MANUAL

# INSTRUMENTATION OF DEPRESSURING SYSTEMS

DEP 32.45.10.10-Gen.

December 1994
(DEP Circulars 60/95 and 62/99 have been incorporated)

**DESIGN AND ENGINEERING PRACTICE**

USED BY

COMPANIES OF THE ROYAL DUTCH/SHELL GROUP

## PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of:

Shell International Oil Products B.V. (SIOP)
and
Shell International Exploration and Production B.V. (SIEP)
and
Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other Service Companies.

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The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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**APPENDICES**

# 1. INTRODUCTION

## 1.1 SCOPE

This is a new DEP which gives requirements and recommendations for the instrumentation of depressuring systems, taking into account **high-rate emergency** depressuring and **low-rate operational** depressuring.

It does not consider the philosophy or the procedure for determining depressuring flow rates; the Principal should be consulted for guidance on this aspect.

Where an IPF classification results in requirements more stringent than the typical design arrangements of this DEP, the instrumentation shall be altered accordingly based on the classification results. See DEP 32.80.10.10-Gen.

This DEP replaces Standard Specification In-2-1 dated July 1986 and shall be used in conjunction with DEP 32.36.01.17-Gen.

## 1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIPM, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors nominated by them (i.e. the distribution code is "C", as defined in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, chemical plants, gas plants, exploration and production facilities and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may 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 as regards 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 with the objective of obtaining agreement to follow this DEP as closely as possible.

## 1.3 DEFINITIONS

### 1.3.1 General definitions

The **Principa**l is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant, authorised to act for, and on behalf of, the Principal.

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction and commissioning for the project.

The Principal may sometimes undertake all or part of the duties of the Contractor.

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

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

### 1.3.2 Specific definitions

**Depressuring**
Reducing the pressure in process equipment at a controlled rate, either due to emergency conditions or for operational purposes.

**Instrumented Protective Function (IPF)**
A function of one or more initiators, an Instrumented Protective System and one or more actuators, for the purpose of preventing hazards.

**Instrumented Protective System**
The (electrical and/or electronic and/or programmable electronic) logic solver component of the Instrumented Protective Function, complete with input and output equipment.

**Probability of Failure on Demand**
The probability of the IPF failing to respond to a demand.
Dimensionless.

**Revealed Failure**
A failure whose occurrence is inherently apparent.

## 1.4 ABBREVIATIONS

| | |
|---|---|
| **Cv** | Control valve (flow) capacity |
| **DCS** | Distributed Control System. |
| **DN** | Diameter Nominal, the size being indicated in millimetres, e.g. DN 15 (which is the metric equivalent of ½ inch nominal size), etc. |
| **ESD** | Emergency Shutdown |
| **IEC** | International Electrotechnical Commission |
| **IPF** | Instrumented Protective Function |
| **PFD** | Probability of Failure on Demand |
| **SIA** | Secure Instrument Air |

## 1.5 CROSS-REFERENCES

Where cross-references are made, the number of the section or sub-section referred to is shown in brackets.

All publications referred to in this DEP are listed in (7).

## 2. GENERAL

High-rate emergency depressuring of plant facilities is applied to immediately evacuate the plant inventory in an emergency. This is to avoid over-pressuring of plant equipment that may occur during a runaway reaction or in cases of fire. The depressuring action also reduces the consequences of leakage. High-rate emergency depressuring can be initiated automatically and/or manually, depending on the type of plant/emergency and the safeguarding strategy.

The arrangements for high-rate emergency depressuring systems are basically dictated by the air failure action of the depressuring valve.

For processes where inadvertent opening of the depressuring valve would not cause damage to the plant equipment, with particular respect to reactor internals and/or cladding or to disturbance to reactor bed, high-rate emergency depressuring systems with air failure open valves are used.

For processes where inadvertent opening of the depressuring valve is not acceptable from an operational or environmental point of view, high-rate emergency depressuring systems with air failure closed valves are used.

Low-rate operational depressuring of plant facilities is applied manually for process safeguarding, control and for other operational reasons, including maintenance.

Low-rate operational depressuring systems are equipped with air failure closed valves to minimise inadvertent depressuring and to satisfy the requirement that it shall close upon the initiation of high-rate emergency depressuring, irrespective of the output of the manual control station.

Arrangements for high-rate emergency depressuring and low-rate operational depressuring required in oil refineries, chemical plants, gas plants and exploration and production facilities may differ, therefore due care and attention shall be given to these when applying the typical depressuring systems.

# 3. HIGH-RATE EMERGENCY DEPRESSURING

## 3.1 HIGH-RATE EMERGENCY DEPRESSURING SYSTEM WITH AIR FAILURE OPEN VALVE

### 3.1.1 Design requirements

The minimum design requirements for a high-rate emergency depressuring system are as follows:

(1) The instrumentation of the depressuring system shall be designed such that the response time to fully stroke the depressuring valve from the time of initiation shall not exceed 20 seconds.

NOTE: Where the above stroking time requirement can not be met (e.g. valves with body sizes DN150 and above), the use of a quick exhaust valve should be considered subject to the approval of the Principal. See DEP 32.36.01.17-Gen.

(2) Remote actuation shall be possible from a safe distance. For plants with a control room, the facility shall be operable from the instrument console.

(3) The depressuring valve shall be as defined in (3.1.2).

(4) Specific design requirements are detailed in (6)

### 3.1.2 High-rate emergency depressuring valve

The minimum requirements for a high-rate emergency depressuring valve are as follows:

(1) The body size should not be less than DN 50. The use of smaller body sizes requires the approval of the Principal and the fluid properties shall be taken into account with regard to plugging of the valve.

(2) The valve shall be tight shut-off metal seat. The valve leakage rate shall not exceed the requirements of Class V (IEC-534-4). See DEP 32.36.01.17-Gen.

