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**Code for installation acceptance of metal mechanical
hydromatic, lubricating and air-driven system equipment**

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**Code for installation acceptance of metal mechanical
hydromatic, lubricating and air-driven system equipment**

GB 50387-2006

Main drafting organization:

China Metallurgical Construction Association

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Foreword

According to the relevant requirements of Document JIANBIAO [2005] No.124 issued by the Ministry of Construction - "Notice on Printing and Distributing 'the Development and Revision Plan (the second batch) of National Engineering Construction Standards and Codes in 2005'", this code was formulated, in combination with the characteristics of metallurgical construction, by China First Metallurgical Construction Co., Ltd. jointly with the organizations concerned, under the organization of China Metallurgical Construction Association.

In the process of formulating this code, the code drafting group learnt the relevant current national laws, regulations and standards, conducted investigations and studies, summarized the experience in the construction quality acceptance of hydromatic, lubricating and air-driven system equipment in metal mechanical equipment installation engineering over the years, discussed and revised the provisions in the code repeatedly, solicited the opinions from related organizations and experts, and finalized this code through review.

This code consists of eight chapters, covering General Provisions; Basic Requirements; Equipment Foundation, Anchor Bolt and Bearing Plate; Equipment and Materials in Site; Equipment Installation; Fabrication and Installation of Pipeline; Pipeline Flushing, Purging and Pressure Test; and Commissioning and Test-run, as well as six appendixes. The unit project in installation of hydromatic, lubricating and air-driven system equipment totally comprises seven sub-section projects and corresponding sub-item projects.

The provisions printed in bold type in this code are mandatory ones and must be implemented strictly.

This code is under the jurisdiction of, and its mandatory provisions are interpreted by the Ministry of Construction. China First Metallurgical Construction Co., Ltd. is in charge of the explanation of specific technical specifications

In order to improve the quality of this code, all relevant organizations are kindly invited to summarize and accumulate actual experiences when implementing this code. Relevant comments and recommendations, whenever necessary, should be fed back to China First Metallurgical Construction Co., Ltd. (Address: No.3, Gongye Avenue, Qingshan District, Wuhan City, 430081, China; E-mail: jisc@cfmcc.com or xiaolw@cfmcc.com) for amendment in future revision.

The chief drafting organization, co-drafting organization and chief drafters of this code are:

Chief Formulation Organization: China First Metallurgical Construction Co., Ltd.

Co-formulation Organization: Shanghai Baoye Group Construction Co., Ltd.

Chief Drafters: Zhuo Guangyu, Xu Zuwen, Li Mingzhu, Wang Shiqing, Wu Gangping, Liu Shiyin, Song Zhanjiang, Liu Zhiyuan, Liu Guangqiu, Luo Jin and Zou Yichang.

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1 General Provisions

1.0.1 This code is prepared with a view to strengthening the management of installation quality of metal mechanical hydromatic, lubricating and air-driven system equipment and guaranteeing the engineering quality.

1.0.2 This code is applicable to the installation quality acceptance of hydromatic equipment, oil lubricating equipment, grease lubricating equipment, oil fog lubricating equipment, sliding bearing static-pressure oil supply equipment, technological lubricating equipment and air-driven system equipment among the metallurgical machinery.

1.0.3 The requirements for installation quality as given in the engineering technical document adopted during installation of hydromatic, lubricating and air-driven system equipment and in the contract agreement shall not be less than those specified in this code.

1.0.4 In addition to the requirements stipulated in this code, the installation quality acceptance of hydromatic, lubricating and air-driven system equipment also shall comply with those stipulated in the current relevant national standards.

2 Basic Requirements

2.0.1 The construction organization of metal mechanical hydromatic, lubricating and air-driven system equipment installation engineering shall be possessed of corresponding engineering construction qualification. At the construction site, corresponding technical standards for construction, and sound quality management system, quality control and inspection systems as well as the technical documents on construction organization design, construction plan and operation design which have been examined and approved by the project technical director shall be available.

2.0.2 As far as the modification of construction drawings is concerned, the Notice of Design Modification or the Certificate of Technical Verification of the design organization shall be provided.

2.0.3 The inspection and acceptance of installation quality of hydromatic, lubricating and air-driven system equipment must adopt the measuring instruments which are qualified through verification and calibration.

