glass rod to check whether the mixture has gel or knot after 48h. If there is no knot, the operable time is ⩾48h.

7.10 Flat flange sealing

Test shall be conducted as specified annex C.

7.11 Pipe thread sealing

Test shall be conducted as specified annex D.

7.12 Shear strength

Test of the shear strength of pins and collars shall be conducted as specified in GB/T 18747.2.

7.13 Tensile lap-shear strength

Test of the tensile lap-shear strength shall be conducted as specified in GB/T 7124.

8 Inspection rules

8.1 Lot grouping and inspection

The products produced by one pot shall be deemed as one lot and the inspection shall be carried out by lot.

8.2 Inspection classification

The product inspection is classified as delivery inspection and type inspection.

8.2.1 Delivery inspection

8.2.1.1 The inspection items of thread-locking anaerobic adhesives are listed as following:

a) Appearance;

b) Viscosity;

c) Thixotropy;

d) Fixing time;

e) Breakaway torque;

f) Prevailing torque.

8.2.1.2 The inspection items of flat sealing anaerobic adhesives are listed as following:

a) Appearance;

b) Viscosity;

c) Thixotropy;

d) Fixing time.

8.2.1.3 The inspection items of pipe thread sealing anaerobic adhesives are listed as following:

a) Appearance;

b) Viscosity;

c) Thixotropy;

d) Fixing time;

e) Breakaway torque.

8.2.1.4 The inspection items of retaining anaerobic adhesives are listed as following:

a) Appearance;

b) Viscosity;

c) Thixotropy;

d) Fixing time;

e) Shear strength.

8.2.1.5 The inspection items of structure bonding anaerobic adhesives are listed as following:

a) Appearance;

b) Viscosity;

c) Fixing time;

d) Tensile lap-shear strength.

8.2.2 Type inspection

Type inspection shall include all the items required in Chapter 5. Type inspection shall be carried out once a year during normal production, and also be carried out for the following conditions:

a) verifying trial manufacturing of new products;

b) there is any major change in raw materials and production process which may affect product quality after official production;

c) the production of a product is suspended for more than 6 months and then resumed;

d) there is any major difference between the result of outbound inspection and the last typed inspection;

e) it is required by the national quality supervision authority or by any user.

9 Mark, package, transport and storage

9.1 Mark

It shall be conducted as specified in HG/T 3075.

9.2 Package

It shall be conducted as specified in HG/T 3075.

9.3 Transport

It shall be conducted as specified in HG/T 3075.

9.4 Storage

It shall be conducted as specified in HG/T 3075. The shelf life of single-component anaerobic adhesives shall be 1 year (or above) since manufacture date. The expired adhesives may be used after inspection as qualified. The shelf life of single-component anaerobic adhesives shall be evaluated as specified in Annex E. The shelf life of micro-capsule thread-locking anaerobic adhesives or other products with special requirements shall be evaluated by the manufacturers.

Annex A
(informative)
Test and evaluation of anti-loosening of thread-locking anaerobic adhesives

A.1 General

Anti-loosening of thread-locking anaerobic adhesives shall be compared and evaluated by transverse vibration test as specified in GB/T 10431. The test shall be conducted on transverse vibration tester. The fastener coated with thread-locking anaerobic adhesives shall be fixed on the tester quickly by clamp force. Then the fastener shall be loosened by producing alternating transverse displacement between the two clamping metal plates on the tester until the clamp force disappear; meantime the figures of clamp force shall be recorded, compared and analyzed.

For testing fastener fixed with adhesives, the fastener coated with adhesives shall be fixed on the tester quickly by clamp force, the test shall not start until the thread-locking anaerobic adhesives is totally cured. The slower the clamp force reduces, the better the anti-loosening of thread-locking anaerobic adhesives will be; on the contrary, the faster the clamp force reduces, the worse the anti-loosening will be.

When there is no special requirement, anti-loosening of thread-locking anaerobic adhesives shall be evaluated by recording and comparing transverse vibration data of fasteners coated with and without adhesives respectively. It is fine to choose other comparison groups for evaluation as agreed by both supplier and customer. Generally, clamp force with adhesives reduces slower.

A.2 Equipment and material

A.2.1 Transverse vibration test equipment as specified in GB/T 10431-2008.

A.2.2 Test fixture: “test device for nut testing” as specified in Figure A.3 of GB/T 10431-2008.

