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I- मुख्य अभियन्ता (ट्रैक मशीन)

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2. फेयरली प्लेस, पूर्व रेलवे, कोलकाता–700 001
3. बड़ौदा हाउस, उत्तर रेलवे, नयी दिल्ली–110 001
4. उत्तरपूर्व रेलवे, गोरखपुर 273012
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7. रेल निलयम, दक्षिण मध्य रेलवे, सिकन्दराबाद–500 371
8. गार्डन रीच, दक्षिणपूर्व रेलवे, कोलकाता–700 043
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12. दक्षिण पश्चिम रेलवे, हुवली–580 023
13. उत्तर मध्य रेलवे, इलाहाबाद–211 001
14. पूर्व तट रेलवे, भुवनेश्वर–751 001
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Sub: Guidelines for quality Monitoring of In-service hydraulic oil

A guideline for quality Monitoring of in-service hydraulic oil in use for "on Track Machine" has been prepared and being issued herewith, Every care has been taken during preparation of above Guidelines, However the discrepancy noticed, if any, may be brought to the knowledge of the undersigned for further improvement

DA: Guidelines

18/10/16

(अनिल चौधरी)
निदेशक रेलपथ मशीन –III

प्रतिलिपि : 1. कार्यकारी निदेशक रेलपथमशीन, रेलवे बोर्ड,रेल भवन, नई दिल्ली
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19/10/16

(अनिल चौधरी)
निदेशक रेलपथ मशीन –III

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Guidelines
for
Monitoring the quality of hydraulic oil

HM /TM/GL-7

October -2016

अनुसंधान अभिकल्प और मानक संगठन लखनऊ–226011

RESEARCH DESIGNS & STANDARDS ORGANISATION

LUCKNOW- 226 011

GUIDELINES FOR MONITORING THE QUALITY OF HYDRAULIC OIL

1. Preamble

Hydraulic oil grade 68 anti wear and others grade oil are used over Indian railway track machines. While working, hydraulic fluid can pick up contamination in the form of dirt, wear particles and water. Contaminating particles circulating in the fluid system cause defects like abrasion, erosion and surface fatigue. It reduces system efficiency, accelerates component wear, reduces performance, lowers productivity, increasing operating cost and may even lead to major break downs like damage to seals, pumps, cylinders, servo valves, proportional valve and other components. Hence it is essential to regularly check and test the quality of hydraulic oil used in track machines for their efficient working.

For testing of used hydraulic oil following guide lines may be followed:

2. Properties to be Checked: Following parameters of hydraulic oil should be monitored:

a. Viscosity at 40^0 C
b. Water content in ppm
c. Total Acid number (TAN)
d. Suspended Particle count**.**

3. Frequency of Analysis:

Hydraulic oil should be tested at every 1000 engine hours**.**

4. Maximum Admissible Tolerances:

a. **Viscosity:** The admissible tolerance of viscosity having up to $\pm$ 10% of the original value i.e., $\pm$10% of viscosity Grade (like 61.2 to 74.8 for HLP 68N). If the viscosity exceeds the tolerance, the oil should be changed immediately after cleaning the tank.

b. **Water Content:** The maximum permissible ingress of water in the hydraulic oil is 0.10% (1 lit of water per 1000 lit of hydraulic oil). If emulsified water exceeds the tolerance the oil should be changed immediately after cleaning the tank.

c. **Acid Level:** Fresh oil TAN value is up to 0.5 mg KOH/gm. The TAN of oil should not exceed 1 mg KOH/gm. If the value exceeds the tolerance, the oil should be changed immediately after cleaning the tank.

d. **Suspended Particle:** The permitted suspended particles is different for different hydraulic component as tabulated below

S.no	Hydraulic components	Required purity according to	
		ISO:4406	NAS 1638
1	Servo valve application	$\leq$ 17/14/11	5*
2	Proportional valve	$\leq$ 18/15/12	6*
3	Vane pump, vane motor , piston pump, radial piston motor, gear pump, flow control	$\leq$ 18/16/14	7
4	Valves, pressure valve, cylinder.	$\leq$ 20/17/13	8

Increase in suspended particles content and water content are normally the main causes of

damage to the hydraulic components and is to be regularly monitored. If the oil is used for longer time the viscosity and TAN value may also exceed to limit and should be changed.

* Servo valve and proportional valve have separate filter to limit the required NAS value.

5.0 Method for analysis of oil purity

a. Laboratory test of sample.
b. inline measuring instruments

Inline measuring instruments are portable, and can be installed either permanently or temporary with the pressure line for the measuring and monitoring.

6.0 Methods for collecting oil sample for laboratory test.

Valve for collecting sample is normally provided by manufacturer. Oil sample should be collected from those sampling valve. In case if the same is not provided. Oil sample should be taken before return filter or any other suitable location as per manufacturer guideline if any.

To take an oil sample (100 ml of oil for each test), the following is required:

- 200 ml particle free glass bottle with cap.
- Five litre open oil container.
- Cloth.

Following instructions to be followed carefully for taking the oil sample:

a. Place the oil container beneath the sampling valve.
b. Open and close the sampling valve five times and leave it open.
c. In case sampling valve is not provided and sample is collected from representative pipe, flush the pipe by draining one liters into a separate container.
d. Open the sample bottle but avoid contamination to ingress.
e. Place the bottle under the oil flow without touching the sampling valve.
f. Fill the bottle approximately 80% full.
g. Place the cap on the bottle immediately after taking the sample.
h. Take the next sample.
i. Close the sampling valve or reconnect the pipe after all samples are collected.
j. All samples must be clearly marked with date of collection, machine number, machine make and model, place of sampling, oil grade, make and date when the oil was filled.

