

Description

Title of the invention: Device for monitoring the tightness of sealing components

Technical domain

[0001] The invention pertains to the domain of devices for monitoring the tightness of sealing components, such as a single-layer or multi-layer membrane (for example a triplex composite) for a fluid storage tank, for example for a liquefied gas. In particular, such tanks can be sealed thermally insulating membrane tanks for storing and/or transporting liquefied gas at low temperatures, such as tanks for transporting liquefied petroleum gas (LPG) for example at a temperature between -50°C and 0°C, or for transporting liquefied natural gas (LNG) with a temperature of approximately -162°C at atmospheric pressure. These tanks can be onshore facilities, gravity-based structures (GBS) on/in the water, or installed on a floating structure. In a floating structure, the tank can be used to transport liquefied gas or to receive the liquefied gas used as fuel to power the floating structure.

Technological background

[0002] To perform a tightness test on a sealing membrane of a fluid storage tank, it is known in the prior art to use a tightness monitoring device consisting of a vacuum box that has an internal chamber in which a pressure drop is created to checked local tightness. Such a vacuum box has a transparent cover and a peripheral partition with a peripheral seal that is designed to be pressed against the sealing membrane being tested in order to sealingly close the internal chamber.

[0003] To perform the tightness test with such a monitoring device, water including surfactants such as soap is applied to the portion of the membrane being tested. The monitoring device is then positioned on the portion being tested and pressure in the internal chamber is reduced, the dimension of the portion being tested therefore corresponding to the dimension of the internal chamber. If there is a leak in the membrane, the formation of bubbles can then be seen near the leak through the transparent cover.

[0004] To perform a tightness test for the entire membrane, this operation then has to be repeated many times in the flat zones and the corner zones of the tank, and notably at the joins between strips of the sealing membrane, where said strips are glued together. By way of example, for a GNL or GPL tank of conventional dimensions, testing the tightness of a membrane covering at least some of the different faces of the tank requires several

thousand tightness tests, usually in the order of 3000 to 5000 tests to cover all of the zones to be checked. These successive operations are difficult to carry out, requiring a plurality of operatives and lots of time to carry out all the entire tightness test.

Summary

[0005] One idea at the heart of the invention is to propose a tightness monitoring device for testing the tightness of a sealed membrane of a tank that is reliable and easy to use in the tank.

[0006] Another idea at the heart of the invention is to propose a tightness monitoring device that is quick to use for testing the tightness of a sealed membrane of a tank in as little time as possible.

[0007] According to one embodiment, the invention provides a device for monitoring the tightness of a sealing component, such as a membrane or a multi-layer, for a fluid storage tank, in which the monitoring device includes a box comprising:

- a peripheral partition having a peripheral wall with a lower end fitted with a peripheral seal designed to be positioned against the sealing component,
- a cover made of a transparent material, the cover being linked to the peripheral partition such that the cover and the peripheral wall are able to define an internal chamber with the sealing component, the peripheral seal being arranged about the entire internal chamber, and in which the monitoring device includes:
 - a handling handle fastened to the box,
 - a control member actuated manually to generate a control signal, the control member being positioned on or in the immediate vicinity of the handling handle to enable a user holding the handling handle to actuate the control member,
 - a pressure-reducing device that is connected to the internal chamber and is designed to reduce the pressure in said internal chamber using a pressure-reducing member, the pressure-reducing device being provided with a controlled valve that can be switched to an open state to link the internal chamber to the pressure-reducing member, and to a closed state to isolate the internal chamber from the pressure-reducing member,
 - a control unit designed to switch the controlled valve in response to the control signal.

[0008] Thanks to these features, the control member positioned on or near to the handling handle enables reliable and easy use by a single user, who can position the monitoring device using the handling handle while activating the vacuum without having to release the handling handle or requiring the presence of another user. Furthermore, such a device

is quicker to use, enabling the tightness of a sealed membrane of a tank to be tested in as little time as possible.

[0009] Depending on the embodiment, such a monitoring device may have one or more of the following features.

[0010] According to one embodiment, the control unit is configured to switch the controlled valve alternately between the open state and the closed state in response to the control signal.

