

MANUAL

INTERLOCKING SYSTEMS FOR SAFETY/RELIEF VALVES

DEP 80.46.30.11-Gen.

December 1999
(DEP Circular 43/02 has been incorporated)

DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

This DEP specifies requirements and gives recommendations for interlocking systems for fitting to isolating (block) valves installed upstream and/or downstream of safety/relief (S/R) valves.

This DEP is a revision of an earlier publication of the same number dated December 1993; a summary of the main changes is given in (1.5).

This DEP should be used for designing interlocking systems for new construction projects where such mechanical interlocking systems have been specified. For the design of new units for a site that has operating experience with a different interlocking system, close contact with the Principal is required to make the new interlocking system compatible with the existing system.

Codes of safety and national and/or local regulations applicable to a location invariably stipulate that the required relief capacity shall always be available during plant operation. For installation of block valves on one or both sides of S/R valves, dispensation has often to be obtained from the authorities. This will usually be granted only if a reliable system is in place to ensure that adequate relief capacity is permanently available. One method of achieving this is by a mechanical interlocking system, the design of which is covered by this DEP. Other methods of achieving this are contained in DEP 80.45.10.10-Gen.

The need for block valves and locking systems is directly influenced by the operating and maintenance philosophies for the particular facility. DEP 80.45.10.10-Gen. provides guidance on the overall design of relief systems that minimise the necessity for such block valves.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in oil refineries, chemical plants, gas plants and, where applicable, in 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 object of obtaining agreement to follow this DEP as closely as possible

1.3 DEFINITIONS

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

The **Principal** 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 word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (4).

1.5 SUMMARY OF MAIN CHANGES SINCE LAST EDITION

This DEP is a revision of the DEP of the same number dated December 1993; other than editorial changes, the main changes have been as follows:

Old section	New section	Change
3.1	3.1	vent connection added
Figure 1	Figure 1	vent connection added
3.2.1	3.2.1	- vent connection added - sixth paragraph now reads: "During operation, only the inlet block valve of the installed spare S/R valve will be in the <i>locked</i> closed position."
Figure 2	Figure 2	vent connection added

2. GENERAL

For the safety of personnel and plant equipment, the relief capacity of process equipment shall be maintained when the plant is in operation or on stand-by under pressure. DEP 80.45.10.10-Gen. covers the overall selection of relief system configurations and recommends that, where operations and maintenance philosophies permit, no block valves are installed in relief systems. Where block valves are required, their use should be minimised, e.g. by siting a single block valve on a combined relief header from a processing train, where maintenance is carried out on a train basis (this block valve shall be locked open during operation of the train).

Where block valves are fitted upstream and/or downstream of S/R valves a system shall be in place to ensure that the required relief capacity is always available.

One method of achieving this is by the installation of an interlocking system which makes it impossible to block off the operating S/R valve until other similar relief capacity has been connected to the system. Other methods are described in DEP 80.45.10.10-Gen. Where such an interlocking system is specified, the following provisions shall apply.

The block valve locking devices shall be of robust construction with materials which will withstand corrosion from the environment and shall be obtained from suppliers approved by the Principal.

The block valve locking devices shall still be easy to operate after being exposed to the elements that can be expected (rain, ice, sun, sandstorms etc).

The fully fabricated locks shall be secured to the block valves with a tamper-proof fixture, and shall be sealed without performing any hot work. The keys shall fit only the locks for which they are designed. The valve operating mechanism shall allow operation of the block valve only when the proper key is inserted in the lock.

All locks and keys shall be provided with unique identification numbers, reflecting the relevant S/R valve number. The selected lock and key type shall have sufficient space for a clear identification system.

3. INTERLOCKING SYSTEMS

Amended per
Circular 43/02

Immediately after removal of an S/R valve (with an installed spare S/R valve in operation), the following actions shall be taken:

- a) S/R valve sizes 1D2, 1E2 and 1½F2 shall be replaced by spare relief valves.
- b) Other S/R valve sizes shall be replaced by spare S/R valves or, if S/R valves are not available, a spool piece (**not** a blind flange) shall be installed in its place. The spool piece shall remain in place until re-installation of the S/R valve. For details of the spool piece, see (3.2.3).

