design verification and authorisation, and clearly identifies the personnel who are responsible for such action(s).

2.5.2 Design Control

Purchase orders should clearly state all the standards, specifications and codes of practice (with issue No.) that shall apply during the design and manufacture of new equipment. Any variation or change to this information should be by means of a purchase order change or amendment.

2.5.3 Design Change Control

The supplier should establish and maintain procedures for the identification, documentation and appropriate review and approval of all changes and modifications.



2.6 Criticality Ratings

The quality programme/inspection/certification requirements should be based on the criticality rating for the equipment determined during the design stages.

Details of the method of determination of C.R.'s are contained in BP Group [RP 50-1](#), but a summary of the method is given in Section 3 Part 1 of this Recommended Practice.

6.6 of Part 1 of this Recommended Practice gives a typical quality programme check list.

2.7 Inspection & Test Plan

2.7.1 General

Where required by the quality programme, prior to the commencement of manufacture, the supplier is to submit an Inspection & Test Plan for review, comment and subsequent approval by the purchaser. When approved, the Inspection & Test Plan will be the basis for all inspection activities during manufacture. (Note: Some manufacturers erroneously call this a Quality Plan).

2.7.2 Inspection Codes

The required inspection activities are identified by means of marking up the Inspection & Test Plan (where applicable). The following are typical of those commonly used.

(a) Company Reference:

A	=	Purchaser
B	=	Certifying Authority
C	=	Designer/manufacturer
D	=	AN Other

(b) Inspection/Monitoring Codes:

A1	=	100% Actual Inspection
A2	=	Sample Actual Inspection
W1	=	100% Witness Inspection
W2	=	Sample Witness Inspection
M	=	Operation Monitoring
R1	=	100% Review of Documentation
R2	=	Sample Review of Documentation
H	=	Hold Point

(c) Documentation Codes:

AP	=	Submit documents for approval
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INF	=	Submit documents for information
DD	=	Submit verified original documents for inclusion in Data Dossiers.

2.8 Manufacture

During the course of manufacture it is essential that the requirements of the Inspection & Test Plan are adhered to. For any stage of the manufacturing process (including inspection and test) which cannot be achieved or requires to be bypassed, a waiver must be requested by the supplier, in writing, and if acceptable, a written approval given by the purchaser.

It is the responsibility of the supplier to ensure that all personnel required to action items on the Inspection & Test Plan are informed of imminent activities within an agreed period before they are to occur, and this should be stated in the order documentation.

2.8.1 Control of the Manufacturing Process

To achieve the aims of the Inspection & Test Plan it is essential that the manufacturing process is controlled in a systematic and disciplined manner, e.g., no welding, contractual testing or specialised inspection should take place unless relevant procedures have been agreed.

The Inspector should verify that manufacturing process control activities are carried out by the supplier as stated in the Inspection & Test Plan and the activities are signed off to indicate completion.

2.9 Inspection/Reports

2.9.1 Inspection/Reporting by the Supplier

The supplier's quality system should ensure that where necessary, equipment and material is inspected prior to use, during manufacture and prior to despatch.

It should also indicate how the results of inspections and tests are recorded. e.g. written reports, signed off Inspection and Test Plans/shop travellers etc.

The supplier should have some means of recording the fact that all inspections and tests have been satisfactorily completed.

2.9.2 Inspection/Reporting by or on behalf of the Purchaser

The Inspector may employ 4 main types of activity to ensure that the requirements of the Purchase Order and the Inspection & Test Plan are achieved. These are review, inspection, witness and monitor.

All inspection activities should be formally reported; reports being copied as a minimum to a permanent record file and distributed according to purchaser requirements.

The content of inspection reports should be in accordance with purchaser requirements; reports normally need to be comprehensive in order to aid continuity of inspection and for subsequent reference. Following is a list of typical information that may be required in an inspection report.

- (a) Means of identification to purchase order or sub order e.g. order number, sub order number.
- (b) Specifications applicable
- (c) Manufacturer (including all sub-suppliers)
- (d) Equipment detail
- (e) Document approvals (and status)
- (f) Problems/deviations
- (g) Actions required
- (h) Inspection activities carried out, including a statement on the result of the inspection
- (i) Next inspection due

See section 6 of Part 1 for sample inspection reports.

2.9.3 Release Notes

When all inspection activities have been satisfactorily completed some sort of release note should be issued, to record the fact.

It is often worthwhile to have this document despatched with the goods; this could aid goods receipt inspection. (See 6.3 of Part 1 for a typical example of an inspection release note)

Note that a conditional release note should only be issued to a supplier with the written agreement of the purchaser.

2.9.4 Non-conformities

When a non-conformity is identified as a result of an inspection activity, it should be subject to the supplier's design change control procedure, whenever the disposition of the non-conformity is other than to replace or rectify the material or equipment in order to satisfy all the original requirements.



2.10

Concessions

If the design is subject to independent review or purchaser agreement it may be a requirement that disposition of non-conformities is subject to third party or purchaser agreement. This requirement should be stated in the purchase documents. The supplier should also address this requirement in his design change control procedure.



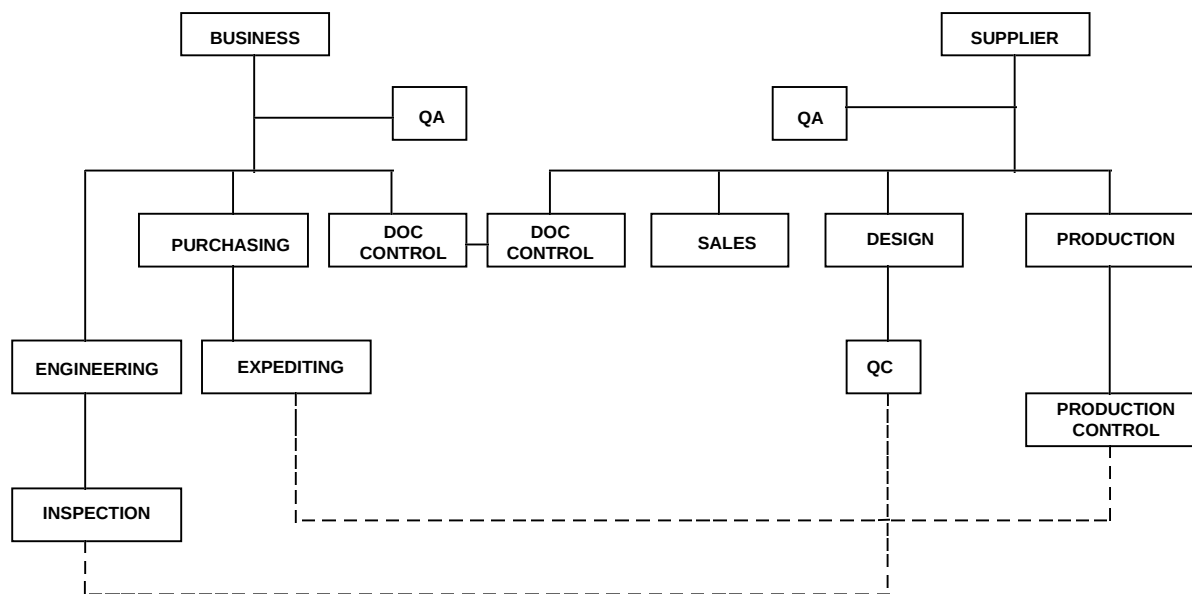


FIGURE 2.1
TYPICAL PURCHASING AND INSPECTION ORGANISATION CHART

3. CRITICALITY RATINGS IN BP

3.1 Scope

This Section gives guidance on the technique for the determination of criticality ratings and development of quality programmes contained in BP Group [RP 50-1](#). Specific details of the method are contained in that code.

3.2 Related Documents

BP Group [RP 50-1](#) Quality Assurance.

3.3 General

3.3.1 Criticality rating is a formalised technique for assessing the importance of a piece of equipment in regard to the effect that its failure would have on the system or scheme as a whole. BP Group [RP 50-1](#) suggests model quality programmes for each of 4 criticality ratings, thereby providing a method of matching quality programmes to service requirements, and achieving fitness for purpose.

3.3.2 The material, item, sub-assembly or service is assessed against a common list of seven criteria using a Design Statement of requirements. A points score (from 1-4) given to each criteria is then totalled. The points total determines the criticality rating.

3.3.3 It is essential that criticality ratings are fixed before order placement occurs, and ideally should be the result of collaboration between the indenting or job engineer and the QA Engineer. In order to achieve the optimum design of quality programme, technically qualified and experienced indenting engineers and QA engineers should carry out this work.

3.4 Application

The procedures within this code of practice are all written for criticality 1 rated equipment. Where other CR's apply, inspection requirements are described in summary sheets at the end of each procedure.

NOTE: The above guide should be read in conjunction with BP Group [RP 50-1](#).

4. SAMPLING INSPECTION

Sampling inspection can provide an effective method of determining confidence levels when properly applied in an appropriate situation.



It is recommended that any sampling procedure employed be based on established statistical techniques e.g. [BS 6001](#) Parts 1, 2 & 3 - Sampling Procedures for Inspection by Attributes.

5. QUALITY RECORDS

5.1 Scope

This section discusses documentation generated by the supplier during manufacture. It also offers guidance on the types of documentation normally required by the Purchaser as part of the purchase order requirements.

5.2 General

In order to demonstrate achievement of the specified technical requirements and the effectiveness of their quality system, the supplier must prepare and maintain quality records - see [ISO 9000](#) series

Certain of these quality records, particularly those that demonstrate the achievement of the specified technical requirements may be subject to review and acceptance by the Purchaser. The extent of the review will depend upon the criticality of the equipment and the Purchaser's quality programme.

Quality records which may be subject to Purchaser's review typically include:-

- Drawings
- Calculations
- Quality and Inspection & Test Plans
- Manufacturing, Inspection and Test Procedures
- Test Results
- Welder and NDT Operator Qualifications

The review may be performed by the Inspector in the case of say, test results and personnel qualifications, or a discipline engineer in the case of drawings and calculations.

Generally, quality records that demonstrate the achievement of the specified technical requirements are required by the Purchaser as a permanent record for future reference, for traceability purposes or to meet statutory requirements.

5.3 Manufacturing Data Book

The required quality records are normally collated into a document commonly known as a manufacturing data book. This may be retained by the Supplier if the Purchaser does not wish to retain this documentation himself.

NOTE: It is advantageous for Purchasers to work with Contractors and Suppliers to progressively increase confidence in their systems so that the need for review and retention of documents is minimised.

The manufacturing data book may contain the following as appropriate:-

- (a) The purchase order, amendments and related correspondence
- (b) The Quality and Inspection and Test Plans
- (c) The original design documents including copies of approved drawings, data sheets, construction specifications (including welding procedures, manufacturing specifications etc.). The above should also include any approvals that may be applicable by Certifying Authorities, Design Authorities and the Purchaser.
- (d) Design change documentation.
- (e) Material test certificates and reports, dimensional records, pressure test records, NDT reports and records etc.
- (f) Inspection Reports, test reports, non-acceptance reports/acceptance reports/certificates.
- (g) Certifying Authority reports, release notes and certificates.
- (h) Final 'As Built' drawings, specifications, data sheets and documentation.
- (i) Specialist reports related to packaging and storage, especially where long term storage is to occur or has occurred prior to delivery to final location.

NOTE: The above list is illustrative only. The appropriate level of final documentation may be greater or lesser in any particular instance but in either case should be well-defined and restricted to those documents considered necessary for possible future reference purposes.

5.4 Sub-Supplier Documentation

It is the responsibility of the Supplier to ensure that all documents produced by his sub-supplier comply with the documentation requirements of the main purchase order or contract. Suppliers should include a suitable clause in all sub-orders to ensure sub-suppliers are aware that they will be subject to the same controls.

The sub-supplier documentation may also be subject to review by the Purchaser's representative.



5.5 Statutory Documents

In many countries there are requirements to maintain certain documentation to satisfy national and local rules and regulations. There are also many similar requirements within the United Kingdom both onshore and offshore. All such requirements should be clearly identified within the purchase order or contract.

5.6 Quality Records Required by Purchaser - Format and Quality

5.6.1 General

For consistency, ease of review, reference, storage and retrieval, particularly where more than one purchase order is involved, it may be important to establish rules for the format and quality of documents to be provided to the Purchaser.

The following should be considered:-

(a) Size

It may be important that document sizes and format are consistent.

(b) Organisation and Presentation

For the reasons stated above it may be important that manufacturing data books are organised and presented in a particular way.

(c) Clarity

The degree of document clarity may be important particularly if documents are to be microfilmed or scanned electronically.

(d) Approval of Documents

It may be important that the approval status of documents is indicated on the document itself e.g. by stamping or by the inclusion of the appropriate transmittal note.

(e) Language

The language in which the documents are written may be important. This should be considered by the purchaser.

(f) Units



The units should be considered e.g. SI., Imperial or American Customary units.

(g) Identification

It is recommended that as a minimum, each document should carry:-

- (i) identity of issuing organisation
- (ii) identity of the originator and approver,
- (iii) date of issue and revision number,
- (iv) supplier document number and title,
- (v) Purchaser Enquiry/Purchase Order number,
- (vi) Purchaser Document Code No.
- (vii) Supplier internal order number,
- (viii) Purchaser equipment number/Tag no. (if applicable).

The Purchaser may also require the addition of a special Project title block to supplier drawings.

Note: See 6.5 and 6.7 for examples of supplier document index proforma and schedule of documentation requirements.

6. EXAMPLES OF INSPECTION AND CERTIFICATION DOCUMENTS

- 6.1 Document Transmittal Note
- 6.2 Works Inspection Report
- 6.3 Works Inspection Release Note
- 6.4 Non-Acceptance Note
- 6.5 Supplier Document Index
- 6.6 QP1 - Quality Programme (Purchaser)
- 6.7 Schedule of Documentation Requirements



6.1

TRANSMITTAL NO:

Addressee	Sender: Name:
------------------	------------------------------------

BP ORDER NO. _____

SUPPLIER ORDER/REF NO.

**PLEASE FIND ENCLOSED AGAINST THE ABOVE REFERENCED ORDER
THE FOLLOWING DOCUMENTS**

Doc. Code No.	Document	Document Reference No.	Revision No.	No of Copies	Action Code	Comment Code
REMARKS						

RE-SUBMIT DOCUMENT BY Date:

ACTION CODE:

1. For agreement before proceeding
2. For review and comment
3. For information only
4. Submitted as final

COMMENT CODE:

- A. No comment. Work may proceed
B. Reviewed with comments
C. Rejected. See comments
D. Review not required

Date: Distribution White - With Document
Blue - Originators File
Yellow - Inspector
Green - Buyer
Pink - With Document For Receipt



6.2 Works Inspection Report

Date:

Page: 1

Main Order Number >
Main Supplier >
Sub Order Number >
Sub Supplier >
Project/Site >
Client/Indentor Contact >

Job Title >
Indentor's Reference >
Expediter's Reference >
Date of Visit >
Release Note Dated >
 M/O Item Numbers >
 S/O Item Numbers >
Rejection Note Dated >
 M/O Item Numbers >
 S/O Item Numbers >
Stage Inspection >
 M/O Item Numbers >
 S/O Item Numbers >
Main Order Complete >
Sub Order Complete >
Further Visits Required >

REPORT NUMBER >

Status of Documentation

(e.g. Drawings, Weld Proc., Qual. Plans, Material & Test Certs)

>

Problems, Rejections, Holds

>

EST. >
VISIT >
TOTAL >

Report Details

>

Inspection Engineer & Date >

Head Office Approval:

Head Office Comments/Distribution



6.3 Works Inspection Release Note

Date:

Page: 1

Main Order Number >
Main Supplier >
Sub Order Number >
Sub Supplier >
Q.C. Engineers Reference >
Expediter's Reference >
Date of Release >
 M/O Item Numbers >
 S/O Item Numbers >
Further Insp'n Visit >
Main Order Complete >
Sub Order Complete >
Mat Ready for Despatch >
Q.A. Report >
3rd Party Inspection >
Test Certificates >

Item No. Details			Quantity	Quantity	
<u>M/O</u>	<u>S/O</u>	<u>Ordered</u>	<u>Inspected</u>	<u>Released</u>	<u>Drawing Description</u>
>	>	>	>	>	>

Remarks

>

Inspection Engineer & Date >

Head Office Approval:

Head Office Comments/Distribution:



6.4 Non-Acceptance Note

Date:

Page: 1

Main Order Number >
Main Supplier >
Sub Order Number >
Sub Supplier >
Q.C. Engineers Reference >
Expediter's Reference >
Date of Release >
 M/O Item Numbers >
 S/O Item Numbers >
Q.A. Report >
New Promised Date >
3rd Party Inspection >

Item No. Details			Quantity
<u>M/O</u>	<u>S/O</u>	<u>Quantity</u>	<u>Description</u>
>	>	>	>

Remarks

>

Inspection Engineer & Date >

Head Office Approval:

Head Office Comments/Distribution:



Supplier Document Index

[illegible]

6.6 Quality Programme

1.	<u>Quality System</u>	<u>Delete as Required</u>
1.1	Supplier shall operate a quality system meeting the requirements of the relevant part of ISO 9000.	Y/N
1.2	The supplier shall ensure that his sub-suppliers also operate a quality system meeting the requirements of the relevant part of ISO 9000.	Y/N
1.3	Supplier's quality system to be assessed/approved (specify) prior to commitment of purchase order.	Y/N
1.4	Major sub-suppliers to be assessed/approved (specify) prior to commitment of purchase order.	Y/N
1.5	Purchaser reserves the right to carry out quality audits at the suppliers and sub-suppliers facilities, at any stage during manufacture.	Y/N
2.	<u>Inspection</u>	
2.1	Pre-production meeting to be held in supplier's works within 4 weeks of order commitment.	Y/N
2.2	Inspection waived.	Y/N
2.3	Residential inspection presence required: by Purchaser nominated representative by others (state)	Y/N Y/N
2.4	Inspection to be monitored by Purchaser or nominated representative throughout execution of order.	Y/N
2.5	This material is subject to independent 3rd party inspection by.....	Y/N
2.6	The following specific inspection points to be witnessed by Purchasers representative (others may be required after perusal of suppliers inspection and test and test plan).	Y/N
2.7	The following specific inspection points to be witnessed by Purchasers specialist engineer (others may be required after perusal of suppliers inspection and test and test plan).	Y/N
2.8	Inspection in work to be sampled on a random basis.	Y/N
2.9	In the event of errors occurring during manufacture, purchaser to be alerted by the supplier immediately.	Y/N
3.	<u>Materials</u>	
3.1	Materials control is required including proof of material, material traceability and certification of pressure retaining parts and load bearing components. Material certification meeting DIN 50049 3lb required.	Y/N
3.2	Material certification meeting the requirements of DIN 50049 31c required, inspectorate will be appointed and at cost of: a) supplier b) purchaser	Y/N Y/N



Schedule of Documentation Requirements

Instructions to Indentor

1. This form shall be used to summarise all the order documentation requirements including those referenced in any attachments.
2. The Indentor is required to complete the 'Required by Client' column of the form for site with a three section code, as follows:-

(a) 1st Section - Quantity of each document

(b) 2nd Section - Type of document

P - Print

R - Reproducible (full size)

M - Microcopy

(c) 3rd Section - Reason for requirement

A - Approval S - Site Records

C - Construction F - Final

I - Information

E.g. Six Prints for Approval - 6PA, One Reproducible as Final = 1RF. Where there is no requirement the column is left blank.

3. More than one code may be used for each document number, e.g.

Doc Number	Description	Reqd by Client	Reqd by PAC	Reqd by Data Book	Reqd in
------------	-------------	----------------	-------------	-------------------	---------

025	Quality Plan	3PA	1PA	1PF	
-----	--------------	-----	-----	-----	--

The above indicates the requirement of Three Prints for Approval by the client, a further One Print for Approval by PAC, plus ONE Print Final in the data book.

Note: The Data Book will only contain Final Documents. Therefore please do not request additional final documents using the first column, as this will be interpreted as an addition to the data book requirements.

4. The Supplier will be instructed to forward all documentation required by Purchaser to the person named in the section (6) below. If you require all the documents to be sent to the Documentation & Certification Group PAC then leave the Required by Purchaser column blank increasing the PAC column by the number of copies required by the client. Documentation & Certification Group will distribute documents in accordance with established procedures or as otherwise advised.
5. If there is insufficient space to specify other documentation please attach a separate sheet detailing your requirement and indicate the appropriate Document Code Number according to the heading (e.g. Design Documentation, Doc. Code 025 onwards).
6. If you have any queries on the use of this form or suggestion for the future issues of this form please contact Documentation & Certification Group, PAC, BP Harlow.

Client copies to be sent to:- PAC copies to be sent to:-

BP International Ltd
BP Engineering
Procurement and Contracts Division
Documentation & Certification Group
BP House
Third Avenue
HARLOW
Essex. CM19 5AG.



SCHEDULE OF DOCUMENTATION REQUIREMENTS

INDENT/ENQUIRY/ORDER NO.

	Docs. Req'd by Purchaser prior to start of manufacture	Docs. Req'd in manufacturing record books
GENERAL DOCUMENTATION		
001 Supplier Document Index		
005 Production Programme		
010 Index of Sub Suppliers/Material		
015 Sub Orders as Requested		
020 Quality Assurance Manual		
025 Quality System 3rd Party Certificate of Approval		
030 Manufacturing Record		
035 Others (specify)		
DESIGN DOCUMENTATION		
040 Quality Plan		
045 Inspection and Test Plan		
050 Concession Requests		
055 Design Data Sheet		
060 Design Calculations		
065 Foundation Details		
070 G.A. Drawings		
075 Detail Drawings		
080 Sectional Drawings inc. Weld Details		
085 Schematic Drawings		
090 Wiring Diagrams		
095 Electrical Cable Routine Diagrams and Schedules		
100 P & ID Diagrams		
105 Material Schedule		



	Docs. Req'd by Purchaser prior to start of manufacture	Docs. Req'd in manufacturing record books
110 Name Plate Drawings		
115 Weight Data		
Others (specify)		
MANUFACTURING PROCEDURES		
120 Welding Including Repairs: WPS's, PQR's plus		
125 NDE Procedures (Specify) Plus Associated NDE Map		
130 Manufacturing/Process Procedures (Specify)		
140 Factory Acceptance Test Procedure		
145 Heat Treatment Procedures		
150 Pressure Test Procedure (Specify)		
155 Painting/Coating Procedure		
160 Packing/Preservation Procedure		
IN PROCESS INSPECTION AND TEST REQUIREMENTS/RESULTS/RECORDS		
165 Chemical Analysis. Cast/Product (Specify)		
170 Mechanical Test Results (Specify)		
175 Material List Cross Referenced to Drawing & Matl. Certs.		
180 Manufacturing Procedure Qualification Records		
185 Heat Treatment Chart/Report		
190 Welder Qualification Register		
195 Welder Qualification Records		
200 NDE Operator Register		
205 NDE Operator Qualification Records		
210 NDE Reports		
215 Dimensional Report		



	Docs. Req'd in manufacturing record books
220 Pressure Test (Prior to any Coating) Chart/Report (Specify)	
225 Type Test Certificates (Specify which Items)	
230 Electrical Test Certificates	
235 Electrical Hazardous Area Certificates	
240 Instrument Calibration Certificates	
245 Performance Test Certificates/Curves (Specify)	
250 Balancing/Overspeed Test Certificate (Specify)	
255 Mechanical Performance Test Results	
260 Stripdown Test Results	
265 Noise Certificate	
270 Vibration Reports	
275 Torque Test Records	
280 SWL/Proof Load Test Certificate	
285 Painting/Coating Report	
290 Certificate of Conformance	
Others (Specify)	
INSPECTION AND TEST, REQUIREMENTS, RESULTS, RECORDS ON COMPLETION	
295 S.I. 289 Certificate	
300 BS 5500 Form X	
305 ASME Certificate	
310 As Built Drawings	
315 Name Plate Rubbing	
320 Weight Certificate	
325 Signed-off Inspection and Test Plan	
330 3rd Party Inspection Reports/Certificates	
335 NACE (MR0175) Latest Edition C of C	
340 Tally Sheet	
345 Release Notes, Supplier/Sub-Supplier/BP/3rd Party (Specify)	
350 QC Data Book (Original)	
355 QC Data Book (Copy)	
Others (Specify)	



	Docs. Req'd in User Manual
USER MANUAL	
360 On-Site Preservation Manuals	
365 Unpacking/Lifting/Storage Requirements	
370 Installation/Pre-Commissioning/Commissioning instructions	
375 Operating Instructions	
380 Maintenance Instructions	
385 Lubrication Charts/Instructions	
390 Parts List	
395 Production Chemical/Safety Data Sheet	
400 Health & Safety at Work Act 1974 - Information to Users	
RECOMMENDED SPARES SCHEDULE	
405 Spares Schedule for Commissioning	
410 Spares Schedule for First Major Overhaul	
415 Spares Schedule for period (Specify)	



PART 2

COMPLETE LIST OF INSPECTION AND TEST PROCEDURES

Procedure No. 1	-	Centrifugal Compressors
Procedure No. 2	-	Centrifugal Pumps
Procedure No. 3	-	Electric Motors
Procedure No. 4	-	Electrical Cable and Fittings
Procedure No. 5	-	Firefighting Equipment
Procedure No. 6	-	Fired Process Heaters
Procedure No. 7	-	Flanged Steel Relief Valve
Procedure No. 8	-	Heat Exchange Equipment
Procedure No. 9	-	Flexible Hoses
Procedure No. 10	-	Hydraulic Equipment
Procedure No. 11	-	Instrumentation and Control Equipment
Procedure No. 12	-	Line Pipe and Casing
Procedure No. 13	-	Lifting Equipment
Procedure No. 14	-	Stockist Supplied Line Pipe & Casing
Procedure No. 15	-	Reciprocating Compressors
Procedure No. 16	-	Shop Fabricated Pipework
Procedure No. 17	-	Steam and Gas Turbines
Procedure No. 18	-	Steel Fabrication
Procedure No. 19	-	Switchgear
Procedure No. 20	-	Electrical Equipment for Use in Potentially Explosive Atmospheres
Procedure No. 21	-	Transformers and Reactors
Procedure No. 22	-	Unfired Pressure Vessels
Procedure No. 23	-	Valves for Process Units
Procedure No. 24	-	Wellhead Equipment



PROCEDURE 1 - CENTRIFUGAL COMPRESSORS

1. SCOPE

- 1.1 This procedure covers the inspection and testing of Centrifugal Compressors.
- 1.2 Where required by a governing code of practice or by purchase order requirements, an Independent Inspection Authority may be required to carry out certain statutory code related actions. This procedure indicates these actions.
- 1.3 It is assumed that all centrifugal compressors will be rated criticality 1 and consequently lower criticalities are not addressed.

2. RELATED DOCUMENTS

- [API 617](#) Centrifugal Compressors for General Refinery Services
- [BS 5265](#) Mechanical Balancing of Rotating Bodies
- [BS 5304](#) Code of Practice Safeguarding of Machinery
- [BS CP 3004](#) Guarding of Machinery
- BP Group [RP 34-1](#) Rotating Machinery
- BP Group [GS 106-2](#) Painting of Metal Surfaces
- BP Group [GS 118-3](#) General standard for welded fabrication and construction
- BP Group [GS 118-4](#) Storage and Control of Welding Consumables
- BP Group [GS 134-3](#) Lubrication, Shaft Sealing & Control Oil Systems for special purpose applications to API 614
- BP Group [GS 134-5](#) Centrifugal Compressors
- BP Group [GS 136-1](#) Materials for Sour Service to NACE MR0175-90
- [API 614](#) Lubrication, Shaft Sealing & Control Oil Systems for special purpose applications.



3. INDEPENDENT INSPECTION AUTHORITY INVOLVEMENT

- 3.1 In the case of centrifugal compressors being manufactured in accordance with a recognised national code, and/or which have to comply with statutory requirements, the involvement of an Independent Inspection Authority (IIA) may be required to ensure that design, manufacture, testing and inspection is in accordance with the relevant codes, standards and specifications.
- 3.2 The Purchaser should nominate or agree the IIA. The Inspector should keep apprised of the activities of the IIA and co-ordinate his own activities with these.
- 3.3 The activities of the IIA will be in accordance with the applicable code, and with any other specific Purchaser requirements, but should include design review, inspection and test, completion of required certification and issue of a certificate of compliance.

4. GENERAL

4.1 Inspection & Test Plan

Before the commencement of manufacture of the centrifugal compressor(s) the Supplier should produce an Inspection & Test Plan. Relevant IIA's and Certifying Authorities should review and approve the plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance standards, verification documents, supplier responsible persons and inspection mark-up.

4.2 The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

4.3 Material Certification and Traceability

- 4.3.1 The supplier should maintain records of material certification and identification. Unless otherwise agreed test certificates should be mill originals, or verified true copies.

Checks should be made to verify compliance with traceability requirements particularly for pressure containing, process wetted and load bearing parts.

- 4.3.2 Where hard stamping is used to identify material, low stress hard die dot stamps are to be used on low temperature materials.

- 4.3.3 The requirements of BP Group [GS 136-1](#) normally apply to material for sour service as defined by that standard.

Acceptance Criteria: [DIN 50049](#), BP Group [GS 136-1](#)

NOTE: Stamping is not normally allowed on alloy, austenitic and Duplex steel and cupro-nickel base alloy material. These materials should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Acceptance Criteria: Project or Purchase Order specifications

4.4 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage, including, but not limited to:-

- (a) The description and location of material and material test certificates used
- (b) The results of any NDT
- (c) The dimensional control and inspection records.
- (d) Pressure test reports.
- (e) Balancing test records.
- (f) Running test records.
- (g) Strip down inspection records.
- (h) Concession application/non conformance records.

5. FABRICATION, ASSEMBLY AND ERECTION

5.1 Fabrication Areas

Work areas where fabrication, assembly and erection are to occur should be clean and uncluttered. If welding work is to occur out of doors, the fabrication area should be protected from the elements and where necessary, heated.

Where stainless steels and non-ferrous metals are being fabricated, the area to be used should be quite separate from that used for carbon and low alloy steels. Separate and clearly identified sets of cleaning and grinding equipment should be maintained for each material.

Note: In some instances e.g. where high alloy materials are utilised for low temperature or clean duty as distinct from corrosive applications, the above requirement may sometimes be relaxed. In case of doubt and in the absence of any specified requirement the Inspector should seek guidance from the Purchaser.

The Purchaser may require to inspect and approve fabrication areas and where applicable, the equipment to be used, before fabrication work can start.

Acceptance Criteria: BP Group [GS 126-1](#) and [126-2](#).

5.2 Fit-up and Tacking

The Inspector should monitor the weld preparation, fit up and tacking of welded joints as indicated in the Inspection & Test Plan.

Tack welding should be carried out by qualified welders in accordance with the applicable welding procedure.

Acceptance Criteria: BP Group [GS 126-1](#) and [126-2](#).

5.3 Welding

5.3.1 Welders

All welds are to be made by qualified welders only.

5.3.2 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group [GS 118-4](#) also gives advice on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables; At the discretion of the Inspector this may include the cut-out of any welds that have been completed with the out-of-specification consumables. (see below)



5.3.3 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the weld should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or re-qualify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

5.3.4 Hydrogen Induced Cracking

Where hydrogen induced cracking is possible, consideration should be given to delaying NDT until 48 hours after welding is completed. - refer to [BS 5135](#) for guidance

Acceptance Criteria: Approved Welding Procedures
BP Group [GS 118-4](#)
BP Group [GS 126-1](#) and [126-2](#)
P.O. Specification

5.4 Bending and Forming

The Inspector should verify or otherwise assure himself that wall thicknesses after bending are not less than the design minimum.

When heat treatment is required, pre- or post-forming, the Inspector should verify compliance with requirements and review heat treatment records.

Acceptance Criteria: Pipe Bending Procedure
Heat Treatment Procedure
BP Group [GS 126-1](#) and [126-2](#)
P.O. Specification

5.5 Heat Treatment

Post-weld and stress relieving heat treatments are to be carried out in accordance with documented procedures.

The Inspector should verify compliance of any such heat treatment with the requirements.

NOTE: Where re-heat treatment is carried out after a local weld repair, the method and procedure should be agreed by the Purchaser.



The Inspector should review the heat treatment records prior to NDT being carried out.

Acceptance Criteria: Approved Heat Treatment Procedure
BP Group [GS 126-1](#) and [126-2](#)
P.O. Specification

5.6 Non-Destructive Testing

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION - All welds and castings are to be visually examined.
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION - The primary method of volumetric weld examination.
- (e) ULTRASONIC EXAMINATION - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing, or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

Where sample examination of welds is specified, the Inspector should nominate the welds to be examined, taking care to ensure that all welders and procedures are covered. To achieve this coverage the specified percentage may require to be exceeded. Any indication from sample examination that a welder or equipment etc., is faulty should necessitate further examination and in the case of gross or extensive defects 100% of the sampled lot is usually necessary.

Acceptance Criteria: BP Group [GSs 126-1](#) and [126-2](#)
P.O. & Project Specifications



5.7 Weld Repairs and Cut Outs

All repairs to welds should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval..

Major excavations should be examined by the Inspector.

Two unsuccessful repairs at the same location should normally necessitate the weld to be cut out and remade, unless a proposal to carry out a further repair is agreed by the Purchaser.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

Records of casting repairs should be kept. These should record the nature, location and depth of defects, the weld procedure(s) used and NDT techniques employed and include NDT and heat treatment records.

Acceptance criteria: Approved Welding Procedure
P.O. Specifications
BP Group [GSs 126-1](#) and [126-2](#).

5.8 Dimensional Control

The Inspector should check major dimensions of the centrifugal compressor equipment against the latest revision of the drawing.

The squareness of flanges and the flatness and finish of the flange faces should be checked, as should flange rating and nozzle positions.

Acceptance Criteria: Approved Drawings

6. PRESSURE TESTING

The Inspector should witness pressure testing as indicated in the Inspection and Test Plan and ensure that approved procedures are followed.

Acceptance Criteria: P.O. Specification, BP Group [GSs 126-1](#) and [126-2](#).

6.1 Hydrostatic Testing

Hydrostatic test media other than water should be agreed by the Purchaser.

Test pressures and any limits on water impurity levels should be checked/verified to be in accordance with specified requirements.



6.2 Pneumatic Testing

Whenever pneumatic strength testing has been specified or agreed, the Inspector should give careful consideration to the inherent dangers of such testing and should not participate in the witness of testing whenever it is clear that any safety aspect may have been compromised. In particular, the following points should be addressed:-

- (a) The extent of NDT required to provide assurance of integrity. Where prior hydrostatic testing to a higher pressure is not to be carried out, NDT should be to the maximum extent.
- (b) The test medium should be non-toxic and non-flammable.
- (c) 110% of design pressure should not be exceeded. Some form of overpressure protection may be necessary and at least two recently calibrated gauges should be used without intervening valves or other restrictions.

7. DYNAMICS, CLEARANCES ETC.

- 7.1 Impellers should be statically and dynamically balanced by the manufacturer before assembly on to the shaft. A witnessed test is normally required of the dynamic balance of the completed rotating assembly.
- 7.2 The out-of-balance requirement for the completed rotating assembly shall be in accordance with [API 617](#) or any more stringent standard which may be specified.
- 7.3 Balancing of rotors within the works is normally done at reduced speed and this speed should be recorded and reported. Full balancing reports should be provided when this is required by the specification or purchase order.
- 7.4 The assembly of the rotating element within the casing should normally be witnessed and a record kept of axial and radial clearances as appropriate and end float within the casing. Where a spare rotating element is ordered this should be trial fitted within the casing of the actual machine for which it is a spare.
- 7.5 At an early stage in manufacture it should be established whether lateral and torsional critical speeds are to be measured or calculated.

- 7.6 A check should be made that the assembly of the rotating element and fixed guide vanes are for the correct rotational direction to the approved drawing particulars.
- 7.7 Mechanical and Electrical run-out of probe tracks should be checked to the requirements of [API 617](#).
- 7.8 The Inspector should ensure that a record is kept of any repairs to rotating elements together with details of any special manufacturing processes. Impeller diameters and vane thicknesses should be recorded.

Acceptance Criteria: Approved drawings

8. RUNNING TESTS

- 8.1 Mechanical running tests in accordance with [API 617](#), BP Group [GS 134-5](#) (if applicable) and the order particulars should be witnessed and a record kept.
- 8.2 The extent of performance testing required at the manufacturers works should be agreed by the Purchaser and such tests witnessed. Where full output tests cannot be taken in the works the record of works tests should be sufficient to enable the duty performance to be calculated. Tests will be to the requirements of [ANSI/ASME PTC.10](#).
- 8.3 Where vibration instruments are supplied and are to be installed on site as part of the compressor unit, test runs in the compressor manufacturer's works are to be taken with these vibration instruments in addition to any which may be used by the manufacturer as part of his test facilities.
- 8.4 Such vibration equipment is to be calibrated during the performance testing.
- 8.5 Bearings and seals shall be examined in accordance with [API 617](#) requirements.
- 8.6 During the examination, bearings may be lightly scraped where this is acceptable and necessary. A careful examination should be made for any signs of damage and salient clearances checked.
- 8.7 Details of the actual shaft seals fitted, including manufacturer's references should be recorded. Bearings and seal assemblies should all be checked for cleanliness.



- 8.8 Gears and gear boxes should normally be examined after test internally and findings recorded and reported.
- 8.9 After test, lubricating oil and seal oil systems, filters and strainers should be examined for contamination, swarf, scale, etc. and a record made accordingly. The source of any foreign object should be determined. See [API Std 614](#), and BP Group [GS 134-3](#).
- 8.10 Although control consoles are not usually used for the control of compressors during the running test (unless specified) the consoles shall be checked for conformity with the purchase order and specifications with independent tests carried out as required.

Acceptance Criteria: BP Group [GS 134-5](#) & [API 617](#)

9. ARRANGEMENT AND DIMENSIONS

- 9.1 Checks of dimensions and arrangement should be made against the manufacturer's approved drawings. These checks should include all salient features to ensure the correct assembly on site and where the circumstances are such that the compressor is not assembled in the works with its own driver then the dimensional checks should be such as to ensure that it will correctly assemble on site with that driver.
- 9.2 A trial assembly should be made of all pipework and manifolds or a record taken where such provision is not possible, with a check that such pipe is properly cleaned.
- 9.3 Alignment checks should be such as to ensure that correct site alignment is possible. Coupling details should be checked. Checks should include that the rotational arrow is correctly fitted.

Acceptance Criteria: Approved drawings

10. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 10.1 The supplier should, in line with his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport.
- 10.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 10.3 Lifting eyebolts and attachments should have a proof load test certificate issued by an approved statutory lifting equipment test house.
- 10.4 The Inspector should carry out inspection of any coatings as required by the Purchase Order and the approved Inspection & Test Plan.



10.5 Each item of equipment should be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification,
BP Group [GS106-2](#),
Project Specification.
Applicable Lifting Equipment Legislation.

11. FINAL INSPECTION AND RELEASE

The Supplier is to provide a documentation and certification package for each compressor. This package should include documentation required by the Purchase Order, which may include, but not be limited, to the following;

- (a) Compressor test results as taken during the running test
- (b) Statutory lifting equipment test certificates for handling equipment
- (c) Pressure test certificates
- (d) Dimensional inspection reports
- (e) Signed Off Inspection & Test Plan
- (f) Weight control reports
- (g) IIA Certificate of conformance.

The format and content of this documentation package should be in accordance with an agreed index and should be compiled during the course of manufacture.

In association with a final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order requirements, should issue a Release Note, a copy of which may be included in the documentation package.



