Table 21DV.106.2.1.2
Accelerated aging conditions

Measured temperature[a] (C)	Test program	
	Rubber or neoprene	Thermoplastic
60	Air oven aging for 70 h at 100 ±2 C	7 days in an air-circulating oven at 87 C
75	Air oven aging for 168 h at 100 ±2 C	10 days in an air-circulating oven at 100 C
80	7 days in an air-circulating oven at 113 C	7 days in an air-circulating oven at 113 C
90	10 days in an air-circulating oven at 121 C	7 days at 121 C or 60 days at 97 C in an air-circulating oven
105	7 days in an air-circulating oven at 136 C	7 days in an air-circulating oven at 136 C

[a]The temperatures specified correspond to the maximum temperature measured on the gasket during the Heating test, Clause 11.

21DV.106.2.2 Foamed neoprene or rubber compounds forming gaskets to seal a fuel-confining part or an electrical enclosure are to be subjected to accelerated aging under the conditions specified in Table 21DV.106.2.1.2. The compounds shall not harden or otherwise deteriorate to a degree that will impair their sealing properties.

21DV.106.2.3 Thermoplastic materials forming gaskets to seal a fuel-confining part or electrical enclosure are to be subjected to accelerated aging under the conditions specified in Table 21DV.106.2.1.2 Thermoplastic material shall not deform or melt, or otherwise deteriorate to a degree that will impair its sealing properties. Solid polyvinyl-chloride gasket material shall have physical properties as specified in Table 21DV.106.2.1.1 before and after the accelerated aging.

21DV.106.2.4 Gaskets of materials other than those mentioned in 21DV.106.2.1 – 21DV.106.2.3 shall be made of material that does not absorb moisture and shall provide equivalent resistance to aging and temperatures.

21DV.106.3 Volume change

21DV.106.3.1 The volume change of a synthetic rubber gasket, seal, or part, shall be not more than 25 percent swelling or 1 percent shrinkage when tested in accordance with ASTM D471 REV A; except as specified in 21DV.106.3.2.

Exception: The swelling shall be not more than 40 percent for a gasket or seal tested in ASTM Reference Fuel C.

21DV.106.3.2 The tests using ASTM Reference Fuels C and H, n-hexane, and IRM 903 Oil are to be conducted at a temperature of 23 ±2 C . Three specimens are to be used in each test. Each specimen is to be placed on a small diameter wire hook. Its volume is then to be determined by weighing first in air (M1) and then in water (M2). The specimens are then to be wiped dry and placed in the test liquid. After 70 h, the specimens are to be removed from the liquid one at a time, immediately wiped dry, and weighed in air while on the same hook (M3). The weight is to be obtained within 30 s after removal from the test liquid. The final weight in water (M4) is to be determined immediately thereafter. Before obtaining the weights in water (M2 and M4), each specimen is to be dipped in ethyl alcohol, then dipped in water, in order to eliminate surface air bubbles. The change in volume is to be calculated

as follows, with the results reported as the average of the three specimens tested:

$$Volume\ Change\ (\%) = \frac{[(M_3 - M_4) - (M_1 - M_2)] \times 100}{(M_1 - M_2)}$$

21DV.106.4 Weight loss

21DV.106.4.1 The weight loss (extraction) of a synthetic rubber gasket, seal, or part, shall not be more than 10 percent when determined in accordance with ASTM D471-95, except as specified in 21DV.106.4.2.

21DV.106.4.2 The test is to be conducted at the same time and using the same specimens as for the volume change test described in 21DV.106.3.1 and 21DV.106.3.2. For this test, each specimen is to be weighed on a balance pan, in air, to the nearest milligram (M1) prior to immersion in the test liquid. After 70 h immersion, and following the weight determinations needed for the volume change calculation, the specimens are to be allowed to reach constant weight by conditioning in air at a temperature of 23 ±2 C for at least 70 h. The specimens are then to be weighed in air (M2). The loss in weight is to be calculated as follows, and the results reported as the average of the three specimens tested:

$$Weight\ Loss\ (\%) = \frac{(M_1 - M_2) \times 100}{M_1}$$

21DV.106.5 Gaskets and seals for metal fuel tank joints

21DV.106.5.1 In addition to complying with the requirements specified in 21DV.106.2.1 – 21DV.106.2.4, gaskets or sealing compounds used to prevent leakage through metal fuel tank joints and located below the intended fuel level in the tank or below the maximum fuel level in a sump shall also not leak after test when subjected to the tests specified in 21DV.106.5.2 – 21DV.106.5.6.

