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NATO PETROLEUM COMMITTEE (NPC)

PETROLEUM HANDLING EQUIPMENT WORKING GROUP (PHEWG)

STANAG 4604 DPP (EDITION 1) (STUDY DRAFT 4) - PERFORMANCE CRITERIA FOR COLLAPSIBLE HOSE ASSEMBLIES FOR FUEL TRANSFER

Note by the Staff Officer

Reference: EAPC(NPC-PHEWG)DS(2008)0001, paragraph 16

1. The attached Study Draft 4 of Edition 1 of STANAG 4604 has been prepared by the French Custodian on behalf of the AC/112 PHEWG in response to PHEWG request at reference.

2. Heads of Delegation are invited to review the document and to prepare for further discussion during the next PHEWG meeting. All comments should be send to the French Custodian, Lt. Col. S. Hilarait (sde2.dcsea@essence.interarmees.defense.gouv.fr)), copy Staff Officer (van-exem.philippe@hq.nato.int) not later than **Wednesday, 9 September 2009**.

(Signed) P. VAN EXEM

1 Enclosure

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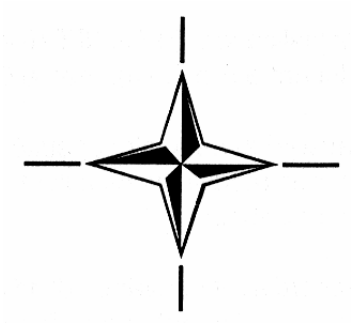
ENCLOSURE 1
EAPC(NPC-PHEWG)D(2009)0007

STANAG 4604
(Edition 1)
(Study Draft 4)

NORTH ATLANTIC TREATY ORGANIZATION
(NATO)



NATO STANDARDIZATION AGENCY
(NSA)

STANDARDIZATION AGREEMENT

(STANAG)

SUBJECT: PERFORMANCE CRITERIA FOR COLLAPSIBLE HOSE ASSEMBLIES FOR FUEL TRANSFER

Promulgated on

STANAG 4604
(Edition 1)
(Study Draft 4)

NATO STANDARDIZATION AGREEMENT (STANAG)

PERFORMANCE CRITERIA FOR COLLAPSIBLE HOSE ASSEMBLIES FOR FUEL TRANSFER

Annexes:
A. TEST OF FUEL STAGNATION IN HOSE ASSEMBLIES.

B. DETERMINATION OF THE COMPATIBILITY OF ELASTOMERS WITH LIQUIDS.

C. HYDROSTATIC TESTS: ELONGATION AND TWISTING OF HOSES AND HOSE ASSEMBLIES.

D. HYDROSTATIC TESTS: PROOF AND BURST PRESSURES OF HOSES AND HOSE ASSEMBLIES.

E. ABRASION TESTING OF HOSES AND HOSE ASSEMBLIES.

Related documents:

STANAG 1135 DPP –	INTERCHANGEABILITY OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS USED BY THE ARMED FORCES OF THE NORTH ATLANTIC TREATY NATIONS
STANAG 3149 DPP –	MINIMUM QUALITY SURVEILLANCE OF PETROLEUM PRODUCTS
STANAG 3682 DPP -	ELECTROSTATIC SAFETY CONNECTION PROCEDURES FOR AVIATION FUEL HANDLING AND LIQUID FUEL LOADING/UNLOADING OPERATIONS DURING GROUND TRANSFER AND AIRCRAFT FUELLING/DEFUELLING
STANAG 3756 DPP –	FACILITIES AND EQUIPMENT FOR RECEIPT AND DELIVERY OF LIQUID FUELS
STANAG 4605 DPP/AFLP-7 –	TACTICAL FUEL HANDLING EQUIPMENT (TFHE) TECHNICAL CHRACTERISTICS

STANAG 7029 SILCEP – CHARACTERISTICS OF AIRCRAFT FUELLING HOSES AND COUPLINGS

STANAG 7036 DPP – FUELS TO BE INTRODUCED INTO AND DELIVERED BY THE NATO PIPELINE SYSTEM (NPS)

REGULATIONS CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR) AND BY RAIL (RID)

ISO STANDARDS 8031 AND 8033

AIM

1. The aim of this agreement is to define the essential characteristics required of collapsible hose assemblies to be used for fuel distribution (handling) operations. In particular, these collapsible hose assemblies are especially well suited to use in theatres of operations and fit perfectly into tactical fuel handling equipment (TFHE) kits.

AGREEMENT

2. Participating nations agree to the collapsible hose assembly characteristics defined in this STANAG and undertake to implement them.

IMPLEMENTATION OF THE AGREEMENT

3. This STANAG is considered implemented when a nation has issued the necessary orders/instructions to its forces putting the specifications contained in this agreement into effect.

DEFINITION

5. **Liner** is the inner casing or envelope of a hose.

6. **Cover** is the outer casing or envelope of a hose.

7. **Reinforcement** is the element designed to confer mechanical characteristics on a hose when the latter is subjected to operational stresses.

8. **Hose** is the assembly comprising the liner, reinforcement and cover, exclusive of the fittings.

9. **Collapsible hose assembly** is the assembly made up of a hose plus fittings, the hose itself being composed of a reinforcement, liner and cover. It assumes a tubular shape only when under pressure but remains flat when empty of liquid.

10. **Fitting** is the part used to connect a hose to a facility or piece of equipment.

