Explanatory note

1. General part

Project of ventilation and air conditioning systems of the Reference-Laboratory located at the address: Turkmenistan, Dashoguz, Niyazov's District, TB Hospital has been developed pursuant to:

- Normative documentation of Turkmenistan:

1) Construction Norms of Turkmenistan (CNT) 3.05.02-94 “Heating, ventilation and air conditioning”;

2) CNT 2.08.02-05 “Public buildings and constructions”;

3) CNT 2.08.04-09 “Health-care facilities”;

4) CNT 2.01.01-98 “Building climatology”;

- Architectural-building and engineering drawings;
- National guidelines for TB Infectious Control of Turkmenistan, Ashkhabad, 2011.
- International recommendations: “Tuberculosis laboratory biosafety manual”, World Health Organization, 2012.

2. Baseline data

Tables #1 and #2 summarize inside and outside air parameters.

Design parameters of outside air

Table #1

Season of year	Parameters B air			
	t, °C	φ,%	i, kJ/kg	d, g/kg
Cold	-17	65	-15,8	0,6
Warm	32	41	64	12,4

Design parameters of inside air

Table #2

Season of year	Optimal air parameters			
	t, °C	φ,%	i, kJ/kg	d, g/kg
Cold	20	60	42	8,7
Warm	22	60	47	9,7

3. Ventilation and air conditioning

1. Premises of the Reference-laboratory are equipped with supply-exhaust ventilation system with mechanical activation integrated with air conditioning.

Premises of the laboratory are conditionally divided into the following zones: “clean” zone for the staff (clean manipulations and office section), “conditionally infectious” (PCR-laboratory, preliminary samples processing, preparation and staining of native smears, microscopy) and “infectious” (performing cultures) zones. Division into zones, regulated air exchange rates are defined pursuant to the requirements of the documents listed in p.1. Air balance by premises is rated for access heat removal based on critical air exchange rate and is given in Table #3.

Air Balance

Table #3

# Room	Type of room	Area of the room S, m^2	Volume of the room V, m^3	Air exchange rate per 1 hour		Supply flow rate L_{supply}, m^3/h	Exhaust flow rate $L_{exhaust}$, m^3/h
				Supply	Exhaust		
1	2	3	4	5	6	7	8
"Infectious" zone of the bacteriologic laboratory (BSL 3)							
4	Samples processing, culture, DST, DNA isolation, smear preparation from sediment	20,1	60,3	As calculated	Air removal from the BSC	980	1400
5	Cultures growth control, Bactec, incubators	21,6	64,8	13	16	820	1050
7	Dirty autoclave	11,3	33,9	As calculated	3 + air removal from the autoclave	420	600

Passage from "infectious" zone of the bacteriologic laboratory into "conditionally infectious zone"							
3	Airlock	6,0	18,0	As calculated	-	830	-
"Conditionally infectious" zone of the bacteriologic laboratory (BSL 2)							
1	Samples receipt	7,5	22,5	-	6	140 from the corridor	140
2	Preliminary samples processing, preparation and staining of native smears	11,0	33,0	As calculated	3 + air removal from the BSC	450	650
6	Shower	2,9	8,7	-	80 m^3/h ~1 fixture	80 from the corridor	80
13	Microscopy	28,9	86,7	12	15	1050	1310
14	Airlock	3,4	10,2	As calculated	-	200	-
15	Preparation of reaction mixtures	7,7	23,1	18	14	420	320
16	Hybridization on DNA strips	7,8	23,4	10	15	240	360
17	Amplification room, detection of amplification products	12,2	36,6	10	15	370	550
24	Corridor of "conditionally infectious" zone	21,6	64,8	As calculated	-	680	-
"Clean" zone of the bacteriologic laboratory							
18	Clean autoclave	12,9	38,7	As calculated	3 + air removal from the autoclave	500	620
19	Sterilization room	16,8	50,4	12	15	610	760
20	Media preparation	16,0	48,0	12	15	580	720
21	Media pouring box	3,7	11,1	As calculated	-	140	-
22	Office of the Head of the Lab	12,6	37,8	-	3	120 from the corridor	120
8	Storage	9,6	28,8	-	6	180 from the corridor	180
9	Washing room	12,8	38,4	12	15	470	580
10	Staffroom	14,6	43,8	-	3	140 from the corridor	140
11	Toilet	3,3	9,9	-	50 m^3/h ~1 toilet bowl	50 from the corridor	50
12	Cloakroom for staff	11,1	33,3	-	3	100 from the corridor	100 from the toilet
23	Corridor of "clean" zone	29,0	87,0	As calculated	-	1200	-

Design and operation of ventilation systems ensure prevention of air leaking from “infectious” zones into the “clean” ones.