21DV.106.5.2 Three representative fuel tanks under test are to be placed in an air oven maintained at a temperature of 100 C for 168 h.

21DV.106.5.3 Three representative fuel tanks under test are to be filled with the intended fuel and placed in a room ambient of 23 ±2 C for 720 h.

21DV.106.5.4 Three representative fuel tanks under test are to be filled with a 50 percent water and 50 percent fuel mixture and placed in a room ambient of 23 ±2 C for 30 days.

21DV.106.5.5 Each representative fuel tank is to be subjected to an aerostatic leakage test before and after aging, fuel exposure, and fuel and water exposure and after the drop test described in 21DV.106.5.6. Each representative gravity tank shall withstand a pressure of 6.9 kPa for 1 min.

21DV.106.5.6 Each representative fuel tank that is intended to be removed for filling is then to be drop tested. The fuel tank is to be half filled with water and dropped 0.8 m, so that impact will be on the bottom of the tank. Each representative fuel tank is then to be subjected to the leakage test specified in 21DV.106.5.5.

21DV.107 During the tests, a flexible polymeric or elastomeric boot that covers a switch and that is flexed when the switch is operated is to be removed, and a part that can be opened or removed without the use of a tool is to be removed or placed in the most adverse position for the test being conducted.

Exception: A boot that is momentarily flexed and not held in the flexed position when the switch is operated and that meets the following conditions is not required to be removed:

a) The boot shall be mechanically secured by fastening means, such as screws;

b) The boot shall not be able to be removed by hand, or depend upon friction for securement; and

c) The boot shall comply with the Aging Test described in 21DV.106.2.

d) For portable equipment for use outdoors, but intended to be stored indoors, and marked in accordance with 7.1DV.1 and for stationary and fixed equipment intended for indoor installation and marked in accordance with 7.1DV.1, the boot shall be cold-conditioned at 0,0 +2,0°C for 3 h. For equipment not marked for storage in accordance with 7.1DV.1, the boot shall be cold-conditioned at –35,0 +2,0°C for 3 h. Immediately after the conditioning, and with the temperature maintained, the boot shall be hand-flexed, with gloves worn to inhibit heat transfer to the boot. The boot shall not harden or otherwise deteriorate to a degree that will impair its sealing properties.

21.101 Parts subjected to the **rated pressure** of the appliance shall be of sufficient mechanical strength.

Compliance is checked by the following tests in 21.101.1 and 21.101.2.

*21.101.1 The high pressure system is subjected to a static pressure test of two times the **rated pressure** for 5 min at room temperature.*

*The high pressure hose shall be subjected to a static pressure test of four times the **rated pressure** at room temperature, whereby the test pressure shall be reached between 15 and 30 s after starting at zero pressure.*

NOTE It will be necessary to render the pressure relief valve and/or alternative sensing device inoperative.

During this test there shall be no rupture.

21.101.2 A supply hose, if any, is subjected to a static pressure test of two times the maximum inlet pressure for 5 min at room temperature.

During this test there shall be no rupture.

21.101.3 A **low pressure accessory** is subjected to a static pressure test of two times the measured pressure in the system, when connected to the most severe high pressure cleaner it is intended to be used with, for 5 min at room temperature.

21.102 Pressure safety devices shall operate reliably.

Compliance is checked by the following test.

The pressure is increased to 110 % of the permissible pressure, or by 1,5 MPa for unheated appliances, and the device shall operate.

21.103 **Hand-held appliances**, hand-guided appliances and appliances carried on the operator's body in normal use and spray guns shall be resistant to dropping.

Compliance is checked by the following test.

The appliance and/or the spray gun is dropped from a height of 1 m onto a surface of hydraulically pressed concrete paving slabs.

