Technical Product Notes

Fittings sizes

Fitting sizes are designated based on the thread sizes defined in EN 10226-1 and ISO 7-1. Connection sizes of pipes, flanges or plumbing fixtures are designated according to thread sizes or nominal diameters (DN).

The following table shows the relationship between size of fittings and the nominal diameter (DN):

Thread size / fitting size	1/8	1/4	3/8	1/2	3/4	1	11/4	11/2	2	21/2	3	4	5	6
Nominal diameter DN (mm)	6	8	10	15	20	25	32	40	50	65	80	100	125	150

Material - malleable cast iron

Malleable cast iron is an iron-carbon alloy which combines the outstanding properties of cast iron (pourability) and steel (strength and ductility).

The chemical composition of the cast produces excellent castability, which makes malleable cast iron particularly suitable for making complicated shapes and producing thin walled parts.

In its cast state malleable cast iron is hard, brittle and unworkable, it only acquires its final microstructure after subsequent heat treatment known as annealing.

As a result of the annealing process (= malleabeli-sing) very good workability and very good ductility are achieved while sufficiently high material strength is maintained.

There are two distinct types of malleable cast iron which are dependent on the annealing method. Their designation is a result of the appearance of the fracture surfaces:

1. **Blackheart malleable cast iron**
is annealed in an inert atmosphere (protective gas or vacuum) and has a uniform microstructure with a higher carbon content.

2. **Whiteheart malleable cast iron**
is annealed in an oxidising atmosphere, and in the process the carbon content of the surface zone is greatly reduced.

Due to the decarburisation of the microstructure whiteheart has a number of advantages when compared to blackheart malleable cast iron:

- **better galvanisability**
  (better alloy formation of the zinc coating)

- **higher strength** with the same elongation

- a limited weldability and solderabilty can be achieved by additional heat treatment
  (see also page 77).

Hot dip galvanising

Galvanising is a very commonly used process for increasing the corrosion resistance of iron based materials. The corrosion proofing effect of zinc is based on its anticorrosive properties.

Zinc is in fact a relatively base metal and corrodes quickly in the presence of oxygen, but in the process it forms a very homogeneous outer layer, which protects from further corrosion.

Hot dip galvanising achieves a zinc coating by repeatedly dipping the prepared workpieces in molten zinc. In the process, several iron zinc alloy layers form on the workpiece surface which guarantee optimal bonding of the zinc coating on the workpiece.

Georg Fischer malleable cast iron fittings are hot dip galvanised to the requirements in EN 10242, using special procedural technique ensuring that uniform coating thicknesses (minimum 500 g/m^2 equivalent to 70 μm) are achieved.

Electroplating

With electroplating zinc is deposited from an electrolyte by applying an electric current to the surface of the workpiece.

The zinc coating achieved in this way is simply an outer layer which is deposited on the base material (no alloy formation takes place with the base material). The zinc coat thickness is a maximum of 25 μm.

Thread

General outline

Threads for pipes, valves, fittings and other pipework components which have a threaded connection are determined by international and national standards.

A basic distinction must be made between

- **Jointing threads**, which are sealing pipe threads, for connections to **EN 10226-1** and/or ISO 7-1 (DIN 2999, BS 21 are replaced by a national version of EN 10226-1 for each European country)

- **Fastening threads** - that are threads for connections to **EN ISO 228-1** not sealing on the thread.

Difference between jointing threads/ fastening threads

The fundamental difference consists of the fact that:

- the pipe thread to **EN 10226-1** achieves a seal on the thread, mainly as a result of metallic compression (taper/parallel) of the interlocking thread surfaces in the jointing area. The sealing effect is improved by using an appropriate jointing medium.

- In contrast, the pipe thread to **EN ISO 228-1** is a purely mechanical fastening thread. Sealing of the components being connected is achieved between sealing faces with flat seat gaskets or by metal sealing surfaces.