QUALITIES REQUIRED

11. No specific manufacturing process is mandatory for collapsible hose assemblies. The following characteristics are required:

a. Good performance of the liner and cover when in contact with fuel.

b. Good resistance of the cover to atmospheric conditions.

c. Good resistance to low temperature.

d. Full lengths achievable without the use of couplings.

e. Retention of the properties of the fuels in the hose (no degradation, even after a long period).

f. Electrostatic conductivity guaranteed.

g. Light and easy to use.

h. Interoperability of fittings.

i. Compliance with regulations (e.g. the ADR in Europe).

DESCRIPTION

12. **Constituent materials.** Provided the minimum requirements in the previous paragraph are met, the constituent materials remain the responsibility of the manufacturer. The specifications in draft standard PR EN 1924, 2003 Edition, are recommended.

13. **Identification.**

The following identification markings shall be affixed by the manufacturer:

a. Indelible marking of the cover every 10 metres.

b. Manufacturer's mark and supplier's reference number.

c. Maximum working pressure.

d. Date of manufacture.

e. Stamp on fittings.

f. Year of initial testing.

14. **Colour.** Exterior colour must be close to NATO IR green GAM C 25x4 or one of the camouflage colours used on soldiers' clothing and on equipment.

15. **Fittings (connectors).**

a. Collapsible hose assemblies shall preferably be equipped with aluminium alloy fittings. The type of hose clips shall be decided by the manufacturer. 40 mm and 65 mm (nominal diameter) hoses may be fitted with the following fittings:

(1) either half-symmetrical

(2) or male/female kamlok type.

b. Hoses larger than 80 mm in nominal diameter shall be equipped with the following fittings:

(1) either half-symmetrical

(2) or threaded (male/female coarse knuckle thread)

(3) or male/female kamlok type.

Irrespective of the type of fittings cited above, nations ratifying this STANAG undertake to provide for the interconnection of equipment in accordance with the provisions of STANAG 3756, by providing adaptors, if required.

16. **Electrical continuity.** For safety reasons, collapsible hose assemblies must have an electrical resistance ≤ 10^6 Ω/m.

TECHNICAL CHARACTERISTICS

17. The table below shows the primary characteristics of collapsible hose assemblies fit for supply (non-exhaustive list).

Nominal Ø, in mm	Maximum weight per m, in kg	Working pressure, in bar		PE (2) in bar	MBP (3) in bar	Unit length, in m
		Normal	MWP (1)			
40	0.4	10	17	26	30	10, 20, and 30
65	0.7	10	17	26	30	20, and 30
80	1	10	17	26	30	20, 30, 100
100	1.3	10	15	23	30	20 , 30, 100
155	1.8	8	10	15	30	20, 40

1 MWP: Maximum working pressure
2 PP: Proof pressure
3 MBP: Minimum burst pressure

Note: Maximum elongation of the collapsible hose assembly at maximum working pressure must be less than 5% of the total length of the collapsible hose assembly.

CONCEPT OF USE

18. Following concept is applicable:

POL products in hose	All fuels indicated in STANAGs 1135 and/or 7036
Usable temperature range	from –20°C to +50°C
Sectioning – Reparability by cutting into sections	Sectioning is permitted, provided there is no degradation of initial hose performance

LABORATORY QUALIFICATION TESTING OF COLLAPSIBLE HOSE ASSEMBLIES

19. In order to guarantee the quality of the collapsible hose assemblies, before or during procurement, two series of tests shall be carried out to verify conformity with these requirements. These tests shall be performed on representative samples by a certified laboratory (certified according to national procedures).

20. The following collapsible hose assembly samples may be used:

a. Three 65 mm (nominal diameter) test specimens, 1 m in length, equipped with half-symmetrical or male/female kamlock couplings.

b. One 65 mm (nominal diameter) test specimen, 1 m in length, without couplings.

TEST DEFINITION

21. Following mechanical and hydraulic testing is required:

a. Elongation testing.

b. Angle of twist.

c. Pressure testing.

d. Burst testing.

e. Abrasion testing.

f. Measurement of electrical continuity, in accordance with ISO 8031 or equivalent.

PHYSICAL/CHEMICAL TESTS

22. Following mandatory testing is required:

a. Stagnation test.

b. Cover/liner adhesion test, in accordance with ISO 8033. This test is only significant when the test piece can be correctly prepared, by initiation of a clear separation between the cover and the reinforcement. If initiation of separation cannot be achieved or leads to inconsistent results, the test shall be deemed insignificant, and adhesion shall then be deemed to be compliant. If application of the test is possible, the adhesion value measured in accordance with ISO 8033 shall be noted.

23. Optional testing. This testing shall be carried out only at a nation's request. Following testing will be required:

a. Measurement of the variation in mass, volume, international rubber hardness degree (IRHD), Shore hardness and gum rate of the cover and liner after immersion in an isooctane/toluene mixture (70/30) for 72 hours at 40°C, by the LSEA T 23 method or equivalent.

24. Summary table of the proposed tests. The methods of tests listed at Annexes A to E provide guidance to nations. Equivalent tests, chosen or developed by nations can be used.