2.0.4 Welders taking part in the welding work in the installation of hydromatic, lubricating and air-driven system equipment must pass corresponding examination and acquire the certificate of qualification, and be engaged in welding of their qualified examination items within the approved scope.

2.0.5 The installation of hydromatic, lubricating and air-driven system equipment shall be carried out according to the established procedures, shall be carried out with handing-over inspection with the work types of relevant disciplines and also be prepared with relevant records. The procedures in this discipline shall be subjected to quality control according to the technical standards for construction; at the end of each procedure, inspection shall be conducted and quality records shall be prepared. As long as the previous procedure is not approved through inspection, the next procedure shall not be commenced.

2.0.6 As for the secondary grouting of equipment and other concealed projects in the installation of hydromatic, lubricating and air-driven system equipment, before concealment the organizations concerned shall be informed by the construction organization to conduct acceptance and prepare acceptance documents.

2.0.7 The installation quality acceptance of hydromatic, lubricating and air-driven system equipment shall be carried out according to sub-item projects, sub-section projects and unit projects on the basis of the self-inspection of construction organization. The sub-section and sub-item projects of hydromatic, lubricating and air-driven system equipment should be classified in accordance with Table 2.0.7; the installation work of hydromatic, lubricating and air-driven system equipment in an independent process system, with total installation length of pipeline larger than or equal to 10,000m, may be classified as a unit project. If it is insufficient to form a unit project, the sub-section projects of hydromatic, lubricating and air-driven system equipment shall be incorporated into the unit project of the installation of mechanical equipment engineering to undergo acceptance.

3 Equipment Foundation, Anchor Bolt and Bearing Plate

3.1 General Requirements

3.1.1 This chapter is applicable to the installation quality acceptance of the foundation, anchor bolt and bearing plate of hydromatic, lubricating and air-driven system equipment.

3.1.2 Inspection and acceptance of foundation must be conducted before equipment installation, and equipment installation shall not be carried out in case of the foundation that is not accepted through inspection.

3.2 Equipment Foundation

I Dominant items

3.2.1 The strength of equipment foundation must meet the requirements of design technical documents.

Inspection amount: Total inspection.

Inspection method: Inspecting the data relevant to foundation handover.

3.2.2 Before locating the equipment, the layout drawing of central target plate and elevation datum point shall be plotted according to the construction drawings and survey control network, according to which the central target plate and elevation datum point shall be arranged and the plumbing shall be measured.

Inspection amount: Total inspection.

Inspection method: Inspecting the surveying results sheet, and inspecting visually.

II General items

3.2.3 The axis position, elevation and dimension of equipment foundation and the position of anchor bolt shall meet the requirements of design technical documents or those stipulated in the current national standard "General Code for Construction and Acceptance of Mechanical Equipment Installation Engineering" (GB 50231).

Inspection amount: Total inspection.

Inspection method: Inspecting the re-inspection records.

3.2.4 The oil stain, crushed stone, soil, accumulated water on the surface of equipment foundation and in the reserved holes of anchor bolts shall be cleared away; the threads and nuts of embedded anchor bolts shall be protected in good order.

Inspection amount: Total inspection.

Inspection method: Inspecting visually.

3.3 Anchor Bolt

I Dominant items

3.3.1 The specification and fastening of anchor bolts must meet the requirements of design technical documents.

Inspection amount: Randomly inspecting 20% (no less than 4 pieces).

4 Equipment and Materials in Site

4.1 General Requirements

4.1.1 This chapter is applicable to the site acceptance of equipment and materials used for installation of hydromatic, lubricating and air-driven system equipment.

4.1.2 During equipment handling and hoisting, the hoisting point shall be located at the position marked on equipment or packing case and proper protective measures shall be taken, and the equipment shall not be damaged during handling and hoisting.

4.1.3 Before installation of equipment and elements, they shall undergo unpacking inspection and corresponding inspection records shall be prepared, the unpacked equipment shall be well protected and shall be timely installed.

4.1.4 After approaching the site, the raw materials shall be stacked regularly according to their specifications and shall be taken with proper measures against damage.

4.2 Equipment

Dominant items

4.2.1 The model, specification, quality and quantity of equipment and elements must meet the requirements of design technical documents.

Inspection amount: Total inspection.

Inspection method: Inspecting visually, and checking the quality certificate documents of equipment.