A.2.3 Degrease cotton.

A.2.4 Degrease reagent: acetone or ethyl acetate.

A.2.5 When there is no special requirement, testing bolt should adopt color galvanized M10 bolt in Grade 10.9 as specified in GB/T 5782, and testing nut should adopt color galvanized M10 nut in grade 10 as specified in GB/T 6170. Matching accuracy for bolt and nut: bolt 6 g, nut 6 H.

Other specification of bolts and nuts can be chosen for test as agreed by both supplier and customer.

A.3 Test steps

A.3.1 Cleaning of sample

Remove oil stain from the surface of bolt by ultrasonic and degrease reagent, dry in air, check and pre-assemble bolt and nut; do not use bolt or nut with obvious bump or glitch, do not use those can not be assembled smoothly. Meanwhile, clean plain washer and cone-face washer with degrease reagent in case of lubricating grease stuck to the bolt otherwise lubricating grease will seriously affect the cure of adhesives.

A.3.2 Transverse vibration test of blank sample without adhesive

Take 10 sets of bolts and nuts, fix one bolt on the fixture, thread it with cone-face washer and plain washer one by one, paint thin layers of lubricating grease on interface of cone-face washer and plain washer and interface of plain washer and nut manually, check surface of the bolt, If there is lubricating grease, it shall be cleaned by degrease cotton dipping with acetone or ethyl acetate, then install nut and screw up it until its clamp force is as high as regulated (if there is no special requirements, it is suggested that the clamp force shall be 50% of the bolt guaranteed load), and record it as $F_{primary1}$, set vibration frequency and amplitude (if there is no special requirements, it is recommended that the frequency shall be 12.5 Hz and amplitude shall be 1 mm). Then start up vibration tester, observe and record clamp force. It refers to the final clamp force $F_{final\ 1}$ when sufficient record is taken (if there is no special requirements, it is recommended that the 1500 records shall be taken). Attenuation rate A of bolt clamp force without adhesive shall be calculated as $A=(F_{primary\ 1}- F_{final\ 1})/ F_{primary\ 1}\times 100\%$. Repeat this operation and test vibration data of other 9 sample pieces. Calculate arithmetic average and standard deviation of attenuation rate A and record them as $A_{average}$ and S_A.

A.3.3 Anti-loosening test of cured thread-locking anaerobic adhesives

A.3.3.1 Single-component thread-locking anaerobic adhesives

Take 10 sets of bolts and nuts, fix one bolt on the fixture, thread it with cone-face washer and plain washer one by one, paint thin layers of lubricating grease on interface of cone-face washer and plain washer and interface of plain washer and nut manually (excess application shall be avoided, which may result in grease adhering to the bolts during assembling, and affecting curing), check surface of the bolt, If there is lubricating grease, it shall be cleaned by degrease cotton dipping with acetone or ethyl acetate; take one tube of anaerobic adhesives, coat it on the nut and bolt uniformly and assemble the nut and bolt; when nut is screwed into position, it shall be screwed into and out three times repeatedly to make sure the back lash of bolt and nut filled up with adhesives, keep screwing nut until the clamp force reaches to the regulated figure (if there is no special requirement, it is suggested that the clamp force is 50% of the bolt guaranteed load), and it shall be recorded as $F_{primary\ 2}$. then put the assembled bolt and nut in static condition until the adhesive complete cure; set vibration frequency and amplitude (if there is no special requirements, it is recommended that the frequency shall be 12.5 Hz, and amplitude shall be 1 mm), and start up vibration tester, observe and record clamp force in vibration; it refers to the final clamp force $F_{final\ 2}$ when sufficient record is taken (if there is no special requirements, it is recommended that the 1500 records shall be taken). If fatigue fracture of bolt happens when clamp force record is not taken enough during vibration, data in 30 seconds before fatigue fracture shall be recorded as $F_{final\ 2}$. Attenuation

rate B of bolt clamp force with cured adhesive shall be calculated as $B=(F_{primary\ 2}- F_{final\ 2})/ F_{primary\ 2}X100\%$, repeat this operation, test vibration data of other 9 sample pieces; calculate arithmetic average and standard deviation of attenuation rate B and record them as $B_{average}$ and S_B.