No.	**Designation**	**Method presented in annex**	**Limit value**	**Equivalent test method**
Mechanical and hydraulic tests				
1	Elongation at 10 bar (%)	T25	< 4 %	
2	Angle of twist at 10 bar	T25	< 25 %	
3	Pressure testing at 15 bar (10 minutes)	T26	No permanent deformation or structural change. Complete leaktightness.	ASTM D 380

No.	Designation	Method presented in annex	Limit value	Equivalent test method
4	Burst testing at 30 bar	T26	No permanent deformation or structural change. Complete leaktightness.	ASTM D 380
5	Abrasion	T28	No leakage, no sign of rupture, and no reinforcement visible	

Physical/chemical tests				
Mandatory tests				
6	Stagnation mg/cm^2	T 17	< 1 mg/cm^2	
7	Adhesion kN/m - without prior immersion - with immersion - immersion for 7 days at 40°C ±2°C in 70/30 isooctane/toluene mixture - immersion for 14 days at 70°C ±2°C in water	ISO 8033	To be noted To be noted To be noted To be noted	ISO 8033

No.	Designation	Method presented in annex	Limit value	Equivalent test method
Optional tests				
8	- Variation in weight of cover	T 23	< 20 %	
	- Variation in weight of liner	T 23	< 20 %	
	- Variation in volume of liner	T 23	< 50 %	
	- Variation in volume of cover	T 23	< 50 %	
	- Variation in hardness (IRHD) of liner	T 23	< 15 points	
	- Variation in hardness (IRHD) of cover	T 23	< 15 points	
	- Variation in Shore hardness of liner	T 23	< 15 points	
	- Variation in Shore hardness of cover	T 23	< 15 points	
	- Variation in gum rate of liner	T 23	< 1mg/ cm^2	
	- Variation in gum rate of cover	T 23	< 1mg/ cm^2	

ACCEPTANCE TESTING

25. Prior to delivery of the collapsible hose assemblies by the manufacturer, the following tests shall be conducted at the supplier's plant on a representative sample of the lot (1/10):

a. Dimensional check and conformity with the specifications.

b. Proof pressure testing for 10 minutes to search for leaks/deformation, for all lengths of hose.

c. After six successive pressure tests at PP, check electrical continuity, which must meet the requirements of section 6.5 (10^6 Ω/m).

d. Check marking (cf. section 6.2).

e. Check fittings (cf. section 6.4)

Annex A TO STANAG 4604
(Edition 1)
(Study Draft 4)

TEST METHOD

TEST OF FUEL STAGNATION IN HOSE ASSEMBLIES

First edition

UNRESTRICTED CIRCULATION

REPRODUCTION AUTHORIZED

CONTENTS

This method draws on the fuel contamination test in specification BSI 3158:1985

1. PURPOSE AND SCOPE

The purpose of this method is to evaluate the gum rate of fuel that has been sitting in a hose.

2. PRINCIPLE

On contact with fuel, the inner wall of a hose releases gums, the rate of which is linked to the nature of the materials making up the liner wall. The gums are revealed after evaporation of the fuel.

3. APPARATUS AND PRODUCT

3.1. Apparatus

- metal plugs for each diameter of hose,
- a two-litre test tube, graduated at 20 ml intervals, with a pouring lip,
- an evaporation bath in accordance with standard NF M 07-004,
- a 50 ml pipette,
- a chemical balance accurate to 0.1 mg,
- a desiccator.

3.2. Test product

The test fuel is a mixture of 70% isooctane and 30% toluene as defined by standard NF T 46-013.

N.B.: The test fuel described above is considered the standard fuel; other fuels can be employed according to the use of the hoses.

3.3. Test pieces

Two hose test pieces 400 mm in length, without connectors, must be supplied for each diameter, one of which can be used for the check test.

4. METHOD

4.1. Rinsing

- Plug one end of the hose.
- Fill the hose to two-thirds of its capacity with the test fuel.
- Plug the other end.
- Agitate for one minute.
- Empty the contents, taking care to allow the liquid to drain out properly.

4.2. Test proper

- Fill the hose with fuel to 50% of its capacity.
- Note the volume of product used (V) and the surface area (S) in contact with the product.
- Keep the hose upright for 72 hours at 22°C ± 3°C.
- Filter the test fuel through Whatman No. 1 blue band filter paper and note any change in the colour of the fuel.
- To determine the gum rate, use the apparatus described in standard NF M 07-004:
    * bath temperature: 280°C
    * air pressure: 0.5 bar.
- Determine:
    * the mass M_1 of gums contained in 50 ml of fuel after the test,
    * the mass M_0 of gums contained in 50 ml of control fuel.

5. EXPRESSION OF THE RESULTS

Calculate as follows, in milligrams per cm^3, the increase in the gum content of the fuel after testing:

$$T = \frac{M_1 - M_0}{50} \times \frac{V}{S}$$

where
V = volume of product used, in ml,
S = contact area, in cm^2,
M_0 = mass of gums in the control fuel, in mg,
M_1 = mass of gums in the test fuel, in mg.

Annex B TO STANAG 4604
(Edition 1)
(Study Draft 4)

TEST METHOD

DETERMINATION OF THE COMPATIBILITY OF ELASTOMERS WITH LIQUIDS

First edition

UNRESTRICTED CIRCULATION

CONTENTS

1. PURPOSE AND SCOPE

This method draws on standard NF T 46-013 "Determination of the action of liquids". The purpose of this method is to establish procedures for evaluating the compatibility of non-aged or aged vulcanized rubbers or similar elastomers with fuels, solvents and mineral and synthetic oils by measurement of their characteristics before and after immersion in the test liquid. The procedures described in the method concern determination of the following:

- Variation in volume and mass after immersion;
- Variation in hardness (IRHD) after immersion;
- Shore hardness
- Increase in the residue content of the fuels and solvents after immersion.