Full designation of pipe threads
using the example of thread size 11/2

Jointing thread to EN 10226-1

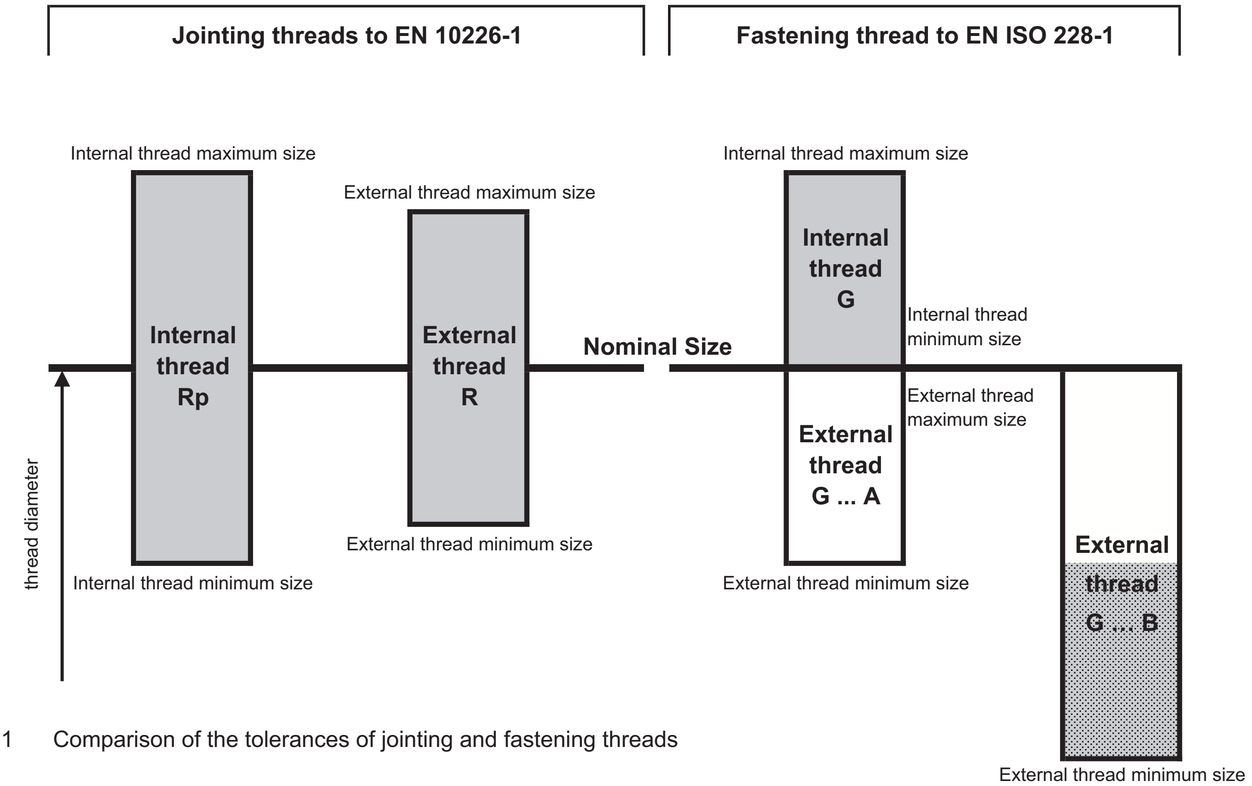
Internal thread (right-hand)	parallel	Rp 11/2
External thread (right-hand)	taper	R 11/2
Comment: the symbol LH is added to designate left-hand thread. Example: Rp 11/2 - LH		

Fastening thread to EN ISO 228-1

Internal thread (right-hand)	parallel	G 11/2
External thread (right-hand) Tolerance class A	parallel	G 11/2 A
External thread (right-hand) Tolerance class B	parallel	G 11/2 B
Comment: the symbol LH is added to designate left-hand thread. Example: G 11/2 - LH		

For external threads to EN ISO 228-1 Georg Fischer uses part of the class B tolerances. (see below).

