# 10 Mechanical joints – wide-tolerance couplings and flange adaptors

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**Technical development has progressed and, as a result, dedicated types of joint, such as push-in socket joints or welded joints are now the norm for pipe systems of all materials. In addition, the latest technology includes dedicated couplings for specific materials. However, given the wide variety of materials used in the water industry, connecting pipeline components of different materials with long term reliability is a real challenge. This is a job which can be done by couplings which are able to cover pipe diameters of quite a wide tolerance range or ones which are even capable of adapting different connecting systems to each another.**

## 10.1 General

Mechanical joints are used amongst other things for repairs, transitions between materials or connections to pipes of old dimensions, or for applications in which the connecting forces have to be kept low.

A basic distinction which can be made in the case of mechanical joints is between specific-size joints, such as those in Gibault couplings, and wide-tolerance joints, conforming respectively to EN 12842 [10.1] and EN 14525 [10.2].

Mechanical joints can be made without any high axial assembling forces because the gaskets offer hardly any resistance to the pushing-in of the pipe, but in return the bolts have to be tightened in a further operation. To ensure that the requisite connecting forces exist, manufacturers lay down bolt tightening torques in the installation instructions **(Table 10.1)**. These torques are often given as a range because they are affected by the dimensions of the pipe being connected.

**Table 10.1:**
Bolt tightening torques
(the example is for MEGA-Flex joints)

| Nominal size | Bolt tightening torques in Nm |
|---|---|
| Up to DN 80 | 55 – 65 |
| DN 100 and above | 95 – 120 |

## 10.2 Construction and operation

A characteristic feature of mechanical joints is the seal between the inside surface of the socket and the outside surface of the pipe made by mechanical compression of the gasket. A gland is usually tightened against the body of the coupling or flange adaptor by means of axially positioned connecting bolts. When this is done, the axial movement of the gasket is re-directed radially onto the surface of the pipe by means of conical guiding surfaces. Such designs are therefore, in principle, developments of the bolted gland joint covered by DIN 28602 [10.3].

## 10.3 Wide-tolerance couplings

Wide-tolerance couplings **(Fig. 10.1 and Fig. 10.2)** connect two plain pipe-ends by making a mechanical joint to each pipe.

Due to the angular deflection possible at the two sockets, these couplings can even compensate for a limited amount of displacement between the pipes. The allowable axial gap between the pipes is found from the minimum depth of engagement required for the mechanical joints and the overall length of the couplings.

Minimum values for the allowable joint gap are laid down in EN 14525 [10.2] for wide-tolerance connectors of nominal sizes from DN 50 to DN 600 **(Table 10.2)**.

**Fig. 10.1:**
Flexible wide-tolerance coupling

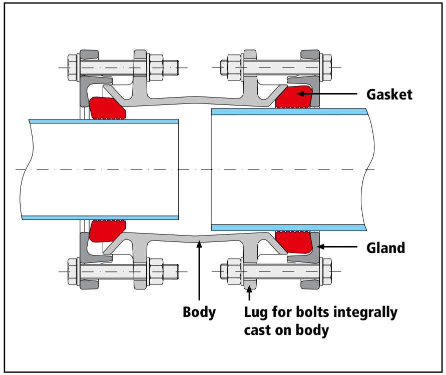


**Fig. 10.2:**
View in section of an assembled wide-tolerance coupling

**Table 10.2:**
Minimum values for the allowable joint gap under EN 14525 [10.2] for wide-tolerance connectors

| Maximum OD or DN of the pipes to be connected | | Joint gap (mm) | |
|---|---|---|---|
| OD (mm) | DN | Coupling | Flange adaptor |
| OD ≤ 110 | DN 100 | 20 | 15 |
| 110 < OD ≤ 225 | 100 < DN ≤ 200 | 25 | 20 |
| 225 < OD ≤ 315 | 200 < DN ≤ 300 | 35 | 30 |
| 315 < OD ≤ 400 | 300 < DN ≤ 400 | 55 | 40 |
| 400 < OD ≤ 630 | 400 < DN ≤ 600 | 70 | 50 |

### 10.3.1 Through-bolts (single bolts)

There are designs of coupling and flange adaptor where the bolts either pull the glands at opposite ends directly towards one another or where they pull the gland towards the flange **(Fig. 10.3)**, the body of the coupling floating as it is clamped in between. The bodies of the couplings and flange adaptors may be single in this case but in couplings the same pre-loading force acts in both joints, i.e. the joints cannot be individually set.