(3) The valve actuator shall have a spring-to-open action and be sized such that it is capable of full operation from open to close or close to open with an air pressure signal of 3.5 bar (ga) at the maximum upstream pressure and the minimum downstream pressure. The actuator shall be able to operate at a maximum air pressure of 7 bar (ga) and shall be tested at 1.5 times this maximum air pressure.

The Manufacturer shall submit the actuator sizing calculation to the Principal for approval.

NOTE: The maximum upstream pressure is the set pressure of the upstream system relief valve.

(4) The actual capacity (Cv factor) of the valve should not be less than the calculated value, see (5), nor exceed this value by more than 10% unless a closer accuracy is specified by the Principal. This may result in a non-standard trim size or a special construction. In this case the actual valve Cv shall be demonstrated by a test in accordance with the control valve capacity test procedure of IEC 534-2-3.

NOTE: In certain applications, the Principal may, for operational reasons, decide to install a restriction orifice plate in series with the depressuring valve. The actual Cv of the valve shall then be sized accordingly. The restriction orifice should be welded in a pipe spool piece to ensure re-installation after a shutdown.

(5) The Mach number in the valve body outlet shall not exceed 0.7.

(6) Limits for noise generated by the depressuring valve shall comply with DEP 31.10.00.31-Gen.

If a 'low-noise' valve design is applied, the fluid properties and valve design shall be checked by the Contractor/Manufacturer, to ensure that plugging can not occur.

A filter shall not be installed upstream of the depressuring valve.

A low-noise restriction plate or silencer shall not be installed downstream of the depressuring valve.

(7) The valve should stroke from closed to open within the shortest possible time, meeting

the time span as given by item 1) of (3.1.1), at the maximum specified instrument air pressure.

(8) The selection of the type of control valve shall be in accordance with DEP 32.36.01.17-Gen. Special attention shall be given to ensuring that the fluid properties and valve design will not result in plugging of the valve.

### 3.1.3 System configuration

For a typical configuration of a high-rate emergency depressuring system with air failure open valve, *normally energised,* refer to Appendix 1. One solenoid valve, which is *energised* in normal operation, is applied for the actuation of the depressuring valve.

For a typical configuration of a high-rate emergency depressuring system with air failure open valve, *normally de-energised*, refer to Appendix 2. Two solenoid valves which operate in series are applied for the actuation of the depressuring valve. The solenoids are *de-energised* in normal operation.

Where a given blowdown rate is not to be exceeded, e.g. limited flare capacity, and a low-rate operational depressuring valve (4) is also required in addition to the high-rate emergency depressuring valve, it shall be so engineered that the low-rate operational valve will be in a closed position whenever the high-rate emergency valve is operated.

## 3.2 HIGH-RATE EMERGENCY DEPRESSURING SYSTEM WITH AIR FAILURE CLOSE VALVE

In processes where inadvertent opening of a depressuring valve is unacceptable from an operational or environmental point of view, a depressuring system incorporating spring-to-close depressuring valves shall be applied. Such a system shall be duplicated in parallel.

This type of depressuring system is generally not applicable to Exploration and Production facilities and is not preferred for other facilities.

### 3.2.1 Design requirements

The minimum design requirements given in (3.1.1) shall also apply for the high-rate emergency depressuring system with air failure close valve.

Specific design requirements are detailed in (6).

### 3.2.2 Depressuring valve

The minimum requirements for a high-rate emergency depressuring valve are as defined in (3.1.2), with the following exceptions:

(1) The valve actuator shall have a spring-to-close action instead of spring-to-open.

(2) The valve shall fully stroke at the minimum specified instrument air pressure, i.e. 3.5 bar (ga) instead of at the maximum air pressure, see item 7) of (3.1.2).

### 3.2.3 System configuration

For a typical configuration of a high-rate emergency depressuring system with air failure close valve, refer to Appendix 3. Two depressuring valves are applied located at a minimum distance of 15 metres apart. It shall not be possible (even inadvertently) to operate both high-rate emergency depressuring valves at the same time.

Where a low-rate operational depressuring valve is also required in addition to the two high-rate emergency depressuring valves, it shall be ensured that the low-rate operational valve is always in the closed position whenever one of the two high-rate emergency valves is operated.

## 3.3 GUIDANCE ON THE SELECTION OF SYSTEM CONFIGURATION

The following gives a comparative overview of the three configurations available for high-rate emergency depressuring systems discussed in the preceding sections. The object is to highlight the different features and characteristics of the three configurations based on the type of instrumentation applied and thus give guidance on the choice of system configuration suited for a particular process application.

The three configurations which are referred to via their Appendix number are compared using a set of criteria based on failure aspects and other factors such as cost and fail-safe mode of the configuration, which are considered key factors in the selection of a particular configuration. Each aspect is given high, low and medium weights depending on how well the criteria are satisfied.

Table 1 shows how the three configurations compare based on the failure aspect criteria and in terms of cost and fail-safe mode.

The following abbreviations are used in Table 1:

| | |
|---|---|
| ELEC | Failure of vital electricity supply |
| FIRE | Fire situation |
| SIA | Failure of instrument air supply |
| SIGCAB | Failure of signal cable to solenoid |

**Table 1 Comparison of three configurations**

| Configuration | Probability of Failure on Demand | | | | Revealed Failure (Inadvertent depressuring) | | | Fail-safe aspects | Hardware cost |
|---|---|---|---|---|---|---|---|---|---|
| | FIRE | ELEC | SIA | SIGCAB | ELEC | SIA | SIGCAB | | |
| Appendix 1 | Medium | N.A. | N.A. | N.A. | High | High | High | High | Low |
| Appendix 2 | Low | High | N.A. | Low | N.A. | High | Low | Medium | Medium |
| Appendix 3 | Low | High | Medium | Low | N.A. | N.A. | Low | Low | High |

N.A. = Not applicable

It is emphasised that the ranking of the three configurations shown in the above table is only valid if the installation requirements for each scheme as defined in (6) has been fully met. This includes the separate routing of signal cables in combination with the specified fireproof cable construction and signal cable line monitoring for normally de-energised systems.