7.0 Standard followed for measuring suspended particle:

As mention above degree of purity is measured as per ISO44O6:1999 or as NAS value standard detail of which are given below:

7.1 ISO4406:1999 standard:

ISO4406:1999 standard determines the quantity of particles in a cumulative way i.e. >4µm, > 6 µm >14µm by using particle counter and assigns characteristic (code) number to them. Contamination level of assignments to particle numbers is to facilitate the assessments of purity of fluid. 100 ml sample taken is defined in terms of number of suspended particles as per table below

S.N	Suspended Particles/100 ml		ISO Number	S.N	Suspended Particles/100 ml		ISO Number
	From	Up to			From	Up to	
1.	**8000000**	**16000000**	**24**	13.	**2000**	**4000**	**12**
2.	**4000000**	**8000000**	**23**	14.	**1000**	**2000**	**11**
3.	**2000000**	**4000000**	**22**	15.	**500**	**1000**	**10**
4.	**1000000**	**2000000**	**21**	16.	**250**	**500**	**9**
5.	**5000000**	**1000000**	**20**	17.	**130**	**250**	**8**
6.	**250000**	**500000**	**19**	18.	**64**	**130**	**7**
7.	**130000**	**250000**	**18**	19.	**32**	**64**	**6**
8.	**64000**	**130000**	**17**	20.	**16**	**32**	**5**
9.	**32000**	**64000**	**16**	21.	**8**	**16**	**4**
10.	**16000**	**32000**	**15**	22.	**4**	**8**	**3**
11.	**8000**	**16000**	**14**	23.	**2**	**4**	**2**
12.	**4000**	**8000**	**13**	24.	**1**	**2**	**1**

Sudden breakdown in an oil system is often caused by large particles (>14µ) in the oil while slower, progressive faults, like wear and tear are caused by the smaller particles (4-6 **µ**). Particle reference sizes are set to 4 µm, 6µm and 14µm in ISO 4406:1999 for classification of hydraulic oil.

Example: if a 100 ml sample is taken and following numbers of suspended particles were found:

450,000 particles >4 µm

120,000 particles >6 µm

14,000 particles >14 µm

Analyzing to ISO classification table (above), this oil sample has a contamination value of 19/17/14.

7.2 NAS 1638:

The oil purity classes according to NAS 1638 is a differential representation of the number of particles within the 5 different size ranges i.e., 5 to 15 µm, 15 to 25 µm, 25 to 50 µm, 50 to 100 µm & >100 µm.

NAS Grade: This is an indication of cleanness of the oil in the system and its values are given below:

article Size (µm)	**NAS** Grade(number of particles in 100 ml)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
5-15	**500**	**1000**	**2000**	**4000**	**8000**	**16000**	**32000**	**64000**	**128000**	**256000**	**512000**	**1024000**
15-25	**89**	**178**	**356**	**712**	**1425**	**2850**	**5700**	**11400**	**22800**	**45600**	**91000**	**182400**
25-50	**16**	**32**	**63**	**126**	**253**	**506**	**1012**	**2025**	**4050**	**8100**	**16200**	**32400**
50-100	**3**	**6**	**11**	**22**	**45**	**90**	**180**	**360**	**720**	**1440**	**2880**	**5760**
>100	**1**	**1**	**2**	**4**	**8**	**16**	**32**	**64**	**128**	**256**	**512**	**1024**

The value in table indicates number of particles per 100 ml of sample.

Example:

The following parameters were measured for an oil specimen:

5-15µm	62000 particles	=NAS 8
15-25 µm	5000 particles	=NAS 7
25-50 µm	500 particles	=NAS 6
50-100 µm	10 particles	=NAS 3
>100 µm	1 particle	=NAS 2

The oil purity according to NAS is always determined by the highest class measured. In above case NAS value is **8.**

7.3 Equivalent value to other Standard classification

S.N	ISO classification as per ISO 4406:1999	NAS Grade as per NAS :1638
1.	ISO-10/07/05	NAS Class-1
2.	ISO-12/11/06	NAS Class-2
3.	ISO14/13/9	NAS Class-3
4.	ISO15/13/10	NAS Class-4
5.	ISO16/14/10	NAS Class-5
6.	ISO17/15/13	NAS Class-6
7.	ISO18/16/13	NAS Class-7
8.	ISO19/17/14	NAS Class-8
9.	ISO 20/18/15	NAS Class-9
10	ISO 22/19/17	NAS Class-10
11	ISO 22/20/17	NAS Class-11
12	ISO 23/21/18	NAS Class-12

8.0 Suggestion to Railway for Monitoring & Controlling the Quality of Oil:

1. With the increase in number of machines it is desirable that Railway may setup its own laboratory for testing above parameters OR may install inline system for monitoring particle contamination and moisture contamination on the machine.
2. Railway may also install a separate inline / offline hydraulic/ electrically driven filtration (max. 5micron) circuit for cleaning hydraulic oil.
3. Polymeric filter may also be used in hydraulic system to absorb moisture from oil.
4. Hygroscopic/desiccant type of breather should be used in lieu of conventional breather cap.