[0011] According to one embodiment, the control member is a first control member that can be actuated manually to generate a first control signal, and the monitoring device also has a second control member that can be actuated manually to generate a second control signal, the control unit being configured to switch the controlled valve to the open state in response to the first control signal and to the closed state in response to the second control signal.

[0012] According to one embodiment, the handling handle is a first handling handle, and the monitoring device also has a second handling handle, the first handling handle and the second handling handle being arranged on the perimeter of the box opposite one another.

[0013] According to one embodiment, the peripheral wall is an internal peripheral wall and the peripheral seal is an internal peripheral seal, the peripheral partition having an external peripheral wall arranged on the outside of the internal peripheral wall such as to define an intermediate chamber between the external peripheral wall and the internal peripheral wall, the external peripheral wall having a lower end fitted with an external peripheral seal that is designed to be positioned against the sealing component about the entire internal peripheral seal,

and in which the pressure-reducing device is connected to the internal chamber and to the intermediate chamber and is designed to reduce the pressure in said internal chamber and said intermediate chamber using the pressure-reducing member, the pressure-reducing device being provided with the controlled valve that can be switched to an open state to link the internal chamber and the intermediate chamber to the pressure-reducing member, and to a closed state to isolate the internal chamber and the intermediate chamber from the pressure-reducing member.

[0014] According to one embodiment, the peripheral seal or the internal peripheral seal and/or the external peripheral seal have a sealing end forming a loop about the entire internal chamber that is designed to be positioned against the sealing component, the sealing end

being positioned in a plane, and the cover being formed parallel to said plane such as to form a tightness monitoring device for a flat zone.

[0015] This enables the monitoring device to check the tightness of the flat zones of the tank.

[0016] According to one embodiment, the peripheral seal or the internal peripheral seal and/or the external peripheral seal have a sealing end forming a loop about the entire internal chamber that is designed to be positioned against the sealing component, a first portion of the sealing end being positioned in a first plane and a second portion of the sealing end being positioned in a second plane that is inclined in relation to the first plane, and the cover being formed in a plane that is inclined in relation to the first plane and to the second plane such as to form a tightness monitoring device for a corner zone.

[0017] This enables the monitoring device to check the tightness of the corner zones of the tank. Indeed, the shape of the peripheral seals enables the inclination of the tank walls to be followed in the corner zones, thereby maintaining an internal chamber and a sealed intermediate chamber.

[0018] Furthermore and as set out below, the dimensions of the box according to the invention are selected such as two perfectly fit the zones to be tested, without being too large. Indeed, it should be noted that in particular in the corner zones or angle zones, the test surface is very often irregular and the actual angle is different from the theoretical design angle, and consequently it would be very difficult to create the vacuum necessary for the tightness test using a box that is too large.

[0019] According to one embodiment, the first plane and the second plane are inclined in relation to one another by an angle of between 60° and 170°, preferably an angle of 90°, 135°, 108.4°, or 161.6°. It should be noted here that the angles of inclination between two contiguous faces relatively frequently found in the domain of the invention, i.e. for LNG or LPG tanks, are typically 90° and 135°.

[0020] According to one embodiment, the longitudinal dimension of the monitoring device is between 290 mm and 432 mm, preferably 320 mm or 430 mm, the longitudinal dimension being intended to be parallel to a tank edge during use. Consequently, in a standard zone, i.e. for example in upper and lower flat zones of the tank, the conventional longitudinal dimension is 320 mm, while in corner zones between two faces of the tank the longitudinal dimension is conventionally 430 mm.

[0021] The monitoring device therefore has an optimal longitudinal dimension to carry out a tightness test over the entire width of a strip of sealing membrane while passing between two preassembled primary insulating blocks.

[0022] According to one embodiment, the monitoring device has at least one lighting device fastened to the peripheral partition and designed to illuminate the internal chamber.

[0023] The lighting device helps to improve the quality of the tightness test, which is performed visually, making it easier to identify leaks.

[0024] According to one embodiment, the monitoring device has a plurality of lighting devices arranged about the entire internal chamber. For example, the lighting is provided using an LED strip.