In selecting the configuration for a high-rate emergency depressuring system, the potential loss of product due to inadvertent depressuring compared to the loss due to equipment damage brought about by inability to depressure when required are very important considerations.

# 4. LOW-RATE OPERATIONAL DEPRESSURING

## 4.1 LOW-RATE OPERATIONAL DEPRESSURING SYSTEM

### 4.1.1 Design requirements

In certain applications, such as in the smaller Exploration and Production facilities, low-rate operational depressuring is initiated by manually opening the valves locally. For larger facilities, the minimum design requirements for a low-rate operational depressuring system are as follows:

(1) The instrumentation of the depressuring system shall be designed such that the response time to fully stroke the valve from the time of initiation shall not exceed 30 seconds.

(2) Remote actuation from a safe distance shall be possible, with the facility to regulate the depressuring rate. For plants with a control room, the facility shall be operable from the instrument console in the control room.

(3) The depressuring valve shall be as defined in (4.1.2).

(4) To comply with (2) and (3) above, the following accessories are required:

For plants which will have electronic control instruments:

- an electro-pneumatic positioner, and
- a manual control station.

For plants which will have pneumatic control instruments:

- a pneumatic positioner, and
- a manual control station.

### 4.1.2 Low-rate operational depressuring valve

The minimum requirements for a low-rate operational depressuring valve are as follows:

(1) The valve body size should not be less than DN 50.

The use of smaller body sizes requires the approval of the Principal and the fluid properties shall be taken into account with regard to plugging of the valve.

(2) The valve shall be tight shut-off metal seat. The valve leakage rate shall not exceed the requirements of Class V (IEC-534-4). See DEP 32.36.01.17-Gen.

(3) The valve actuator shall have a spring-to-close action and shall be sized such that it is capable of full operation from close to open, or open to close, and it should normally operate between 0.2 to 1.0 bar (ga).

NOTE: The maximum upstream pressure is the set pressure of the upstream system relief valve.

(4) The Cv of the valve shall be that normally selected for a control valve against the conditions specified. To avoid oversized trims, the use of reduced trims in larger bodies shall be considered.

The Contractor shall ensure that the valve to be supplied matches the calculated duty; the valve trim shall not be oversized.

NOTE: The application of a maximum limit stop adjustment to limit the actual Cv of the valve requires the written approval of the Principal.

(5) The Mach number in the valve body outlet shall not exceed 0.7.

For systems where the valve will be used more than 10 times per year, the Mach number shall not exceed 0.3.

(6) Limits for noise generated by the depressuring valve shall comply with DEP 31.10.00.31-Gen.

If a low-noise valve design is applied, then the fluid properties and the valve design shall be checked by the Contractor/Manufacturer to ensure that plugging can not occur.

A filter shall not be installed upstream of the depressuring valve.

A low-noise restriction plate or silencer shall not be installed downstream of the depressuring valve.

(7) The valve shall fully stroke when operated from the remote location within the shortest possible time, not exceeding 30 seconds.

(8) The selection of the type of control valve shall be in accordance with DEP 32.36.01.17-Gen. Special attention shall be given to ensuring that the fluid properties and valve design will not result in plugging of the valve.

#### 4.1.3 System configuration

For a typical configuration of a low-rate operational depressuring system using electronic control, refer to Appendix 4. For systems with pneumatic control, see Appendix 5.

A normally energised solenoid valve shall be installed between the positioner output and the valve actuator such that when the high-rate emergency depressuring valve is actuated, the low-rate operational valve shall close irrespective of the output from the manual control station.

### 4.2 LOW-RATE OPERATIONAL DEPRESSURING SYSTEM WITH ADDITIONAL AUTOMATIC INITIATION

This low-rate operational depressuring system is applied for certain types of platformers and hydrotreaters, where additional automatic initiation is required.

This system is generally not applicable for Exploration and Production facilities.

#### 4.2.1. Design requirements

The minimum requirements given in (4.1.1) shall also apply for this low-rate operational depressuring system configuration.

#### 4.2.2 Low-rate operational depressuring valve

The minimum requirements for the low-rate operational depressuring valve for this configuration shall be as defined in (4.1.2).

#### 4.2.3 System configuration

For a typical configuration of a low-rate operational depressuring system with additional automatic initiation, refer to Appendix 6. A normally energised solenoid valve shall be installed after the valve positioner to be activated by the ESD system. A normally de-energised solenoid valve shall be installed before the valve actuator such that when the high-rate emergency depressuring valve is actuated, the low-rate operational valve shall close irrespective of the output from the manual control station. In case the vital electricity supply fails, low rate operational depressuring can still be initiated irrespective of the arrangement of the high rate emergency depressuring system.

This configuration shall include:

- The provision of an automatic start of low-rate operational depressuring. When low-rate operational depressuring is initiated, in the event of an automatic start, the valve shall fully open.
- The provision of a secured air supply system, which shall have adequate capacity to stroke the valve fully at least three times in case of an air supply failure.

  NOTE: One stroke is from fully open to fully closed and the reverse.

# 5. DEPRESSURING VALVE CALCULATIONS

## 5.1 HIGH-RATE EMERGENCY DEPRESSURING VALVE CALCULATION

Unless otherwise stated by the Principal, the formula for calculating the Cv factor of the depressuring valve shall be based on IEC 534-2 and shall be approved by the Principal. The over-sizing factors in the formula shall not be applied for high-rate emergency depressuring valves.