A.3.3.2 Micro-capsule thread-locking anaerobic adhesives

Mix part A and B uniformly in the appointed proportion; take 10 sets of bolts and nuts, coat uniformly mixed adhesives on 10 bolts, put bolts in (70±2)℃ air dry oven for (45±1)min to dry, take them out, cool them down to room temperature; take one bolt with adhesives, fix it on the fixture, thread it with cone-face washer and plain washer one by one, paint thin layers of lubricating grease on interface of cone-face washer and plain washer and interface of plain washer and nut manually (excess application shall be avoided, which may result in grease adhering to the bolts during assembling, and affecting curing), check surface of the bolt, If there is lubricating grease, it shall be cleaned by degrease cotton dipping with acetone or ethyl acetate; take one tube of anaerobic adhesives, coat it on the nut and bolt uniformly and assemble the nut and bolt; when nut is screwed into position, it shall be screwed into and out three times repeatedly to make sure the back lash of bolt and nut filled up with adhesives, keep screwing nut until the clamp force reaches to the regulated figure (if there is no special requirement, it is suggested that the clamp force is 50% of the bolt guaranteed load), and it shall be recorded as $F_{primary\ 2}$. then put the assembled bolt and nut in static condition until the adhesive complete cure; set vibration frequency and amplitude (if there is no special requirements, it is recommended that the frequency shall be 12.5 Hz, and amplitude shall be 1 mm), and start up vibration tester, observe and record clamp force in vibration; it refers to the final clamp force $F_{final\ 2}$ when sufficient record is taken (if there is no special requirements, it is recommended that the 1500 records shall be taken). If fatigue fracture of bolt happens when clamp force record is not taken enough during vibration, data in 30 seconds before fatigue fracture shall be recorded as $F_{final\ 2}$. Attenuation rate B of bolt clamp force with cured adhesive shall be calculated as $B=(F_{primary\ 2}- F_{final\ 2})/ F_{primary\ 2}X100\%$, repeat this operation, test vibration data of other 9 sample pieces; calculate arithmetic average and standard deviation of attenuation rate B and record them as $B_{average}$ and S_B.

A.3.4 Evaluation of test result

Compare arithmetic average and standard deviation of attenuation rate A with that of B, the smaller the attenuation rate is, the better the anti-loosening of thread-locking anaerobic adhesives will be; the smaller the standard deviation is, the more reliable the data will be.

Annex B
(informative)
Test and evaluation of lubricity of thread-locking anaerobic adhesives

B.1 General

Application of thread-locking anaerobic adhesives will have some influence on friction coefficient and uniformity of friction coefficient of fastener during assembly. Because of difference of formula, friction coefficient of fastener can be increased, remained or decreased during assembly when adhesives are used. But discreteness of thread friction coefficient with adhesives will decrease generally.

The discreteness of thread friction coefficient will decrease after adhesives are applied. This phenomenon is called lubricity.

Thread friction coefficients with and without adhesives shall be tested respectively as specified in GB/T 16823.3-2010. The standard deviation of thread friction coefficients of different test groups shall be calculated respectively. Decrease of standard deviation after applying adhesives represents lubricity. The bigger the decrease is, the better the lubricity will be.

Lubricity of thread-locking anaerobic adhesives is beneficial for stability and conformity of assembly. For precision assembly, the change of friction coefficient shall be paid close attention if adhesive is used. During assembly, tightening torque shall be adjusted accordingly based on the influence on friction coefficient in case of tightening failure or overload.

B.2 Equipment and material

B.2.1 Multi-function torque-clamp force analysis and test equipment shall be as specified in GB/T 16823.3.

B.2.2 Testing gasket or washer: 7.2.2 HH testing gasket or washer as specified in GB/T 16823.3-2010.

B.2.3 Degrease cotton and Degrease reagent: acetone or ethyl acetate.

B.2.4 When there is no special requirement, testing bolt should adopt color galvanized M10 bolt in Grade 10.9 as specified in GB/T 5782, and testing nut should adopt color galvanized M10 nut in grade 10 as specified in GB/T 6170. Matching accuracy for bolt and nut: bolt 6 g, nut 6 H.

Other specification of bolts and nuts can be chosen for test as agreed by both supplier and customer.

B.3 Test steps

B.3.1 Clean of sample

Remove oil stain from the surface of bolt by ultrasonic and degrease reagent, dry in air, check and pre-assemble bolt and nut; do not use bolt or nut with obvious bump or glitch, do not use those cannot be assembled smoothly. Meanwhile, clean gasket and washer to be used with degrease cotton dipped in degrease reagent as specified in GB/T 16823.3-2010 7.2.2 HH.

