

From the Chief Executive

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Sent via email

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Rt. Hon. Stephen Timms MP
Chair of the Work and Pensions Select Committee
House of Commons
London
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Dear Mr Timms,

In recognition of the Work and Pensions Committee's longstanding interest in the Health and Safety Executive's (HSE) approach to asbestos management, in particular following last year's inquiry and helpful report, I would like to bring to your attention to HSE's recently launched communications campaign '*Asbestos & You*'. This campaign is aimed at those working in the building industry and seeks to further raise awareness of the risks of encountering asbestos.

Our campaign targets workers across a number of trades, including demolition, electrical, plumbing, plastering, joinery, floor and wall coverings, glazing, roofing, and decorating. In the initial part of the campaign, we are targeting younger workers that have begun their trade in the last decade, who may be less familiar with the risks of asbestos exposure than their more experienced peers.

Our campaign utilises a broad range of communications channels, including social media, trade publications, and print media. We are also working with key industry stakeholders, who are supporting us in promoting the campaign to their wider membership and supply chains.

Partners in this work include the Health in Construction Leadership Group, Construction Leadership Council, Construction Industry Advisory Committee, British Occupational Hygiene Society, the Institute of Safety and Health, and many others. In addition, Jewson, a large chain of builders' merchants, will be sharing our messages in store and via email with their customers, the majority of whom are small and medium sized enterprises.

Our campaign will run for at least 2 years and we are monitoring a number of key performance indicators in order to understand which messages and channels deliver the most effective and efficient results in driving awareness. Further information can be found on the campaign website: <https://workright.campaign.gov.uk/campaigns/asbestos/>.

In addition to the above, we are planning a further campaign, due to launch later this year, which will run alongside '*Asbestos & You*'. This second campaign will focus on the duty to manage asbestos safely in buildings by highlighting the requirements placed upon those responsible for buildings to manage any asbestos present.

I hope the above is of interest to the Committee and that this effectively demonstrates the importance, placed by HSE, on educating those who may come into contact with asbestos whilst working.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Sarah Albon', written in a cursive style.

Sarah Albon
Chief Executive, Health and Safety Executive

Responses to questions in your letter dated 9th February**1a) Can you send the Committee a copy of the newly completed research on asbestos exposures among asbestos removal workers**

The report is currently going through final accessibility publication checks and has not yet been published on the HSE website. I have included a pre-release copy of the report for your information, however I would appreciate if you would not share this more widely until it is published.

1b) Please provide a statement of progress and findings in relation to each of the three research priorities identified.

In response to the asbestos legacy issue in GB, HSE, the Department for Education (DfE) and the Government Office for Science held a stakeholder workshop in 2015. The top three areas for further research highlighted by the group were:

- i. Reviewing the evidence of the comparative risk of managing asbestos in situ versus removal.*

HSE has been undertaking work on this first priority, however this had to be paused during the pandemic as HSE staff could not access relevant premises. The team are planning to re-start this work shortly. This and previous work on measurement techniques will inform how we complete research to take forward the building of the evidence base on the effective management and safe removal of Asbestos.

- ii. Assessing measurement techniques at lower fibre concentrations.*

HSE scientists have assessed a commercially available alternative for fibre measurement, now available in GB and developed in Japan, (fluorescence microscopy) however the findings of that assessment did not support its use. HSE scientists also continue to liaise with counterparts in other national laboratories (e.g. in Germany) who also consider alternatives that become available.

- iii. Building the evidence base on the effectiveness of asbestos management and safe removal.*

HSE scientists measured personal exposure and compliance on licenced asbestos work in 2019. The work identified a reduction in average concentrations from 1997-98 research and some areas where further industry improvement could be made.

At the present time there are no costed proposals for future work, as this will depend on individual scope; however a reasonable estimate would be between £250k-400k per project. The timing and scope of any work in this space would need to be considered and prioritised in line with HSE's other work and subject to available funding/resources.