Cv calculations shall be performed for data at times 0 (assuming valve fully open), 3.75, 7.5, 11.25 and 15 minutes after the start of depressuring. In case the Cv values are not equal over time, Process Design/Engineering shall adjust the input data.

The Cv of the selected valve, when fully open, shall be equal to the Cv calculated within -0% and +10%, unless another accuracy is specified by the Principal.

It shall be verified, either by calculation and/or by testing in the field, that high-rate emergency depressuring takes place within the specified time.

## 5.2 LOW-RATE OPERATIONAL DEPRESSURING VALVE CALCULATION

**Amended per Circular 62/99**

For low-rate operational depressuring valve calculations, refer to DEP 32.36.01.17-Gen.

## 6. SPECIFIC DESIGN REQUIREMENTS

In normally *de-energised* high rate emergency depressuring systems, the valve accessories, including solenoid valves positioned at or close to the valve, together with the secure instrument air supply buffer vessel and its associated equipment, shall be of fire resistant construction. The fire resistance duration shall, as a minimum, enable the system to perform its function with respect to the time required for depressuring.

NOTES: 1. Where the depressuring valve and its components are located outside of the fire risk area, the above fire resistant requirements may be relaxed subject to the approval of the Principal.

2. Solenoid valves shall be located as close as possible to the depressuring valve to minimise time lags when venting/supplying.

In normally *energised* systems, fire resistance and/or protection is optional due to the 'fail safe' nature of the system.

The location of the accessories, the routing of the instrument air and signal lines and the method of protection shall be approved by the Principal.

Above-ground instrument air supply lines, after the isolation valve on the main instrument air header and pneumatic signal lines, shall be made up from stainless steel tubing and compression fittings. The tubing shall be fixed to the supports with stainless steel materials, using electrically non-conductive spacer material to isolate the tubing from the supports.

Galvanised steel shall not be used for cable trays or other supporting materials when applied in the vicinity of stainless steel equipment in a fire risk area.

For normally *de-energised* high-rate emergency depressuring systems, the cabling and the coil circuits of the solenoid valves shall be continuously monitored for open circuit, short circuit and earth faults. The fault alarms shall be annunciated in the instrument console. The method of circuit monitoring shall be approved by the Principal.

For normally *de-energised* high-rate emergency depressuring systems, where the signal cable to the solenoid valves is installed above ground, the cable shall be of fireproof construction, in accordance with IEC-331, i.e. it shall withstand temperatures up to 750 °C for a period of three hours.

For high-rate emergency depressuring system employing two solenoid valves, the signal cables to the solenoid valves shall run via separate routes, see Appendices 2 and 3.

The solenoid valve(s) shall be provided with a resilient disc/seat material giving a tight shut off feature.

Pilot-operated solenoid valves shall not be used.

The solenoid valve shall be able to operate, under all conditions, at a maximum air pressure of 7 bar (ga) and shall be tested at 1.5 times the maximum air pressure.

For each application, a depressuring valve stroking time calculation shall be submitted for approval by the Principal. The minimum port size of the solenoid valve shall be verified and taken into account for the stroking time calculation.

The exhaust port of solenoid valves shall be provided with a port protector.

**Amended per Circular 62/99**

Unless otherwise specified by the Principal, the capacity of the secure instrument air buffer vessel shall be sized for a minimum supply pressure of 3.5 bar (ga). See DEP 32.36.01.17-Gen. for the sizing of the SIA. For each application, sizing calculations for the capacity of the secure instrument air buffer vessel shall be submitted for approval by the Principal.

Instrument air shall be supplied via the instrument air system, see DEP 31.37.00.11-Gen. Each depressuring valve shall be provided with a separate secure instrument air buffer vessel as shown in the typical arrangements, see Appendices 1, 2, 3 and 6.

The differential pressure controller upstream of the SIA buffer vessel, should be set at +1 bar. This will ensure that after total instrument air supply failure and buffer vessel exhaustion, air will flow to recharge the buffer vessel as soon as possible upon resumption of the supply.

In the event of a total mains supply failure, the vital electricity supply shall maintain sufficient voltage to all users for a minimum of 30 minutes.

A calculation of the electrical load requirements for the complete system shall be submitted for approval by the Principal.

The application of quick exhaust valves to achieve the operating times stated requires the approval of the Principal.

In applications/locations where freezing can occur, valve stems, solenoid valves and other mechanical moving parts shall be protected against ice formation. The method of protection shall be approved by the Principal

Special attention shall be paid to depressuring valves in which the differential pressure over the valve results in a temperature drop which will cause freezing of the stuffing box and ice formation on the stem. Valves shall be provided with an extended bonnet for this condition.

High-rate depressuring valves shall be equipped with spring return actuators, preferably of the multiple-spring type (for redundancy).

Double-acting piston actuators shall not be used.

Test facilities should be provided to test the solenoid valves by initiating them individually and to permit the entire system to be tested on-stream without causing an upset of the facilities in operation. The test facilities shall be approved by the Principal.

The test facilities shall be shown on the process engineering flow schemes (PEFS) and in all the related schemes, e.g. logic and relay diagrams, etc.

Mechanical test facilities for depressuring valves, e.g. upstream/downstream isolation valves, leak test facilities (valves), etc., shall be available.

For depressuring systems with two solenoid valves, the indoor signal cables to the solenoid valves, including the manual switch, shall be routed separately. Only signals from different configuration systems and/or other depressuring valves may be combined in the same system cables and only type E 30/28 system cables shall be applied, see DEP 32.37.20.31-Gen.

For high rate emergency depressuring systems the facility for remote actuation shall be a hardwired two or three position switch, see appendices 1, 2 and 3.

For arrangements which show a remote facility to regulate the depressuring rate, the manual control station may form part of the Distributed Control System (DCS), see Appendices 4 and 6.