Premises in the "infectious" and "conditionally infectious" zones are designed to be under negative pressure.

Remaining volume of supply air is supplied into the corridor or airlocks and flows into the rooms under negative pressure through back-flow valves (SN1-SN4) or transfer grilles in door panels.

Airlock with overpressure is installed at the entrance into the “infectious” zone and PCR laboratory. At the boundary of “clean” and “conditionally infectious” zone there is a hermetically sealed partition wall. When door is opened air flows from the corridor of the “clean” zone into the corridor of the “conditionally infectious” zone due to higher pressure.

3. The Project provides for simultaneous operation of the following ventilation systems:

- S1, E1, E4: “infectious” zone;
- S2, E2: “conditionally infectious” and “clean” zones;
- S3, E3: PCR laboratory;
- S4, E5: “clean” zone;

Independent ventilation systems are provided for the following rooms:

- shower: E6;
- toilet: E7.

4. Air is supplied and exhausted from the upper zone.

For air supply there are provided supply diffusors with static pressure chambers, thus providing uniform transfer of air along the section of the air distributor. For air exhaust there are provided aluminum egg crate return grilles.

All air diffusers have white protecting powder coating. Air flow rate is adjusted by means of air flow control valves or throttle-valves.

5. Supply equipment is located in the ventilation heat-insulated chamber on the attic.

Systems S1 and S2 include the following equipment: filters, electric air heaters, channel air conditioners and fans. Systems S3 and S4 include only channel air conditioners which operate in straight flow mode.

Compression-condensation units of S1-S4 systems are located outside on the foundation base.

6. Outdoor air is taken into the ventilation system in the clean zone at an altitude of not less than 3.5 meters from the surface level. Outside air, supplied by supply plants, is subject to filtration with coarse or fine filters (class G4 or F5) in accordance with the acting normative documents.

7. Electric air heaters with total heat power of 100.5kW are provided for heating of the supplied air. Freon air-coolers with total refrigerating power of 74.0 kW are provided for cooling of the supplied air.

For heating of supplied air during cold period (systems S1 and S2) there are two steps:

- 1st step: electric heaters for heating the air from -17°C to -5°C with total heat power of 21.3 kW;
- 2nd step: electric heaters of channel air conditioners for heating the air from -5°C to +20°C with total heat power of 42.0 kW.

Heating of supplied air for systems S3 and S4 is carried out at outdoor temperature over -5°C by means of channel air conditioner heaters with total heat power of 37.2 kW due to lack of sufficient electric capacity.

8. The equipment of the exhaust systems is located on the attic.

9. Air removed from the “infectious” zone is decontaminated in sections of bactericidal air treatment (systems E1 and E4). The section presents a channel device equipped with Philips UV lamps. Power of the used lamps is about 75W (230V).

10. The Project provides for arrangement of air ducts in the space of the false ceiling.

11. Exhaust air ducts installed in the attic and supply air ducts are insulated with heat sealing foil material with a glue layer (thickness 20 mm) in order to prevent condensate dropout.

12. The Project provides for air removal from biosafety cabinets classes 1 and 2 by means of exhaust hoods, installed right above the cabinets (systems E2 and E4).

4. Used equipment

The Project provides for the use channel equipment of Systemair, Korf, Mitsubishi Electric, O.ERRE axial fans and Systemair air diffusers.

Air ducts for the ventilation systems are manufactured from zinc-galvanized steel with thickness of S=0.5-1.0 mm. Round air ducts – spiral rolled, rectangular air ducts – on a mounting rail with sealed seams.

It is possible to change the project equipment to analogous provided that full compliance with technical characteristics is ensured and it is agreed with the project manager.

5. Noise control activities

The Project provides for the following control measures of noise caused by ventilation equipment:

- arrangement of equipment in ventilation chambers;
- installation of silencers and flexible sound-absorbing air ducts;
- installation of flexible connections upstream and downstream of fan.

6. Automation

The Project provides for automation of the ventilation systems. See Project 2013-025-01– AHV.

7. Electric power supply

Current electric main of the building will be used for electric power supply of the ventilation equipment.

Electrical parameters of the equipment are listed on page 1 of the Project.

Laying of additional electric mains will be conducted in compliance with the electric safety code, and fire code.