Comparison of the tolerances of jointing and fastening threads



Illustr. 1 Comparison of the tolerances of jointing and fastening threads

… for tolerance ranges used by Georg Fischer

… for tolerance ranges used by Georg Fischer, G … B in a limited range

Combination of jointing threads (sealing on the thread) with fastening threads (not sealing on the thread)

The combination of an external parallel thread G, tolerance class A or B in accordance with EN ISO 228-1, with an internal parallel thread Rp in accordance with EN 10226-1 needs special consideration.

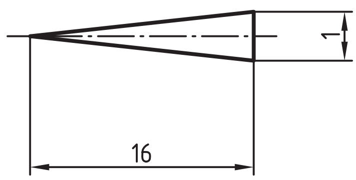
When it is neccessary to have this combination, the positive or negative tolerance of the internal thread to EN 10226-1 shall be considered in the relevant product standards, where external parallel threads G are used. Such a combination of threads **may not necessarily** achieve a leak-tight joint (be EN ISO 228-1, chapter 6).

Construction and function of jointing threads which are sealing on the threads to EN 10226-1 (ISO 7-1)

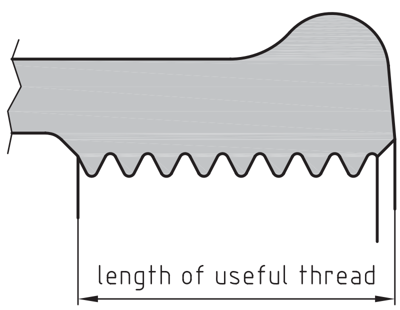
Thread types, dimensions, tolerances and designations per thread size are specified in standard EN 10226-1 (ISO 7-1).

The most important dimensions for these jointing threads (pipe threads) and medium and heavy-duty pipes are given in the table on page 74.

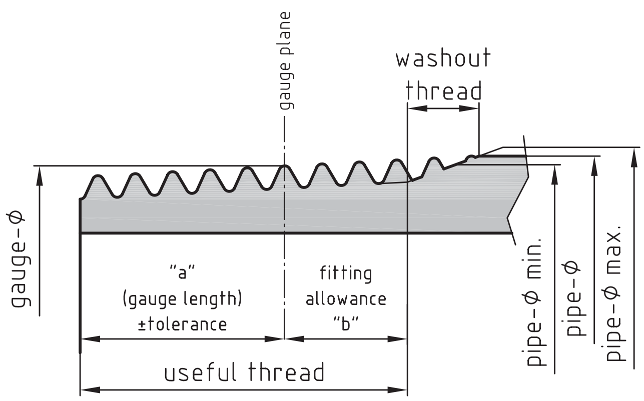
For parallel internal threads
(Illustr. 3) Care must be taken that the useful thread length allows the external thread to be screwed in, to achieve adequate compression and sealing, even when the external thread is at the maximum permitted gauge length.



Illustr. 2 Taper form of the 1:16 external thread diameter. The thread profile is at a right angle to the pipe axis.



Illustr. 3 Parallel internal thread Rp



Illustr. 4 Taper external thread R

For taper external threads
(Illustr. 4) There are some details to be considered. The taper is in the ratio of 1:16 (Illustr. 2).

The total pipe thread length is divided into 3 sections. (Illustr. 4)

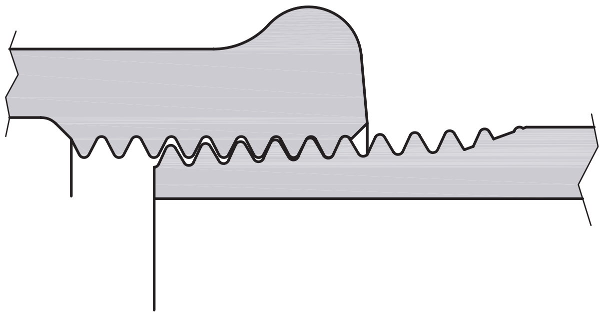
- Gauge length "a" is specified and may vary within the tolerances. The design is such that even with the minimum possible internal thread diameter the external thread can easily be screwed in and the sparingly applied sealing material is drawn perfectly into the joint.