For plants which will have pneumatic control instruments, the manual control station shall be a stand-alone module, see Appendix 5.

Except where local manual operation of low-rate operational depressuring valves is applied, depressuring valve(s) shall be supplied without a handwheel and without mounting facilities for a handwheel, i.e. brackets, threaded holes, etc., shall not be available on the valve.

For remote depressuring valve status display, the high-rate emergency valve shall be provided with one limit switch for the fully closed position. The limit switch shall be of the proximity type.

# 7. REFERENCES

In this DEP reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

**Amended per Circular 62/99**

## SHELL STANDARDS

| | |
|---|---|
| Index to DEP publications and standard specifications | DEP 00.00.05.05-Gen. |
| Noise control | DEP 31.10.00.31-Gen. |
| Instrument air supply | DEP 31.37.00.11-Gen. |
| System cabling | DEP 32.37.20.31-Gen. |
| Control valves - Selection, sizing and specification | DEP 32.36.01.17-Gen. |
| Classification and Implementation of IPF | DEP 32.80.10.10-Gen. |

## INTERNATIONAL STANDARDS

| | |
|---|---|
| Industrial process control valves<br>Part 2: Flow Capacity | IEC 534-2 |
| Part 2, section 3: Test procedures | IEC 534-2-3 |
| Industrial process control valves part 4:<br>Specification for inspection and routine testing | IEC 534-4 |
| Fire resisting characteristics of electric cables | IEC 331 |

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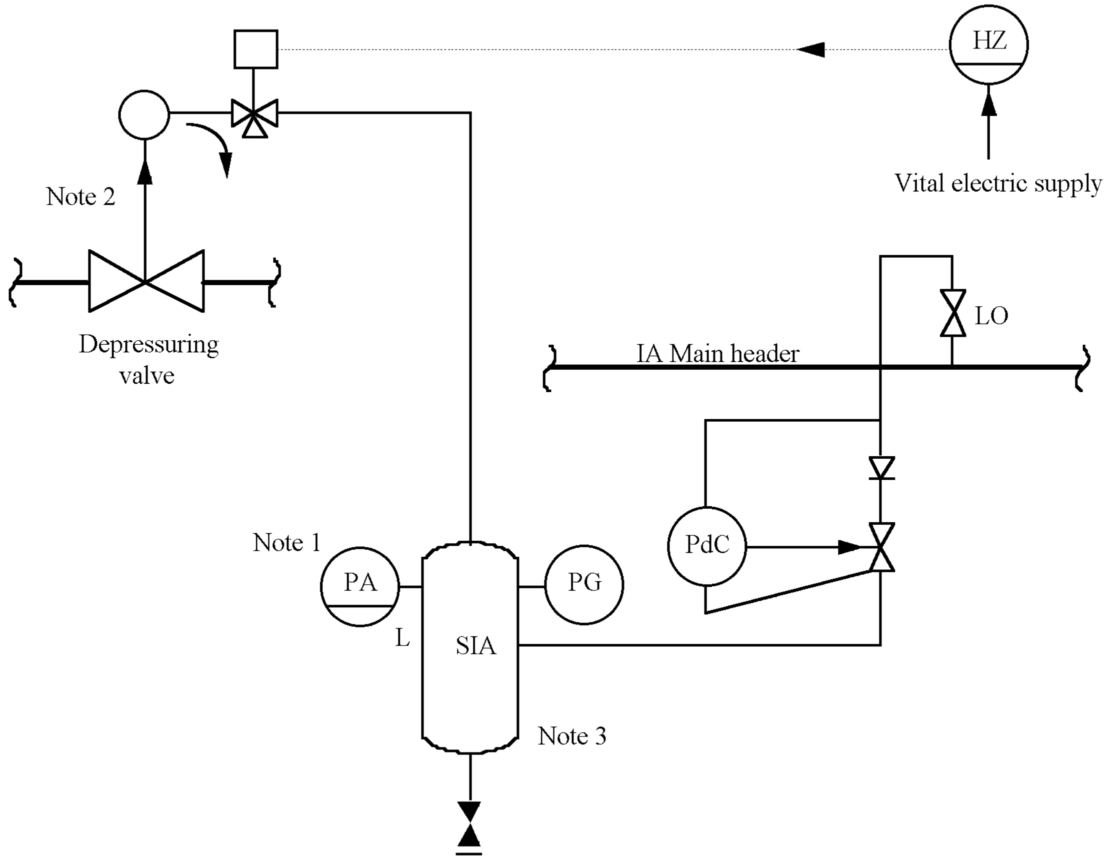
*Copies can also be obtained from national standards organizations*

## APPENDIX 1 TYPICAL ARRANGEMENT FOR HIGH-RATE EMERGENCY DEPRESSURING SYSTEM WITH AIR FAILURE OPEN VALVE (NORMALLY ENERGISED)

