



GS 130-3

PRE-DELIVERY TESTING AND INSPECTION OF INSTRUMENTATION AND CONTROL SYSTEMS

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SCOPE AND PURPOSE This document specifies the minimum requirements for pre-delivery testing and inspection of instrumentation and control systems. It is applicable to control panels, equipment racks and work stations that incorporate electrical/electronic, pneumatic and hydraulic devices.											
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FOREWORD

Introduction to BP Group Recommended Practices 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 Guidance for Specification

This Guidance for Specification identifies the minimum requirements for pre-delivery testing and inspection of control systems. The intention is to standardise common requirements for systems and to minimise on-site testing.

Application

This Guidance for Specification is intended to guide the purchaser in the use or creation of a fit-for-purpose specification for enquiry or purchasing activity.

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Specification, and may discuss alternative options.

This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Specification Ready for Application

A Specification (BP Spec 130-3) is available which may be suitable for enquiry or purchasing without modification. It is derived from this BP Group Guidance for Specification by retaining the technical body unaltered but omitting all commentary, omitting the data page and inserting a modified Foreword.

Principle Changes from Previous Edition

This document covers the same scope as old Std 130 but is written to express key requirements which minimise on-site testing.



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 International or the Custodian. See Quarterly Status List for contacts.



1. INTRODUCTION

1.1 Scope

1.1.1 This specification details the minimum requirements for pre-delivery testing and inspection of instrumentation and control systems.

It is applicable to control panels, equipment racks and work stations that incorporate electrical/electronic, pneumatic and hydraulic devices. This specification applies to panels where the normal pneumatic supply is instrument air. Where a panel is designed to operate on another medium e.g. Nitrogen or Hydrocarbon gas, additional requirements should be specified to cater for any additional hazards, e.g. asphyxiation, corrosion, impact on electrical certification.

The purpose of the pre-delivery test is to:-

- (a) *Ensure the equipment is safe to operate and maintain.*
- (b) *Ensure that the equipment meets the functional specification of the order.*
- (c) *Confirm the equipment has been designed and built to the specified design codes and standards and that the appropriate certification is available.*
- (d) *Ensure the integrity and function of the equipment as constructed.*

Where equipment performance can be affected by external factors such as power supply, connection to the plant, earthing or physical environment these factors should be accounted for in the specification of Site Acceptance Tests i.e. factors which change by virtue of the move from factory to site.

1.1.2 This specification applies to testing of instrumentation and control systems, or elements thereof, forming an integrated part of any of the following:-

- (i) Discrete systems.
 - (a) *Single variable controllers, logic units, alarm units or indicators.*
 - (b) *Small integrated systems.*
 - (c) *Small plc arrays, data acquisition systems, intelligent controllers in which commands are limited to those accessible through special function keys or menus.*
- (ii) Large integrated control systems.

Proprietary Distributed Control Systems with distributed processing power where controller function is configured from a set of basic commands through an operator interface based on visual display units with a portion of freely configurable graphics.



- (iii) Software packages implemented on multi-purpose mini and mainframe computers.

Advanced control packages where detail of the control action is configured from a set of commands through an operator interface based on visual display units with a portion of freely configurable graphics.

1.2 Quality Assurance

Verification of the vendor's quality system is normally part of the pre-qualification procedure, and is therefore not specified in the core text of this specification. If this is not the case, clauses should be inserted to require the vendor to operate and be prepared to demonstrate the quality system to the purchaser. The quality system should ensure that the technical and QA requirements specified in the enquiry and purchase documents are applied to all materials, equipment and services provided by sub-contractors and to any free issue materials.

Further suggestions may be found in the BP Group RPSEs Introductory Volume.

2. TESTING AND INSPECTION

2.1 General Requirements

- 2.1.1 A detailed Factory Acceptance Test (FAT) procedures document shall be prepared by the vendor and submitted for approval before commencement of formal testing at the vendors works. Tests shall only be run in accordance with agreed procedures. The vendor shall indicate the expected results which would confirm successful completion of the tests.

The test procedure may only be varied by agreement with the purchaser. Departures from the procedure by the vendor shall be subject to approval by the purchaser.

- 2.1.2 The equipment shall be as complete and functional as reasonably practicable.

This includes all peripherals and portable programming or communications devices.

For inter-panel or system links, the equipment to be installed on site should be used for the tests whenever possible.

- 2.1.3 The vendor shall submit the equipment for test only after he has completed his own inspection and tests.

Any defects found during vendor testing should be rectified prior to pre-delivery testing.

- 2.1.4 The vendor shall operate the equipment during the tests. The inspection personnel may attend all or part of each test.



