

Fact Sheet Tunnel Work – in Switzerland

I. Description of work environment and exposures

1.1. Work environment

Tunnels come in every shape, diameter, function and length; screwing themselves through different kinds of mud, ice, rock and gravel. However, in most cases there is a rock overlay above the tunnel, which may be just a few but up to several hundred meter high (e.g. in Switzerland up to 1600m). Further, tunnels come in lengths of a few dozen to several km (in Switzerland up to 57km). This determines both the access and time required to get in and out as well as emergency evacuation routes. Furthermore, the rock overlay determines the climate, especially heat exposure, as well as water pressure and gas release. Moreover, workers get exposed to everything what's in, or comes alongside with, the rock. Besides climatic conditions, confined spaces are a typical issue; either in tunnel drilling or maintenance work on drilling machines or installation shafts. From both the worker's and exposure perspective, the work environment changes dramatically from first drilling explorations up to the final test on technical installations before delivery or later maintenance work during full operation.

1.2. Possible exposures in tunnel work:

- Climate (heat, up to 70°C with high humidity -> cardiopulmonary demanding, water loss, heat stroke)
- Noise, vibration, shockwaves from explosive drift
- Dust (Quartz -> silicosis; Asbestos -> lung cancer; diesel fumes -> lung cancer; metal dust -> blood pressure)
- Chemicals (e.g. concrete -> skin irritation; acrylamide -> c/p nerve damage)
- Vapors, aerosols (e.g. vapors from rock drilling -> skin & lung irritation)
- Flammable Gases
- Pressure, e.g. at the shield of the drilling machine, as peaks during detonations
- Radiation (e.g. rock may contain Uranium, Radon gas)
- Shift work
- Artificial light (no daylight -> stress hormones)
- Mechanical & electrical hazards from machines, installations, tunnel collapse, rock bomblets by blasting operations

1.3. Overall, the risk assessment will base on the factors

- Exposures (chemical, physical, climate, radiation, lighting, etc)
- Exposure time, exposure ways (e.g. skin, lung ingestion), pattern
- Individual properties
- Preventive measures in place (e.g. cooling cabin, beverages)
- Prevalence / likelihood of occurrence

II. Personal protective devices

- Jumper suit (clo 1-1.5), safety shoes, helmet, gloves (total clo 1.5-2.5)
- FFP3 /half-mask or gas mask if required
- Ear protectors, protective goggles
- Rebreather
- PID (methane gas detector)

III. Health demands

- No pregnancy (if women are allowed at all in tunnel work)
- Good physical health, no cardiovascular or pulmonary diseases
- Sufficient vision (alarms may be just visual in noisy environments)
- Intact equilibrioception
- Intact eardrum
- Sufficient hearing
- No claustrophobia

IV. Medical examination

General double approach: workplace- and person-orientated examinations

4.1 Pre/post-employment

General eligibility check for tunnel work; based on national legislation; further drop-out check for possible occupational health problems after tunnel work or retirement; comprising of

- Occupational anamnesis
- General health check
- Lung x-ray
- Pulmonary function test
- EKG, plus exercise-EKG
- Lab tests (blood, liver function, renal function)

4.2 Periodically (2-3 yrs interval):

- Eardrum and inner ear; mandatory for all workers in special pressurized environments, e.g. in front of the shield of the drilling machine
- Hearing ability; mandatory for all in noisy environments
- Lung function and x-ray; mandatory for all exposed to silica dust
- EKG plus exercise-EKG, mandatory for all in pressurized a/o heat stress
- Preventive examinations due to individual needs, e.g. due to allergic reactions to chemicals or known medical conditions, e.g. skin or lung problems
- pattern due to actual exposure situation and individual needs and health conditions
- Additional tests by specialists in cases of inconclusive aptitude for tunnel work

V. Medical examination methods

5.1 Extensive occupational anamnesis

5.2 Check for any starting signs of an occupational disease, e.g.

- Aural examination
- Lung function, thorax x-ray; if required ct scan
- Biomonitoring, e.g. if exposed to acrylamide or other chemicals
- Allergy tests & skin examination

VI. Occupational medical expertise and advice

VI.1 Improvement of work environment

Only possible by regulations and company standards

VI.2 Improvement of personal behavior

Worker instruction of self-examination/observation on perceived exhaustion, dizziness, skin problems and general health

VII. Re-Integration management of long term sick employees

Depends on actual health problems; however, in most cases any medical condition other than unlimited workability won't allow a return to tunnel work

VIII. Work place health management options

- sufficient food & beverage supplied at the tunnel workplace
- cooling cabins
- on-site worker health survey by trained supervisor; e.g. for heat stress overload
- employer offers free medical checkups for all tunnel workers, additional to mandatory check-ups

Suggested literature

- Bakke B 2014-Characterization of Occupational Exposure to Air Contaminants in Modern Tunnelling Operations
- Cohen JM 2013-Air Quality Regulation in Metropolitan Railways
- DGUV 2010-Leitfaden für Betriebsärzte zur arbeitsmedizinischen Untersuchungen
- EKAS Richtlinie 6514-2005-Untertagarbeiten
- Hurley JF 2003-Assessment of health effects of long-term occupational exposure to tunnel dust in the London Underground
- Oliver LC 2006-Airway disease in highway and tunnel construction workers exposed to silica
- Palmer KT 2015-Rheumatic effects of vibration at work
- SUVA 2012-Berufliches Tauchen und Arbeiten im Überdruck-2869_08
- SUVA-Arbeitsmedizinische Prophylaxe bei Arbeiten im Untertagebau im feucht-warmen Klima-2869_26_D
- WorkCover NSW 2006-Code of Practice for Tunnels Under Construction