

DEP SPECIFICATION

INSTRUMENT SIGNAL LINES

DEP 32.37.20.10-Gen.

February 2014

DESIGN AND ENGINEERING PRACTICE



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TABLE OF CONTENTS

1.	INTRODUCTION	4
1.1	SCOPE	4
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	4
1.3	DEFINITIONS	4
1.4	CROSS-REFERENCES	6
1.5	SUMMARY OF MAIN CHANGES.....	6
1.6	COMMENTS ON THIS DEP	6
1.7	DUAL UNITS.....	7
1.8	NON NORMATIVE TEXT (COMMENTARY).....	7
2.	ELECTRIC CABLING.....	8
2.1	GENERAL	8
2.2	SIGNAL SEGREGATION IN MULTICORE CABLES	8
2.3	SELECTION AND SPECIFICATION OF INSTRUMENT CABLES	9
2.4	PROTECTION OF CABLES AGAINST FIRE DAMAGE	11
2.5	SYSTEM CABLING	12
3.	CABLE SEGREGATION, ROUTING AND INSTALLATION.....	12
3.1	CABLE SEGREGATION.....	12
3.2	ROUTING	12
3.3	JUNCTION BOXES FOR MULTICORE CABLES	13
3.4	CABLE GLANDS	14
3.5	CABLE TRAYS	15
3.6	TRENCHES	15
3.7	CABLE PULLING AND INSTALLATION ASPECTS	16
3.8	CONTROL ROOM/AUXILIARY ROOM AREAS.....	17
4.	EARTHING (GROUNDING) AND BONDING	18
4.1	GENERAL	18
4.2	CONNECTIONS TO THE EARTHING (GROUNDING) SYSTEMS	18
4.3	EARTHING (GROUNDING) OF INTRINSICALLY SAFE CIRCUITRY	19
5.	LIGHTNING PROTECTION OF INSTRUMENTATION	20
5.1	GENERAL	20
5.2	INSTRUMENTATION AND CABLING IN THE FIELD.....	20
6.	IDENTIFICATION AND MARKING	20
6.1	IDENTIFICATION OF SYSTEM CABLES	20
6.2	IDENTIFICATION OF SINGLE CABLES.....	21
6.3	IDENTIFICATION OF MULTICORES AND JUNCTION BOXES	21
6.4	MARKING	22
7.	REFERENCES	23

APPENDICES

APPENDIX 1	DISTANCE BETWEEN CABLE TRENCHES.....	25
APPENDIX 2	ARRANGEMENT OF CABLE TRENCHES.....	26

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design and engineering of instrument signal lines and cabling. It covers design, material selection and installation methods for onshore and offshore applications.

In the context of this DEP, instrument signal lines include electric signal lines from transmitters to their receiving instruments, Process Automation Systems (PAS), Instrumented Protective Systems (IPS) and the lines from these systems to the relevant actuating elements such as solenoid valves, converters, transducers or control valves.

Signal lines for applications such as fire and gas detection and vibration monitoring systems are also within the scope of this DEP.

Hydraulic and pneumatic signal lines, Ethernet (IEEE-802), Power Line Communication and wireless connection types are not covered in this DEP.

Fibre optic cables are covered in DEP 32.71.00.30-Gen.

Telephone System, Plant Radio System, Public Address and General Alarm (PAGA), Computer Data Systems, Closed-Circuit Television and Security systems are covered in DEP 32.71.00.10-Gen.

This is a revision of the DEP of the same number dated September 2011; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorisation to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil refineries, chemical plants, gas plants and exploration and production facilities as well as distribution storage depots and installations. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Term	Definition
Bonding	The act of connecting together exposed conductive parts and extraneous conductive parts of apparatus, systems or installations that are at essentially the same potential (IEC TR 61000-5-2). NOTE For safety purposes, bonding generally involves (but not necessarily) a connection to the immediately adjacent earthing system.
Cavity floor	Computer floor or false floor.
Fieldbus	A digital, serial, multidrop, data bus for communication with industrial control and instrumentation devices such as -- but not limited to - transducers, actuators and local controllers. This standard only covers the fieldbus physical layer.
Instrument earth	Dedicated functional earth for instrument systems.
Protective earth	Equipment grounding conductor for personnel protection.
Tray	Aboveground cable support system, such as U-shaped flat-bottomed or ladder type. Open trays as well as covered trays are possible.

1.3.3 Abbreviations

Term	Definition
AL/HDPE/PA	Aluminium / high density polyethylene / polyamide (nylon) that combines overall metal screening with inner sheathing.
AWG	American Wire Gauge
CCR	Central Control Room
PAS	Process Automation System
EM	Electromagnetic
EMC	Electromagnetic compatibility
FAR	Field Auxiliary Room
HDPE	High density polyethylene, used as outer sheathing
IPF	Instrumented protective function
IPS	Instrumented protective system
MDF	Main distribution frame
MESC	Material and Equipment Standards and Code
MS	Metal screen (with drain wire)
PE	Polyethylene
PVC	Polyvinyl chloride
SWA	Steel wire armouring
SWB	Steel wire braiding

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (7).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated September 2011. The following are the main, non-editorial changes.