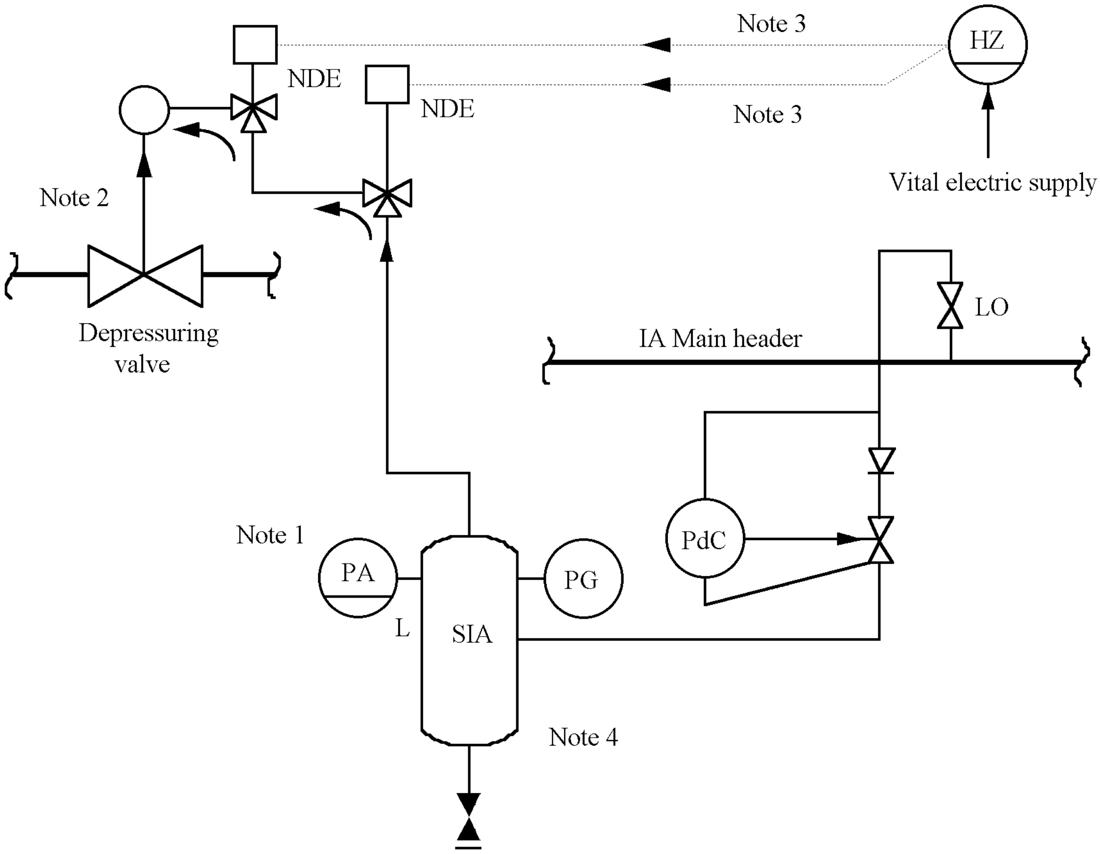



SIA = Secure Instrument Air
IA = Instrument Air
LO = Locked open

NOTES:

1. Alarm setting is dictated by the minimum pressure required for three (3) full strokes of the depressuring valve.
2. The depressuring valve(s) shall be provided with one limit switch for the fully closed position.
3. The provision of an SIA vessel for each depressuring valve is generally not applicable to Exploration and Production facilities.

## APPENDIX 2 TYPICAL ARRANGEMENT FOR HIGH-RATE EMERGENCY DEPRESSURING SYSTEM WITH AIR FAILURE OPEN VALVE (NORMALLY DE-ENERGISED)

