

# Hydraulic hose assemblies

## Testing and replacement

Stand: 18.02.2019

### Translation of the German version.

Hydraulic hose assemblies are used in almost all machines applying hydraulically controlled assemblies, especially where rigid pipes for fluid transmission cannot be used.

Due to pressure pulses, wear and tear, ageing, damages, faulty integration and many other factors, hydraulic hose assemblies represent particular hazards. Safety regulations therefore specify that the user of the machine has to check the hydraulic hose assemblies prior to the first use and afterwards in regular intervals and replace them when faults occur or when the assemblies have already been in use too long.



Figure 1: Hydraulik-Schlauchleitungen

## 1 Required tests

For reasons of warranty and safe functioning, machines and their hydraulic hose assemblies within hydraulic systems have to be checked. The legal provisions for compulsory testing are specified in the Betriebssicherheitsverordnung BetrSichV [1], which sets out the provisions of the

## Table of Contents:

- 1 Required tests ..... 1
- 2 Checking for proper installation and safe function (formerly referred to as: initial test) ..... 2
- 3 Checking for safe provision and use (formerly referred to as: recurrent test) .... 2
- 4 Replacement of hydraulic hose assemblies ..... 3
- 5 Legal bases for the tests ..... 6
- 6 Summary and limits of application ..... 8
- Annex (Tables 1 – 8) ..... 10

ArbSchG [2] (German Industrial Safety Act) for the users of equipment.

New machinery has to comply with European directives. This is documented by a declaration of conformity and the CE mark. However, this does not ensure that newly procured machines bearing this mark are free of safety deficiencies. In addition, work equipment may be damaged by transportation, after relocation or due to improper mounting.

Therefore, machines and their hydraulic hose assemblies have to be checked after proper assembly. This check for proper installation and safe function has to be initiated by the user after assembly and prior to commissioning or prior to recommissioning. This procedure was formerly referred to as “initial test” (see clause 2).

In addition, machines and their hydraulic hose assemblies are exposed to „damaging influences“

or wear and tear. Nevertheless, work equipment shall always be safe at the beginning of work.

In this context, the user has to:

- identify potential hazards in order to assess their risks,
- specify safety measures for the safe provision and use and
- ensure that they are complied with.

These safety measures include the examination and replacement of hydraulic hose assemblies.

Work equipment has to be checked at regular intervals for „safe provision and use“; formerly referred to as “recurrent test” (see clause 3). These tests have to be initiated by the user as well. The obligation for testing also applies to hose assemblies intended for measuring purposes.

The user has to specify the type of test, the test scope and the test intervals as part of the risk assessment according to § 3 (6) BetrSichV. These criteria together with the test results are part of the written documentation of a risk assessment according to § 3 (8) BetrSichV. The test results are also part of the documentation according to § 14 (7) BetrSichV.

The test scope described in the Annex is a recommendation. Individual in-house experience may be taken into account when specifying the test scopes.

## 2 Checking for proper installation and safe function (formerly referred to as: initial test)

When checking “for proper installation and safe function”, criteria are assessed that relate to the installation or which can only be assessed on the completely installed machine. This also includes the examination of the assembled hydraulic hose assemblies.

Some of these test criteria can already be assessed during a “visual inspection” in deactivated state, others require “functional testing” with activated energy supply. The machinery movements and the hazards due to leakages or escaping pressure fluid jets need to be taken into account.

The overview in Table 1 shows the recommended scope of a „visual inspection“ (of the hydraulic hose assemblies) (see Annex). The overview concerning the recommended scope of testing for

a “functional test” (of the hydraulic hose assemblies) is given in Table 2.

## 3 Checking for safe provision and use (formerly referred to as: recurrent test)

Since hydraulic hose assemblies are subject to damaging influences, they have to be checked for „safe provision and use“ at regular intervals.

Checks are also required:

- after accidents,
- after modifications (conversions) to the machine,
- subsequent to new mounting at a different location without simultaneous modification of the old machine,
- after longer terms of non-use and
- after repair measures as a result of damage (collision, acts of God) – in this case as extraordinary test.

All tests aim to detect and eliminate damages on hydraulic hose assemblies in good time.

### 3.1 Recommended test scope

Table 3 provides a detailed overview on the recommended test scope for the „safe provision and use“ (concerning hydraulic hose assemblies).

### 3.2 Test criteria for hydraulic-hose assemblies

Table 4 indicates the recommended test criteria for the testing of each individual hydraulic hose assembly with regard to the safe working condition.

### 3.3 Recommended check intervals

The employer has to specify the intervals for the checks according to § 3 (6) BetrSichV within the scope of the risk assessment and the determination of measures for the safe provision and use of work equipment. This should already be done on the commissioning of the machine.

The time intervals between recurrent tests have to be chosen such that deviations from the safe working condition of work equipment can be identified in time and flaws can be eliminated.

The provisions for checks and check intervals as stated in the rules and regulations of accident insurers can still be regarded as code of practice and can be taken to specify check intervals.

The criteria listed in Table 5 may influence the check intervals of machines or that of their safety-

related components such as hydraulic hose assemblies. These criteria should also be considered for checking the proven intervals given in the DGUV regulations so far (to prolong or reduce the intervals, if required).

It is legally required to keep the proof and the result of the performed test at least until the next test. Keeping the proofs and results throughout years, for example in the machine file, creates the basis for a quantification of risks and a proper specification of safety measures, including the replacement and test intervals (see clause 4.2).

If flaws are detected in the course of testing, especially on hydraulic hose assemblies which have only recently been in use, it is recommended to reduce the test interval for the relevant section of the hydraulic system of the machine.