[0025] According to one embodiment, the monitoring device has an air discharge pipe that is connected firstly to a pressure-reducing member of the pressure-reducing device, and secondly to the intermediate chamber such as to bring the pressure P_1 in the intermediate chamber below atmospheric pressure, the internal peripheral wall comprising a communication channel fluidly linking the internal chamber and the intermediate chamber.

[0026] According to one embodiment, the monitoring device has a pressure regulator positioned on the communication channel, said pressure regulator being designed so that the internal chamber is brought to a pressure P_2 below atmospheric pressure and greater than the pressure P_1 when the pressure-reducing device is activated.

[0027] According to one embodiment, the monitoring device has a safety valve that is connected to the intermediate chamber and can be switched to a closed state when the pressure in the intermediate chamber is equal to or greater than a pressure P_{min} , and to an open state when the pressure in the intermediate chamber is less than the pressure P_{min} to link the intermediate chamber with the outside.

[0028] According to one embodiment, the value P_{min} is between 200 and 1000 mbar, preferably 800 mbar.

[0029] According to one embodiment, the invention also discloses a monitoring method carried out using a tightness monitoring device as mentioned above on a sealing component of a fluid storage tank, in which the method comprises the following steps:

- applying water containing surfactants or injecting a colored gas respectively on or beneath a portion to be tested of the sealing component,

- placing the tightness monitoring device on the portion to be tested using the handling handle so that the peripheral seal is in contact with the portion to be tested,
- activating the control member to reduce the pressure in the internal chamber using the pressure-reducing device,
- looking through the transparent cover for the appearance of bubbles in the portion to be tested or colored gas in the internal chamber respectively.

[0030] According to one embodiment, activation of the control member also reduces the pressure in the intermediate chamber, and the intermediate chamber is brought to a pressure P1 below atmospheric pressure during the pressure reduction stage.

[0031] According to one embodiment, the internal chamber is brought to a pressure P2 below atmospheric pressure and above the pressure P1 during the pressure reduction stage.

Short description of the figures

[0032] The invention can be better understood, and additional objectives, details, features and advantages thereof are set out more clearly, in the detailed description below of several specific embodiments of the invention given solely as non-limiting examples, with reference to the drawings attached.

[0033] [Figure 1] [Figure 1] is a schematic top view of a tightness monitoring device according to a first embodiment, placed on a sealing membrane.

[0034] [Figure 2] [Figure 2] is a schematic cross-section view taken along the line II-II in [figure 1] of the tightness monitoring device according to the first embodiment.

[0035] [Figure 3] [Figure 3] is a perspective view of a tightness monitoring device according to the first embodiment for flat zones.

[0036] [Figure 4] [Figure 4] is a perspective view of a tightness monitoring device according to a second embodiment for a corner zone.

[0037] Figure 5] [Figure 5] is a partial view of a tightness monitoring device according to a third embodiment, showing one of the handling handles.

[0038] Figure 6] [Figure 6] is a partial perspective view of a tank corner structure with the schematic placement of a tightness monitoring device according to the second embodiment.

Description of embodiments

[0039] A tightness monitoring device 4 that can be used to detect leaks in a sealing component, such as a sealing membrane 1 for a fluid storage tank, is described below.

[0040] In the example below, the fluid storage tank is a sealed and thermally insulating tank for storing and/or transporting liquefied gas. The sealing membrane 1 is a sealing membrane made of a stratified composite material consisting of an aluminum sheet between two layers of fiberglass and resin. The sealing membrane 1 includes a plurality of elements made of composite material that are glued together by overlapping such as to form an overlapping zone 3.

[0041] However, the invention can also be used in other types of tank and for other types of sealing membrane. For example, the sealing membrane can be a metal membrane consisting of a plurality of elements welded together.

[0042] During the tightness test stage used to check the tightness of the membrane 1, the tightness monitoring device 4 is positioned on a portion 2 to be tested of the membrane 1. This portion 2 to be tested can be the location of an overlapping zone 3, as shown in the attached figures, in particular figures 1 and 6, or any other zone of the sealing membrane 1.