- NOTES:
1. The reason for prohibiting the use of a blind flange is that if the block valve upstream of the blind flange were to be opened (which the interlocking system will allow to be done) then the block valve upstream of the operating S/R valve could "legitimately" be closed, thereby eliminating the relief capacity (or, in the case of multiple S/R valves, reducing the relief capacity to below acceptable limits).
 2. The spool pieces are not designed to give full relief capacity. They are designed as a warning device in the event of incorrect valve operation; if the incorrect block valve would be opened, the noise of the flow in the spool will warn the operator.

Two situations (discharge to atmosphere and discharge to flare), are described in (3.1) and (3.2), both of which are designed to allow the safe removal of an S/R valve for maintenance. A schematic layout of each is shown in Figure 1 and Figure 2.

3.1 DISCHARGE TO ATMOSPHERE

Spared S/R valves discharging directly to atmosphere (via individual tail pipes) require block valves only in the inlet pipes of the S/R valves. These block valves shall each be provided with a single lock, but with only one key in total. During operation the key shall be trapped in the lock of the closed block valve of the installed spare S/R valve.

The key shall be retractable from the lock only by locking open the block valve. Hence only one block valve can be in the closed position at any time.

The spool piece between the upstream block valve and the relief valve shall be fitted with a vent connection in order to allow de-pressurising before the removal of the relief valve.

3.1.1 Removal procedure

At the starting position (Figure 1) the inlet block valve of S/R valve A is locked open. The inlet block valve of S/R valve B is closed. The switch key is trapped in lock B.

If maintenance during operation is required on S/R valve A, the following procedure shall apply:

1. Open inlet block valve of S/R valve B.
2. Remove switch key from lock B.

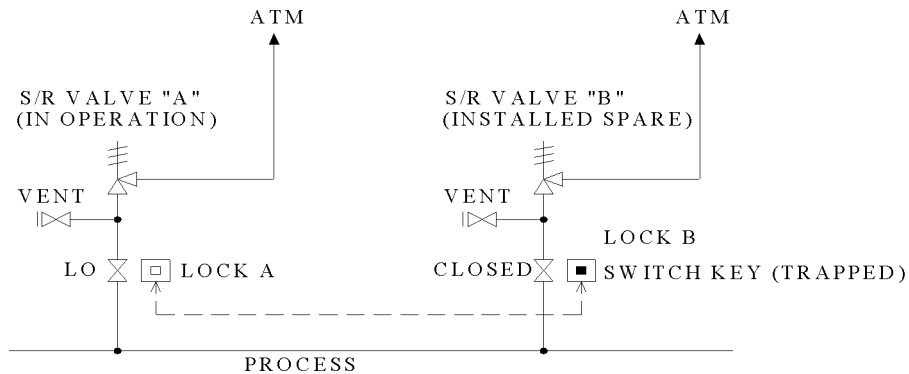
Both block valves are now in the locked open position.

3. Insert the switch key in lock A.
4. Close the inlet block valve of S/R valve A.
5. Using the vent valve, depressurise the pipe spool between the block valve and S/R valve A.
6. Remove S/R valve A for maintenance.
7. Install another S/R valve or, if one is not available, an open spool piece (3.2.3) in place of S/R valve A.

S/R valve B is now in operation and S/R valve A has become the installed spare.

This procedure is identical for situations where more than two parallel S/R valves are discharging to atmosphere.

Figure 1 Discharge to atmosphere



3.2 DISCHARGE TO FLARE

3.2.1 System description

Spared S/R valves discharging to a closed (flare) system require block valves in both the inlet and outlet pipes of the S/R valves. The outlet block valves shall be provided with single locks, and the inlet block valves shall be provided with double locks.

The spool piece between the upstream block valve and the relief valve shall be fitted with a vent connection in order to allow de-pressurising before the removal of the relief valve.

Each S/R valve shall be provided with a unique key which fits Lock 1 of its inlet block valve and the lock of its outlet block valve.

The key of the outlet block valve shall be retractable only when the outlet block valve is locked open.

The key of Lock 1 of the inlet block valve shall be retractable only when the switch key is inserted in Lock 2 of the same inlet block valve.

Each set of S/R valves shall be provided with a single switch key which fits Lock 2 of all inlet block valves. The switch key shall be retractable only when the inlet block valve is locked open. This shall only be possible when the key of Lock 1 is inserted in the lock. During operation, only the inlet block valve of the installed spare S/R valve will be in the locked closed position. All other block valves will be locked open. Locking open the outlet block valve of the installed spare S/R valve (or its replacement spool piece) prevents pressure build-up in case the inlet block valve should leak.