2a) Please tell us why, despite first consulting on an updated version in 2015, it took until last year before the analyst guide was published in final form.

The latest version of HSG248 was published in 2021 following public consultation in 2015. It is an extremely technical document that required a lot of detailed work and in-depth consultations with key stakeholders and the public. The points raised took time for HSE specialists to resolve, including completing some site-based research to understand current areas of poor practice so these could be addressed and improved through changes to the guidance. We acknowledge this took longer than anticipated. This did not however mean there was a decrease in standards, as this was a revision and improvement to existing guidance.

3a) Please provide data on the number of inspections carried out by the HSE of asbestos work which is categorised as ‘notifiable non-licensed’, for each year between 2016/17 and 2020/21.

3b) Please also provide any data which indicates the volume of inspections of asbestos work categorised by others as not needing to be notified and not requiring a licensed contractor.

Our inspection records do not distinguish between notifiable non-licensed work (NNLW) and non-licensed that is not notifiable (NLW). When carrying out site interventions they are both addressed simply as non-licensed asbestos activities. For both NNLW and NLW, if dutyholders are following published guidance the risk of exposure will be low.

Most of the NNLW notifications we receive (22,731 in the work-year to date, April 21 to March 22) are from those who know about the duty for example LAs, major social housing providers. We currently do not have figures on how many of these notifications directly resulted in an inspection. The information gathered is used to inform future interventions locally and nationally e.g. in the construction sector the information will be used to help inform the targeting of refurbishment and small site work priorities in HSE's work plan.

The committee should note that the NNLW category was created as part of the revisions to CAR introduced in 2012. These revisions were only introduced after HSE received a reasoned opinion from the European Commission requiring that they should be introduced to ensure that the Asbestos Directive had been fully implemented into UK law. HSE consulted on the revisions on the basis that while the new clauses relating to NNLW would be added, in the UK we would continue to base our regulatory strategy on the existing definition of the *higher risk* licensed work. *The creation of the NNLW class was no benefit to worker protection in practical safeguarding terms.* At the time 87% of consultees agreed with that approach and the revisions were introduced on that basis. Therefore, while it is accurate to say HSE considers NNLW when building a picture of sites to visit, the understanding of the industry is that HSE's focus will remain on the licensing process. We can and do inspect non-licensed work as part of our routine inspection where it is a relevant issue e.g. when visiting refurbishment work of a non-domestic premises built before 2000.

4a) Please document the range, nature and scale of evidence available on asbestos exposure levels in schools which provides assurance that schools are a safe environment.

This is understandably a sensitive issue that is of great concern to parents and workers across the country. Our position is that the risks arising from the presence of Asbestos-Containing Materials (ACMs) in schools are no greater than those from ACMs in other buildings, provided that they are managed, maintained in good condition and remain undisturbed. If this level of protection cannot be achieved, then under current law the asbestos must be removed.

In summary, HSE's position is partly based on research and sampling carried out in 2006 which cast doubt on the applicability of conclusions drawn from an earlier study in 1986 (details below). As well as carrying out school inspections, where we rarely see evidence of damaged asbestos/ asbestos in a poor condition, we will continue to work with DfE on their management approach to seek further assurance that ACMs are managed appropriately in schools.

Research and sampling studies

The value of 0.0005 f/ml, sometimes cited as typical for school buildings containing asbestos, was based on an analysis of data collected in 1986 from air sampling in four UK schools¹. The estimate is an average of a total count of 30 asbestos fibres detected over 21 samples from the four schools. Of the 30 fibres counted, 29 were chrysotile and 26 of these were from one particular school with 15 fibres associated with a single sample from a darkroom described as having a "damaged cementitious sprayed ceiling and little ventilation".

More recent work carried out in 2006² did not detect any asbestos fibres when using long-running sampling and transmission electron microscope (TEM) analysis during normal occupation of classrooms in 7 'CLASP' system-built schools (a type known to contain significant quantities of asbestos materials) after remediation work had taken place.