[0043] The tightness monitoring device 4 has a box 5 comprising a peripheral partition 7 and a visibly transparent cover 6 to enable a user to observe the portion 2 to be tested through the cover 6. The cover 6 is linked to the peripheral partition 7 on each of the edges thereof such as to form a sealed internal chamber 13 with the peripheral partition 7.

[0044] Figures 1 to 3 show a first embodiment of the tightness monitoring device 4. As shown in [figure 1], in which only the box 5 of the monitoring device 4 is illustrated with the membrane 1, the cover 6 is rectangular and the peripheral partition 7, which is also rectangular, is fastened on each of the four edges to the cover 6 such as to form a rectangular parallelepipedic box 5. However, in embodiments that are not shown, the box 5 can have any shape suited to the portion 2 to be tested of the membrane, for example an elongate shape, a polygonal shape or a cylindrical shape, the peripheral partition 7 adapting to the shape of the transparent cover 6.

[0045] [Figure 2] also shows the first embodiment of the monitoring device 4. In this embodiment, the peripheral partition 7 has an upper portion 8, an internal peripheral wall 9, and an external peripheral wall 10. The internal peripheral wall 9 has a lower end fitted with an internal peripheral seal 11 that is designed to be positioned against the membrane 1 about the entire internal chamber 13. The internal peripheral wall 9 also has an upper end linked sealingly to a lower end of the upper portion 8. The upper portion 8 is linked sealingly at one upper end to the cover 6.

[0046] The assembly formed by the portion 2 to be tested, the internal seal 11, the internal wall 9, the upper portion 8, and the cover 6 thus form all of the walls of the internal chamber 13, enabling said chamber to be substantially fluid-tight during a tightness test, except for any leaks from the portion 2 to be tested of the membrane 1 or connection to a pressure-reducing device 17.

[0047] The peripheral partition 7 also has an external peripheral wall 10 arranged outside the internal peripheral wall 9 and spaced apart therefrom. The external peripheral wall 10 has a lower end fitted with an external peripheral seal 12 that is designed to be positioned against the membrane 1 about the entire internal peripheral seal 11. The external peripheral wall 10 also has an upper end linked sealingly to the lower end of the upper portion 8.

[0048] The assembly formed by the membrane 1, the external seal 12, the external peripheral wall 10, the upper portion 8, the internal peripheral wall 9, and the internal seal 11 forms all of the walls of an intermediate chamber 14, enabling said chamber to be fluid-tight during a tightness test, except for any leaks from the membrane 1, connection to a pressure-reducing device 17, or to the internal chamber 13.

[0049] In the first embodiment shown in [figure 2], the internal chamber 13 is linked fluidly to the intermediate chamber 14 by at least one communication channel 20 made in the internal peripheral wall 9.

[0050] The monitoring device 4 also has a pressure-reducing device 17 that has a first (and in this embodiment, single) pressure-reducing member 18 connected to the intermediate chamber 14 by a first pipe 15. The first pipe 15 thus traverses the external peripheral wall 10 to enable the pressure in the intermediate chamber 14 to be reduced by the first pressure-reducing member 18. In this embodiment, the pressure in the internal chamber 13 is also reduced using the communication channel 20 between the internal chamber 13 and the intermediate chamber 14, using the pressure-reducing member 18.

[0051] Furthermore, in this embodiment, the dimension of the communication channel 20 in relation to the volume of the internal chamber 13 and to the volume of the intermediate chamber 14 is determined such as to slow the equalization of pressure between the internal chamber 13 and the intermediate chamber 14 when the pressure-reducing device 17 is activated. The dimension of the communication channel therefore enables the pressure drop in the intermediate chamber 14 to be greater than the pressure drop in the internal chamber for a given duration during a tightness test, thereby improving the reliability of the test. Advantageously, the communication channel is dimensions such as

to generate a loss with a flow rate equal to or greater than the flow rate of the leak. By way of example, this communication channel can therefore have a diameter of between 0.1 mm and a few millimeters depending on the size of the leaks that can reasonably be expected in consideration of the sealing components being tested.