B.3.2 Friction coefficient test of blank sample without adhesive

Friction coefficient shall be tested as specified in GB/T 16823.3-2010. Take 10 sets of bolts and nuts, fix one bolt on the fixture of test equipment, thread it with HH gasket or washer, screw in nut, connect with tightening sleeve, start up equipment, record the friction coefficient μ_{th1} when clamp force reaches 75% of the guaranteed load. Repeat this operation and test friction coefficient of other 9 sample pieces, take records, calculate arithmetic average and standard deviation of thread friction coefficients S_1.

B.3.3 Friction coefficient test with adhesive

B.3.3.1 Single-component thread-locking anaerobic adhesives

Friction coefficient shall be tested as specified in GB/T 16823.3-2010. Take 10 sets of bolts and nuts, fix one bolt on the fixture of test equipment. Take one tube of adhesive, shake hard before use, coat on the inside thread of nut uniformly. Do not coat it or let it flow on the side of supporting (please clean up the adhesive by degrease cotton dipped in degrease regent in case stuck with adhesive). Then screw nut in the bolt when nut is screwed nearly into position, it shall be screwed into and out three times repeatedly, then connect nut with tightening sleeve, start up the equipment, test and record thread friction coefficient μ_{th2} when clamp force reaches 75% of the guaranteed load. Repeat this operation and test friction coefficient of other 9 sample pieces with adhesive applied, take records, then calculate arithmetic average and standard deviation of thread friction coefficients S_2.

B.3.3.2 Micro-capsule thread-locking anaerobic adhesives

Mix part A and B uniformly in the appointed proportion; take 10 sets of bolts and nuts, coat uniformly mixed adhesives on 10 bolts, while not coat the front two to three thread; put bolts in (70±2)℃ air dry oven for (45±1)min to dry, take them out, cool them down to room temperature, seal for late use; take one bolt with adhesives, fix it on the force /torque sensor fixture as specified in GB/T 16823.3-2010; screw nut in bolt two to three thread; connect nut with tightening sleeve; start up the equipment, test and record thread friction coefficient μ_{th2} when clamp force reaches 75% of the guaranteed load. Repeat this operation and test friction coefficient of other 9 sample pieces, take record; then, calculate arithmetic average and standard deviation of thread friction coefficients S_2.

B.4 Evaluation of test result

Calculate the decreasing of standard deviation of thread friction coefficient after coating adhesive by equation $T=(S_1-S_2)/S_1\times100\%$, take one decimal for the result; the number T is bigger, the lubricity is better.

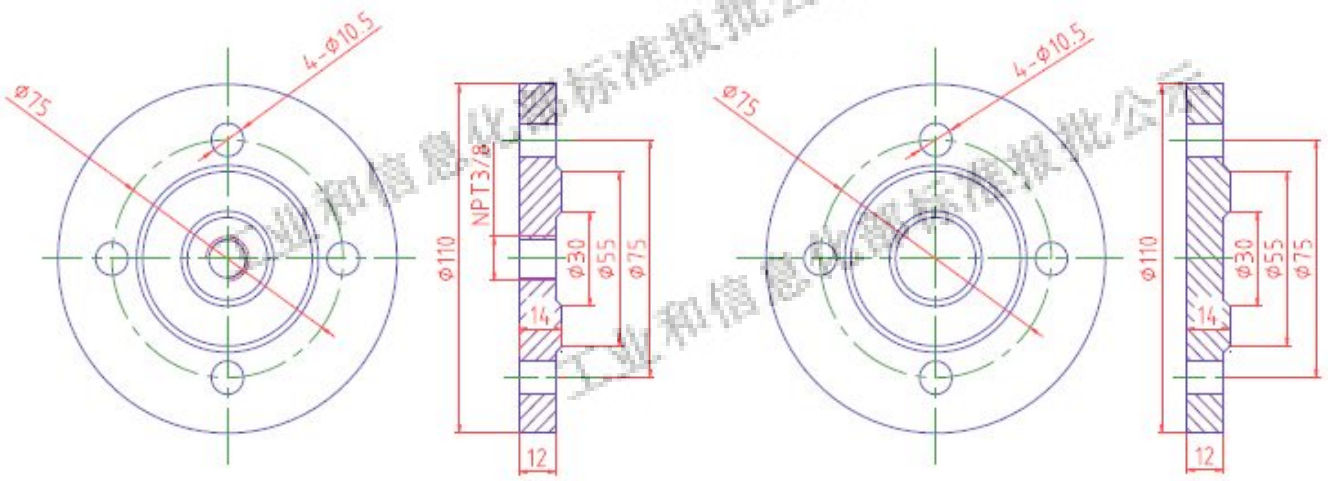
Annex C
(normative)
Sealing test of flat flange