- Distance "b" is the thread zone which is decisive for sealing. The length of the fully formed thread roots behind the gauge plane is dedicated to provide a sufficient tightening length for the tool, even with the maximum permissible internal thread diameter; this produces tight compression between the threads and thus a permanently reliable seal.

- The washout thread is not fully formed at the root, and normally remains visible after a joint is made. If it is screwed in too tightly, (beyond the fitting allowance) there is a risk of leakage.
  The crests of thread over the entire length of the useful thread should be fully formed.

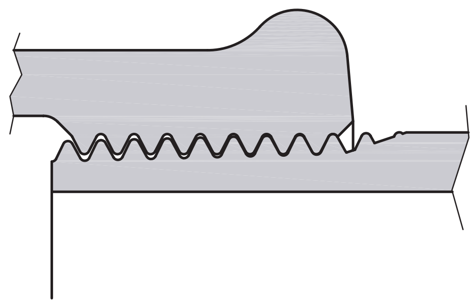
Fittings allowance "b" is the thread zone decisive for sealing. Fully formed profile at thread root and also at most thread crests. Diameter increasingly larger than internal thread diameter; this produces the compression effect. "b", in conjunction with the 1:16 taper, produces sufficient compression, even with the largest permissible female thread diameter.

As an example illustr. 5 shows a 1 inch joint with a fitting screwed on hand tight. There are still 2 3/4 threads available on the external thread for tightening with a wrench (see pipe thread table page 74 fitting allowance "b").



Illustr. 5 Hand tight engagement

Illustr. 6 shows, the thread connection tightened according to the standard. It can be screwed together a little less or a little more to adjust the direction of the fitting's outlet (or the overall length of the pre-assembled pipeline). The connection is nevertheless perfectly pressure tight.



Illustr. 6 Tightened with wrench

The **sealing effect on the thread** is achieved by the fact that the internal and external threads (pitch diameters) touch from the first moment of contact on and then compress when further tightened with a wrench.

Thus in a taper/parallel joint the **sealing material** only has to fill the inevitable deviations from the theoretical thread profile and roughness of the thread surfaces. Therefore only a small amount of suitable sealing material is necessary.

Tensile load, compressive stress or reversed bending stress on the joint are absorbed by the metal to metal contact.

To ensure the sealing effect of the taper/parallel joint actually takes place, the following points must be taken into account:

- The **thread cutting tool** must be adjusted so that the fitting can be screwed by hand thread, leaving enough thread (without sealant) for tightening with a wrench. In this way the necessary compression to achieve a seal is obtained even when the internal thread diameter is the maximum permissible.

- The end of the useful external thread (length a + b, see illustr. 4) should not be screwed in deeper than to the first fully formed thread of the internal thread (see illustr. 6), otherwise the compression required for sealing may be reduced by the incomplete root of the washout on the external threads.

Gauging

The gauging of both the jointing thread and the fastening thread is done with standardised plug and ring gauges.

- The plug thread gauges used for checking **fastening threads** are go and no go plug gauges and / or go and no go ring gauges. These are standardised in EN ISO 228-2. To assess the dimensional conformity to EN ISO 228-1 of thin walled parts the pitch diameter must be taken as an average between two diameter measurements offset by 90°.

- The plug thread gauges used for checking **jointing threads** are limit gauges, plug gauges for internal threads and ring gauges for external threads. These were **standardised** to **EN 10226-3** in 2005, identical to ISO 7-2 of 2000.

It should be noted that thread inspection using gauges is a comparative test.

This has particular implications when checking the **parallel internal thread** (jointing thread) to EN 10226-1 especially if the thread is chamfered.

The plug gauges according to EN 10226-3 and ISO 7-2 imply a chamfer, removing 1/2 pitch of the internal thread. The resulting chamfer diameter on the example of a 90° chamfer is given in the table of Illustr.7!