The check intervals summarized in Table 6 are recommended for the testing of hydraulic hose assemblies; they are subject to:

- company-specific and machinery-related specifications of check intervals by the user of the work equipment and
- specific provisions given by the machine manufacturer or the manufacturer of the hoses or hose assemblies

It may be that the user specifies the same check intervals according to the „Betriebssicherheitsverordnung“ as he did, before the Betriebs-sicherheitsverordnung came into effect. For example: hydraulic hose assemblies are tested prior to commissioning and afterwards at least once a year or according to the defined provisions given by the manufacturer in the operating instructions of the machine (e.g. 1x/ 2x/ 4x per year) with regard to their safe working condition.

Depending on:

- the location of use or
- the provision and type of secondary safeguards (e.g. covers) on hydraulic hose assemblies and
- the relevant risk assessment,

different check intervals (as well as for replacement), may possibly be specified for different hydraulic hose assemblies at the same machine. Due to the high number of different intervals on the individual machines, the use of a database system seems to be reasonable in this case.

## 4 Replacement of hydraulic hose assemblies

Defective hydraulic hose assemblies have to be replaced.

If hydraulic hose assemblies are replaced, it has to be ensured that they are sufficiently dimensioned for the load to be expected and that a confusion of the connections is prevented.

### 4.1 Replacement resulting from the test results

If flaws are identified on the testing of the hydraulic hose assembly with regard to the safe working condition (see test criteria, Table 4), they have to be eliminated immediately or adequate measures have to be taken which ensure that the machine will not be operated until the hydraulic hose assembly is replaced.

Hydraulic hose assemblies must neither be repaired nor reassembled by old parts.

Defective hydraulic hose assemblies should be taken as an opportunity to take into account further protective measures. For example:

- are the test intervals scheduled at a sufficient frequency?
- are the lines replaced in sufficient frequency?
- are the causes of faults examined?
- is the discussion on required measures held together with the machine manufacturer?

Further information concerning the selection of the new hydraulic hose assembly to be installed is included in clause 4.3.

**Defective hydraulic hose assemblies have to be replaced!**

### 4.2 Replacement due to aging

Even if the visual inspection of the hydraulic hose assembly shows no external safety defects, the compound of the internal and external layer consisting of rubber and a single- or multi layer pressure carrier consisting of a steel mesh or fabric ply may be damaged inside.

Basically, hoses and hose assemblies are subject to a natural ageing process even if they are stored properly and operated under admissible loads. This reduces the performance of the hydraulic hose assemblies.

Since the lifetime of a hydraulic hose assembly is limited, the user has to make sure that hydraulic

hose assemblies are replaced at appropriate intervals. This constitutes a measure for maintaining the safe condition according to § 10 (1) BetrSichV.

The possible lifetime (i.e. period of use) of hydraulic hose assemblies especially depends on the operation and environmental conditions. Due to the wide range of applications for hydraulic hose assemblies, it is thus not possible for technical reasons to specify a binding, maximum admissible lifetime.

Specific information or instructions given by the manufacturer of hose assemblies shall be complied with in any case. The recommendations of the machine manufacturer concerning the lifetime have to be considered as well when specifying the replacement intervals within the company.

The indicated reference value of 6 years for the recommended lifetime of „normally“ stressed/used hydraulic hose assemblies, includes a storage period of max. 2 years. See clause 4.5.1 of DGUV Rule 113-020 „Hydraulikschlauchleitungen und Hydraulikflüssigkeiten – Regeln für den sicheren Einsatz [3].

The reference value of 2 years as recommended lifetime of increasingly stressed hydraulic hose assemblies already represents the maximum permissible lifetime. When producing the hydraulic hose assembly (or the machine), the hose should not be older than 4 years.

Deviations from the indicated reference values for the recommended maximum lifetime (for prolongation) are possible if relevant test values and experience are available which permit a safe further use beyond the recommended lifetime. An extended lifetime of the hydraulic hose assembly additionally requires that no risks result from the hydraulic fluids or from the line itself due to a damage or hose fracture and that no hazardous motions of the machine or the load occur.

For hoses consisting of thermoplastic or metallic hydraulic hose assemblies, different reference values for the lifetime as those mentioned above may apply.

The specifications set for the lifetime of hydraulic hose assemblies should be included in the operational documentation, such as the machine file, the test plan or in the work instructions as part of the quality management manual.

Konkrete Angaben oder Anweisungen eines Herstellers von Schlauchleitungen müssen in jedem Fall beachtet werden und auch die Empfehlungen

When determining the replacement intervals or the lifetime for the individual hydraulic hose assemblies used on a machine, the user has to refer primarily to the above mentioned replacement intervals recommended by the manufacturer and also to his/her own experience gained from individual operating conditions. This especially holds true when the recommended lifetime of 6 years is planned to be exceeded.

Prolonging the recommended reference value of lifetime of 6 years is possible if:

- corresponding test values and experience on part of the machine manufacturer, the user or the hose and hose assembly manufacturers are available and
- a risk assessment has been conducted and documented in writing and protective measures have been specified by the user. This must also include secondary safeguarding measures in case of failure of hydraulic hose assemblies (e.g. hose break protection) to prevent an increased risk, and
- the test for safe condition is carried out at appropriate fixed time intervals – if necessary reduced – by an authorized person according to § 2 (6) BetrSichV.

Table 7 shows a summary of the most important factors influencing the replacement intervals.

Prolonging the replacement intervals is not permissible without a written documentation of the previous test results, the risk assessment (taking into account the current test results and the assessment of the criteria mentioned in Table 7 and the specified protective measures.

If the lifetime of the hydraulic hose assemblies is planned to be extended beyond the recommended 6 years, reduced test intervals are recommended for safety reasons.

