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**Technical requirements for optical fibre monitoring systems for
the safe operation of directly buried insulated pipelines**

直埋保温管道安全运行光纤监测系统技术条件

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6.1 Temperature Measurement System

- 6.1.1 The single-channel temperature measurement time should not exceed 1 minute.
- 6.1.2 The temperature measurement error should not exceed 3°C.
- 6.1.3 The temperature measurement positioning error should not exceed 1m.
- 6.2 Vibration Measurement System The location error of vibration anomalies should not exceed 20m.

7.1.1 Optical Cable

- 7.1.1.1 Optical cables within the same monitoring channel should be of the same structure

and from the same batch.

7.1.1.2 The temperature measurement system and the vibration measurement system should share a single optical cable.

7.1.1.3 The design of the monitoring channel should be determined based on the length of the monitored pipeline and the maximum monitoring distance of the temperature/vibration measuring host.

7.1.1.4 Inspection and testing points should be arranged on the monitoring system, and the maximum pipeline length between two adjacent inspection and testing points should not exceed 5 km. Pilot projects should be set up inside heat exchange stations or thermal well chambers. If there are no thermal well chambers, manhole wells should be set up.

7.1.1.5 The following arrangements can be selected for the cross-sectional layout of optical cables.

a) When two hot water pipes each use one fiber optic cable, it can be installed on the inner or outer side of the lower part of the pipes. The fiber optic cable can be laid in the soil, but... It should not be obstructed by hot water pipes. See Figure 2 for a schematic diagram of the dual optical fiber cable arrangement for hot water pipes.

7.1.2 Server Rack

7.1.2.1 The cabinet can be installed in the control room of the heat exchange primary station, relay pump station, pressure-reducing heat exchange station, and heating station, etc.

7.1.2.2 When the server rack is installed indoors, it shall meet the following requirements.

- a) The clearance between the heating pipe and the heating pipe shall not be less than 300mm, and the pipe shall not be installed above the heat dissipation equipment;
- b) The net distance from water supply and drainage pipes shall not be less than 200mm;
- c) The net distance between the gas pipeline and the gas meter shall not be less than 300mm.

7.1.2.3 When the server rack is installed outdoors, the clear distance between the bottom of the rack and the ground should be greater than 300mm, and there should be no obstructions or climbing obstacles within 1.5m of its perimeter. vegetation.

7.1.3 Monitoring Platform

7.1.3.1 The monitoring platform server can be set up on a cloud server or a server in a self-owned data center.

7.1.3.2 The monitoring platform display interface and the client for the audible and visual

alarms should be located in the heating monitoring center and integrated with other heating management platforms. show.

7.2.1 Fiber Optic Cable Laying

7.2.1.1 The bending radius of the optical cable shall not be less than 25 times the outer diameter of the optical cable.

7.2.1.2 Optical cables should be fixed during installation, and the fixing interval should not exceed 3m.

7.2.1.3 The rules for bundling optical cables with conduits are as follows:

- a) The sag of the optical cable between two adjacent fixed points should not exceed 50mm, and at least one fixed point should be installed every 12m of optical cable. Fixing points secured with circumferential cable ties;
- b) The binding spacing at elbows and bends should not exceed 2m;
- c) The performance of the circumferential binding material should comply with the provisions of QB/T 4010, and PET polyester strapping is recommended.

7.2.1.4 Optical cable junction boxes should be located inside heating wells or manholes. Each optical cable outside the junction box should have a pre-existing length and should not... It should be less than 5m.

7.2.1.5 The optical cable reserved in the well chamber should be coiled and placed on the optical cable slack rack.

7.2.1.6 The requirements for fiber optic cable entry manholes are as follows:

- a) Flexible hoses should be used for protection when fiber optic cables are introduced into manholes;
- b) The two ends of the optical cable that need to be connected should overlap and cross along the axial direction of the pipe before being led into the manhole.

7.2.1.7 The requirements for optical cable connections are as follows:

- a) A 1.6m length of optical fiber should be reserved inside the fiber optic splice closure. The radius of curvature of the remaining optical fiber coil should not be less than 30mm. Fiber optic splicing and encapsulation are required. After completion, it is coiled inside the junction box and securely fixed.
- b) Each optical fiber should be permanently labeled with a fiber number;

7.2.2 Server rack and power supply

7.2.2.1 The rack installation method can be either base-mounted or suspended, and should

meet the following requirements.

- a) When using a base-mounted design, the concrete foundation should be pre-constructed according to the dimensions of the temperature/vibration measurement main unit cabinet and the pre-drilled holes at the bottom. The verticality deviation of the rack installation shall not exceed 2% of the height of the temperature/vibration measurement main rack;
- b) When using a suspended type, expansion bolt holes should be pre-drilled at the rear of the temperature/vibration measurement main cabinet;
- c) After the temperature/vibration measurement main unit cabinet is fixed in place, the optical cable is fused and connected to the temperature/vibration measurement main unit.

7.2.2.2 When the mains power supply is configured in the cabinet, it shall comply with the provisions of GB 19517.

8 System Testing

8.1 Test Content The fiber optic monitoring system should undergo simulation testing, including temperature positioning error, temperature measurement error, vibration alarm testing, and monitoring platform testing.

8.2.1 Test Method

8.2.1.1 Within a single channel range, at least three representative test points (front, middle, and rear) should be selected on the optical cable under test to measure temperature. Positioning error test.

8.2.1.2 The test shall be performed according to the following steps.

- a) Place the temperature measuring unit at the starting point of the pipe to be measured;
- b) Select a test point and measure the actual distance from the test point to the starting point;
- c) Heat the optical cable at the test point using a heating pad. The heating pad should be 0.5m to 1m wide, cover the optical cable, and be in close contact with the surface of the cable. The dough should be heated for 5 to 10 minutes.
- d) Read the distance from the test point to the starting point displayed on the temperature measurement host.

8.2.2 Error Calculation The positioning error should be calculated according to formula (2).

8.2.3 Qualification Criteria The temperature positioning error at each test point should not exceed 1m.