4.3 Raw Materials

Dominant items

4.3.1 The model, specification, quality, quantity and properties of raw materials, standard parts and the like shall meet the requirements of design technical documents or those of the current national product standards. When approaching the site, they shall undergo acceptance inspection and be prepared with acceptance records. If the re-inspection is required in the design technical documents or the relevant national standard, they shall undergo re-inspection as required.

Inspection amount: Checking all the quality certificate documents. Randomly inspecting 1% (no less than 5 pieces) of real objects.

Inspection method: Checking the quality certificate documents, re-inspection report and acceptance records, and inspecting the appearance or actually measuring.

5 Installation of Equipment

5.1 General Requirements

5.1.1 This chapter is applicable to the installation quality acceptance of metal mechanical hydromatic, lubricating and air-driven system equipment, excluding the air supply equipment and the air-driven system equipment with working pressure above 1.0MPa.

5.1.2 The installation position of control valve shall be convenient for operating and maintaining.

5.2 Installation of Oil Tank

I Dominant items

5.2.1 The oil tank must be cleaned up without any visible contaminant left inside.

Inspection amount: Total inspection.

Inspection method: Inspecting visually, and inspecting the records of concealed projects.

II General items

5.2.2 The permissible deviation of the installation of oil tank shall be in accordance with those specified in Table 5.2.2.

Inspection amount: Total inspection.

Inspection method: See Table 5.2.2.

Table 5.2.2 Permissible Deviation of the Installation of Oil Tank

Item No.	Inspection item	Permissible deviation	Inspection method
1	Vertical and horizontal center-lines	10.0mm	Measured by pull-line
2	Elevation	±10.0mm	Measured by level-gauge or ruler
3	Levelness or perpendicularity	1.5/1,000	Measured with level or hanging ruler

5.3 Installation of Cooler and Steam Heater

I Dominant items

5.3.1 The pressure test of cooler and steam heater must meet the requirements of design technical documents; in case that no relevant requirement is given in the design technical documents, the cooler and steam heater shall be tested with water medium under 1.25 times of their working pressure and shall be free from leakage and pressure drop after being kept at the test pressure for 30min.

Inspection amount: Total inspection.

Inspection method: Inspecting visually, and inspecting the pressure testing record.

II General items

5.3.2 The permissible deviation of installation of cooler and steam heater shall be in accordance with those specified in Table 5.3.2.

6 Fabrication and Installation of Pipeline

6.1 General Requirements

6.1.1 This chapter is applicable to the fabrication and installation quality acceptance of hydromatic, lubricating and air-driven pipelines.

6.1.2 As for the rust removal of carbon steel pipelines in hydromatic and lubricating systems, the tank-type pickling process or circulating pickling process may be adopted.

6.1.3 Forced joint is disallowed for the connection between pipes and between pipe and equipment.

6.1.4 Before pipeline painting, the iron rust, welding slag, burr, oil, water and other contaminants on the pipeline surface shall be cleared away; before pressure testing, the weld shall not be painted.

6.2 Pipeline Welding

Dominant items

6.2.1 For the pipeline welding, corresponding welding procedure qualification shall be carried out, and the welding work instructions shall be prepared according to the welding procedure qualification report.

Inspection amount: Total inspection.

Inspection method: Inspecting the welding procedure qualification and welding work instructions.

6.2.2 The butt welds of steel pipes in hydromatic and lubricating oil systems shall be welded or primed by argon arc welding and be filled by electric arc welding; as for the welding of stainless steel pipelines, shielding gas shall be applied into the pipeline.

Inspection amount: Total inspection.

Inspection method: Inspecting visually.

6.2.3 The internal quality of butt welds of hydromatic and grease pipelines shall meet the requirements of design technical documents; in case that no relevant requirement is given in the design technical documents, the internal quality shall meet the requirements of Grade II internal quality of butt welds as stipulated in the current national standard "Code for Construction and Acceptance of Field Equipment, Industrial Pipe Welding Engineering" (GB 50236).

Inspection amount: See Table 6.2.3.

Inspection method: Inspecting the flaw detection report.

