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Dated 07.03.2011

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TECHNICAL CIRCULAR NO. RDSO/2011/EL/TC/0108, Rev.'0', Dated 07.03.2011.

Sub:- Test procedure for Testing of Air Dryers and its efficacy on Electric Locomotives in Electric Loco Sheds / Workshops.

Ref:- Railway Board letter No. 2001/Elect.(TS)/441/8Pt dated 12.01.2009.

Railways have experienced difficulty in conducting air dryer tests after its repair & overhauling. RDSO has examined and streamlined the parameters for conducting tests on air dryers. These instructions for working of air dryer and test procedure /maintenance of air dryers are being issued to increase awareness about working of air dryer and to carry out testing of air dryer in electric loco sheds and workshops.

1.0 System Components of Air Dryer

1.1 Pre-Coalesce:

A borosilicate or other type of element designed to restrict and collect tiny aerosol contaminants, primarily oil and other contaminants, which may prove detrimental to the successful operation of any form of desiccant.

1.2 **Desiccant Tower**

The desiccant beads, which extract the moisture from the air, are housed in two towers. These are also called desiccant towers.

1.3 **Pressure Switch**

An integral pressure sensing device is located internally to control the air drying cycle. The air dryer cycles only when the predetermined pressure is reached.

If an emergency arises and air pressure drops below the pre determined level cycling stops immediately and air flows through the air dryers to support the immediate air requirements.

1.4 **Purge valve**

There is one purge valve located at the bottom of each desiccant tower. Alternatively, there is a common purge valve connected to both desiccant towers. Purge valve allows the regenerative air to discharge moisture through the desiccant tower to atmosphere.

1.5 **Humidity Indicator**

A color indicator is located at each outlet check valve as a visual indication to monitor the condition of air after passing through each desiccant tower. Alternatively, there is a common humidity indicator is located at the outlet of final filter.

1.6 **Final Filter**

This is a unit, which removes any dust generated after the air has passed through the main dryer system. Alternatively, desiccant may be supplied in a fabric cloth bag, which can act as final filter. In such cases, separate final filter will not be required.

2.0 OPERATION OF AIR DRYER

Compressed air after main reservoir MR-2 of Electric Locomotive passes through a pre-coalesce filter. This removes significant amount of debris, moisture and oil from the compressed air. After pre-coalesce filter air enters into the actuator, which decides the entry of air to either of two desiccant towers (A and B). Position of actuator is controlled by timer unit. For example, in a particular cycle, wet air enters from the bottom of the tower (A) and passes through desiccant bed where moisture is adsorbed by the desiccant. Dry air with dew point less than ambient temperature comes out from the top and finally goes out of dryer to final filter. Final filter removes traces of desiccant powder, if any, from the dry air and air then goes to main reservoir MR-3 of Electric Locomotives.

A small part of the dry air (10-20% of inlet air capacity) is drawn from the dry air outlet of tower (A) and is passed through

regenerative orifice of non-return valve and on to the desiccant bed of the other tower (B). It removes the moisture collected in the second tower and thus reactivates the desiccant. The moisture laden air is vented through exhaust valve which is also called purge valve. Thus in this cycle tower (A) works as dehydrating tower and tower (B) works as regenerative tower.

After completion of this cycle the working of two towers reverses and now the tower (A) works as regenerative tower and tower (B) works as dehydrating tower. In this way two towers alternatively work as dehydrating/regenerative towers. This reversal takes place after a predetermined time period. This is called cycle time of the air dryer. Cycle time of air dryer is normally 1 to 2 minutes.

3.0 TESTING PROCEDURE OF AIR DRYER

The test has to be conducted by connecting the Air Dryer as per enclosed piping diagram to the test rig.

Compressor capacity with Main Reservoir pressure and testing voltage $\pm 30\%$ operating voltage depending upon type of unit to be tested is given as below:

| Application | Flow Rate (Litre / minute) | | | MR Pressure | Operating Voltage $\pm 30\%$ |
|---------------|-------------------------------|------|------|---------------------------|------------------------------|
| Electric Loco | 1000 | 2000 | 3000 | 8-10.5 kg/cm ² | 110 Volts DC |
| EMU/MEMU | 1000 | 1700 | 2000 | 6-8 kg/cm ² | 110 Volts DC |

Connect the controlled DC power supply to timer card. All cocks to be left closed all switches to be left open at above MR pressures. The test operators must be acquitted with the pertinent safety regulations.

The following parameters are to be recorded for the above conditions:

- 3.1 Visual checking of Humidity indicator
- 3.2 Pressure drop across the unit.
- 3.3 Memory feature of air dryer.
- 3.4 Drying period & regeneration period.
- 3.5 Pressure setting of pressure switch.
- 3.6 Dew point temperature at the inlet & outlet of Air Dryer.
- 3.7 Purge loss percentage.

3.1 Visual checking of Humidity indicator:

It indicates condition of air after passing through air dryer.

Visually check the colour of humidity indicator. Indication of various color are as under.

a) Blue colour: Dryer is performing correctly.

b) Lavender: Dryer is suspected for any malfunctioning.