C.1 Test material and equipment

C.1.1 Test piece

Test piece shall be composed of one pair of flanges coated with thread-locking anaerobic adhesives. The flange shall be processed with 45# carbon steel and the surface roughness Ra shall be (0.8～3.2) μm. Test piece and flange structure are indicated in Figure C.1.

Dimensions in millimeter



a) up flange

b) bottom flange

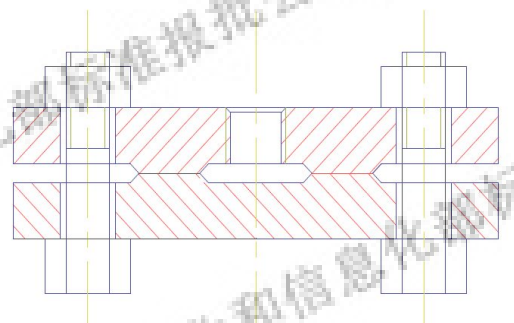


Figure c.1 Flange drawing and schematic diagram of assembly

C.1.2 Color galvanized bolt and nut

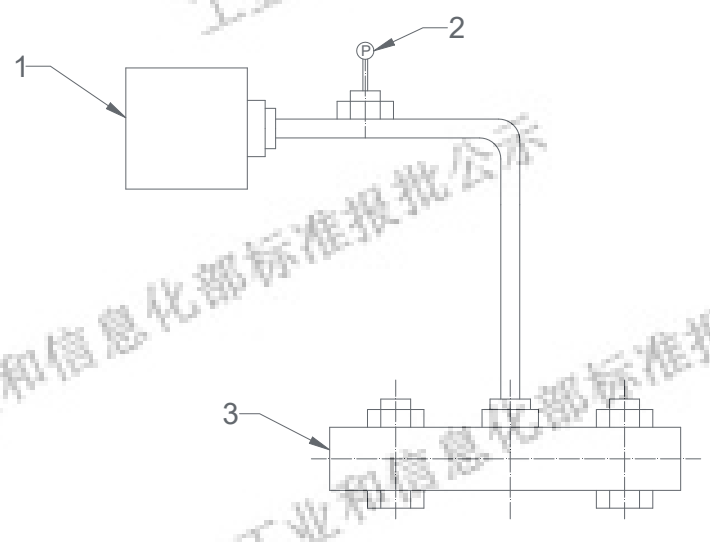
Testing bolt should adopt color galvanized M10 bolt in Grade 8.8 as specified in GB/T 5782, and testing nut should adopt color galvanized M10 nut in grade 8 as specified in GB/T 6170. Matching accuracy for bolt and nut: bolt 6 g, nut 6 H. Do not use them repeatedly.

C.1.3 Cleaning materials

Degrease cotton and degrease agent: acetone or ethyl acetate.

C.1.4 Test equipment for sealing property

The equipment shall be configured with stable gas source/hydraulic source with adjustable pressure as indicated in Figure C.2.



Key

1 Hydraulic source

2 Pressure gauge

3 Flange pair

Figure C.2 Schematic diagram of face flange sealing test equipment

C.1.4.1 The pneumatic test equipment shall be mainly composed of stable gas source with adjustable pressure, pressure gauge and joint. Pneumatic test equipment shall be composed of nitrogen cylinder filled with high pressure nitrogen, pressure reducing valve, pneumatic tube, pressure gauge and fast joint. Nitrogen cylinder filled with high pressure nitrogen shall be the gas source. Except fast joint on equipment interface, all other parts of the equipment shall be sealed by twining Teflon tape or sealing gasket.

C.1.4.2 The oil pressure test equipment shall be mainly composed of stable gas source with adjustable hydraulic source, pressure gauge and joint. Oil pressure test equipment shall be composed of hydraulic pump, hydraulic gauge, high pressure joint pipe and fast joint. The hydraulic oil shall be #32 anti-wear hydraulic oil. Except fast joint on equipment interface, all other parts of the equipment shall be sealed by such as twining Teflon tape or sealing gasket.