This suggested a long-term average exposure of less than 0.00005 f/ml in these classrooms, ie at least 10 times lower than the previous estimate based on 1980s data. Three samples from a school corridor near frequently used doors mounted on asbestos containing columns gave an estimate of 0.0001 f/ml based on the detection of only 1 amosite fibre. The use of 0.0005 f/ml as a reliable guide to exposures typical in current GB schools is therefore questionable.

Work with DfE

As part of our work to ensure that schools maintain a safe environment, HSE hold regular meetings with DfE to address the management of asbestos across the school estate and ensure that we maintain a joined-up approach to the regulation of asbestos and associated

¹ Burdett-GJ; Jaffrey-SAMT (1986) Airborne asbestos concentrations in buildings, Annals of Occupational Hygiene.30, 2, 185-199

² [Further measurements of fibre concentrations in CLASP construction buildings \(hse.gov.uk\)](https://www.hse.gov.uk/research/contractresearch/CLASP.htm)

sector communications. Future meetings will include discussion of emerging findings from DfE's CDC2 programme.

As outlined to the Committee DfE's CDC2 (Condition Data Collection 2) programme is the successor to their Condition Data Collection (CDC) programme, which ran from 2017-2019. The CDC2 programme:

- will visit every government funded school and FE College in England to collect building condition data, general site information and site management data;
- will help the Department for Education (DfE) prioritise future funding of the school estate in England;
- has a specific assurance section covering asbestos duty to manage;
- will run for 5 years between 2021 to 2026.

DfE expected to visit about 3,500 schools in the first year, followed by about 5,000 schools in each subsequent year until the total number of schools in scope (approximately 22,000 educational establishments) have been visited.

HSE are also represented on the Asbestos in Schools Steering Group (AiSSG), chaired by DfE, which also includes members from unions represented by the Joint Union Asbestos Committee (GMB chairs JUAC).

Conclusions

It is important to note that standards of control in relation to ACMs have only become more stringent over the last few decades. Controls in place now are much tighter than they were in the 1970s, 80s and 90s and the CDC survey is being used to help prioritise repairs and rebuilding of the school estate.

The results of the 2006 study also support HSE's view that where ACMs are managed, maintained in good condition and remain undisturbed, a school is a safe environment.

While we acknowledge that the research base is not particularly extensive, it does indicate that even when there is known damage to asbestos, the levels of fibres do not rise significantly as the impact of the damage subsides rapidly. When materials are undamaged there is no elevated risk above the background levels. We continue however to be open to considering any further research.

HSE plans to carry out further 'duty to manage asbestos' inspections in schools across GB and will continue to work with DfE on their management approach.

Supplementary information

1. Role of accreditation

Analysts must be accredited by UKAS (United Kingdom Accreditation Service). Where analysts are conducting sampling and testing, it is important that they meet and are accredited to relevant standards to do so. The relevant standard is the International Standard ISO/IEC 17025 for laboratories carrying out tests and/or calibrations, including sampling. This accreditation is required in the Control of Asbestos Regulations 2012 due to the very specialist nature of the role. Other EU countries have similar arrangements.

Analysts carry out a thorough visual examination and air test of the area where asbestos has been removed to certify that the area is safe or fit for re-occupation. They can also carry out sampling to identify asbestos-containing materials for surveyors of building owners.

While there is no legal requirement for asbestos surveyors to be accredited, HSE strongly recommends using surveyors accredited to standard BS EN ISO/IEC 17020. In order for the system to work, each of those with a role in it have to carry out their role competently. Licencing and accreditation exists for two of those roles and accreditation of surveyors has been considered in the past, around 2004, but was not taken forward as alternatives to a regulatory approach were felt to be the best way forward due to the burden this placed micro business. Two "individual certification" schemes were established in an attempt to address this for self-employed asbestos surveyors but both closed in 2013 due to low numbers. Competence remains an important issue for HSE and so this could be considered as part of any future work in this area.