The shortening of the distance between the glands causes a lengthening of the distance for which the bolts project beyond the nuts. In couplings of the present kind, the change in length at the two sockets adds up at the bolts, meaning that there may be cases where socket wrenches using standard-depth sockets cannot be used. Deep sockets giving a longer depth of penetration for bolts may be necessary to enable torque wrenches to be used to check that torques are as laid down by the manufacturer.

**Fig. 10.3:**
Through-bolts: the gland is pulled directly towards the flange

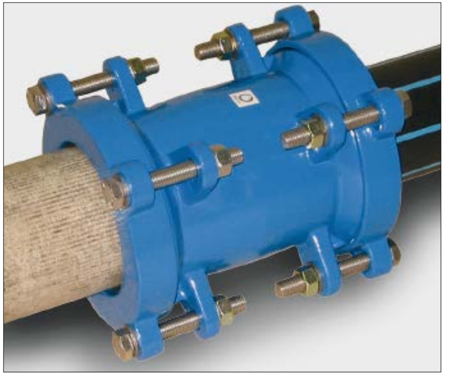

**Fig. 10.4:**
Wide-tolerance coupling for transitions between materials (fibre-cement pipe on the left, PE pipe on the right) where bolts are fastened to the body

### 10.3.2 Bolts fastening to the body (double bolts)

To enable the length of bolt needed to be reduced and the joints at opposite ends to be made in succession and if required with different connecting forces, there are alternative systems using double bolts **(Fig. 10.4)**.

In these designs, each joint has a set of bolts of its own which are fastened to lugs **(Fig. 10.2)** integrally cast on the body of the coupling.
In this case, the lengthening of the projecting part of the bolt is the result of the shortening of the mechanical joint at only one end of the coupling; also the applied pressure can be matched to the pipe connected to the given end **(Fig. 10.4)**.

## 10.4 Wide-tolerance flange adaptors

Wide-tolerance flange adaptors **(Fig. 10.5 and Fig. 10.6)** enable plain pipe ends to be connected to flanges and are therefore equipped with a mechanical joint at the end to which the pipe is connected and with a flange to EN 1092-2 [10.4] at the opposite end.

There are flange adaptors which are slid completely onto the pipes to be connected, but because of this the full area of the flange gasket may possibly not be covered because of the increase in inside diameter at the flange.

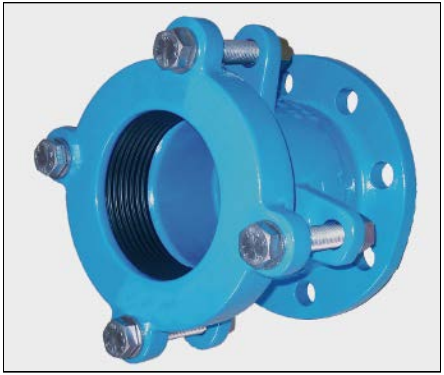

**Fig. 10.5:**
Flexible wide-tolerance flange adaptor

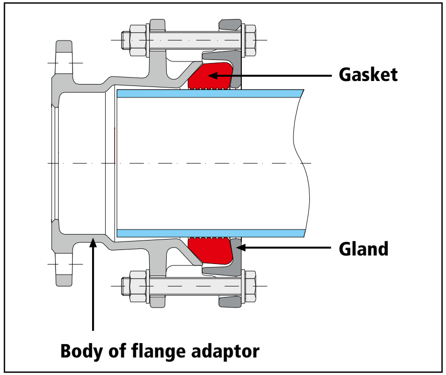


**Fig. 10.6:**
View in section of an assembled wide-tolerance flange adaptor

## 10.5 Preloading of gasket

The self-augmenting sealing action as the internal pressure rises which is known to occur as a result of the socket geometry in the case of TYTON® rubber gaskets does not occur in mechanical joints. In wide-tolerance couplings and flange adapters, the pressure with which the gasket system is applied must therefore make allowance for the long-term relaxation of the elastomer even at the time of connection, i.e. higher bolt tightening torques are required for reliable long-term operation even though considerably lower values may produce a short-term seal.