- Verify dryer is cycling.
- If dryer is cycling correctly and auto drain valve of main reservoir No.1 is operating correctly, release the loco for service.

c) White: Possible damaged dryer.

- Verify dryer is cycling.
- Remove humidity indicators and look for desiccant dust or residue on inside of manifold and humidity indicators.
- If desiccant dust or residue is seen– Remove dryer for attention.
- If no desiccant dust or residue is seen on inside of manifold- Install new humidity indicators. Again verify dryer is cycling correctly & main reservoir drain valve is operating correctly - Release loco for service.

d) Yellow or Brown colour: Damaged dryer

It indicates that desiccant has been contaminated with oil. Replacement of coalescing element and desiccant is required.

3.2 Pressure Drop across the unit:

Open Cock C-1, Close Cock C-2 & C-3.

Wait for pressure build up and observe pressure indicator until tower (A) is charged.

Note pressure build up time:

i) Time taken from 0 to 8.0 Kg/cm² = --- seconds

ii) Time taken from 0 to 10.5 Kg/cm² =---- seconds.

As soon as reading in pressure Gauge M2 is within 0.30 Kg/cm² of Pressure gauge M1, briefly open cock C-3 and close again to discharge any trap air in the circuit. Stop the Compressor.

Observe pressure drop across the dryer unit (compare readings of M1 and M2), Reading of M2 gauge should be within 0.2 Kg/cm² of M1 gauge after 4 minutes.

No Air should escape anywhere.

3.3 Memory feature test of Air Dryer:

- Keep the pressure in MR at Maximum specified value.
- Stop the Compressor.
- No pressure drop in pressure gauge should be observed in 4 minutes. When compressor gets unloaded purging of air should stop and when compressor again gets loaded purging should continue.

3.4 Drying and Regenerative cycle time:

Cock C-2 & C-3 are closed & Cock C-1 is open. Switch ON the compressor. Wait till first switching operation of PRV valve. As soon as air vents out from silencer port 'A' of dual chamber piston valve (PRV), record the actual timing before the air vents out audibly again from the piston valve silence port.

While the dryer is cycling, there should be a slight and continuous exhaust from the relevant purge valve. After pre-determined cyclic time, exhaust from the purge valve stops and that of the second tower starts exhausting. This cycle should be reversed after cycle time. Observe and record readings for minimum 02 consecutive cycles. The cycle timings of various makes of air dryer are as under:

| Make | Cycle time |
|----------------------------|--|
| FTIL air dryer | 1 minute drying and 1 minute regeneration |
| Stone India Ltd. air dryer | 1 minute drying and 1 minute regeneration |
| Knorr-Bremse air dryer | 2 minute drying and 2 minute regeneration |

- Regeneration Time of one Tower is equivalent to Drying time of 2nd Tower.
- Duration between Tower Changes over should be almost instantaneous.

3.5 Pressure setting at the start of cycling operation:

- First close Cock C-1 and Open Cock C-2 & C-3.
- M2 - Pressure Gauge must read '0' Kg/cm².
- Now open Cock C-1 and Close Cock C-2 & C-3.

Charge the system from zero pressure and check the dryer does not cycle immediately. Note the pressure when the dryer starts cycling.

Pressure settings of start of cyclic operation are as under:

| Make | Pressure at which Air Dryer start operation |
|------------------------|---|
| FTIL air dryer | 7.0 kg/cm ² |
| SIL air dryer | 7.0 kg/cm ² |
| Knorr-Bremse air dryer | 4.6 kg/cm ² |

3.6 Dew Point Temperature:

The Dew Point Depression temperature value should be achieved as per below points:

- For new or overhauled (new desiccant) Air dryer it should be $\geq 30^{\circ}$ C.
- For Air Dryers already in service (more than 1 year) it should be $\geq 15^{\circ}$ C.

3.7 Purge loss:

Purge loss is to be calculated by any of the following method:

A) Through Flow Meter :

- Connect the flow meter at the purging port i.e. silencer port 'A' of the Air Dryer as indicated in test rig enclosed.
- Record the reading of flow meter F-1 (in LPM).
- Record the reading of flow meter F-2 (in LPM) during purging (say X lpm).
- Purge loss = $X * 100 / F-1$.

B) Through Manual Purging :

- Open isolating Cock C-1 and Close isolating cocks C-2 & C-3.
- Set RGCP setting as 10.5 Kg/cm² cut-out pressure and 8.5 Kg/cm² as cut-in pressure
- Fill the MR1 & MR2 at 10.5 Kg/cm² pressure. Switch off the compressor.
- Manually purge the Air Dryer till the compressor restarts.
- Calculate air consumed in per purging operation.

Example for calculation of purge loss by manual purging:

- Check RGCP setting.
- Fill Reservoirs up to 10.5 Kg/cm² pressure.
- Compressor will cut off at 10.5 Kg/cm² after filling of reservoirs.
- Manually purge the Air dryer till such time compressor restart.
- Record number of Purges (say – **X**).

