DGUV
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DGUV-Information

Hydraulic threaded connections

Risk of confusing metric and inched threads

Issue 09/2017 Translation of the German version. FB HM-025

The fluid connections of assemblies and components in hydraulic systems of machines are implemented by hydraulic threaded connections.

The absence of thread identifications causes the risk of confusing metric and inched threads during assembly. This led to accidents in the past.

The present information replaces edition 09/2014.

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1 Risk of confusion

A closer inspection of hydraulic threaded connections clearly shows that the majority of threaded connections being used in hydraulic systems is not marked by the manufacturer with regard to their thread type. Additionally, some thread shapes can hardly be distinguished due to their geometric similarity and size. Some stud ends and ports of different thread types fit together although they represent dangerous and non pressure-resistant connections since they have been mixed-up.

Figure 1: Very similar metric and inched stud ends which can be mixed up

As a result, threaded connections with an inched G ½“ thread for example, can be easily and almost unnoticed screwed into metric M 22x1,5 bores without one of the threads is being stripped.

This faulty connection, consisting of, e.g. an inched stud end in a metric port is not at all capable of withstanding the operating pressures and can tear abruptly. This may lead to serious injuries due to ejected parts and leaking hydraulic fluids.

Table 1 shows some of the possible dangerous confusions with metric stud ends (male threads) fitting into inched ports (female threads).

metric			inched		
male thread	nominal diameter	lead	female thread	nominal diameter	lead
M12x1,5	12 mm	1,5	G ¼ A	13,1 mm	1,3
M16x1,5	16 mm	1,5	G ⅜ A	16,6 mm	1,3
M20x1,5	20 mm	1,5	G ½ A	20,9 mm	1,8
M26x1,5	26 mm	1,5	G ¾ A	26,4 mm	1,8
M33x2	33 mm	2	G 1 A	33,2 mm	2,3

Table 1: Confusion of metric male threads in inched female threads

Table 2 shows some of the possible dangerous confusions, including inched stud ends (male threads) fitting into metric ports (female threads).

inched			metric		
male thread	nominal diameter	lead	female thread	nominal diameter	lead
G 1/8 A	9,7 mm	0,9	M10x1	10 mm	1
G ¼ A	13,1 mm	1,3	M14x1,5	14 mm	1,5
G ½ A	20,9 mm	1,8	M22x1,5	22 mm	1,5
G ¾ A	26,4 mm	1,8	M27x2	27 mm	2
G1 ¼ A	41,9 mm	2,3	M42x2	42 mm	2
G1 ½ A	47,8 mm	2,3	M48x2	48 mm	2

Table 2: Confusion of inched male threads within metric female threads

2 Current standards

DIN EN ISO 4413 [1] specifies in clause 5.3.2.5.2:

„Within a hydraulic system, ports, studs, and connectors should be limited to the minimum number of standard series possible. All port connections should be in accordance with ISO 6149-1, ISO 6149-2 and ISO 6149-3 for threaded port connections, or ISO 6162-1, ISO 6162-2 or ISO 6164 for four-screw flange port connections". [2, 3, 4, 5]

It is furthermore noted in DIN EN ISO 4413:

„When using more than one type of ISO standard threaded port connection [e. g. ISO 1179 (all parts), ISO 9974 (all parts) and ISO 11926 (all parts)] in a system, there is a strong possibility of incompatible intermixing between some stud ends from one connection series and some ports from a different connection series, causing leakage and severe failure of the connection system. Ports and stud ends that conform to ISO 6149-1, ISO 6149-2 and ISO 6149-3 are marked such that they are identifiable" [6, 7, 8].

In industrial hydraulics, the standards DIN EN ISO 9974 (Connections for general use and fluid power - with ISO 261 threads) [9]) and DIN EN ISO 1179 part 1-4 (pipe fittings with thread according to DIN EN ISO 228-1 [10]) are mainly applied. An identification of the thread shape is not intended for neither of the standards so far.

3 Identification

In order to avoid the confusion of threads, it is generally recommended to provide a marking on metric ports and stud ends (according to ISO 9974) and for inched ones (according to ISO 1179) which is analogous to those of DIN ISO 6149 part 1 - 3 (ports and stud ends with thread according to DIN ISO 261 and O-ring-sealing).

This is a task for the manufacturers of threaded connection systems and their components.

Standard makers are requested to include relevant requirements for the identification of stud ends and ports in the relevant standard revisions and standards in progress.

Figure 2: Example of a standardized unambiguous marking on stud ends according to DIN EN ISO 6149 with metric thread for pipe connections by means of notch (circumferential notch)

The designing engineers of machinery manufacturers, purchasers of technical equipment as well as users, factory planners and maintenance personnel should ask for identified ports and stud ends for machinery.

4 Recommended measures

The risk of confusion can be reduced by changing over to threaded connection systems of *one* standard series on a machine.

In future, all ports and stud ends with metric thread according to ISO 261 should be marked with a circumferential notch (stud end) and with a projecting ring line or a stamped „M" (port) (see DIN EN ISO 6149 part 1 - 3).

This would unambiguously identify metric threads. The inched threads according to DIN EN ISO 228 should be marked in a different way so that a differentiation towards metric threads is unambiguous.

Since standard revisions and the subsequent transitional periods normally take a long time, it is recommended to specify markings in the factory standards by now.

It is recommended in particular, to change over the customer specifications (i. e. the delivery specifications) to one standard series.

