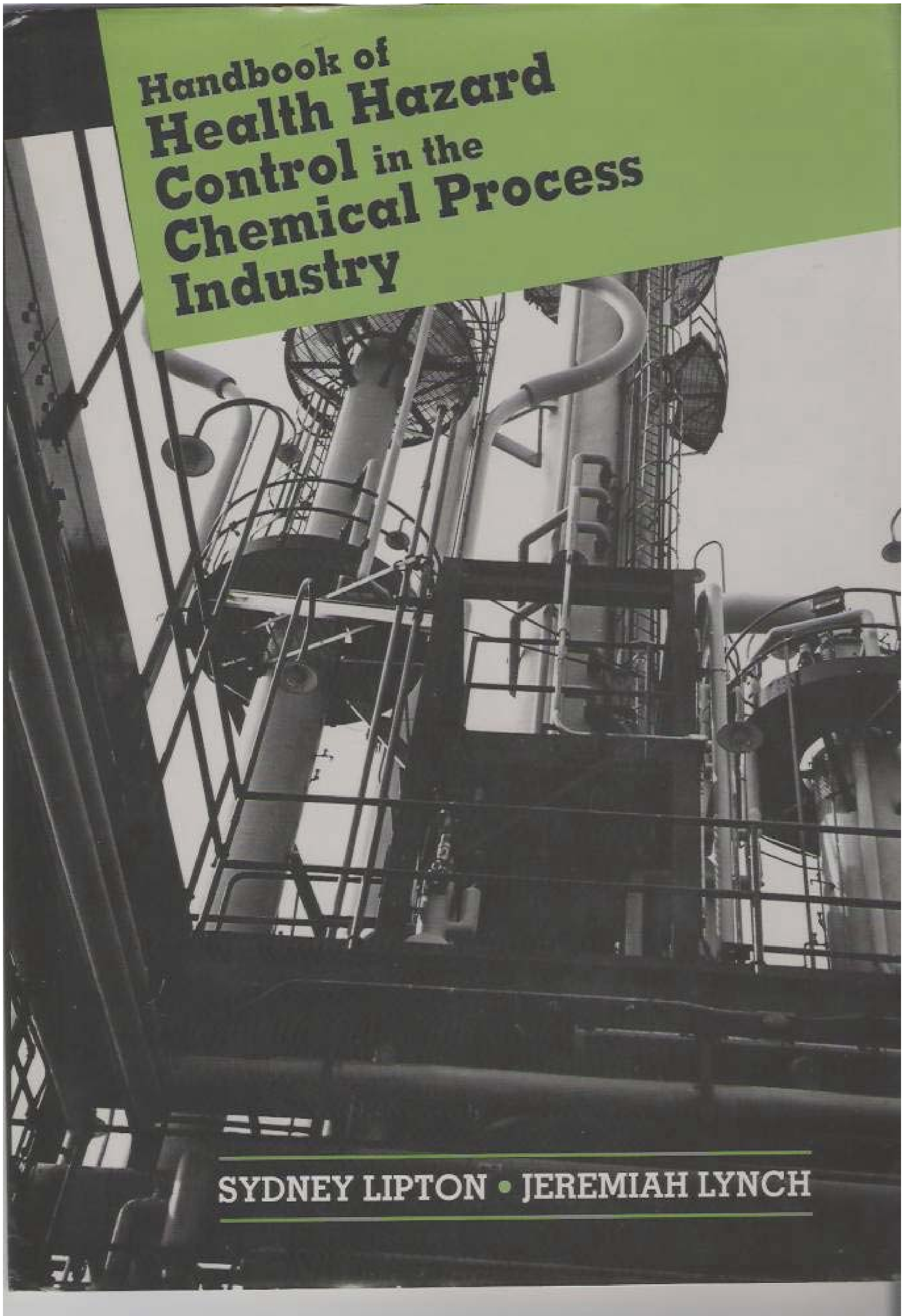
# Handbook of Health Hazard Control in the Chemical Process Industry



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leaks from the flange, the leakage must be enclosed and disposal requires complete containment. Where there are leaks and a vapor disposal point can be used, a flange retaining ring can be used to collect the vapor and vent the vapors to the receiver. With venting systems, sealants are not used.

An important consideration in enclosing or sealing a leak is the allowable temperature rating of the sealing system. All components of the seal system must be satisfactory for the operating and design temperatures.