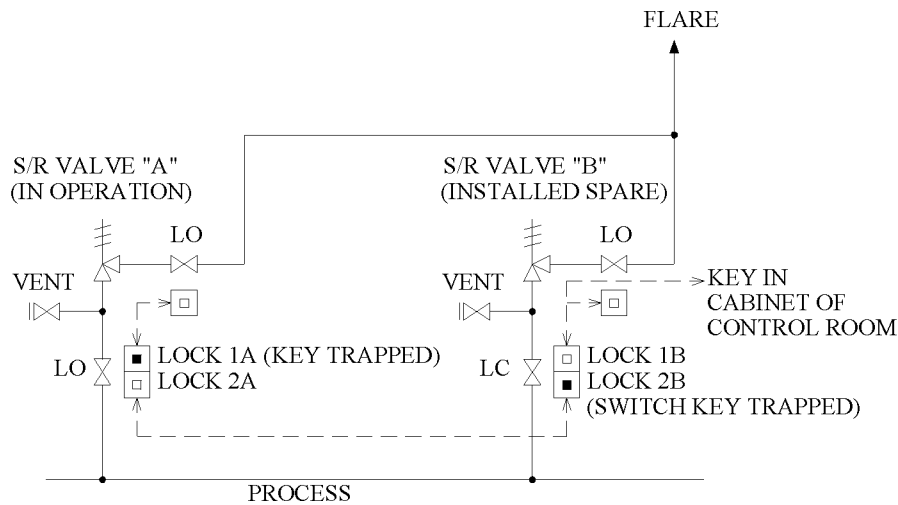
The keys of the locks of the block valves of the S/R valves in operation will be trapped in Lock 1 of the inlet block valves.

The switch key will be trapped in Lock 2 of the closed inlet block valve of the spare S/R valve.

Since the switch key is needed to unlock and close an inlet block valve, only one block valve can be in the closed position at any time.

The key of Lock 1 of the inlet block valve of the spare S/R valve shall be stored in a cabinet in the control room which shall only be accessible to authorized personnel. This cabinet shall clearly indicate the place for storing each individual interlocking key, thus providing a constant visual indication of all interlocking systems of the plant.

Figure 2 Discharge to flare



3.2.2 Removal procedure

At the starting position (Figure 2) both outlet block valves and the inlet block valve of S/R valve B are locked open. The inlet block valve of S/R valve A is locked closed.

If maintenance during operation is required on S/R valve A, the following procedure shall apply:

1. collect the key for the outlet block valve and Lock 1B of the inlet block valve of S/R valve B
2. insert the key in Lock 1B
3. open the inlet block valve of S/R valve B
4. remove the switch key from Lock 2B

All block valves are now in the locked open position.

5. insert the switch key in Lock 2A
6. close the inlet block valve of S/R valve A
7. remove the key from Lock 1A
8. insert this key in the lock of the outlet block valve of S/R valve A
9. close the outlet block valve of S/R valve A
10. using the vent valve, depressurise the pipe spool between the inlet block valve and the S/R valve A
11. remove S/R valve A for maintenance
12. install another S/R valve or, if one is not available, an open spool piece (3.2.3) in place of S/R valve A.
13. open the outlet block valve of S/R valve A
14. lock the outlet block valve of S/R A by removing the key
15. return this key to the control room

S/R valve B is now in operation and S/R valve A has become the installed spare.

3.2.3 Spool piece details

For systems up to and including class 900, the spool piece shall be made from schedule 80 pipe and elbows. For classes 1500 and 2500, the spool piece shall be made from schedule 160 pipe and elbows. The pipe shall be welded at both ends to blind flanges having the same size and rating as the S/R valve that the spool piece replaces. Each blind flange shall have been drilled at the connection point to suit the size of the spool piece pipe. The finished spool piece shall have the same built-in dimensions as the S/R valve it replaces. The size of the spool piece shall be as follows:

Amended per
Circular 43/02

S/R valve size	Nominal size of spool piece (pipe, elbows)
1D2, 1E2, 1½F2	Not applicable (see first part of section 3)
2H3	DN 20
3K4	DN 25
4L6	DN 25
6Q8	DN 50
8T10	DN 50

4. 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.

SHELL STANDARDS

Index to DEP publications and standard specifications

DEP 00.00.05.05-Gen.

Pressure relief and flare systems

DEP 80.45.10.10-Gen.