Table 6.2.3 Random Inspection Amount of Radiographic Inspection on Welds

Working pressure [MPa]	Random inspection amount [%]
<6.3	5
6.3~31.5	15
>31.5	100

6.2.4 The appearance quality of butt welds of hydromatic and grease pipelines shall

- 3 The bent part of pipe should be free from such defects as wrinkle and peeling.
Inspection amount: Randomly inspecting 5% (no less than 10 pieces)
Inspection method: Inspecting visually, and measuring with ruler.

6.4.3 The thread machining of pipelines shall meet the requirements of design technical documents. After completion of thread machining, the thread surface shall be free from such defects as crack, pit and burr. As for the thread with slight mechanical damage or incomplete section, the accumulated length of such thread shall not be larger than 1/3 of a circle and the height decrease of thread teeth shall not be larger than 1/5 of its height.

- Inspection amount: Randomly inspecting 5% (no less than 10 points).
Inspection method: Inspecting visually, and testing by screwing the pipe.

6.5 Pipeline Installation

General items

6.5.1 The laying of steel pipeline shall meet the following requirements:

- 1 The pipeline route shall meet the requirements of design technical documents; the permissible deviation of the straightness of horizontal pipeline shall be 2/1,000 and shall not be larger than 30mm; the permissible deviation of perpendicularity of vertical pipeline shall be 3/1,000 and shall not be larger than 20mm. Pipelines shall be installed according to the coordinate position and elevation specified in the design technical documents. The permissible deviation of coordinate position is 15mm and that of elevation is ± 15 mm.

Inspection amount: Randomly inspecting 5% (no less than 10 points).

Inspection method: Observing, measured by ruler or hanging ruler, and inspected by level-gauge.

- 2 The distance from the outer wall of pipe to the edges of adjacent pipelines and pipe fittings shall not be less than 10mm, the flanges or movable joints on the pipeline at the same row shall be mutually staggered by no less than 100mm; the through-wall pipeline shall be equipped with sleeve, and its joint position should be more than 800mm away from the wall surface.

Inspection amount: Randomly inspecting 5% (no less than 10 points).

Inspection method: Inspecting visually, and measuring with ruler.

- 3 The gradient of oil return pipeline in lubricating system shall meet the requirements of design technical documents; in case that no relevant requirement is given in the design technical documents, the oil return pipeline shall be inclined towards the oil return direction and the inclination grade shall be 12.5/1,000~25/1,000.

Inspection amount: Randomly inspecting 5% (no less than 10 points).

Inspection method: Observing, and inspecting with level-gauge.

- 4 The gradient and slope direction of oil fog lubricating pipeline must be inclined upward along the oil fog flow direction, the inclination grade shall be larger than 5/1,000 and there shall be no trap on the pipeline.

Inspection amount: Randomly inspecting 5% (no less than 10 points).

Inspection method: Observing, and inspecting with level-gauge.

- 5 The flange connection shall be concentric with the pipeline, and the

7 Pipeline Flushing, Purging and Pressure Test

7.1 General Requirements

7.1.1 This chapter is applicable to the pressure tests of hydromatic, lubricating and air-driven pipelines, and the quality acceptance for flushing project of hydromatic and lubricant pipeline and for purging project of grease pipeline and air-driven pipeline.

7.1.2 Flushing of hydromatic and lubricant pipeline and purging of grease pipeline and air-driven pipeline shall be provided with corresponding operation plans, and the flushing and purging loops shall be defined to ensure that all the pipelines can be flushed and purged successively.

7.1.3 When the flushing oil (liquid) is added into oil tank, it shall be filtered and the filtration precision should not be less than the precision requirement of the system.

7.1.4 The hydraulic cylinder, hydraulic motor, energy accumulator, servo valve and proportioning valve, etc. shall not be included in flushing and pressure test.

7.1.5 The oil circulating flushing of the pipelines in hydromatic and lubricant systems shall make the contamination level of pipeline chamber meet the requirements of design technical documents. The contamination level shall be determined with particle counting method. The evaluation of contamination level shall be conducted according to the current national standard "Hydraulic Fluid Power - Fluids - Method for Coding the Level of Contamination by Solid Particles" (GB/T 14039) (see Appendix F).

7.1.6 Cylinder and air motor as well as water-separating filter, oil fogger and control valve, etc. shall not be included in pipeline purging.

7.1.7 The pressure test shall be carried out after the flushing or purging of hydromatic, lubricating and air-driven pipelines is qualified. The pressure test must be provided with pressure testing plan.