*Sealants.* Sealants are obtained from various manufacturers and sealant composition is proprietary. This requires an investigation of sealant suitability for the application. Since sealant is injected to thoroughly fill all voids and prevent leakage to the atmosphere around the stud bolts, the sealant must be compatible with the internal process fluid. Consequently, sealants should not react with the process fluid and should not contain any materials that result in bolt stress corrosion cracking. If any reaction occurs with the process fluid, reaction products can be corrosive and/or explosive. Nuclear quality sealants may be preferable since the contaminants in the sealant materials applied in nuclear plants are a minimum. This eliminates any possibility of reaction of process fluid with sealing contaminants, which may happen.

The preferred sealant will gradually become a flexible solid, which minimizes any potential increase in stud loading and permits thermal movement without leakage. Manufacturers generally have a number of sealants available that differ in characteristics and composition. The sealant is normally selected by a manufacturer based upon the process fluid and operating conditions. Pressure is not a variable in sealant selection. In addition to other considerations, sealants from different vendors should probably not be used in the same flange since they may not be compatible.

*Sealant Injection.* Sealant is injected into an encapsulated void space with a hydraulic hand-pump sealant gun. The hand-pump guns are preferred because they provide the operator with "feel" for flow resistance and pressure buildup. Sealant injection may increase bolt loadings, since the sealant flows between the flanges. Consequently, the maximum sealant pressure should not exceed about 6500 psig (449 bar) and should be specified prior to injection, preventing overpressuring.

During injection, all unused ports are generally open to permit venting any enclosed vapor. When all ports have been injected except the one remaining port, the final port vent is permitted to remain open and the sealant within the ring then sets for a period of time defined by the manufacturer, allowing the sealant to reach equilibrium and the bolt load to stabilize. Finally, the sealant is injected into the last port to complete the sealing process.

The amount of sealant required should be calculated before injection. Excess sealant can be forced into the process stream where the sealant may interfere with the equipment and instrumentation downstream of the sealing point. Alternatively, the pressured sealant could move the gasket, which could result in increased leakage.

*Sealant Reinjection.* Although a joint has been sealed, there is a possibility the joint will leak after some period of time. While the joint could be reinjected with sealant, this potential solution should be carefully investigated to determine whether sealant reinjection is a problem. A careful inspection of the flange joint and the bolt studs should be instituted prior to reinjection. Where potential deterioration of the studs is possible as a result of corrosion, erosion, or stress corrosion cracking, the studs should be examined ultrasonically. Any damaged studs are replaced prior to sealant reinjection. This procedure is straightfoward with a flange retaining ring, but cannot be performed with a flange enclosure. The flange retaining ring may be preferred if a flange leak must be controlled for a long period of time until turnaround. If the sealant has a long life and does not affect the bolts, and if the process fluid will not affect the bolts, an enclosure is satisfactory. Since sealant technology continually improves, performance or operating data may indicate that newer sealants have a long life and do not affect the bolts.

For leak control and sealing, industrial hygiene personnel should carefully review sealant materials and potential exposures during the sealing operation. Following shutdown and removal of enclosures, sealant compound generally covers the flange. In addition, the flange joint must be opened and the flanges completely cleaned prior to installation of a new gasket. These operations should be reviewed along with disposal of the sealant.

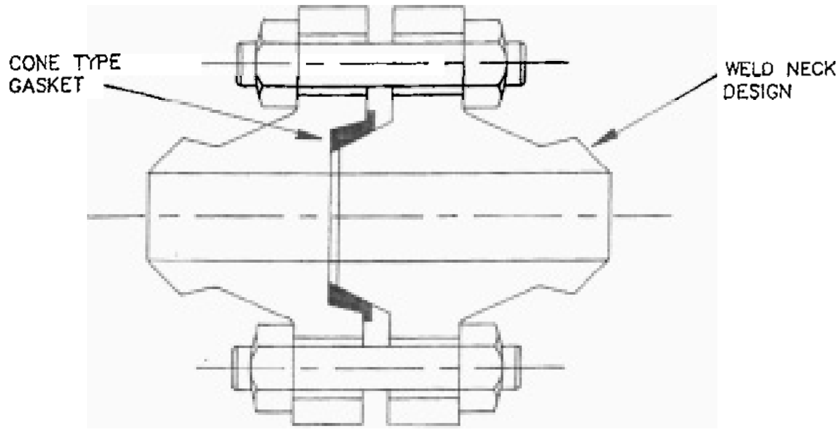
## 9.9 ALTERNATIVES

While some of the newer developments in gasket design were reviewed new flange designs were not mentioned. A variety of new flanges is available in the commercial market, with relatively little plant operating information about their performance, which is of concern with regard to emission control. New flanges that meet the various mechanical design code requirements should be tested for emissions leakage. One new flange that may have potential emission control benefits is reviewed in this section.