2. PRINCIPLE

The test consists in putting aged on non-aged rubber test pieces in contact with the test liquid for a period and at a temperature dictated by particular rules (specifications, etc.) and in then determining the variation in their volume, mass and hardness. When the nature of the test liquid (fuel or solvent) permits, the increase in the liquid's residue content is determined by evaporation.

3. APPARATUS AND PRODUCTS

3.1 Apparatus

- A ground-necked flask of sufficient dimensions to contain the test liquid;
- A reflux condenser;
- A water-bath;
- An evaporation bath in accordance with standard NF EN 26246;
- A chemical balance accurate to 0.1 mg.
- A desiccator with silica gel;
- A vacuum drier;
- A microhardness tester allowing determination of the international rubber hardness degree (IHRD) in accordance with the microtest in standard NF T 46-003;
- A Shore hardness tester;
- Whatman No. 1 blue band filter paper.

3.2 Products

- Immersion liquid according to request;
- 4 test pieces of the elastomer under test, between 1 and 3 cm^3 in volume and with a uniform thickness of 2 mm ± 0.2 mm whenever possible. When this is not possible the form of the elastomer under test will determine the dimensions of the test piece;
- Distilled water;
- Isooctane;
- Toluene;
- Petroleum ether;
- EXTRAN cleaning fluid;
- Liquid detergent (e.g. XS-78).

4. METHOD

4.1 Preparation of the test

- Clean 4 test pieces with the immersion product and dry them for 15 minutes at 70 ± 5°C. *(If the immersion product is oil, this stage is not performed.)*
  - 3 pieces will be used for the test;
  - 1 piece will be used as a reference for evaluation of the variation in mass during drying.

- Measure the initial hardness (IRHD) of the following two test pieces:
  Hardness D_{I0} for the reference test piece,
  Hardness D_0 for test piece no. 1.

  Note 1*: If the dimensions of the test pieces make it impossible to measure the IRHD, determine the Shore hardness whenever possible.*

- Weigh, to within 1 mg, the four test pieces in air
  mass $\mathbf{m_{I0}}$ for the reference test piece,
  mass $\mathbf{m_0}$ for each of the test pieces;

- Weigh, to within 1 mg, the 3 test pieces in distilled water, at laboratory temperature (mass $\mathbf{m_1}$).

  Note 2: *Take care to eliminate air bubbles during immersion.*

- Dry the test pieces with lint-free filter paper.

- Fill the flask with 150 ml ± 10 ml of immersion product.

- Immerse the 3 test pieces in the liquid and arrange them so that they are properly separated from one another in the flask.

- Place a reference sample (the same volume) of the immersion liquid under the same conditions; this will be tested for residue content at the end of the test.

4.2. Immersion test

- Switch on the thermostatic water-bath.

- Adjust the temperature according to the specifications (normally 50°C for tests using the isooctane/toluene mixture).

- Regulate the inlet water (water + anti-freeze) temperature of the condenser to 0°C ±10°C.

- When the water-bath is at the correct temperature:

- Place the flask containing the immersion liquid and the three test pieces in the water-bath;

- Fit the condenser to the immersion flask if necessary;

- Start counting the test time as soon as the condenser is in place.

Note 3: *- Rubber test pieces must be shielded from light during the test.*

- In a given flask, place only test pieces of the same rubber that have undergone the same treatment.

- At the end of the immersion period required (normally 70 ± 1 hours):

- Switch off the water-bath and remove the immersion flask from it;

- Allow the flask to return to ambient temperature;

- Determine the residual volume of immersion liquid;

- Remove the test pieces from the liquid, wipe them with filter paper to remove immersion product from their surface and carry out the post-test measurements immediately.

Note 4: *In the case of oils or viscous products, dip them in petroleum ether and wipe them quickly.*

4.3. Evaluation of the state of the test pieces after the immersion test

4.3.1 Variation in volume and hardness immediately after the end of immersion

- Weigh, to within 1 mg, the 3 test pieces in air (mass $\mathbf{m_2}$).

- Weigh, to within 1 mg, the 3 test pieces in distilled water, at laboratory temperature (mass $\mathbf{m_3}$).

Note 5: *Take care to eliminate air bubbles from the test piece during immersion.*

- Dry the test pieces with lint-free filter paper.

- For each test piece, calculate the variation in volume, as a percentage, by means of the following formula:

$$V\% = \frac{(m_2-m_3) - (m_0-m_1)}{(m_0 - m_1)} \times 100$$

where:

- $\mathbf{m_0}$ is the initial mass of the test piece in air;
- $\mathbf{m_1}$ is the initial apparent mass of the test piece in water;
- $\mathbf{m_2}$ is the mass of the test piece in air after immersion in the test liquid;
- $\mathbf{m_3}$ is the apparent mass of the test piece in water after immersion in the test liquid;

- Calculate the mean of the variations in volume of the 3 test pieces (V_m%).

- Measure the hardness (IRHD) of test piece no. 1 (D_1).

***Note 6**: If the dimensions of the test pieces make it impossible to measure the IRHD, determine the Shore hardness.*

- Calculate the variation in hardness, $\mathbf{d_1 - d_0}$ of test piece no. 1,

where:
- $\mathbf{d_0}$ is the hardness of the test piece before immersion,
- $\mathbf{d_1}$ is the hardness of the test piece immediately after immersion.

4.3.2 Variation in volume and hardness after 24 hours' drying after the end of immersion

- Place the 3 test pieces and the reference test piece in a vacuum drier at a pressure of 30 to 40 kPa and a temperature of 85°C ± 5°C for 24 hours. For test liquids with low volatility, place the test pieces between two filter papers and continue drying until a constant mass is obtained.