INSPECTION CHECK LIST

CENTRIFUGAL COMPRESSORS

PARA REF	ACTION	YES	NO	N/A
4.1	Inspection and Test Plan reviewed and approved?			
4.2 (a)	All major sub-suppliers approved?			
4.2 (b)	Vendor drawings, procedures and design data approved?			
4.2 (c)	Correct issues of drawings, specifications etc. used?			
4.2 (d)	Welders and NDT operators suitably qualified?			
4.3.1	Material certification records monitored and verified?			
4.4	Manufacturing records monitored and verified?			
5.1	Manufacturing areas reviewed and approved?			
5.2	Fit up and tacking of welded joints and fittings monitored and acceptable?			
5.3	Weld procedures approved?			
5.4	Check wall thickness after bending? Stress relief heat treatment complies with approved procedure?			
5.6/5.7	Defect repairs monitored through all stages?			
5.7	Weld repair procedure approved?			
5.8	Dimension checks satisfactory?			
6.	Pressure testing witnessed and acceptable?			
7.1	Impeller Balancing checks witnessed and acceptable?			
7.2	Balancing of rotors witnessed, and reports raised?			
7.4	Axial and radial clearances recorded? End float recorded?			
7.5	Lateral and torsional critical speeds measured/ calculated?			
7.6	Rotating element of fixed guide vanes are in correct rotational direction?			
8.2	Mechanical/performance tests witnessed?			
	Are any output tests to be carried out at site?			
8.3	Contract vibration instruments installed for shop tests?			



PARA REF	ACTION	YES	NO	N/A
8.4	Calibrated?			
8.6	Bearing clearances measured and recorded?			
8.7	Type of shaft seals recorded?			
8.8	Gears & gear boxes examined after test? Pinions removed?			
8.9	Oil systems examined for contamination of foreign matter?			
	Any contamination found?			
8.10	Control console tested?			
	With compressor?			
	Independent of compressor?			
9.1	Compressor coupled with own driver for dimensional checks?			
	Compressor dimensionally correct and recorded?			
9.2	Trial assembly of interconnecting pipework and manifolds with dimensional checks complete?			
9.3	Rotational direction and rotational arrow correct?			
	Alignment checks carried out?			
	Acceptable?			
10.1	Handling, preservation and packaging procedures approved?			
10.2	Handling, preservation and packaging monitored and accepted?			
10.3	Lifting attachments inspected and fully certified?			
10.4	Coating inspected?			
10.5	Equipment weighed?			
11.	All inspections and tests complete			
11.	Documentation reviewed and approved?			
11.	Inspection release note issued?			



PROCEDURE 2 - CENTRIFUGAL PUMPS

1. SCOPE

- 1.1 This procedure covers inspection and testing of Centrifugal Pumps.
- 1.2 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to Criticality 1 items only. Inspection requirements for Criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure.

2. RELATED DOCUMENTS

BP Group RP 34-1	Rotating Machinery
BP Group GS 134-4	Centrifugal Pumps
API 610	Centrifugal Pumps for General Refinery Services
BS 5265	Mechanical Balancing of Rotating Bodies.
BP Group GS 118-3	General standard for welded fabrication and construction
BP Group GS 118-4	Storage and Control of Welding Consumables.
BS 5316 Pt. 1	Specification for acceptance tests for centrifugal, mixed flow and axial pumps
BS 5304	Code of Practice Safeguarding of Machinery
BS CP 3004	Guarding of Machinery
BP Group GS 106-2	Painting of Metal Surfaces

3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of manufacture of the equipment, the Supplier should prepare an Inspection & Test Plan.



The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

3.2 Supplier's Facilities

The purchaser may require to carry out an initial visit to the works to ensure that the facilities required to carry out specific purchase order requirements are available and acceptable prior to the commencement of work.

Acceptance Criteria: Purchase order/specifications.

3.3 Material Certification and Traceability

- 3.3.1 The supplier should maintain records of material certification and identification. Unless otherwise agreed test certificates should be mill originals, or verified true copies.

Checks should be made to verify compliance with traceability requirements particularly for pressure containing, process wetted and load bearing parts.

- 3.3.2 Where hard stamping is used to identify material, low stress hard die dot stamps are to be used on low temperature materials.

- 3.3.3 The requirements of BP Group [GS 136-1](#) normally apply to material for sour service as defined by that standard.

Acceptance Criteria: [DIN 50049](#), BP Group [GS 136-1](#)

NOTE: Stamping is not normally allowed on alloy, austenitic and Duplex steel and cupro-nickel base alloy material. These materials should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Acceptance Criteria: Project or Purchase Order specifications



3.4 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage including, but not limited to the following:-

- (a) The description and location of material and material test certificates used
- (b) NDT records
- (c) Dimensional control and inspection records
- (d) Pressure test records
- (e) Balancing test records
- (f) Running test records
- (g) Strip down inspection records
- (h) Concession applications/non-conformance records

4. NON-DESTRUCTIVE TESTING

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements. Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION - All welds and castings are to be visually examined.
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION - The primary method of volumetric weld examination.



- (e) **ULTRASONIC EXAMINATION** - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing, or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

Where sample examination of welds is specified, the Inspector should nominate the welds to be examined, taking care to ensure that all welders and procedures are covered. To achieve this coverage the specified percentage may require to be exceeded. Any indication from sample examination that a welder or equipment etc., is faulty should necessitate further examination and in the case of gross or extensive defects 100% of the sampled lot is usually necessary.

Acceptance Criteria: BP Group [GS118-5,6,7](#)
[ANSI B31.3](#)
P.O. & Project Specifications

5. HEAT TREATMENT

Post-weld and stress relieving heat treatments are to be carried out in accordance with documented procedures.

The Inspector should verify compliance of any such heat treatment with the requirements.

NOTE: Where re-heat treatment is carried out after a local weld repair, the method and procedure should be agreed by the Purchaser.

The Inspector should review the heat treatment records prior to NDT being carried out.

6. WELDED PUMP CASINGS

Where pumps with casings fabricated by welding are supplied, Procedure No.1 paragraphs 5.2 and 5.3 should be referred to for guidance.

7. WELD REPAIRS

All repairs to welds should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval..

Major excavations should be examined by the Inspector.

Two unsuccessful repairs at the same location should normally necessitate the weld to be cut out and remade, unless a proposal to carry out a further repair is agreed by the Purchaser.



It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

Records of casting repairs should be kept. These should record the nature, location and depth of defects, the weld procedure(s) used and NDT techniques employed and include NDT and heat treatment records.

Acceptance Criteria: Approved Procedures

8. HYDROSTATIC PRESSURE TESTING

- 8.1 Hydrostatic pressure tests should be witnessed by the Inspector as indicated in the Inspection and Test Plan.
- 8.2 Where more stringent tests are required in specified cases, for pumps on duties which make them particularly susceptible to casing leakage, then details of such tests should be specified in the order particulars and these should be witnessed by the Inspector.
- 8.3 For hydrostatic pressure test, pumps should be complete with pipework up to the first break point.
- 8.4 Hydrostatic test media other than water should be agreed with the purchaser.
- 8.5 Test pressures and any limits on water impurity levels should be checked/verified to be in accordance with specified requirements.

Acceptance Criteria: Purchase Order Specifications, [API 610](#)

9. BALANCING

- 9.1 Unless otherwise specified the static and dynamic balancing of horizontal and vertical pumps will be in accordance with the requirements of BP Group [GS 134-4](#) or [API 610](#). Balancing should be witnessed by the Inspector if so indicated in the Inspection and Test Plan.
- 9.2 The Inspector should witness the dynamic balance check of the pump's rotating element.

Acceptance Criteria: Purchase Order Specifications
BP Group [GS 134-4](#),
[API 610](#)



10. PUMP CLEARANCES

- 10.1 Pump clearances should be measured with the impeller diameter as fitted and these measurements recorded.

Acceptance Criteria: Purchase Order Specifications.

11. COUPLINGS

- 11.1 Coupling out of true shall be measured and depending upon the type of coupling shall be limited to a maximum of 0.05 mm (0.002") double amplitude. Non-flexible coupling hubs, such as for Fluidrive hydraulic coupling fixed back plates shall be limited to a maximum out of true of 0.025 mm (0.001") on the hub mounting faces.

- 11.2 Spacer type couplings are used to enable attention to be given to mechanical shaft seals of other items of equipment without affecting the alignment of the plant. Consequently the spacer must be removable without moving either the pump or the driver on the bedplate. The limitation is usually the coupling bolts and a check is to be made by the Inspector that removal of the spacer is possible either by visual examination of the coupling or by physical removal of the spacer as necessary.

Acceptance Criteria: Purchase Order Specifications

12. RUNNING TESTS

Tests should be witnessed by the Inspector.

- 12.1 Mechanical running/performance tests should be carried out at rated speed, unless otherwise agreed.
- 12.2 NPSH test requirements should be stated in Purchase Order specifications or data sheets. These tests are normally required where the available NPSH as indicated on the data sheet does not exceed the required NPSH at the specified duty point by more than 610 mm (2 ft). A full NPSH test curve is required. NPSH tests carried out at reduced speed and conversion factors other than the square of the speed are subject to agreement of the Purchaser.
- 12.3 Performance and NPSH tests shall be carried out in accordance with [BS 5316](#) PT1 and [AP1 610](#). Where the supplier is unable to meet these requirements, prior approval should be obtained.
- 12.4 During the test the Inspector should check the following:-



- (a) compatibility of all components
 - (b) driver is of the correct direction of rotation
 - (c) oiling and cooling systems, if combined are compatible.
- 12.5 The duration of the running test is at the discretion of the Inspector but should not be less than one hour, unless otherwise stated in the P.O. specifications.
- In all cases the running time should be sufficient to allow bearing temperatures to maximise and stabilise.
- 12.6 Noise level tests should be witnessed by the Inspector when specified. Irrespective of whether noise levels are specified or not the occurrence of excessive noise should be reported by the Inspector together with any indication of the source of such noise.
- 12.7 The Inspector should check that the mechanical seals fitted are of the type specified.
- Acceptance Criteria: Purchase Order Specifications,
BP Group [GS 134-4](#),
[AP1 610](#), [BS 5316](#)

13. DISMANTLING STRIP INSPECTION

- 13.1 The extent of any dismantling required to perform strip examinations should be stated in purchase order specifications together with the extent of witness by the Inspector. Notwithstanding this, strip examinations should always be carried out to investigate probable damage or assembly problems brought to light by testing and these should be witnessed by the Inspector.
- 13.2 Oiling systems should be examined for evidence of foreign matter and the source should be determined.
- 13.3 Screwed shaft sleeves and locking nuts should be of right and left hand threads to prevent unscrewing rotation of the pump. Instances of non-compliance should be reported for approval.
- 13.4 Casing thickness checks may be required at salient points such as in the volute chambers.



14. DIMENSIONS

- 14.1 The Inspector should check dimensions and arrangements against approved drawings. Due note should be taken of the handing of suction and discharge flanges, motor terminal box position and rotation of components.
- 14.2 The Inspector should check dimensions with the components assembled on the bedplate. Where the situation exists that the driver will not meet the pump until assembly on site, then the dimensional checks taken are to be such as to ensure correct assembly with the driver.
- 14.3 The Inspector should check that there are sufficient grout holes in the bed plate to meet the requirements of [API 610](#).
- 14.4 The Inspector should check the coupling guards, when fitted, against the requirements of [BS 5304](#) and [BS CP 3004](#).

Acceptance Criteria: Approved drawings

15. ALIGNMENT

Alignment should be checked by the Inspector (as convenient during the inspection) with consideration that re-alignment will be checked on site. To this end one component, pump or driver, should not be dowed.

16. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 16.1 The supplier should, in line with his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport.
- 16.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 16.3 Lifting eyebolts and attachments should have a proof load test certificate issued by an approved statutory lifting equipment test house.
- 16.4 The Inspector should carry out inspection of any coatings as required by the Purchase Order and the approved Inspection & Test Plan.
- 16.5 Each item of equipment may require weighing prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification, BP Group GS 106-2, Project Specification, applicable Lifting Equipment Legislation.



17. FINAL INSPECTION AND RELEASE

The Supplier is to prepare for approval a documentation and certification package for each pump. This package shall contain documentation required in the Purchase Order. This may include, but not be limited, to the following:-

- (a) Material test certificates for pressure containing, rotating or wetted parts, and for supporting structures.
- (b) pump characteristic curves and results taken during the running test.
- (c) Statutory lifting equipment test certificates for handling equipment.
- (d) Welding procedures, qualification records and welder qualification records.
- (e) NDE procedures, reports and NDE operator qualifications
- (f) Pressure test certificates,
- (g) Lifting Equipment Certification
- (h) Dimensional inspection reports,
- (i) Signed off Inspection and Test Plan
- (j) Approved concession requests
- (k) Weight control reports.

The format of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST CENTRIFUGAL PUMPS

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan reviewed and approved?			
3.1	All calculations, drawings and design data approved?			
3.1	All documents in use are latest approved revision?			
3.1	All major sub suppliers approved?			
3.1	Inspection and test techniques approved?			
3.1/4.	NDE Procedures approved? NDE operators qualifications accepted?			
3.1	Pump testing procedures are approved?			
3.2	Manufacturing areas reviewed and approved?			
3.3	Material certification records and traceability verified?			
3.4	Manufacturing records monitored and verified?			
5.	Heat treatment procedure approved? Process monitored? Certificates/charts reviewed?			
6.	Weld procedures for welded construction pumps approved? Qualified welders?			
7.	Weld repair procedure approved? Qualified welders? Acceptance for repair? Cut-outs seen by the Inspector Engineer? Defect repair monitored through all stages			
8.	Hydrostatic pressure testing witnessed?			
9.1	Static and dynamic balancing check witnessed?			
9.2	Dynamic balance check of rotating element witnessed?			
10.	Pump clearance measured and recorded?			
11.	Coupling alignment/mating checks?			
12.2 & 12.3	NPSH tests carried out? Test curve produced?			
12.4	Following checks made:- Compatibility of all components?			
	Driver direction correct?			
	Oil & cooling system compatibility?			
12.5	Final temperature rise at bearings taken?			
12.6	Noise level limitation tests acceptable?			
12.7	Correct mechanical seals fitted?			



PARA REF	ACTION	YES	NO	N/A
13.1	Seals, shafts and bearings examined for damage after dismantling following running tests?			
	Any damage found?			
13.2	Oiling system examined for evidence of foreign matter?			
	Any contamination found?			
13.3	Screwed shaft sleeves and locking nuts checked for left and right hand threads?			
13.4	Casing thickness checks carried out and recorded?			
14.1	Dimensional checks carried out?			
14.3	Bed plate checked for sufficient grout holes?			
14.4	Coupling guards fitted and acceptable?			
15.	Alignment checks carried out?			
	Acceptable?			
16.1	Handling, preservation and packaging procedures approved?			
16.2	Handling, preservation and packaging monitored and accepted?			
16.3	Lifting attachments inspected and fully certified?			
16.4	Coating inspected?			
16.5	Equipment weighed?			
17.	All inspections and tests complete?			
	Documentation reviewed and approved?			
	Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENT AGAINST CRITICALITY RATINGS

CENTRIFUGAL PUMPS

ACTION	I	II	III	IV
Inspection and Test Plan reviewed and approved?	Yes	Yes	No	No
All calculations, drawings and design data approved?	Yes	Yes	No	No
All documents in use are latest approved revision?	R	R	No	No
All major sub-suppliers approved?	Yes	Yes	No	No
Inspections, test techniques approved?	Yes	R	No	No
NDE procedures approved?	R	R	No	No
NDE operators qualified?	R	R	No	No
Pump testing procedures are approved?	Yes	Yes	No	No
Manufacturing areas reviewed and approved?	R	R	No	No
Material certification records monitored and verified?	R	R	No	No
Manufacturing records reviewed and approved?	R	R	No	No
Heat treatment procedures approved? Process checks? Charts reviewed?	M.R	M.R	R	No
Weld repair procedure approved?	R	R	No	No
Welder qualifications verified?	R	R	No	No
Acceptance for repair?	Yes	Yes	No	No
All cuts-outs seen by the Inspection Engineer?	Yes	M	No	No
Defect repairs monitored through all stages?	M	M	No	No
Weld procedures for welded construction pumps approved? Welder qualification verified?	R	R	No	No
Hydrostatic pressure testing witnessed?	Yes	Yes	R	No
Dynamic balancing check witnessed and acceptable?	Yes	Yes	R	No
Pump clearance measured and recorded?	Yes	R	No	No
Coupling alignment/mating checks made?	Yes	R	No	No
NPSH tests carried out?	Yes	R	R	R
Test curve produced?	Yes	R	R	R
Following checks made:- - compatibility of all components?	Yes	M	No	No
- driver direction correct?	Yes	M	No	No
- couplings correct?	Yes	M	No	No
- oil and cooling system compatibility?	Yes	M	No	No



ACTION	I	II	III	IV
Final temperature rise at bearing taken?	Yes	R	No	No
Noise level limitation tests acceptable?	Yes	Yes	No	No
Check correct mechanical seals fitted?	Yes	Yes	No	No
Seals, shafts and bearings examined for damage after dismantling following running?	Yes	R	No	No
Oiling system examined for evidence of foreign matter?	Yes	R	No	No
Screwed shaft sleeves and locking nuts checked for left and right hand threads?	Yes	Yes	No	No
Casing thickness checks carried out and recorded?	Yes	M,R	R	No
Full dimensional checks carried out?	Yes	Yes	R	No
Bed plate checked for sufficient grout holes?	Yes	R	R	No
Coupling guards fitted and acceptable?	Yes	Yes	R	No
Alignment checks carried out?	Yes	M	R	No
Handling, preservation and packaging procedures approved?	Yes	M	R	No
Lifting attachments inspected and fully certified?	Yes	Yes	R	R
Coating inspected?	Yes	M	R	No
Equipment weighed?	Yes	M	R	R
Documentation reviewed and approved?	Yes	Yes	R	R
Inspection release note issued?	Yes	Yes	Yes	N/A
Final Inspection	Yes	Yes	Yes	No

LEGEND: YES= REQUIRED, NO= NOT REQUIRED, M=MONITORED (PROCESS/ACTIVITY), I= SAMPLE INSPECTION/CHECK, R= REVIEW DOCUMENTATION/CERTS, N/A= NOT APPLICABLE

Note:- Where R is used for an approval activity, the Purchasers Inspector shall approve the documentation rather than the specialist Engineer



PROCEDURE 3 - ELECTRIC MOTORS

1. SCOPE

- 1.1 This procedure covers the inspection and testing of vertical and horizontal shaft electric motors at a supplier's works.
- 1.2 It is anticipated that only motors above 75 kW (100 HP) will be subject to purchaser's inspection.
- 1.3 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to Criticality 1 items only. Inspection requirements for Criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure.

2. RELATED DOCUMENTATION

BP CP 10	Rotating Machinery
BP Group GS 112-4	High Voltage Induction Motors
BP Group GS 112-3	Low Voltage Induction Motors
BS 4999	General Requirements for Rotating Electrical Machines
BS 5000	Specification for Rotating Electrical Machines of Particular Types or for Particular Applications
BS 5265	Mechanical Balancing of Rotating Bodies
BS 5501	Electrical Apparatus for Potentially Explosive Atmospheres

3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of manufacture of electric motors the supplier should prepare an Inspection & Test Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-



- (a) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (b) The correct issues of drawings, specifications etc. are used.
- (c) Where type approvals such as BASEEFA or CENELEC etc. are required, the Inspection and Test Plan should indicate acceptance of the type certification prior to the commencement of manufacture. - see Procedure No. 20

NOTE: Where motors are to be incorporated within a skid unit or are to drive a large unit such as a compressor, the supplier's quality plan should address the means by which pertinent information such as inertia characteristics, vibration etc. are to be communicated to the main equipment supplier.

3.2 Supplier's Facilities

The Purchaser may require to carry out an initial visit to the supplier's works to ensure that where required, the facilities required to carry out specialised purchase order requirements are available and acceptable prior to the commencement of work.

An initial visit would usually be made for the following types of equipment:-

- (a) Large motors driving reciprocating compressors where the motor inertia is a significant part of the total inertia. A check should be taken that the motor manufacturer has passed information on his inertia characteristics over to the compressor manufacturer.
- (b) Vertical shaft motors associated with pumps where a significant part of the pump weight and thrust is being taken by the motor bearings.
- (c) Two-pole motors with speed increasing gears driving high speed pumps or high speed compressors where vibration or critical speed characteristics may be of significance.
- (d) Uni-directional motors which are so by reason of the fan blade arrangement or by reason of uni-direction tilting pad bearings.
- (e) large, unusual or single bearing motors at the discretion of the Purchaser

4. MANUFACTURING

Inspection by the Purchaser during manufacture is not normally required and would be confined to the following on very large or special motors:-

- 4.1 Witnessed dynamic balancing of the rotor prior to assembly. Reported departures from the following running vibration characteristics should be handled by the supplier's design change control procedure. (Peak-to-peak vibration amplitude for a motor at rated voltage and speed running uncoupled and on a machined surface bedplate with the motor unbolted and either a half key or coupling fitted shall not exceed 0.03 mm (0.001") for a two-pole and 0.05 mm (0.002") for a four-pole and above motor.)
- 4.2 Inter-turn electrical insulation tests on coils prior to stator winding.
- 4.3 Hydro pressure testing of air/water coolers (usually at sub-vendors).

5. TESTING

- 5.1 'Complete Tests' should be witnessed by the Inspector on one machine of each rating as follows:-
 - (a) Measurement of no-load current volts and watts, to enable calculation of no-load losses.
 - (b) Measurement to allow calculation of locked rotor current.
 - (c) Measurement to allow calculation of starting torque and starting current. These should be taken at as high a voltage as possible and due allowance made for the effects of saturation.
 - (d) Measurement of winding resistance, hot and cold, to enable calculation of the winding temperature rises to be made at the end of the full load heat run.
 - (e) Full load heat run to be taken until constant temperatures are attained in the winding. Temperature rise should be measured by change of resistance unless measurement by thermometer is specified.
 - (f) Measurement of percentage slip at full, three quarters and half load.
 - (g) Measurement to allow calculation of efficiency by summation of losses method at full load, three quarters load and half load.



- (h) Measurement to allow calculation of power factor at full load, three quarters load and half load.
- (i) High voltage withstand test immediately after load test, plus measurement of insulation resistance before and after load test.
- (j) Inspection of bearings and mechanical running and operation of the motor at full load. Oil rings, if fitted, must be found free to rotate. After test, top halves of sleeve bearings should be removed for inspection.
- (k) For sleeve bearing machines check should be made that the rotor is free over the whole range of end float and that the unbalanced force required to restore it to the centre position is not excessive running on no-load. Note should be taken that the fan is free of the end cowl under these conditions.
- (l) During the running tests of the motor, the system should be examined for oil leaks with due note being taken of any oil being sucked from the bearing housing by the fan characteristics.
- (m) During the load run the temperature rise of the driving end bearing should be taken on either the bearing shell or on the bearing housing as available.
- (n) For motors having oil flow lubricated bearings the amount of oil flow to each bearing should be measured.
- (o) Oil pumps should be checked to prime when starting and be such as to not limit the end float of the motor.
- (p) Constant level oil lubricated ball and roller bearing motors should be checked for correct oil level with the motor on a horizontal bedplate and that the system is free from leaks under running conditions. Where the constant oilers are of a type which are rotated for filling then they should be such that they cannot be left inadvertently in the 'filling' position when running on site.
- (q) Light running tests to check running balance with the half-coupling fitted should be at the discretion of the Inspector. Where couplings are fully machined all over then light running tests will generally not be obligatory. Light running tests would be required for large V rope pulleys and similar items which should be separately balanced. Attention should be paid to unusual couplings fitted, such as those excessively small or large in size or cast iron types on high speed duty.



Slip ring motors should be tested as squirrel cage motors with the addition of:-

- (r) On heat run, record temperature rise of rotor windings and slip rings.
 - (s) Where slip rings are continuously rated, note any excessive brush wear.
 - (t) Record open circuit rotor voltage with stator energised at line voltage.
 - (u) Burn-out test of 125% volts for 15 minutes with slip rings open circuit.
- 5.2 'Abbreviated Tests' should be witnessed on all other other machines. These shall be as indicated in 5.1 (a), (b), (d), (cold resistance only), (i), (j) and (k) above.
- 5.3 When manufacturer's facilities are such that tests as detailed above cannot be carried out, or where such tests may be in conflict with the specification requirements, then this should be brought to the notice of the purchaser at an early stage for consideration

6. INSPECTION

In the case of small motors and at the discretion of the Inspector, final inspection is usually carried out at the same time as the Factory Acceptance Tests. In the case of larger motors, or when non-conformances are found, a final inspection should be made after all details such as terminal boxes, lube systems, temperature/vibration monitoring instrumentation, nameplates, etc. are fitted and the motor finish painted.

Final inspection should include the following:-

6.1 Rotation

- 6.1.1 When rotation is uni-directional by reason of the fan or bearings then this should be checked as being in conformity with the order details and approved drawing by examination of the fan blades and/or bearings and directional arrow indicated on motor.



6.2 Terminal Boxes

- 6.2.1 The terminal box should be checked as being in accordance with the order particulars and the approved drawing, noting that it is on the correct side of the motor and orientated correctly.
- 6.2.2 The terminal box should be checked that it is in accordance with the specification and complete in terms of cable glands, cable ferrules and cable lugs suitable for the specified cable requirements. This particularly includes high fault level boxes.

6.3 Dimensions

- 6.3.1 Salient dimensions should be checked in accordance with the approved drawing. Due note should be taken of specification requirements for electrical clearance and creepage distances for the code as specified (such as OCMA Spec Elec 1).
- 6.3.2 Dimensions checked should comprise fixing hole sizes and centres, shaft overhang, distance from first hole to shaft end, centre-line height, shaft diameter and keyway when coupling is not fitted.

6.4 Half Couplings and Shaft Fitments

- 6.4.1 Fluid drive hydraulic coupling hubs and similar should be true to 0.03 mm (0.001") double amplitude. Motor manufacture will require to take note of the large overhung mass of such couplings in his critical speed calculations.
- 6.4.2 Shaft fitment details should be recorded in the Inspector's report

6.5 Weatherproofing

- 6.5.1 Weatherproofing should be checked on outdoor motors to ensure that the ingress of water or dirt to the interior of the bearings (sleeve or ball and roller) terminal boxes or windings is not possible.
- 6.5.2 On weatherproof ball and roller bearing motors, the driving end bearing should be fitted with a shaft 'flinger' and seal unless otherwise agreed.
- 6.5.3 Vertical shaft motors associated with fin fan coolers should be examined for adequacy of weatherproofing, particularly when the shaft extension is uppermost.

6.6 Slip Ring Motors

- 6.6.1 Check fit of slip ring short circuiting contacts if fitted with 0.05 mm (0.002") feeler gauge.
- 6.6.2 Record grade, type number and size of brushes fitted. Check they are free in the housing.

7. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 7.1 The supplier should, as part of his quality plan, have prepared a procedure for handling, preservation, packaging and transport.
- 7.2 The Inspector should monitor the preservation, handling and packaging of electric motors (including identification).
- 7.3 Specialist lifting equipment such as slings and lifting frames should be load tested in accordance with the relevant legislation and a test certificate issued by an approved statutory lifting equipment test house.
- 7.4 All openings into terminal boxes should be closed to prevent the ingress of dirt or moisture.
- 7.5 Ball and roller bearing motors should be packed to prevent 'false Brinelling' in transit by appropriate means, e.g. by shaft clamping.
- 7.6 Sleeve bearing motors should be blocked to prevent axial rotor movement causing damage in transit.
- 7.7 Each item of equipment may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification, Applicable Lifting Equipment Legislation

8. FINAL INSPECTION AND RELEASE

- 8.1 The Supplier should provide a documentation and certification package for electric motors. This package should include documentation required by the purchase order. This may include but not be limited to the following:-
 - (a) test certification for the tests carried out in accordance with Section 5 of this procedure,
 - (b) lifting equipment test certificates for handling equipment,



- (c) hazardous area certification,
- (d) dimensional inspection reports,
- (e) signed off Inspection and Test Plan,
- (f) Weight control reports.

The format of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.

8.2 Electrical Equipment for Use in Potentially Explosive Atmospheres

- refer to Procedure 20



INSPECTION CHECK LIST

ELECTRIC MOTORS

PARA REF	ACTION	YES	NO	N/A
3.1	Approval of drawings, calculations etc?			
3.1	Approval of Inspection and Test Plan?			
3.1	Hazardous area certification approval?			
3.1	Agreed method of communication of driver related data to main equipment supplier?			
3.1	Approval of handling, preservation and packaging procedures?			
3.2	Review of manufacturing facilities?			
4.1	Check dynamic balance (large) special motors?			
4.2	Check inter-turn electrical insulation tests on coils prior to stator winding (larger special motors)?			
4.3	Witness hydro test of air/water coolers (large/special motors)?			
5.1	WITNESS TESTING			
5.1 (a)	No load current volts and watts?			
5.1 (b)	Locked rotor current?			
5.1 (c)	Starting torque/current?			
5.1 (d)	Winding resistance?			
5.1 (e)	Full load heat run?			
5.1 (f)	% slip?			
5.1 (g)	Efficiency?			
5.1 (h)	Power factor?			
5.1 (i)	High voltage withstand?			
5.1 (j)	Bearings, running, oil ring sleeves?			
5.1 (k)	Rotor freedom?			
5.1 (l)	Oil leaks?			
5.1 (m)	Temperature?			
5.1 (n)	Oil flow?			
5.1 (o)	Oil pump prime/motor end float?			
5.1 (p)	Leaks/levels/filling position?			



PARA REF	ACTION	YES	NO	N/A
5.1 (q)	Light running tests with couplings?			
	Additional Tests for Slip Ring Motors:-			
5.1 (r)	Temperature rise of rotor loading and slip rings?			
5.1 (s)	Excessive brush water?			
5.1 (t)	Open circuit rotor voltage?			
5.1 (u)	Burn-out tests?			
6	FINAL INSPECTION			
6.1.1	Directional Check?			
6.2.1	Check terminal box?			
6.2.2	Check terminal box glanding, cabling and fitting?			
6.3.1	Dimensional clock?			
6.3.2	Coupling truth check?			
6.4.1/2	Check shaft fitment details and record?			
6.5.1	Weatherproofing?			
6.5.2	Check approval of drawing and bearing sealing arrangements?			
6.5.3	Vertical shaft motors check weatherproofing?			
6.6.1	Fit of slip-ring short circuit contacts?			
6.6.2	Check brush freedom and record details of brushes?			
7	CHECK HANDLING, PROTECTION, PACKAGING			
7.4	Terminal box openings?			
7.5	Shaft clamping-ball and rotor bearing motors?			
7.6	Sleeve bearings motor shaft block?			
7.2	Identification?			
8	FINAL INSPECTION AND RELEASE			
7.3	Check certification?			
	Functional test?			
	Lifting equipment?			
	Hazardous area equipment?			
	Dimensional inspection?			
	Signed off Inspection and Test Plan?			
	Weight control reports?			



**GUIDE TO PURCHASER INSPECTION REQUIREMENTS
AGAINST CRITICALITY RATINGS**

ELECTRIC MOTORS

ACTION	I	II	III	IV
Inspection and Test Plan approval?	Yes	Yes	No	No
Approval of drawings, calculations etc.?	Yes	No	No	No
Hazardous area certification approval?	Yes	Yes	Yes	Yes
Agreed method of communication of driver related data to main equipment supplier?	Yes	No	No	No
Approval of handling, preservation and packaging procedures?	R	R	No	No
Review of manufacturing facilities?	Yes	No	No	No
Check dynamic balance (large) special motors?	Yes	Yes	R	R
Check inter-turn electrical insulation tests on coils prior to stator winding (larger special motors)	Yes	R	No	No
Witness hydro test of air/water coolers(large/special motors)	Yes	R	No	No
WITNESS TESTING				
No load current volts and watts	Yes	Yes	R	No
Locked rotor current?	Yes	Yes	R	No
Starting torque/current?	Yes	Yes	R	No
Working resistance?	Yes	Yes	R	No
Full load heat run?	Yes	Yes	R	No
% Slip?	Yes	Yes	R	No
Efficiency?	Yes	Yes	R	No
Power factor?	Yes	Yes	R	No
High voltage withstand?	Yes	Yes	R	No
Bearings, runnings, oil rings sleeves?	Yes	Yes	R	No
Rotor freedom?	Yes	Yes	R	No
Oil leaks?	Yes	Yes	R	No
Temperature?	Yes	Yes	R	No
Oil flow?	Yes	Yes	R	No
ACTION				
Oil pump prime/motor end float?	Yes	Yes	R	No
Leaks/levels/fittings portion?	Yes	Yes	R	No



ACTION	I	II	III	IV
Light running tests with coupling?	Yes	Yes	R	No
Slip ring motors additional tests?	Yes	Yes	R	No
Temperature rise of rotor loading and slip rings?	Yes	Yes	R	No
Excessive brush wear?	Yes	Yes	R	No
Burn-out test?	Yes	Yes	R	No
FINAL INSPECTION				
Directional check?	Yes	Yes	R	No
Check terminal box? Dimensional check?	Yes	Yes	R	No
Coupling truth check?	Yes	R	R	No
Check shaft fitment details and record?	Yes	R	R	No
Weatherproofing?	Yes	Yes	R	No
Check approval of drawing and bearing sealing arrangements?	Yes	R	No	No
Vertical shaft motors check weatherproofing?	Yes	Yes	R	No
Fit of slip-ring short circuit contacts? Check brush freedom and record details of brushes?	Yes	R	R	No
Witness load test and NDE	Yes	Yes	R	R
Check certification for Functional test?	Yes	Yes	Yes	R
Check certification for Lifting equipment?	Yes	Yes	R	R
Check certification for Hazardous area equipment?	Yes	Yes	Yes	R
Dimensional Inspection?	Yes	Yes	R	No
Signed off Inspection and Test Plan?	Yes	Yes	No	No
Weight control reports?	Yes	Yes	No	No
CHECK HANDLING PROTECTION, PACKAGING				
Terminal box openings?	Yes	Yes	No	No
Shaft clamping-ball & rotor bearing motors?	Yes	Yes	No	No
Sleeve bearings motor shaft block?	Yes	Yes	No	No
Identification?	Yes	Yes	Yes	No

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED (PROCESS/ACTIVITY), I=RANDOM INSPECTION/CHECK, R=REVIEW DOCUMENTATION/CERTIFICATION

(NOTE WHERE R IS USED FOR AN APPROVAL ACTIVITY THE INSPECTION ENGINEER SHALL APPROVE THE DOCUMENT, RATHER THAN THE SPECIALIST BP ENGINEER)

WARNING: IN USING THESE CHECK LISTS THE INSPECTION REQUIREMENTS CONTAINED IN THE PURCHASE ORDER CODES AND STANDARDS MUST BE CARRIED OUT AS A MINIMUM



PROCEDURE 4 - ELECTRICAL CABLE AND FITTINGS

1. SCOPE

- 1.1 This procedure covers the inspection and testings in a supplier's works of electrical cable and fittings.

2. RELATED DOCUMENTS

BP Group [GS 112-12](#) Fire resistant power cables

BP Group [GS 112-13](#) Fire resistant instrument cables

BP Group [GS 112-14](#) Flame retardant cables

BP Group [RP 12-13](#) Cables, Cable Systems and Wiring

[BS 4066](#) Method of test on a single vertical insulated wire or cable

[BS 5345](#) Codes of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres

[BS 6004](#) PVC-insulated cables (non-armoured) for electric power and lighting

[BS 6207](#) Copper-sheathed cables with copper conductors

[BS 6346](#) PVC-insulated cables for electricity supply

[BS 6480](#) Lead or lead alloy sheathed cables for working voltages up to and including 3kv

[BS 6883](#) Elastomer-insulated cables for fixed wiring in ships

3. GENERAL

- 3.1 Inspection requirements specified in this procedure are for criticality 1 rated items. Inspection requirements for criticality rated 2, 3, 4 items are contained in the table at the end of this procedure.



3.2 Inspection & Test Plan

Before the commencement of manufacture of electrical cable and fittings the supplier should prepare a manufacturing Inspection & Test Plan.

The manufacturing Inspection & Test plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up, and should ensure that:-

- (a) Required approvals of manufacturing and test procedures are obtained before proceeding with the relevant activity.
- (b) The correct issues of specifications are used.

4. MANUFACTURE

4.1 The Inspector should check the supplier's goods receiving inspection system.

4.2 The Inspector should check the construction of power electrical cables and fittings, paying particular attention to: drawing, specification and procedure approval, stranding of conductors, insulation of cores including core centralisation and thickness and core numbering.

4.2.1 Cable samples should be checked for attributes listed in 4.2.1. of the inspection check list attached to this procedure.

4.3 HT and LT cable glands should be checked to ensure compliance with purchase order specification requirements.

4.4 Dimensional Control

The Inspector should check the overall dimensions and arrangements in accordance with approved drawings.

Acceptance Criteria: Purchase Order Specifications

5. TESTING

5.1 General

The Inspector should witness the testing of electrical cables and fittings in accordance with the Inspection & Test plan. These tests should include, but may not be limited to:-

- (a) Insulation resistance and capacitance



- (b) Core resistance in ohms per km corrected to 20°C
- (c) High voltage
- (d) Power factor/voltage/temperature
- (e) Partial discharge
- (f) Bending
- (g) Flame retardance

Acceptance Criteria: Purchase Order Specifications
British IEC standards.

6. FINAL INSPECTION AND RELEASE

The Supplier should provide a documentation and certification package for cable and cable fittings. This package should include documentation required in the purchase order. This may include but not be limited to the following:-

- (a) Test certificates for the testing carried out in accordance with para 5. above,
- (b) Lifting equipment test certificates for handling equipment,
- (c) Dimensional inspection reports,
- (d) Signed off Inspection & Test Plan,
- (e) Weight control reports.

The format of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST ELECTRICAL CABLE AND FITTINGS

PARA REF	ACTION	YES	NO	N/A
3.2	All required procedure approvals obtained?			
3.2	Correct issue of specifications used?			
	CONSTRUCTION MONITORING/DIMENSIONAL CONTROL			
4.1	Material receipt inspection, including cable glands?			
4.2	Stranding of conductors checked?			
4.2	Insulation of cores, including core centralisation and thickness?			
4.2	Numbering of cores?			
4.2.1	Twisting of cores? (Sample)			
4.2.1	Screening of cores? (Sample)			
4.2.1	Armouring of cable (Sample)			
4.2.1	Outer insulation of cable, machining, core centralisation and thickness? (Sample)			
4.3	Cable glands?			
4.4	Overall dimensions in accordance with drawing & specifications?			
	WITNESS TESTING			
5.1 (a)	Insulation resistance and capacitance?			
5.1 (b)	Core resistance?			
5.1 (c)	High voltage?			
5.1 (d)	Power factor/voltage/temperature test?			
5.1 (e)	Partial discharge?			
5.1 (f)	Bending test?			
5.1 (g)	Flame retardance testing?			
	FINAL INSPECTION AND ACCEPTANCE			
6.	Handling, Preservation, Packing, and Transport arrangements checked? (including identification check)			
7.	Documentation package reviewed & approved? (including lifting gear certification and weight record)?			
7.	Inspection Release Note issued?			