C.1.4.3 Pressure gauge or oil pressure gauge shall keep the reading at 15%～85% range when

the pieces are tested.

C.1.4.4 Torque wrench shall be configured with reading and peak value record, its accuracy shall be at least 0.1N·m. Digital display torque wrench shall be used.

C.2 Test steps

C.2.1 Surface treatment

Flange fitting surface shall be cleaned by degrease cotton dipping in degrease agent repeatedly until there is no obvious oil stain on the degrease cotton; bolt and nut shall be cleaned as well if there is oil stain on them. Do not touch the cleaned fitting surface of test piece directly by hand during assembly.

C.2.2 Coat and assembly

Coat thread-locking anaerobic adhesives according to surface width and fitting space, Coat thread-locking anaerobic adhesives on fitting surface of one flange uniformly and make sure the space is filled with adhesives after assembly; assemble flange, screw up bolts in order of opposite angles. The tightening torque shall be (40.0±1.0)N·m.

C.2.3 Cure

Cure adhesive under standard conditions after test piece is assembled. cure 2 hours for air tightness test of face flange, cure 24 hours for sealing pressure (oil pressure) of face flange.

C.2.4 Test

C.2.4.1 Flat flange sealing (air pressure)

Install the test piece on the pneumatic test equipment, soak it in water, press on it by slowly and uniformly adjusting the pressure reducing valve. Pressure increase speed shall be controlled at 0.1MPa/min～0.2MPa/min until the pressure reaches the regulated figure, which shall be 0.4MPa if there is no special requirement. Keep this pressure for 60s and check if the sealing part bubbles continuously or not. If yes, the testing piece leaks; if not, it does not leak. Record pressure figure and testing result.

C.2.4.2 Flat flange sealing (oil pressure)

Install the cured testing piece on the interface of pressure test equipment and press on it uniformly. The pressure increase speed shall be controlled at 20MPa/min～30MPa/min until it reaches the regulated pressure. Keep the pressure for 60s and check if the sealing part leaks. If not, it means the testing piece meets the regulated pressure, keep increase pressure on it until it leaks, read and record maximum sealing pressure.

C.3 Testing result

C.3.1 Sealing performance of flat flange (air pressure)

If the test piece does not leak under the specified pressure, the sealing performance of flat flange (air pressure) under this pressure is judged to be qualified.

C.3.2 Sealing performance of flat flange (oil pressure)

Take a round number of readings, take the arithmetic average of the maximum sealing pressure as the test result.

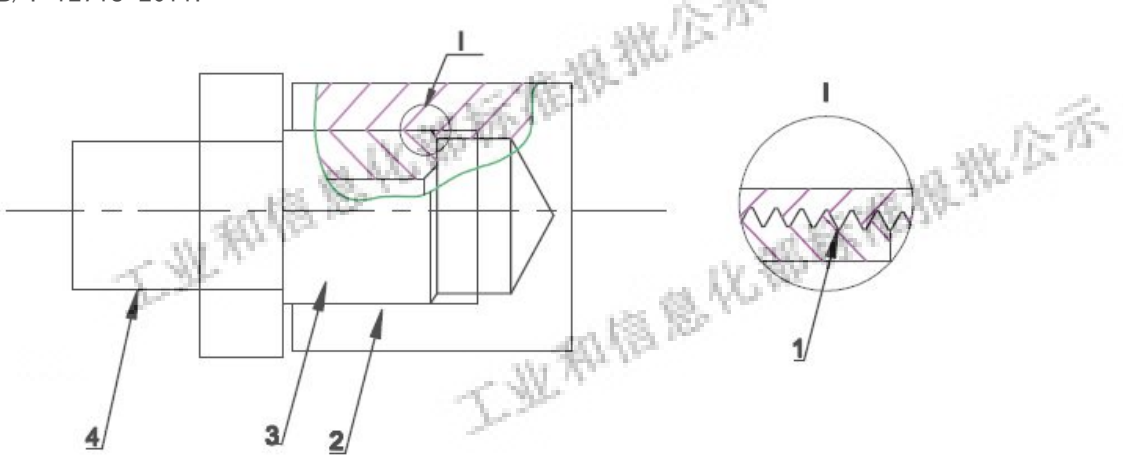
Annex D
(normative)
Sealing test of pipe thread

D.1 Test material and equipment

D.1.1 Test piece

Test piece shall be composed of nipple and coated exterior hexagon cap as indicated in Figure D.1.