- Allow the test pieces to return to ambient temperature.

- Weigh, to within 1 mg, the four test pieces in air
  mass $\mathbf{m_{r1}}$ for the reference test piece,
  mass $\mathbf{m_4}$ for each of the test pieces.

- For each test piece, calculate the variation in mass, as a percentage, by means of the following formula:

$$M\% = \frac{(m_4 - m_0)}{m_0} \times 100$$

where:
- $\mathbf{m_0}$ is the initial mass of the test piece in air;
- $\mathbf{m_4}$ is the mass of the test piece in air after immersion in the test liquid and vacuum-drying.

- Calculate the mean of the variations in mass of the 3 test pieces ($\mathbf{M_m}$%).

- Calculate the effect of drying, as a percentage, on the mass of the test piece by means of the following formula:

$$M_r\% = \frac{(m_{r1} - m_{r0})}{m_{r0}} \times 100$$

where:
- $\mathbf{m_{r0}}$ is the mass of the reference test piece before drying;
- $\mathbf{m_{r1}}$ is the mass of the reference test piece after drying.

***Note 7:** Calculation of $\boldsymbol{M_r}$ allows the variation in mass due to drying to be evaluated and possibly taken into account in interpretation of the variation in the mass **M**.*

- Measure the hardness (IRHD) after drying of the following two test pieces:
  Hardness $\mathbf{d_{r1}}$ for the reference test piece,
  Hardness $\mathbf{d_2}$ for test piece no. 1.

***Note 8**: If the dimensions of the test pieces make it impossible to measure the IRHD, determine the Shore hardness.*

- Calculate the variation in hardness, $\mathbf{d_{r1} - d_{r0}}$, of the reference test piece.

  where:
  - $\mathbf{d_{r0}}$ is the hardness of the reference test piece before drying,
  - $\mathbf{d_{r1}}$ is the hardness of the reference test piece after drying.

- Calculate the variation in hardness, $\mathbf{d_2 - d_0}$ of test piece no. 1.

  where:
  - $\mathbf{d_0}$ is the hardness of the test piece before immersion,
  - $\mathbf{d_2}$ is the hardness of the test piece after 24 hours' drying after the end of immersion.

4.4. Evaluation of the contamination of the liquid after the immersion test

4.4.1 – Cleaning of the evaporation beakers

- Wash the beakers with hot Extran.
- Rinse them with water.
- Dip the beakers in a c.10% hydrochloric acid solution.
- Rinse them with water.
- Allow them to drain on absorbent paper.
- Store the clean beakers in the dryer at 180° C.

N.B.: The cleaning cycle should be repeated if traces remain.

4.4.2 – Initial weighing of the evaporation beaker

- On removal from the dryer, the beaker should be placed in a desiccator with a desiccating agent for at least 2 hours.
- Weigh the evaporation beaker (not in a draught, keeping the time the desiccator is open to a minimum). The mass to be taken into account is the one displayed as soon as the balance's stabilization indicator goes out.

4.4.3 - Evaporation of the immersion product

- Switch on the evaporation bath (temperature 280°C ± 10°C).
- Filter the immersion product using Whatman No. 1 blue band filter paper.
- Pipette 50 ml of immersion product into the evaporation beaker.
- Place the beaker containing the liquid in the evaporator.
- Position the air diffusion nozzle and adjust the pressure to 0.6 ± 0.2 bar.
- Evaporate for at least 2 hours. Evaporation is complete when there is no liquid or oily residue left in the beaker.
- After evaporation, place the beaker in the desiccator.

***Note 9:** Determine the residue content of the reference immersion liquid.*

***Note 10:** Determine the effect of evaporation on an empty reference beaker.*

4.4.4 – Weighing of the beaker after the evaporation test

- Keep the beaker in the desiccator for at least 2 hours.
- Weigh the evaporation beaker (not in a draught, keeping the time the desiccator is open to a minimum). The mass to be taken into account is the one displayed as soon as the balance's stabilization indicator goes out.

4.4.5 - Determination of the gum content

4.4.5.1 – Calculation of the total residue mass, $\mathbf{MR_1}$, in the product after the immersion test

$$\mathbf{MR_1 = ((me_1 - me_0) - (mv_1 - mv_0)) * Ve_1/50}$$

where: $\mathbf{me_1}$ = mass of the beaker after evaporation of 50 ml of test liquid after immersion, in mg,
$\mathbf{me_0}$ = mass of the empty beaker, in mg,
$\mathbf{mv_1}$ = mass of the empty reference beaker after evaporation, in mg,
$\mathbf{mv_0}$ = mass of the empty reference beaker before evaporation, in mg,
$\mathbf{Ve_1}$ = residual volume of immersion liquid after the test, in ml.

4.4.5.2 – Calculation of the total residue mass, $\mathbf{MT_1}$, in the reference product

$$\mathbf{MR_1 = ((me_1 - me_0) - (mv_1 - mv_0)) * Ve_1/50}$$

where: $\mathbf{mt_1}$ = mass of the beaker after evaporation of 50 ml of test liquid, in mg,
$\mathbf{mt_0}$ = mass of the empty beaker, in mg,
$\mathbf{mv_1}$ = mass of the empty reference beaker after evaporation, in mg,
$\mathbf{mv_0}$ = mass of the empty reference beaker before evaporation, in mg,
$\mathbf{Vt_1}$ = residual volume of reference liquid after the test, in ml.