The specifications made with regard to the thread type and its identification may be included in the company's working instructions.

Note:

Employees who are charged with the design of hydraulic systems and hydraulics maintenance have to be instructed with regard to the danger of confusion and the relevant precautions specified in the company.

5 Summary and limits of application

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

The present DGUV-Information has been developed by the statutory accident insurance expert committee on hydraulics and pneumatics in cooperation with the associated „Institut für Arbeitsschutz (IFA) of Deutsche Gesetzliche Unfallversicherung (DGUV).

It is particularly intended as information to designers of manufacturers and users when specifying and using hydraulic threaded connections on machines and systems which fall within the scope of the European Machinery Directive [11].

The particular specifications for other applications (in mining or similar) have to be taken into account.

The provisions according to individual laws and regulations remain unaffected by this DGUV-Information. The requirements of the legal regulations apply in full.

In order to get complete information, it is necessary to read the relevant regulation texts and the current standards.

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

This is the translation of the German DGUV-Information FB HM-025, published as issue 09/2017. An updating has become necessary due to editorial changes.

Further DGUV-Information and Information Sheets of the expert committee woodworking and metalworking (Fachbereich Holz und Metall) can be downloaded from the internet [12].

As to the aims of the DGUV-Information, refer to DGUV-Information FB HM-001 „Aims of the DGUV-Information published by the expert committee woodworking and metalworking“.

German bibliography:

[1] DIN EN ISO 4413, Fluidtechnik – Allgemeine Regeln und sicherheitstechnische Anforderungen an Hydraulikanlagen und deren Bauteile); 2011-04, Beuth Verlag

[2] DIN EN ISO 6149 Leitungsanschlüsse für Fluidtechnik und allgemeine Anwendung – Einschraublöcher und Einschraubzapfen mit metrischem Gewinde nach ISO 261 und O-Ring-Abdichtung, Ausgabe 2007-05, Beuth-Verlag
Teil 1: Einschraublöcher mit Absenkung für O-Ring-Abdichtung
Teil 2: Maße, Konstruktion, Prüfverfahren und Anforderungen für Einschraubzapfen, schwere Reihe (S-Reihe)
Teil 3: Maße, Konstruktion, Prüfverfahren und Anforderungen für Einschraubzapfen, leichte Reihe (L-Reihe)

[3] ISO 6162 Fluidtechnik – Flanschverbindungen mit einteiligen oder geteilten Flanschen und metrischen Schrauben oder Inch-Schrauben; Teil 1: Flanschverbindungen für Drücke von 3,5 MPa (35 bar) bis 35 MPa (350 bar), DN 13 bis DN 127, Ausgabe 2012-12, Beuth-Verlag

[4] ISO/DIS 6162-2 Normentwurf Fluidtechnik - Flanschverbindungen mit einteiligen oder geteilten Flanschen und metrischen Schrauben oder Inch-Schrauben - Teil 2: Flanschverbindungen, Anschlüsse und Montageflächen für den Einsatz bei einem Druck von 42 MPa (420 bar), DN 13 bis DN 76, Ausgabe 2016-09, Beuth Verlag

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[6] DIN EN ISO 1179 Leitungsanschlüsse für allgemeine Anwendung und Fluidtechnik – Einschraublöcher und -zapfen mit Gewinde nach ISO 228-1 und Elastomerdichtring oder metallener Dichtring. Beuth-Verlag
Teil 1: Einschraublöcher, Ausgabe 2014-03
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Teil 3: Einschraubzapfen mit O-Ring-Dichtung mit Stützring (Formen G und H), leichte Reihe (L). Ausgabe 2008-08
Teil 4: Einschraubzapfen mit metallener Dichtkante (Form B), nur für allgemeine Anwendung, Ausgabe 2008-08

[7] DIN EN ISO 9974 Leitungsanschlüsse für Fluidtechnik und allgemeine Anwendung – Einschraublöcher und Einschraubzapfen mit Gewinde nach ISO 261 und Elastomerdichtung oder metallener Dichtkante, Ausgabe 2000-09, Beuth-Verlag
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Teil 2: Einschraubzapfen mit Elastomerdichtung (Typ E)
Teil 3: Einschraubzapfen mit metallener Dichtkante (Typ B)

[8] ISO 11926 Leitungsanschlüsse für allgemeine Anwendung und Fluidtechnik - Einschraubloch und Einschraubzapfen mit Gewinde nach ISO 725 und O-Ring-Abdichtung, Ausgabe 1995-05, Beuth-Verlag
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Teil 3: Einschraubzapfen, leichte Reihe (L-Reihe)

[9] DIN ISO 261 Metrisches ISO-Gewinde allgemeiner Anwendung – Übersicht, Ausgabe 1999-11, Beuth-Verlag

[10] DIN EN ISO 228-1 Rohrgewinde für nicht im Gewinde dichtende Verbindungen - Teil 1: Maße, Toleranzen und Bezeichnung; Grenzmaße, Ausgabe 2003-05, Beuth-Verlag

[11] Richtlinie 2006/42/EG (Maschinenrichtlinie) Amtsblatt der Europäischen Gemeinschaften Nr. L 157/24 vom 09.06.2006 mit Berichtigung im Amtsblatt L76/35 vom 16.03.2007.

[12] Internet: www.dguv.de/fb-holzundmetall Publikationen oder www.bghm.de Webcode: <626>

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