For this purpose, manufacturers draw attention in their documentation to clearly specified requirements. It has to be ensured that these requirements are complied by the use of suitable tools (torque wrenches) **(Table 10.1)**.

## 10.6 Ranges of pipe outside diameters

Specific-size mechanic joints, such as Gibault couplings for example, are designed for a relatively small range of pipe outside diameters and can thus often only be used for a single type of pipe. Under DN 14525, wide-tolerance couplings **(Fig. 10.4)** and flange adapters are designed for defined minimum working diameter ranges for each nominal size up to DN 600 **(Table 10.3)**.

**Table 10.3:**
Minimum working diameter range under EN 14525 [10.2]

| Maximum OD or DN of the pipes to be connected | | Minimum working diameter range |
|---|---|---|
| OD (mm) | DN | (mm) |
| OD ≤ 110 | DN ≤ 100 | 10 |
| 110 < OD ≤ 225 | 100 < DN ≤ 200 | 15 |
| 225 < OD ≤ 315 | 200 < DN ≤ 300 | 20 |
| 315 < OD ≤ 400 | 300 < DN ≤ 400 | 25 |
| 400 < OD ≤ 630 | 400 < DN ≤ 600 | 30 |

## 10.7 Allowable angular deflection

The minimum value of angular deflection defined in EN 14525 [10.2] relates to the entire tolerance range of the given wide-tolerance connector. The bodies of wide-tolerance couplings and flange adaptors have to be designed for an angular deflection of at least 3° in the case of pipes of the maximum allowable outside diameter. Because of this, pipes of smaller outside diameters have considerably more space for angular deflection in the body of the wide-tolerance coupling or flange adaptor. Where required, it may therefore be necessary for the user to set a limit on the possible angular deflection to enable the joint to maintain its full sealing performance, which becomes less good the more the angular deflection specified by the manufacturer is exceeded.

A sideways, heightwise or angular displacement between the pipe ends to be connected can be compensated for by a wide-tolerance coupling within the limits set by the allowable angular deflections at the two joints.

Unless some additional support is provided, wide-tolerance couplings adjust to the displacement by "floating".

It needs to be borne in mind in this case that where pipes of widely differing outside diameters are connected, experience shows that there tends to be considerably more angular deflection at the connection to the smaller pipe. This is because of the amount of space available in the body and also because of the smaller overlap between the parts of the joint.

## 10.8 Restraint

In most applications, flexible joints such as MEGA-Flex joints are adequate regardless of their nature.

In the case of non-restrained pressure pipe systems, thrust blocks are installed. In Germany these are designed as specified in DVGW-Arbeitsblatt GW 310 [10.5]. Restrained pressure pipe systems do not require any thrust blocks. The number of restrained joints between pipes is calculated as specified in DVGW-Arbeitsblatt GW 368 [10.6] in Germany. Depending on the installation and operating conditions, there are pipe materials, such as polyethylene for example, which may be subject to considerable expansion when there are wide variations in temperature. The resulting changes in length may make it necessary for there to be restrained joints in a pipe system, possibly even when there are no thrust forces from the internal pressure.

On the basis of their construction, wide-tolerance joints of restrained design can be divided into integrated and independent systems.