- 2.1.5 The vendor shall supply all consumable materials and any test and simulation or calibration equipment (hardware and software).
- This includes equipment for testing input, output, sequential control and system loading both hardware and software.*
- 2.1.6 Any test interrupted for any reason shall be deemed unsuccessful and shall be recommenced as agreed, in part or total.
- 2.1.7 All testing shall be recorded. Test records shall be signed by the personnel witnessing the tests.
- Wherever possible tests should be arranged to result in output to a printer or copier to confirm details of the tests carried out. The printout forming part of the test documentation.*
- 2.1.8 All spare items included in the supply shall where possible, be subject of testing in accordance with this specification.
- 2.1.9 Any faults discovered during inspection and testing that seriously affect a significant portion of the system shall be rectified before proceeding further into the test. Other faults shall be recorded systematically on a 'punch list', together with the required corrective action. All previously tested circuits, systems and components affected by the rectification work shall be retested. Where this corrective action requires a modification to the original design, this shall be referred to the purchaser for design approval.
- 2.2 Visual Inspection**
- 2.2.1 The panel and its contents shall be inspected to ensure that it has been constructed to the order, specification and approved drawings.
- The inspection will ensure:-*
- (a) *All items of equipment are present and in accordance with specifications and purchase order.*
 - (b) *There is adequate accessibility for operation and maintenance.*
 - (c) *The equipment is dimensionally correct.*
 - (d) *The finish and Ingress Protection are correct.*
 - (e) *When necessary the weight and centre of gravity may be determined.*
- 2.2.2 Equipment assemblies and sub-assemblies shall be examined in respect of finishing, wiring, tubing, piping, labelling and general construction.
- Emphasis should be given to items which affect personnel safety.*

External connection points for electrical, tubing, piping etc. should be checked against approved drawings.

- 2.2.3 The facilities to ensure safe handling, transport and installation of the finished panel/assembly shall be examined.

This may include lifting lugs, spreader bars, custom built cradle or stand etc.

2.3 Power Distribution, Supplies and Earthing

- 2.3.1 The power supplies, the segregation of supplies, wiring, earthing and personal protection shall be checked to ensure that they comply with the design specification.

Care should be taken when there are earthing requirements for combinations of a.c. Safety (mains), Lightning Protection, Instrument (reference), Computer or Intrinsic Safety.

- 2.3.2 All power supply units shall be checked to ensure that they comply with the design specification and that they supply a voltage and current, within specification over the whole range of input supply conditions.

This may include steady state, pulse, surge, start-up, interruption of power for part or several cycles and operation on battery back-up.

Polarity and labelling should be checked in d.c. systems.

- 2.3.4 Tests shall be carried out to verify correct operation of changeover or back-up systems, including isolation facilities for maintenance.

- 2.3.5 All isolators and protective devices (e.g. MCBs, fuses) shall be checked to ensure that they are marked with rating and a unique identification, that they are connected to the correct circuits and that they safely isolate the circuits.

It should be established that sufficient discrimination exists within the distribution to ensure that in the event of a fault, the protective device associated with the faulty instrument or circuit is the only protective device to operate and there are no effects on other circuits due to dips or surges. The effect of field cabling should be considered to establish that the loop resistance is low enough to cause the protection to operate.

It should be established that resetting of any isolator or device does not adversely affect any other component within the system.

2.4 Pneumatic Supplies and Distribution

- 2.4.1 The vendor shall provide dry compressed air of suitable quality and with sufficient capacity to enable the complete panel or system to be tested.



The supply should be connected upstream of the main inlet filters and regulators.

- 2.4.2 All protective devices and isolators (e.g. relief valves, valves) shall be functionally tested and checked to ensure that they are marked with rating and a unique identification, that they are connected to the correct circuits and that they protect or safely isolate the circuits.

Particular care shall be taken with over pressure protection of Ex 'p', pressurised or purged enclosures.

- 2.4.3 Any header, vessel or component which has been subjected to a hydraulic pressure test shall be thoroughly dried and cleaned before reconnection to the pneumatic system.

- 2.4.5 Tests shall be carried out to verify correct operation of changeover or back-up systems, including isolation facilities for maintenance.

2.5 Hydraulic Supplies and Distribution

- 2.5.1 All hydraulic supply, distribution, equipment, piping/tubing shall be in accordance with BP Group [GS 134-1](#).

2.6 Component Function, Calibration and Loop Checks.

- 2.6.1 Components shall be tested individually, prior to testing in a loop. The instrument manufacturers standard hardware and calibration tests shall be carried out on all items of equipment or devices.

- 2.6.2 Any equipment which may be damaged by testing shall be temporarily disconnected for the tests.

This may include Intrinsic Safety barriers during insulation resistance testing.

- 2.6.3 After completion of component tests, all equipment associated with a loop shall be tested simultaneously. Loops shall be tested individually. However, where loops interact, these shall be tested as a system.

The test should ensure:-

- (a) *Correct indication and response of all variables on all operator interfaces e.g. process variables, status, alarm condition and timing, sequence, response times to alarms and operator changes. etc.*
- (b) *Correct operation of all parameters from all operator interfaces e.g. output change, mode change, action change.*
- (c) *Where appropriate the final control system configuration settings should be left on the equipment.*
- (d) *That there is no interaction with any other loop.*



- 2.6.4 Dummy loads shall be fitted where it is necessary to simulate field devices.