4.4.5.3 – Calculation of the increase in residue mass, **MR**, in the immersion liquid

$$\mathbf{MR = MR_1 - MT_1}$$

4.4.5.4 - Determination of the increase in the gum content

- Determine, in cm^2, the immersed surface area $\mathbf{S_0}$ of the test pieces.

- The gum content is equal to the increase in residue mass of the immersion liquid per unit of surface area, expressed in cm^2 ($\mathbf{MR/S_0}$).

5. EXPRESSION OF THE RESULTS

On the test sheet, mention:

- the reference of the test method,
- the reference of the sample,
- the nature of the immersion liquid,
- the test conditions,
- the variation in volume of each test piece,
- the mean of the variations in volume of the test pieces,
- the variation in the mass of each test piece,
- the mean of the variations in mass of the test pieces,
- the variation in the mass of the reference test piece (the effect of drying),
- the variation in the hardness of the reference test piece (the effect of drying),
- the variation in the hardness of the test piece immediately after immersion,
- the variation in the hardness of the test piece after immersion and drying for 24 hours,
- and, if so requested,:
    - the increase in the gum content of the liquid.

Annex C TO STANAG 4604
(Edition 1)
(Study Draft 4)

TEST METHOD

HYDROSTATIC TESTS: ELONGATION AND TWISTING OF HOSES AND HOSE ASSEMBLIES

First edition

UNRESTRICTED CIRCULATION

CONTENTS

1. Purpose and scope

This method draws on standard NF S 61-112 "Firefighting equipment: collapsible discharge hoses of diameters 25, 36.5, 45, 70 and 110 mm" and ISO 1402 "Rubber and plastics hoses and hose assemblies – Hydrostatic testing". The purpose of this method is to define procedures for evaluating the elongation and twisting of hoses under stress.

The tests described in this method are applicable to all hoses and hose assemblies.

2. Principle

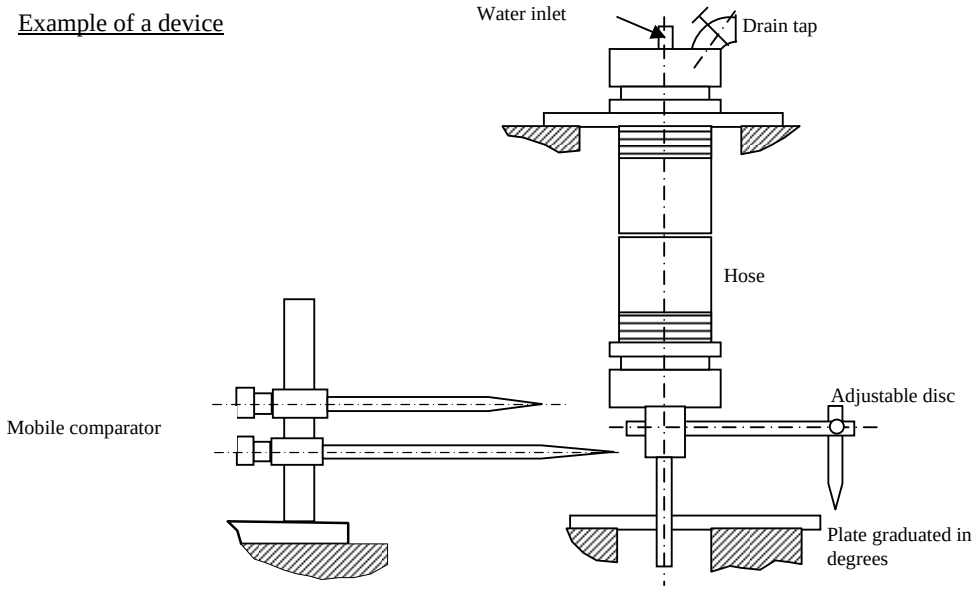
The elongation and twisting test consists in applying a stress to the hose (by filling it with water at a given pressure) and measuring the variation in length and twist caused by that stress.

3. Apparatus and equipment

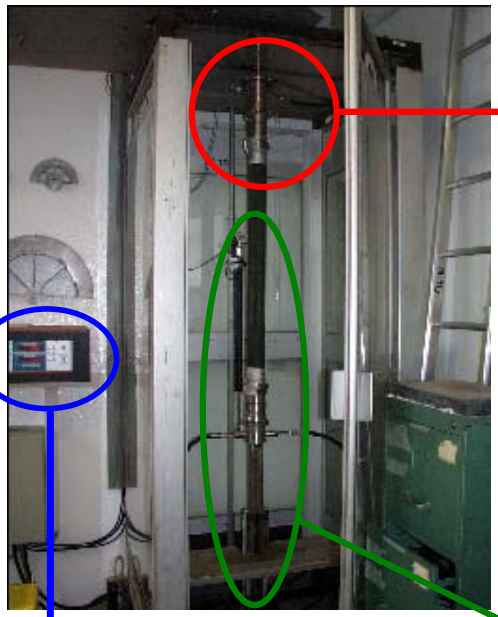
3.1. Apparatus

- a device for keeping the test piece in a vertical position
- a device for measuring elongation (e.g. a mobile comparator)
- a device for measuring twist angle
- a device for putting the hose under pressure (pump). Water is used to fill the hose.