[0052] In another embodiment that is not shown, the peripheral partition 7 need not include an upper portion 8. In this case, the internal chamber 13 would be delimited by the portion 2 to be tested, the internal peripheral wall 9, and the cover 6. Furthermore, the intermediate chamber 14 would be limited by the membrane 1, the external seal 12, the external wall 10, the cover 6, the internal wall, and the internal seal 11.

[0053] In another embodiment that is not shown, a pressure regulator can be positioned in the communication channel 20. The pressure regulator can be a valve designed to ensure a pressure difference between the internal chamber 13 and the intermediate chamber 14. Indeed, for example, if the pressure P2 in the internal chamber 13 is to be greater than a pressure P1 in the intermediate chamber 14, the pressure regulator can be set to allow fluid communication between the internal chamber 13 and the intermediate chamber 14 until the pressure in the internal chamber 13 reaches the pressure P1, then to stop fluid communication once the value P1 has been reached. Indeed, since the pressure-reducing member 18 is connected to the intermediate chamber 14, said member can continue to reduce the pressure in the intermediate chamber 14 to a pressure less than the pressure P1.

[0054] In another embodiment that is not shown, the internal chamber 13 is not linked to the intermediate chamber by a communication channel 20. Indeed, the internal chamber 13 and the intermediate chamber 14 may be independent of one another, thereby enabling each one to be connected to the pressure-reducing device 17 independently.

[0055] As shown in figures 2 and 3, the box 5 has two handling handles 23 that are fastened to the peripheral partition 7 close to the cover 6. The two handling handles are positioned opposite one another to enable a user to grip the monitoring device 4 with both hands and to easily position the monitoring device on the portion 2 to be tested. For example, in [figure 3], the handling handles 23 are fastened using a bracket to the external peripheral wall 10. The handling handles 23 are oriented away from the peripheral seals 11, 12.

[0056] In the embodiment illustrated in figures 2 and 3, one of the handling handles 23 is fitted with a control member 24, in this case a pushbutton, that can be actuated by the hand of the user holding the handle 23 to generate a control signal 26. In this embodiment, the control member 24 is positioned directly on the handle 23. This control signal 26 is sent to

a control unit 28. The control unit 28 is configured to switch a controlled valve 27 on the pressure-reducing device in response to this control signal 26, to switch this valve 27 from an open state to a closed state and vice versa.

[0057] In the open state, the controlled valve 27 enables fluid communication of the internal chamber 13 and the intermediate chamber 14 with the pressure-reducing member 18. In the closed state, the controlled valve 27 isolates the internal chamber 13 and the intermediate chamber 14 from the pressure-reducing member 18.

[0058] Control members other than pushbuttons may be used as an alternative, for example capacitive touch buttons, a pivoting lever, or any other manually activated member.

[0059] In another embodiment shown in [figure 5], the monitoring device 4 has a first control member 24 that can be actuated manually to generate a first control signal 26, and the monitoring device 4 also has a second control member 25 that can be actuated manually to generate a second control signal 26. The control unit 28 is then configured to switch the controlled valve 27 to the open state in response to the first control signal 26 coming from the first control member 24, and to the closed state in response to the second control signal 26 coming from the second control member 25. Furthermore, in this embodiment, the control members 24, 25 are not positioned on the handling handle 23 but in the immediate vicinity thereof, so that said control members can be actuated by one hand of a user holding the handling handle 23.

[0060] The monitoring device 4 also has a plurality of lighting devices 22 that are shown in [figure 2] and that are positioned on the internal peripheral wall 9 to illuminate the internal chamber 13.

[0061] The monitoring device 4 also has a safety valve 29 shown in figures 2 and 3 that is connected to the intermediate chamber 14 and can be switched to a closed state when the pressure in the intermediate chamber 14 is equal to or greater than a pressure P_{min} , and to an open state when the pressure in the intermediate chamber 14 is less than the pressure P_{min} to link the intermediate chamber 14 with the outside. The safety valve 29 therefore prevents the formation of an excessive vacuum not required for monitoring in the intermediate chamber 14 or the internal chamber 13, thereby preventing any damage being caused to the monitoring device 4 or detachment of the membrane 1.