Section/Clause	Change
All	Removed references to Trunking
All	Revised scope of this DEP (deleted a number of special applications that are not relevant to Instrument Signal Lines)
1.6	Updated feedback system
1.8	Added new section
2.2	Added fieldbus cabling in Table 1
2.3.2.1	Added Cable Type 4 for FF and HART systems
2.3.2.3	Deleted fibre optic from Table 1
3.3	Added details on junction boxes and marking of junction boxes
3.8.1	Compiled spare requirements in single section (Table 3)
4.1	Updated content on earthing
7	added references for standards and new drawings
Appendix 3	removed, converted into drawing S 37.101
Appendix 4	removed, converted into drawing S 37.121
Appendix 4	removed, converted into drawing S 37.131

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://sww.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (Other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. ELECTRIC CABLING

2.1 GENERAL

Single cables are used to connect field instruments to field mounted junction boxes. Multicore cabling subsequently connect the junction box to a main distribution frame (MDF) or cabinets in the central control room (CCR) or field auxiliary room (FAR).

1. System cables may be used to connect cabinets to other cabinets and the MDF.
2. Multicore cabling should be routed underground, wherever possible and consistent with the design of other plant facilities. Aboveground cabling is acceptable provided a definite cost advantage is demonstrated, or where it is the local standard practice.

2.2 SIGNAL SEGREGATION IN MULTICORE CABLES

1. Segregation of signals is a key requirement towards prevention of electromagnetic interference.
2. When electric signals are assigned to multicore cables, the following signal segregation rules shall be followed:
 - a. Based on signal level classes
 - b. Intrinsically safe and non-intrinsically safe signals as required by IEC 60079-14.
 - c. The supply and return conductors of a signal shall be contained in the same cable pair.

Table 1 Classification of instrument signal levels

SIGNAL LEVEL CLASS (note 1)	SIGNAL TYPE	EXAMPLES
1	Analogue low level (mV signals)	Thermocouples (note 4)
	Analogue medium level	Resistance temperature measurements
2	Analogue high level (e.g., 1-10 V(dc), 4-20 mA)	Electronic instrumentation loops
	Binary low level (below 24 V(dc) and below 0.5 VA)	Actuating logic systems, annunciators
	Digital low level (pulse train)	Turbine meters, proximity sensors
	Fieldbus signals	FOUNDATION Fieldbus (note 5)
3	Digital high level (pulse train)	Tank gauging system
	Proximity sensors for machine monitoring	Vibration sensors
4	On-off medium level (< 50 V or > 0.5 VA, < 40 VA)	24 V(dc) solenoids (note 2,3)
5	High level signals > 50 VAC and DC power signals higher than class 4	110 V(dc) solenoids (note 2)
	Power supply cables > 50 VAC)	Power supply cables to instrument cabinets and field instruments

NOTES: 1. The classification is based on the use of cables with metal screen for signal level classes 1, 2, 3 and 4.

2. The classification is based on de-coupled solenoids to limit induction. A solenoid-operated valve shall be equipped with an arc suppression device across the coil if the digital output channel of the associated system does not have this feature built-in.
 3. For North American application, 24 VDC solenoids may be combined with signal levels class 2 if the wire size is adequate for the current.
 4. From a signal level perspective thermocouple and RTD conductors do not require segregation. However, considering conductor materials and number of conductors per point, these two types of cables are not normally combined in a multicore cable.
 5. From a signal level perspective, FF cables may be combined with other Level 2 cables. However, FF requirements regarding conductor specification and distance limitation normally preclude such combinations in multicore cables.
3. Segregation of signals by function is not required, e.g., signal level class 2 signals for IPS, PAS and FGS may be connected to the same junction box and in the same multicore cable. However, where practical, functional segregation may be required for operability and maintainability reasons (e.g., segregation between process units or segregated cabling for fire and gas systems).
 4. Thermocouples and Resistance Temperature Detector signals, wherever practical, should be converted locally in the field to become standard 4-20 mA or fieldbus signals which then fall in signal level class 2.
 5. Where field devices using signal level classes 2 or 3 require a low power 24 VDC supply this may be combined in the same single cable as the signal.

2.3 SELECTION AND SPECIFICATION OF INSTRUMENT CABLES

2.3.1 General

1. Factors in determining the cable type are:
 - a. Signal level class (Table 1);
 - b. Number of signals in the same cable;
 - c. Type of environment in which the cable is installed;
 - i. Indoor;
 - ii. Underground;
 - iii. Outdoor aboveground;
 - d. The EMC requirements
2. The above leads to the selection of a cable type from Table 2 which refers to:
 - a. MESC SPE 68.51/001
 - b. MESC SPE 68.71/001
3. These cable specifications are based on BS 5308 Part 1 and can be used in temperatures between -40 °C to 65 °C (-40 °F to 150 °F) providing that at temperatures below 0 °C (32 °F) they are not subject to movement and/or impact.
4. Instrument signal cables shall not be used for direct connection to a low impedance source, e.g., the public mains electricity supply.

2.3.2 Conductors

1. The maximum permissible current rating and allowable voltage drop criteria shall be observed in selecting the conductor size of signal cables. Larger conductor diameters may be required to reduce the voltage drop in long cables.
2. The minimum effective conductor diameter shall be 1.13 mm for single signal cables and 0.8 mm for multicore signal cable.
3. For North American applications, the minimum conductor gauge shall be 16 AWG for single signal cables and 18 AWG for multicore signal cable.