**A prolongation of the replacement intervals must not result in a hazardous situation which may lead to injuries to employees or other persons!**

Provided that the required check intervals (see clause 3.3) are observed, we recommend the intervals mentioned in Table 8 as reference values for the replacement of hydraulic hose assemblies.

Some machine manufacturers have specified shorter test and replacement intervals in their operating instructions (e.g. semiannual testing and replacement after two years) which have to be observed. This results from the hazard analysis and the protection concept for particular hydraulic hose assemblies with increased requirements (such as e.g. specific gravity-loaded axes).

It has proven successful in practice to commonly agree in writing on internal specifications - in particular in case of an intended prolongation of the lifetime of hydraulic hose assemblies,

Provided that the required check intervals (see clause 3.3) are observed, we recommend the intervals mentioned in Table 8 as reference values for the replacement of hydraulic hose assemblies.

Some machine manufacturers have specified shorter test and replacement intervals in their operating instructions (e.g. semiannual testing and replacement after two years) which have to be observed. This results from the hazard analysis and the protection concept for particular hydraulic hose assemblies with increased requirements (such as e.g. specific gravity-loaded axes).

It has proven successful in practice to commonly agree in writing on internal specifications - in particular in case of an intended prolongation of the lifetime of hydraulic hose assemblies,

- e. g. among the production manager, the representatives of the works council, the safety expert and representatives of the maintenance and setting personnel.

#### **Example: Metal die casting foundry**

„A die casting foundry operates metal die casting machines in 3-shift operation.

The responsible person is aware of the hazards when dealing with liquid metal and hot surfaces. He/she has carried out a risk assessment and has checked or additionally taken protective measures. A possible immediate hazard due to a direct leakage of pressure fluid or by whipping of the hose line and a secondary hazard (such as unexpected movements in case of line rupture) have taken into account and are prevented by protective measures.

The responsible person has specified in his/her individual internal working instructions, that the hydraulic hose assemblies have to be subjected to a daily visual inspection and an annual more detailed examination. In addition, the hydraulic hose assemblies which have been identified as defective have to be replaced immediately and all others after 6 years. The initial and the replaced spare hose assemblies have to be of high quality. The responsible person ensures the compliance and execution of the aforementioned measures.

The company has reported 10 years of positive experience with this protection concept which is available in writing and stored together with a hazard analysis. No accidents have occurred due to failure of hydraulic hose assemblies.

The procedure mentioned in the example above complies with the Arbeitsschutzgesetz (German Occupational Safety and Health Act) and the

Betriebssicherheitsverordnung (Ordinance on Industrial Safety and Health), including the fact that the user has deviated from the recommended reference values for replacement intervals (6 years) at multiple shift operation as stated in DGUV Rule 113-020.

The procedure followed by the user complies with DGUV Rule 113-020 since the responsible person is allowed to deviate (in Tables 1 and 2 of DGUV Rule 113-020 or Tables 6 and 8 of this information 015) from the recommended reference values of the test and replacement intervals, if suitable and effective protective measures have been taken.

The responsible person in the example can provide the proof by

- the protective measures taken (written proof including verification) and
- individual in-house experience

Further information concerning the selection of the new hydraulic hose assembly to be installed is included in clause 4.3.

#### **Information:**

Further explanations to relevant standards and rules, to examples of applications and to an approach for risk assessment of the hydraulic hose assemblies are also included in publication [4].

Further general safety information to hydraulic maintenance is included in DGUV information 209-70 „Sicherheit bei der Hydraulikinstandhaltung“ (bisher BGI 5100) English version 209-071 „Safe maintenance of hydraulic systems“ (up to now BGI 5100) [5].

### **4.3 Selection and storage of hydraulic hose assemblies**

The replacement of hydraulic hose assemblies must always be carried out according to the manufacturer's instructions. If, however, operating instructions and a support by the manufacturer cannot be provided, this means:

The hose, fitting and hose assembly have to be selected in such a way, that

the requirements with respect to the hose assembly marking are fulfilled,

- the admissible loads (maximum occurring pressures) of all components of the hose assembly will not be exceeded with the operating pressures to be expected.
- those operating pressures are considered, the control system or the hydraulic pump have been

- designed for, and which are indicated on the nameplates of such hydraulic system components,
- all requirements of the applicable European or international product standards (e. g. EN, ISO SAE standards) are fulfilled,
  - the machine's operating frequency or the frequency of pressure pulses do not result in an early failure or a complete breakdown.
  - the cross sections or nominal diameters are sufficiently dimensioned so that no inadmissible accumulation pressures occur which, for example, obstruct the free backflow to the tank.
  - the compatibility of hose and sealing materials in conjunction with the hydraulic fluid being used is ensured,
  - designs of hose assembly fittings consisting of a (drilled) pipe socket with olive are not used, as these do no longer correspond to the state-of-the-art.

In summary, the newly installed hydraulic hose assembly has to be suitable for the intended use with regard to pressure, volume flow, possible pressure surges, length and and resistance towards the hydraulic fluid used.

**It has to be checked whether the selected hydraulic hose assembly is suitable for the intended use.**

Hydraulic hose assemblies should be procured fully assembled only. Preference should be given – if not already stated by the manufacturer – to standardized hoses/hose assemblies, e.g. according to DIN EN 853 [6], DIN EN 854 [7], DIN EN ISO 3949 [8], DIN EN 856 [9], DIN EN 857 [10] or according to ISO standards, see also no. 3 of Annex 4 of DGUV Rule 113-020.

On the provision of spare hydraulic hose assemblies, the influencing factors for the recurrent replacement intervals should also be taken into account (see Table 7).

If a hydraulic hose assembly is self-assembled, it has to be observed that the selected components (hose and fittings) are compatible regarding their dimensions, shape and pressure stage. Therefore, it is imperative to observe the provisions of the hose and fitting manufacturers.