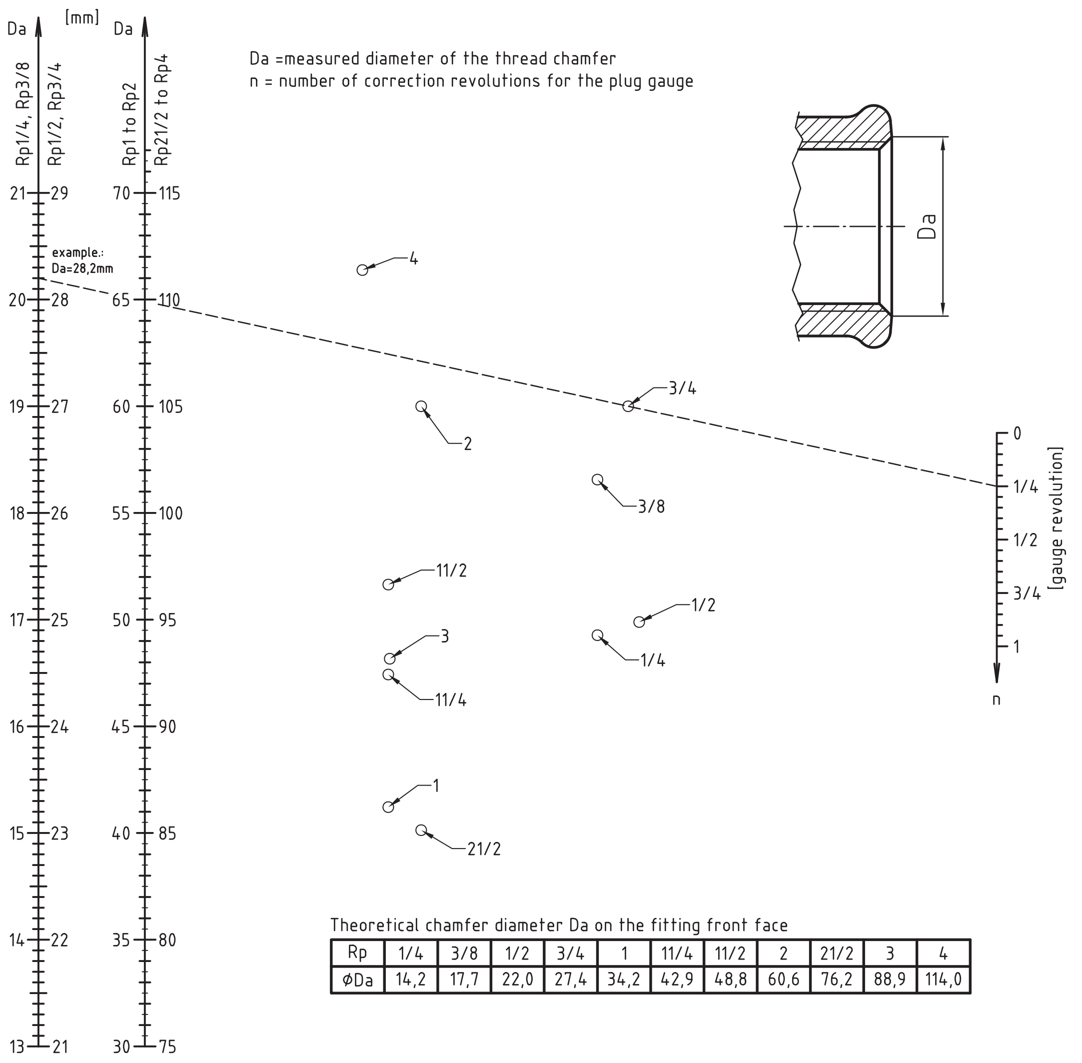
The bigger the chamfer the further the plug gauge can be screwed in; i.e. the thread diameter seems larger than it really is.

This is due to the thread section removed by the chamfer. Georg Fischer has developed the following nomogram to simply correct the effect of the chamfer on the test result. It should be used as follows:

The outer diameter D_a (Illustr. 7) of the thread chamfer is measured first. Then a straight line is drawn on the nomogram to join the points corresponding to the thread size and the measured diameter (D_a).
The point of intersection of this straight line with the n axis, indicates the number of necessary correction revolutions n.

