

TECHNICAL DELIVERY SPECIFICATION

II Technical Equipment Instructions

TA03 Hydraulics

Status 07/2015



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1 Scope of Application

The technical instructions described here apply specifically to the machine/machine system's hydraulic system. They supplement the instructions listed in document I General Information of the Technical Delivery Specification of ZF Friedrichshafen AG and alongside these, are valid for all ZF plants.

2 General Requirements

2.1 Approved list

Only components, assemblies, devices and process materials appearing in the approved list may be used.

2.2 Standardized components

The unlimited exchange of different brands of standardized components and assemblies must be possible in terms of function and installation. This only applies to components which do not have a safety function (see TA07 Safety of Machinery, Environmental Protection and Fire Protection, Chapter 2.1.2 Risk assessment).

2.3 Accessibility

All components and assemblies must be easily accessible for maintenance and repair work and may not be concealed by pipes or hoses or any other components/assemblies.

No screw connections are permitted in hard-to-reach areas of the hydraulic pipework.

2.4 Catch pans

See TA07 Safety of Machinery, Environmental Protection and Fire Protection, Chapter 10.

2.5 Design

The hydraulic system must be designed to ensure that there is adequate reserve pressure and volume within a working cycle.

2.6 Protective measures

Protective measures must take into account the local conditions at the installation site that affect the machine/machine system.

2.7 Adjusting devices

Adjusting devices for components (e. g. pumps, flow regulators, pressure valves, etc.) must be secured against accidental adjustments.

3 Normative References

3.1 General requirements

As a basic principle, the agreements listed in document I General Information regarding normative references apply.

These Technical Equipment Instructions for the machine/machine system's hydraulic system are based on DIN EN ISO 4413 which must be complied with, including any recommendations and additional requirements.

An informative overview on the country-specific laws, guidelines and standards can be found in the Appendix (Chapter 14) of this document.

4 Liquid Reservoirs

4.1 Intake lines

Intake lines must end at least 50 mm above the reservoir floor and be mechanically decoupled.

4.2 Design

Liquid reservoirs must be sealed from contaminants getting in.

The liquid reservoir's size must be designed to be at least three to five times the pump capacity.

Liquid reservoirs must comply with DIN 24339 (reservoir form AN, cover form C).

[Only high-endurance pressure accumulators with a load cycle > 2,000,000 may be used.](#)

Two easily accessible (reserve) bores in accordance with the respective size of the intake pipe / standard thread (closed with plug) must be allowed for the reservoir so that e. g. oil filtering is possible during bypass operation.

4.3 Fluid-level indicator

An accessible and replaceable view glass shall be used to indicate the pressure fluid level. It must be externally visible when it is being filled, during the work cycle and when the machine/machine system is down. Dip sticks are not permitted.

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The markings for the maximum level when the machine/machine system is down and for the maximum and minimum levels when the machine/machine system is running must be permanently identified on the level indicator and be externally visible.

4.4 Level control

There must be a level control in the liquid reservoir with two switch points for the minimum level:

1st switch point → Oil level min → Preliminary warning (refill with oil)
2nd switch point → Oil level < min → Shut-down (after cycle end).

4.5 Operating temperature

When the ambient temperature is at its maximum at the machine/machine system's location, the maximum pump input temperature prescribed by the pump manufacturer for the hydraulic system may not be exceeded.

4.6 Temperature monitoring

Proof shall be provided that the temperature in the liquid reservoirs cannot exceed 65°C.

Temperature monitoring must be secured with a switch point:

Switch point → Oil too hot → Shut-down (after cycle end).

4.7 Ventilation filter

The liquid reservoirs must have a ventilation filter. The ventilation filter's filter element must be replaceable; it must be finer than the smallest filter in the system.

Under very dirty or dusty conditions, the ventilation filter must have a visual contaminant indicator.

4.8 Filling

The liquid reservoir must be filled via a filter (e. g. filler nozzle with integrated filler inlet filter).

4.9 Drain

A drain with blind plug must be installed at the lowest point of the liquid reservoir.

5 Pumps

The pump performance reserve of all pumps used in the machine/machine system must be at least 20%. These pumps are preferably volume or pressure-controlled.

The pumps must be mounted outside the reservoir/tank.

6 Cylinders

6.1 Working surfaces

The piston rod working surfaces must be tempered, micro-machined and corrosion-proof.

6.2 Damping

Precise cylinder motions shall be damped in end position (possibly with oil brakes).