Example of a device



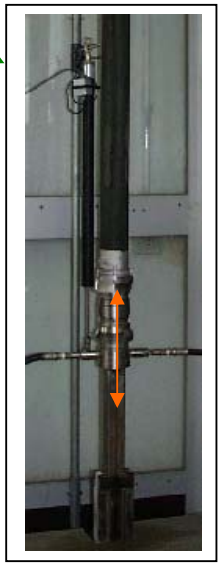
Another example: apparatus with automatic measuring equipment.



Torsion sensor

Digital display:

- Angle measurement (degrees)
- Elongation (cm)
- Pressure (bar)



Elongation sensor

3.2. **Equipment**

Test pieces:

- 1 test piece fitted with two quarter-turn connectors defined by the reference specification (by default, GUILLEMIN symmetrical quarter-turn connectors as defined by standard NF E 29-572 shall be used), 1 m in length (see photo below).

4. Testing

4.1. Preparation of the test

- Ensure that the test piece conforms to the specifications (as regards length and connectors)
- Install the test piece on the apparatus or test rig.
- Position the measuring devices (reset automatic devices, position comparators, etc.).

4.2. Test

- Pressurizing of the test piece: fill the test piece with water until the working pressure laid down in the reference specification is reached (in the absence of a reference specification, pressurize to 10 bar).
- Maintain that pressure for the specified period (two minutes if not specified).

4.3. Results

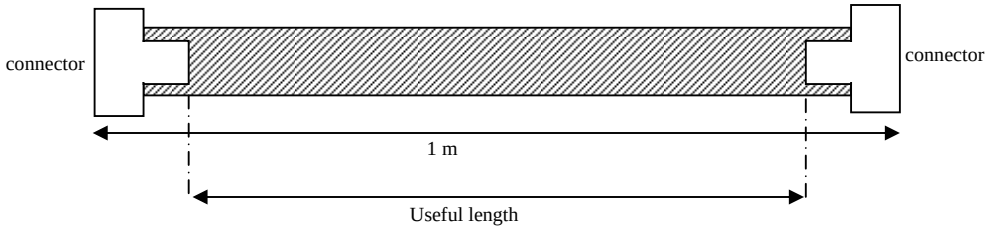
4.3.1. Elongation

- Measure the elongation observed in the test piece. The elongation will be indicated either by a display read-out in the case of an automatic device, or by reading the comparator.

The variation shall be expressed as a percentage:

$$\% \text{ elongation} = \frac{Elongation}{Useful\ length} \times 100$$

The useful length of the hose is the length excluding the connectors.



4.3.2. Twist

- Read the twist angle from the measuring device (in degrees).

4.3.3. Expression of the results

On the test sheet, mention:

- the reference of the test method,
- the reference of the sample,
- the test conditions,
- the elongation (%) of the hose under stress,
- the twist under stress.

Annex D TO STANAG 4604
(Edition 1)
(Study Draft 4)

TEST METHOD

HYDROSTATIC TESTS: PROOF AND BURST PRESSURES OF HOSES AND HOSE ASSEMBLIES

First edition

UNRESTRICTED CIRCULATION

CONTENTS

1. Purpose and scope

This method draws on standard NF S 61-112 "Firefighting equipment: collapsible discharge hoses of diameters 25, 36.5, 45, 70 and 110 mm" and ISO 1402 "Rubber and plastics hoses and hose assemblies – Hydrostatic testing". The purpose of this method is to define procedures for evaluating the resistance of hoses to proof and burst pressures.

The tests described in this method are applicable to all hoses and hose assemblies.

2. Principle

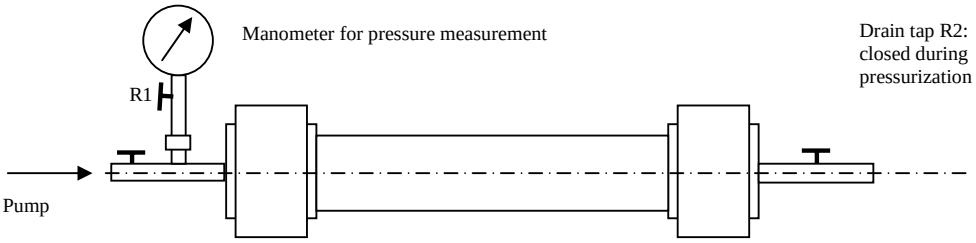
The hydrostatic proof pressure and burst pressure test consists in applying a stress to the hose (by filling it with water at a given pressure) and verifying that the hose withstands that pressure without deterioration.

3. Apparatus and equipment

3.1. Apparatus

- A rig for subjecting the test piece to a given pressure.
- A device for putting the hose under pressure (pump). Water is used to fill the hose.

Example of a rig (cf NF S 61-112).



3.2. Equipment

Test pieces:

- 1 test piece fitted with two quarter-turn connectors defined by the reference specification (by default, GUILLEMIN symmetrical quarter-turn connectors as defined by standard NF E 29-572 shall be used), 1 m in length (see photo below).

4. Testing

4.1. Preparation of the test

- Ensure that the test piece conforms to the specifications (as regards length and connectors)
- Install the test piece on the apparatus or test rig.

4.2. Proof pressure testing

- Pressurizing of the test piece: fill the test piece with water until the working pressure laid down in the reference specification is reached (in the absence of a reference specification, pressurize to 15 bar). That pressure must be established within a time laid down by the reference specification or in 15 seconds if no time is laid down by the specification.
- Maintain that pressure for the specified period (ten minutes if not specified).
- Inspect the state of the hose visually (see 4.4).

4.3. Burst pressure testing

This test is carried out immediately after proof pressure testing.