**GUIDE TO PURCHASER'S INSPECTION REQUIREMENTS AGAINST
CRITICALITY RATING
ELECTRICAL CABLES AND FITTINGS**

ACTION	I	II	III	IV
Inspection and Test Plan reviewed and approved?	Yes	No	No	No
All drawings and specifications approved?	R	R	No	No
Check all manufacturing/testing procedures approved?	R	R	No	No
Check all drawings/specifications/procedures are current issue	R	R	R	No
Construction/dimensional control check? (see inspection check list)	Yes	I,R	M	No
Cable gland check? (see inspection check list)	Yes	I	I	No
Testing witness? (see inspection check list)	Yes	I,R	R	No
Handling, preservation and packaging to be approved?	R	R	No	No
Final inspection to be carried out?	Yes	Yes	I	No
Check packaging, handling, preservation?	Yes	M	I	No
Documentation package to be reviewed and approved?	Yes	Yes	Yes	No
Inspection Release Note to be issued?	Yes	Yes	Yes	No

LEGEND YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED
(PROCESS/ACTIVITY), I=RANDOM INSPECTION/CHECK, R=REVIEW
DOCUMENTATION/CERTIFICATION (NOTE: WHERE R IS USED FOR
AN APPROVAL ACTIVITY THE DOCUMENT SHALL BE APPROVED
BY THE INSPECTION ENGINEER RATHER THAN THE SPECIALIST
BP ENGINEER)



PROCEDURE 5 - FIREFIGHTING EQUIPMENT

1. SCOPE

1.1 This procedure covers the inspection and testing in a manufacturer's works of fire fighting equipment subject to Statutory Regulations, BP Standards and National Codes.

1.2 The categories of equipment covered by this procedure are:-

- (a) Foam tenders
- (b) Monitors
- (c) Inductors
- (d) Hoses, branchpipes, couplings and nozzle connections
- (e) Underground fire hydrants
- (f) Fire pumps
- (g) Water deluge valve skids
- (h) Halon skids

NOTE: Recommended inspection requirements (back page) are only included for Criticality 1 & 2 items as it is assumed that no firefighting equipment will be criticality 3 or 4.

2. RELATED DOCUMENTATION

BS 336	Specification for fire hose couplings and ancillary equipment
BS 750	Specification for underground fire hydrants and surface box frames and covers
BS 5041 Pt.1-5	Fire hydrant systems equipment
BS 5306 Pt.5	Halon systems
BP Group RP 24-1	Active Fire Protection
NFPA 12	Carbon dioxide systems



NFPA 12A Halon 1301 systems

NFPA 12B Halon 1211 systems

3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of manufacture of major items of firefighting equipment (foam tenders, mobile firepumps, water deluge skids, halon skids), the supplier should produce an Inspection & Test Plan.

NOTE: Note that inspection requirements for other items of fire fighting equipment shall be agreed, before commencement of manufacture.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

Acceptance Criteria: Purchase Order and related specifications

3.2 Material Certification & Traceability

The supplier should maintain records of material certification and identification. Material identification may be by colour coding.

Checks should be made to verify compliance with traceability requirements particularly for pressure containing, process wetted and load bearing parts.

Acceptance Criteria: [DIN 50049](#) BP Group [GS 136-1](#)

NOTE: Stamping is not normally allowed on alloy, austenitic and Duplex steel and cupro-nickel base alloy material. These materials



should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Acceptance Criteria: Project or Purchase Order specifications

3.3 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage containing, as applicable:-

- (a) description and location of material and material test certificates used,
- (b) welder identification for each weld or group of welds and the weld procedure and consumables used,
- (c) NDT and visual examination records
- (d) dimensional control and inspection records,
- (e) mechanical assembly and testing of component units,
- (f) test reports,
- (g) approved concessions.

4. MANUFACTURING

4.1 The purchaser may require to make an initial visit to the supplier's works to ensure that the facilities required to carry out purchase order requirements are available and acceptable prior to the commencement of work.

4.2 The Inspector should check that all welders and weld procedures are suitably qualified.

4.3 The Inspector should review NDT operator qualifications, procedures, records and reports.

Acceptance Criteria: P.O. & Project Specifications

4.4 Dimensional Control

The Inspector should monitor dimensional control during construction in accordance with the latest revision of the drawings.

Acceptance Criteria: Approved drawings



4.5 Assembly

The Inspector should monitor the assembly of components and assembly of the units up to completion.

5. INSPECTION & TESTING

Checks should be made against order, specification and drawing requirements, and should include, but may not be limited to:

5.1 Foam Tenders

- 5.1.1 Inspection of the chassis-cab unit. Check that the manufacturer has knowledge of, and has complied with the transport regulations of the country of operation.
- 5.1.2 Check layout of the controls and equipment. Check that adequate removable panels are as specified in the order and approved drawings and are fitted to allow satisfactory maintenance to be carried out on major items, such as the fire pump, power take off and the control panel.
- 5.1.3 Check during manufacture, and before the final skin is fixed to ensure that the workmanship and strength of the framework is adequate to support the loading specified.
- 5.1.4 Check finish, undersealing, painting and signwriting on completion, also internal finish of the lockers and cab.
- 5.1.5 Test foam compound tank by allowing it to stand filled with water for 12 hours during initial inspection stage, and check tank venting arrangement.
- 5.1.6 Check the foam compound pump by engaging appropriate power take-off gear from the engine. Establish that performance is in accordance with specification and check that a strainer is provided on the upstream side of the pump, and the safety release valve by-pass system operates satisfactorily if the pump is of the geared type.
- 5.1.7 Check the output of the water pump by engaging the power take-off from the engine, recording characteristic readings, head/quantity, kW, (BHP) and NPSH. If facilities are not available for the latter, check the pump performance with 3m (10 ft) suction lift. Check that nominal engine kW, (BHP) with power take-off is sufficient for kW (BHP) absorbed by pump, allowing for efficiency and operating range.



- 5.1.8 Hydrostatic pressure test all water lines, including the heat exchanger, to normal maximum water pump pressure plus 1.75 bar (25 lbf/in²) and check for leaks.
- 5.1.9 Check and record maximum suction available (m bar) ("Hg) by closing suction valve.
- 5.1.10 Check operation of all controls and gauges and ensure that each is clearly labelled, and, if required, in the language of the country in which the appliance will be used.
- 5.1.11 Check quality of foam production on all lines, particularly where constant flow injection units are fitted.
- 5.1.12 Check stowed equipment specified in the order, and ensure these items are suitably fixed to prevent loss or damage.
- 5.1.13 Check all electrical fittings, including lights in lockers, vehicle lights and searchlights where specified. Check that double pole wiring installation is fitted.
- 5.1.14 Check that the grease points and lubricating oil points are accessible and filled with the appropriate BP Grade, details of which are to be specified in the Operating Manual.
- 5.1.15 Road test the vehicle fully loaded and obtain axle loadings on a weigh-bridge.
- 5.1.16 Check the turning circle and road wheel clearances with reference to bodywork under full working load.
- 5.1.17 Ensure that a copy of the Operating Manual is provided in the cab unless otherwise specified in the order.
- 5.2 Monitors**
- 5.2.1 Check foam production, noting compound pick-up rate, water consumption and foam production rate at stated operating pressure at the jet head, recording readings obtained.
- 5.3 Inductors**
- 5.3.1 Check calibration and ensure calibration markings and setting means are satisfactory.



5.4 Underground Fire Hydrants

- 5.4.1 Carry out hydraulic testing as detailed in the order or, if not specified in the order, to the requirements of [BS 750](#) or other National Code.

5.5 Mobile Fire Pumps

- 5.5.1 Check that the manufacturer has knowledge of, and has complied with the transport regulations of the country of operation.
- 5.5.2 Check the performance of pumps, recording characteristics at operating speeds, head/quantity, kW, (BHP) with a 3m (10 ft) suction lift.
- 5.5.3 Check towing characteristics if pump is trailer mounted.
- 5.5.4 Check brakes and electrical pick-up connections are satisfactory.

5.6 Water Deluge Skids

- 5.6.1 Witness hydrostatic testing of all pipework.
- 5.6.2 Check all pressure switch settings.
- 5.6.3 Check air control systems, trip settings, etc.
- 5.6.4 Witness functional test of deluge valve.
- 5.6.5 Check integrity of isolation valves.
- 5.6.6 Check electrical signal output, limit switches, and earth continuity.
- 5.6.7 Check all tag numbering.

5.7 Halon Skids

- 5.7.1 Witness hydrostatic test on halon manifolds
- 5.7.2 Witness Nitrogen test on assembled piping systems
- 5.7.3 Check all pressure switch settings
- 5.7.4 Witness functional test of solenoid valve
- 5.7.5 Witness functional test of solenoid valve manual override
- 5.7.6 Witness functional test of pneumatic actuators



- 5.7.7 Check weight of halon bottles supplied
- 5.7.8 Earth continuity
- 5.7.9 Ensure that BS halon logo is displayed and text is as required by purchase order.
- 5.8 Hoses, branchpipes, couplings and nozzle connectors shall also be checked against order and specification requirements.

6. ELECTRICAL EQUIPMENT FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES

See Procedure 20

7. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 7.5.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.
- 7.5.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 7.5.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT. When spreader bars or other equipment are to be used, units should be labelled accordingly.
- 7.5.4 The Inspector should carry out inspection of any coatings as required by the purchase order and the inspection and test plan.
- 7.5.5 Items of equipment may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification,

8. FINAL INSPECTION AND RELEASE

The Supplier should prepare a documentation and certification package for each item or package of equipment. This package should comprise documentation as required by the Purchase Order.

The documentation package should be compiled during the course of manufacture.



In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST
FIREFIGHTING EQUIPMENT

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan approval?			
3.3	Review records of manufacturing material usage?			
4.1	Check suppliers facility?			
4.2	Check weld procedure qualification and welder qualifications?			
4.3	Check NDE procedure and NDE operator approval?			
4.3	Check NDE results and documentation?			
4.4	Sample check dimensional control?			
4.5	Sample check assembly?			
5.1 - 5.8	Inspection & witness test - see individual sections for details			
7.5.1	Approval of procedure for handling preservation, packaging and transport?			
7.5.3	Witness load test and subsequent NDE?			
8.	Final inspection (including check identification)? Review documentation package? Issue release note?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATINGS

FIREFIGHTING EQUIPMENT

ACTION	I	II
Quality plan approval?	Yes	No
Review records of manufacturing/materials usage?	R	No
Check suppliers facility?	Yes	No
Check weld procedure and welder qualifications?	R	R
Check NDE procedures and NDE operator approvals?	R	No
Review NDE results and documentation?	Yes	Yes
Sample check dimensional control?	M	No
Sample check assembly?	M	No
Inspection and witness test? (see Section 5)	Yes	I,R
Approval of handling, preservation, packaging and transport procedure?	R	No
Witness load test and subsequent NDE?	Yes	R
Final inspection?	Yes	Yes
Review documentation?	Yes	Yes
Issue release note?	Yes	Yes

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED
(PROCESS/ACTIVITY) I=RANDOM INSPECTION/CHECK, R=REVIEW
DOCUMENTATION/CERTIFICATION

(NOTE WHERE R IS USED FOR AN APPROVAL ACTIVITY THE INSPECTION
ENGINEER SHALL APPROVE THE DOCUMENT, RATHER THAN THE
SPECIALIST BP ENGINEER)

WARNING: IN USING THESE CHECK LISTS THE INSPECTION
REQUIREMENTS CONTAINED IN THE PURCHASE ORDER CODES AND
STANDARDS MUST BE CARRIED OUT AS A MINIMUM.



PROCEDURE 6 - FIRED PROCESS HEATERS

1. SCOPE

- 1.1 This procedure covers inspection and testing in a manufacturer's works for fired process heaters and is based on the understanding that a proportion of the inspection will take place on site and thus be covered by BP Group Recommended Practice, BP Group [RP 32-2](#).
- 1.2 Sub assemblies and components covered would include, but not be limited to the following:-
- (a) Furnace structural steel for site assembly
 - (b) Furnace structural steel panels fitted with refractory anchors, etc.
 - (c) Furnace coils fabricated into elements which may or may not be terminated by headers (i.e. Pressure Testing may or may not be possible at the fabricator's works).
 - (d) Furnace coil supports and associated suspension systems
 - (e) Burner assemblies
 - (f) Refractory quarls
 - (g) Associated equipment such as sootblowers, safety valves, thermocouples, alarm and trip devices, forced and induced draft fans etc.
 - (h) Lifting devices
- 1.3 The following are excluded from the above scope of work unless inspection is required in addition to the independent inspection necessary for statutory certification:-
- (a) Steam boilers
 - (b) Steam raising coils associated with fired heaters
 - (c) Steam raising coils associated with waste heat boilers
- 1.4 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to criticality 1 items only. Inspection



requirements for criticality 2, 3 and 4 items are detailed in the inspection summary list at the end of this procedure. Inspection and Test Plans should be developed accordingly.

2. RELATED DOCUMENTS

BP Group [GS 118-4](#) Storage and Control of Welding Consumables.

BP Group [RP 32-2](#) Site Inspection, Testing and Pre-commissioning of New Plant.

BP Group [RP 22-1](#) Fired Heaters.

German Standard
[DIN 50049](#) Inspection Certification.

3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of manufacture of fired heaters the supplier should produce an Inspection & Test Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers and sub-contractors are approved or agreed as required.
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

Acceptance Criteria: Purchase Order and related specifications



3.2 Material Certification & Traceability

The supplier should maintain records of material certification and identification. Unless otherwise agreed test certificates should be mill originals, or verified true copies.

Checks should be made to verify compliance with traceability requirements particularly for pressure containing, process wetted and load bearing parts.

Where hard stamping is used to identify material, low stress hard die dot stamps are to be used on low temperature materials.

The requirements of BP Group [GS 136-1](#) normally apply to material for sour service as defined by that standard.

Acceptance Criteria: [DIN 50049](#), BP Group [GS 136-1](#)

NOTE: Stamping is not normally allowed on austenitic and Duplex steel and cupro-nickel or nickel base alloy material. These materials should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Acceptance Criteria: Project or Purchase Order specifications

3.3 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage, including, but not necessarily limited to:-

- (a) description and location of material and material test certificates used,
- (b) weld procedures and consumables used,
- (c) welder identification for each weld,
- (d) records of NDT and visual weld examination,
- (e) dimensional control and inspection records,
- (f) heat treatment records,
- (g) pressure test reports, recorder charts and gauge identification,
- (h) marked-up construction drawings,
- (i) concession application/non-conformance records.

Acceptance Criteria: Purchase Order QA Requirements

3.4 Marking

All fired heaters should be marked in accordance with code and purchaser requirements.

Acceptance Criteria: Purchase Order and Project Specification

4. FABRICATION, ASSEMBLY AND ERECTION

4.1 Fabrication Areas

Work areas where fabrication, assembly and erection are to occur should be clean and uncluttered. If welding work is to occur out of doors, the fabrication area should be protected from the elements and where necessary, heated.

Where stainless steels and non-ferrous metals are being fabricated, the area to be used should be quite separate from that used for carbon and low alloy steels. Separate and clearly identified sets of cleaning and grinding equipment should be maintained for each material.

NOTE:- In some instances the above requirement may be relaxed. In case of doubt and in the absence of any specified requirement, the Inspector should seek guidance from the purchaser.

The purchaser may require to inspect and approve fabrication areas and where applicable, the equipment to be used, before fabrication work can start.

Acceptance Criteria: Purchase Order specification

4.2 Fit-up and Tacking

The Inspector should monitor the weld preparation, fit up and tacking of welded joints in accordance with the requirements of the approved Inspection & Test Plan.

Tack welding should be carried out by qualified welders in accordance with the applicable welding procedure.

Acceptance Criteria: Purchase Order specification

4.3 Welding

Welds should be made by qualified welders only.

4.3.1 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group [GS 118-4](#) also gives advice on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be



non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables; At the discretion of the Inspector this may include the cut out of any welds that have been completed with the out-of-specification consumables. (see below)

4.3.2 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the weld should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or re-qualify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

4.3.3 Hydrogen Induced Cracking

Where hydrogen induced cracking is possible, consideration should be given to delaying NDT until 48 hours after welding is completed. - refer to [BS 5135](#) for guidance.

Acceptance Criteria: Approved Welding Procedures
BP Group [GS 118-4](#)
BP Group [GS 126-1](#) and [126-2](#)
P.O. Specification

4.4 Bending and Forming

The Inspector should verify or otherwise assure himself that wall thicknesses after bending or hot or cold forming are not less than the design minimum. A visual inspection should also be carried out supplemented as appropriate by NDT by a suitable technique to investigate any suspect areas..

When heat treatment is required, pre- or post-forming the Inspector should verify compliance with requirements and review heat treatment records.

Acceptance Criteria: Bending/Forming Procedures. Heat Treatment Procedure.

4.5 Heat Treatment

Post-weld and stress relieving heat treatments should be carried out in accordance with documented procedures.



The Inspector should verify compliance of any such heat treatment with the requirements.

NOTE: Where re-heat treatment is carried out after a local weld repair, the method and procedure should be agreed by the Purchaser.

The Inspector should review the heat treatment records prior to NDT being carried out.

4.6 Non-Destructive Testing

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION - All welds and castings are to be visually examined.
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION - The primary method of volumetric weld examination.
- (e) ULTRASONIC EXAMINATION - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing, or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

Where sample examination of welds is specified, the Inspector should nominate the welds to be examined, taking care to ensure that all welders and procedures are covered. To achieve this coverage the specified percentage may require to be exceeded. Any indication from sample examination that a welder or equipment etc., is faulty should necessitate further examination and in the case of gross or extensive defects 100% of the sampled lot is usually necessary.

Acceptance Criteria: P.O. & Project Specifications



4.7 Weld Repairs and Cut Outs

All repairs to welds should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval..

Two unsuccessful repairs at the same location should normally necessitate the weld to be cut out and remade, unless a proposal to carry out a further repair is agreed by the Purchaser.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

4.8 Dimensional Control

The Inspector should check major dimensions of the equipment against the latest revision of the drawing.

The squareness of flanges and the flatness and finish of the flange faces should be checked, as should flange ratings and nozzle positions.

Acceptance Criteria: Approved Drawings

5. PRESSURE TESTING

5.1 General

Pressure testing should be carried out in accordance with documented procedures. Test pressures may be specified by the purchaser or be determined from the construction code and should be verified by the Inspector.

The Inspector should witness pressure testing.

The risk of brittle fracture during pressure testing may be an important consideration for some materials as could the risk of freezing. Heating of the test medium may be necessary.

Acceptance Criteria: P.O. Specification, BP Group [GS 122-1](#)

5.2 Hydrostatic Testing

Hydrostatic test media other than water should be agreed by the Purchaser.

Test pressures may be specified by the purchaser or be established by supplier's calculations and should be verified by the Inspector.

Any limits on water impurity levels should be checked/verified to be in accordance with specified requirements.



6. FUNCTIONAL AND OTHER TESTING

- 6.1 Associated equipment such as burner assemblies and control panels should be checked at manufacturer's works but full functional testing is not normally carried out until the equipment is installed on site, prior to commissioning.
- 6.2 Associated equipment such as alarm and trip devices, ID and FD fan skids etc. should be inspected at sub vendor's works in accordance with inspection & test plan requirements.

7. TAGGING

The Inspector should ensure that all removable components are tagged securely with a securely affixed label containing all information necessary for identification during site erection.

8. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 8.1 The supplier should, in line with his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport.
- 8.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 8.3 Supplied lifting equipment and attachments should have proof load test certification issued by an approved statutory lifting equipment test house.
- 8.4 The Inspector should carry out inspection of any coatings as required by the Purchase Order and the approved Inspection & Test Plan.
- 8.5 The equipment may require to be weighed prior to shipping and a weight report issued.
- 8.6 Airblowing of coils to remove moisture and addition of inhibitor (e.g. for stainless steel coils should be checked by the Inspector.

Acceptance Criteria: Purchase Order Specification BP Group GS 106-2, Applicable Lifting Equipment Legislation.

9. FINAL INSPECTION AND RELEASE

- 9.1 The Supplier should provide a documentation and certification package for each fired heater. This package should include



documentation required in the Purchase Order which may include but will not be limited to the following:-

- (a) material test certificates including any special test reports and raw material test certificates, for all pressure containing/process wetted parts, and for supporting/load bearing structures.
- (b) welding procedures, welding procedure qualification records and welder qualification records,
- (c) NDT procedures, reports and operator qualifications,
- (d) marked up location drawings showing weld identifications, NDT report Nos. and material identification,
- (e) heat treatment records.
- (f) pressure test certificates and pressure gauge calibration certificates and if required, water purity certificates,
- (g) lifting equipment certification,
- (h) dimensional inspection reports,
- (i) signed off Inspection & Test Plan
- (j) weight control reports.

9.2 The format and/or content of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

FIRED HEATERS

PARA REF	ACTION	YES	NO	N/A
3.1	Calculations, drawings and design data reviewed and approved?			
3.1	Major sub contractors approved?			
3.1	Drawings and specifications checked for latest issue?			
3.1	Welding procedure specifications and qualifications approved before any welding operations are carried out?			
3.1	Welder qualifications reviewed and approved by the Inspection Engineer?			
3.1	Heat treatment procedures approved prior to commencement of welding?			
3.1	Applicable NDT procedures approved prior to the commencement of any welding operations?			
3.1	NDT operator qualifications reviewed and approved by the Inspection Engineer?			
3.1	Pressure testing procedures approved prior to testing being carried out?			
3.1	Handling, preservation, packaging and transport procedures approved?			
3.2	Material received inspected and material certificates reviewed and accepted?			
3.2	All material marked in accordance with method?			
3.3	Manufacturing records being compiled and approved?			
4.1	Fabrication area(s) inspected and approved?			
4.2	Fit up and tacking of welded joints and fittings monitored and acceptable?			
4.3	Welding checked and pre-heat and interpass temps acceptable?			
4.4	Forming of pipework and plates checked and accepted?			
4.5	Heat treatment checked & reports approved?			
4.6	NDT checked and reports approved?			
4.7	Weld repairs and cut-outs checked?			



PARA REF	ACTION	YES	NO	N/A
4.8	Main dimensions checked and accepted?			
8.	Handling, preservation and packaging monitored and accepted? (inc. identification)			
9.	FINAL INSPECTION AND RELEASE			
	All inspections complete and accepted?			
	Documentation package reviewed and accepted?			
	Inspection or release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATINGS

FIRED HEATERS

ACTION	I	II	III	IV
Inspection and Test Plan reviewed and approved?	Yes	Yes	No	No
Code approvals, clarifications and quality activities included in the Inspection and Test Plan?	R	R	N	N
Equipment drawings, calculations, design data and specification approval by BP.	Yes	Yes	R	No
Equipment drawings, calculations, design data and specification approval by IIA	Yes	Yes	Yes	Yes
Major sub suppliers approval?	Yes	Yes	No	No
Welding procedure qualification tests witness and approval?	R	R	No	No
Heat treatment procedure approval?	R	R	No	No
NDE procedures approval, NDE operator qualification check?	Yes	R	R	No
Pressure test procedures approval?	R	R	No	No
Handling, preservation, packaging and transport procedures approval?	R	No	No	No
Material receipt inspection and review of material test certificates?	M,R	M,R	R	No
Witness charpy impact testings?	Yes	R	R	No
Manufacturing records compilation and approval?	R	R	R	No
Component marking in accordance with approved method? (inc. transfer stamping witness)	Yes	I	M	No
Fabrication area(s) inspection and approval?	Yes	I	No	No
Examination of cut edges and heat affected zones?	Yes	I	No	No
Examination of fit up and tacking of welded joints and fittings?	Yes	I	No	No
Welding to be checked (including pre-heat and interpass temperatures)?	M	M	M	No
Bending & forming of pipework to be checked?	M	M	No	No
Heat treatment to be monitored?	M	R	R	No
NDE witness and reports to be stamped and approved?	Yes	I,R	R	No



ACTION	I	II	III	IV
Weld repairs/cut-outs to be checked and NDE accepted? Re-heat treatment reports and charts to be approved?	Yes	I,R	R	No
Main dimensions to be checked and accepted?	Yes	Yes	Yes	No
PRESSURE TESTING				
Test location & equipment to be checked and approved?	M	No	No	No
Test medium to be checked for purity?	Yes	Yes	No	No
Pneumatic or gas testing safety checks to be carried out?	Yes	Yes	Yes	No
Tests to be witnessed?	Yes	Yes	Yes	No
Handling, preservation and packaging procedures to be approved?	R	R	No	No
Handling, preservation and packaging to be checked? (inc. identification)	Yes	M	M,R	No
FINAL INSPECTION AND RELEASE				
All inspections complete?	Yes	Yes	M,R	No
Documentation package to be reviewed?	Yes	Yes	Yes	No
Lifting gear certification to be checked?	Yes	Yes	Yes	No
Inspection release note to be issued?	Yes	Yes	Yes	No

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED
(PROCESS/ACTIVITY) I=RANDOM INSPECTION/CHECK, R=REVIEW
DOCUMENTATION/CERTIFICATION

(NOTE WHERE R IS USED FOR AN APPROVAL ACTIVITY THE
INSPECTION ENGINEER SHALL APPROVE THE DOCUMENT,
RATHER THAN THE SPECIALIST BP ENGINEER)

WARNING: IN USING THESE CHECK LISTS THE INSPECTION REQUIREMENTS
CONTAINED IN THE PURCHASE ORDER CODES AND STANDARDS
MUST BE CARRIED OUT AS A MINIMUM.

NOTE: AT THE DISCRETION OF THE INSPECTION ENGINEER ROUTING
CHECKS (E.G. WITNESSING OF WELD PROCEDURE SPECIFICATION
TESTING) CAN BE LEFT TO THE IIA, AS LONG AS WRITTEN
VERIFICATION IS MADE AVAILABLE BY THE IIA THAT THE
ACTIVITY HAS BEEN SATISFACTORILY CARRIED OUT.



PROCEDURE 7 - FLANGED STEEL RELIEF VALVES

1. SCOPE

- 1.1 This procedure covers the inspection and testing of flanged steel relief valves purchased in accordance with the requirements of [API Std 526](#) and [API Std 527](#).
- 1.2 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to Criticality 1 items only. Inspection requirements for Criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure.

2. RELATED DOCUMENTS

BP Group [RP 44-1](#) Overpressure Protection Systems

[API Std 526](#) Flanged Steel Safety Relief Valves

[API Std 527](#) Commercial Seat Tightness of Safety Relief Valves With Metal-to-Metal Seats

[ASME](#) Boiler and Pressure Vessel Codes.

3. GENERAL

3.1 Inspection & Test Plan (I & T Plan)

Before the commencement of assembly of safety relief valves the supplier should produce an I & T Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.



- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.
- (e) Calculations in relation to flow rate, orifice size etc., are reviewed and approved.

Acceptance Criteria: Purchase Order and related specifications

3.2 **Material Certification & Traceability**

Original or verified true copies of material test certificates may be required. Material identification may be by colour coding except that all pressure containing castings should at all times carry markings traceable to material test certificates. Traceability may also be required for process wetted parts and springs.

Checks should be made to verify compliance with traceability requirements particularly for pressure containing and process wetted parts.

Where hard stamping is used to identify material, low stress die stamps are to be used on low temperature materials.

NOTE: stamping is not to be used on austenitic and Duplex steel or cupro-nickel or nickel base alloy material. These materials should only be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Acceptance Criteria: Project or Purchase Order Specification. [DIN 50049](#) BP Group [GS 136-1](#)

3.3 **Records of Manufacturing and Material Usage**

The supplier should keep records of manufacturing and material usage including;

- (a) The description and location of material including part numbers and spring references.
- (b) Records of NDT and visual examinations.
- (c) Dimensional control and inspection records.
- (d) Pressure test reports, (including relief settings).
- (e) Functional test reports.
- (f) Seat leakage test reports.
- (g) Concession application/non-conformance records.

Acceptance Criteria: Purchase Order Requirements



4. WELDED CONSTRUCTION AND WELD REPAIRS

Where relief valves are fabricated by welding, Procedure No. 23 should be referred to for guidance on the subjects of welding, heat treatment and non-destructive testing.

5. DIMENSIONAL CONTROL

The Inspector should monitor the dimensional control of manufacturing and assembly of the valves in accordance with the latest revision of the drawings etc.

A final dimensional check should be carried out on completed valves, to include major dimensions and flange sealing face finish.

6. PRESSURE TESTING

Pressure testing should be carried out in accordance with documented procedures

The Inspector should witness pressure testing as indicated by the inspection and test plan and purchase order specifications.

Acceptance Criteria: P.O. Specification

Hydrostatic test media other than water should be agreed by the Purchaser.

Test pressures should be verified by the Inspector. Any limits on water impurity levels should be checked/verified to be in accordance with specified requirements.

7. FUNCTIONAL TESTING

7.1 Functional testing procedures may be subject to approval prior to the commencement of testing.

7.2 The Inspector should witness functional testing of relief valves as indicated in the inspection and test plan and purchase order specifications.

7.3 Function testing is normally carried out using air, nitrogen or water.

Water testing should only be performed on valves for liquid duty. Where seat tightness cannot be satisfactorily established using water the Inspector should request that at least this part of the test should be done with air or nitrogen.

NOTE:- Attention should be paid to the safety aspects of the supplier's test facilities and procedures.



- 7.4 The function test should demonstrate that the set pressure can be satisfactorily achieved, the sensitivity of the set pressure adjustment, and that seat leakage rates are within specified limits. Leak tightness of bellows and body/bonnet joints should also be checked.

Acceptance criteria:- [API Std 527](#)

- 7.5 Safety valves for steam boilers to [ASME Section 1](#) are required to have their capacity certified.

When it is necessary to demonstrate reseal pressure (blowdown) and capacity, extensive facilities are required. These are therefore normally checked when steam is first raised at site under the surveillance of an independent inspectorate.

Acceptance criteria:- [ASME Sect 1](#)

NOTE: When seat leakage testing is carried out using air or nitrogen the discharge of open bonnet type valves should be submerged in clean fresh water. There should be no visible seat leakage.

8. INSPECTION

Inspections should include checks of the following:-

- (a) Valves features and materials are according to purchase order requirements.
- (b) Orifice size is correct.
- (c) Adjustments can be locked or sealed as required.
- (d) Any coating/painting requirements complied with.

9. TAGGING

The Inspector should ensure that each valve is tagged with a securely attached label containing as a minimum, the following information:-

- (a) The Manufacturers name or identifying trade mark.
- (b) The valve size (nominal pipe size, inlet by outlet and orifice designation).
- (c) Type, style, model or figure number.
- (d) Capacity at nominated percentage overpressure when required.
- (e) Serial Number.
- (f) Set pressure.



- (g) Back pressure.
- (h) Cold differential test pressure.
- (i) Tag Number, vocab No and WIN.

10. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 10.1 The supplier should, in line with his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport.
- 10.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 10.3 The Inspector should carry out inspection of any coatings as required by the Purchase Order and the approved Inspection & Test Plan.

Acceptance Criteria: Purchase Order Specification, BP Group [GS 106-2](#).

11. FINAL INSPECTION AND RELEASE

- 11.1 The Supplier may be required to provide a documentation and certification package for each relief valve or for a complete order. This package should include documentation required by the Purchase Order which may include but not be limited to the following:-
 - (a) Material test certificates
 - (b) Pressure and functional test certs.
 - (c) Welding procedures, welding procedure qualification records and welder qualification records.
 - (d) NDT procedures, reports and operator qualifications.
 - (e) Drawings and parts lists.
 - (f) Dimensional inspection reports.
 - (g) Signed off I & T plan.
 - (h) Weight control reports.
- 11.2 The format of this documentation package may be required to be in accordance with an agreed index.



In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

FLANGED STEEL SAFETY RELIEF VALVES

PARA REF	ACTION	YES	NO	N/A
3.1	All major sub suppliers approved?			
3.1	All calculations reviewed and approved?			
3.1	All drawings and specifications checked?			
3.1	Inspection and test techniques for castings and forgings approved?			
3.1	Heat treatment procedures approved?			
3.1	NDE Procedures approved?			
3.1	Hydrostatic testing procedures and functional testing procedures approved?			
3.1	Handling, preservation, packaging and transport procedures approved?			
3.2	Material received inspected and material certificates reviewed and accepted?			
3.2	All material marked in accordance with approved method?			
3.3	Manufacturing records being compiled and approved?			
5.	Machining, surface preparation and flatness in accordance with approved drawings?			
5.	Dimensional control monitored and satisfactory?			
6.	Pressure testing witnessed and accepted?			
7.	Functional testing witnessed and accepted?			
7.	Seat leakage test carried out? Leakage rate acceptable?			
8(a)	Valve features and materials in accordance with requirements?			
8(b)	Correct orifice size?			
8(c)	Adjustments lockable?			
8(d)	Coating/painting satisfactory?			
9.	Valve tagged in accordance with requirements?			



PARA REF	ACTION	YES	NO	N/A
10	Handling, preservations and packaging monitored and accepted?			
	FINAL INSPECTION AND RELEASE			
11.	All inspections and tests complete and accepted?			
11.	Documentation package reviewed and accepted?			
11.	Inspection or release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATING

FLANGED STEEL RELIEF VALVES

ACTION		I	II	III	IV
All major sub-suppliers approved?		Yes	R	No	No
All calculations to be reviewed and approved?		Yes	Yes	Yes	N/A
All drawings and specifications to be checked?		Yes	Yes	I	No
Inspection and test techniques for casings and forgings to be approved?		Yes	R	R	No
Heat treatment procedures to be approved?		Yes	R	R	No
NDE Procedures to be approved?		R	R	No	No
Hydrostatic testing procedures and functional testing procedures to be approved?		R	R	No	No
Handling, preservation, packaging and transport procedures to be approved?		R	R	No	No
Material to be received inspected and material certificates to be reviewed and accepted?		R	I,R	R	No
Manufacturing records to be compiled and approved?		Yes	Yes	Yes	N/A
Cleanliness standards for equipment and materials etc., to be checked?		Yes	I	I	No
All material marking to be checked?		Yes	M	R	No
Heat treatment to be checked and reports and charts to be approved?		R	R	R	No
NDE to be checked and reports reviewed?		Yes	I,R	R	No
Weld repairs to be checked and approved?		Yes	I,R	R	N/A
Machining to be checked?		I	M	No	No
Dimensional control to be checked?		I	M	No	No
Pressure testing of body and bonnet to be witnessed and accepted?		Yes	Yes	Yes	No
Functional testing to be witnessed and accepted?		Yes	Yes	Yes	No
Seat leakage test to be carried out. Leakage rate checked?		Yes	Yes	Yes	No
Handling, preservation and packaging to be checked?		M	M	M	No
FINAL	Final dimensional/visual check?	Yes	Yes	Yes	No
INSPECTION AND	Documentation package to be reviewed and accepted?	Yes	Yes	Yes	No
RELEASE	Inspection release note to be issued?	Yes	Yes	Yes	No



LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED
(PROCESS/ACTIVITY) I=RANDOM INSPECTION/CHECK, R=REVIEW
DOCUMENTATION/CERTIFICATION

(NOTE WHERE R IS USED FOR AN APPROVAL ACTIVITY THE
INSPECTION ENGINEER SHALL APPROVE THE DOCUMENT,
RATHER THAN THE SPECIALIST ENGINEER).

WARNING: IN USING THESE CHECK LISTS IT SHOULD BE NOTED THAT THE
INSPECTION REQUIREMENTS CONTAINED IN THE PURCHASE
ORDER CODES AND STANDARDS MUST BE CARRIED OUT AS A
MINIMUM.



PROCEDURE 8 - HEAT EXCHANGE EQUIPMENT

1. SCOPE

- 1.1 This procedure should be read in conjunction with Procedure No. 22 - Unfired Pressure Vessels - the contents of which can be applied equally to heat exchangers. This procedure contains only supplementary guidance specific to the inspection and test of heat exchange equipment manufactured to standards as listed below.

2. RELATED DOCUMENTS

BP Group [RP 26-1](#) Heat Exchange Equipment

BP Group [GS 156-2](#) Surface Condensers for Steam Turbines

BP Group [GS 126-1](#) Shell and Tube Heat Exchangers - TEMA Type

BP Group [GS 126-2](#) Air-Cooled Heat Exchangers

[TEMA](#) Standards of Tubular Heat Exchanger
Manufacturers Association

BP Group [GS 118-9](#) Tube end welding of heat exchangers tubes

3. INSPECTION

- 3.1 Tubesheets and baffle plates should be dimensionally checked before assembly of the bundle. Tolerances for hole diameters are contained in [TEMA](#) but these may be superseded by purchase order specifications.

Checks should include that grooves in tubesheet holes are correct if required.

Where tubes are to be welded, tubesheet holes should be checked for cleanliness and to confirm that the tubend weld preparation is correct.

- 3.2 Shells should be checked internally prior to closure of fixed tubesheet type exchangers or prior to insertion of the bundle. Checks should be visual for workmanship and completeness. It should also be confirmed that any required NDT of welds or air testing of compensating pads has been completed satisfactorily at this stage.

- 3.3 The bundle should be visually and dimensionally checked prior to insertion.



- 3.4 The insertion of the bundle may be required to be witnessed.
- 3.5 A wetting agent should be used when testing the shellside of an exchanger to facilitate the detection of leaks at tubend welds or expansions.
- 3.6 After testing, the exchanger should be thoroughly dried internally. The procedure for this may require approval by the purchaser.
- 3.7 All mating bolted parts should be match marked to facilitate reassembly in the same orientation. Marking should also be applied to provide traceability to a particular exchanger. This may be by WIN number or serial number.
- 3.8 Test rings supplied with an exchanger to facilitate site testing should be appropriately marked as applicable to a particular exchanger or group of exchangers.
- NOTE: The Inspection Check Lists that follows, should be read in conjunction with Procedure No. 22.



INSPECTION CHECK LIST

HEAT EXCHANGE EQUIPMENT

PARA REF	ACTION	YES	NO	N/A
4.1	All approvals, clarifications and quality related activities required by the code are complete?			
4.1	All calculations, drawings and design data reviewed and approved by relevant authorities?			
4.1	All drawings and specifications are checked to ensure that they are the latest issue?			
4.1	All major sub contractors approved?			
4.1	All applicable welding procedure specifications and qualifications are approved before any welding operations are carried out?			
4.1	Welder qualifications are to be reviewed and approved by the Inspection Engineer?			
4.1	Heat treatment procedures are approved prior to commencement of welding?			
4.1	All applicable NDE procedures are approved prior to the commencement of any welding operations? NDE operator qualifications are to be reviewed and approved by the Inspection Engineer?			
4.1	Pressure testing procedures are approved prior to testing being carried out?			
4.1	Handling, preservation, packaging and transport procedures are approved?			
4.3	Material received inspection, and material certificates reviewed and accepted?			
4.3	All material marked in accordance with approved method?			
4.4	Manufacturing records to be compiled and approved?			
5.1	Fabrication area(s) inspected and approved?			
5.2	Fit up and tacking of welded joints and fittings monitored and acceptable?			
5.3	Welding monitored and pre-heat and interpass temps acceptable?			