The test is made five times, the appliance and/or spray gun being in a position such that its major axis is horizontal and so that a different part of the device is exposed to the impact each time.

The appliance or spray gun is then dropped five times, with its major axis vertical, and with the nozzle pointing downwards.

*After this test, the appliance or spray gun shall show no damage to such an extent that compliance with this standard is impaired; in particular, **live parts** shall not have become accessible.*

22 Construction

This clause of Part 1 is applicable except as follows.

22.7 Addition:

Any safety device shall be either inaccessible to the user or it shall be evident that the setting of the **safety valve** is sealed and there is no provision for rendering the device inoperative.

Cleaning agent ejected from the **safety valve** shall be directed safely.

22.7DV D2 ***Modification: add the following to Subclause 22.7 of the Part 1:***

Overpressure protection

22.7DV.1 A pressure-relief device which inhibits a pressure increase that occurs as a result of the closing of a trigger gun, or malfunction of a bypass or dump valve, shall be set and have a flow capacity such that pressure does not continue to increase after the discharge of the relief device.

Exception: A pressure-relief device is not required in an application when the construction of the appliance is such that it does not pose a potential risk of injury to users under abnormal pressure conditions. The integrity of the construction is to be determined by the test described in clause 21.

22.7DV.1.1 Compliance is checked by determining the start-to-discharge pressure described in 22.7DV.2. Each of three representative devices is to be subjected to a gradually increasing hydraulic pressure, and the pressure at which the device begins to open is to be recorded.

22.7DV.1.2 For a rupture-disc type relief device, these values shall be within 5 percent of each other and their average identified as the setting for the rupture-disc type relief device to be used. For a relief valve, the pressure setting of each representative device is considered to be the average of the three opening-pressure values obtained for that representative device. The three average values shall be within 10 percent of each other and their average identified as the start-to-discharge pressure setting for the relief valve to be used.

22.7DV.2 A pressure-relief device is considered to be a pressure-actuated valve or rupture member intended to relieve excessive pressures automatically. The start-to-discharge pressure settings of these devices shall be within 10 percent of each other when determined in accordance with clause 22.7DV.1.1. The manufacturer of the product pressure system shall calibrate 100 percent of relief devices.

Exception: Three rupture discs tested in accordance with 22.7DV.1.1, and subjected to the Burst disk overpressure protection test, Annex A, DVA.3.1.5, meet the intent of the requirement.

22.7DV.3 There shall be no shutoff valve between the pressure-relief means and the parts that it is intended to protect.

22.7DV.4 A pressure relief device shall be installed so that it is readily accessible for inspection and repair.

22.7DV.5 Compliance is checked by operating the relief device, such as during the hydrostatic pressure test.

22.7DV.6 A pressure-relief device having an adjustable setting is judged on the basis of the maximum setting unless the adjusting means is reliably sealed at a lower setting.

22.10DV D2 *Modification: add the following to Subclause 22.10 of the Part 1:*

A protective device that permits resetting or replacement by the user after it opens shall be accessible for inspection and repair.

22.12 Addition:

It shall not be possible to disconnect parts of the high pressure system without **tools** if this results in impairing the safety within the meaning of this standard.

22.14DV D2 *Modification: add the following to Subclause 22.14 of the Part 1:*

Whenever referee measurements are necessary to determine that a part such as an enclosure, a frame, a guard, a handle, or similar feature is not sufficiently sharp to constitute a risk of injury to persons, the method described in UL 1439 is to be employed.

22.17DV D2 *Modification: add the following to Subclause 22.17 of the Part 1:*

For a cord-connected or fixed product that is intended to be wall-mounted, means shall be provided to reduce the likelihood that an appliance is dislodged from the wall, regardless of whether the product is mounted directly or via brackets or other means.

Compliance is checked by inspection. To determine whether a product complies with the requirement, any part of the enclosure or barrier that can be removed without the use of tools to gain access to the hanging means is to be removed.

22.30DV D2 *Modification: add the following to Subclause 22.30 of the Part 1:*

Parts of class I construction which serve as part of the protective earthing arrangement shall be constructed or assembled such that during servicing they:

- **are unlikely to be disturbed; or**

- **are unlikely to be reassembled incorrectly if they are disturbed.**

22.35 Modification:

Delete the note.