- Air discharge through air dryer in **X** Purges = (Pressure drop x Reservoirs capacity) = 2 Kg/cm² * Reservoirs capacity in liter = **(A)**
- Air consumption in one purge = **A / X = (B)**
- Therefore % loss = (B/ (reservoir capacity x 10.5)) x 100 %.

Purge and depressurization loss of percentage of inlet air flow required for regeneration should not be more than 20% at design capacity for Electric Locomotive application and 15% for EMU/MEMU application.

4.0 Maintenance schedule of Air dryer :

Detailed maintenance procedure to be followed for various make of air dryer is given in maintenance manual of respective make of air dryer. Railways/PUS should insist for supply of maintenance manual of air dryer. As per clause No. 8.1 of air dryer specification No. MP 0.01.00.06 (Rev-03), March-07, the supplier has to supply one set of maintenance manual for every set of 05 air dryers. However important aspects related to maintenance schedule and items to be checked in schedule have been mentioned in RDSO maintenance instruction No. MP.MI-18 Rev-02, April 2008.

- 5.0** Air dryer should only be isolated when purge losses through air dryer exceeds the specified values and it is difficult to maintain the MR air pressure with air dryer in circuit. However air dryer bypass arrangement should not be removed in electric locomotives.

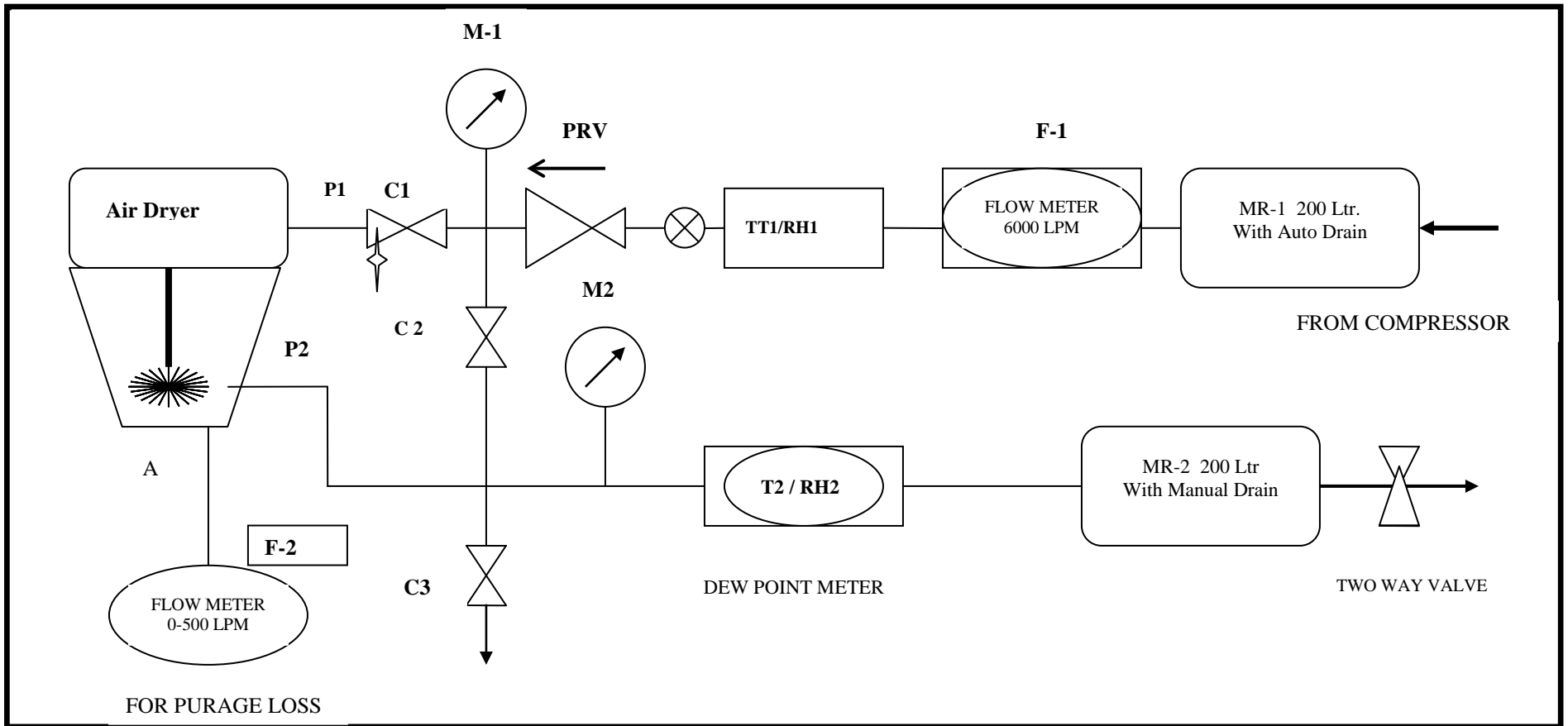
Encl.: As above.

(A. K. Goswami)
for Director General/Elect.

Copy to: As per Standard Mailing List No. EL/M/0019

Encl.: As above.

(A. K. Goswami)
for Director General/Elect.



AIR DRYER TEST RIG PIPING DIAGRAM