7.2 Pipeline Flushing

Dominant items

7.2.1 The pipeline circulating flushing oil (liquid) shall be compatible with equipment, element, sealing element and working medium. The oil quality shall be in accordance with the relevant current national standards.

Inspection amount: Total inspection.

Inspection method: Examining the quality certificate, and examining the cleanliness inspection report of each batch of oil.

7.2.2 The contamination levels of chambers of hydromatic and lubricating pipelines shall meet the requirements of design technical documents; if there is no relevant requirement, they shall meet the following requirements:

1 The contamination level of hydraulic servosystem shall not be greater than -/15/12.

2 The contamination level of hydraulic control system with proportioning valve and that of static-pressure oil supply system of static bearing shall not be greater than -/17/14.

Inspection method: Inspecting visually, and inspecting the pressure testing record.

7.6 Pressure Test for Air-driven Pipeline System

Dominant items

7.6.1 The pressure test for air-driven pipeline system shall meet the requirements of design technical documents; if there is no relevant requirement, when the compressed air is used as the test medium, the test pressure shall be 1.15 times of working pressure; under the test pressure, stabilize the pressure for 10min, and then drop the test pressure to working pressure, and inspect the system to make sure that the pipeline welds and joints are free from leakage and the pipeline is free from permanent deformation.

Inspection amount: Total inspection.

Inspection method: Inspecting visually, and inspecting the pressure testing record.

8 Commissioning and Test-run

8.1 General Requirements

8.1.1 Prior to commissioning and test-run, the test-run plan shall be prepared by the construction organization and the commissioning and test-run cannot be carried out until the test-run plan is approved by the chief supervision engineer (technical director of the development organization).

8.1.2 The hydromatic, lubricating and air-driven system equipment and pipeline engineering shall be installed completely, in addition, the installation inspection records and data shall be complete. The control devices of the water, air (steam), electric and metering and control instruments shall be inspected completely according to the system, and shall meet the test-run requirements.

8.1.3 The energy, media, materials, machines and tools, and testing instruments, etc. necessary for commissioning and test-run shall meet the requirements on commissioning and test-run.

8.1.4 The safety protection devices in system shall meet the design requirements. As for the functions requiring commissioning in the test-run, the commissioning shall be completed in the test-run to make the functions meet the requirements of design or equipment technical documents.

8.1.5 After the test-run of single unit is qualified, the element and loop commissioning shall be conducted according to pressure and system, and the no-load linkage test-run cannot be carried out until the system commissioning is qualified.

8.1.6 The designation of working oil (liquid) shall meet the requirements of design technical documents, and the oil quality must meet the current national product standard.

8.2 Commissioning and Test-run of Hydromatic Equipment

8.2.1 The pre-charge air pressure of air charged accumulator and the counter weight of gravity accumulator must meet the requirements of design technical documents.

Inspection amount: Total inspection.

Inspection method: Inspecting the commissioning records.

8.2.2 The locating of liquid level monitoring devices of oil tank and accumulator must meet the requirements of design technical documents, and once the liquid level change exceeds the specified height, the specified alarm signal must be sent out and the specified interlocking action must be realized immediately.

Inspection amount: Total inspection.

Inspection method: Inspecting the commissioning records, and inspecting visually.

8.2.3 Commissioning of oil heater and cooler shall make the oil temperature meet the requirements of design technical documents.

Inspection amount: Total inspection.

Inspection amount: Total inspection.

Inspection method: Observing, and inspecting the commissioning records.

8.7 Commissioning and Test-run of Air-driven System Equipment

8.7.1 After commissioning, the automatic drain water-separating gas filter must be able to drain automatically.

Inspection amount: Total inspection.

Inspection method: Inspecting visually.

8.7.2 All the control valves shall work normally and their setting values must meet the requirements of design technical documents.

Inspection amount: Total inspection.

Inspection method: Inspecting the commissioning records.

8.7.3 The commissioning and test-run of actuator shall be conducted in accordance with those specified in Article 8.2.7 of this code.

8.7.4 All pipelines shall be free from air leakage and abnormal vibration.

Inspection amount: Total inspection.

Inspection method: Inspecting visually, and inspecting the commissioning records.