PARA REF	ACTION	YES	NO	N/A
5.4	Forming of pipework and plates monitored and accepted?			
5.5	Heat treatment monitored & reports approved?			
5.6	NDE monitored and reports approved?			
5.8	Main dimensions checked and accepted?			
6.	Design test medium checked for purity?			
6.	Pressure tests carried out and accepted?			
7.	Handling, preservation and packaging monitored and accepted? (incl. identification)			
	FINAL INSPECTION AND RELEASE			
8.3	All inspections complete and accepted?			
8.3	Documentation package reviewed and accepted?			
3.4	IAA Certificate of Conformance issued?			
8.3	Inspection or release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATINGS

HEAT EXCHANGE EQUIPMENT

ACTION	I	II	III	IV
Quality Plan review and approval by BP and IIA?	Yes	Yes	Yes	N/A
Code approvals, clarifications and quality activities included in the Inspection and Test Plan	Yes	Yes	N/A	N/A
Equipment drawings, calculations, design data and specification approval by BP?	Yes	Yes	R	No
Equipment drawings, calculations, design data and specification approval by IIA?	Yes	Yes	Yes	Yes
Major sub suppliers approval?	Yes	Yes	No	No
Welding procedure qualification tests witness and approval?	R	R	R	No
Welder qualification test witness and approval?	R	R	R	No
Heat treatment procedure approval?	Yes	R	No	No
NDE Procedures approval, NDE Operator qualification check?	R	R	R	No
Pressure test procedures approval?	R	R	No	No
Handling, preservation, packaging and transport procedures approval?	R	R	No	No
Material receipt inspection and review of material test certificates?	M,R	M,R	R	No
Manufacturing records compilation and approval?	R	R	R	No
Component marking in accordance with approved method? (inc. transfer stamping witness)	Yes	I	M,R	No
Fabrication area(s) inspected and approval?	Yes	I	I	No
Examination of cut edges and heat affected zones?	Yes	I	I	No
Examination of fit-up and tacking of welded joints and fittings?	Yes	I	I	No
Welding to be checked (including pre-heat and interpass temperatures)?	I,R	I,R	No	No
Bending & forming of pipework to be checked?	M,R	M,R	R	No
Heat treatment to be monitored?	M	M,R	R	No
NDE witness and reports to be stamped and approved?	Yes	I,R	R	No
Weld repairs/cut-outs to be checked and NDE accepted? Re-heat treatment reports and charts to be approved?	Yes	I,R	R	No



Main dimensions to be checked and accepted?	Yes	Yes	I,R	No
PRESSURE TESTING				
Test location & equipment to be checked and approved?	Yes	Yes	No	No
Test medium to be checked for purity?	Yes	Yes	No	No
Pneumatic or gas testing safety checks to be carried out?	Yes	Yes	Yes	No
Tests to be witnessed?	Yes	Yes	Yes	No
Handling, preservation and packaging procedures to be approved?	R	R	No	No
Handling, preservation and packaging to be checked? (inc. identification)	M	M	No	No
FINAL INSPECTION AND RELEASE				
All inspections complete?	Yes	Yes	M,R	No
Documentation package to be reviewed?	Yes	Yes	Yes	No
IIA Certificate of Conformance to be issued?	Yes	Yes	Yes	Yes
Inspection release note to be issued?	Yes	Yes	Yes	No

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED (PROCESS/ACTIVITY) I=RANDOM INSPECTION/CHECK, R=REVIEW DOCUMENTATION/CERTIFICATION

(NOTE WHERE R IS USED FOR AN APPROVAL ACTIVITY THE INSPECTION ENGINEER SHALL APPROVE THE DOCUMENT, RATHER THAN THE SPECIALIST BP ENGINEER).

WARNING: IN USING THESE CHECK LISTS IT SHOULD BE NOTED THAT THE INSPECTION REQUIREMENTS CONTAINED IN THE PURCHASE ORDER CODES AND STANDARDS MUST BE CARRIED OUT AS A MINIMUM.

NOTE: AT THE DISCRETION OF THE INSPECTION ENGINEER ROUTINE CHECKS (E.G. WITNESSING OF WELD PROCEDURE SPECIFICATION TESTING) CAN BE LEFT TO THE IIA, AS LONG AS WRITTEN VERIFICATION IS MADE AVAILABLE BY THE IIA THAT THE ACTIVITY HAS BEEN SATISFACTORILY CARRIED OUT.



PROCEDURE 9 - FLEXIBLE HOSES

1. SCOPE

- 1.1 This procedure covers inspection and testing of hoses manufactured for use in refineries, chemical works and offshore installations intended for the transfer of oils, chemicals, liquefied gases and intermediate feedstocks.
- 1.2 The following types of hoses are excluded from this scope:-
- (a) Air and water hoses.
 - (b) Snuffing steam hoses and lances.
 - (c) Hydraulic hoses used on machinery and transport.
 - (d) Subsea umbilical hoses for wellhead control systems.
- 1.3 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to Criticality 1 items only. Inspection requirements for Criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure.

2. RELATED DOCUMENTS

BP Group RP 30-1	Instrumentation
BP Group GS 134-1	Hydraulic Power Supplies
BP Group GS 128-2	Offshore Tanker Loading and Discharging
BP Group GS 128-1	Dock Loading and Discharging
BP Group GS 142-10	High Pressure Flexible Pipes for Production Duties
BP Group GS 142-11	High Pressure Flexible Pipes for Riser Systems



3. GENERAL

3.1 Inspection & Test Plan (I & T Plan)

Before the commencement of manufacture of the equipment, the Supplier should prepare an Inspection & Test Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

Acceptance Criteria: Purchase Order and related Specification

3.2 Material Certification & Traceability

The supplier should maintain records of material certification and identification.

Checks should be made to verify compliance with traceability requirements .

Where hard stamping is used to identify material, low stress die stamps are to be used on low temperature materials.

NOTE: Stamping is not normally allowed on austenitic and Duplex steels and cupro-nickel or nickel base alloy materials. These materials should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Type approval certification will be required together with supporting test documents and certificates of conformity which clearly establish that the hose is suitable for the required application.

Where hoses are of metallic construction, chemical analysis and mechanical test certification is required.

Acceptance Criteria: Project or Purchase Order Specification.



3.3 Records of Manufacture and Material Usage

The Supplier should keep records of manufacturing and material usage including:-

- (a) The description and location of material used and material test certification.
- (b) Weld records and welder traceability (if applicable).
- (c) NDT records (if applicable)
- (d) Dimensional control and inspection records.
- (e) Pressure test records and gauge identification.
- (f) Concession applications/non-conformance records.

Acceptance Criteria: Purchase Order & QA requirements

4. MANUFACTURING, ASSEMBLY AND TESTING

4.1 Material Testing

All items forming part of the pressure envelope are to be manufactured from material that has been subjected to material testing in accordance with the relevant material specification. Witness of such testing may be required.

Acceptance Criteria: Project/Purchase Order Specification

4.2 Welding

Any welding should be carried out by suitably qualified welders to documented weld procedures.

4.3 Heat Treatment

Any heat treatment should be carried out in accordance with documented procedures.

The Inspector should verify that any heat treatment is carried out in compliance with the requirements.

Acceptance Criteria: Heat Treatment Procedure.

4.4 Non Destructive Testing

Any NDT should be carried out in accordance with documented procedures, using qualified operators.



The Inspector should check the NDT and review and approve all NDE records, reports, and operator qualifications.

Acceptance Criteria: Project or Purchase Order Specifications

4.5 Dimensional Control

The Inspector should check major dimensions in accordance with the latest revision of the drawings and specification requirements.

Particular attention should be given to the growth during hydrostatic testing.

Acceptance Criteria: Approved Drawings and Test Procedures

5. PRESSURE TESTING

- 5.1 Pressure testing should be carried out in accordance with documented procedures. Test pressures may be specified by the purchaser or be determined from the product specification and should be verified by the Inspector.

The Inspector should witness pressure testing as indicated in the inspection and test plan.

- 5.2 Hydrostatic test media other than water should be agreed by the Purchaser.

Any limits on water impurity levels should be checked/verified to be in accordance with specified requirements.

Acceptance Criteria: P.O. Specification

- 5.3 During pressure testing of the finished hose the change in length should be recorded and where electrical continuity testing is carried out, this should also be recorded at the pressures as specified within the procedure. (Normally change in length and continuity are recorded prior to test, at 1/4, 1/2, 3/4 and full test pressure and again after the pressure has been released).

- 5.4 In addition to final testing, destructive testing of each batch of hoses of rubber type construction, may require to be witnessed by the Inspector.

Acceptance Criteria: Approved Test Procedures

6. TAGGING

The Inspector should ensure that each hose is tagged with a permanently affixed label containing information required by the Purchase Order. This will include, but may not be limited to:-



- (a) Manufacturer's name or trade mark.
- (b) Hose size.
- (c) Product(s) that the hose is certified to carry.
- (d) Pressure rating.
- (e) Temperature limitations of the hose.
- (f) BP Vocab No; Tag No; and WIN; where applicable.

7. HANDLING, PRESERVATION PACKAGING AND TRANSPORTATION

- 7.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment. Internal drying and end sealing should be addressed and corrosion inhibition may also be necessary.
- 7.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 7.3 Items of equipment may require to be weighed prior to shipping and a weight report issued.

8. FINAL INSPECTION AND RELEASE

- 8.1 The manufacturer may be required to provide a documentation package for each hose or batch of hoses on the purchase order. The documentation should be as specified in the purchase order and will typically consist of the following:
 - (a) Material test certificates including type approval for the required service conditions.
 - (b) Welding procedure specifications.
 - (c) NDT procedures.
 - (d) Pressure test records including gauge serial nos. and calibration certificates and electrical continuity measurements.
 - (e) Dimensional reports including change of length during hydrostatic testing.
 - (f) Signed off Inspection & Test Plans.



(g) Weight Certificate.

8.2 The format of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

FLEXIBLE HOSES

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan approved?			
3.1	All drawings checked for latest issue?			
3.1	Test procedures approved?			
3.1	Heat treatment procedures approved?			
3.1	Weld procedures specification approved?			
3.1	Welder qualifications approved?			
3.1	NDE procedures approved?			
3.1	NDE operator qualifications approved?			
3.2	Material certification and identification checked?			
4.1	Material testing witnessed?			
4.2	Welding checked?			
4.3	Heat treatment checked?			
4.4	NDT checked and reports reviewed?			
4.5	Major dimensions checked before, during and after pressure test?			
5.1	Pressure testing witnessed?			
5.4	Batch destructive testing witnessed?			
5.3	Continuity test witnessed?			
6.	Tagging checked?			
7.	Handling, preservation and packaging checked?			
	FINAL INSPECTION AND RELEASE			
8.	Final inspection carried out?			
	Documentation package checked?			
	Release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATING

FLEXIBLE HOSES

ACTION	I	II	III	IV
Approval of Inspection and Test Plan?	Yes	Yes	No	No
Check drawings for latest issued?	R	R	R	No
Approval of test procedures?	Yes	Yes	R	No
Approval of heat treatment procedures?	Yes	R	R	No
Approval of weld procedure specifications?	R	R	R	No
Approval of welder qualifications?	R	R	No	No
Approval of NDE procedures?	R	R	No	No
Approval of NDE operator qualifications?	R	R	No	No
Check material certification and review material certification?	Yes	Yes	R	No
Witness material testing?	R,I	R	No	No
Check welding?	I	I	M	No
Check heat treatment?	M	R	R	No
Check NDE? Review NDE records?	R,M	R	R	No
Check major dimensions?	Yes	Yes	R	No
Witness pressure testing?	Yes	Yes	R	R
Witness batch destructive testing?	Yes	R	R	No
Witness continuity testing?	Yes	R	R	No
Check tagging?	Yes	Yes	Yes	Yes
Check handling, preservation and packaging?	Yes	Yes	I	I
Final inspection?	Yes	Yes	Yes	Yes
Documentation review?	Yes	Yes	Yes	Yes
Release note issued?	Yes	Yes	Yes	Yes

LEGEND: YES=MANDATORY (100%), NO=NOT REQUIRED, M=MONITORED (PROCESS/ACTIVITY), I=RANDOM INSPECTION/CHECK, R=REVIEW DOCUMENTATION/CERTIFICATION, N/A=NOT APPLICABLE



PROCEDURE 10 - HYDRAULIC EQUIPMENT

1. SCOPE

1.1 This procedure covers the inspection and test of hydraulic equipment in a supplier's works.

1.2 This procedure covers all hydraulic control equipment.

NOTE: Recommended Inspection requirements contained in the narrative sections of this procedure cover criticality 1 items, recommendations for criticality II, III and IV are covered in the listing at the end of this procedure.

2. RELATED DOCUMENTS

BP Group [RP 12-5](#) Part 5 - Power supplies for control equipment

BP Group [RP 30-1](#) Instrumentation

BP Group [RP 30-2](#) Protective Instrumentation Systems

BP Group [GS 134-1](#) Hydraulic Power Supplies

BP Group [GS 130-4](#) Pressure gauges

BP Group [GS 112-2](#) Electric Motor Operated Valve Actuators for Intermittent Operation of Isolation Valves

BP Group [GS 130-3](#) Test and Inspection, Instrument Panels for Electronic Instruments

[BS 1041](#) Code for Temperature Measurement

[BS 1780](#) Specification for Bardon Tube Pressure Vacuum Gauges

[BS 1042](#) Measurement of Fluid Flow in Closed Conduits

[BS 1655](#) Specification for Flanged Automatic Control Valves for the Process Control Industry

[BS 5345](#) Codes of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres



3. INSPECTION & TEST PLAN

Before the commencement of manufacture of hydraulic equipment the supplier should produce an I & T Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

It is important to ensure that certification requirements for sub-supplied material are included in the order/spec/I & T Plan.

Acceptance Criteria: Purchase Order and related specification

4. MANUFACTURING

4.1 Material Certification & Traceability

The supplier should maintain records of material certification and identification.

Checks should be made to verify compliance with any traceability requirements for pressure containing parts.

NOTE: Stamping is not normally allowed on austenitic and Duplex steels and cupro-nickel or nickel base alloy materials. These materials should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

4.2 Construction

The Inspector should check construction in accordance with the requirements of the I & T Plan and purchase order specifications. Particular attention should be paid to workmanship and accessibility for maintenance. Pipe pulling during fitting should be minimised, couplings should be correctly tightened and mountings should be adequate.

Acceptance Criteria: Approved I & T Plan. Purchase Order Specifications.

4.3 Welding

The Inspector should review welder and weld procedure qualifications. Welding should be monitored.

4.4 NDT

The Inspector should review NDT operator qualifications, procedures, results, and documentation. NDT should be sample witnessed unless otherwise specified.

4.5 Dimensional Control

The Inspector should check the overall dimensions and arrangements in accordance with the latest issue of drawings.

4.6 Electrical Equipment for Use in Potentially Explosive Atmospheres

Refer to Procedure No. 20.

5. TESTING

5.1 General

The Inspector should witness the testing of hydraulic equipment in accordance with the I & T Plan. These tests should comprise, but shall not be limited to:-

- (a) Pressure Testing of high pressure equipment/pipework to specified pressures, i.e. nominally 1.5 times design pressure. This testing should include sub-assemblies of pipework, valves, etc.
- (b) After assembly, the sampling of hydraulic oil during the flushing process, to ensure the pipework and system in general are cleaned to the required standard as specified in the purchase order. Typically this could be 05/42/2 'Class RN 2000' for miniature servo-valves. NB. the system should be flushed to a



standard applicable to the piece of equipment which would be most susceptible to contamination/damage.

- (c) Pressure testing of the assembled equipment.
- (d) Continuity and insulation testing of electrical equipment to ensure the assembly installation has been wired as per. approved diagrams.
- (e) Function testing of all failsafe devices/trips, to ensure the equipment is protected as per the order and specification requirements. This would typically include, overpressure trip, overcurrent trip, high temperature trips, etc.
- (f) Full function/performance testing of all equipment to ensure correct operation, in accordance with specifications and agreed or approved procedures.

Acceptance Criteria: Approved I & T Plan, Order Specification.

6. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 6.1 The supplier should, as part of his quality plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.
- 6.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 6.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT. When spreader bars or other equipment are to be used, units should be labelled accordingly.
- 6.4 The Inspector should carry out inspection of any coatings as required by the purchase order and the inspection and test plan.
- 6.5 Items of equipment may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification, applicable Lifting Equipment Legislation.



7. FINAL INSPECTION AND RELEASE

The Supplier should provide a documentation and certification package for the equipment. This package should include documentation required in the Purchase Order and may include but not be limited to the following:-

- (a) test certificates for the testing carried out in accordance with Section 5. above
- (b) hazardous area equipment certification.
- (c) lifting equipment test certificates for handling equipment,
- (d) dimensional inspection reports,
- (e) weight control reports.

The format of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



**GUIDE TO PURCHASER INSPECTION REQUIREMENTS
AGAINST CRITICALITY RATINGS**

HYDRAULIC EQUIPMENT

ACTION	I	II	III	IV
Check drawings/specifications approval?	Yes	Yes	No	No
Inspection and Test Plan approval?	Yes	Yes	No	No
Check all drawings and specifications are latest issue?	R	R	No	No
Check test procedures are approved?	Yes	R	No	No
Approval of suppliers works?	Yes	No	No	No
Sub-order certification approval?	R	R	No	No
Review material test certification?	Yes	I	No	No
Check traceability?	Yes	I	No	No
Review hazardous area certification?	Yes	Yes	Yes	Yes
Check construction?	Yes	I	No	No
Check qualification of weld procedures and welders?	R	R	No	No
Monitor welding?	M	M	No	No
Review NDE procedures, operator qualifications, results and documentation?	R	R	No	No
Sample witness NDE?	Yes	No	No	No
TESTING				
Pressure testing of sub-assemblies?	Yes	Yes	R	No
Flushing?	Yes	Yes	R	No
Pressure testing of assembly?	Yes	Yes	R	No
Function testing of failsafe devices?	Yes	Yes	R	No
Function/performance testing?	Yes	Yes	R	No
Handling packing & preservation procedure approval?	R	R	No	No
Check handling, packing & preservation and identification?	Yes	I	No	No
Witness load testing?	Yes	R	R	R
Check weight?	R	R	R	R
FINAL INSPECTION				
Verify that all tests, checks and inspection are complete?	Yes	Yes	Yes	No
Review certification? (includes Hazardous Area and Lifting Gear Equipment)?	Yes	Yes	Yes	No
Issue release note?	Yes	Yes	Yes	No



ACTION	I	II	III	IV
Check paint finish?	Yes	I,R	R	No
Check identification?	Yes	Yes	Yes	No
Check workmanship?	Yes	I	I	No

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITOR
 (PROCESS/ACTIVITY) I=RANDOM INSPECTION/CHECK, R=REVIEW
 DOCUMENTATION/CERTIFICATION (NOTE: WHERE R IS USED FOR
 AN APPROVAL ACTIVITY THE DOCUMENT SHALL BE APPROVED
 BY THE INSPECTION ENGINEER RATHER THAN THE SPECIALIST
 BP ENGINEER)



INSPECTION CHECK LIST

HYDRAULIC EQUIPMENT

PARA REF	ACTION	YES	NO	N/A
3.	Drawings/specifications approval?			
3.	Inspection and Test Plan approval?			
3.	All drawings and specification are latest issue?			
3.	Drawings and specifications approval?			
3.	Test procedures are approved?			
3.	Approval of suppliers works?			
3.	Sub order certification approval?			
4.1	Review material test certification?			
4.1	Check traceability?			
4.6	Review hazardous area certification?			
4.2	Check construction?			
4.3	Check qualification of weld procedures and welders?			
4.3	Monitor welding?			
4.4	Review NDT procedures, operator qualifications, results and documentation?			
4.4	Sample witness NDE?			
5.	Testing			
5.1 (a)	Pressure testing of sub-assemblies?			
5.1 (b)	Flushing?			
5.1 (c)	Pressure testing of assembly?			
5.1 (d)	Electrical testing?			
5.1 (e)	Function/performance testing?			
5.1 (f)				
6.1	Handling, packaging and preservation procedure approval?			
6.2	Check handling, packing and preservation and identification?			
6.5	Witness load testing?			
6.5	Check weight?			
	FINAL INSPECTION			
7.	Verify that all tests/checks and inspections are complete?			



PARA REF	ACTION	YES	NO	N/A
7.	Review clarification (include hazardous area and lifting gear certification)?			
7.	Issue release note?			
7.	Check paint finish and identification?			
7.	Check workmanship?			



PROCEDURE 11 - INSTRUMENTATION AND CONTROL EQUIPMENT

1. SCOPE

- 1.1 This procedure covers the inspection and testing of instrumentation and control equipment in a supplier's works.
- 1.2 The following categories of equipment are covered by this procedure:-
- (a) field mounted instruments of electrical pneumatic or direct reading type.
 - (b) panel mounted instruments.
- 1.3 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to Criticality 1 items only. Inspection requirements for Criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure

2. RELATED DOCUMENTS

BP Group RP 12-5	Part 5 - Power supplies for control equipment
BP Group RP 30-1	Instrumentation
BP Group RP 30-2	Protective Instrumentation Systems
BP Group GS 130-3	Test and inspection, instrument panels - electronic
BP Group GS 112-2	Electric motor operated valve actuators for intermittent operation of isolation valves
BP Group GS 130-4	Pressure gauges
BS 1041	Temperature/time indicators
BS 1042	Measurement of fluid flow in closed conduits
BS 1655	Flanged automatic control valves
BS 1780	Bourdon tube pressure and vacuum gauges
BS 5501	Electrical Equipment for Potentially Explosive Atmospheres



3. GENERAL

3.1 Inspection and Test Plans (I & T Plan)

Before the commencement of manufacture the supplier should produce an I & T Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.

Prior to commencement of manufacture the purchaser may visit the Suppliers Works to confirm that all required facilities are available. In particular logical sequencing of manufacturing operations should be checked.

It is important to ensure that certification requirements for sub-supplied material are included in the order/spec/quality plan.

Acceptance Criteria: Purchase Order and related specification

4. MANUFACTURING

4.1 Construction

The Inspector may be required to monitor the construction of panels and other packaged items during assembly.

The Inspector should ensure that correct materials are being used, e.g. cables, cable glanding, piping components etc. in accordance with the purchase order requirements.

Monitoring should ensure that good engineering practices are being used with respect to for e.g. radii of the cables during bending, making off of cable glanding, termination of cable ends, etc.

5. INSPECTION & TESTING

5.1 General

In the event of the equipment being intended for use in a hazardous area, the Inspector should ensure that classification of the equipment meets the requirements of the order, and that this classification is not compromised during installation, by incorrect practices. (See Procedure No. 20.)

5.2 Visual checks should be made for conformity of ranges, ratings, materials of construction, tagging etc.

5.3 Welding

When welded construction is used the Inspector should review weld procedure specifications and qualifications, welder qualifications and their application. Checks should also be made of any required NDT.

NOTE :- Radiography of thermowell tips is often required. The purpose of this examination is to detect the presence of any centreline defect originating in the barstock from which the thermowell was made as well as being a check on bore concentricity and the quality of any welding.

Acceptance Criteria: Purchase Order Specifications

5.4 Dimensional Control

The Inspector should check salient dimensions and arrangements in accordance with the approved drawings.

5.5 Testing

The Inspector should witness testing as required by purchase order specifications and as indicated on the Inspection and Test Plan. These tests may include, where relevant, (but not be limited to):-

- (a) Functional tests using a simulator (if available). Current transformer fed instruments should be checked using the current injection method. (This requirement should be mentioned in the order specification).
- (b) High voltage tests at $2 U_0 + 1 \text{ KV}$ where U_0 is the rated voltage of the equipment, precautions being taken to protect light current low voltage solid state devices. When EPROMS (erasable programmable only memories) are used in the equipment, flash photographs must not be taken (to avoid wiping out the EPROMS).
- (c) Software programmes should be run 3 times to ensure repeatability.



- (d) Accuracy, hysteresis and sensitivity checks.
- (e) Pressure and/or leak tests

Acceptance Criteria: Inspection and Test Plan,
Purchase Order Specifications

6. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 6.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.
- 6.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 6.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT. When spreader bars or other equipment are to be supplied, these should be provided with proof load test certification issued by an approved statutory lifting equipment test house and marked accordingly.
- 6.4 The Inspector should carry out inspection of any coatings as required by the purchase order and the inspection and test plan.
- 6.5 Items of equipment may require to be weighed prior to shipping and a weight report issued.

7. FINAL INSPECTION AND RELEASE

- 7.1 The Supplier should provide a documentation and certification package for the equipment. This package should include documentation as required by the Purchase Order and may include but not be limited to the following:-
 - (a) test certificates for the testing carried out in accordance with para 5.0 above,
 - (b) hazardous area certification
 - (c) lifting equipment test certificates for handling equipment, and cubicle load test,
 - (d) dimensional inspection reports,
 - (e) weight control reports.



- 7.2 The format and content of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.

7.3 **Electrical Equipment for Use in Potentially Explosive Atmospheres**

- refer to Procedure 20.



INSPECTION CHECK LIST

INSTRUMENTATION AND CONTROL EQUIPMENT

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan approval?			
3.1	Drawings and specifications are latest issued?			
3.1	Drawings and specifications approval?			
3.1	Test procedures approved?			
4.1	Check panels during assembly?			
5.2	Visual checks - ranges, ratings, materials, tagging etc.?			
5.3	Welding and NDT checks?			
5.4	Dimension checks?			
4.1	Check radiographs? (Thermowells)			
4.2	Check main dimensions?			
5.5	Testing			
5.5 (b)	High voltage?			
5.1 (c)	Software?			
5.1 (d)	Accuracy?			
5.1 (d)	Hysteresis, Sensitivity?			
5.1 (e)	Pressure/leak tests?			
6.	Cubicle load test and NDE/			
6.	Handling, preservation, packaging, transport procedure approval?			
6.	Check handling, preservation, packaging?			
7.	Final inspection (including identification)?			
7.	Review test certification (including hazardous area certification and load test certification).			
7.	Issue release note?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATINGS

INSTRUMENTATION AND CONTROL EQUIPMENT

PARA REF	ACTION	I	II	III	IV
3.1.1	Inspection and Test Plan approval?	Yes	No	No	No
3.1.1	Drawings and specifications approval?	Yes	No	No	No
3.1.1	Drawings and specifications are latest issue?	R	R	R	No
3.1.1	Test procedure approval?	Yes	R	No	No
4.1	Check panels during assembly?	I	I	No	No
4.1	Weld procedure specifications approval? (Thermowells)?	R	R	No	No
4.1	Weld procedure qualification test witness? (Thermowells)?	R	R	No	No
4.1	Check welder qualifications (Thermowells)?	R	R	No	No
4.1	Check radiographs (Thermowells)?	R	R	No	No
4.2	Check main dimensions?	Yes	Yes	Yes	No
5.1	Testing				
5.1 (a)	Functional?	Yes	Yes	R	No
5.1 (b)	High voltage?	Yes	Yes	R	No
5.1 (c)	Software?	Yes	Yes	R	No
5.1 (d)	Accuracy?	Yes	Yes	R	No
5.1 (d)	Hysteresis?	Yes	Yes	R	No
5.1 (d)	Sensitivity?	Yes	R	No	No
6.	Witness load test of cubicle and NDE?	Yes	R	R	No
6.	Handling, preservation, packaging, transport procedure approval?	Yes	R	No	No
6.	Check handling, preservation, packaging?	Yes	R	No	No
7.	Final inspection (including identification)?	Yes	Yes	Yes	No
7.	Review test certification (including hazardous area certification and load test certification)?	Yes	Yes	Yes	No
7.	Issue release note?	Yes	Yes	Yes	No



LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED
(PROCESS/ACTIVITY) I=RANDOM INSPECTION/CHECK, R=REVIEW
DOCUMENTATION/CERTIFICATION

(NOTE WHERE R IS USED FOR AN APPROVAL ACTIVITY THE
INSPECTION ENGINEER SHALL APPROVE THE DOCUMENT,
RATHER THAN THE SPECIALIST BP ENGINEER)

WARNING: IN USING THESE CHECK LISTS THE INSPECTION REQUIREMENTS
CONTAINED IN THE PURCHASE ORDER CODES AND STANDARDS
MUST BE CARRIED OUT AS A MINIMUM.



PROCEDURE 12 - LINE PIPE AND CASING

1. SCOPE

- 1.1 This procedure covers the inspection and testing of line pipe, casing and tubing manufactured by seamless, and electric fusion, electric resistance and electric induction welding processes at a supplier's pipe mill.
- 1.2 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to criticality 1 items only. Inspection requirements for criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure.
- 1.3 Because inspection facilities at pipe mills are predominantly "in-line" it is normally necessary for any purchaser's mill inspection to be carried out on a full or part time resident basis. For criticality 4, the guidelines contained in Procedure No. 14 - "Stockist-Supplied Line Pipe and Casing" would in most cases be more appropriate irrespective of where the inspection were to take place.

2. RELATED DOCUMENTATION

BP Group GS 102-1	Casing, Tubing and Drill Pipe - Seamless
BP Group GS 102-2	Casing, Tubing and Drill Pipe - Electric Resistance Welded
BP Group GS 142-1	Line Pipe and fittings - Submerged Arc Welded Pipe to API 5L
BP Group GS 142-2	Seamless pipe to API 5L
BP Group GS 142-3	Electric Resistance Welded pipe to API 5L
BP Group GS 136-1	Materials for sour service to NACE Std MR-01-75
BP Group GS 106-3	External coating for steel transmission pipelines
BP Group GS142-8	Pipe for Refineries, Chemical Plants & Associated Installations
API 5L	Specification for Line Pipe



API 5CT	Specification for Casing & Tubing
API 5A	Specification for Casing, Tubing and Drill Pipe
API 5B	Specification for Threading, Gauging & Thread, Inspection of casing, tubing and Line Pipe Threads.

3. GENERAL

3.1 Inspection and Test Plan (I & T Plan)

Before the commencement of the manufacture of pipe the supplier should produce an I & T Plan which may require approval.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required.
- (b) Required approvals of design data, procedures, etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

Acceptance Criteria: Purchase Order and related specifications.

3.2 Material Certification and Traceability

The supplier should maintain records of material certification and identification. Test certificates should be certified originals.

Traceability to the original cast or heat should be maintained throughout manufacture to the Inspector's satisfaction. Unique numbering of pipes may also be required and traceability of these should also be to the Inspector's satisfaction.

Identification should be by hard stamping unless otherwise required by the relevant standard; stamping is to be by low stress stamps on low temperature material.

The requirements of BP Group [GS 136-1](#) normally apply to material for sour service as defined by that standard.

Acceptance Criteria: [DIN 50049](#) BP Group [GS 136-1](#)



NOTE: Stamping is not normally allowed on high alloy materials. These materials should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

3.3 Records of Manufacturing and Material Usage

The supplier shall keep records of manufacturing and material usage as specified in the purchase order and specification.

Acceptance Criteria: Purchase Documentation Requirements

4. MATERIAL TESTING

4.1 Chemical Composition

The supplier should provide a chemical analysis of each heat of material for review and approval by the Inspector.

On completion of the manufacture the Supplier should also supply product analyses of the material used for review and approval by the Inspector.

NOTE: Mill-control analyses offered by the Supplier should be regarded as being extra voluntary samples over and above those required by the specification.

Acceptance Criteria: Purchase Order/specification API Standards, BP Specifications

4.2 Mechanical Tests

The Inspector should witness mechanical testing of material and welds and the sampling of test material should either be witnessed or be otherwise to his satisfaction.

In the case of material certification being requested to meet the requirements of [DIN 50049.3.1.c](#), the involvement of an Independent Inspection Authority would make witness by the purchaser's Inspector unnecessary.

Acceptance Criteria: Purchase order/specification, API Standards, BP Specifications

5. NON-DESTRUCTIVE TESTING

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor ongoing NDT activities and review records in accordance with the marked-up inspection and test plan.



The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

- (a) VISUAL EXAMINATION
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals.
- (d) RADIOGRAPHIC EXAMINATION - This is normally only used within the scope of this procedure for examination of submerged arc welding of linepipe and repairs thereto.
- (e) ULTRASONIC/ELECTROMAGNETIC EXAMINATION - The primary methods of volumetric examination of parent material and welds and also thickness survey for products within the scope of this procedure. It is important that the requirements are understood by the mill particularly in respect of the extent, orientation and sensitivity of these examinations and the Inspector should check that the mill facilities have the capability to meet the requirements.

Acceptance Criteria: Purchase order/specifications, API Standards, BP Specifications

6. WELDING

6.1 ERW and EIW

Conventional weld procedures and qualifications are not appropriate to electric resistance and electric induction welding processes.

The Inspector should monitor these processes to establish confidence in the equipment and operators.

6.2 EFW (SAW)

6.2.1 All welds should be made by qualified welders only.

6.2.2 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group [GS 118-4](#) also gives advise on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables. Any affected pipes should also be rejected.



6.2.3 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Particular attention should be paid to the start of a production run or shift. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the affected pipes should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or requalify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

Acceptance Criteria: Approved welding procedures

7. WELD REPAIRS

All repairs to welds should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval..

Two unsuccessful repairs at the same location should normally necessitate the pipe to be cut back.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters should be similar to that for the original weld.

Acceptance Criteria: Approved welding procedure

8. HEAT TREATMENT

Heat treatments should be carried out in accordance with documented procedures. The Inspector should verify compliance of any such heat treatment with the requirements.

9. DIMENSIONAL CONTROL

The Inspector should check the following:-

- (a) End thickness



- (b) End bevel dimensions (root and angle)
- (c) O/D, Ovality
- (d) End squareness
- (e) Peaking
- (f) Weld cap height
- (g) Weights
- (h) Straightness
- (i) Specified lengths
- (j) Drifting
- (k) Threading & couplers (where applicable)
- (l) Gauges and other measuring instruments used by the mill for tolerance compliance.

Acceptance Criteria: Purchase order/specification, API Standards, BP Specifications

10. HYDROSTATIC TESTING

The Inspector should monitor hydrotesting and check the calibration of gauges used.

Welded pipe should be tested such that the weld seam is visible to the operator during pressurisation.

Whenever NDT is applied after hydrotesting, it should be confirmed that the pressure test is repeated after any repair.

Acceptance Criteria: Purchase Order Specification, API Standards.

11. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 11.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the material.
- 11.2 The Inspector should monitor the preservation, handling and packaging of the material.



- 11.3 The Inspector should carry out inspection of any coatings as required by the purchase order and the Inspection and Test Plan.
- 11.4 Pipes or bundles should be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification, API Standards.

12. FINAL INSPECTION AND RELEASE

- 12.1 The Supplier may be required to provide a documentation and certification package for each batch of material or on completion of the order. This package should contain documentation required by the Purchase Order, and may include but not be limited to the following:-

- (a) material test certificates including any special test reports,
- (b) welding procedures, welding procedure qualification records and welder qualification records,
- (c) NDT procedures, records and operator qualifications.
- (d) pressure test certificates,
- (e) dimensional inspection reports,
- (f) coating reports
- (g) weight control reports,
- (h) signed off Inspection and Test Plan

- 12.2 The format of this documentation package may be required to be in accordance with an agreed index.

In association with a satisfactory final inspection of the material and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

LINE PIPE AND CASING FROM PIPE MILL

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan reviewed and approved? (inc. Approval of major sub-supplier)			
3.1	All procedures submitted and approved?			
3.2	Material Certification/traceability reviewed/accepted?			
3.2	All pipe marked in accordance with approved method?			
3.3	Manufacturing records being compiled?			
4.1	Chemical analysis checked and approved?			
4.2	Mechanical tests witnessed and accepted?			
5.	NDT monitored and records and reports reviewed?			
5.	NDT procedures approved and operators qualified?			
6.2	All welding procedures approved?			
6.2.3	Welding monitored and pre-heat and interpass temperatures accepted?			
7.	Welders qualified and approved?			
7.	Weld repairs monitored and NDT accepted. Repairs re-heat treated?			
8.	Heat treatment monitored and reports and charts approved?			
9.	Dimensional and visual checks carried out?			
	PRESSURE TESTING			
10.	Test procedure and equipment checked and accepted?			
10.	Witness of test carried out and accepted?			
11.	Handling, preservation and packaging procedures approved and issued?			
11.	Handling, preservation and packaging monitored and accepted?			



	FINAL INSPECTION AND RELEASE			
12.	All inspections complete and accepted?			
	Documentation package reviewed and accepted?			
	Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATINGS

LINE PIPE AND CASING FROM PIPE MILL

ACTION	I	II	III	IV
Approval of quality plan?	Yes	Yes	Yes	No
Approval of major sub-suppliers?	Yes	No	No	No
Approval of specifications?	Yes	Yes	Yes	No
Approval of welding procedures?	Yes	Yes	R	No
Approval of welder qualifications?	R	R	R	No
Approval of heat treatment procedures?	Yes	Yes	R	No
Approval of NDE procedures? Approval of NDE operators?	R	R	R	No
Review of material test certification and traceability?	R	R	R	No
Completion and approval of manufacturing records?	Yes	Yes	R	No
All pipework to be marked in accordance with approved method?	R	R	R	No
Review of chemical analysis?	R	R	R	No
Witness of mechanical testing?	Yes	Yes	R	No
Monitor of welding including pre-heat and interpass?	M	M	No	No
Monitor of heat treatment and review of reports/charts?	M	M,R	R	No
Monitor NDE, review of NDE reports?	M,R	M,R	R	No
Monitor of weld repairs/cut outs, NDE and reheat treatments?	M,R	M,R	R	No
Dimensional check?	Yes	M	R	No



PRESSURE TESTING				
Test procedure and equipment check?	R	M	No	No
Witness of testing?	Yes	M	No	No
Approval of handling, preservation and packaging procedures?	R	R	R	R
Monitor of handling, preservation and packaging?	M	M	No	No
FINAL INSPECTION AND RELEASE				
All inspections satisfactorily complete and Inspection and Test Plan signed-off?	Yes	Yes	Yes	No
Documentation package review?	Yes	Yes	Yes	N/A
Inspection release issue?	Yes	Yes	Yes	N/A

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED (PROCESS/ACTIVITY) I=SAMPLE INSPECTION/CHECK, R=REVIEW DOCUMENTATION/CERTIFICATION NA=NOT APPLICABLE



PROCEDURE 13 - LIFTING EQUIPMENT

1. SCOPE

- 1.1 This procedure covers the inspection and testing in a manufacturer's works of lifting equipment which is subject to statutory regulations.
- 1.2 The categories of equipment covered by this procedure are:-
- (a) Cranes, (pedestal and mobile)
 - (b) Loading arms
 - (c) Lifts
 - (d) Powered hoists
 - (e) Winches
 - (f) Chain hoists and pulley blocks
 - (g) General portable lifting equipment (Slings, shackles, ropes etc.)
- 1.3 This procedure does not supersede any requirement laid down in purchase order specifications/standards.
- 1.4 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to criticality 1 items only. Inspection requirements for criticality 2 items are detailed in the inspection summary list at the end of this procedure. Inspection & Test plans should be developed accordingly. (It is assumed that no lifting equipment would have a criticality rating of 3 or 4).

2. RELATED DOCUMENTS

- | | |
|---|--|
| BP Group GS138-1 | Offshore Hydraulic Powered Pedestal Cranes. |
| BP Group GS138-4 | Overhead Travelling Cranes and Monorail Cranes. |
| BP Group GS138-3 | Marine Loading Arms. |
| Lloyds Register of Shipping | Code for Lifting Appliances in a Marine Environment. |



Det Norske Veritas	Rules for Certification of Lifting Appliances.
UK Statutory Instrument 1974 No 289	The Offshore Installations (Construction and Survey) Regulations 1974.
UK Statutory Instrument 1976 No 1019	The Offshore Installations (Operational Safety, Health and Welfare) Regulations 1976.
UK Statutory Instrument 1970 No 1453	The Anchors and Chain Cables Rules
The Anchors and Chain Cables Act 1967	
Guidance Note PM20	Guidance notes from the Health & Safety Executive for cable laid slings and grommets.

3. CERTIFYING AUTHORITY

- 3.1 In the case of lifting equipment for use offshore a Certifying Authority (CA) involvement may be required. The CA involvement will be dependent on the statutory regulations governing operations in the particular location.
- 3.2 The CA requirements should be identified by their review, comment and approval of the supplier's I & T Plan.
- 3.3 The Inspector should ensure that his activities are co-ordinated with those of the CA.

4. GENERAL

4.1 Inspection & Test Plan (I & T Plan)

Before the commencement of manufacture of lifting equipment the supplier should provide an I & T Plan. The Certifying Authority should also approve the I & T Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.



The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

Acceptance Criteria: Purchase Order and related specifications

4.2 Material Certification and Traceability

The supplier should maintain records of material certification and identification. Test certificates should be mill originals, or verified true copies of mill originals. Material identification may be by colour coding but all pressure containing/load bearing parts should at all times carry markings traceable to material test certificates.

Where hard stamping is used to identify material, low stress die stamps should be used on low temperature materials.