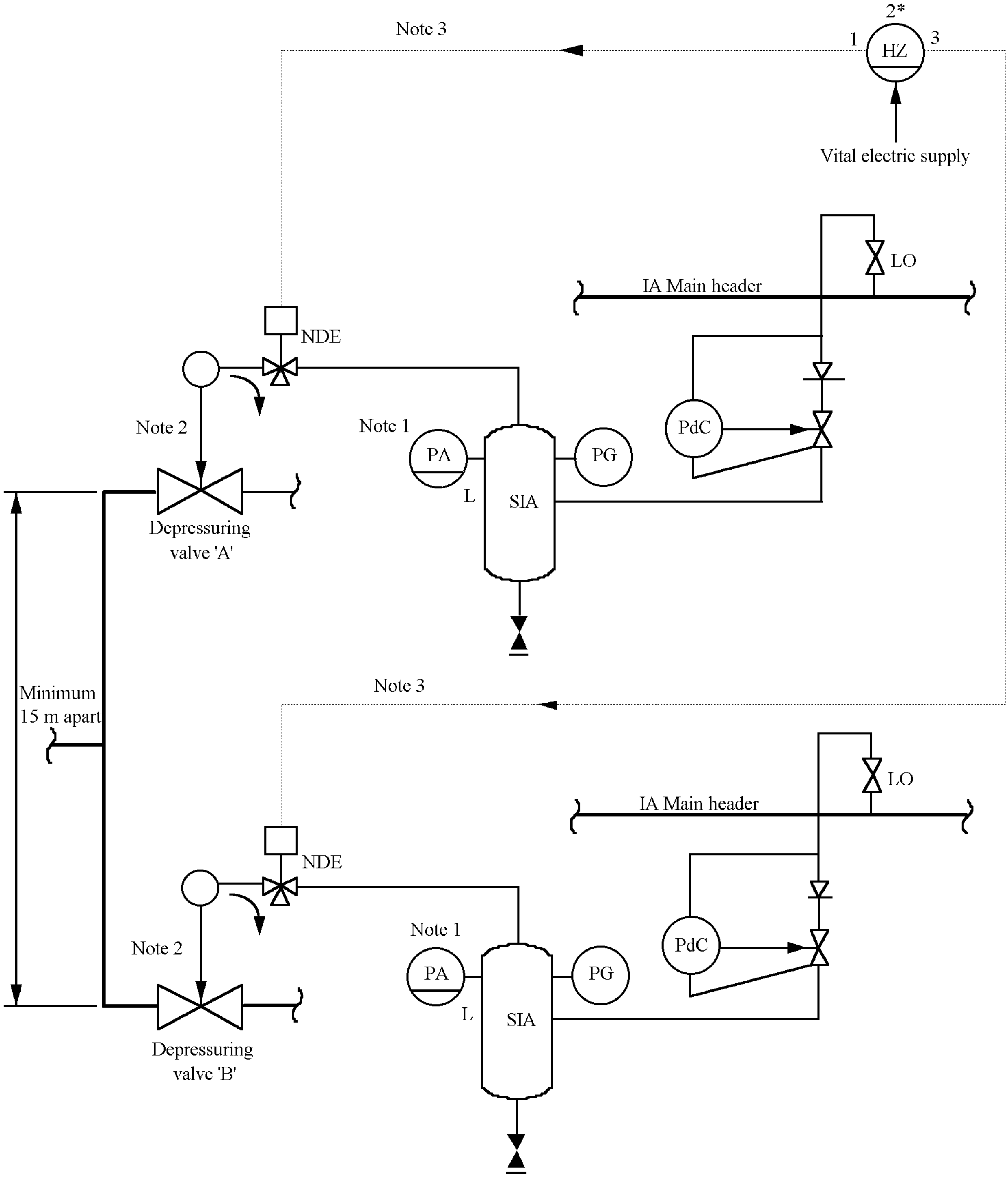



| | | |
|---|---|---|
| SIA | = | Secure Instrument Air |
| IA | = | Instrument Air |
| LO | = | Locked open |
| NDE | = | Normally De-energised |

NOTES:

1. Alarm setting is dictated by the minimum pressure required for three (3) full strokes of the depressuring valve.
2. The depressuring valve(s) shall be provided with one limit switch for the fully closed position.
3. Cables shall be laid in separate routes, provided with line monitoring facilities and shall be of fireproof construction.
4 The provision of an SIA vessel for each depressuring valve is generally not applicable to Exploration and Production facilities.

## APPENDIX 3 TYPICAL ARRANGEMENT FOR HIGH-RATE EMERGENCY DEPRESSURING SYSTEM WITH AIR FAILURE CLOSE VALVES (NORMALLY DE-ENERGISED)




* Three position switch:

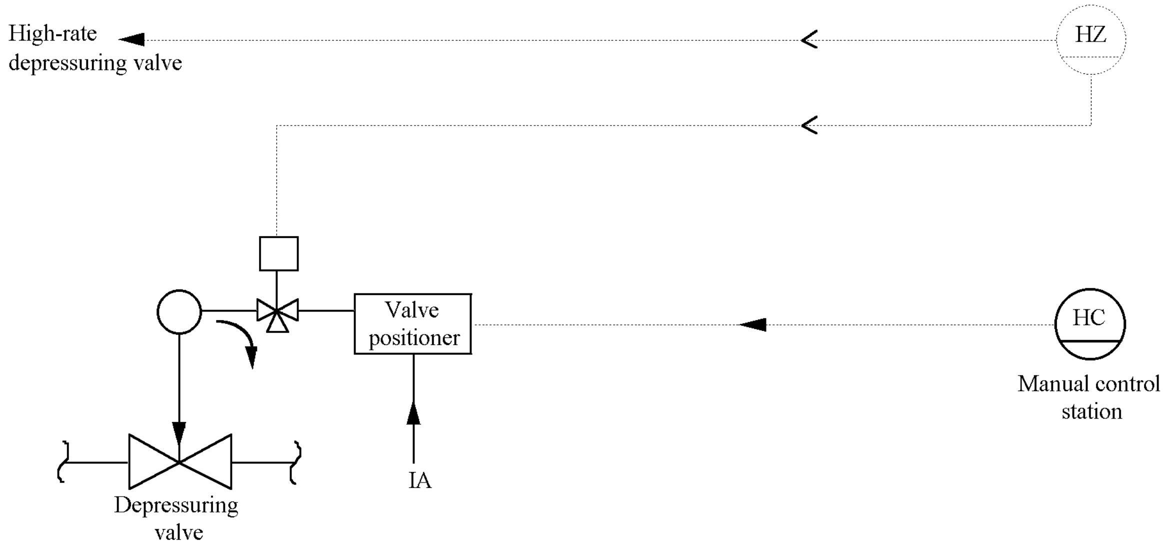
| | | | | | |
|---|---|---|---|---|---|
| 1 | = | Valve 'A' open | SIA | = | Secure Instrument Air |
| 2 | = | Both valves closed | IA | = | Instrument Air |
| 3 | = | Valve'B' open | LO | = | Locked open |
| | | | NDE | = | Normally de-energised |

NOTES:
1. Alarm setting is dictated by the minimum pressure required for three (3) full strokes of the depressuring valve.
2. Depressuring valves shall be provided with one limit switch for the fully closed position.
3. Cables shall be laid in separate routes, provided with line monitoring facilities and shall be of

fireproof construction.

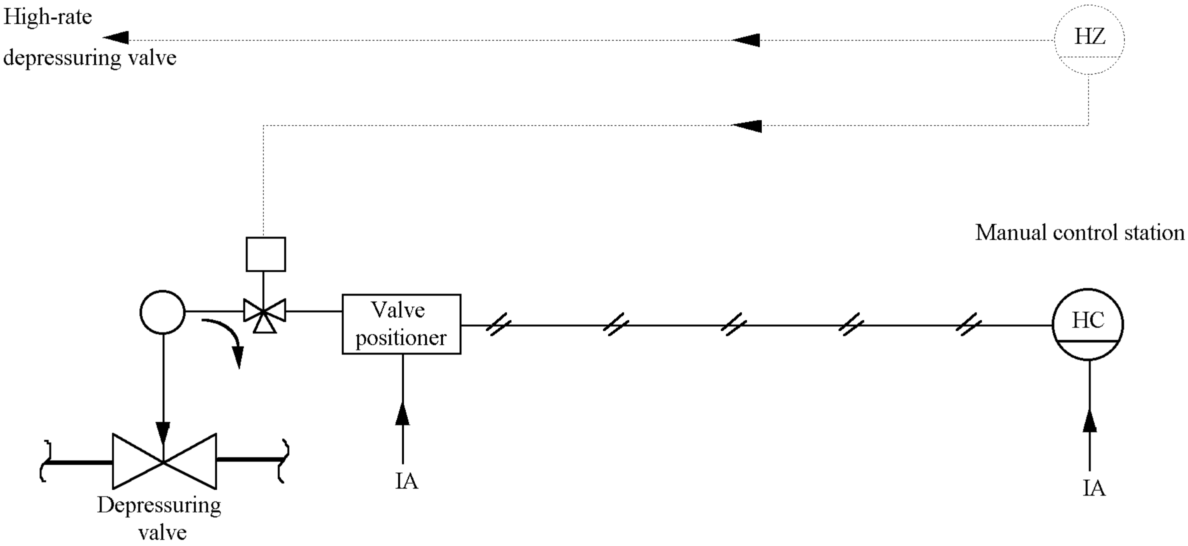
4. The provision of an SIA vessel for each depressuring valve is generally not applicable to Exploration and Production facilities.