Appendix B Quality Acceptance Records of Sub-section Projects in Installation of Metal Mechanical Hydromatic, Lubricating and Air-driven System Equipment

B.0.1 The quality acceptance of sub-section projects in the installation of metal mechanical hydromatic, lubricating and air-driven system equipment shall be recorded according to Table B.0.1.

Table B.0.1 Quality Acceptance Records of Sub-section Projects

Name of unit project		Name of sub-section project	
Construction organization	Technical department director	Quality department director	
Subcontractor	Subcontractor director	Subcontracting technical director	
No.	Name of sub-item project	Inspection and evaluation of the construction organization	Acceptance comments of the supervision (development) organization
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
No-load linkage test-run of single equipment			
Quality control data			
Acceptance organization	Construction organization	Project manager:	Date
	Subcontractor	Project manager:	Date
	Supervision (development) organization	Chief supervision engineer: (project leader of the development organization)	Date

C.0.3 The appearance quality acceptance of unit projects in the installation of metal mechanical hydromatic, lubricating and air-driven system equipment shall be recorded according to C.0.3.

Table C.0.3 Acceptance Records for Appearance Quality of Unit Projects

Name of unit project		Construction organization							
No.	Inspection item	Quality random inspection condition						Quality evaluation	
								Qualified	Unqualified
1	Connecting bolt								
2	Pipeline laying								
3	Sealing condition								
4	Laying of thermal insulating materials								
5	Paint brushing								
6	Walking board, ladder and railing								
7	Weld								
8	Incision								
9	Finished product protection								
10	Civilized construction								
Comprehensive evaluation on appearance quality		Professional quality inspector:			Professional supervision engineer:				
		Date			Date				
		Project manager of the construction organization:			Chief supervision engineer:				
		Date			Date				

Appendix D Commissioning and Test-run Records for Metal Mechanical Hydromatic, Lubricating and Air-driven System Equipment

D.0.1 The commissioning and test-run of hydromatic, lubricating and air-driven system equipment shall be recorded according to Table D.0.1.

Table D.0.1 Commissioning and Test-run Records for Hydromatic, Lubricating and Air-driven System Equipment

Name of unit project		Name of sub-section project		Sub-item project	
Construction organization				Project manager	
Supervision organization				Chief supervision engineer	
Subcontractor				Subcontracting project manager	
Commissioning and test-run items		Commissioning and test-run conditions		Commissioning and test-run results	
Evaluation suggestion:	Project manager:		Technical director:		Quality inspector:
	Date		Date		Date
	Supervision engineer: (Professional project technical director of the development organization)				
	Date				

Appendix F Coding of hydraulic transmission, oil solid particle contamination level (Excerpted from National Standard GB/T 14039-2002)

2 Normative References

The following standards contain provisions which, through reference in this standard, constitute provisions of this standard. For dated reference, subsequent amendments to (excluding corrigendum), or revisions of, any of these publications do not apply. However, all parties coming to agreements based on this standard are encouraged to investigate the possibility of applying the latest editions of the standards. For undated references, the latest edition of the normative document referred to applies.

GB/T 18854-2002 Hydraulic Fluid Power - Calibration of Liquid Automatic Particle Counters (ISO 11171:1999, MOD)

ISO 4407:1991 Hydraulic Fluid Power - Fluid Contamination - Determination of Particulate Contamination by the Counting Method Using a Microscope

ISO 11500:1997 Hydraulic Fluid Power - Determination of Particulate Contamination by Automatic Counting Using the Light Extinction Principle

3 Description of Designation

3.1 General provisions

The purpose of the designation is to simplify the reporting of particle count data by converting the numbers of particles in oil liquid per unit volume into a wider range of classes or codes. The contamination level designation of oil liquid consists of codes. An increase in the code is generally a doubling of the number of particles.

According to the original designation in GB/T 14039-1993, the contamination level of oil liquid is expressed by the particle concentration codes at two sizes, i.e. $>5\mu\text{m}$ and $>15\mu\text{m}$. However, considering the different calibration criteria adopted by automatic particle counters, the above particle sizes have been changed in this standard, and after change the reported sizes are $4\mu\text{m(c)}$, $6\mu\text{m(c)}$ and $14\mu\text{m(c)}$, among which the last two sizes are equivalent to the $5\mu\text{m}$ and $15\mu\text{m}$ particle sizes reported with the calibration method of automatic particle counter in ISO 4402:1991 which has been superseded by ISO 11171:1999. The $\mu\text{m(c)}$ means the particle size measured with automatic particle counter which has been calibrated according to GB/T 18854-2002.