Acceptance Criteria: Purchase Order Specification

4.3 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage containing:-

- (a) description and location of material and material test certificates used,
- (b) welder identification for each weld and procedures used,
- (c) records of NDT and visual examinations,
- (d) dimensional control and inspection records,
- (e) heat treatment records,
- (f) marked-up construction drawings,
- (g) concession application/non-conformance records.
- (h) records of mechanical assembly and testing of component units

- (i) test records

Acceptance Criteria: Purchase Order QA Requirements

5. FABRICATION, ASSEMBLY AND ERECTION

5.1 Fabrication Areas

Work areas where fabrication, assembly and erection are to occur should be clean and uncluttered. If welding work is to occur out of doors, the fabrication area should be protected from the elements and where necessary, heated.

Acceptance Criteria: BP Group [GSs 126-1](#) and [126-2](#)

5.2 Fit-up and Tacking

The Inspector should monitor the weld preparation, fit up and tacking of welded joints as indicated in the Inspection & Test Plan.

Tack welding should be carried out by qualified welders in accordance with the applicable welding procedure.

Acceptance Criteria: BP Group [GSs 126-1](#) and [126-2](#)

5.3 Welding

5.3.1 General

Welds should be made by suitably qualified welders working to suitably qualified procedures which may require approval.

5.3.2 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group [GS 118-4](#) also gives advise on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables; At the discretion of the Inspector this may include the cut out of any welds that have been completed with the out-of-specification consumables. (see below)



5.3.3 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the weld should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or requalify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

5.3.4 Hydrogen Induced Cracking

Where hydrogen induced cracking is possible, consideration should be given to delaying NDT until 48 hours after welding is completed. - refer to [BS 5135](#) for guidance.

Acceptance Criteria: Approved Heat Treatment Procedure. BP Group [GSs 126-1](#) and [126-2](#), PO specification

5.4 Heat Treatment

Heat treatments should be carried out in accordance with documented procedures.

The Inspector should verify compliance of any such heat treatment with the requirements.

NOTE: Where re-heat treatment is carried out after a local weld repair, the method and procedure should be agreed by the purchaser.

The Inspector should review the heat treatment records.

5.5 Non-Destructive Testing

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION - All welds and castings should be visually examined.

- (b) **MAGNETIC PARTICLE EXAMINATION** - To supplement visual examination on ferrous materials,
- (c) **LIQUID PENETRANT EXAMINATION** - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) **RADIOGRAPHIC EXAMINATION** - The primary method of volumetric weld examination.
- (e) **ULTRASONIC EXAMINATION** - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing, or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

Where sample examination of welds is specified, the Inspector should nominate the welds to be examined, taking care to ensure that all welders and procedures are covered. To achieve this coverage the specified percentage may require to be exceeded. Any indication from sample examination that a welder or equipment etc., is faulty should necessitate further examination and in the case of gross or extensive defects 100% of the sampled lot is usually necessary.

5.6 Weld Repairs

All repairs to welds should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval.

Two unsuccessful repairs at the same location should normally necessitate the weld to be cut out and remade, unless a proposal to carry out a further repair is agreed by the Purchaser.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

5.7 Dimensional Control

The Inspector should monitor the dimensional control of construction in accordance with the latest revision of the construction drawings.

5.8 Assembly

All major load bearing components should be visually inspected before assembly. NDT should be used as an aid to visual inspection where appropriate. Load test certificates and certificates of examination should be reviewed for lifting equipment (ropes, hooks, pulleys etc.)

The Inspector should monitor the assembly of components and the assembly of the units up to completion.

5.9 Testing

All equipment should be function tested and load tested in accordance with agreed or approved procedures. These tests should be witnessed by the Inspector.

Following each test visual inspection should be carried out by the Inspector.

NDT may be required on load bearing welds before and after test.

6. CABLES, SLINGS AND SHACKLES

6.1 Base material test certificates covering materials for use in multi strand cables, cable laid slings and forged shackles should be provided.

6.2 The condition of components should be examined by the Inspector prior to manufacture/assembly.

Acceptance Criteria: P.O. Specification

7. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

7.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.

7.2 The Inspector should monitor the preservation, handling and packaging of the equipment.

The Inspector should, during monitoring, ensure that movement of rotating or reciprocating elements are blocked to prevent damage in transit and that equipment is clearly labelled as to mechanical restraints used.

7.3 The Inspector should carry out inspection of any coatings as required by the purchase order and the inspection and test plan.

7.4 Items of equipment may require to be weighed prior to shipping and a weight report issued.



- 7.5 All lifting equipment should be checked for correct identification and marking of SWL in accordance with specifications, standards and statutory requirements.

Acceptance Criteria: Purchase Order Specification, Project Specification.

8. FINAL INSPECTION AND RELEASE

- 8.1 The Supplier should provide a documentation and certification package for each piece or item of lifting equipment. This package should include documentation as required by the Purchase Order. This may include but not be limited to the following:-

- (a) material test certificates including any special test reports and raw material test certificates,
- (b) fittings material test certificates,
- (c) welding procedures, welding procedure qualification records and welder qualification records,
- (d) NDT procedures, reports and operator qualifications.
- (e) marked up location drawings showing welding identifications and NDT report nos. and material identification,
- (f) Load test certificates, functional test certificates, endurance test certificates,
- (g) dimensional inspection reports,
- (h) signed off Inspection and Test Plan
- (i) weight control reports
- (j) CA certificate

- 8.2 The format and content of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



**9. ELECTRICAL EQUIPMENT FOR USE IN POTENTIALLY EXPLOSIVE
ATMOSPHERES**

See Procedure No. 20.



INSPECTION CHECK LIST
LIFTING EQUIPMENT (CRANES)

PARA REF	ACTION	YES	NO	N/A
3.2	Inspection and Test Plan reviewed and approved by CA?			
4.	Inspection and Test Plan reviewed and approved?			
4.1	All major sub suppliers are approved?			
4.1	All drawings & specifications are checked to ensure that they are the latest issue?			
4.1	All drawings, calculations and design data are reviewed and approved by relevant authorities?			
4.1	All applicable welding procedure specifications and qualifications are approved before any welding operations are carried out. Welder qualifications are reviewed and approved by the Inspection Engineer?			
4.1	Heat treatment procedures are approved prior to commencement of welding?			
4.1	All NDT procedures are approved prior to the commencement of any welding operations?			
4.1	Testing procedures are approved prior to testing being carried out?			
4.1	Procedure for handling, preservation, packaging and transport are approved?			
4.2	Material received, inspected and material certificates reviewed and accepted?			
4.2	All material marked in accordance with approved method?			
4.3	Manufacturing record compiled?			
5.2	Fit up and tacking of welded joints and fittings monitored and acceptable?			
5.3	Welding checked and pre-heat and interpass temps acceptable?			
5.4	Heat treatment checked and reports and charts approved?			
5.5	NDT monitored and reports approved?			



5.6	Weld repairs/cut outs checked and NDT accepted? Re-heat treatment complete?			
5.8	Mechanical inspection carried out on the following Gearboxes:-			
	Hydraulic Drives?			
	Winches/Drums?			
	Fuel & Hydraulic Tanks?			
	Bearings & Sheaves			
	Prime Mover?			
5.8	Load test certificates & certificates of examination approved for ropes, hooks, pulleys etc.?			
5.8	Assembly prior to shop testing checked?			
5.9	Shop Testing:			
	Functional testing in accordance with specification?			
	Load testing to statutory requirements?			
	Load test in accordance with endurance test procedure approved?			
5.9	Post test inspections carried out? (Visual, NDT)			
7.1	Handling, preservation and packaging procedures approved and issued?			
7.2	Handling, preservation and packaging checked and accepted?			
8.	FINAL INSPECTION AND RELEASE			
	All inspections complete and accepted? (including marking/ identification check)			
	Documentation package reviewed and accepted?			
	Inspection release note issued?			



INSPECTION CHECK LIST
CABLES, SLINGS AND SHACKLES

PARA REF	ACTION	YES	NO	N/A
4.1	All specifications submitted and approved by relevant authority?			
4.1	NDT procedures approved, operators qualified?			
4.2/6.2	Material inspected on receipt and identification checked?			
6.1	Material test certificates reviewed and accepted?			
5.5	NDT checked and reports approved?			
5.9	Shop Testing: load tests witnessed? dimension checks under load?			
5.9	Post test inspection carried out? (dimensional, visual, NDT)			
7.1	Handling, preservation and packaging procedures approved?			
7.2	Handling, preservation and packaging checked and accepted?			
8.	FINAL INSPECTION AND RELEASE			
6.1				
	All inspections complete and approved? (including marking and tagging check)			
	Certificates approved & collated? - Material test certificates - NDE certificates - Load test certificates - Certificate of test and examination (C of C)			
	Documentation package reviewed and accepted?			
	Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATING

LIFTING EQUIPMENT (CRANES)

ACTION	I	II
Major sub suppliers approval?	Yes	Yes
Check drawings and specifications to ensure that they are the latest issue?	R	R
Review drawings, calculations and design data by relevant authorities?	Yes	Yes
Welding procedure specifications and qualifications approval before any welding operations are carried out? Welder qualifications approval by the Inspection Engineer?	R	R
Heat treatment procedure approval prior to commencement of welding?	R	R
NDE procedure approval prior to the commencement of any welding operations?	R	R
Testing procedures approval prior to testing being carried out?	Yes	R
Procedures for handling, preservation, packaging and transport approval?	R	R
Material receipt, inspection and material certification review?	R	R
Manufacturing records compilation and approval?	M,R	M,R
Check material marking in accordance with approved method?	M	M
Check fit up and tacking of welded joints and fittings?	I	I
Check welding including pre-heat & interpass temps?	M	M
Check heat treatment and review reports and charts?	M,R	M,R
Check NDE and review reports?	M,R	M,R
Check weld repair/cut-outs and review NDE reports? Check re-treatment carried out?	M,R	M,R
Gearboxes	Yes	I
Hydraulic Drives	Yes	I
Winches/Drums	Yes	I
Fuel & hydraulic tanks	Yes	I
Bearings & sheaves	Yes	I
Prime Mover	Yes	I
Load test certificates and certificates of examination reviewed for ropes, hooks, pulleys etc.?	Yes	Yes
Check assembly prior to shop testing?	Yes	I



ACTION	I	II
SHOP TESTING WITNESS:		
Functional testing in accordance with specification?	Yes	Yes
Load testing to statutory requirements?	Yes	Yes
Load test in accordance with endurance test procedure approved?	Yes	Yes
Post test inspection?	Yes	Yes
Handling, preservation and packaging procedures approval?	R	R
Check handling, preservation and packaging?	M	M
FINAL INSPECTION		
Test location & equipment to be checked and approved?	Yes	Yes
Documentation package review?	Yes	Yes
Inspection release note issued?	Yes	Yes

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED
(PROCESS/ACTIVITY) I=RANDOM INSPECTION/CHECK, R=REVIEW
DOCUMENTATION/CERTIFICATION

(NOTE: WHERE R IS USED FOR AN APPROVAL ACTIVITY THE
INSPECTION ENGINEER SHALL APPROVE THE DOCUMENT,
RATHER THAN THE SPECIALIST BP ENGINEER

WARNING: IN USING THESE CHECK LISTS IT SHOULD BE NOTED THAT THE
INSPECTION REQUIREMENTS CONTAINED IN THE PURCHASE
ORDER CODES AND STANDARDS MUST BE CARRIED OUT AS A
MINIMUM.

NOTE: AT THE DISCRETION OF THE INSPECTION ENGINEER ROUTINE
CHECKS (E.G. WITNESSING OF WELD PROCEDURE SPECIFICATION
TESTING) CAN BE LEFT TO THE IIA, AS LONG AS WRITTEN
VERIFICATION IS MADE AVAILABLE BY THE IIA THE ACTIVITY
HAS BEEN SATISFACTORILY CARRIED OUT.



**RECOMMENDED INSPECTION REQUIREMENTS
AGAINST CRITICALITY RATING**

CABLES, SLINGS & SHACKLES

ACTION	I	II
All specifications to be submitted and approved by relevant authority?	Yes	No
NDE procedures approval, NDE operators qualification check?	Yes	No
Material receipt inspection and material certification?	Yes	No
NDE check and review of reports?	Yes	R
SHOP TESTING		
Load test witness?	Yes	R
Dimension checks under load?	Yes	No
Post test inspection carried out - dimensional, visual and NDE (where applicable)?	Yes	Yes
Handling, preservation & packaging procedures approved?	Yes	No
Handling, preservation & packaging checked & accepted?	Yes	Yes
FINAL INSPECTION AND RELEASE		
Check all inspections complete? (inc. markings and tagging)	Yes	Yes
Certification approval?	Yes	Yes
Documentation package reviewed?	Yes	Yes
Inspection release note issued?	Yes	Yes

LEGEND: YES=MANDATORY, NO=NOT REQUIRED, M=MONITOR,
R=RANDOM INSPECTION N/A=NOT APPLICABLE



PROCEDURE 14 - STOCKIST SUPPLIED LINE PIPE & CASING

1. SCOPE

- 1.1 This procedure covers the inspection and where applicable, testing of Line Pipe, Casing supplied "as new" from a stockist.
- 1.2 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to criticality 1 items only. Inspection requirements for criticality 2,3 and 4 items are detailed in the Inspection summary list at the end of this procedure.

2. RELATED DOCUMENTATION

- BP Group [GS 102-1](#) Casing, Tubing and Drill Pipe - Seamless
- BP Group [GS 102-2](#) Casing, Tubing and Drill Pipe - Electric Resistance Welded
- BP Group [GS 142-1](#) Line Pipe and Fittings - Submerged Arc Welded Pipe to API 5L
- BP Group [GS 142-2](#) Seamless Pipe to API 5L
- BP Group [GS 142-3](#) Electric Resistance Welded Pipe to API 5L
- BP Group [GS 136-1](#) Materials for sour service to NACE Std MR-01-75
- BP Group [GS 106-3](#) External Coating for Steel Transmission Pipelines
- BP Group [GS 142-8](#) Pipe for Refineries, Chemical Plants & Associated Installations
- [API 5L](#) Specification for Line Pipe
- [API 5CT](#) Specification for Casing & Tubing
- [API 5A](#) Specification for Casing, Tubing and Drill Pipe
- [API 5B](#) Specification for Threading, gauging & Thread Inspection of Casing, Tubing & Line Pipe Threads



3. GENERAL

3.1 Material Certification & Traceability

The stockist should maintain records of material certification, identification and traceability. Test certificates are to be certified as originals, or verified true copies.

Cast or Heat numbering are to be by hard stamping or roll stamping unless otherwise required by the relevant standard. Hard Stamping should be by low stress dot stamps.

The certification should be checked by the Inspector against purchase order, specification and API requirements. Supplementary certification may be required to cover additional tests and operations carried out by or on behalf of the stockist.

4. MATERIAL VERIFICATION/INSPECTION

4.1 Material inspection and verification should be by the sampling approach described herein.

4.1.1 The Inspector should assess the material storage area and the overall condition of the material and verify its identification and traceability for each batch offered.

4.1.2 Pipes should be examined for the following attributes (Note criticality 2 items should require sample inspection only - see recommended inspection list attached to this procedure).

- (a) Mechanical condition (internal/external)
- (b) Identification/traceability/certification (100%)
- (c) End thickness check and squareness (where applicable)
- (d) End bevel dimensions (where applicable)
- (e) Threading condition & couplers
- (f) Threading dimensions o/d, i/d, w/t, ovality
- (g) Drifting
- (h) Peaking
- (i) Weld cap height (where applicable)
- (j) Logging



(k) Lengths

(l) Straightness

NOTE: Additional testing such as impact testing, hardness testing etc. may be required to upgrade standard API material to meet BP Group Specification requirements.

4.1.3 Criticality 2 only (sample inspection).

Should any rejections occur all tubes from that batch may need to be inspected for that attribute.

All sample sizes are variable at the discretion of the Inspection Engineer, e.g. if the pipe is clearly in poor condition (corroded), either all pipes will require visual inspection (inside and outside) and logging or alternatively the material could be rejected. Guidance should be sought from the purchaser.

NOTE: Sampling techniques are described in BS 6001.

5. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

5.1 The Inspector should monitor the preservation, handling and packaging of the material against the purchase order requirements or an agreed procedure..

5.2 The Inspector should carry out inspection of any coatings as required by the purchase order and the inspection and test plan.

5.3 Pipes or bundles should be weighed prior to shipping and a weight report issued.

Acceptance Criteria: P.O. Specification, BP Group [GS 106-3](#).

6. FINAL INSPECTION AND RELEASE

6.1 The Supplier may be required to provide a documentation and certification package for each batch of material or the complete order. This package should contain documentation as required by the Purchase Order. This may include but not be limited to the following:-

- (a) material test certificates including any special test reports, heat treatment details and test pressures
- (b) NDT Reports
- (c) dimensional inspection reports,



- (d) logging reports,
- (e) tally sheets with weights
- (f) other reports of inspections carried out by third parties, e.g. thread inspection, drifting.

6.2 In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

STOCKIST SUPPLIED LINE PIPE AND CASING

PARA REF	ACTION	YES	NO	N/A
3.1	Material/certification check? Traceability check?			
4.2	Material/storage area check?			
4.2	O/All condition of material check?			
4.3/4.4	Any rejects in sample selection? Final percentage inspection?			
4.3	Check Inspections Straightness Mechanical condition (internal/external) Identification/traceability/certification (100%) End thickness check and squareness (where appl) End bevel dimensions (where applicable) Threading condition & couplers Threading dimensions o/d, i/d. w/t, ovality, etc. Drifting Peaking Weld cap height (where applicable) Logging Lengths			
5.1	Handling, preservation and packaging checked?			
5.2	Coating checked?			
6.0	FINAL INSPECTION AND RELEASE			
	Check all inspections complete?			
	Documentation package review?			
	Inspection release note issued?			



**GUIDE TO PURCHASER INSPECTION REQUIREMENTS
AGAINST CRITICALITY REQUIREMENTS**

STOCKIST SUPPLIED LINE PIPE & CASINGS

ACTION	I	II	III	IV
Check material certification and traceability?	Yes	Yes	Yes	No
Check condition of all material?	Yes	Yes	R	No
Checks/inspections required:				
Mechanical condition	Yes	I	I	No
Identification/traceability	Yes	Yes	I	No
Certification	R	R	R	No
End thickness & squareness	Yes	I	R	No
End bevel dimensions	Yes	I	R	No
Threading condition & couplers	Yes	I	I	No
Threading dimensions	Yes	I	R	No
O/D, I/D, W/T, Ovality	Yes	I	R	No
Drift	Yes	I	R	No
Peaking	Yes	I	I	No
Logging	Yes	I	R	No
Weld cap height?	Yes	I	I	No
Impact/Hardness Testing	Yes	R	R	No
Lengths	Yes	I	R	No
Handling, preservation and packaging procedures approved?	R	R	No	No
Handling, preservation and packaging monitored & accepted?	M	M	No	No
FINAL INSPECTION AND RELEASE				
All inspections complete and accepted?	Yes	Yes	Yes	No
Documentation package reviewed and accepted?	Yes	Yes	Yes	No
Inspection release note issued?	Yes	Yes	Yes	No

LEGEND: YES=100%, I=SAMPLE INSPECTION (RANDOM 10% MINIMUM SAMPLE OR AT THE DISCRETION OF THE INSPECTION ENGINEER). SEE SECTION 4 FOR OTHER DETAIL, NO=NOT REQUIRED, R=REVIEW DOCUMENTATION, N/A=NOT APPLICABLE



PROCEDURE 15 - RECIPROCATING COMPRESSORS

1. SCOPE

- 1.1 This procedure covers the inspection and testing of Reciprocating Compressors.
- 1.2 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to criticality 1 items only. Where lower criticalities are appropriate, a suitable inspection programme should be established for that criticality.

2. RELATED DOCUMENTATION

API 618	Reciprocating Compressors for General Refinery Services.
BP Group GS 134-6	Reciprocating Compressors to API 618.
BS 5304	Code of practice safeguarding of machinery.
BS CP 3004	Guarding of machinery
BS Group GS 118-3	General standard for welded fabrication and construction.
BP Group GS 118-4	Storage and control of welding consumables.
BP Group GS 106-2	Painting of Metal surfaces.

3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of manufacture of the equipment, the supplier should produce an Inspection & Test Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..



- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

3.2 The purchaser may require to carry out an initial visit to the supplier's works to ensure that the facilities required to carry out specialised purchase order requirements are available and acceptable prior to the commencement of the work.

Acceptance Criteria:- Purchase order and related specifications.

3.3 Material Certification & Traceability

Any requirements for material certification and traceability should be stated in the purchase order specifications. The supplier should maintain records of material certification and identification as required.

Checks should be made to verify compliance with traceability requirements particularly for pressure containing, process wetted and load bearing parts.

Where hard stamping is used to identify material, low stress die stamps are to be used on low temperature materials.

The requirements of BP Group [GS 136-1](#) normally apply to material for sour service as defined by that standard.

Acceptance Criteria: [DIN 50049](#), BP Group [GS 136-1](#).

4. WELDING

4.1 Welders

Welds should be made by qualified welders only.

4.2 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group [GS 118-4](#) also gives advise on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables; At the discretion of the



Inspector this may include the cut out of any welds that have been completed with the out-of-specification consumables. (see below)

4.3 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the weld should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or requalify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

4.4 Hydrogen Induced Cracking

Where hydrogen induced cracking is possible, consideration should be given to delaying NDT until 48 hours after welding is completed. - refer to [BS 5135](#) for guidance.

4.5 All repairs to welds should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval.

Major casting repairs may require the specific approval of the purchaser.

Major excavations should be examined by the Inspector.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

Records of casting repairs should be kept. These should record the nature, location and depth of defects, the weld procedure(s) used and NDT techniques employed and include NDT and heat treatment records.

5. HEAT TREATMENT

Heat treatments should be carried out in accordance with documented procedures.

The Inspector should verify compliance of any such heat treatment with the requirements.



NOTE: Where re-heat treatment is carried out after a local weld repair, the method and procedure should be agreed by the Purchaser.

The Inspector should review the heat treatment records.

6. NDT

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION - All welds and castings should to be visually examined.
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials.
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION - The primary method of volumetric weld examination.
- (e) ULTRASONIC EXAMINATION - Applicable primarily to volumetric examination of castings and forgings.

7. PRE-ASSEMBLY

- 7.1 NDT on components should be completed and witnessed by the Inspector as indicated in the Inspection and Test Plan prior to assembly i.e. crankshafts, connecting rods, crossheads, flywheel bores.
- 7.2 Crankcase sumps should be checked for leaks by means of filling with oil or kerosene or any other medium which may be specified. Welded construction crankcases should have all welds inspected.



8. ASSEMBLY

The Inspector should ensure that the following checks are carried out:-

- 8.1 Correct fitting of valves, valve unloaders and clearance pockets together with their free operation with the springs in the housings.
- 8.2 When balance weights are fitted, these should fit tightly with no side clearance on the horns.
- 8.3 With compressors having an integral flange mounted motor or other driver, the motor should be in position and the truth of the motor coupling checked before fitting with reference to the flange spigot. Equally, the mating flange and spigot on the compressor should be checked (by rotating the crankshaft) with clock gauge readings.
- 8.4 Bearing clearances should be taken by appropriate means and the readings recorded. Care should be taken to ensure that the bearing shells are correctly aligned in the housings and that they are not loose therein. Details of bearings should be recorded.
- 8.5 Lubricating oil piping and seal oil piping should be examined for cleanliness and the materials of manufacture should be stated.
- 8.6 Relief valves should be tested for set point and capacity and the blow-off and re-seat pressures recorded.
- 8.7 Piston diameters, liner diameters and other wearing dimensions should be recorded in the report. Piston end clearances (Bump clearance) should be witnessed and recorded. Details of piston rings should be given.

9. RUNNING TESTS

The Inspector should witness/carry out the following:-

- 9.1 The compressor unloaded run test. The test should be carried out at maximum speed for a period of 4 hours or until the load taken by the driving motor is constant.
- 9.2 During the test the complete compressor should be examined for any signs of joint leakage.
- 9.3 The test record to be kept during the running test should be agreed with the manufacturer and it should include all readings taken during the test including bearing temperature, oil pressures and temperatures, water flow rates and quantities.



- 9.4 The extent of the performance testing required at the manufacturer's works should be specified in the order and such tests should be witnessed. The record of performance tests, whether taken in the manufacturer's works or on site should be sufficient to enable the performance characteristics to be calculated in accordance with [ASME PTC9](#).
- 9.5 After the running test the compressor should be dismantled sufficiently to allow the Inspector to examine the bores and piston rods.
- 9.6 Filters and strainers should be examined after the test for swarf or foreign material and the source of such material should be ascertained.
- 9.7 Alignment details should be re-checked as required.
- 9.8 Gears and gear boxes should normally be examined internally after test and findings recorded and reported.
- 9.9 Although control consoles are not usually used for the control of compressors during the running test (unless specified) the consoles should be checked for conformity with the purchase order and specifications, with independent tests carried out as required

Acceptance Criteria:- P.O. Specifications.

10. DIMENSIONS

The Inspector should carry out the following checks:-

- 10.1 Dimensions should be checked against the manufacturer's approved drawings to cover all salient dimensions, inlet and flange details and positions, mating flanges, etc.
- 10.2 Where the compressor is such that it is not being run with its own driver, then the dimensions taken should be such as to ensure the correct assembly of the completed unit on site.
- 10.3 A trial assembly should be made of all pipework and manifolds or a record taken where such provision is not possible, with a check that such pipe is properly cleaned.
- 10.4 Check that the rotation and the rotational indication arrow are correct to the approved drawing.

Acceptance criteria:- Approved drawings.



11. HANDLING, PRESERVATION, PACKAGING & TRANSPORT

11.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.

11.2 The Inspector should monitor the preservation, handling and packaging of the equipment.

The Inspector should, during monitoring, ensure the following:-

- (a) Movement of rotating or reciprocating elements are to be blocked to prevent damage in transit by sliding. Equipment to be clearly labelled as to mechanical restraints used.
- (b) Equipment is labelled, warning of any inhibitors or desiccants used.

11.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT. When spreader bars or other equipment are to be supplied, these should be provided with proof load test certification issued by an approved statutory lifting equipment test house and marked accordingly.

11.4 The Inspector should carry out inspection of any coatings as required by the purchase order and the Inspection and Test Plan.

11.5 Items of equipment may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria:- Purchase Order Specification, BP Group [GS 106-2](#), Applicable Lifting Equipment Legislation

12. FINAL INSPECTION & RELEASE

12.1 The supplier should provide a documentation and certification package for each Reciprocating Compressor.

12.2 The format and contents of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

RECIPROCATING COMPRESSORS

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan reviewed and approved?			
3.1	All calculations, drawings and design data approved?			
3.1	All documents in use are latest approved revisions?			
3.1	Inspection and test procedures approved?			
3.1	NDT procedures approved?			
3.1	All test procedures approved?			
3.1	All major sub-suppliers are approved?			
3.1	All handling, packing, etc. approved?			
3.2	Manufacturing areas reviewed & approved?			
3.3	Material certification records reviewed and approved?			
4.5	Repair procedures approved?			
6.	NDT procedures approved?			
7.1	NDT on components witnessed and accepted?			
7.3	Crankcase sump checked for leaks?			
8.	Correct fittings of valves and operation?			
	Balance weights fitted?			
	Compressor/motor drive couplings checked?			
	Bearing clearances taken?			
	Lube oil and seal oil piping examined for cleanliness?			
	Material type recorded?			
	Relief valves tested?			
	Re-seat pressure stated?			
	Piston and liner diameters recorded?			
	Piston clearance (bump) witnessed, recorded?			
	Piston ring particulars recorded?			
9.1	Compressor unloaded run test witnessed?			
9.2	Any joint leaks detected during the run test?			
9.3 & 9.4	All run test readings taken during test?			
9.5	Piston bores and rods examined after test?			



PARA REF	ACTION	YES	NO	N/A
9.6	Filters & strainers examined for contamination after test? Source of contamination (if any) identified?			
9.7	Alignment details rechecked?			
9.8	Gear & gear boxes examined internally after test?			
9.9	Control consoles examined? Independent tests carried out?			
10.1	Dimensional checks carried out?			
10.4	Rotation & rotational indication arrows correct to approved drawings?			
11.1	Handling, preservation and packaging procedures approved?			
11.2	The monitoring of handling, preservation and packaging approved?			
11.3	Lifting attachments inspected and fully certified?			
11.4	Coating inspected?			
11.5	Compressor weighed?			
12.	All inspections and tests complete?			
	Documentation reviewed and approved?			
	Release note issued?			



PROCEDURE 16 - SHOP FABRICATED PIPEWORK

1. SCOPE

- 1.1 This procedure covers the inspection and testing of shop fabricated pipework in a manufacturer's works.
- 1.2 The following categories of pipework are covered by this procedure:-
- (a) carbon and carbon manganese steel pipework,
 - (b) alloy steel pipework,
 - (c) austenitic and duplex steel, cupro-nickel and nickel based alloy pipework.
- 1.3 Fabrication shall mean bending, welding tubes or pipes together, attachment of flanges, branches and nipples, etc.
- Welded pipe and fittings, where allowed by the purchase order specifications, should normally be bought in by the fabricator to ASTM/ANSI standards but in some circumstances large diameter pipe may be longitudinally seam welded by the pipework fabricator in which case the purchaser should agree base materials, weld procedures and NDT techniques and extent.
- 1.4 It should be noted that the narrative sections of this procedure relate to criticality 1 items only. Inspection requirements for criticality 2, 3 and 4 items are detailed in the inspection summary list at the end of this procedure.

2. RELATED DOCUMENTS

BP Group [GS 118-4](#) Storage and Control of Welding Consumables

BP Group [GS 118-5](#) Fabrication of Carbon and Carbon Manganese Steel Pipework

BP Group [GS 118-6](#) Fabrication of Alloy Steel Pipework

BP Group [GS 118-7](#) Fabrication of Austenitic and Duplex Steel Pipework, Cupro-nickel and Nickel Based Pipework

[ANSI B31.3](#) Chemical Plant and Petroleum Refinery Piping



ASME

Boiler and Pressure Vessel Code, Section IX Welding and Brazing Qualifications

BS 2910

Methods for Radiographic Examination of Fusion Welded Circumferential Butt Welds in Steel Pipe

3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of fabrication of pipework the supplier will produce an Inspection & Test Plan for approval.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

Acceptance Criteria: Purchase Order and related specifications

3.2 Material Certification & Traceability

The supplier should maintain records of material certification and identification. Unless otherwise agreed test certificates should be mill originals, or verified true copies.

Traceability requirements should be stated in the purchase order specifications.

Checks should be made to verify compliance with traceability requirements particularly for pressure containing and load bearing parts.

Where hard stamping is used to identify material, low stress die stamps are to be used on low temperature materials.

The requirements of BP Group [GS 136-1](#) normally apply to material for sour service as defined by that standard.



Acceptance Criteria: [DIN 50049](#), BP Group [GS 136-1](#)

NOTE: Stamping is not normally allowed on austenitic steels and cupro-nickel or nickel base alloy materials. These materials should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Acceptance Criteria: Purchase Order Specifications,
BP Group [GSs 118-5, 118-6](#) and [118-7](#)

3.3 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage including the following as appropriate.

- (a) the description and location of material and material test certificates used,
- (b) the welder identification for each weld or group of welds and weld procedure used.
- (c) the records of NDT and visual weld examination,
- (d) the dimensional control and inspection records,
- (e) pressure test records and gauge identification.
- (f) heat treatment records.
- (g) marked-up isometric drawings,
- (h) Concession applications and non-conformance records

3.4 Pipework Marking

All pipework should be identified to the Inspector's satisfaction or as required by the purchaser. Each sub-assembly should carry identification to the isometric and item number. (See NOTE Section 3.2 above.)

Acceptance Criteria: BP Group [GSs 118-5, 118-6](#) and [118-7](#).,
Purchase Order Specification.

4. FABRICATION, ASSEMBLY AND ERECTION

4.1 Fabrication Areas

Work areas where fabrication, assembly and erection are to occur should to be clean and uncluttered. If welding work is to occur out of



doors, the fabrication area should be protected from the elements and where necessary, heated.

Where stainless steels and non-ferrous metals are being fabricated, the area to be used should be quite separate from that used for carbon and low alloy steels. Separate and clearly identified sets of cleaning and grinding equipment should be maintained for each material.

NOTE: In some instances e.g. where high alloy materials are utilised for low temperature or clean duty as distinct from corrosive applications, the above requirement may sometimes be relaxed. In case of doubt and in the absence of any specified requirement the Inspector should seek guidance from the Purchaser.

The Purchaser may require to inspect and approve fabrication areas and where applicable, the equipment to be used, before fabrication work can start.

Acceptance Criteria: BP Group [GSs 118-5, 118-6 and 118-7](#)

4.2 Fit-up and Tacking

the Inspector should monitor the weld preparation, fit up and tacking of welded joints as indicated in the Inspection & Test Plan.

Tack welding should be carried out by qualified welders in accordance with the applicable welding procedure.

Acceptance Criteria: Approved Welding Procedures, BP Group [GSs 118-5, 118-6 and 118-7](#)

4.3 Welding

4.3.1 General

Witness of weld procedure qualification testing may be required.

Welds should be made by qualified welders only.

4.3.2 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group [GS 118-4](#) also gives advice on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables; At the discretion of the Inspector this may include the cut out of any welds that have been completed with the out-of-specification consumables. (see below)

4.3.3 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the weld should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or requalify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

4.3.4 Hydrogen Induced Cracking

Where hydrogen induced cracking is possible, consideration should be given to delaying NDT until 48 hours after welding is completed. - refer to [BS 5135](#) for guidance.

Acceptance Criteria: Approved Welding Procedures
BP Group [GS 118-4](#)
BP Group [GS 126-1](#) and [126-2](#)
P.O. Specification

4.4 Bending and Forming

The Inspector should verify or otherwise assure himself that wall thicknesses after bending or forming are not less than the design minimum. A visual inspection should also be carried out supplemented as appropriate by NDT by a suitable technique to investigate any suspect areas..

When heat treatment is required, pre- or post-forming the Inspector should verify compliance with requirements and review heat treatment records.

All pipe bending shall be carried out in accordance with an approved procedure.

Acceptance Criteria: Pipe Bending Procedure.
Heat Treatment Procedure.

4.5 Heat Treatment

Post-weld heat treatments should be carried out in accordance with documented procedures.

The Inspector should verify compliance of any such heat treatment with the requirements.



The Inspector should review the heat treatment records.

Acceptance Criteria: Approved Heat Treatment Procedure.
BP Group [GSs 118-5, 118-6 and 118-7](#),
[ANSI B31.3](#)

4.6 NDT

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION - All welds should be visually examined.
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION - The primary method of volumetric weld examination.
- (e) ULTRASONIC EXAMINATION - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing, or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

Where sample examination of welds is specified, the Inspector should nominate the welds to be examined, taking care to ensure that all welders and procedures are covered. To achieve this coverage the specified percentage may require to be exceeded. Any indication from sample examination that a welder or equipment etc., is faulty should necessitate further examination and in the case of gross or extensive defects 100% of the sampled lot is usually necessary.

Acceptance Criteria: BP Group [GSs 118-5, 118-6 and 118-7](#), [ANSI B31.3](#), P.O. & Project Specifications



4.7 Weld Repairs and Cut Outs

All repairs to welds should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval.

Two unsuccessful repairs at the same location should normally necessitate the weld to be cut out and remade, unless a proposal to carry out a further repair is agreed by the Purchaser.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

Acceptance Criteria: Approved Welding Procedure. P.O. Specifications. BP Group [GSs 118-5, 118-6 and 118-7, ANSI B31.3](#).

4.8 Dimensional Control

The following checks should be carried out:

- (a) Dimensions in accordance with the latest revision of the piping drawing/isometric (including major dimensions and any weld bevels).
- (b) Squareness of flanges to the pipework and the flatness and finish of the flange faces.
- (c) Where pipework is to be supplied with field weld ends, care is to be taken to ensure that sufficient extra material is left in accordance with the approved drawing etc.
- (d) Recommended dimensional tolerances of fabricated pipework are covered in BP Group [GSs 118-5, 118-6 and 118-7](#).

Acceptance Criteria: Approved Drawings,
BP Group [GSs 118-5, 118-6 and 118-7](#).

5. PRESSURE TESTING

5.1 General

Pressure testing should be carried out in accordance with documented procedures. Test pressures may be specified by the purchaser or be determined from the design code and should be verified by the Inspector.

The risk of brittle fracture during pressure testing may be an important consideration for some materials as could the risk of freezing. Heating of the test medium may be necessary.



The Inspector should witness pressure testing as indicated in the inspection and test plan.

5.2 Hydrostatic Testing

Hydrostatic test media other than water should be agreed by the Purchaser.

Any limits on water impurity levels should be checked/verified to be in accordance with specified requirements.

5.3 Pneumatic Testing

Whenever pneumatic strength testing has been specified or agreed, the Inspector should give careful consideration to the inherent dangers of such testing and should not participate in the witness of testing whenever it is clear that any safety aspect may have been compromised. In particular, the following points should be addressed:-

- (a) The extent of NDT required to provide assurance of integrity. Where prior hydrostatic testing to a higher pressure is not to be carried out, NDT should be to the maximum extent.
- (b) The test medium should be non-toxic and non-flammable.
- (c) 110% of design pressure should not be exceeded. Some form of overpressure protection may be necessary and at least two recently calibrated gauges should be used without intervening valves or other restrictions.
- (d) The possibility of brittle fracture occurring during testing should be considered.

6. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 6.1 The supplier should have, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.
- 6.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 6.3 The Inspector should carry out inspection of any coatings as required by the purchase order and the inspection and test plan.

Acceptance Criteria: Purchase Order Specification. BP Group [GS 106-2](#).



7. FINAL INSPECTION AND RELEASE

7.1 The Supplier should provide a documentation and certification package for each isometric drawing number. This package should contain documentation as required by the Purchase Order and may include but not be limited to the following:-

- (a) pipe material test certificates including any special test reports and other raw material test certificates.
- (b) fittings material and test certificates,
- (c) welding procedures, welding procedure qualification records and welder qualification records,
- (d) heat treatment records,
- (e) NDT procedures, reports and operator qualifications,
- (f) marked up isometric drawings showing welding identifications, NDT report Nos., and material traceability when required.
- (g) pressure test certificates, pressure gauge calibration certificates and water purity certificates,
- (h) dimensional inspection reports,
- (i) signed off Inspection and Test Plans,
- (j) weight control reports.

The format of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the piping and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

SHOP FABRICATED PIPEWORK

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan reviewed and approved?			
3.1	All pipework drawings and specifications submitted and approved?			
3.1	All welding procedures and approved and qualification testing witnessed (if required)?			
3.1	Welders qualified and approved?			
3.1	Heat treatment procedures approved?			
3.1	NDT procedures approved and operators qualified?			
4.1	All major sub suppliers are approved?			
3.1	Hydrotest procedures approved?			
3.1	All handling, packing, etc. are approved?			
3.2	Material received inspected and material certificates reviewed and accepted?			
3.4	All pipework marked in accordance with approved method?			
4.1	Fabrication area(s) inspected and approved?			
4.3	Fit up and tacking of welded joints and fittings monitored and acceptable?			
4.3	Welding monitored and pre-heat and interpass temps acceptable?			
4.4	Bending and forming of pipework monitored and accepted?			
4.5	Heat treatment monitored and reports and charts approved?			
4.6	NDE reviewed and reports approved?			
4.7	Weld repairs/cut-outs monitored and accepted? Heat treatment re-done?			