## APPENDIX 4 TYPICAL ARRANGEMENT FOR LOW-RATE OPERATIONAL DEPRESSURING SYSTEM (APPLYING ELECTRONIC CONTROL)




IA = Instrument Air

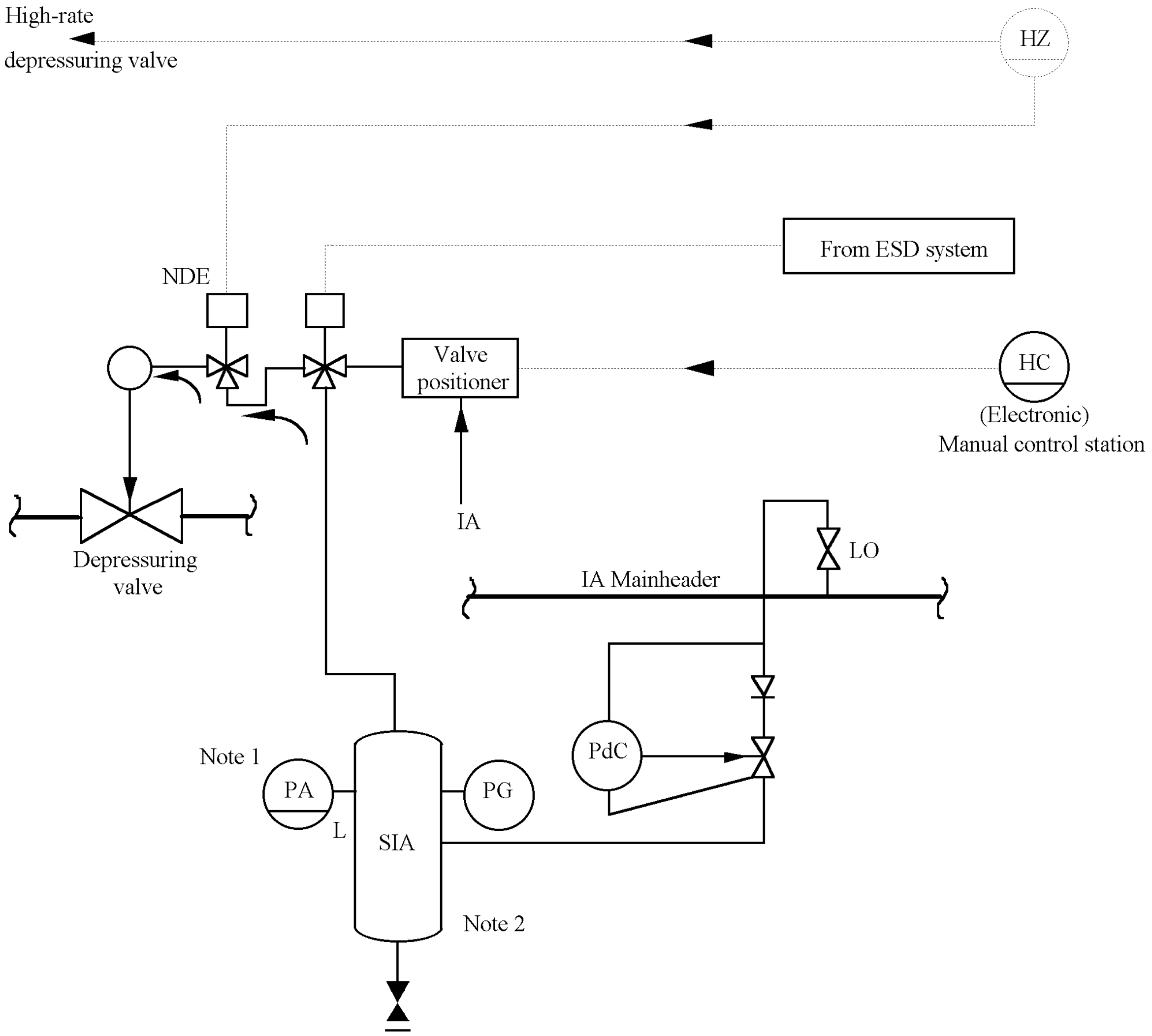
## APPENDIX 5 TYPICAL ARRANGEMENT FOR LOW-RATE OPERATIONAL DEPRESSURING SYSTEM (APPLYING PNEUMATIC CONTROL)




IA = Instrument Air

## APPENDIX 6 TYPICAL ARRANGEMENT FOR LOW-RATE OPERATIONAL DEPRESSURING SYSTEM WITH ADDITIONAL AUTOMATIC INITIATION

**Amended per Circular 60/95**




| | | |
|---|---|---|
| SIA | = | Secure Instrument Air |
| IA | = | Instrument Air |
| LO | = | Locked open |
| ESD | = | Emergency shut down |
| NDE | = | Normally de-energised |

NOTES:

1. Alarm setting is dictated by the minimum pressure required for three (3) full strokes of the depressuring valve.
2. The provision of an SIA vessel for each depressuring valve is generally not applicable to Exploration and Production facilities.