Addition:

These parts are subject to the hammer test of Clause 21. If this insulation does not meet the requirement of 29.3, these are subject to the following impact test.

A sample of the covered part is conditioned at a temperature of 70 °C ± 2 °C for 7 days (168 h). After conditioning, the sample is allowed to attain approximately room temperature.

Inspection shall show that the covering has not shrunk to such an extent that the required insulation is no longer given or that the covering has not peeled off, so that it may move longitudinally.

After this, the sample is maintained for 4 h at a temperature of – 10 °C ± 2 °C.

While still at this temperature, the sample is then subjected to impact by means of the apparatus shown in Figure 102. The weight "A", having a mass of 0,3 kg, falls from a height of 350 mm onto the chisel "B" of hardened steel, the edge of which is placed on the sample.

One impact is applied to each place where the insulation is likely to be weak or damaged in normal use, the distance between the points of impact being at least 10 mm.

After this test, it shall show that the insulation has not peeled off and an electric strength test as specified in 16.3 is made between metal parts and metal foil wrapped round the insulation in the required area.

22.47 This clause of Part 1 is not applicable.

22.48 This clause of Part 1 is applicable except as follows:

Replace the existing text of the test by:

Compliance is checked by the relevant tests of IEC 61770, as modified in Annex AA of this standard.

22.48DV D2 *Modification: replace Clause 22.48 of the Parts 1 and 2 by the following:*

Backflow prevention

22.48DV.1 Appliances having provision for connection to a potable water supply shall be in compliance with Clause 22.48DV.2 or 22.48DV.3 as applicable.

22.48DV.2 Appliances incorporating a liquid storage tank which may be supplied from a potable water supply shall be in compliance with one of the following design types:

a) an air-gap shall be provided between the water inlet and the maximum water level in the storage tank. The height of the air-gap shall be at least three times the diameter of the water supply pipe to the tank and shall not be less than 25 mm. All appliances except those intended for stationary installation shall comply with the indicated test.

Compliance is checked by inspection and the following test. The air-gap required by 22.48DV.2(a) shall be maintained when the tank is filled to the maximum water level condition that may occur and the cleaning machine is

1) tilted up to 15° in any direction; and

2) tipped over and the air-gap is measured 60 s later.

b) a vacuum breaker in compliance with ASSE 1001 shall be provided; or

c) a backflow preventer, in compliance with ASSE 1019, ASSE 1052, or ASSE 1057 shall be provided.

22.48DV.3 Appliances not incorporating a liquid storage tank shall be marked as specified in 7DV.2 D2 or shall be in compliance with the above Clause 22.48DV.2.

22.101 Appliances shall have no opening less than 60 mm from the floor that could admit liquid to **live parts**.

Compliance is checked by measurement.

22.102 A drain hole for condensed water or spillage of any liquid shall have a diameter of not less than 5 mm or an area of not less than 30 mm, the width not being less than 3 mm.

Compliance is checked by measurement.

22.102DV D2 *Modification: add the following to Subclause 22.102 of the Part 2:*

An enclosure for electrical components shall have provision for drainage if the enclosure employs knockouts or unthreaded openings.

22.103 The appliance or the **trigger gun** shall be provided with a device for stopping the liquid flow to the nozzle. For hand-held washing devices, steam cleaners and **trigger guns** this device shall operate automatically without hydraulic pressure when its operating means is not actuated by the user.

The operating means of hand-held washing devices, steam cleaners and **trigger guns** shall have a device by means of which it can be locked when the device is in the non-operating condition.

Hand-held washing devices, steam cleaners and **trigger guns** shall not have any locking means in the operating condition.

The operating means shall be positioned so that there is no risk of inadvertent actuation when put down on a flat surface.

Water jetters shall not be operated by a valve lever that projects out from the apparatus in the off-position in such a way that accidental contact would cause inadvertent actuation.