The material shall be #Q235 steel. The part of nipple for coating adhesive shall be exterior thread NPT1/2-14 as specified in GB/T 12716-2011, and the other part shall be sealed by Teflon tape or sealing gasket. The exterior hexagon cap shall be interior thread NPT1/2-14 as specified in GB/T 12716-2011.



Key:

1 coating part of pipe thread;

2 exterior hexagon cap of interior thread NPT1/2-14;

3 one part of exterior thread NPT1/2-14 of nipple;

4 the other part of nipple, shape and size of interface shall match with interface of test equipment.

Figure D.1 Schematic diagram of adhered test piece

D.1.2 Cleaning material

Degrease cotton and Degrease reagent: acetone or ethyl acetate.

D.1.3 Test equipment

Test equipment shall be as same as the one in C.1.4.

D.2 Test step

D.2.1 Surface treatment

Remove oil stain from the surface of sample by degrease reagent, dry in air before use.

D.2.2 Coating and assembly

Coat adhesive from the thread end of nipple for at least 3 screw threads, assemble hexagon cap, screw it in and out for three times repeatedly to make sure the back lash of bolt and nut filled up with adhesive, screw up until the torque reach (80±1)N·m with a torque wrench in the end.

D.2.3 Cure

D.2.3.1 Pipe thread sealing (air pressure)

It shall be solidified for 2h after it has been assembled. The overflowing thread-locking anaerobic adhesives shall be cleaned with degrease cotton after it is solidified.

D.2.3.2 Pipe thread sealing (oil pressure)

It shall be solidified for 24h after it has been assembled. The overflowing thread-locking anaerobic adhesives shall be cleaned with degrease cotton after it is solidified.

D.2.4 Test

D.2.4.1 Pipe thread sealing (air pressure)

Install the test piece on the pneumatic test equipment, soak in water; give pressure by adjusting the pressure valve slowly and uniformly, increase pressure with the speed from around 0.1 MPa/minute to 0.2 MPa/minute until it reaches the regulated figure, normally 0.4MPa if there is no special requirement; keep the pressure for 60 seconds and check if there are continuous bubbles or not on the sealing part. If yes, the test piece leaks; if not, it does not leak. Record pressure and test result.

D.2.4.2 Pipe thread sealing (oil pressure)

Install cured test piece on the test equipment, exhaust it; then start to test, give pressure uniformly, increase pressure with the speed from around 20 MPa/minute to 30 MPa/minute until it reaches the regulated figure; keep the pressure for 60 seconds and check if the sealing part leaks; record pressure and test result; keep increase pressure until it leaks, record pressure, and which is the maximum sealing pressure.

D.3 Test result

D.3.1 Pipe thread sealing (air pressure)

The pipe thread sealing is qualified if no leak happens in test under the regulated pressure,

D.3.2 Pipe thread sealing (oil pressure)

Take a round number of the arithmetic average of the maximum sealing pressure as the test result.

Annex E
(normative)
Test of storage stability

E.1 General

Storage stability shall be tested by accelerated aging as the following methods:

- standard method: package bottle 50℃×28d;

- fast method: glass test tube 82℃×1h.

When these two methods conflict, the standard method shall be referred.

E.2 Standard method

Take a bottle of unopened thread-locking anaerobic adhesives (50 ml package specification), put it in (50±1)℃ electric thermostatic drier with automatic temperature control or other equivalent oven to accelerate aging for 28 days. Afterwards, pour out all thread-locking anaerobic adhesive, check the appearance of the adhesives. If no gel, knot or impurities are observed, it means that it can be stored in the room temperature stably for at least 1 year.

E.3 Fast method

Take one clean glass tube (with diameter 10 mm and height 100 mm) and fill in half of thread-locking anaerobic adhesives, put it in (82±1)℃ oil bath/water bath for 1 hour aging, the liquid level of oil bath/water batch pot shall be higher than that of thread-locking anaerobic adhesives in tube, finally pour out all thread-locking anaerobic adhesives, check the appearance of adhesives carefully, if no gel or knot are observed in 30 minutes, it means that the adhesives can be stored at room-temperature stably for at least 1 year generally.