The particle size measured with an optical microscope according to ISO 4407:1999 is the maximum size, whereas the size measured with automatic particle counter is the equivalent size converted from the projected area of particles and is different from the value measured by microscopic method in most situations. During the measurement by microscope, the reported particle sizes ($\geq 5\mu\text{m}$ and $\geq 15\mu\text{m}$) shall be the same as those specified in GB/T 14039-1993.

Note: Particle counting is affected by a variety of factors. These factors include sampling method, position, accuracy of particle counting as well as the sampling container and its cleanliness, etc.. During sampling, it is required

to be extremely careful to ensure that the obtained sample liquid can represent the circulating oil liquid in the overall system.

3.2 Constitution of designation

The designation of contamination level reported by counting with automatic particle counter comprises three codes which respectively represent the following particle sizes and their distribution:

The first code represents the number of particles, with size greater than or equal to 4 $\mu\text{m(c)}$, in per milliliter of oil liquid;

The second code represents the number of particles, with size greater than or equal to 6 $\mu\text{m(c)}$, in per milliliter of oil liquid;

The third code represents the number of particles, with size greater than or equal to 14 $\mu\text{m(c)}$, in per milliliter of oil liquid;

The contamination level designation reported by counting with microscope comprises the particle concentration codes within two particle size ranges, i.e., $\geq 5 \mu\text{m}$ and $\geq 15 \mu\text{m}$.

3.3 Determination of designation

3.3.1 The codes are determined according to the number of particles in per milliliter of liquid sample (see Table 1).

Table 1 Determination of Code

Number of particles per milliliter		Code
>	\leq	
2,500,000	-	>28
1,300,000	25,00,000	28
640,000	1,300,000	27
320,000	640,000	26
160,000	320,000	25
80,000	160,000	24
40,000	80,000	23
20,000	40,000	22
10,000	20,000	21
5,000	10,000	20
2,500	5,000	19
1,300	2,500	18
640	1,300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2.5	5	9
1.3	2.5	8
0.64	1.3	7

160 (including 160); the number of particles with size greater than or equal to 6 $\mu\text{m(c)}$ is between 20 and 40 (including 40); the third code " ≥ 7 " expresses the number of particles, with size greater than or equal to 14 $\mu\text{m(c)}$, in per milliliter of oil liquid is between 0.64 and 1.3 (including 1.3), but the count value is less than 20. At this time, the reliability of statistics reduces. Due to the lower reliability, the code of 14 $\mu\text{m(c)}$ part may actually be higher than 7, i.e., the number of particles in per milliliter of oil liquid may be greater than 1.3.

3.5 Determination of designation by counting with microscope

3.5.1 Counting shall be carried out in accordance with ISO 4407.

3.5.2 The first code shall be determined according to the number of particles greater than or equal to 5 $\mu\text{m(c)}$.

3.5.3 The second code shall be determined according to the number of particles greater than or equal to 15 $\mu\text{m(c)}$.

3.5.4 In order to be consistent with data report obtained with an automatic particle counter, the designation shall be composed of three parts, with the first part expressed by a symbol "-".

For example: -/18/13.

4 Note explanation (referring to this standard)

In case that this standard is used, the following note shall be used in the test report, product sample and sales documents: "The contamination level designation of solid particles in oil liquid shall meet 'Hydraulic Fluid Power - Fluids - Method for Coding the Level of Contamination by Solid Particles' (GB/T 14039-2002) (ISO 4406:1999, MOD)".

Wording Explanation

1 Words used for different degrees of strictness are explained as follows in order to mark the differences in implementing the requirements of this code:

- 1) Words denoting a very strict or mandatory requirement:
"Must" is used for affirmation; "must not" for negation.
- 2) Words denoting a strict requirement under normal conditions:
"Shall" is used for affirmation; "shall not" for negation.
- 3) Words denoting a permission of a slight choice or an indication of the most suitable choice when conditions permit:
"Should" is used for affirmation; "should not" for negation;
"May" is used to express the option available, sometimes with the conditional permit.

2 "Shall comply with..." or "shall meet the requirements of..." is used in this code to indicate that it is necessary to comply with the requirements stipulated in other relative standards and codes.

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