[0062] The first embodiment illustrated in figures 1 to 3 shows a monitoring device 4 for a flat testing zone. The internal and external peripheral seals 11, 12 have a sealing end 30 forming a loop about the entire internal chamber 13 that is designed to be positioned

against the portion 2 to be tested, such that the sealing end 30 is positioned in the plane P. The cover is formed parallel to the plane P. The box 5 of the monitoring device is a rectangular parallelepiped with no back wall, the back wall being formed by the portion 2 to be tested. This enables the monitoring device 4 to check the tightness of the flat zones of the tank.

[0063] The second embodiment illustrated in [figure 4] shows a monitoring device for an angled testing zone.

[0064] In this embodiment, the internal peripheral seal 11 and the external peripheral seal 12 have a sealing end 30 forming a loop about the entire internal chamber that is designed to be positioned against the sealing component. This sealing end 30 has a first portion 31 positioned in a first plane P1 and a second portion 32 linked to the first portion 31 and positioned in a second plane P2 that is inclined in relation to the first plane P1 by an angle matching the angle of the tank. Furthermore, the cover 6 is in this case formed in a plane inclined in relation to the first plane P1 and to the second plane P2. The box 5 of the monitoring device 4 in this embodiment is a prism with a quadrilateral base, one of the angles of which is the angle of the tank, in which two side walls are missing, the two side walls being formed by the angled portion 2 to be tested. Furthermore, in order to facilitate the positioning of the monitoring device 4 in the corner of the tank, one of the handles 23 is an inverted U-shape, while the other handle 23 is T-shaped.

[0065] A sealed and thermally insulating tank has a plurality of walls 33, 34, each of which is formed by at least one thermally insulating barrier and at least one sealing membrane. In a corner of a sealed and thermally insulating tank at the join between two walls 33, 34, a corner structure is positioned to guarantee the continuity of the thermally insulating barrier and of the sealing membrane of the two walls 33, 34. Such a corner structure is shown in [figure 6]. In the present invention, the tank walls 33, 34 have a secondary thermally insulating barrier 35, a secondary sealing membrane 1, which is the membrane to be tested, supported by the secondary thermally insulating barrier 35, a primary thermally insulating barrier 36 fastened to the secondary sealing membrane 1 and a primary sealing membrane (not shown) supported by the primary thermally insulating barrier 36.

[0066] The corner structure therefore has elements forming a portion of the secondary thermally insulating barrier 35, elements forming a portion of the secondary sealing membrane 1, and elements forming a portion of the primary thermally insulating barrier 36. Consequently, the corner structure helps to guarantee the continuity of the different thermally insulating barriers and sealing membranes at the join between a first tank wall

33 and a second tank wall 34 inclined in relation to the first tank wall 33 by a given angle, for example an angle of 90°.

[0067] The corner structure shown in [figure 6] is made up of the following:

- a row of secondary insulating panels 37 of the first wall 33 and a row of secondary insulating panels 37 of a second wall 34 that are fastened to the load-bearing structure (not shown),
- rigid sealed sheets 41 glued to the secondary insulating panels 37,
- flexible sealed sheets 42 making the join between two adjacent rigid sealed sheets 41, on the secondary insulating panels of a given wall or of different walls, as shown in [figure 5],
- a row of primary corner insulating panels 38 fastened to the rigid sealed sheets 41, the primary corner insulating panels 38 comprising a primary insulating block 39 of the first tank wall 33 and a primary insulating block 39 of the second tank wall 34 that are fastened together using an angle iron 40.

[0068] The risk of leak is greatest at the flexible sealed sheets 42, notably at the fold formed to follow the inclination between the first tank wall 33 and the second tank wall 34. For this reason, it is advantageous for the monitoring device 4 to be placed as close as possible to the angle of the corner structure. The monitoring device 4 is shown schematically in position in [figure 6].