Correction is carried out by retracting the plug gauge by n revolutions, back from the hand tight position. The new position of the plug gauge indicates the actual size of the internal thread diameter.

Example:
On the elbow 90-3/4 a chamfer diameter of (D_a=) 28.2 mm was measured. By joining the points D_a= 28.2 and 3/4, and extending the line n = 1/4 is read on the n axis.



Theoretical chamfer diameter Da on the fitting front face

Rp	1/4	3/8	1/2	3/4	1	11/4	11/2	2	21/2	3	4
ØDa	14,2	17,7	22,0	27,4	34,2	42,9	48,8	60,6	76,2	88,9	114,0

Illustr. 7 Nomogram (to be reproduced only with the express permission of Georg Fischer)

Pipe threads (EN 10226/ISO 7) and threaded pipes (EN 10255/ISO 65)
The most important dimensions

Thread size Nominal diameter DN		1/8 6	1/4 8	3/8 10	1/2 15	3/4 20	1 25	11/4 32	11/2 40	2 50	21/2 65	3 80	4 100	5 125	6 150
Pipe threads															
Plug gauge diameter (thread external diameter in the measuring plane)	mm	9,728	13,157	16,662	20,955	26,441	33,249	41,910	47,803	59,614	75,184	87,884	113,030	138,430	163,830
Pitch	mm	0,907	1,337	1,337	1,814	1,814	2,309	2,309	2,309	2,309	2,309	2,309	2,309	2,309	2,309
Number of threads per inch		28	19	19	14	14	11	11	11	11	11	11	11	11	11
Gauge length «a» (external thread)	mm	4,0	6,0	6,4	8,2	9,5	10,4	12,7	12,7	15,9	17,5	20,6	25,4	28,6	28,6
Tolerance for «a»	mm	± 0,9	± 1,3	± 1,3	± 1,8	± 1,8	± 2,3	± 2,3	± 2,3	± 2,3	± 3,5	± 3,5	± 3,5	± 3,5	± 3,5
Fitting allowance «b» Number of threads		2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	3 1/4	4	4	4 1/2	5	5
length [ca.=approx.]	ca. mm	7,0	10,0	10,0	13,0	15,0	17,0	19,0	19,0	24,0	27,0	30,0	36,0	40,0	40,0
Threaded pipes															
Outside diameter	mm	10,2	13,5	17,2	21,3	26,9	33,7	42,4	48,3	60,3	76,1	88,9	114,3	139,7	165,1
Surface area of the pipe	ca. m²/m	0,032	0,042	0,054	0,067	0,085	0,106	0,133	0,152	0,189	0,239	0,279	0,359	0,439	0,519
Medium duty															
Wall thickness	ca. mm	2,0	2,3	2,3	2,6	2,6	3,2	3,2	3,2	3,6	3,6	4,0	4,5	5,0	5,0
Inside diameter	ca. mm	6,2	8,9	12,6	16,1	21,7	27,3	36,0	41,9	53,1	68,9	80,9	105,3	129,7	155,1
Clear opening	ca. cm²	0,30	0,62	1,25	2,04	3,70	5,85	10,18	13,79	22,15	37,28	51,40	87,09	132,12	188,94
Capacity	ca. l/m	0,030	0,062	0,125	0,204	0,370	0,585	1,018	1,379	2,215	3,728	5,140	8,709	13,212	18,894
Pipe mass, plain end black pipe	ca. kg/m	0,40	0,64	0,84	1,21	1,56	2,41	3,10	3,56	5,03	6,42	8,36	12,20	16,60	19,80
Heavy duty															
Wall thickness	ca. mm	2,6	2,9	2,9	3,2	3,2	4,0	4,0	4,0	4,5	4,5	5,0	5,4	5,4	5,4
Inside diameter	ca. mm	5,0	7,7	11,4	14,9	20,4	25,7	34,4	40,3	51,3	67,1	78,9	103,5	128,9	154,3
Clear opening	ca. cm²	0,19	0,47	1,02	1,74	3,27	5,19	9,29	12,76	20,66	35,36	48,89	84,13	130,50	186,99
Capacity	ca. l/m	0,020	0,047	0,102	0,174	0,327	0,519	0,929	1,276	2,066	3,536	4,889	8,413	13,050	18,699
Pipe mass, plain end black pipe	ca. kg/m	0,49	0,77	1,02	1,44	1,87	2,93	3,79	4,37	6,19	7,93	10,30	14,50	17,90	21,30