- Gradually increase the pressure for a specified time (default 15 s) until the burst pressure laid down by the specification is reached (default 30 bar if the burst pressure is not otherwise specified).
- Release the pressure as soon as this pressure is reached.
- Inspect the state of the hose visually (see 4.4).

4.4. Results

4.4.1. Proof pressure

When the pressure is established, check the state of the hose: there must be no leakage (complete watertightness) or permanent deformation of the hose.

4.4.2. Burst pressure

The hose must not burst when under pressure or show permanent deformation once the pressure has been released.

4.4.3. Expression of the results

On the test sheet, mention:

- the reference of the test method,
- the reference of the sample,
- the test conditions,
- the observations at proof pressure:
    - no leakage, no bursting and no deformation: compliant
    - leakage, burst or deformation: non-compliant
- the observations at burst pressure:
    - no leakage, no bursting and no deformation: compliant
    - leakage, burst or deformation: non-compliant.

Annex E TO STANAG 4604
(Edition 1)
(Study Draft 4)

TEST METHOD

ABRASION TESTING OF HOSES AND HOSE ASSEMBLIES

First edition

UNRESTRICTED CIRCULATION

CONTENTS

1. Purpose and scope

This method draws on standard NF S 61-112 "Firefighting equipment: collapsible discharge hoses of diameters 25, 36.5, 45, 70 and 110 mm". The purpose of this method is to define procedures for evaluating the resistance of hoses to abrasion.

The tests described in this method are applicable to all hoses and hose assemblies.

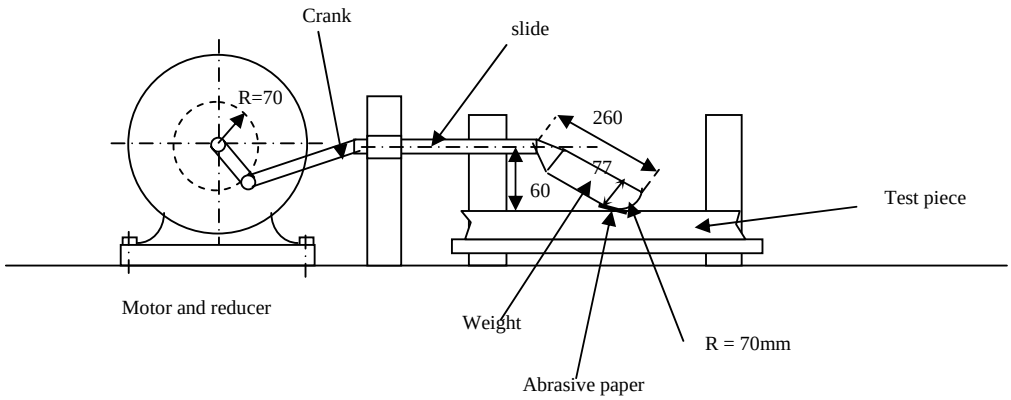
2. Principle

The abrasion test consists in subjecting the hose to a stress generated by movement of a weight covered in abrasive paper over the hose. The movement causes abrasion, and the test checks whether the hose can withstand it without deterioration.

3. Apparatus and equipment

3.1. Apparatus

- A device for subjecting the test piece to to-and-fro movement of a weight.
  The device must meet the following conditions:
- It must be able to move the weight to and fro 100 (±2%) times a minute.
- The weight's travel must be 14 cm.
- A device for pressurizing the test piece (see method LSEA T-26).
  Example of an abrasion rig (cf NF S 61-112).



3.2. Equipment

Test pieces:

- 1 test piece fitted with two quarter-turn connectors defined by the reference specification (by default, GUILLEMIN symmetrical quarter-turn connectors as defined by standard NF E 29-572 shall be used), 1 m in length (see photo below).

1 m

Test weight

The weight of the moving part used depends on the diameter of the hose being tested and is given by the table below:

Unit of measurement:	Diameter			
	DN 40	DN 65	DN 80	DN 100
Kg	4	5	5	6

The moving part is 260 mm long and 77 mm wide. The surface in contact with the test piece is covered with abrasive paper (default: NORTON G-121, 50-grade paper) cut into strips 7 cm wide.

Bristle brush:

This is needed for cleaning of the test piece (see 4.3).

4. Testing

4.1. Samples for testing

Testing is carried out on a test piece that may or may not have undergone other tests (working pressure, proof pressure, burst pressure tests).

4.2. Preparation of the test

- Ensure that the test piece conforms to the specifications (as regards length and connectors)
- Install the test piece on the apparatus or test rig.
- Select the appropriate weight and position the abrasive paper.
- Fill the hose with water at the test pressure given by the specification (default: 5 bar).

4.3. Test

- Perform 150 to-and-fro movements along the length of the test piece.
- Turn the test piece so as to position the weight on the generatrix diametrically opposite the one that has undergone abrasion.
- Perform three series of 50 to-and-fro movements along the length of the test piece, cleaning the test piece between the series to remove dust.

4.4. Pressure test after abrasion

This test is performed on the test piece tested in 4.3. The pressure is gradually increased within a set time to a pressure laid down in the specification (default: in 15 s, to 15 bar).

4.5. Results

The sample tested must neither leak nor show signs of rupture (no fabric showing, and no tearing-off of the cover).

4.5.1. Expression of the results

On the test sheet, mention:

- the reference of the test method,
- the reference of the sample,
- the test conditions,
- the observations after the pressure test:
    - no leak and no rupture: compliant
    - leak or rupture: non-compliant