The installed hydraulic hose assemblies must not consist of hoses or used press fittings which have already been used as part of a hose assembly before!

A safe hydraulic hose integration assumes detailed knowledge of the integration procedure, the devices and components. The integration should only be made by a person who is authorized to carry out testing according to § 2 (6)

BetrSichV. After the hose assembly has been produced, it has to be checked visually by an authorized person or by suitable procedures. If the integrator does not meet the requirements for a person who is authorized for testing, the QM manual includes corresponding procedure instructions for the selection of a different authorized person.

The integration only allows the use of devices and equipment which are approved by the fittings manufacturer.

The storage period should not exceed 4 years for hoses and 2 years for hydraulic hose assemblies. Storage should be at a cool, dry and dust-free place; direct solar or ultraviolet radiation has to be avoided; nearby heat sources have to be shielded. The ends of hoses and hose assemblies should be closed during storage. Storage temperatures below -10°C have to be avoided; for thermoplastic materials, other reference values may apply. For further information, see DGUV Rule 113-020.

The manufacturer's assembly instructions have to be observed.

#### Information:

Further information concerning pipeworks and the connections is given in DIN 20066 [11].

**Hydraulic hose assemblies should only be purchased from a hose assembly manufacturer in a pre-assembled state.**

## 5 Legal bases for the tests

The legal provisions for testing work equipment (machines, systems and thus hydraulic hose assemblies) are specified in the Betriebssicherheitsverordnung (Ordinance on Industrial Safety and Health) which sets out the provisions of the German Industrial Safety Act (ArbSchG).

The user of the work equipment himself/herself has to specify the type, the scope and the test intervals for his/her individual application conditions within the scope of a risk assessment (BetrSichV § 3) [6] and carry out the tests accordingly (BetrSichV § 14). The provisions and recommendations of the manufacturer have to be observed.

The DGUV Rule 113-020 is the guideline for implementing the Betriebssicherheitsverordnung with regard to hydraulic hose assemblies. On publication of the DGUV Rule 113-020, the previous DGUV Rule 113-015 (former Rule BGR 237) [13] has expired.

The check and replacement intervals have to be documented in writing together with other protective measures according to § 3 (8) BetrSichV. The test results have to be enclosed to this documentation as well.

The test results have to be documented (e.g. with the test report of the work equipment in the machine file) and maintained (at least until the next test, preferably over years) in the company.

The tests must only be implemented by authorized persons instructed by the employer (see clause 5.1).

## 5.1 Persons authorized to carry out testing of hydraulic hose assemblies

A person who is authorized to carry out testing, as defined by the Betriebssicherheitsverordnung, is a person who has the required expert knowledge and skills for the testing of hydraulic hose assemblies acquired by vocational training, occupational experience and contemporary professional activities. (see § 2 (6) BetrSichV, TRBS 1203 [12] and DGUV Rule 113-020 clause 4.4.3).

There is no specific job profile for „authorized persons“ in respect of the particular testing tasks for hydraulic hose assemblies. The following 3 requirements, however, have to be fulfilled:

- **Professional training**  
The person authorized for testing has completed a vocational training which provides the proof of his/her professional skills, based on professional qualifications or similar proofs (certificates). For the testing of hydraulic hose assemblies, a completed technical vocational training should be available or a comparable technical qualification which is adequate for the intended testing activities. This should ensure the proper execution of the tests.
- **Professional experience**  
Professional experience assumes that the authorized person has dealt with the equipment to be tested for a sufficient period of time. The authorized person should have had sufficient opportunities to initiate the tests, e.g. as a result of the risk assessment or from daily observation. The person authorized for testing should have experienced enough opportunities. By participating in tests of work equipment, the authorized person has gained experience in the execution of the planned or similar tests. He/she has furthermore gained the required knowledge in dealing with test equipment and the evaluation of test results. The vocational experience also enables to assess whether a proposed test procedure is suited for the

work equipment to be tested. This also includes that the hazards in conjunction with testing activities and the work equipment to be tested can be identified.

- **Contemporary professional activity**  
A contemporary professional activity related to the intended tests and adequate further training are available. A contemporary professional activity includes the execution of several tests per year (maintenance of testing experience). A longer interruption of the testing activities requires the renewal of test experience and the required expert knowledge by participating in tests of other parties. The person authorized for testing has to have and maintain knowledge as to the state of the art with regard to the work equipment to be tested and to the hazards to be assessed.

He/she has to be familiar with:

- the Betriebssicherheitsverordnung (Ordinance on Industrial Safety and Health) and the corresponding technical Rules, and
- further federal occupational safety and health regulations (e.g. ArbSchG (German Occupational Safety and Health Act), GefStoffV (Ordinance on Hazardous Substances) and the corresponding technical Rules and
- regulations and requirements with regard to quality (e. g. ProdSG (Product Safety Act), applicable product safety regulations ProdSV) with regulations of the accident insurance institutions and other regulations (e. g. standards, approved testing principles)

so that he/she is able to assess the safe state of the work equipment.

Experts who have carried out the tests of hydraulic hose assemblies so far, who fulfill the three aforementioned requirements and who are familiar with the contents of the Betriebssicherheitsverordnung and the relating modifications are considered to be authorized persons and may still be charged with the tests.

The authorized person is in no way bound by directives while performing testing, and therefore, shall not be put at a disadvantage (see § 14 (6) BetrSichV).

## 5.2 FAQ's

Since the first publication of this information in 2005, questions have been repeatedly raised about the legal basis for protective measures against hazards in case of failure of the hydraulic hose assembly.