For details see the relevant standards

Length tolerances

The permitted length tolerances for standardised types of fittings are given in the table below.
For straight parts (nipples, sockets, etc) the tolerance refers to the face to face dimension.
For fittings with changes of direction (bends, elbows, tees) the tolerance refers to the face to centre (axis) dimension.

The stated tolerances for **unions** are referring to the individual union parts and not to the complete fitting.

Length tolerance — Dimensions in mm

Dimensions (overall lengths)		tolerance
	to 30	± 1,5
over 30	to 50	± 2,0
over 50	to 75	± 2,5
over 75	to 100	± 3,0
over 100	to 150	± 3,5
over 150	to 200	± 4,0
over 200		± 5,0

Angle tolerance

The axis of the fitting threads may deviate by a maximum of 0.5° from the specified angle.

Widths across flats for malleable iron fittings

The catalogue section gives the sizes of wrenches required.

Steel fittings

Steel fittings are marked with "**ST**" in the catalogue section. For technical reasons the zinc coating of the steel fittings is done by electroplating. Galvanised steel fittings are therefore not suitable for drinking water installations.

Georg Fischer steel fittings (apart from cat. nos. 290, 291, 531, 596) can be recognised by a code groove on the hexagon.

Union fittings

Flat seat unions

Flat seat unions are supplied without sealing gaskets (except 599a, 1330, 1335). The overall lengths and z dimensions refer to the assembled union with a sealing gasket 2 or 3 mm thick (see page 79 for sizes of sealing gaskets). The choice of a suitable sealing ring material depends on the working requirements. During production pressure tests are only carried out on the piece parts (union ends and union bushes).

Flat seat unions can be dismantled completely and reassembled (see Illustr. 8).

Illustr. 8 Flat seat union Fig. 330

Taper seat unions

Before use of all conical (metallic) seat unions the sealing surfaces are to be cleaned and to be treated with a thin film of lubricant (like oil or in case of drinking water exclusively one that is suitable according to DIN 30660 e.g. thread sealing paste to DIN 30660).

If taper seat unions are reused, Georg Fischer do not take over a warranty for the sealing performance.

Conical/spherical and spherical sealing seat unions

Fig. 342 and 342a offer high sealing efficiency due to specially formed sealing surfaces. Fig. 346 with spherically produced sealing surfaces allows a smooth angular movement from 0 to 6°.
Limits for the use of figures 342, 342a and 346 see page 76. Fig. 342 and 342a are not suitable for use in drinking water installations.

Union piece parts

Most Georg Fischer flat seat union components are available as spare parts.

Georg Fischer taper seat union piece parts must not be interchanged or reused. Therefore we do only offer these for sale in exceptional cases.

Taper seat union ends and bushes are inspected in the works, fitted together and only available at the sales outlets as a complete assembly.

We would like to point out that cast-on flanges and taper dimensions on union piece parts are not standardised on either an international or on a European level. They are subject to a works standard which may be revised for technical reasons. Georg Fischer assumes no liability for pressure tightness if these parts are interchanged with other taper seat unions parts of Georg Fischer or other brands, or if the fitting are reused after dismantling.

Guideline for tightening taper seat unions (Final assembly) valid also for fig. 342, 342a, and 346

Fitting size	1/8	1/4	3/8	1/2	3/4	1	11/4	11/2	2	21/2	3	4
Tightening torque Nm	15	20	30	50 **) 60	65 **) 80	80 **) 100	150	180	240	310	350	470
max. allowable revolutions *)	1/4	1/4	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2

*) maximal nut-revolutions after hand-tight fastening

**) deviating tightening torques for 342, 342a and 346