Compliance is checked by inspection and the following test:

*The operating means of the **trigger gun** of a high pressure cleaner or of a hand-held washing device shall be locked in the non-operating condition. The pressure in the fluid system is adjusted to 2,5 MPa. The actuator of the operating means shall then be stressed for 1 min at room temperature with a force of 150 N, applied in the middle of the actuator in the normal direction of operation.*

During and after the test, there shall be no leakage of water. After the test, the locking device shall still be functional.

NOTE 101 Drainage of water from the nozzle is permissible during the test of the first requirement.

22.104 Appliances, except steam cleaners, provided with a fixed or adjustable **pencil jet nozzle** facility shall have a distance from the trigger to the nozzle greater than 750 mm.

Compliance is checked by measurement.

22.104DV D2 *Modification: add the following to Subclause 22.104 of the Part 2:*

22.104DV.1 A TYPE 2 CLEANING MACHINE shall be provided with a lance or wand having a trigger mechanism located at least 750 mm from the discharge nozzle.

22.104DV.2 If the lance or wand is of a type that can be detached from the trigger mechanism, a high pressure cleaner shall not be capable of discharging cleaning fluid at a discharge pressure greater than 690 kPa with the part removed.

22.104DV.3 A TYPE 3 CLEANING MACHINE shall comply with the requirements for a Type 2, except that the trigger mechanism on the lance or wand shall be located at least 1,22 m from the discharge nozzle.

22.104DV.4 Nonmetallic hose used to connect the lance to a TYPE 3 CLEANING MACHINE shall be shrouded by a protective device for a distance of at least 610 mm from the nearest grasping area of the lance. The shroud shall interrupt and disperse the fluid flow in the event of hose rupture so as to prevent operator injury.

22.105 Fitments on the high-pressure hoses shall only be accomplished by the manufacturer or his agent using specialist tools.

Water jetters shall have a clearly visible red marking around the high-pressure hose at a distance of 50 cm from the rigid part of the nozzle.

Compliance is checked by inspection and measurement.

22.106 Appliances and their parts shall not have uncontrolled movement to a hazardous degree when used in accordance with the manufacturers' instructions.

Portable appliances having a mass exceeding 100 kg shall have a parking brake or equivalent means.

Compliance is checked by inspection.

22.107 The component of the reaction force of the nozzle in the direction of the spray gun, F_r, shall be limited to 150 N.

F_r is calculated as follows:

$$W = \sqrt{(200 \times \Delta p)}$$

where

W is the water exit velocity, in m/s;

Δp is the rated pressure, in bar.

$$F = \frac{W \times Q}{60}$$

where

F is the reaction force in the direction of the nozzle, in newtons;

Q is the rated flow, in l/min.

$F_r = F \times \cos(\alpha)$

where

α is the angle between the nozzle and the spray lance, see Figure 103.

If the reaction force in the direction of the handle exceeds 150 N, the trigger gun shall be equipped with a support by which the reaction force is completely or partially transferred to the operator's body. Instead of a support, trigger guns can also be equipped with a two-hand activation mechanism that can only be operated when both operating elements are activated at the same time.

Considering the middle of the finger grip as a pivot point, the torque reaction T on the handle shall not be more than 20 Nm in any direction. T is calculated as follows:

$T = F \times l \times \sin(\alpha)$

where

l is the distance between nozzle and trigger, in m. See figure 103.

Compliance is checked by calculation and inspection.

22.108 The **trigger gun** and lance shall be provided with two handles. One of the handles could be a suitable shape of the spraying pipe.

Compliance is checked by inspection.

22.109 High pressure cleaners shall be fitted with a switch or contactor in their supply circuit that ensures **all-pole disconnection**.

22.109DV DR *Modification: add the following to Subclause 22.109 of the Part 2:*

A single-phase product rated 125 volts or less is permitted to be fitted with a single-pole, current-interrupting device located in the ungrounded conductor of the supply circuit.

22DV.110 D2 *Addition: add the following to Clause 22 of the Part 2:*

22DV.110.1 A product, if not assembled by the manufacturer as a unit, shall be arranged in major subassemblies. Incorporation of a subassembly into the final assembly shall not require alteration, cutting, drilling, threading, welding, or similar tasks by the installer. Two or more subassemblies that must bear a definite relationship to each other for the intended installation or operation of the product shall be arranged and constructed so that they may