The Machinery Directive 2006/42 EC [14] requires this in general in Annex I, No. 1.3.2 para. 4 and no. 1.5.3. In DIN EN ISO 4413 [15] it is required in 5.4.6.5.3:

- If the failure of a hose assembly may cause a hazard due to whipping, the hose assembly has to be retained by suitable means or shielded. If this is not possible due to the intended machine movements, information on the residual risks has to be provided.
- If the failure of a hose assembly may cause a hazard by a fluid jet or a fire hazard, the hose assembly has to be retained or shielded by suitable means (see above). If this is not possible due to the intended machine movements, information on the residual risks has to be provided.

According to this, it has to be ensured that suitable protective measures are provided on hydraulic hose assemblies which may cause a hazard due to whipping or leakage of hydraulic fluid such as fastening, capture device or shielding.

#### Information:

The shieldings include e. g.

- protective tubing according to clause 4.2.8 of DGUV Rule 113-020 or
- fixed covers  
(see e.g. DGUV information FB HM-086 „Hydraulische Prüfstände“ (Hydraulic test benches [16], clause 4.1.1). in appropriate size or fully shaped

Hazards have to be expected e.g. if persons are present in close proximity of the hydraulic hose assemblies during the main operating time of the work equipment, such as e. g. at driving positions, in control positions of a machine or along operational traffic routes.

## 6 Summary and limits of application

This information is based on expert knowledge gathered by the expert committee woodworking and metalworking, subcommittee machinery, robotics and automation of DGUV in the field of hydraulic equipment of machines and systems.

This „Fachbereich AKTUELL“ has been prepared by experts of accident insurance institutions on the topic hydraulics and pneumatics of DGUV with the collaboration of the Institute for Occupational Safety and Health of the German Social Accident Insurance (DGUV-Institut für Arbeitsschutz (IFA).

This information is particularly intended to assist the user in specifying:

- types of tests;
- test intervals;
- test scope; and
- test criteria.

It should help to specify replacement intervals of hydraulic hose assemblies which are used in machinery and systems, and which are currently included in the scope of the European Machinery Directive.

The contents or extracts of this „Fachbereich AKTUELL“ or the tables may be applied for preparing process or working instructions in QM manuals or QM systems.

This „Fachbereich AKTUELL“ refers to hydraulic hose assemblies that have been excluded from the scope of the Pressure Equipment Directive [17]. For hydraulic hose assemblies which have not been excluded from the scope of that directive, further requirements according to the Pressure Equipment Directive and the Betriebssicherheitsverordnung have to be considered in addition. For relevant information, see clause 7 of DGUV Rule 113-020.

The particular provisions for different applications (e.g. in the mining industry or similar) have to be considered.

The provisions according to individual laws and regulations remain unaffected by this DGUV information. The requirements of the legal regulations apply unrestrictedly.

In order to get complete information, it is necessary to consult all applicable regulation contents.

This „Fachbereich AKTUELL“ replaces the same titled version, which was published as of Issue 03/2018 and is the English translation of the German issue “FBHM-015” of 18.02.2019. An updating has become necessary due to editorial changes.

The expert committee woodworking and metalworking is composed of representatives of the German Social Accident Insurance Institutions, federal authorities, social partners, manufacturers and users.

Further „Fachbereich AKTUELL“ or information sheets of the expert committee woodworking and metalworking (Fachbereich Holz und Metall) are available for download on the internet [18].

As to the aims of the „Fachbereich AKTUELL“ or DGUV-Information in the format of an information sheet, refer to DGUV information FB HM-001 „Aims of the DGUV information published by the expert committee woodworking and metalworking“.