PARA REF	ACTION	YES	NO	N/A
	PRESSURE TESTING			
5.	Test site & equipment checked and accept?			
5.2	Test medium checked for purity?			
5.3	Pneumatic or gas testing safety checks carried out?			
	Test carried out and accepted?			
6.	Handling, preservation and packaging procedures approved and issued?			
6.	Handling, preservation and packaging monitored and accepted?			
7.0	FINAL INSPECTION AND RELEASE			
	All inspections complete and accepted?			
	Documentation package reviewed and accepted?			
	Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATINGS

SHOP FABRICATED PIPEWORK

ACTION	I	II	III	IV
Inspection and Test Plan reviewed and approved?	Yes	R	No	No
All pipework drawings and specifications submitted and approved?	Yes	Yes	No	No
All welding procedures witnessed and approved?	R	R	R	No
Welders qualifications witnessed and approved?	R	R	R	No
Heat treatment procedures approved?	R	R	R	No
NDE procedures approved, NDE operators qualified?	R	R	R	No
All major sub-suppliers approved?	Yes	Yes	No	No
Hydrotest procedures approved?	R	R	R	N/A
Material received inspected and material certificates reviewed and accepted?	R,M	M,R	R	No
Manufacturing records to be compiled and approved?	R,M	M,R	No	No
All pipework to be marked in accordance with approved method?	R,M	M,R	No	No
Fabrication area(s) to be inspected and approved?	Yes	M	R	No
Fit up and tackling of welded joints and fittings to be checked and accepted?	M	M	No	No
Welding to be checked and pre-heat and interpass temperatures accepted?	M	M	No	No
Bending and forming of pipework to be checked and accepted?	M	M	No	No
Heat treatment checked and reports and charts approved?	R,M	M,R	R	No
NDE reviewed and reports approved?	R,M	M,R	R	No
Weld repairs/cut outs monitored and NDE accepted? Heat treatment re-done	M,R	M,R	R	No
Main dimensions checked and accepted?	Yes	Yes	I,R	No



ACTION	I	II	III	IV
PRESSURE TESTING				
Test sites & equipment checked & accept?	Yes	M,R	No	No
Test medium to be checked for purity?	Yes	No	No	No
Pneumatic or gas testing safety checks to be carried out?	Yes	Yes	M	No
Tests carried out, witnessed and accepted?	Yes	Yes	M,R	No
Handling, preservation and packaging procedures approved?	R	R	R	R
Handling, preservation and packaging monitored and accepted?	M	M	No	No
FINAL INSPECTION AND RELEASE				
All inspections complete and accepted?	Yes	Yes	M,R	No
Documentation package reviewed and accepted? Yes	Yes	Yes	Yes	No
Inspection release note issued?	Yes	Yes	Yes	No

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, I=SAMPLE INSPECTION, M=MONITOR (PROCESS OR ACTIVITY), N/A=NOT APPLICABLE.

NOTE:- WHERE R IS USED FOR AN APPROVAL ACTIVITY, THE PURCHASER'S INSPECTOR SHALL APPROVE THE DOCUMENT RATHER THAN THE SPECIALIST ENGINEER



PROCEDURE 17 - STEAM AND GAS TURBINES

1. SCOPE

1.1 This procedure covers the inspection and testing of steam and gas turbines of the following types:-

- (a) General purpose steam turbines in accordance with [API 611](#)
- (b) Special purpose steam turbines in accordance with [API 612](#) and BP Group [GS 134-7](#)
- (c) Industrial combustion gas turbines in accordance with [API 616](#) and BP Group [GS 134-12](#), and aero derivative gas turbines

NOTES:

General Purpose Steam Turbines are defined as those horizontal or vertical turbines used to drive equipment that is usually duplicated, is relatively small in size (Max 600 KW [670 HP]) or is in non-critical service.

Special Purpose Steam Turbines are defined as those horizontal turbines that are used to drive equipment that is not spared, is relatively large in size, or is in critical service.

Aero Derivative Gas Turbines should be inspected in compliance to BP Group [GS 134-12](#) as far as is practicable.

1.2 It should be noted that it is assumed that all steam and gas turbines will be criticality 1 rated equipment. Therefore no inspection requirements are listed for criticality 2, 3 or 4.

2. RELATED DOCUMENTS

BP Group [RP 34-1](#) Rotating Machinery.

BP Group [GS 134-7](#) Special Purpose Steam turbines to API 612

BP Group [GS 134-12](#) Type H Industrial Combustion Gas Turbines to API 616

[API Std 611](#) General Service Steam Turbines for Refinery Service.

[API Std 612](#) Special Purpose Steam Turbines for Refinery Service.

[API Std 616](#) Type H Industrial Gas Turbines for Refinery Service



3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of assembly of steam or gas turbines the supplier should produce a Inspection & Test Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals (including statutory approvals) of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.
- (a) All calculations, drawings and design data, including statutory authority approvals etc., are reviewed and approved.

Acceptance Criteria: Purchase Order and related specifications

3.2 Functional Testing Schedule

The Supplier should prepare a Functional Testing Schedule. This schedule should detail all the tests to be carried out to the designated unit. It should also describe the design parameters to be achieved by the designated unit under test.

The Functional Test Schedule should also make provision for the approval and acceptance of the test and the results by the necessary approval authorities (Purchaser, Certifying Authority, etc.)

Acceptance Criteria: Purchase Order and related specifications

3.3 Material Certification & Traceability

Material certification and traceability requirements should be stated in purchase order specifications.

The supplier should maintain records of material certification and identification as required. Unless otherwise agreed test certificates should be mill originals, or verified true copies.



Checks should be made to verify compliance with traceability requirements particularly for pressure containing, process wetted and load bearing parts.

Acceptance Criteria: Purchase Order Specification.
API Standards.

3.4 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage containing;

- (a) the description and location of material and material test certificates used,
- (b) welder identification for each weld and procedures used,
- (c) records of NDT and visual examinations
- (d) dimensional control and inspection records,
- (e) pressure test reports and gauge identification,
- (f) unit instrumentation calibration records
- (g) balancing records,
- (h) approved concession application/non-conformance records.

Acceptance Criteria: Purchase Order
QA Requirements

4. MANUFACTURING, ASSEMBLY AND ERECTION

4.1 Manufacturing Areas

Work areas where fabrication, assembly and erection are to occur should be clean and uncluttered. If welding work is to occur out of doors, the fabrication area should be protected from the elements and where necessary, heated.

Where stainless steels and non-ferrous metals are being fabricated, the area to be used should be quite separate from that used for carbon and low alloy steels. Separate and clearly identified sets of cleaning and grinding equipment should be maintained for each material.

NOTE: In some instances e.g. where high alloy materials are utilised for clean duty as distinct from corrosive applications, the above requirement may sometimes be relaxed. In case of doubt and in the absence of any specified requirement the Inspector should seek guidance from the Purchaser.



The Purchaser may require to inspect and approve fabrication areas and where applicable, the equipment to be used, before fabrication work can start.

Acceptance Criteria: Purchase Order Specifications

4.2 Heat Treatment

Post-weld and stress relieving heat treatments should be carried out in accordance with documented procedures.

The Inspector should verify compliance of any such heat treatment with the requirements.

NOTE: Where re-heat treatment is carried out after a local weld repair, the method and procedure should be agreed by the purchaser.

The Inspector should review the heat treatment records.

Acceptance Criteria: Approved Heat Treatment Procedure.

4.3 Non-Destructive Testing (NDT)

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION - All welds and castings should be visually examined.
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION - The primary method of volumetric weld examination.
- (e) ULTRASONIC EXAMINATION - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing,

or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

Where sample examination of welds is specified, the Inspector should nominate the welds to be examined, taking care to ensure that all welders and procedures are covered. To achieve this coverage the specified percentage may require to be exceeded. Any indication from sample examination that a welder or equipment etc., is faulty should necessitate further examination and in the case of gross or extensive defects 100% of the sampled lot is usually necessary.

Acceptance Criteria: BP Group [GSs 118-5, 118-6 and 118-7](#),
[ANSI B31/3](#), P.O. Specifications

4.4 Weld Repairs of Castings

All repairs should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval.

Specific purchaser approval of major repairs may also be required.

Major excavations should be examined by the Inspector.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

Records of casting repairs should be kept. These should record the nature, location and depth of defects, the weld procedure(s) used and NDT techniques employed and include NDT and heat treatment records.

Acceptance Criteria: Approved Welding Procedure.
P.O. Specifications.

4.5 Dimensional Control

The Inspector should check major dimensions during manufacturing, assembly and erection in accordance with the latest revision of the manufacturing specification and drawings etc.

Acceptance Criteria: Approved Drawings



5. PRESSURE TESTING

5.1 General

Pressure testing should be carried out in accordance with documented procedures. Test pressures may be specified by the purchaser or be determined from the appropriate API or ANSI standard and should be verified by the Inspector.

The Inspector should witness pressure testing as indicated in the Inspection and Test Plan.

The risk of brittle fracture during pressure testing may be an important consideration for some materials. Heating of the test medium may be necessary.

5.2 Hydrostatic Testing

Hydrostatic test media other than water should be agreed by the Purchaser.

Any limits on water impurity levels should be checked/verified to be in accordance with specified requirements.

5.3 Pneumatic Testing

Whenever high pressure pneumatic testing has been specified or agreed, the Inspector should give careful consideration to the inherent dangers of such testing and should not participate in the witness of testing whenever it is clear that any safety aspect may have been compromised. In particular, the following points should be addressed:-

- (a) The extent of NDT required to provide assurance of integrity.
- (b) Hydrostatic testing as above should always be carried out prior to high pressure pneumatic testing.
- (c) The test medium should be non-toxic and non-flammable.
- (c) 110% of design pressure should not be exceeded. Some form of overpressure protection may be necessary and at least two recently calibrated gauges should be used without intervening valves or other restrictions.

6. FUNCTIONAL TESTING

6.1 General Purpose Steam Turbines

- 6.1.1 Performance testing should fulfil the requirements of [API 611](#) and any special requirement stated in the order.
- 6.1.2 Mechanical run testing should fulfil the requirements of [API 611](#) and any special requirement stated in the order.
- 6.1.3 The performance of governors and speed regulating devices, including overspeed and trip valve should be tested and the results recorded in the inspection report.
- 6.1.4 Vibration readings should be recorded. Where vibration instruments are included in the supply, these should be used in the tests.
- 6.1.5 On completion of tests, bearings and seals should be opened up for examination.
- 6.1.6 On completion of tests, oil filters and strainers should be opened and examined for contamination by swarf, scale, etc. The source of any foreign matter should be determined.
- 6.1.7 Where dismantling, inspection and re-assembly of the turbine after running tests is required by the order, a careful examination should be made for signs of damage to seals, shaft and blading.

6.2 Special Purpose Steam Turbines

- 6.2.1 Performance testing should fulfil the requirements of [API 612](#), BP Group [GS 134-7](#) and any special requirements stated in the order.
- 6.2.2 Mechanical run testing should fulfil the requirements of [API 612](#), BP Group [GS 134-7](#) and any special requirements stated in the order.
- 6.2.3 The performance of governors and speed regulating devices, including overspeed and trip valve should be tested and the results recorded.
- 6.2.4 Vibration readings should be recorded. Where vibration instrumentation is included in the supply, these should be used in the tests.
- 6.2.5 On completion of tests, bearings and seals should be opened up for examination.

6.2.6 On completion of tests, oil filters and strainers should be opened and examined for contamination by swarf, scale etc. The source of any foreign matter should be determined.

6.2.7 Where dismantling, inspection and re-assembly of the turbine after running tests is required by the order, a careful examination should be made for signs of damage to blading, shaft and seals.

6.3 Gas Turbines

6.3.1 Performance testing should fulfil the requirements of [API 616](#) and BP Group [GS 134-12](#) and any special requirements of the order.

6.3.2 Mechanical running tests should fulfil the requirements of [API 616](#), BP Group [GS 134-12](#) and any special requirements of the order.

6.3.3 Duration of test should be for a minimum of 4 hours and should cover the specified operating speed range.

6.3.4 Each turbine should be complete with all its auxiliary equipment, instrumentation and controls. Transistorised instrumentation and controls should be given a prolonged soak testing as these components may give trouble during commissioning and site operation.

6.3.5 Temperature recording at the turbine exhaust or combustion chamber outlet flange (t max.) is critical. Instrumentation for this duty must be accurate, quickly responsive to temperature change and robust.

6.3.6 The performance of governors and speed regulating devices including overspeed trip should be tested and the results recorded.

6.3.7 The performance of all warning and shut down devices should be tested for correct operation and the results recorded.

6.3.8 Vibration readings should be recorded at each speed/load setting throughout the specified operating range. The type of instrument used should be of a type which permits frequency analysis to be made and should be approved by the purchaser. Vibration readings may be taken at bearing housings or mounting pedestals. Additional points may be requested to give a more complete vibration survey.

6.3.9 Continuous monitoring of all pressure and temperature readings should be carried out and readings recorded.

6.3.10 On completion of testing, sufficient dismantling will be required to permit complete inspection of bearings, blading, and gearing. Complete dismantle of turbine casings is not normally required if performance has been satisfactory. Maximum use of inspection



equipment, e.g. fibre optics, should be made to examine condition of blading and chambers.

- 6.3.11 After test, oil filters and strainers should be opened and examined for contamination by swarf, scale etc. The source of any foreign matter should be determined.

7. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 7.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.
- 7.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- The Inspector should, during monitoring, ensure equipment is clearly labelled as to any mechanical restraints used and any inhibitors or desiccants used.
- 7.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT. When spreader bars or other equipment are to be supplied, these should be provided with proof load test certification issued by an approved statutory lifting equipment test house and marked accordingly.
- 7.4 The Inspector should carry out inspection of any coatings as required by the purchase order and the inspection and test plan.
- 7.5 Items of equipment may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification.
BP Group [GS 106-2](#).
Applicable Lifting Equipment Legislation.

8. FINAL INSPECTION AND RELEASE

The Supplier should provide a documentation and certification package for each Turbine. This package should contain documentation required in the Purchase Order and may include but not be limited to the following:

- (a) material test certificates
- (b) test certificates for the testing carried out in accordance with para 6.0 above.
- (c) approved welding procedures



- (d) statutory lifting equipment test certificates for handling equipment,
- (e) NDT reports
- (f) pressure test certificates and pressure gauge calibration certificates,
- (g) dimensional inspection reports,
- (h) signed off Inspection and Test Plan
- (i) weight control reports.

The format and content of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.

9. ELECTRICAL EQUIPMENT FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES

See Procedure No. 20.



INSPECTION CHECK LIST

STEAM & GAS TURBINES

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan reviewed and approved?			
3.1 ((a)	All drawings and specs submitted and approved?			
3.1 (b)	Checked for latest issue?			
3.1 (c)	All major sub-suppliers approved?			
3.1 (d)	Inspection and test techniques approved?			
3.1 (e)	Functional testing schedule approved?			
3.1 (f)	Handling protection etc. procedures - approved?			
3.3	Material certification records monitored and verified?			
4.1	Manufacturing areas reviewed and approved?			
4.2	Heat treatment operating procedure?			
4.2	Heat treatment operation monitored and accepted?			
	Reports signed off?			
4.3	NDE procedures approved?			
4.3	NDE records approved?			
4.5	Overall dimensions in accordance with approved drawings and specifications?			
5.2	Hydro test procedure approved? Tests witnessed and accepted?			
5.3	Pneumatic test procedures approved? Tests witnessed and accepted?			
	GENERAL PURPOSE STEAM TURBINES			
6.1.1	Performance testing fulfils P.O. requirements and API 611			
6.1.3	Performance tests on Governors, speed regulating devices overspeed and trip valves acceptable and results recorded?			
6.1.4	Are vibration instruments used part of supply?			
	Vibration readings recorded?			
6.1.5	Bearings and seals examined after test?			
6.1.6	Oil filters and strainers examined for completion of tests?			
	Any contamination found?			



PARA REF	ACTION	YES	NO	N/A
6.1.7	Seals, shafts and blading examined for damage after dismantling, following running test?			
	Any damage found?			
	SPECIAL PURPOSE STEAM TURBINES			
6.2.1	Performance testing fulfils P.O. requirements, API 612 and BP Group GS 134-7 ?			
6.2.2	Mechanical run testing fulfils P.O. requirements, API 612 and BP Group GS 134-7 ?			
6.2.3	Performance tests on Governors, speed regulating devices overspeed and trip valves acceptable and results recorded?			
6.2.4	Are vibration instruments used part of supply?			
	Vibration readings recorded?			
6.2.5	Bearings and seals examined after test?			
6.2.6	Oil filters and strainers examined for contamination after completion of tests?			
	Any contamination found?			
6.2.7	Seals, shafts and blading examined for damage after dismantling, following running test?			
	Any damage found?			
GAS TURBINES				
6.3.1	Performance testing fulfils P.O. requirements, API 616 and BP Group GS 134-12 ?			
6.3.2	Mechanical run testing fulfils P.O. requirements, API 616 and BP Group GS 134-12 ?			
6.3.3	Specified operating speed range tested?			
	Minimum test duration of 4 hours carried out?			
6.3.4	Has a prolonged soak test been carried out on auxiliary equipment, instrumentation and controls?			
6.3.5	Has temperature instrument calibration checks been carried out?			
	Temperature checks carried out at Turbine exhaust?			
	Combustion chamber?			
6.3.6	Performance tests on Governors, speed regulating devices overspeed and trip valves acceptable and results recorded?			



PARA REF	ACTION	YES	NO	N/A
6.3.7	All warning and shut down devices tested and results recorded?			
6.3.8	Vibration readings at each speed/load setting recorded?			
6.3.9	Pressure and temperature readings recorded from continuous monitoring of tests?			
6.3.10	Bearings, blading and gearing examined for damage after dismantling following running test?			
6.3.11	Oil filters and strainers examined for contamination after completion of tests?			
	Any contamination found?			
7.1	Handling, preservation and packaging procedures approved?			
7.2	Handling, preservation and packaging monitored and accepted?			
7.4/7.4	Lifting equipment and attachments inspected and fully certified?			
7.5	Coating inspected?			
7.6	Equipment weighed?			
8.	All inspections and tests complete?			
	Documentation reviewed and approved?			
	Inspection release note issued?			



PROCEDURE 18 - STEEL FABRICATION

1. SCOPE

- 1.1 This procedure covers the inspection and testing of steel fabrications in a manufacturer's works.
- 1.2 Fabrication shall mean bending, welding plate or sections together, attachment of fittings etc.
- 1.3 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to criticality 1 items only. Inspection requirements for criticality 2, 3 and 4 items are detailed in the inspection summary list at the end of this procedure.

2. RELATED DOCUMENTS

BP Group [GS 118-3](#) General Standard for Welded Fabrication and Structures.

BP Group [GS 118-4](#) Storage and Control of Welding Consumables.

ASME Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications.

3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of fabrication the supplier should produce an Inspection & Test Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-contractors are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.



- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.

Acceptance Criteria: Purchase Order and related specifications

3.2 Material Certification & Traceability

The supplier should maintain records of material certification and identification. Material test certificates may be required to be mill originals, or verified true copies.

Checks should be made to verify compliance with traceability requirements particularly for process wetted and load bearing parts.

Where hard stamping is used to identify material, low stress die stamps are to be used on low temperature materials.

NOTE: Stamping is not normally allowed on austenitic and Duplex steels and cupro-nickel or nickel base alloy materials. These materials should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Acceptance Criteria: Project or Purchase Order Specification.
[BP Group GSs 118-5, 118-6 and 118-7](#)

3.3 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage including the following as applicable.

- (a) the description and location of material and material test certificates used,
- (b) welding procedure applications.
- (c) the welder identification for each weld, or group of welds.
- (d) the records of NDT and visual weld examination,
- (g) the dimensional control and inspection records,
- (f) marked-up drawings,
- (g) Concession requests

Acceptance Criteria: Purchase Order QA Requirements



3.4 Material Marking

All fabrications should be marked to the satisfaction of the Inspector or as required by the purchaser. Each sub-assembly should carry identification to the drawing and item number.

Acceptance Criteria: Purchase Order Specification.

4. FABRICATION, ASSEMBLY AND ERECTION

4.1 Fabrication Areas

Work areas where fabrication, assembly and erection are to occur should be clean and uncluttered. If welding work is to occur out of doors, the fabrication area should be protected from the elements and where necessary, heated.

Where stainless steels and non-ferrous metals are being fabricated, the area to be used should be quite separate from that used for carbon and low alloy steels. Separate and clearly identified sets of cleaning and grinding equipment should be maintained for each material.

NOTE: In some instances e.g. where high alloy materials are utilised for low temperature or clean duty as distinct from corrosive applications, the above requirement may sometimes be relaxed. In case of doubt and in the absence of any specified requirement the Inspector should seek guidance from the Purchaser.

The Purchaser may require to inspect and approve fabrication areas and where applicable, the equipment to be used, before fabrication work can start.

Acceptance Criteria: BP Group [GS 118-3](#)

4.2 Fit-up and Tacking

The Inspector should monitor the weld preparation, fit up and tacking of welded joints as indicated in the Inspection & Test Plan.

Tack welding should be carried out by qualified welders in accordance with the applicable welding procedure.

Acceptance Criteria: Approved Welding Procedures,
BP Group [GS 118-3](#)

4.3 Welding

Welds should be made by qualified welders only.



4.3.1 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group GS 118-4 also gives advice on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables. At the discretion of the Inspector this may include the cut out of any welds that have been completed with the out-of-specification consumables. (see below)

4.3.2 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the weld should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or requalify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

4.3.3 Hydrogen Induced Cracking

Where hydrogen induced cracking is possible, consideration should be given to delaying NDT until 48 hours after welding is completed. - refer to [BS 5135](#) for guidance.

Acceptance Criteria: Approved Welding Procedures,
BP Group [GS 118-4](#)

4.4 Bending and Forming

A visual inspection should be carried out after bending or forming supplemented as appropriate by NDT by a suitable technique to investigate any suspect areas..

When heat treatment is required the Inspector should verify compliance with requirements and review heat treatment records.

Acceptance Criteria: Bending and Forming Procedure,
Heat Treatment Procedure.



4.5 Heat Treatment

Post-weld and stress relieving heat treatments should be carried out in accordance with documented procedures.

The Inspector should verify compliance of any such heat treatment with the requirements.

NOTE: Where re-heat treatment is carried out after a local weld repair, the method and procedure should be agreed by the Purchaser.

The Inspector should review the heat treatment records.

4.6 NDT

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION - All welds and castings should be visually examined.
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION - The primary method of volumetric weld examination.
- (e) ULTRASONIC EXAMINATION - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing, or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

Where sample examination of welds is specified, the Inspector should nominate the welds to be examined, taking care to ensure that all welders and procedures are covered. To achieve this coverage the specified percentage may require to be exceeded. Any indication from sample examination that a welder or equipment etc., is faulty should

necessitate further examination and in the case of gross or extensive defects 100% of the sampled lot is usually necessary.

Acceptance Criteria: BP Group [GS 118-3](#),
P.O. & Project Specifications

4.7 Weld Repairs and Cut Outs

All repairs to welds should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval.

Two unsuccessful repairs at the same location should normally necessitate the weld to be cut out and remade, unless a proposal to carry out a further repair is agreed by the Purchaser.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

Acceptance Criteria: Approved Welding Procedure,
P.O. Specifications,
BP Group [GS 118-3](#)

4.8 Dimensional Control

The Inspector should check major dimensions of the fabrication in accordance with the latest revision of the construction drawing.

Acceptance Criteria: Approved Drawings

5. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 5.1 The supplier should have, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.
- 5.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 5.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT. When spreader bars or other equipment are to be supplied, these should be provided with proof load test certification issued by an approved statutory lifting equipment test house and marked accordingly.
- 5.4 The Inspector should carry out inspection of any coatings as required by the purchase order and the Inspection and Test Plan.



- 5.5 Items of equipment may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification, BP Group [GS 106-2](#), Lifting equipment legislation.

6. FINAL INSPECTION AND RELEASE

- 6.1 The Supplier should provide a documentation and certification package. This package should contain documentation as required by the Purchase Order and may include but not be limited to the following:-

- (a) material test certificates including any special test reports and raw material test certificates, for all load bearing structures.
- (b) welding procedures, welding procedure qualification records and welder qualification records,
- (c) NDT procedures, reports and operator qualifications,
- (d) heat treatment procedures and records,
- (e) marked up drawings showing welding identifications, NDT report nos., and material traceability when required
- (f) dimensional inspection reports,
- (g) weight control reports.

The format of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the fabrication(s) and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

STEEL FABRICATION

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan reviewed and approved?			
3.1	All drawings, specifications and calculations submitted and approved and are latest issue?			
3.1	All major sub-contractors approved?			
3.1	All welding procedures approved?			
3.1	Welders qualified and approved?			
3.1	Heat treatment procedures approved?			
3.1	NDT procedures approved and operators qualified?			
3.1	Handling etc. procedures approved?			
3.2	Material received inspected and material certificates reviewed and accepted?			
3.3	Manufacturing records being compiled?			
3.4	All marking in accordance with agreed method?			
4.1	Fabrication area(s) inspected and approved?			
4.2	Fit up and tacking of welded joints and fittings monitored and acceptable?			
4.3	Welding monitored including pre-heat and inter-pass temperatures?			
4.4	Bending and forming of steelwork monitored and accepted?			
4.5	Heat treatment monitored and reports and charts stamped approved?			
4.6	NDT monitored and reports accepted?			
4.7	Weld repairs/cut outs monitored and NDT checked? Re-heat treatment carried out?			
4.8	Main dimensions checked and accepted?			
5.1	Handling, preservation and packaging procedures approved?			
5.2	Handling, preservation packaging monitored, accepted?			
5.3	Lifting points NDT checked?			
5.3	Load test certification reviewed?			



PARA REF	ACTION	YES	NO	N/A
6.	FINAL INSPECTION AND RELEASE			
	All inspections complete and accepted?			
	Documentation package reviewed and accepted?			
	Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATINGS

STEEL FABRICATION

ACTION	I	II	III	IV
Inspection and Test Plan reviewed and approved?	Yes	R	R	No
All pipework drawings, specifications and calculations submitted and approved?	Yes	Yes	No	No
All major sub-suppliers approved?	Yes	Yes	No	No
Welding procedures witnessed and approved?	Yes	Yes	m	No
Welders qualifications witnessed and approved?	R	R	M	No
Heat treatment procedures approved?	Yes	R	No	No
NDE procedures approved, NDE operators qualified?	Yes	R	R	No
Load test procedures approved?	Yes	R	R	No
Material received inspected and material certificates reviewed and accepted?	M,R	M,R	R	No
Manufacturing records to be compiled and approved?	R	R	I	No
All material to be marked in accordance with approved method?	M,R	M,R	M,R	No
Fabrication area(s) to be inspected and approved?	Yes	M	No	No
Fit up and tacking of welded joints and fittings to be checked?	M	M	No	No
Welding to be checked and pre-heat and interpass temperatures accepted?	M,R	M	No	No
Bending and forming of pipework to be checked?	M	M	No	No
Heat treatment to be checked and reports and charts stamped approved?	M,R	M,R	R	No
NDE monitored and reports stamped approved?	M,R	M,R	R	No
Weld repairs/cut outs monitored and NDE checked? Re-heat treatment carried out?	M,R	M,R	R	No
Main dimensions checked and accepted?	Yes	Yes	I,R	No
Load test procedure approved?	Yes	R	No	No
Load test witnessed?	Yes	Yes	M,R	R
Handling, preservation and packaging procedures approved?	R	R	R	R



ACTION	I	II	III	IV
Handling, preservation and packaging checked and accepted?	M	M	No	No
FINAL INSPECTION AND RELEASE				
All inspections complete and accepted?	Yes	Yes	M	No
Documentation package reviewed and accepted?	Yes	Yes	I	No
Inspection release note issued?	Yes	Yes	Yes	No

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED (PROCESS/ACTIVITY), I=SAMPLE INSPECTION/CHECK, R=REVIEW DOCUMENTATION/CERTIFICATION, N/A=NOT APPLICABLE

NOTE:- WHERE R IS USED FOR AN APPROVAL ACTIVITY THE PURCHASER'S INSPECTOR SHALL APPROVE THE DOCUMENT RATHER THAN THE SPECIALIST ENGINEER



PROCEDURE 19 - SWITCHGEAR

1. SCOPE

- 1.1 This procedure covers the inspection and test of electrical switchgear.
- 1.2 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to Criticality 1 items only. Inspection requirements for Criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure.

2. RELATED DOCUMENTS

BP Group [RP 12-6](#) High Voltage Switchgear

BP Group [RP 12-7](#) Low Voltage Switchgear

BP Group [GS 112-9](#) High Voltage Switchgear and Control Gear

BP Group [GS 112-8](#) Factory - Built Assemblies of low voltage Switch and Control Gear

3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of manufacture the supplier should produce an Inspection & Test Plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.

Acceptance Criteria: Purchase Order and related specifications



4. MANUFACTURING

4.1 Construction

The Inspector should monitor the construction of switchgear as follows:-

Busbars should be checked to ensure correct mounting and restraint to withstand magnetostrictive forces under short circuit conditions.

Neutral connection arrangements and earthing terminals.

Wiring, instrumentation and relay installation.

Acceptance Criteria: Inspection & Test Plan,
Purchase Order Specifications.

4.2 Dimensional Control

The Inspector should check the following:-

- (a) Overall dimensions and arrangements in accordance with the approved drawings
- (b) Clearance within panels etc. to provide for maintenance and dissipation of heat.

5. TESTING

5.1 General

The Supplier should make available certification verifying that the design has been successfully type tested.

The Inspector should witness the testing of switchgear in accordance with agreed or approved procedures. Tests should comprise, but not be limited to:-

- (a) High voltage testing, on all components, including current transformers and voltage transformers, to the specified voltage withstand levels specified in the relevant code.
- (b) Check calibration of overload trip coil/circuit by current injection method. Where current transformers are installed in switchgear, primary injection testing should be carried out to ensure the correct functioning of protection systems. (See procedure 20 - Transformers and Reactors)
- (c) Pressure Testing

- (d) Resistance testing (if called for), by measuring with a low resistance ohmmeter or by passing a specified current, measuring the voltage drop across the contacts and calculating the resistance.
- (e) Close and open the isolator, contactor, or switchgear five times manually or at rated voltage if automatic, and check that it functions satisfactorily, i.e. no adjustments are allowed during the five testing cycles. If the gear is designed for auto reclose, reclose five times and check satisfactorily operation. These tests should be repeated at 85% and 115% of rated coil operating voltages.
- (f) Dielectric testing, to be carried out at $(2 U_o + 1 K_v)$ for one minute (U_o = rated voltage); between poles with contacts closed (open if there is a short circuit between poles; between frames and poles with main contacts closed; across terminals of each pole with main contacts open, to control all auxiliary circuits).

Acceptance Criteria: Inspection & Test Plan.

5.2 Alarms

Alarm devices should be tested for correct operation. The Inspector should witness testing of alarms.

Acceptance Criteria: Inspection & Test Plan.

6. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 6.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.
- 6.2 The Inspector should monitor the preservation, handling and packaging of the equipment.
- 6.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT. When spreader bars or other equipment are to be supplied, these should be provided with proof load test certification issued by an approved statutory lifting equipment test house and marked accordingly.
- 6.4 The Inspector should carry out inspection of any coatings as required by the purchase order and the Inspection and Test Plan.

- 6.5 Items of equipment may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification,
Applicable Lifting Equipment Legislation.

7. FINAL INSPECTION AND RELEASE

- 7.1 The Supplier should provide a documentation and certification package for the switchgear. This package should include documentation as required by the Purchase Order and may include but not be limited to the following:-

- (a) test certificates for the testing carried out in accordance with Section 5 above.
- (b) statutory lifting equipment test certificates for handling equipment,
- (c) hazardous area certification,
- (d) dimensional inspection reports,
- (e) weight control reports.

The format and content of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.

- 7.2 Electrical Equipment for use in Potentially Hazardous Atmospheres
See Procedure No. 20.



INSPECTION CHECK LIST

SWITCHGEAR

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan reviewed and approved?			
3.1	All drawings and specifications submitted and approved?			
3.1	All manufacturing/testing procedures approved?			
3.1				
	CONSTRUCTION MONITORING/DIMENSIONAL CONTROL			
4.1	Construction being carried out in accordance with approved procedures and specifications?			
4.1	Busbar mounting?			
4.1	Neutral cons and earthing checked?			
4.1	Wiring checks?			
4.2	Overall dimensions in accordance with drawings and specifications?			
4.2	Internal clearance?			
	TESTING			
5.1	Type test certificate availability?			
5.1 (a)	High voltage?			
5.1 (b)	Current injection check of protection systems?			
5.1 (c)	Pressure?			
5.1 (d)	Contact resistance?			
5.1 (e)	Functional?			
5.1 (f)	Dielectric?			
5.2	Alarms tested?			
	HANDLING PRESERVATION AND PACKAGING			
6.	Handling, preservation and packaging procedures approved?			
6.	Lifting equipment tested?			
6.	Lifting frames and slings tested?			
6.	Coating inspected?			



PARA REF	ACTION	YES	NO	N/A
	FINAL INSPECTION AND RELEASE			
7.	All inspections and tests complete?			
7.	Documentation package reviewed and approved?			
7.	Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATING

SWITCHGEAR

ACTION	I	II	III	IV
Inspection and Test Plan review and approval?	Yes	R	No	No
Drawings and specifications approval?	Yes	Yes	No	No
Manufacturing/testing procedures approval?	R	R	No	No
Construction monitoring in accordance with approved procedures and specs?	M	M	No	No
Dimensional check in accordance with drawings and specs? (see Inspection Check List)	Yes	I	I	No
Type test certificate check?	Yes	Yes	No	No
Testing witness? (see Inspection Check List)	Yes	I,R	I,R	No
Handling, preservation and packaging to be approved?	R	R	No	No
Lifting eyebolts test witness? (and certificate issued)	R	R	R	No
Coating to be checked?	Yes	I,R	I,R	No
Final inspection to be carried out? (including preservation and packaging)	Yes	Yes	Yes	No
Documentation package to be reviewed and approved?	Yes	Yes	Yes	No
Inspection release note to be issued?	Yes	Yes	Yes	No

LEGEND: YES=REQUIRED, NO=NOT REQUIRED, M=MONITORED
(PROCESS/ACTIVITY) I=RANDOM INSPECTION/CHECK, R=REVIEW
DOCUMENTATION/CERTIFICATION

(NOTE WHERE R IS USED FOR AN APPROVAL ACTIVITY THE
INSPECTION ENGINEER SHALL APPROVE THE DOCUMENT,
RATHER THAN THE SPECIALIST BP ENGINEER)

WARNING: IN USING THESE CHECK LISTS THE INSPECTION REQUIREMENTS
CONTAINED IN THE PURCHASE ORDER CODES AND STANDARDS
MUST BE CARRIED OUT AS A MINIMUM.



PROCEDURE 20 - SKID MOUNTED ELECTRICAL EQUIPMENT FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES

1. SCOPE

- 1.1 This procedure covers the inspection and test requirements in a manufacturers works for skid mounted electrical equipment for use in potentially explosive atmospheres.
- 1.2 This procedure covers the review of certification and the inspection of equipment.
- 1.3 The inspections detailed are to be carried out in addition to normal electrical testing e.g. insulation testing, earth continuity.
- 1.4 It is assumed that all Electrical Equipment For Use In Potentially Explosive Atmospheres will be rated criticality 1 and therefore all inspection activities detailed in this procedure will be required. Inspection requirements are not therefore specified for criticality 2, 3 or 4.

2. RELATED DOCUMENTS

- [BS 5345](#) Selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres.
- BP Group [RP 12-2](#) Electrical Equipment in Flammable Atmospheres and Combustible Dusts.

3. INVENTORY

- 3.1 It is recommended that Suppliers be required to generate an inventory of all electrical equipment to be installed in skids for hazardous areas (to include instruments with electrical content) and that this be submitted for approval. The following information should be included:-
 - (a) Equipment tag number.
 - (b) Brief description.
 - (c) Manufacturer.



- (d) Model/Type number.
 - (e) Location on skid.
 - (f) Certifying authority. (e.g. BASEEFA)
 - (g) Certificate number.
 - (h) Certificate issue date.
 - (i) Licence expiry date - BASEEFA only.
 - (j) Type of protection. (e.g. Ex d)
 - (k) Apparatus (gas) group. (e.g. IIB)
 - (l) Temperature class. (e.g. T4)
 - (m) IP Rating - if available. (e.g. IP54)
- 3.2 For packages containing a large number of items, the Purchase Order should request the supplier to provide this schedule, the inspection required will hence be a review of the schedule against the equipment installed.
- 3.3 The compilation of the inventory is a time consuming exercise and is best performed on an on-going basis as equipment is installed.
- 3.4 Untagged, bulk and component type items (glands, plugs etc.) should be entered once for each type.

4. CERTIFICATION

- 4.1 Read all the certificates relating to the equipment and check as outlined below:-
- (a) Certificate number and code match that on schedule.
 - (b) Certificate applies to the model/type installed.
 - (c) Area code is suitable for application. (zone, apparatus group and T rating).
 - (d) License (if applicable) is valid.*
 - (e) Take note of any special conditions relating to safe use.



- 4.2 This will be a lengthy exercise and is best done as equipment is fitted/certificates become available.
- 4.3 Where appropriate sub-referenced certificates should also be obtained and checked.
- 4.4 Some package equipment vendors manufacture certified equipment and hold their own license. If any items of this type are present on the inspected package then they should be checked for compliance to the certified drawings.
- * Arrangements may be in place which specify that the license need only be valid up to the time of ex-works delivery from the manufacturer or skid delivery from the package vendor.

5. PHYSICAL INSPECTION

- 5.1 Inspect the installation and interconnection of the equipment is as required by the applicable Standard (e.g. [BS 5345](#)). Use the inspection checklist as a guide.
- 5.2 Physical inspection is paramount. Keep in mind the type of protection employed and the concepts upon which it is based.

INSPECTION CHECK LIST

SKID MOUNTED ELECTRICAL EQUIPMENT FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES

	YES	NO	N/A
All installed certified equipment is recorded in the schedule.			
All installed equipment which should be certified is certified.			
There are no unauthorised modifications to equipment.			
Any special conditions in the certification are complied with.			
Glands and plugs are of the correct type and properly installed.			
Electrical connections are tight.			
Gaskets where fitted are allowed and in good condition.			
Cabling is of the correct type securely installed and un-damaged.			
Earth connects are as per specifications and secure.			
Equipment is adequately protected against environment.			
Installation is clean, dry and tidy.			
Correct gland - any barrier glands required?			
Use of uncertified plugs.			
Sealing washers - specified? If so flamepath impaired?			
Retro-fitted terminals in J.B.'s.			
Non UK certified equipment - pay special attention to certification/equipment.			
IP ratings - will the equipment survive in the environment?			
Ex d, Ex e and Ex n equipment.			
Enclosure, glasses and glass metal sealing gaskets/compounds OK.			
Flange faces are clean and undamaged.			
Flame paths are not impaired.			
Terminal of the correct type.			
Un-used terminals are screwed down.			
Motors are of correct duty/type and Ex e motor control includes for "te" time considerations.			
For Ex i equipment			
Barriers are correct type and properly installed/earthed.			
Printed circuit boards are clean and undamaged.			



Cable screens are present and earthed in accordance with specification.			
Cable armour is earthed in accordance with specification.			
Circuit segregation is maintained by cabling, J.B.'s and barriers - refer to specification			
Will barrier - instrument distance effect energy limitation?			
For Ex p equipment.			
Automatic protective system is set correctly.			
Inlet temperature is below max specified.			
Protective gas and delivery system are satisfactory.			
Pressure/flow/purge is adequate.			



PROCEDURE 21 - TRANSFORMERS AND REACTORS

1. SCOPE

- 1.1 This procedure covers inspection and testing in a manufacturer's works of Transformers and Reactors.
- 1.2 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to Criticality 1 items only. Inspection requirements for Criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure.

2. RELATED DOCUMENTS

BP Group [RP 12-9](#) Transformers and Reactors

[BS 171](#) Power Transformers

3. GENERAL

3.1 Inspection & Test Plan

The manufacturing Inspection & Test Plan should include all quality related activities; reference standards; acceptance standards, verification documents; supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance standards, verification documents, supplier responsible persons and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.