7 Valves

7.1 General requirements

The valves used in the machine/machine system's hydraulic system must comply with DIN 24340-2 and DIN ISO 7368.

7.2 Modular design

Linked valves (linking systems) must feature modular design.

The linking and control plates must be mounted on components rigidly, securely and strain-free.

7.3 Electric actuation

For valves with electrical connections (not for proportional servo valves), device plug connections (line outlets) must be supplied with an LED, protective diode, connection diagram in accordance with DIN EN 175301-803, a 24 V DC voltage and a protective circuit.

Proportionally servo valves must have a device plug connection (line outlet).

7.4 Manual operation

It must be possible to manually operate electrically operated directional valves, except for proportional and proportionally servo valves (manual auxiliary operation in case of emergency); however, operating the valve by accident must be prevented.

7.5 Safety valves

All safety valves must have a CE mark, and the relevant EU declaration of conformity must be included in the machine/machine system's technical documentation.

The safety valve must accommodate the permitted pressure of the pressure accumulator with the ability to backwash the entire pump capacity. Any resulting increase in pressure may not exceed 10%.

7.6 Shut-off valve and non-return valve

A shut-off valve (stop cock) must be installed in the supply line and a non-return valve in the tank line respectively for linkage and control plates.

8 Pressure Accumulator

8.1 General requirements

The pressure devices must comply with the directive on pressure devices (DGRL 97/23/EC) or respectively the directive for simple pressure reservoirs (2009/105/EC) and the AD2000 Z1 basic rules.

The following documentation must be supplied for the hydraulic accumulator:

- a) Drawings of the reservoir with material-related information
- b) [EU declaration of conformity](#) for the reservoir and the safety valves
- c) Maximum admissible endurance for the reservoir
- d) Risk assessment
- e) Operating Instructions

Safety shut-off blocks must be used for all pressure accumulators.

Movement caused by a shut-down (also "EMERGENCY STOP") or a power outage may not endanger operators or the machine/machine system.

Only fixed pipelines leading to the pressure accumulators are permitted.

8.2 Filling gas

Nitrogen must be used as the filling gas for the pressure accumulator.

Bladder accumulators are to be installed upright.

If possible, inflation pressures above 180 bar should be avoided.

[The inflation pressure indicator must be permanently applied next to the pressure accumulator \(for design, see Chapter 13.1\).](#)

9 Piping

9.1 Pipelines

For pipelines, seamlessly drawn precision steel tubes must be used which meet the requirements of DIN EN 10220.

Seamlessly drawn precision pipes made of stainless steel in compliance with DIN EN ISO 1127 must be used in areas of the machine/machine system at risk of corrosion (chemicals, water spray, condensation, etc.).

9.2 Hose lines

Hose lines must comply with DIN 20066 and may only be used

- for moving units
- when units/assemblies are changed due to production needs
- to dampen mechanical and hydraulic vibrations and/or noises
- for measurement

lines.

The failure of the hydraulic hose lines (leakage of pressure medium / banging of the hose) must not become a threat for employees. This hazard may also be prevented by ensuring that the hose lines used within the work station's range or at transport routes are equipped with protective covers and safety chains / wire ropes or screens.

Hose lines which are more than 2 years old must not be installed.

9.3 Line connections

9.3.1 Number

The number of connections in the piping must be kept to a minimum (e. g. using bending pipes instead of elbows, distribution blocks instead of T-connections, etc.).

9.3.2 Flange connections

With a nominal bore of more than DN 40, flange connections must have O-ring seals.

9.4 Pressure measurement points

9.4.1 Position

The machine/machine system must have a pressure measurement point on each pressure switch and for each pressure overflow and safety valve.

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In addition to that, to enable pressure tests, accessible pressure measurement points must be provided with M 16x2 screw connections (miniature measuring connection) on all cylinder control lines near the cylinder connections both before and after each pressure line filter.

9.4.2 Manometer selector valve

All pressure measurement points are to lead to one manometer selector valve where the selected operating pressure is displayed.

10 Filters

10.1 General requirements

The pressure liquid filters installed in the machine/machine system must ensure that the pressure liquid is constantly kept clean.

Only such pressure liquid filters complying with DIN 24550 are permitted.

The machine tool filtering must be designed so that the filter elements last at least six months under the machine's operating conditions while at the same time warranting that the required purity of the pressure medium is maintained.

The filter manufacturer and/or subcontractor must always be included in the design of the filters. This service is currently offered free of charge by the companies "Pall" and "Hydac" for example.