**German bibliography:**

- [1] Verordnung zur Neuregelung der Anforderungen an den Arbeitsschutz bei der Verwendung von Arbeitsmitteln und Gefahrstoffen (Betriebssicherheitsverordnung – BetrSichV) vom 03. Februar 2015, (Bundesgesetzblatt 2015 Teil 1 Nummer 4 vom 06.02.2015), zuletzt durch Artikel 5 Absatz 7 der Verordnung vom 18. Oktober 2017 (BGBl. I S. 3584).
- [2] Gesetz über die Durchführung von Maßnahmen des Arbeitsschutzes zur Verbesserung der Sicherheit und des Gesundheitsschutzes der Beschäftigten bei der Arbeit (Arbeitsschutzgesetz ArbSchG, Ausfertigungsdatum: 07.08.1996 (BGBl. I S. 1246), zuletzt geändert durch Art. 427 der Verordnung vom 31.8.2015 I 1474.
- [3] DGUV-Regel 113-020 „Hydraulik-Schlauchleitungen und Hydraulik-Flüssigkeiten – Regeln für den sicheren Einsatz“ Ausgabe 10-2017, Fachbereich Rohstoffe und chemische Industrie FB RCI, Heidelberg, Berufsgenossenschaft Rohstoffe und chemische Industrie.
- [4] Hydraulik-Schlauchleitungen – Sicherheit der Umgebung bei Versagen und Verwendungsdauer, Sonderdruck aus o+p „Ölhydraulik und Pneumatik“ 41 (1997), Nr. 11 – 12.
- [5] DGUV 209-070 (bisher: BGI/GUV-I 5100) „Sicherheit bei der Hydraulik-Instandhaltung“, Ausgabe 2014-01, DGUV, Fachbereich Holz und Metall, Postfach 3780, 55027 Mainz
- [6] DIN EN 853, Gummischläuche und –schlauchleitungen - Hydraulikschläuche mit Drahtgeflecht-einlage - Spezifikation, 2016-09, Beuth Verlag GmbH, Berlin
- [7] DIN EN 854, Gummischläuche und –schlauchleitungen - Hydraulikschläuche mit Textileinlage - Spezifikation, 2016-09, Beuth Verlag GmbH, Berlin
- [8] DIN EN ISO 3949, Kunststoffschläuche und –schlauchleitungen - Textilverstärkte Typen für hydraulische Anwendungen - Spezifikationen, 2018-11, Beuth Verlag GmbH, Berlin; ersetzt die DIN EN 855
- [9] DIN EN 856, Gummischläuche und –schlauchleitungen - Hydraulikschläuche mit Drahtspiral-einlage - Spezifikation, 2016-09, Beuth Verlag GmbH, Berlin
- [10] DIN EN 857, Gummischläuche und –schlauchleitungen - Kompakthydraulikschläuche mit Drahtgeflecht-einlage - Spezifikation, 2016-09, Beuth Verlag GmbH, Berlin
- [11] DIN 20066 „Fluidtechnik; Schlauchleitungen; Maße, Anforderungen“, 2018-03, Beuth-Verlag GmbH, Berlin.
- [12] Technische Regel für Betriebssicherheit TRBS 1203 „Befähigte Personen“, Ausgabe: März 2010, geändert und ergänzt: GMBI 2012 S. 386
- [13] DGUV Regel 113-015 (vormals Berufsgenossenschaftliche Regel 237) „Hydraulik-Schlauchleitungen“, Fachausschuss Chemie (FA CH) der Deutschen Gesetzlichen Unfallversicherung DGUV, 2008, zurückgezogen und ersetzt durch DGUV Regel 113-020, siehe [3].
- [14] Richtlinie 2006/42/EG des Europäischen Parlaments und des Rates vom 17. Mai 2006 über Maschinen (Maschinen-Richtlinie), Amtsblatt der Europäischen Union, Nr. L 157/24 vom 09.06.2006 mit Berichtigung im Amtsblatt L76/35 vom 16.03.2007.
- [15] DIN EN ISO 4413, Fluidtechnik – Allgemeine Regeln und sicherheitstechnische Anforderungen an Hydraulikanlagen und deren Bauteile; Ausgabe 2011-04, Beuth Verlag, Berlin.
- [16] „Fachbereich AKTUELL“ FBHM-086 „Hydraulische Prüfstände“, Ausgabe 10/2017, Fachbereich Holz und Metall, Postfach 3780, 55027 Mainz
- [17] Richtlinie 2014/68/EU des Europäischen Parlaments und des Rates vom 15. Mai 2014 zur Harmonisierung der Rechtsvorschriften der Mitgliedsstaaten über die Bereitstellung von Druckgeräten auf dem Markt (Druckgeräte-Richtlinie), Amtsblatt der Europäischen Union, L 189/164 vom 27.06.2014.
- [18] Internet: [www.dguv.de/fb-holzundmetall](http://www.dguv.de/fb-holzundmetall) Publikationen oder [www.bghm.de](http://www.bghm.de) Webcode: <626>

**Picture credits:**

The picture mentioned on page 1 of this information has been kindly provided by:

Figure 1: Institut für Arbeitsschutz (IFA) der Deutschen Gesetzlichen Unfallversicherung DGUV 53754 Sankt Augustin

**Table credits:**

- Table 1:** Recommended test scope „Visual inspection“ (prior to commissioning or recommissioning)
- Table 2:** Recommended test scope „functional testing“ (prior to commissioning or recommissioning)
- Table 3:** Recommended test scope „for safe provision and use“ (recurrent or extraordinary test)
- Table 4:** Recommended test criteria for hydraulic hose assemblies
- Table 5:** Factors influencing the check intervals of hydraulic hose assemblies
- Table 6:** Recommended check intervals
- Table 7:** Factors influencing the replacement intervals
- Table 8:** Recommended replacement intervals

**Table 1: Recommended test scope „Visual inspection“  
(prior to commissioning or recommissioning)**

- Does all user information relevant for operating the hydraulic system in a safe manner exist (e. g. hydraulic circuit diagram, parts list, system description, drawings, operating/maintenance instructions, documents on hydraulic accumulators, safety data sheets on the hydraulic fluids used, and if necessary, information on additional protective measures)?
- Do the hydraulic hose assemblies correspond to the hydraulic circuit diagram or to the parts list and the system description (e. g. nominal width, pressure stage, line specifications, suitability for the hydraulic fluid used)?
- Have safety measures been taken for the case of extraordinarily high pressure surges or pressure boosts, such as for example, pressure relief valves?
- Are the individual hoses of the hydraulic hose assemblies marked with the name or a short sign of the manufacturer, EN-number and type (pressure stage), nominal diameter, quarter/year of manufacture? (see DIN EN ISO 4413 and standards for hose assemblies)
- Are hydraulic hose assemblies durably labeled, e.g on the fittings with the name or short sign of the manufacturer, the max. admissible operating pressure, year/month of manufacture?
- Are hydraulic hose assemblies installed in such a way, that, for example according to DIN 20066::
  - the natural position does not impair the movement;
  - twisting of the hose or a tensile load due to a line of insufficient length or insufficient bending radii are avoided;
  - the hose is led by buckling protection (if applicable at the connection element);
  - external mechanical influences or abrasion at the edges are avoided by sufficient distance;
  - damage by running over is avoided by means of hose bridges;
  - loosely installed hose assemblies are protected by hose guiding devices (such as hose brackets and hose fixtures of sufficient width);
  - a thermal protection (shielding) protects from high temperatures?
  - a protection against ambient influences, such as metalworking fluid is provided (see DIN 20066)?
- Are the hydraulic hose assemblies designed and arranged with regard to their installation location in such a way, that they:
  - cannot be confused and are durably marked for unambiguous identification according to their location;
  - are protected against any foreseeable damage, e.g. mechanical or due to high machine cycle frequencies)?
  - are not installed towards the direction of motion of highly vibrating axes?
  - do not impair repair and maintenance of the work equipment?
- Are hydraulic hose assemblies which are used in areas with higher requirements, (e.g. keeping a load elevated) protected against hose break?
- Are hydraulic hose assemblies which, in case of failure, may cause hazards due to whiplash or escape of hydraulic fluid provided with suitable protective measures, such as fastening, capturing device, shielding or protective hose? (Hazards may be expected, for example if persons are present very close to the hydraulic hose assembly, see clause 5.2)
- Have the hydraulic hose assemblies been installed in such a way that they cannot be used as climbing aid?
- Do the hydraulic hose assemblies of the machines which have been subject to commissioning or repeated recommissioning already show damages (s. Table 4)? If damages have been detected, proceed according to clause 4.1
- Have the installed hydraulic hose assemblies or hoses not exceeded the period of storage or use, recommended by the individual manufacturer (see clause 4.2)?
- Have the hydraulic hose assemblies not been varnished?
- Have test intervals been specified for the recurrent test of hydraulic hose assemblies? Do higher requirements induce reduced test intervals (see also operating instructions of the machine)