4. MANUFACTURING

4.1 Construction

The Inspector should monitor the construction of power transformers and reactors in accordance with the requirements of the approved Inspection & Test Plan.

HT and LT cable glands should be checked to ensure compliance with purchase order and specification requirements.

NOTE: Single core cables will require non magnetic terminal box plates above 600 amp rating.

Acceptance Criteria: Inspection & Test Plan, Purchase Order Specifications.

4.2 Dimensional Control

The Inspector should check overall dimensions and arrangements in accordance with approved drawings

Neutral connection arrangements and tank earthing terminals should also be checked.

5. TESTING

5.1 General

The Inspector should witness the testing of transformers and reactors in accordance with the requirements of the Inspection and Test Plan & test procedures. These tests should include, but not be limited to:-

- (a) Measurement of winding resistance on all tapings at a recorded ambient temperature.
- (b) Ratio, polarity and phase relationships. The turns ratio should be checked by means of a ratiometer on all tapings after assembly in tank.
- (c) Measurement of impedance voltage.
- (d) Measurement of load losses by copper loss.
- (e) Insulation resistance.
- (f) No-load losses and no-load current.

- (g) Induced over-voltage withstand.
- (h) Separate source voltage withstand.

Acceptance Criteria: Inspection & Test Plan,
[BS 171](#). OCMA Specification Elect 6.

5.2 Neutral Current Transformers

Where neutral current transformers are fitted, the Inspector should ensure that a check is made that the connections are correct on the neutral connection for unrestricted earth leakage protection as appropriate. Neutral current transformer ratios should be checked to drawing, specification or order particulars as appropriate either by checking the ratio marked on the current transformer or, where this is not visible, by primary injection testing.

Acceptance Criteria: Inspection & Test Plan, [BS 171](#).

5.3 Heat Run Testing

On the first transformer of each rating, a heat run test should be carried out to enable calculation of temperature rise by resistance, of all windings under short circuit conditions at reduced voltage. In addition temperature rises by thermometer in the oil top will be required.

From this heat run estimates should be obtained by resistance of the high tension windings of the temperature rises within these windings.

At the discretion of the purchaser, a type test on a similar transformer may be accepted in lieu of the heat run.

Acceptance Criteria: Inspection & Test Plan,
[BS 171](#). OCMA Specification Elect 6.

5.4 Impulse Testing

For transformers that are directly connected to overhead lines, the manufacturer should be required to produce evidence of impulse testing having been done on a similar transformer.

If this has not occurred the Inspector should witness impulse tests in accordance with the Inspection and Test Plan and the purchase order specifications.

Acceptance Criteria: Inspection & Test Plan,
[BS 171](#). OCMA Specification Elect 6.

5.5 On-Load Tap Changers

Where applicable, on-load tap changers should be fitted and these should be operated over the full range from the voltage control during testing.

Acceptance Criteria: Inspection & Test Plan,
[BS 171](#). OCMA Specification Elect 6.

5.6 Alarms

Bucholz trip and alarm devices should be tested for correct operation by gas injection and the Inspector should check that this has been carried out by the manufacturer.

Tests of operation of winding temperature indicators/alarms should be carried out or evidence of testing by the manufacturer provided.

Acceptance Criteria: Inspection & Test Plan,
[BS 171](#). OCMA Specification Elect 6.

5.7 Pressure Testing

The Inspector should witness the pressure testing of the completed transformer/reactor with disconnecting chambers.

The transformer/reactor should be filled with oil and subjected to a pressure test of 1 bar (15 psi) for 24 hours. No pressure drop or leakage is allowable.

Acceptance Criteria: Inspection & Test Plan,
[BS 171](#). OCMA Specification Elect 6.

6. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

6.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.

6.2 The Inspector should monitor the preservation, handling and packaging of the equipment.

6.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT. When other items of lifting equipment are to be supplied, these should be provided with proof load test certification issued by an approved statutory lifting equipment test house and marked accordingly.

6.4 The Inspector should carry out inspection of any coatings as required by the purchase order and the Inspection and Test Plan.



- 6.5 Items of equipment may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification.
BP Group [GS 106-2](#). Project Specification.
Applicable Lifting Equipment Legislation.

7. FINAL INSPECTION AND RELEASE

The Supplier should provide a documentation and certification package for each Transformer or Reactor. This package should contain documentation as required by the Purchase Order and may include but not be limited to the following:-

- (a) test certificates for the testing carried out in accordance with para 5. above, to include values of impedance voltage as measured, reactance and regulation, efficiency for unity and 0.8 power factor, voltage ratios on all taps, iron loss, copper loss (full load) adjusted to 75°C, resistances on all taps for HV and on LV windings,
- (b) statutory lifting equipment test certificates for handling equipment, eyebolts, attachments and any other lifting equipment.
- (c) pressure test certificates and pressure gauge calibration certificates,
- (d) dimensional inspection reports,
- (e) signed off Inspection & Test Plan,
- (f) weight control reports.

The format of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

TRANSFORMERS AND REACTORS

PARA REF	ACTION	YES	NO	N/A
3.1	Inspection and Test Plan reviewed and approved?			
3.1	All drawings, calculations, design data and specifications submitted and approved?			
3.1	All major sub-suppliers approved?			
3.1	All manufacturing/testing procedures approved?			
3.1	Handling, preservation etc. proc. approved?			
	CONSTRUCTION MONITORING/DIMENSIONAL CONTROL			
4.1	Construction being carried out in accordance with approved procedures and specs?			
4.1	HT & LT glands checked?			
4.1	Non magnetic terminal box plates fitted to single core cables above 600 amp?			
4.2	Overall dimensions in accordance with drawings and specifications?			
4.2	Neutral cons and earthing checked?			
5.1	Testing General?			
5.1 (a)	Measurement of winding resistance?			
5.1 (b)	Turns ratio checked?			
5.1 (c)	Measurement of impedance voltage?			
5.1 (d)	Measurement of load loss?			
5.1 (e)	Insulation resistance?			
5.1 (f)	No-load losses?			
5.1 (g)	Induced over-voltage withstand?			
5.1 (h)	Separate source voltage withstand?			
5.2	Neutral current transformers?			
5.2	Connections checked on neutral con?			
5.2	Transformer ratios checked in accordance with drawing specification etc.?			
	HEAT RUN TESTING			
5.3	Heat run testing carried out?			
5.3	Estimate of temperature risers in windings obtained?			



PARA REF	ACTION	YES	NO	N/A
	IMPULSE TESTING			
5.3	Type test in lieu of above approved?			
5.4	Evidence of impulse testing from Supplier?			
5.4	Impulse testing witnessed?			
	ON LOAD TAP CHANGERS			
5.5	On load tap changers tested through range?			
	ALARMS			
5.6	Alarms tested?			
	PRESSURE TESTING			
5.7	Pressure testing carried out?			
	HANDLING PRESERVATION AND PACKAGING			
6.	Handling, preservation and packaging procedures approved?			
6.	Lifting eyebolts tested?			
6.	Lifting frames and slings tested?			
6.	Coating inspected?			
	FINAL INSPECTION AND RELEASE			
7.	All inspections and tests complete?			
7.	Documentation package reviewed and approved?			
7.	Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATING

TRANSFORMERS AND REACTORS

ACTION	I	II	III	IV
Inspection and Test Plan reviewed and approved?	Yes	R	No	No
All drawings and specifications approved?	Yes	Yes	No	No
All manufacturing/testing procedures approved?	Yes	R	No	No
All major sub-suppliers approved?	Yes	Yes	No	No
Construction checked in accordance with approved procedures and specs?	M	M	R	No
Overall dimensions checked in accordance with drawings and specs?	Yes	M	R	No
Testing witnessed?	Yes	Yes	R	No
Heat turn testing carried out?	Yes	Yes	R	No
Type test in lieu of above can be approved?	N/A	Yes	Yes	No
Evidence of impulse testing required from supplier?	Yes	Yes	Yes	No
Impulse testing to be witnessed	Yes	M,R	No	No
Alarm testing to be witnessed?	Yes	Yes	No	No
Pressure testing to be witnessed	Yes	Yes	M,R	No
Handling, preservation and packaging procedures to be approved?	Yes	Yes	No	No
Lifting eyebolts to be tested?	Yes	Yes	Yes	No
Lifting frames and slings to be tested?	Yes	Yes	R	No
Coating to be inspected?	M	M	No	No
Final inspection to be carried out?	Yes	Yes	Yes	No
Documentation package to be reviewed and approved?	Yes	Yes	Yes	No
Preservation and packing to be checked?	Yes	M	No	No
Inspection release note to be issued?	Yes	Yes	Yes	No

LEGEND: YES=REQUIRED (100%), NO=NOT REQUIRED, M=MONITORED (PROCESS/ACTIVITY), I=SAMPLE INSPECTION/CHECK, R=REVIEW DOCUMENTATION/CERTIFICATION, N/A=NOT APPLICABLE.



PROCEDURE 22 - UNFIRED PRESSURE VESSELS

1. SCOPE

- 1.1 This procedure covers inspection and testing of unfired pressure vessels in a manufacturer's works.
- 1.2 The involvement of the independent or statutory inspection authority (IIA) is also briefly covered.
- 1.3 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to criticality 1 items only. Inspection requirements for criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure. Inspection & Test Plans should be developed accordingly.
- 1.4 This procedure does not supersede any requirement set out in purchase order specifications/standards.

2. RELATED DOCUMENTS

- BP Group [GS 146-1](#) Unfired pressure vessels. Vessels to BS 5500.
- BP Group [GS 146-2](#) Unfired pressure vessels. Vessels to Codes other than BS 5500.
- BP Group [GS 146-3](#) Unfired pressure vessels. Vessels not exceeding 20 mm thick.
- BP Group [GS 146-4](#) Unfired pressure vessels. Vessels operating close to atmospheric pressure.
- BP Group [GS 118-4](#) Storage and Control of Welding consumables.
- [BS 2600](#) Radiographic examination of fusion welded butt joints in steel
- [BS 5169](#) Specification for fusion welded steel air receivers
- [BS 5500](#) Specification for unfired fusion welded pressure vessels
- [ASME](#) Boiler and Pressure Vessel Code, Section VIII.



3. INDEPENDENT INSPECTION AUTHORITY INVOLVEMENT

3.1 The various construction codes define requirements, responsibilities and sometimes qualifications of Inspectors and design review organisations other than those of the manufacturer. Statutory requirements may also apply particularly in offshore applications.

3.2 The purpose of code required inspection is primarily to gain an independent assessment of the integrity of the vessel concerned under pressure and consequently there are several important aspects of compliance outwith the remit of the independent inspectorate as defined in the Codes.

Except for small simple vessels of low criticality, the code and statutorily required inspections are generally considered insufficient to provide the purchaser with assurance that all specified requirements have been met and that the vessel is fit for its intended purpose in all respects.

This recommended practice addresses inspections which may be deemed by the purchaser to be necessary. Some of these activities will already be covered by independent bodies.

3.3 The purchaser should consider how best to apportion responsibilities for design review and inspection whilst keeping within code and statutory requirements. The inspection of any sub-contracted fabrication work should also be considered.

3.4 It is often effective for one inspection authority to perform more than one function. For example in the case of [BS 5500](#) vessels an inspectorate operating independently within the purchasing company may perform inspection against purchase order requirements and also act as the Inspecting Authority as defined by the Code.

It is also in order for design review and independent inspection to be performed by different organisations.

4. GENERAL

4.1 Inspection & Test Plan

Before the commencement of fabrication of unfired pressure vessels the supplier should produce an Inspection and Test Plan for approval. Relevant IIA's and Certifying Authorities should also review and approve the plan.

The Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.



The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.
- (e) Approvals, clarifications and quality related activities required by the code are completed. Where the construction code requires that documents, procedures etc. be agreed or approved by the purchaser but the purchaser has not requested such a document for review this should be highlighted in the Inspector's report.

Acceptance Criteria: Purchase Order and related specifications

- 4.2 The purchaser may require to carry out an initial visit to the suppliers works to ensure that adequate facilities are available.

4.3 Material Certification and Traceability

- 4.3.1 The supplier should maintain records of material certification and identification. Unless otherwise agreed test certificates should be mill originals, or verified true copies.

Checks should be made to verify compliance with traceability requirements particularly for pressure containing, process wetted and load bearing parts.

- 4.3.2 Where hard stamping is used to identify material, low stress die stamps should be used on low temperature materials.

NOTE: Stamping is not normally allowed on austenitic and Duplex steel and cupro-nickel base alloy materials. These materials should be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Acceptance Criteria: Project or Purchase Order specifications

Particular attention should be paid to the method of verification of transfer stamping to cut sections, test pieces etc. Transfer stamping may be required to be witnessed (items stamped) by the Inspector or the IIA.



4.3.3 The requirements of BP Group [GS 136-1](#) normally apply to materials for sour service as defined by that standard.

Acceptance Criteria: [DIN 50049](#),
BP Group [GS 136-1](#),
Project or Purchase Order Specification.

4.4 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage containing:-

- (a) the description and location of material and material test certificates used,
- (b) welder identification for each weld, the weld procedure used and repair records,
- (c) records of NDT and visual examinations,
- (d) dimensional control and inspection records,
- (e) heat treatment charts/records,
- (f) pressure test records and gauge identification,
- (g) marked-up construction drawings,
- (h) concession application/non-conformance records.

Acceptance Criteria: Purchase Order

4.5 Marking

All pressure vessels should be marked in accordance with code and purchase order requirements.

Match marking should be applied as necessary to facilitate correct assembly of components.

Acceptance Criteria: Purchase Order & Code

5. FABRICATION, ASSEMBLY AND ERECTION

5.1 Fabrication Areas

Work areas where fabrication, assembly and erection are to occur should be clean and uncluttered. If welding work is to occur out of doors, the fabrication area should be protected from the elements and where necessary, heated.



Where stainless steels and non-ferrous metals are being fabricated, the area to be used should be quite separate from that used for carbon and low alloy steels. Separate and clearly identified sets of cleaning and grinding equipment should be maintained for each material.

NOTE: In some instances e.g. where high alloy materials are utilised for low temperature or clean duty as distinct from corrosive applications, the above requirement may sometimes be relaxed. In case of doubt and in the absence of any specified requirement the Inspector should seek guidance from the Purchaser.

The Purchaser may require to inspect and approve fabrication areas and where applicable, the equipment to be used, before fabrication work can start.

Acceptance Criteria: BP Group [GSs 146-2, 146-4](#) and [146-5](#)
Purchase Order Specification

5.2 Fit-up and Tacking

The Inspector should monitor the weld preparation, fit up and tacking of welded joints as indicated in the Inspection & Test Plan.

Tack welding should be carried out by qualified welders in accordance with the applicable welding procedure.

Acceptance Criteria: BP Group [GSs 146-2, 146-4](#) and [146-5](#)
Purchase Order Specification

5.3 Welding

Welds should be made by qualified welders only and to suitably qualified and approved procedures.

Codes may require that procedure and welder qualifications be authenticated by an inspectorate meeting specified criteria.

The purchaser may decline to accept existing qualifications and require that qualifications be witnessed by an inspectorate nominated by themselves.

5.3.1 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group [GS 118-4](#) also gives advice on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables; At the discretion of the Inspector this may include the cut out of any welds that have been completed with the out-of-specification consumables. (see below)

5.3.2 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the weld should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or requalify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

5.3.3 Hydrogen Induced Cracking

Where hydrogen induced cracking is possible, consideration should be given to delaying NDT until 48 hours after welding is completed. - refer to BS 5135 for guidance.

Acceptance Criteria: Approved Welding Procedures
BP Group [GS 118-4](#)
BP Group [GS 126-1](#) and [126-2](#)
P.O. Specification

Acceptance Criteria: Approved Welding Procedures,
BP Group [GS 118-4](#),
BP Group [GSs 146-2, 146-4](#) and [146-5](#)
Purchase Order Specification

5.4 Bending and Forming (Pipes, Strakes, Dished Heads etc.)

The Inspector should verify or otherwise assure himself that wall thicknesses after bending or hot or cold forming are not less than the design minimum. A visual inspection should also be carried out supplemented as appropriate by NDT by a suitable technique to investigate any suspect areas..

When heat treatment is required, pre- or post-forming the Inspector should verify compliance with requirements and review heat treatment records.

Acceptance Criteria: Approved Welding Procedures,
BP Group [GS 118-4](#),
BP Group [GSs 146-2, 146-4](#) and [146-5](#)
Purchase Order Specification

5.5 Heat Treatment

Post-weld and stress relieving heat treatments should be carried out in accordance with documented procedures.



The Inspector should verify compliance of any such heat treatment with the requirements.

NOTE: Where re-heat treatment is carried out after a local weld repair, the method and procedure should be agreed by the Purchaser.

The Inspector should review the heat treatment records.

Acceptance Criteria: Approved Heat Treatment Procedure,
Construction Code
Purchase Order Specification

5.6

NDT

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION - The primary method of volumetric weld examination.
- (e) ULTRASONIC EXAMINATION - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing, or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

Where sample examination of welds is specified, the Inspector should nominate the welds to be examined, taking care to ensure that all welders and procedures are covered. To achieve this coverage the specified percentage may require to be exceeded. Any indication from sample examination that a welder or equipment etc., is faulty should necessitate further examination and in the case of gross or extensive defects 100% of the sampled lot is usually necessary.



Acceptance Criteria: BP Group [GSs 126-1](#) and [126-2](#)
P.O. & Project Specifications

Acceptance Criteria: BP Group [GS 146-2](#), [146-4](#) and [146-5](#)
P.O. & Project Specifications

5.7 Weld Repairs and Cut Outs

All repairs to welds and parent material should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval.

Two unsuccessful repairs at the same location should normally necessitate the weld to be cut out and remade, unless a proposal to carry out a further repair is agreed by the Purchaser.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.

The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

Acceptance Criteria: Approved Welding Procedure.
P.O. Specifications, Construction Code,
BP Group [GS 146-2](#), [146-4](#) and [146-5](#)

5.8 Dimensional Control

The Inspector should check dimensions of pressure vessels against the latest revision of the drawing.

Particular attention should be paid to circularity requirements for vessels subject to external pressure or internal vacuum.

The squareness of flanges and the flatness and finish of the flange faces shall be checked as well as nozzle positions, weld preps for site welding and flange ratings.

Acceptance Criteria: Approved Drawings,
Purchase order specifications,
Construction Codes

6. PRESSURE TESTING

6.1 General

Pressure testing should be carried out in accordance with documented procedures. Test pressures may be specified by the purchaser or be determined from the construction code and should be verified by the Inspector.

The Inspector should witness pressure testing.



The risk of brittle fracture during pressure testing may be an important consideration for some materials as could the risk of freezing. Heating of the test medium may be necessary.

6.2 Hydrostatic Testing

Hydrostatic test media other than water should be agreed by the Purchaser.

Any limits on water impurity levels should be checked/verified to be in accordance with specified requirements.

6.3 Pneumatic Testing

Whenever pneumatic strength testing has been specified or agreed, the Inspector should give careful consideration to the inherent dangers of such testing and should not participate in the witness of testing whenever it is clear that any safety aspect may have been compromised. In particular, the following points should be addressed:-

- (a) The extent of NDT required to provide assurance of integrity. Where prior hydrostatic testing to a higher pressure is not to be carried out, NDT should be to the maximum extent.
- (b) The test medium should be non-toxic and non-flammable.
- (c) 110% of design pressure should not be exceeded. Some form of overpressure protection may be necessary and at least two recently calibrated gauges should be used without intervening valves or other restrictions.

7. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

7.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.

7.2 The Inspector should monitor the preservation, handling and packaging of the equipment.

The Inspector should, during monitoring, ensure that the vessel is clearly marked to indicate the presence and location of any of the following:-

- (a) temporary internal transit restraints
- (b) loose internals
- (c) inhibitors, desiccants etc.



- 7.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT.
- 7.4 The Inspector should carry out inspection of any coatings as required by the purchase order and the Inspection and Test Plan.
- 7.5 Items may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification,
BP Group [GS 106-2](#).

8. FINAL INSPECTION AND RELEASE

- 8.1 The Supplier should provide a documentation and certification package for each pressure vessel. This package should contain documentation as required by the purchase order. This may include but not be limited to the following:-
- (a) material test certificates including any special test reports and raw material test certificates, for all pressure containing/wetted parts, and for supporting/load bearing structures.
 - (b) fittings material test certificates,
 - (c) approved welding procedures, welding procedure qualification records and welder qualification records,
 - (d) NDT procedures, reports and operator qualifications,
 - (e) marked up location drawings showing weld identifications and NDT report nos., material ids,
 - (f) heat treatment records.
 - (g) pressure test certificates and pressure gauge calibration certificates and if required, water purity certificates,
 - (h) lifting equipment certification.
 - (i) code certification, (e.g. [BS 5500](#) Form X)
 - (j) IIA Certificate of Conformance,
 - (k) dimensional inspection reports,
 - (l) signed off Inspection and Test Plan,



(m) weight control reports.

8.1 The format and content of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

UNFIRED PRESSURE VESSELS

PARA REF	ACTION	YES	NO	N/A
4.1	All approvals, clarifications and quality related activities required by the code complete?			
4.1	All calculations, drawings and design data reviewed and approved by relevant authorities?			
4.1	All drawings and specifications checked to ensure that they are the latest issue?			
4.1	All major sub contractors approved?			
4.1	All applicable welding procedures specifications and qualifications approved before any welding operations are carried out? Welder qualification review?			
4.1	Heat treatment procedures approved prior to commencement of welding?			
4.1	All applicable NDT procedures approved prior to the commencement of any welding operations? NDT operator qualifications reviewed and approved?			
4.1	Pressure testing procedures approved prior to testing being carried out?			
4.1	Handling, preservation, packaging and transport procedures approved?			
4.3	Material received inspected and material certificates reviewed and accepted?			
4.4	Manufacturing records compiled and approved?			
4.5	Vessel marked in accordance with Code and Specification requirements?			
5.1	Fabrication area(s) inspected and approved?			
5.2	Fit up and tacking of welded joints and fittings checked?			
5.3	Welding checked including pre-heat and interpass temps?			
5.4	Forming of pipework and plate checked?			
5.5	Heat treatment checked and reports reviewed?			
5.6	NDT monitored and reports approved?			
5.8	Dimensions checked?			



PARA REF	ACTION	YES	NO	N/A	
6.1	PRESSURE TESTING	Tests witnessed?			
6.1		Test medium checked for purity			
7.		Handling, preservation and packaging checked? (inc. identification)			
8.	FINAL INSPECTION AND RELEASE	All inspections complete?			
		Documentation package reviewed?			
		IIA certificate of conformance issued?			
		Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATINGS

UNFIRED PRESSURE VESSELS

ACTION	I	II	III	IV
Inspection and Test Plan approval by BP and IIA?	Yes	Yes	Yes	N/A
All code approvals, clarifications & quality activities to be included in the Inspection and Test Plan?	Yes	Yes	N/A	N/A
Equipment Drawings, calculations, design data and specifications approval by BP?	Yes	Yes	R	No
Equipment Drawings, calculations, design data and specifications approval IIA?	Yes	Yes	Yes	Yes
Major sub supplier approval?	Yes	Yes	No	No
Welding procedure qualification test witness and approval?	Yes	R	R	No
Welder qualification test witness and approval?	R	R	R	No
Heat treatment procedure approval?	Yes	R	R	No
NDE procedure approval, NDE operator approval? Pressure test procedures approval?	Yes R	R R	R No	No No
Handling, preservation, packaging and transport procedures approval?	R	R	No	No
Material receipt, inspection and review of material test certificates?	M,R	M,R	R	No
Manufacturing record compilation and approval?	R	R	R	No
Component marking in accordance with approved method? (inc. transfer stamping witness)	M,R	M,R	M,R	No
Fabrication area(s) inspection and approval?	Yes	I	I	No
Examination of cut edges and heat affected zones?	Yes	I	I	No
Examination of fit up and tacking of welded joints and fittings?	Yes	I	I	No
Welding to be checked (including pre-heat and interpass temperatures)?	M,R	M,R	No	No
Bending and forming of pipework to be checked?	M,R	M,R	No	No
Heat treatment to be checked and reports and charts to be stamped approved?	M,R	M,R	R	No
Weld repairs/cut outs to be checked and NDE accepted? Re-heat treatment reports and charts to be approved?	Yes	I,R	R	No
Main dimensions to be checked?	Yes	Yes	I,R	No



ACTION		I	II	III	IV
PRESSURE TESTING	Test location & equipment to be checked and approved?	Yes	Yes	No	No
	Test medium to be checked for purity?	Yes	Yes	No	No
	Pneumatic or gas testing safety checks to be carried out?	Yes	Yes	Yes	No
	Tests to be witnessed?	Yes	Yes	Yes	No

LEGEND: YES=REQUIRED (100%), NO=NOT REQUIRED, M=MONITORED (PROCESS/ACTIVITY), I=SAMPLE INSPECTION/CHECK, R=REVIEW DOCUMENTATION/CERTIFICATION, N/A=NOT APPLICABLE.

(NOTE WHERE R IS USED FOR AN APPROVAL ACTIVITY THE INSPECTION ENGINEER SHALL APPROVE THE DOCUMENT, RATHER THAN THE SPECIALIST BP ENGINEER)

WARNING: IN USING THESE CHECK LISTS IT SHOULD BE NOTED THAT THE INSPECTION REQUIREMENTS CONTAINED IN THE PURCHASE ORDER CODES AND STANDARDS MUST BE CARRIED OUT AS A MINIMUM.

NOTE: AT THE DISCRETION OF THE INSPECTION ENGINEER ROUTINE CHECKS (E.G. WITNESSING OF WELD PROCEDURE SPECIFICATION TESTING) CAN BE LEFT TO THE IIA, AS LONG AS WRITTEN VERIFICATION IS MADE AVAILABLE BY THE IIA THE ACTIVITY HAS BEEN SATISFACTORILY CARRIED OUT.



PROCEDURE 23 - VALVES FOR PROCESS UNITS

1. SCOPE

- 1.1 This procedure covers the inspection and testing of valves manufactured for use in refineries, chemical works and offshore installations.
- 1.2 The following types of valves are included:-
- (a) Steel wedge gate valves with flanged and butt weld ends, classes 150 to 2500, to the requirements of [BS 1414](#) and in accordance with BP Group [GS 162-1](#).
 - (b) Cast and forged carbon and alloy steel wedge gate valves in sizes 1 1/2 inch and smaller to [BS 5352](#) and in accordance with BP Group [GS 162-3](#).
 - (c) Steel gate valves to [API 600](#) and in accordance with [API 598](#).
 - (d) Steel ball valves to [BS 5351](#).
 - (e) Flanged steel globe valves to [BS 1873](#).
 - (f) Flanged steel check valves to [BS 1868](#).
- 1.3 It should be noted that inspection requirements detailed in the narrative sections of this procedure relate to Criticality 1 items only. Inspection requirements for Criticality 2,3 and 4 items are detailed in the inspection summary list at the end of this procedure.

2. RELATED DOCUMENTS

- BP Group [GS 162-1](#) Steel Wedge Gate, Globe and Check Valves Flanged and Butt Welded. Class 150 to 2500, 2" and Over.
- BP Group [GS 136-1](#) Materials for Sour Service to NACE Std MR0175.
- BP Group [GS 162-3](#) Cast and Forged Carbon and Alloy Steel Gate Valves in sizes 1 1/2" and Smaller.
- [BS 1414](#) Steel Wedge Gate Valves, Flanged and Butt Welded.
- [BS 1868](#) Steel Check Valves, Flanged and Butt Welded.



BS 1873	Steel Globe Valves, Flanged and Butt Welded.
BS 6755	Inspection and test of valves.
BS 5351	Specification for Ball Valves for Petrochemical Services.
BS 5352	Specification for Steel Wedge, Globe and Check Valves 50 mm and smaller.
API 598	Valve Inspection and Test.
API 600	Steel Gate Valves.

3. GENERAL

3.1 Inspection & Test Plan

Before the commencement of assembly of valves the supplier may be required to produce an Inspection & Test Plan.

The Inspection & Test Plan if required should include all quality related activities, reference standards, acceptance criteria, verification documents, supplier responsible persons and inspection mark-up.

Where it has been determined that the inspection and/or testing of valves will be on a sample basis the Inspector should nominate the quantity of valves in each batch in accordance with these requirements. (guidance based on criticality ratings appended to this procedure)

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..
- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.
- (e) Firesafe test reports or certification are provided as required

Acceptance Criteria: Purchase Order and related specifications



3.2 Material Certification & Traceability

Original or verified true copies of material test certificates may be required. Material identification may be by colour coding except that all pressure containing steel and nickel alloy parts should at all times carry markings traceable to material test certificates. Traceability may also be required for process wetted parts.

Checks should be made to verify compliance with traceability requirements particularly for pressure containing and process wetted parts.

Where hard stamping is used to identify material, low stress die stamps should be used on low temperature materials.

NOTE: stamping should not be used on austenitic and Duplex steel or cupro-nickel or nickel base alloy material. These materials should only be marked using indelible markers or paint, or a stress free permanent marking method such as vibro-etching.

Acceptance Criteria: Purchase Order Specification.

3.3 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage containing:-

- (a) the description and location of material and material test certificates used.
- (b) weld repair records and the procedures and welders used.
- (c) welder identification for each fabrication weld and the procedure used.
- (d) NDT records .
- (e) dimensional control and inspection records.
- (f) pressure and leakage test records.
- (g) marked-up construction drawings for fabricated valves.
- (i) concession application/non-conformance records.

Acceptance Criteria: Purchase Order Requirements

4. MANUFACTURING, ASSEMBLY AND ERECTION

4.1 Fabrication Areas

Work areas where fabrication and assembly are to occur should be clean and uncluttered. If welding work is to occur out of doors, the fabrication area should be protected from the elements and where necessary, heated.

Where stainless steels and non-ferrous metals are being fabricated, the area to be used should be quite separate from that used for carbon and low alloy steels. Separate and clearly identified sets of cleaning and grinding equipment should be maintained for each material.

NOTE: In some instances e.g. where high alloy materials are utilised for low temperature or clean duty as distinct from corrosive applications, the above requirement may sometimes be relaxed. In case of doubt and in the absence of any specified requirement the Inspector should seek guidance from the Purchaser.

The Purchaser may require to inspect and approve fabrication areas and where applicable, the equipment to be used, before fabrication work can start.

Acceptance Criteria: Purchase Order Specifications

4.2 Material Testing

All items forming part of the pressure envelope are to be manufactured from material that has been subjected to material testing in accordance with the relevant material specification.

The Inspector may be required to witness the mechanical testing of material for valves.

In the case of material certification being requested to meet the requirements of [DIN 50049.3.1.c](#) however, the activities of an Independent Inspection Authority should make the involvement of the purchaser's inspector unnecessary.

For materials required for sour service, the requirements of BP Group [GS 136-1](#) should apply.

Acceptance Criteria: [DIN 50049](#),
BP Group [GS 136-1](#)

4.3 Welding

4.3.1 General

Any welds should be made by suitably qualified welders only using suitably qualified procedures.



4.3.2 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group [GS 118-4](#) also gives advice on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables; At the discretion of the Inspector this may include the cut out of any welds that have been completed with the out-of-specification consumables. (see below)

4.3.3 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the weld should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or requalify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

4.3.4 Hydrogen Induced Cracking

Where hydrogen induced cracking is possible, consideration should be given to delaying NDT until 48 hours after welding is completed. - refer to BS 5135 for guidance.

Acceptance Criteria: Welding Procedures,
BP Group [GS 118-4](#), [126-1](#) and [126-2](#)
PO Specification

4.4 Heat Treatment

Heat treatments should be carried out in accordance with documented procedures.

The Inspector should verify compliance of any heat treatment with the requirements .

Where heat treatment is to be repeated after a material inlay/overlay or local weld repair, the complete valve body should be subjected to the treatment. Local heat treatment of welds should only be allowed with the agreement of the purchaser.

Acceptance Criteria: Heat Treatment Procedure.



4.5 Non-Destructive Testing (NDT)

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation is normally required to some extent.

- (a) VISUAL EXAMINATION - All welds and castings should be visually examined.
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION - The primary method of volumetric weld examination.
- (e) ULTRASONIC EXAMINATION - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing, or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

Acceptance Criteria: BP Group [GS 118-5](#), [118-6](#) and [118-7](#),
[ANSI B31/3](#),
P.O. Specifications

4.6 Weld Repairs and Cut-Outs

All repairs should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval..

Specific approval by the purchaser may be required before proceeding with major repairs to castings.

Major excavations may be required to be examined by the Inspector.

It should be confirmed that any heat affected zones of previous welds are completely removed before re-welding.



The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

Acceptance Criteria: Welding Procedure,
P.O. Specifications.

4.7 Dimensional Control

The Inspector should check major dimensions of the valves in accordance with the latest revision of the drawing and valve standards.

The squareness of flanges and the flatness and finish of the flange faces should be checked by the Inspector.

Ring grooves should be gauged.

Acceptance Criteria: Approved Drawings,
ANSI standards

5. PRESSURE TESTING

5.1 Hydrostatic Body and Seat Leakage Testing

Irrespective of the % sample testing to be witnessed, the Inspector should obtain assurance that all of the sampled batch has been tested satisfactorily prior to witness testing.

Where 100% witness testing is to be carried out the Inspector may at his discretion agree to witness the shop testing on this basis.

Valve bodies should be subjected to a hydrostatic test as per the specification (Generally 1.5 times maximum allowable cold working pressure).

Hydrostatic seat leakage tests (generally 1.1 times maximum allowable cold working pressure) should be applied in both directions except for unidirectional valves.

The medium for hydrostatic testing should be water unless otherwise agreed by the purchaser. Any limit on impurity levels should be specified.

Detailed information on pressure testing of valves can be found in [BS 6755](#).

In order that sampling inspection can be effective it is recommended that an established statistical approach be employed e.g. [BS 6001](#) - Sampling Procedures for Inspection by Attributes.

In the event of a sampled valve failing to meet the specified requirements, the cause of failure should be investigated and the results of this investigation should influence the way the sampling proceeds.

5.2 Pneumatic Testing

Low pressure (7 bars) seat leakage testing as required by the various standards for some valve types are generally considered not to be significantly hazardous.

Whenever High pressure pneumatic testing has been specified or agreed, the Inspector should give careful consideration to the inherent dangers of such testing and should not participate in the witness of testing whenever it is clear that any safety aspect may have been compromised either in respect of the valve or the test facilities. In particular, the following points should be addressed:-

- (a) Hydrostatic testing as above should always be carried out prior to high pressure pneumatic testing.
- (b) The extent of NDT required to provide assurance of integrity.
- (c) The test medium should be non-toxic and non-flammable.
- (d) The pneumatic test pressure should be lower than the hydrostatic pressure already applied to the seat.
- (e) Some form of overpressure protection may be necessary and at least two recently calibrated gauges should be used without intervening valves or other restrictions.

6. FUNCTIONAL TESTING

6.1 Functional testing procedures may be required to be approved prior to the commencement of testing.

6.2 The Inspector should witness functional testing of valves as indicated in the Inspection and Test Plan. It should be clearly established whether actuators are to be tested with valves.

6.3 Witness of torque testing may be required. In any case the Inspector should assess whether the torque found necessary to operate the valve is reasonable.

6.4 Anti-static Valves should be continuity checked.

6.5 Actuators

6.5.1 In the absence of any specific requirement it is recommended that actuators are operated using the operating medium through the full range of travel at least six (6) times. Mechanical/manual overrides should be cycled at least once during functional testing.

- 6.5.2 The actuator should be capable of opening the valve under the differential hydrostatic pressures specified.
- 6.5.3 The actuator should be capable of operating the valve through one complete cycle without stopping. The following data should be recorded, as a minimum:-
- (a) For motorised actuators, the starting and running currents.
 - (b) For pneumatic or hydraulic actuators, the pressure required to initially move the actuator.
 - (c) The times to operate the valve and actuator through its full range of travel at the specified pneumatic pressure.
- 6.5.4 The valve seats should be leak tested after actuated closure.
- Acceptance Criteria: Purchase order specification.

7. TAGGING

- 7.1 The Inspector should ensure that each inspected valve is tagged with a permanently attached label containing all the data required by the purchase order specification in addition to that required by the valve standard.
- NOTE:- Unidirectional valves should be clearly marked as such in accordance with the relevant valve standard.

8. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 8.1 The supplier should, as part of his Quality Plan have prepared a procedure for handling, preservation, packaging and transport of the equipment which may require purchaser approval .
- 8.2 The Inspector should check the preservation, handling and packaging of the equipment against specification and procedure requirements..
- 8.3 Particular attention should be paid to lifting points, all of which should be load tested and subsequently subjected to NDT.
- 8.4 The Inspector should carry out Inspection of any coatings as required by the purchase order and the Inspection and Test Plan.
- 8.5 Items of equipment may require to be weighed prior to shipping and a weight report issued.
- Acceptance Criteria: Purchase Order Specification.



9. FINAL INSPECTION AND RELEASE

9.1 The Supplier may be required to provide a documentation and certification package for each order or item. This package should include documentation as required by the Purchase Order which may include but not be limited to the following:-

- (a) material test certificates including any special test reports and raw material test certificates, for all pressure containing/wetted parts, and for supporting structures.
- (b) welding procedures, welding procedure qualification records and welder qualification records.
- (c) NDT procedures, reports and operator qualifications.
- (d) marked up location drawings showing weld identifications, NDT report Nos, and material indents.
- (e) firesafe test data or certification
- (f) heat treatment records.
- (g) pressure test certificates and pressure gauge calibration certificates and if required, water purity certificates.
- (h) hazardous area certification - see Procedure No. 20 - Electrical Equipment for Use in Potentially Explosive Atmospheres
- (i) dimensional inspection reports.
- (j) signed off Inspection and Test Plan
- (k) weight control reports.

9.2 The format of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the valves and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.



INSPECTION CHECK LIST

VALVES FOR PROCESS UNITS

PARA REF	ACTION	YES	NO	N/A
3.1	All drawings and design data (incl. firesafe) approved?			
3.1	All drawings and specifications checked?			
3.1	All weld procedures approved? All welders qualified?			
3.1	Heat treatment procedures approved?			
3.1	NDT procedures approved and operators qualified?			
3.1	Pressure testing procedures and functional testing procedures approved?			
3.1	Major sub-suppliers approved?			
3.1	Handling, packing and preservation procedures approved?			
3.2	Material received, inspected and certified?			
3.2	All material marked in accordance with approved method?			
4.1	Cleanliness standards for equipment and materials etc., are being maintained?			
4.4	Heat treatment monitored and reports and charts approved?			
4.5	NDT reviewed and reports approved?			
4.6	Weld repairs monitored and NDT accepted? Heat treatment re-done?			
4.7	End connections correct and within tolerances?			
4.7	Dimensional control monitored and approved?			
5.	Pressure and leak testing of body, bonnet and seat accepted?			
6.	Functional testing witnessed and accepted?			
6.2	Actuator tested with valve?			
6.3	Torque tests accepted?			
6.4	Anti-static continuity check?			
6.5	Valves stroked with actuator and times recorded?			
7.	Valve tagged in accordance with requirements?			
8.	Handling, preservation and packaging monitored and accepted?			