10.2 Purity

The selection of the purity class is determined by the most sensitive component:

- General hydraulics: Classification based on ISO 4406, minimum purity class 19/16/13.
- Proportional valves: Classification based on ISO 4406, minimum purity class 17/15/12.
- Servo valves: Classification based on ISO 4406, minimum purity class 15/13/10.

10.3 Accessibility

Filters must be accessible and the filter inserts replaceable without disassembling other components/assemblies.

10.4 Monitoring filter soiling

The filters must have an electronic soiling indicator with a readout/signal on the control panel. If the maximum permissible level of soiling for the filter is exceeded, the machine/machine system must be shut down in accordance with the agreed criteria.

The filter soiling level must be monitored at two switch points:

1. Switch point → Filter contamination 75% → Preliminary warning: "Change filter!"
2. Switch point → Filter contamination 100% → Shut-down (after cycle end).

10.5 Other instructions

Using bypass filters is preferable.

Return flow filters with bypass valve are permitted only in connection with pressure filters.

Pressure filters may only be used with a bypass valve. Pressure filters as protective filters only without bypass valve and only with high-pressure filter elements.

Filters with screw cartridges and intake filters are not permitted.

Filters behind safety valves are not permitted.

11 Heat Exchangers

The use of heat exchangers must be coordinated with the Customer according to local conditions.

Only safety heat exchangers are permitted in conjunction with drinking water/river water.

Immersion heaters (surface power density may not exceed 0.7 W/cm²) and oil preheaters must be secured with a safety thermostat or dry protection.

12 Pressure Fluid

12.1 Use

The pressure fluid used in the hydraulic system may not be used as lubrication.

Only hydraulic fluids based on DIN 51524-2 may be used that do not corrode lead or lead-containing storage materials.

12.2 Flow speed

The flow speed of the pressure liquid through the piping must be great enough to ensure that the machine/machine system operates and produces as stipulated at every operating temperature. Reference values for the flow speed of the pressure liquid must be complied with.

12.3 Fire hazard

If there is a fire hazard at the machine/machine system, then the pressure liquid must be flame resistant.

-
- DIN EN ISO 4413 Hydraulic fluid power - General rules and safety requirements for systems and their components

14.2 European requirements

Re 8.1. General requirements for pressure tanks, pipelines, equipment accessories and hydraulic reservoirs

- Directive 97/23/EC of the European Community on pressure equipment
- Directive 2009/105/EC on simple pressure vessels
[New directive, valid as of 2016-04-20: 2014/29/EU](#)
- AD 2000 Specifications, Z1 Rules and Regulations (Working group on pressure vessels; in German AD: Arbeitsgemeinschaft Druckbehälter).

Re 7.3 Electrical actuation

- DIN EN 175301-803 Detail Specification: Rectangular connectors - Flat contacts, 0.8 mm thickness, locking screw not detachable

Re 9.1 Pipelines

- DIN EN ISO 10220 Seamless and welded steel tubes - General tables of dimensions and masses per unit length
- DIN EN ISO 1127 Stainless steel tubes - Dimensions, tolerances and conventional masses per unit length

14.3 German legal requirements

Re 3.1 General requirements (Normative References)

Re 8.1 General requirements for pressure tanks, pipelines, equipment accessories and hydraulic reservoirs

All hydraulic accumulators are subject to the operational safety requirements §15 as well as the corresponding technical rules for pressure vessels (TRBS).

Re 4.2 Design (Liquid Reservoirs)

- DIN 24339 Fluid power; hydraulic reservoirs made of steel; dimensions, requirements, test methods; nominal capacity 63 to 1250 (reservoir form AN, cover form C).

Re 7.1 General requirements (Valves)

- DIN 24340-2 Hydraulic valves; mounting surfaces and connecting plates for directional control valves
- DIN ISO 7368 Hydraulic fluid power; two-way slip-in cartridge valves; Cavities

Re 9.2 Hose lines

- DIN 20066 Fluid power systems - Hose assemblies - Dimensions, requirements

Hose assemblies must be inspected regularly, in accordance with the respective DIN standard.

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Re 10.1 General requirements (Filters)

- DIN 24550 Fluid power - Hydraulic filters

Re 12.1 Use (Pressure Fluid)

- DIN 51524-2 Pressure fluids - Hydraulic oils - Part 2: HLP hydraulic oils;
Minimum requirements

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