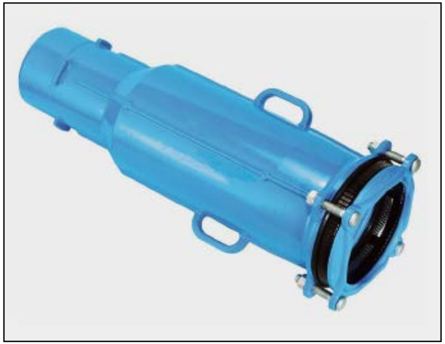

**Fig. 10.7:**
BAIO® - Multijoint® cut-in sleeve transition fitting

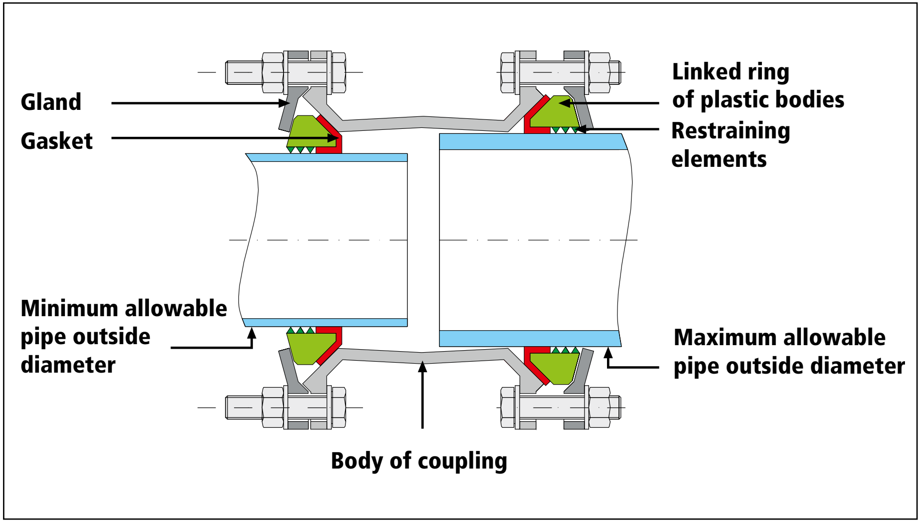


**Fig. 10.8:**
Coupling with mechanical joints and integrated restraint system (double bolts)

### 10.8.1 Integrated restraint system

In this compact design **(Figs. 10.7 and Fig. 10.8)**, the gasket and restraint ring are both compressed in a single operation.
The connecting force is transmitted to the body of the gasket by the restraint ring in this case. The gap between the socket and the surface of the pipe is filled by plastic bodies which can be moved relative to one another, and the dimensions of the gasket and the restraining elements are reduced to the minimum required.

### 10.8.2 Independent restraint system

In independent systems **(Fig. 10.9)**, the gasket and restraint ring operate independently of one another. At the time of connection, the gasket is first compressed against the pipe to be connected, and the restraint ring is then able to act on the pipe with whatever connecting forces are required in the given case regardless of the force with which the gasket is applied.

Because the gap between the gasket and pressure ring and the pipe has to be filled solely by the rubber gasket, these systems are fitted with rubber gaskets of very large volume.

This system is less compact and requires higher effort in installation but, if carefully handled, it does allow optimum settings to be made for the given application.

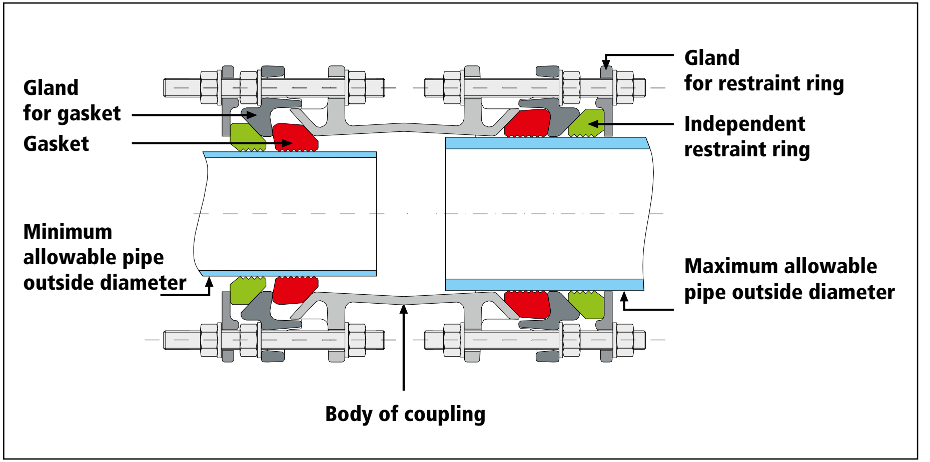


**Fig. 10.9:**
Coupling with mechanical joints and independent restraint system

## 10.9 References


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