PARA REF	ACTION	YES	NO	N/A
	FINAL INSPECTION AND RELEASE			
9.	All inspections complete and accepted?			
9.2	Documentation package reviewed and accepted?			
9.2	Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST CRITICALITY RATING

VALVES FOR PROCESS UNITS

ACTION	I	II	III	IV
All drawings and specifications to be approved?	Yes	R	No	No
Weld procedures approved? Welders qualified?	Yes	R	R	No
Heat treatment procedures to be approved?	Yes	R	R	No
NDE procedures to be approved? NDE operators qualified?	R	R	R	No
Hydrostatic testing procedures and functional testing procedures to be approved?	Yes	R	R	No
Major sub-suppliers to be approved?	Yes	Yes	No	No
Material to be receipt inspected and material certificates to be reviewed and accepted?	M,R	R	R	No
Manufacturing records to be compiled and approved?	M,R	M,R	No	No
Cleanliness standards for equipment and materials etc. to be monitored?	M	M	No	No
All material marking to be checked?	M	M	M	No
Heat treatment to be witnessed and reports and charts to be approved?	M,R	M,R	R	No
NDE records to be reviewed and reports approved?	R	R	R	No
Weld repairs/welding to be checked?	Yes	M	R	No
Machining to be checked?	M	R	R	No
Dimensional control to be checked?	M	R	R	No
Pressure testing of pressure envelope to be witnessed and accepted?	Yes	Yes	I,R	No
Functional testing to be witnessed and accepted?	Yes	Yes	I,R	No
Seat leakage test to be carried out? Leakage rate checked?	Yes	Yes	I,R	No
Handling, preservation and packaging to be checked?	M	M	R	No
FINAL INSPECTION AND RELEASE				
All inspections and tests complete and accepted?	Yes	Yes	Yes	No
Documentation package to be reviewed and accepted?	Yes	Yes	Yes	No



PROCEDURE 24 - WELLHEAD EQUIPMENT

1. SCOPE

1.1 This procedure covers the inspection and testing of wellhead equipment manufactured in accordance with the requirements of [API 6A](#).

1.2 The equipment covered by this procedure is as follows:-

- (a) Flanged end and outlet connections
- (b) Threaded end and outlet connections
- (c) Christmas trees
- (d) Gate valves, needle valves for control lines, chemical injection valves, etc.
- (e) Casing and tubing heads
- (f) Casing and tubing hangers
- (g) Tubing head adaptors
- (h) Chokes
- (i) Tees and crosses
- (j) Test and gauge connections
- (k) Fluid sampling devices
- (l) Crossover connections
- (m) Independent screwed wellheads
- (n) Studs and nuts
- (o) Ring joint gaskets, metallic seals
- (p) Clamps

NOTE: Figures 1 and 2 identify the equipment nomenclature used in this procedure.



- 1.3 [API 6A](#) identifies inspection and testing of materials within several Product Specification Levels (PSL's 1 to 4). For clarity this procedure has been written on the basis of procurement to PSL 3. The check lists for Inspection Requirements Against Inspection Level at the end of this procedure give guidance on the levels of inspection recommended against each PSL.

NOTE: Criticality ratings are not used on this listing for this procedure.

PSL 3 is generally the accepted level for offshore equipment and PSL 2 for equipment for onshore use. However environmental considerations at site may require a higher PSL to be implemented. Figure 3 gives information on the API guidance for determination of PSL's.

2. CERTIFYING AUTHORITY INVOLVEMENT

- 2.1 In the case of wellhead equipment being manufactured for use on the UK continental shelf, wellhead equipment is part of the facilities covered by [UK Statutory Instrument No 289 1974](#) - Offshore Installations (Construction and Survey) Regulations. This requires the involvement of a Certifying Authority who is required to approve the design and manufacture of wellhead equipment.
- 2.2 The Supplier should ensure that the requirements of the Certifying Authority are complied with and is also to keep the Inspector informed at all times of the Certifying Authority activities.
- 2.3 The purchaser should nominate the Certifying Authority for particular orders for offshore related wellhead equipment. The Inspector should co-ordinate his own activities with those of the Certifying Authority Representative.
- 2.3.1 To satisfy the regulatory requirements the following procedure should be followed:-
- (a) The Supplier should submit a 'Specification of Manufacture' to the Certifying Authority for review and acceptance.
 - (b) On satisfactory review of the Specification of Manufacture the Certifying Authority should issue an 'Independent Review Certificate' to the Supplier.
 - (c) During manufacture of the equipment the Certifying Authority may monitor the process.



- (d) On completion of the equipment, and providing the equipment has been manufactured in accordance with the Manufacturing Specification, and all acceptance criteria have been met, the Certifying Authority should issue a 'Certificate of Conformance' to the supplier.

3. RELATED DOCUMENTS

API 6A	Wellhead and Christmas Tree Equipment.
API 5B	Specification for Threading, Gaging and Thread Inspection of Casing, Tubing and Line Pipe Threads.
API 14D	Specification for Wellhead Surface Safety Valves and Underwater Safety Valves for Offshore Service.
BP Group GS 106-2	Painting of metal surfaces
BP Group GS 136-1	Materials for Sour Service to NACE Std MR-01-75.
BP Group GS 162-5	Well Head and Christmas Tree Equipment - Land and Topsides Wellhead, Christmas Tree Valves and Valve Actuators.
BP Group GS162-6	Wellhead and Christmas Tree Equipment - Subsea Wellhead Valves, Christmas Tree Valves and Actuators.
UK Department of Energy	Guidance for the Design and Construction of Offshore Installations.

4. GENERAL

4.1 Inspection and Test Plan

Before the commencement of manufacture or assembly of wellhead equipment the supplier should produce an Inspection & Test Plan for approval.

The manufacturing Inspection & Test Plan should include all quality related activities, reference standards, acceptance criteria, verification formats, supplier responsible personnel and inspection mark-up.

The Inspection & Test Plan should also ensure that the following occur:-

- (a) Major sub-suppliers are approved or agreed as required..



- (b) Required approvals of drawings, design data, procedures, calculations etc. are obtained before proceeding with the relevant activity.
- (c) The correct issues of drawings, specifications etc. are used.
- (d) Only suitably qualified welders and NDT operators are used and their qualification records made available to the Inspector.
- (e) All calculations and design data are reviewed and approved by the Certifying Authority.
- (f) The techniques for inspection and test of forgings and castings are approved by the purchaser, particularly the details of positioning and orientation of test coupons.
- (g) Gauging equipment is calibrated and documented.

Acceptance Criteria: [API 6A](#), Purchase Order and related specifications

4.3 Material Certification & Traceability

The supplier should maintain records of material certification and identification. Test certificates for pressure envelope items should be certified originals, or certified copies of originals (e.g. In the case of forgings, where material is retested for mechanical values and the chemical analysis values are taken from the original mill certificate, as long as the transferred information is certified as correct the certificate supplied by the forgemaster is acceptable as 'original').

Components must be identified by stamping or engraving. Where hard stamping is used to identify material, low stress hard die dot stamps should be used.

Acceptance Criteria: Purchase Order Specification.

The requirements of BP Group [GS 136-1](#) normally apply to materials for sour service as defined by that specification.

4.4 Records of Manufacturing and Material Usage

The supplier should keep records of manufacturing and material usage containing:-

- (a) the description and location of material and material test certificates used, and records of hardness tests carried out,

NOTE: It is recommended that, where impact tested base materials are specified, these tests should be witnessed and approved by the Inspector.



- (b) NDT records,
- (c) Repair records,
- (d) dimensional control and inspection records including thread gauging records,
- (e) pressure test reports, recorder charts and pressure gauge identification,
- (f) non-conformance reports and documented rectification actions

Acceptance Criteria: Purchase Order QA Requirements

5. MANUFACTURING, ASSEMBLY AND ERECTION

5.1 Manufacturing Areas

Work areas should be clean and uncluttered. If work is to occur out of doors, the work area should be protected from the elements and where necessary, heated.

Where stainless steels and non-ferrous metals are being welded or fabricated, the area to be used should be quite separate from that used for carbon and low alloy steels. Separate and clearly identified sets of cleaning and grinding equipment should be maintained for each material.

The purchaser may require to inspect and approve manufacturing areas and where applicable, the equipment to be used before manufacturing, assembly and erection work can start.

Acceptance Criteria: Purchase Order Specifications

5.2 Material Testing

All items forming part of the pressure envelope have to be manufactured from material that has been subjected to material testing in accordance with sections IV and V of [API 6A](#). The Inspector should monitor the metallurgical testing of material for wellhead equipment.

In the case of material certification being requested to meet the requirements of [DIN 50049.3.1.c](#), the activities of an independent Inspection Authority would make the involvement of the purchaser unnecessary.

ing gaskets should be hardness tested in accordance with sections IV and V of [API 6A](#). The Inspector should confirm that the hardness testing of ring gaskets is carried out.

For materials required for sour service, the requirements of BP Group [GS 136-1](#) should apply.



Acceptance Criteria: [API 6A, DIN 50049.3.1.c,](#)
[BP Group GS 162-5 and 162-6](#)



5.3 Welding

5.3.1 General

All welds should be made by suitably qualified welders working to suitably qualified procedures which may be subject to approval.

5.3.2 Consumables

It is important that welding consumables are stored and controlled in accordance with manufacturers' recommendations. BP Group [GS 118-4](#) also gives advice on the control of welding consumables.

The storage and use of welding consumables should be sample checked by the Inspector. Where welding consumables are found to be non-conforming to the welding procedure, they should be rejected and replaced by correctly stored consumables; At the discretion of the Inspector this may include the cut out of any welds that have been completed with the out-of-specification consumables. (see below)

5.3.3 Parameters

The Inspector should sample check all welding parameters as detailed on the weld procedure specification. Where there is evidence that welding has been performed with one or more of the essential variables outwith specification the weld should be rejected.

When such a rejection occurs it is the Supplier's responsibility to investigate and establish the extent of the non-conformity to the satisfaction of the Inspector.

Any remedial action or further examination necessary to bring welding back within specification should also be agreed with the Inspector. Where the Supplier opts to revise or requalify the weld procedure this should be handled in accordance with the Supplier's design change control procedure and may therefore also be subject to the agreement of the Purchaser.

5.3.4 Hydrogen Induced Cracking

Where hydrogen induced cracking is possible, consideration should be given to delaying NDT until 48 hours after welding is completed. - refer to [BS 5135](#) for guidance.

5.4 Heat Treatment

The Inspector should ensure that heat treatment is carried out in compliance with the requirements of the approved procedure and [API 6A](#).

Where re-heat treatment is to be carried out after a material inlay/overlay or local weld repair, the complete body/component should be subjected to the treatment.

Stress relief heat treatment should be monitored by the Inspector.



Acceptance Criteria: Approved Heat Treatment Procedure. [API 6A](#)

5.5 NDT

All NDT should be carried out in accordance with documented procedures, using qualified operators.

The Inspector should monitor, review and approve all NDT procedures (application), records and reports.

The following methods of NDT may be utilised, in accordance with specifications, standards, and Inspection and Test Plan requirements.

Surface preparation may be required to some extent.

- (a) VISUAL EXAMINATION - All welds and castings should be visually examined.
- (b) MAGNETIC PARTICLE EXAMINATION - To supplement visual examination on ferrous materials,
- (c) LIQUID PENETRANT EXAMINATION - To supplement visual examination of ferrous materials on non-magnetic or non-ferrous metals and, if specified, for examination for root runs of ferrous metals prior to weld completion.
- (d) RADIOGRAPHIC EXAMINATION
- (e) ULTRASONIC EXAMINATION - May be specified to supplement or replace radiography where radiography may be difficult due to joint geometry or thickness, or for defect sizing, or where defects may be difficult to detect using radiography, due for example to orientation or configuration.

5.6 Weld Repairs (including castings and forgings)

All repairs to welds should be in accordance with suitably qualified repair welding procedures which may also require Purchaser approval..

Major excavations should be examined by the Inspector.

Two unsuccessful repairs at the same location should normally necessitate the weld to be cut out and remade, unless a proposal to carry out a further repair is agreed by the Purchaser.

It should be confirmed that the heat affected zones of previous welds are completely removed before re-welding.



The monitoring of welding parameters and the consideration of the susceptibility to hydrogen induced cracking should be similar to that for the original weld.

5.7 Dimensional Control

The Inspector should monitor the dimensional control of manufacturing, assembly and erection in accordance with the latest revision of the manufacturing specification, drawings, and [API 6A](#) as applicable.

Thread gauging should be monitored by the Inspector. Gauging shall be in accordance with [API 5B](#)

Acceptance Criteria: Approved Drawings,
[API 6A](#), [API 5B](#)

6. PRE-ASSEMBLY COMPONENT INSPECTION

- 6.1 Prior to assembly of wellhead equipment and components, the component parts of each piece of equipment should be set out by the supplier and a verification inspection carried out against the relevant purchase order specifications and drawings and any concessions/non-conformances.

The purpose of this inspection is to verify the correctness of each component against material and dimensional requirements prior to final assembly of equipment and components. Material certificates should be reviewed at this stage.

Acceptance Criteria: Purchase order specifications,
[API 6A](#)

7. DRIFTING

- 7.1 Assembled wellhead equipment should be drift tested as required by BP Group [GS 162-5](#) and [162-6](#).

The Inspector should witness drift testing.

Acceptance Criteria: BP Group [GS 162-5](#) and [162-6](#).

8. FUNCTIONAL TESTING

- 8.1 All wellhead equipment should, where practicable, be functionally tested in an assembled condition. The Inspector should witness functional testing.

In the case of casing and tubing hangers, the 'first-off' in a series run should be trial fitted to their respective bodies and their sealing arrangements pressure tested in accordance with Section 9.



8.2 Functional testing should include:-

- (a) Operation of all valves through full range of travel at least six (6) times.
- (b) Operation of actuators using the operating medium through full range of travel at least six (6) times. Actuators should be connected to their primary device. Mechanical/manual overrides are to be cycled at least once during functional testing.
- (c) Leak testing of actuators.

Acceptance Criteria: Purchase Order Specifications,
Design Criteria,
[API 6A](#), [API 14D](#)

9. PRESSURE TESTING

The Inspector should witness all pressure testing.

9.1 Hydrostatic Testing

Wellhead assemblies, bodies and valve bodies should be subjected to a hydrostatic test as specified by [API 6A](#) and BP Group [GS 162-5](#) and [162-6](#).

The medium for hydrostatic testing should be inhibited water unless otherwise specified. Any limit on impurity levels should be specified.

9.1.1 Christmas Trees

Assembled Christmas trees should be subjected to a hydrostatic body test prior to dispatch from the supplier's works. Trees assembled from previously hydrostatically tested equipment need only be tested to rated working pressure.

9.1.2 Valves

Valves should be subjected to a hydrostatic body test either as part of the Christmas tree assembly or individually.

After being subjected to the body test the valves should be subjected to a hydrostatic seat test pressure equal to the rated working pressure.

On completion of hydrostatic seat testing, the valve seat should be air tested at a low pressure of between 80 and 100 psi max. The valve should be fully opened and re-shut and the test pressure re-applied for a further 15 minutes; this test should be repeated at least 6 times. The leakage rate should be zero. In the case of actuated valves the seat leakage should be checked prior to and after the 6 operations. Bi-



directional valves should have the above seat pressure tests applied to each side of the gate or plug.

Air testing should be carried out with the outlet side submerged in water. The testing medium should be dry air.

9.1.3 Other items that require pressure testing should include the following:-

TEST PRESSURE

Backseats	Max. working pressure (MWP)
Gland packing	Hydrostatic test pressure (HTP)
Bonnet seals	HTP
Flange seals	HTP
Test and bleeder ports	HTP
Control line exists	HTP
Injection ports	HTP

Acceptance Criteria: API 6A,
BP Group GS 162-5 and 162-6

9.2 Gas Testing

High pressure gas testing should be carried out in accordance with procedures that have been approved. The Inspector should review the test facilities and equipment to ensure that safety has not been compromised. The review and approval of procedures should include safety aspects.

The test medium should be nitrogen.

A pressure relief device should be provided, having a set pressure not higher than the test pressure plus the lesser of 3.5 bar (50 psi) or 10% of the test pressure.

The test should be conducted at ambient temperatures, and the equipment under test should be completely submerged in clean clear water.

The test pressure should not exceed the rated working pressure of the equipment.

Valves should be subjected to a seat pressure test similar to 9.1.2 above.

Acceptance Criteria: [API 6A](#),
[BP Group GS 162-5 and 162-6](#),
Purchase order specification

9.3 Assemblies

If items are to be delivered in an assembled condition (i.e. Bolted together), the assembly should be pressure tested as above, to determine the integrity of the bolted joints.



10. HANDLING, PRESERVATION, PACKAGING AND TRANSPORT

- 10.1 The supplier should, as part of his Quality Plan, have prepared a procedure for handling, preservation, packaging and transport of the equipment.
- 10.2 The Inspector should monitor the preservation, handling and packaging of the equipment. Particular attention should be paid to the following:-
- (a) draining and drying of the equipment by a suitable non-detrimental method.
 - (b) tagging
 - (c) rust preventative coatings/inhibitors
 - (d) flange face protection
 - (e) identification of gaskets and other loose item.
- 10.3 The Inspector should carry out inspection of any coatings as required by the purchase order and the Inspection and Test Plan.
- 10.4 Items of equipment may require to be weighed prior to shipping and a weight report issued.

Acceptance Criteria: Purchase Order Specification

11. FINAL INSPECTION

- 11.1 The supplier should prepare and submit for approval to the Inspector, a documentation and certification package for each piece of wellhead equipment. This package should include documentation as required by the purchase order. This should include but may not be limited to the following:-
- (a) Approved welding procedures and welder qualification records.
 - (b) Approved NDT procedures and operator qualifications.
 - (c) Approved heat treatment procedures.
 - (d) Material test records and certificates
 - (e) Hardness test records.
 - (f) Heat treatment records.



- (g) NDT records for the following:-
 - (i) Surface NDT
 - (ii) Weld volume NDT
 - (iii) Repair weld NDT
 - (iv) Volumetric NDT
- (h) Welding process records itemising:-
 - (i) Welder identification
 - (ii) Post weld heat treatment.
- (i) Pressure testing records.
- (j) Gas testing records, if applicable.
- (k) Records of drift testing.
- (l) All concessions and outstanding non-conformances.
- (m) Signed off Inspection & Test Plan.

11.2 The format and content of this documentation package may be required to be in accordance with an agreed index. The documentation package should be compiled during the course of manufacture.

In association with a satisfactory final inspection of the equipment and on completion of the handling, preservation and packaging requirements, the Inspector should review the documentation package and if found to be satisfactory and in accordance with the Purchase Order, should issue a release note, a copy of which may be required in the documentation package.

11.3 All components are to have been checked to have conformed to purchaser marking requirements and those of [API 6A](#).

11.4 The Inspector should confirm that the Certifying Authority has issued a Certificate of Conformance as applicable.



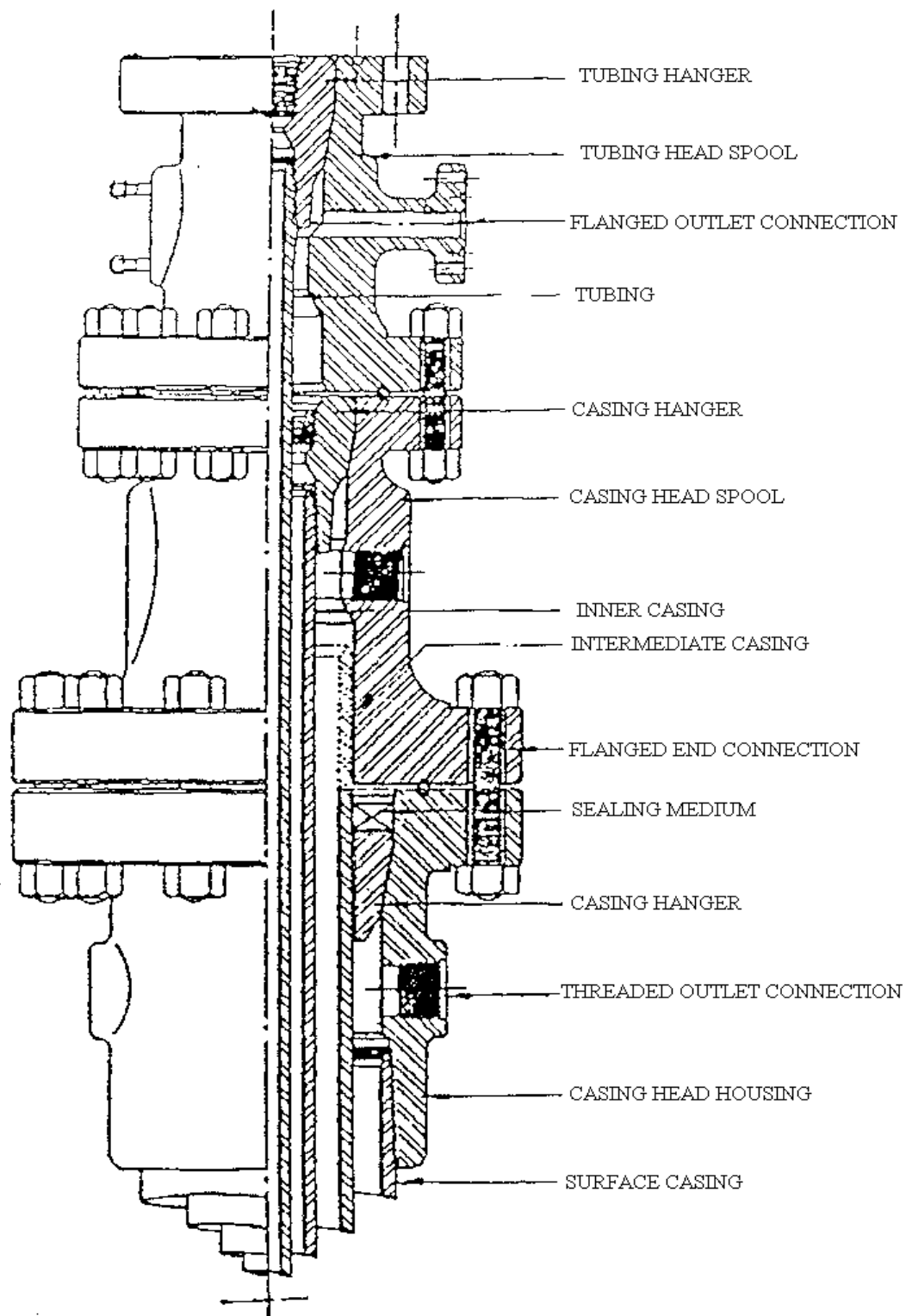


FIGURE 1

TYPICAL WELLHEAD ASSEMBLY NOMENCLATURE



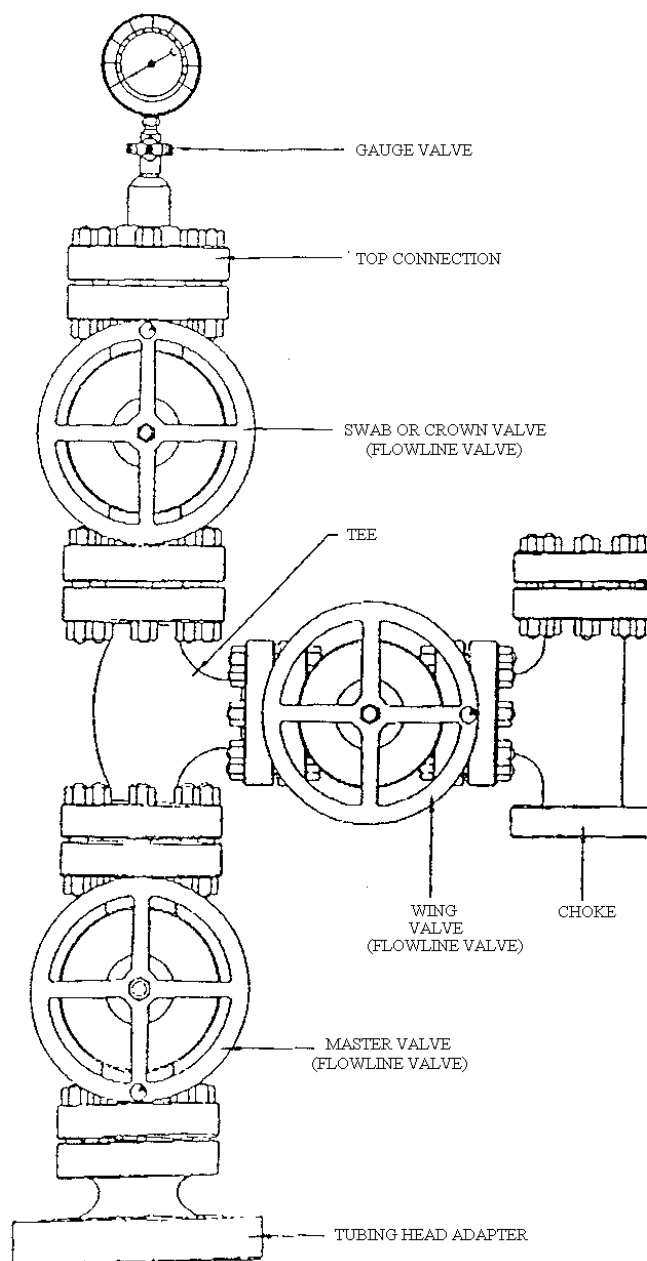


FIGURE 2
TYPICAL CHRISTMAS TREE NOMENCLATURE

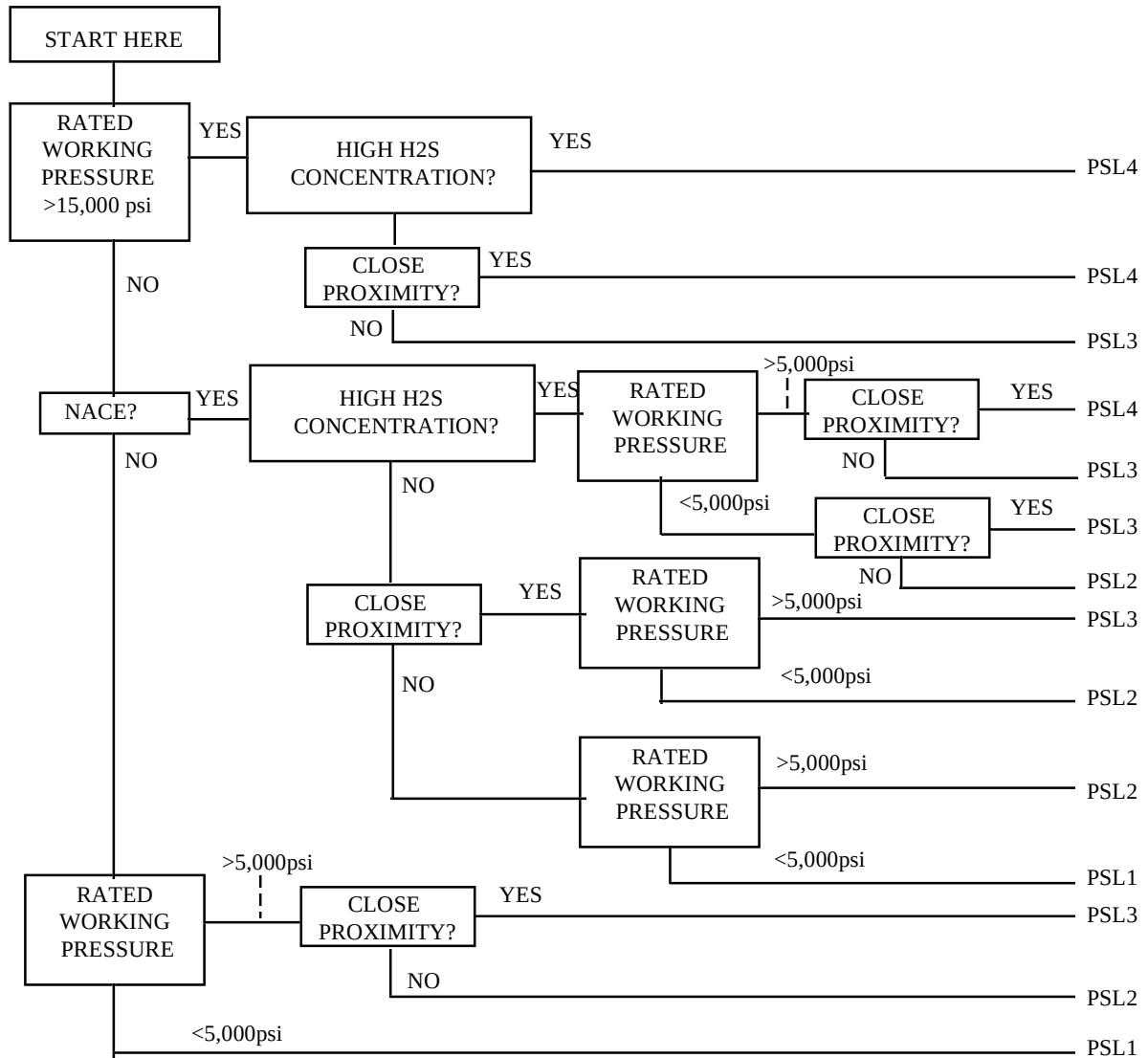


FIGURE 3.1

RECOMMENDED MINIMUM PSL FOR PRIMARY PARTS OF WELLHEADS AND CHRISTMAS TREE EQUIPMENT



CLOSE PROXIMITY?

Use 'YES' if the well meets any of the following conditions:-

1. 100 PPM radius of exposure (ROE) of H₂S is greater than 50" from the wellhead and includes any part of a public area except a public road.
2. 500 PPM ROE of H₂S is greater than 50" from the wellhead and includes any part of a public area including a public road.
3. Well is located in any environmentally sensitive area such as parks, wildlife preserves, city limits etc.
4. Well is located within 150" of an open flame or fired equipment.
5. Well is located within 50" of a road (lease road excluded).
6. Well is located in state or federal waters.
7. Well is located on or near inland navigable waters.
8. Well is located in or near surface domestic water supplies.
9. Well is located within 350" of any dwelling.

These are recommended minimum considerations. It will be necessary to meet any local regulatory requirements.

FIGURE 3.2

DETERMINATION OF CLOSE PROXIMITY



INSPECTION CHECK LIST

WELLHEAD EQUIPMENT

PARA REF	ACTION	YES	NO	N/A
4.1 (a)	All drawings, specifications and calculations approved?			
4.1 (b)	All major sub-suppliers approved?			
4.1 (c)	Inspection and test techniques for casings and forgings approved?			
4.1 (d)	Gauging equipment is calibrated and documented?			
4.1 (e)	All applicable welding procedure specifications and qualifications approved?			
4.1 (f)	Heat treatment procedures approved?			
4.1 (g)	NDE procedures approved?			
4.1 (h)	Hydrostatic testing procedures and gas testing procedures approved?			
4.1 (i)	Functional test procedures approved?			
4.3	Incoming material inspected and material certificates reviewed and accepted?			
4.3	Manufacturing records being compiled and approved?			
4.3 & 10.1.3	All materials marked in accordance with approved method?			
5.1	Cleanliness standards for equipment and materials etc., are being maintained?			
5.3	Heat treatment monitored and reports/charts approved?			
5.4	NDE reviewed and reports approved?			
5.5	Weld repairs monitored and NDE accepted? Heat treatment re-done?			
5.6	Machining, surface preparation and flatness in accordance with approved drawings?			
5.6	Dimensional control monitored and approved?			
6.	Pre-assembly component inspection carried out?			
7.	Drifting carried out and witnessed?			
8.	Functional testing witnessed and accepted?			
9. & 9.2	Valve pressure testing witnessed and accepted? Applicable seat testing carried out?			



PARA REF	ACTION	YES	NO	N/A
9.2	Gas testing carried out? Witnessed and approved?			
10.	Handling, preservation and packaging procedures approved and issued? Monitored and accepted?			
	FINAL INSPECTION AND RELEASE			
11.	All inspections complete and accepted?			
11.1	Documentation package reviewed and accepted?			
11.3	Manufacturers certificate of compliance issued?			
11.4	Certifying authority certificate of conformance issued?			
11.5	Inspection release note issued?			



GUIDE TO PURCHASER INSPECTION REQUIREMENTS AGAINST PRODUCT SPECIFICATION LEVEL (PSL)

WELLHEAD EQUIPMENT

ACTION	I	II	III	IV
1. GENERAL				
All drawings, specifications and calculations checked and approved?	Yes	Yes	Yes	Yes
Approval of major sub-suppliers?	Yes	Yes	Yes	Yes
Approval of techniques for inspection?	Yes	Yes	Yes	Yes
Welding procedures and welders qualified and approved?	Yes	Yes	Yes	N/A
NDE procedures and personnel approved?	Yes	Yes	Yes	Yes
Heat treatment procedures approved?	Yes	Yes	Yes	Yes
Approval of pressure and functional test procedure?	Yes	Yes	Yes	Yes
Check of measuring and test equipment (inc. calibration)?	I	I	I	I
2. WELDING				
Preparation of welds checked and NDE of prep reviewed and accepted?	I	M	Yes	N/A
Welding to be monitored and pre-heat and interpass temperatures accepted?	I	M	Yes	N/A
Heat treatment monitored and reports/charts approved?	I	M	Yes	N/A
NDE reviewed and reports approved?	Yes	Yes	Yes	N/A
Dimensional checking of size and finish?	Yes	Yes	Yes	Yes
3. PRESSURE ENVELOPE				
Witness of tensile testing?	No	No	M	M
Witness of hardness testing, review of reports and accept?	M	M	M	M
If to NACE	Yes	Yes	Yes	Yes
Witnessing of volumetric NDE and approval of reports?	N/A	N/A	Yes	Yes
Visual inspection of surface finish	M	M	I	I
Witnessing of surface NDE and approval of reports?	I	I	Yes	Yes
Dimensional checking of size and finish?	M	M	M	M
4. STEMS				
Witness of tensile testing?	No	No	M	M
Witness of impact testing	No	No	M	M



ACTION	I	II	III	IV
Witness of hardness testing, review of reports and accept?	M	M	M	M
If to NACE	Yes	Yes	Yes	Yes
Visual inspection of surface?	M	M	R	R
Witness of surface NDE and approval of reports?	No	No	M	M
Witnessing of volumetric NDE and approval of reports?	N/A	N/A	M	M
Dimensional checking of size and finish?	No	No	M	M
5. VALVE BORE SEALING MECHANISMS				
Witness of tensile testing of component prior to and after hardfacing?	No	No	M	M
Witness of impact testing?	No	No	M	M
Witness of hardness testing review of reports and accept?	No	No	M	M
If to NACE	Yes	Yes	Yes	Yes
Witnessing of surface NDE and approval of reports?	No	No	M	M
Witnessing of volumetric NDE and approval of reports?	N/A	N/A	M	M
Dimensional checking of size and finish?	M	M	M	M
6. RING JOINT GASKETS				
Dimensional checking of size of gaskets?	I	M	M	M
Witness of hardness testing and acceptance of reports?	I	M	M	M
7. FASTENINGS AND GASKETS				
Witness of tensile testing?	No	No	No	No
Witness of impact testing?	No	No	No	No
Witness of hardness testing, review of reports and accept?	No	No	No	No
Acceptance of chemical analysis reports?	Yes	Yes	Yes	Yes
Manufacturers certificates of compliance?	Yes	Yes	Yes	Yes
Dimensional checking of size and finish?	No	No	No	No
8. TESTING				
Witnessing of drift testing of all assembled components?	Yes	Yes	Yes	Yes
Witnessing of pressure testing?	Yes	Yes	Yes	Yes
Witnessing of gas testing?	N/A*	N/A*	N/A*	Yes
9. PACKAGING AND PRESERVATION				
Equipment drained and dried after testing?	Yes	Yes	Yes	Yes



ACTION	I	II	III	IV
Exposed metal surfaces coated with rust preventative?	Yes	Yes	Yes	Yes
Flange faces protected against mechanical damage?	Yes	Yes	Yes	Yes
Equipment boxed and/or palletised?	Yes	Yes	Yes	Yes
Loose ring gaskets and minor items individually boxed or wrapped and safely secured?	Yes	Yes	Yes	Yes

LEGEND:

YES = ACTION REQUIRED (MAY ENTAIL APPROVAL OF DOCUMENTATION OR WITNESS OF AN ACTIVITY)

NO = ACTION NOT REQUIRED

M = MONITOR (SEE DEFINITIONS)

I = SAMPLE INSPECTION / CHECK

R = REVIEW OF QUALITY RECORDS E.G. MANUFACTURING/ INSPECTION /TEST RECORDS.

WHEN R IS USED FOR AN APPROVAL ACTIVITY IS INDICATES THAT IT IS NORMALLY CONSIDERED ACCEPTABLE THAT THE REVIEW/APPROVAL IS PERFORMED BY THE INSPECTOR RATHER THAN SAY THE DISCIPLINE ENGINEER.

WARNING: IN USING THESE CHECK LISTS THE INSPECTION REQUIREMENTS CONTAINED IN THE PURCHASE ORDER CODES AND STANDARDS MUST BE CARRIED OUT AS A MINIMUM.



DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory volume.

Purchaser:	The department, organisation or project having the responsibility for the procurement of new equipment.
Supplier:	The organisation, company or agency that is contracted to provide new manufactured equipment to BP.
Inspector	The person appointed by the supplier or the purchaser to carry out engineering inspection in the suppliers works.
Certifying Authority:	The body whose function is to ensure compliance with statutory requirements in the country of usage of the equipment and whose approval is acceptable to the government of that country.
Competent Person:	A person having such practical and theoretical knowledge and actual experience of the type of equipment to be examined as will enable him to detect defects or weaknesses which it is the purpose of the examination to discover and to assess their importance in relation to the strength and functions of the particular equipment.
Inspection:	Activities such as measuring, examining, testing, gauging one or more characteristics of a product or service and comparing these with specified requirements to determine conformity.
Approval:	Indicates review and written approval by an authorised body. The suppliers quality system should identify who in the organisation is authorised to undertake approval activities. The purchaser who may require to have some input into the document review process, however should bear in mind the possible implications e.g. transfer of responsibility / legal, of using the term 'approval' and therefore may wish to use alternative terms such as 'agree' or 'review' or 'for information' to make it clear that the supplier retains full responsibility for the content of the documentation. Therefore when using the 'guide to purchaser inspection requirements against criticality



ratings' matrix, the purchaser may wish to substitute the word 'approve' for 'agree' or 'review' when he wishes to examine the suppliers documentation for whatever reason.

Monitoring:	A specific overseeing activity nominated within a Quality or Inspection & Test Plan that requires the Inspector to ensure an activity or sequence of manufacture complies with specification. (e.g. monitor assembly, indicates that the Inspection Engineer would, by random visits and inspections, verify that an assembly operation is being carried out in accordance with the specification.)
Concession:	Written authorisation by BP to use or release a quantity of material, components or stores which do not conform to the specified requirements.
Non-conformity:	The non-fulfilment of specified requirements.
Criticality Rating:	A formalised technique for measuring the importance of a piece of equipment with regard to the effect that its failure would have on the system or scheme as a whole and on this basis to determine consequently the level of Quality Assurance to be applied.
Quality Programme	A documented set of activities and events serving to define the quality requirements to be met. Quality programmes should be prepared by both suppliers and purchasers. Form ref. QP1 is an example of a typical purchaser quality programme.
Quality Plan:	A document prepared by the contractor or supplier setting out the specific quality practices, resources and activities in chronological order, relevant to a particular order or contract.
Inspection & Test Plan	A document prepared by the contractor or supplier setting out all manufacturing, construction, installation, commissioning and quality activities in a logical sequence relating to the manufacturing programme.

Abbreviations

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BASEEFA	British Approvals Service for Electrical Equipment in Flammable Atmospheres
BPE	BP Engineering
BS	British Standard
BSI	British Standards Institute



CAF	Compressed Asbestos Fibre
CENELEC	European Committee for Electrotechnical Standardisation
DIN	Deutsche Institut für Normung
DNV	Det Norske Veritas
IEC	International Electrotechnical Commission
IIA	Independent Inspection Authority
IP	Institute of Petroleum
LRS	Lloyds Register of Shipping
NDE	Non-Destructive Examination
NDT	Non-Destructive Testing
NPSH	Net Positive Suction Head
OMCA	Oil Companies Material Association
QA	Quality Assurance
SI	Système International d'Unités