[0069] In the gap between two adjacent secondary insulating panels 37 of a given tank wall, the two primary corner insulating blocks 38 are spaced apart from one another by a distance D in the direction of the tank edge formed by the intersection of the two tank walls 33, 34. The longitudinal dimension of the monitoring device 4 in the direction of the tank edge is advantageously less than this distance D. In the example embodiment, this distance D is 322 mm or 432 mm.

[0070] Furthermore, the flexible sealed sheet 42 positioned between two adjacent secondary insulating panels 37 of a given tank wall has a width L in the direction of the edge. In order to minimize the number of tests required, it is advantageous for the longitudinal direction of the monitoring device 4 in the direction of the tank edge to be greater than this width L, as shown in [figure 6]. In the example embodiment, the width L of the sheets 42 is 250 mm.

[0071] Although the invention has been described in relation to several specific embodiments, it is evidently in no way limited thereto and it includes all of the technical equivalents of the

means described and the combinations thereof where these fall within the scope of the invention.

[0072] Use of the verb "comprise" or "include", including when conjugated, does not exclude the presence of other elements or other steps in addition to those mentioned in a claim.

[0073] In the claims, reference signs between parentheses should not be understood to constitute a limitation to the claim.

Claims

[Claim 1] A device (4) for monitoring the tightness of a sealing component (1) for a fluid storage tank, in which the monitoring device (4) includes a box (5) comprising:

- a peripheral partition (7) having a peripheral wall (9) with a lower end fitted with a peripheral seal (11) designed to be positioned against the sealing component (1),
- a cover (6) made of a transparent material, the cover (6) being linked to the peripheral partition (7) such that the cover (6) and the peripheral wall (9) are able to define an internal chamber (13) with the sealing component (1), the peripheral seal (11) being arranged about the entire internal chamber (13), and in which the monitoring device (4) includes:
 - a handling handle (23) fastened to the box (5),
 - a control member (24) actuated manually to generate a control signal (25), the control member (24) being positioned on or in the immediate vicinity of the handling handle (23) to enable a user holding the handling handle (23) to actuate the control member,
 - a pressure-reducing device (17) that is connected to the internal chamber (13) and is designed to reduce the pressure in said internal chamber (13) using a pressure-reducing member (18), the pressure-reducing device (17) being provided with a controlled valve (27) that can be switched to an open state to link the internal chamber (13) to the pressure-reducing member (18), and to a closed state to isolate the internal chamber (13) from the pressure-reducing member (18),
 - a control unit (28) designed to switch the controlled valve (27) in response to the control signal (26).

[Claim 2] The monitoring device (4) as claimed in claim 1, in which the control unit (28) is configured to switch the controlled valve (27) alternately between the open state and the closed state in response to the control signal.

[Claim 3] The monitoring device (4) as claimed in claim 1, in which the control member is a first control member (24) that can be actuated manually to generate a first control signal, and the monitoring device also has a second control member (25) that can be actuated manually to generate a second control signal, the control unit (28) being configured to switch the controlled valve (27) to the open state in response to the first control signal and to the closed state in response to the second control signal.

[Claim 4] The monitoring device (4) as claimed in claim 3, in which the handling handle is a first handling handle (23), and the monitoring device (4) also has a second handling handle (23), the first handling handle and the second handling handle (23) being arranged on the perimeter of the box (5) opposite one another.

[Claim 5] The monitoring device (4) as claimed in one of claims 1 to 4, in which the peripheral wall is an internal peripheral wall (9) and the peripheral seal is an internal peripheral seal (11), the peripheral partition (7) having an external peripheral wall (10) arranged on the outside of the internal peripheral wall (9) such as to define an intermediate chamber (14) between the external peripheral wall (10) and the internal peripheral wall (9), the external peripheral wall having a lower end fitted with an external peripheral seal (12) that is designed to be positioned against the sealing component (1) about the entire internal peripheral seal (11), and in which the pressure-reducing device (17) is connected to the internal chamber (13) and to the intermediate chamber (14) and is designed to reduce the pressure in said internal chamber (13) and said intermediate chamber (14) using the pressure-reducing member (18), the pressure-reducing device (17) being provided with the controlled valve (27) that can be switched to an open state to link the internal chamber (13) and the intermediate chamber (14) to the pressure-reducing member (18), and to a closed state to isolate the internal chamber (13) and the intermediate chamber (14) from the pressure-reducing member (18).