**The installed hydraulic hose assemblies shall not consist of hoses or used press fittings which have already been used as part of a hose assembly before!**

**Table 2: Recommended test scope „functional testing“ (prior to commissioning or recommissioning)**

- Does the machine perform all hydraulic machine functions as intended? Do they comply with the system description?
- Are there unusual acoustic signals (e. g. decompression shocks, relief cavitation noise) at the hydraulic machine functions during the intended machine operation?
- Are there signs pointing to high pressure peaks or pressure boosts on the hydraulic hose assemblies (e. g. whipping of lines)?
- All parts of the hydraulic system have to be pressurized with at least the intended maximum operating pressure which can be reached taking into account all intended applications:
  - Have no measurable leakages been detected at the hydraulic hose assemblies and connection elements (are the lines and connections leakproof)?
  - Are there no visible damages or deformations on the hydraulic hose assemblies?
  - Are there no scour marks or knees, no torsion, no value which falls below the minimum bending radii or other inadmissible mechanical loads (see also Table 1- visual inspection) at the hydraulic hose assemblies moving under operation conditions?

**Table 3: Recommend test scope „for safe provision and use“ (recurrent or extraordinary test)**

- Is the manufacturer’s information for use (operating instructions, hydraulic circuit diagram, parts list etc.) still complete and available?
- Does the installed hydraulic hose assembly still meets applicable specifications? Do the operating and ambient conditions of the machine still comply with the initial intended use of the machine?
 

(The following has to be observed, e.g.: product type, cycle times, number of units produced, hydraulic pressures and volume flows, temperatures, hydraulic fluid(s) used, velocities / stopping times of the hazardous movements, moved/elevated masses, type of feeding and removal of workpieces, installation location, external influences (e.g. vibrations, moisture, contamination by hydraulic fluid, UV-radiation, mechanical influences, ambient temperature etc.), position of transport paths and type of transport means used (hazards of damage), space and access for operation and maintenance, arrangement and attachment of accessories, interaction/ link with other machines).
- Have the above mentioned preconditions changed, which previously formed the basis for specifying a defined lifetime of the hydraulic hose assembly? If so, have the testing periods and replacement intervals been considered accordingly and if necessary, been changed?
- Are all markings on the hydraulic hose assemblies still existent and legible?
- Do the hydraulic hose assemblies show none of the deficiencies indicated in table 4? If deficiencies are detected, proceed according to clause 4.1
- Are safety measures against whipping of the hydraulic hose assembly and/or leakage of hydraulic fluid on the relevant hydraulic hose assemblies still existing (see Table 1)?
- Have the periods for recurrent tests at the hydraulic hose assemblies been specified and are they complied with?
- The periods have to be specified and the required tests have to be carried out by the user.
- Have the replacement intervals recommended by the manufacturer or the maximum lifetime specified by the user for hydraulic hose assemblies been taken into account (s. clause 4.2)?
- Have reduced test intervals been determined, e.g. to half-yearly or quarterly (instead of yearly or half-yearly) in case of intended prolonged lifetime of hydraulic hose assemblies?
- Have modifications been carried out at the machine or the hydraulic system (control system and equipment)?
  - a) Have these modifications been identified and have they been incorporated in the machine documentation?
  - b) Have those modifications to the machine and in the hydraulic system (control system and equipment) and after more complex repair works resulted in the execution of a check for „proper installation and safe function“, especially if the repair works are associated with a new installation of hydraulic hose assemblies (see clause 2 and Tables 1 and 2).

**Table 4: Recommended test criteria for hydraulic hose assemblies**

- Is the hydraulic hose assembly free from leakages on the hose or fittings?
- Is the hose coming out of the fitting?
- Are there damages or deformations to fittings reducing the functionality and strength of the fittings or the connection fitting-hose?
- Is the external layer damaged up to the insert, caused by scour marks, cuts, cracks?
- Is the external layer embrittled or is there a visible crack formation in the hose material identifiable?
- Are there deformations not corresponding to the natural shape of the hydraulic hose assembly, in pressurized or depressurized condition or when being bent, e.g. layer separation, formation of bubbles, pinch points, knees?
- Is the fitting corroded reducing the functionality and strength?
- Can the hose assemblies still move freely or are there pinch, shear, or scour points caused by attaching new parts of the system or power units?
- Is it ensured that hydraulic hose assemblies do not project into traffic paths, even when the power units connected via hydraulic hose assemblies are driven to their respective end position?
- Have hydraulic hose assemblies been varnished (cracks and labeling cannot be seen!)?
- Have the storage periods and the lifetime been exceeded (see clause 4.2)?
- Have all covers been remounted and function (after testing, relocation, conversions)?
- Are intended stripping and retaining protection means and protective hoses provided and still properly mounted? (see clause 4.2.8 of DGUV Rule 113-020).