These may be hydraulic, pneumatic, electric or electronic, they should simulate the expected service conditions, including allowances for field cabling/ tubing etc. and should be connected at field terminations only.

2.7 Software Tests

- 2.7.1 Software tests are relevant where part of the functionality of the panel is defined by software.

- 2.7.2 Where the software is supplied in more than one form and/or medium e.g. source code, compiled code on tape, disc or PROM/EPROM etc. a verification of each shall be carried out to ensure consistency.

- 2.7.3 The facilities to load, dump, initialise and recover the software dependent elements of the system, using the appropriate media shall be fully demonstrated.

Any auto recovery or re-start facilities should be tested to ensure correct mode on re-start.

- 2.7.4 Software flow sheets that define all software functions shall be provided. Using these as a basis the correct operation of each function shall be tested, for all combinations of pertinent inputs, commands and sequences.

- 2.7.5 The vendor shall propose an arrangement to test high software loading e.g. induced binary chatter, system tasks on continuous cycle (history collection).

Control processing, display, alarm and operator response times should remain within the specified limits.

2.8 System Tests

- 2.8.1 System tests shall ensure the characteristics of the whole system are checked, including all redundancy features.

This may entail repeating a test with different redundant items on duty, ensuring no adverse effect to system operation.

In systems with redundant power supplies, system modules, clock sources, communications, storage devices (and media) etc., the co-ordination of requirements for system operation will be checked. i.e. to ensure that redundant modules, communications links and start up facilities are not linked to a single power supply or module.



When it is impractical to simultaneously connect large numbers of dummy loads, individual loops may be tested with a dummy load and the system performance demonstrated by calculation. Care should be taken to ensure that sufficient allowance is made for field components which may affect performance e.g.. length of field cabling/tubing etc.

2.8.2 Security features supplied with the system shall be tested.

2.8.3 System diagnostics and alarms shall be tested.

2.8.4 Interfaces to other systems shall be tested.

2.9 Electromagnetic Interference

2.9.1 Tests shall be carried to demonstrate that the equipment will operate satisfactorily within the limits specified for immunity to radio frequency interference. This shall include the defined frequency range(s) and signal strength(s).

Project or site specific equipment should be used for the test.

2.9.2 Tests shall be carried out to ensure that the equipment does not produce more than the specified level of radio frequency interference.

2.9.3 Where applicable Electrostatic Discharge tests shall be included.

2.10 Environmental Testing

2.10.1 All panel doors shall be closed and any forced ventilation shall be in operation throughout the test under load conditions. Where there is redundancy of forced ventilation, this shall be checked by operation with the minimum arrangement in operation.

2.10.2 Ambient Temperature Tests either elevated, low temperature or cyclic testing of the complete panel shall be performed recorded and retained as and when specified by the purchaser.

These tests may be appropriate if individual components have not been tested during their construction.

The requirement for extensive 'heat soak' testing of electronic systems should be carefully considered. The costs of preparing for and undertaking heat soak tests should also be considered.

2.10.3 Where tolerance to impact, vibration, dust, humidity, corrosive atmospheres etc. is required, additional tests may be specified by the purchaser.



3. DOCUMENTATION

- 3.1 The vendor shall supply a test procedures document with detail of all tests to be carried out and with test sheets indicating the expected results, which would confirm successful completion of the tests.

This would normally be supplied and approved 2 to 8 weeks prior to the start of testing as specified in the functional specification.

- 3.2 The vendor shall submit a current inventory of all equipment, applicable documentation, software programs and drawings, with revision levels, before testing commences.

The equipment inventory should reference equipment by model, serial number and location within the system. Modules should only be moved within the system, with the approval of the inspection personnel.

On successful completion of pre-delivery tests the software should enter a software revision management system, with back-up procedures and change control documentation.

- 3.2 Documentation as detailed within the equipment specification and purchase order shall be available prior to the start of testing.

This may consist of:-

- (a) *System drawings e.g. power distribution, earthing, panel and console layout, network communications and input/output terminations etc.*
- (b) *Equipment safety certification dossier, including hazardous area, electrical safety certificates and mechanical relief valve test certificates.*
- (c) *Failure Modes and Effects Analysis.*
- (d) *Operation and maintenance manuals with all information necessary for subsequent commissioning and maintenance of the equipment during the life of the installation.*
- (e) *Detailed test sheets for on site commissioning and routine maintenance of the equipment.*
- (f) *Spare parts lists.*

- 3.3 The vendor shall submit list of deviations from order, specification and design drawings with outstanding actions identified.

- 3.4 The vendor shall submit a 'punch list' recording all actions outstanding at the end of the test period.

- 3.5 Calibration and conformance certificates for calibration equipment shall be available for inspection.



- 3.6 The vendor shall compile a record of changes during test. This record shall detail why changes were required, what corrective action was taken and possible implications of the change. The record shall be authorised by vendor and purchaser representatives.



DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory Volume.

Abbreviations

None



LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

BP Group [GS 134-1](#) Hydraulic Power Supplies
(replaces BP Std 115)