[Claim 6] The monitoring device (4) as claimed in claim 5, in which the internal peripheral seal (11) and/or the external peripheral seal (12) have a sealing end (30) forming a loop about the entire internal chamber (13) that is designed to be positioned against the sealing component (1), the sealing end (30) about the entire internal chamber being positioned in a plane, and the cover being formed parallel to said plane such as to form the tightness monitoring device (4) for a flat zone.

[Claim 7] The monitoring device (4) as claimed in claim 5, in which the internal peripheral seal (11) and/or the external peripheral seal (12) have a sealing end (30) forming a loop about the entire internal chamber that is designed to be positioned against the sealing component (1), a first portion (31) of the sealing end being positioned in a first plane P1 and a second portion (32) of the sealing end being positioned in a second plane P2 that is inclined in relation to the first plane, and the cover being formed in a plane that is inclined in relation to the first plane and to the second plane such as to form the tightness monitoring device (4) for a corner zone.

- [Claim 8] The monitoring device (4) as claimed in claim 7, in which the longitudinal dimension of the monitoring device is between 290 mm and 432 mm, preferably 320 mm or 430 mm, the longitudinal dimension being intended to be parallel to a tank edge during use.
- [Claim 9] The monitoring device (4) as claimed in one of claims 1 to 8, in which the monitoring device (4) has at least one lighting device (22) fastened to the peripheral partition (7) and designed to illuminate the internal chamber (13).
- [Claim 10] The monitoring device (4) as claimed in one of claims 1 to 9 in combination with claim 5, in which the monitoring device (4) has an air discharge pipe (15) that is connected firstly to a pressure-reducing member (18) of the pressure-reducing device (17), and secondly to the intermediate chamber (14) such as to bring the pressure P1 in the intermediate chamber (14) below atmospheric pressure, the internal peripheral wall (9) having a communication channel (20) fluidly linking the internal chamber (13) and the intermediate chamber (14).
- [Claim 11] The monitoring device (4) as claimed in claim 10, in which the monitoring device (4) has a pressure regulator positioned on the communication channel (20), said pressure regulator being designed so that the internal chamber (13) is brought to a pressure P2 below atmospheric pressure and greater than the pressure P1 when the pressure-reducing device (17) is activated.
- [Claim 12] The monitoring device (4) as claimed in one of claims 1 to 11 in combination with claim 5, in which the monitoring device (4) has a safety valve (29) that is connected to the intermediate chamber (14) and can be switched to a closed state when the pressure in the intermediate chamber (14) is equal to or greater than a pressure Pmin, and to an open state when the pressure in the intermediate chamber (14) is less than the pressure Pmin to link the intermediate chamber (14) with the outside.
- [Claim 13] A monitoring method carried out using a tightness monitoring device (4) as claimed in any one of the preceding claims on a sealing component (1) of a fluid storage tank, in which the method comprises the following steps:
- applying water containing surfactants or injecting a colored gas respectively on or beneath a portion (2) to be tested of the sealing component (1),
 - placing the tightness monitoring device (4) on the portion (2) to be tested using the handling handle (23) so that the peripheral seal (11) is in contact with the portion (2) to be tested,
 - activating the control member (24) to reduce the pressure in the internal chamber

(13) using the pressure-reducing device (17),

- looking through the transparent cover (6) for the appearance of bubbles in the portion (2) to be tested or colored gas in the internal chamber (13) respectively.

[Claim 14] The monitoring method as claimed in claim 13, carried out using a tightness monitoring device (4) as claimed in claim 5, in which activation of the control member (24) also reduces the pressure in the intermediate chamber (14), and the intermediate chamber (14) is brought to a pressure P_1 below atmospheric pressure during the pressure reduction stage.

[Claim 15] The usage method as claimed in claim 14, in which the internal chamber (13) is brought to a pressure P_2 below atmospheric pressure and above the pressure P_1 during the pressure reduction stage.