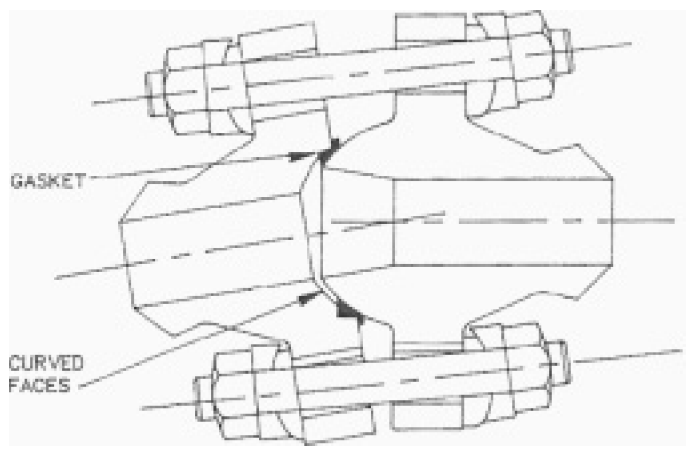
### 9.9.1 TAPER-LOK® Flanges

A standard TAPER-LOK® flange set is shown in Figure 9.15. These flange joints have male and female ends with a metal, cone-shaped gasket. The standard flange has a self-aligning capability that allows for a maximum of 2° in axial pipe misalignment. Special flange designs provide for handling 10° and 20° pipe misalignments with a flange set capable of handling a 10° misalignment shown in Figure 9.15. This design has curved faces to allow for misaligned piping centerlines. The 20° flange set has a somewhat different design.

These flanges are smaller and lighter than conventional flanges and due to their design, the self-aligning flange sets apparently maintain seal integrity to 1500°F temperatures and 20,000-psig pressures. The flanges are designed for piping sizes that range from 1 in. (25.4 mm) to greater than 72 in. (1830 mm). Flange TAPER-LOK applications in process operations are generally concentrated in high-temperature and high-pressure service, with temperatures to 1400°F (760°C) and pressures between 8000 and 10,000 psi (551–690 bar). Some of the advantages




STANDARD TAPER-LOK® FLANGE




TAPER-LOK® FLANGES FOR A 10" PIPING MISALIGNMENT

***Figure 9.15*** *TAPER – LOK® flanges (Courtesy of TAPER – LOK® Corp.).*

claimed for this flange in addition to the previous comments are:

1. Reduced space and weight compared with standard flanges.
2. Smaller bolt sizes than the bolts required in standard flanges.
3. Lower torque requirements.
4. Blowout-proof gasket.
5. Very low emissions leakage. Some early laboratory data are available indicating emissions leakage was essentially nil at room temperature. Published data are lacking on leakage performance.

6. The flanges are self centering.
7. The gaskets are constructed of metal and are reusable.
8. Lower installation costs owing to smaller flanges and lower torque requirements.

Although this flange design differs from standard flanges, the potential low emissions performance in process service should be evaluated. The flange meets the various code requirements according to the manufacturer and is apparently acceptable for installation since the flanges have been installed in services with mechanical code specifications.

### 9.9.2 Welding

Various methods of controlling leakage have been mentioned in the chapter; welding the flanges is another such technique which is described in reference 32 and has been used successfully. However, there are limitations on seal welding since flange beveling is required and the technique is expensive. This procedure is generally limited to flange installations where leakage is a consistent problem. Moreover, beveled flanges must be analyzed to determine whether they are mechanically acceptable for process temperature and pressure conditions after the beveling action has been completed.

Since process units have large numbers of flanges, a reduction in the number of flanges is desirable as a method of reducing overall loss and the number of leaking flanges. However, elimination of flanges is difficult and requires changes in piping designs and configurations. The reduction in flanges should begin with process units in the design stage as a method of developing criteria for the elimination of flanges.

For threaded fittings, seal welding eliminates leakage and seal-welded connections are not included in the number of connectors that must be reported to the EPA under the HON regulations. In existing plants where the regulations will become applicable, seal welding will reduce monitoring requirements.

## 9.10 SPECIFICATIONS

For improved emission control, plants should consider gasket specifications based on performance criteria. These criteria provide a method of comparing various gaskets under standard conditions. With the new PVRC/MTI gasket tests and procedures, standard test procedures are available for gasket evaluation.

Gasket specifications issued by process facilities would require gasket manufacturers to supply the test information requested in the specification. Typical specifications might include the following:

1. *Fire Resistance*. A gasket manufacturer would be requested to supply test information from FITT tests conducted in accordance with PVRC procedures described in Section 9.5. The tests must be conducted on NPS 4 gaskets. In addition, a $T_{p\,\min}$ value must be determined on a postexposure basis.