**Table 5: Factors influencing the check intervals of hydraulic hose assemblies**

- Hazards which may occur when using the work equipment for all relevant operation procedures (basis: risk assessment);
- Increased requirements to safety (increase of stability in case of hazards to persons due to elevated loads or gravity-loaded axes) e.g. due to the protection concept of the machine manufacturer and provisions for reduced intervals in the operation manual;
- Conditions of use of work equipment and hydraulic system (e.g. particular loads, conditions with defined overload, operating times, cycle times, operation parameters, influence of the hydraulic fluid used. see Table 3);
- Ambient conditions, for example, damaging external influences such as vibration, moisture, contamination, mechanical influences, increased ozone content in outside air (e.g. caused by electric motors or welding transformers), UV-radiation and more, s. tables 1 and 3);
- It has to be compared whether the actual operating conditions / conditions of use still comply with the conditions intended by the manufacturer at the time of procurement;
- Observe manufacturer's information (of machine manufacturer or the manufacturer of the hydraulic hose assemblies) concerning check intervals;
- Check age and level of wear of the work equipment or the hydraulic hose assembly;
- Prolongation of replacement intervals;
- Type and system by means of which the intended maintenance is carried out, especially for safety relevant components and wear parts;
- Make use of experience made by the operating / set-up/ maintenance personnel with the work equipment and the hydraulic system including the hydraulic hose assemblies (with regard to failure behaviour, occurrence of defects, interruptions, increase of such incidents on machines or systems);
- Evaluation of results from visual and function inspection prior to the daily use of the machine;
- Any known damages and accidents on comparable machines or hydraulic systems;
- Evaluation of test results of recurrent tests on these hydraulic hose assemblies or those being operated under comparable conditions;
- Test results prior to commissioning.

<b>Table 6: Recommended check intervals</b>	
<b>Requirements for hydraulic hose assembly</b>	<b>Recommended check interval</b>
Normal requirements	12 months
Higher requirements, e. g. due to: <ul style="list-style-type: none"> <li>• increased operating times (e.g. multiple-shift operation) or short cycle times of machine or pressure pulses,</li> <li>• strong external and internal influences (related to media) which strongly reduce the lifetime of the hydraulic hose assembly,</li> <li>• intended prolonged lifetime (replacement intervals), see clause 4.2,</li> <li>• hydraulically hand-operated tools (e.g. mobile scissors at scrapyards).</li> </ul>	6 months

<b>Table 7: Factors influencing the replacement intervals</b>
<ul style="list-style-type: none"> <li>• Information and instructions given by the manufacturer of the hydraulic hose assemblies or the machine manufacturer in the operating instructions, particularly provisions given by the manufacturer for gravity-loaded axes;</li> <li>• Dimensioning of the hydraulic hose assembly (ratio of nominal pressure or pressure stage of hose or hose assembly up to operating pressures reached in the hydraulic machine circuit).</li> <li>• Approved quality of hoses or hose assemblies for requirements far beyond the minimum criteria according to DIN EN or ISO, such as serviceability far beyond the required minimum number of pressure pulses according to standard; proof e. g. by test certificate or by written confirmation of hose manufacturer.</li> <li>• Operating and ambient conditions;</li> <li>• Type of hydraulic fluid used or its purity and/or filtration of abrasive particles.</li> <li>• Hazards due to hydraulic fluid, the pipe itself or a hazardous machine or load movement in case of damage or break of the hose assembly;</li> <li>• Test values and experience provided by the machine manufacturer or the manufacturer of the hose or hose assembly or the user of the machine, which permit a further use beyond the maximum lifetime recommended in DGUV Rule 113-020;</li> <li>• Hazard and risk assessment documented in writing by the user, taking also into account secondary protective measures against hazards due to failure of the hose assembly, (e. g. cover, line break protection, collection tray);</li> <li>• Proper execution of tests (including test report) on the safe state in adequately determined time intervals, (if necessary reduced) by an authorized person.</li> </ul>

<b>Table 8: Recommended replacement intervals</b>	
<b>Recommended replacement intervals</b>	<b>Recommended replacement interval</b>
Normal requirements	6 years (lifetime including max. 2 years of storage)
Higher requirements, e. g. due to: <ul style="list-style-type: none"> <li>• increased operating times (e.g. multiple-shift operation) or short cycle times of machine or pressure pulses,</li> <li>• strong external and internal influences (related to media) which strongly reduce the lifetime of the hydraulic hose assembly,</li> <li>• intended prolonged lifetime (replacement intervals), see clause 4.2,</li> <li>• hydraulically hand-operated tools (e.g. mobile scissors at scrapyards).</li> </ul>	2 years (lifetime)

**Publisher**

Deutsche Gesetzliche  
Unfallversicherung e.V. (DGUV)

Glinkastraße 40  
10117 Berlin  
Telefon: 030 13001-0 (Zentrale)  
Fax: 030 13001-6132  
E-Mail: [info@dguv.de](mailto:info@dguv.de)  
Internet: [www.dguv.de](http://www.dguv.de)

Sachgebiet „Maschinen, Robotik und Fertigungsautomation“  
im Fachbereich „Holz und Metall“  
der DGUV > [www.dguv.de](http://www.dguv.de) Webcode: d544779

An der Erarbeitung dieser „Fachbereich AKTUELL“ FBHM-015 haben mitgewirkt:

- Referat 5.3 Schutz- und Steuereinrichtungen des Instituts für Arbeitsschutz der DGUV (IFA)