

## Seal/Gasket accident study

In early March 2017, the ARIA database identified 349 events involving fittings and seals/gaskets. These elements are often encountered on pipe flanges and are also essential sealing components for valves or other equipment. Insufficiently tightened flange bolts and deficient leak inspections on seals/gaskets are often the cause of an accident.

### Equipment involved

Location of seals/gaskets:

- flanges (ARIA 45845, 21773, 8730, 3481, 9184...)
- valves or pump packing (ARIA 2994, 26544, 42320, 37439)
- manholes (ARIA 46576, 43379)
- branch connections (level gauges, measuring devices, valves: ARIA 5449, 48377)
- floating roofs (ARIA 46008, 20819)
- perchlorethylene dry cleaning machines (ARIA 47298)
- fluid non-return or check valves (ARIA 5857)
- compressor flanges (ARIA 45791)...



### Circumstances

The following phases are conducive to accident events:

- transfer of fluids / unloading/filling operations (ARIA 504, 1240, 45648)
- tests / leak tests (ARIA 34397)
- maintenance / servicing (seal/gasket replacement: ARIA 3965, 9485, 47298)
- overpressure on a system / water hammering (ARIA 22215, 41300, 47682)



### Hazardous phenomena observed



**Fires**  
56 accidents (16%)



**Explosions**  
25 accidents (7%)



**Release of materials**  
324 accidents (93%)

### Substances involved

Material	Number of accidents	Material	Number of accidents
AMMONIA	43	PROPANE	13
HYDROCHLORIC ACID	26	ETHYLENE	9
CHLORINE	23	HYDROCARBON	9
HEATING OIL	17	CRUDE OIL	9
SULPHURIC ACID	15	LIQUIFIED COMBUSTIBLE GAS	8
NATURAL GAS	14	HYDROGEN	8

## Disturbances resulting in accidents (primary causes)

The following problems stem from **human errors** during assembly operations or from poor working practices:

- seal/gasket incorrectly positioned in its groove / installation problem (ARIA 6434, 30507, 47277, 47218, 47654 ....)
- flange bolts incorrectly tightened / insufficient number of bolts to ensure a good seal (ARIA 39816)
- lack of verification of the flatness of the flange assembly or of the flatness of the seal/gasket (ARIA 46694, 45596)
- seals/gaskets are not replaced following work / worn seal/gasket reused (ARIA 6435, 8730, 35295, 43890)
- operator error during the operating phase / valve opened inadvertently (ARIA 9467, 9485)

**Equipment failures** are also observed and highlighted:

- poor seal/gasket condition (ARIA 5857, 7506)
- metal worn around the stud through holes (ARIA 45538)
- problems with the selection of the threaded rods of fittings (ARIA 26617)
- seal/gasket design (choice of materials ARIA 48641, 26617 / manufacturing defect ARIA 36136)
- corrosion problems on steel components (ARIA 13660, 21259, 33311)
- external mechanical stresses which impair the sealing of the joint (problem of backfilling in the pipelines for transporting dangerous substances: ARIA 37654)

The **other disruptive factors** more specifically concern the following:

- natural events (freezing/thawing or high temperatures that affect the physico-chemical characteristics of the products: ARIA 19212, 26508, 38614)
- malicious acts (removal of a seal on a pipe: ARIA 9341)

### Analyse the root causes of the accidents to help prevent them



The problems highlighted mainly concern the **management of on-site risks**, and relate to:

#### **The organisation of inspections:**

- lack of supervision of subcontractors / acceptance of works (ARIA 47654, 18920)
- non-inspection of dead legs (ARIA 35402) / failure to take into account weak signals (repetitive leaks ARIA 42291)
- leak checks under actual operating conditions (ARIA 39816)
- flanges not disassembled to inspect the position of the seal/gasket or the alignment of pipes (ARIA 45628, 41442)
- preventive maintenance plan not including the manufacturer's recommendations (pump seal: ARIA 45509)

#### **Selection/design of installations or equipment:**

- problem with identifying standard seals/gaskets as opposed to those manufactured to specific requirements (ARIA 41611), which can subsequently lead to procurement difficulties
- Belleville washers not used (ARIA 45538)
- resistance of the seal/gasket to thermal cycles (ARIA 1792)
- seal/gasket hidden by heat insulation or inaccessible (ARIA 41537)

#### **Poor understanding of the products used in industrial processes:**

- behaviour of the fluids depending on the temperature (ARIA 48487)
- acid solutions that attack the steel and clamping bolts (ARIA 45845)

For all comments/suggestions or to report an accident or incident:

[barpi@developpement-durable.gov.fr](mailto:barpi@developpement-durable.gov.fr)

The summaries of accidents recorded in the ARIA base may be consulted at

[www.aria.developpement-durable.gov.fr](http://www.aria.developpement-durable.gov.fr)