2. HSE and UKAS licence fee

HSE's licence fee for asbestos removal is cost recoverable, so the amount was set to cover the costs for HSE to operate the scheme when it was originally set up. HSE licensing is an exacting approach including checks by HSE inspectors of licence applications and the actual performance of licensed contractors. Further information on this scheme can be found here: [Asbestos Licensing, how does it operate? \(hse.gov.uk\)](https://www.hse.gov.uk/asbestos/licensing/).

[UKAS](https://www.ukas.com/) is self-financing and charges fees to conformity assessment bodies to cover operational costs and other expenditure, but HSE is not involved in setting this fee.

As UKAS' sponsor Department within Government, BEIS provides funding to undertake public interest activities (i.e. non-fee earning activities) in representing the UK's interests in the global accreditation system.

3. Duty to manage inspection activity in 2020/21

Whilst there was no targeted campaign in 2020/21, unlike the planned inspections HSE has planned for 2022/23, compliance with 'duty to manage' would have been reviewed where applicable in wider routine inspections. However, as with any inspection activity, unless there was a fault, we wouldn't necessarily have recorded an issue.

To confirm HSE did complete 890 inspections of licensed asbestos contractors in the year 20/21. This is a high priority area of work which is built in to all of our business planning.

4. Legal competency requirements

Competence plays an important role in ensuring the safe management of asbestos. This is set out within the overarching duties of the Management of Health and Safety at Work Regulations (MHSW) 1999. The risk assessment elements of the regulations set out that they are to be completed by competent people and the framework makes clear that if the dutyholder isn't competent, they are to employ someone who is. Surveyors, for example, must be competent and comply with the requirements of CAR 12 during their work.

For those working directly with asbestos, CAR 12 is clear that they must be provided with adequate information, instruction and training so the employees can carry out their work safely. In addition, anyone liable to disturb asbestos during their work must have received the correct level of information, instruction, and training to enable them to understand the risk to themselves or others and carry out their work safely to avoid the risk.

HSE publishes detailed guidance on what is required [Asbestos information, instruction and training \(hse.gov.uk\)](https://www.hse.gov.uk/asbestos/information/index.htm)

5. Approaches to removal of asbestos by other EU Countries

The Minister reflected that HSE's approach to leaving asbestos in place, only where it is safe to do so, aligns with some of the other evidence presented by EU regulators, such as Germany, during the inquiry. Planned refurbishment or demolition provides the opportunity to proactively remove it in a managed way. HSE recognises that the Net Carbon Zero and other aspects of the "green agenda" will involve the refurbishment of huge numbers of properties over decades. This is both an opportunity for the removal of asbestos, but also a risk if it is not done safely.

HSE were asked to respond to the statement that there is a *'there is a European wide programme, as colleagues have just mentioned, having a national register, and that is a requirement across the EU member states now and there is a programme of removal as well. clear delineation between our approach and the approach in Europe'*. To our knowledge within Europe Poland has a removal plan which is due to complete in 2032. This plan is, according to published research currently behind schedule. The Netherlands has no removal plan but incentivises removal of asbestos roofs with funding and subsidised solar panels on new roofs.

Germany, France and the US all use an approach similar to GB where materials can be left in situ based on a risk assessment with removal being required when based on risk this is the best approach. HSE Science Division has recently reviewed the current literature regarding asbestos regulatory frameworks across a number of industrialised nations. A summary of the findings of their work is included as appendix 1 to this letter.

Where a ACM is in good condition, we are unable to justify the proactive removal of asbestos as it could simply create more exposure than it will prevent. We know that there is no easy way of safely removing asbestos from buildings: disturbing asbestos creates fibre release and so it is best removed at the end of a building's life or before refurbishment work providing

it can be managed safely up until that point. Those that do the removal work need to do it according to stringent control requirements to avoid exposure and future disease risk. Careful management of asbestos remaining in buildings will be necessary alongside any programme of asbestos removal, however rapid. The UK used particularly high levels of brown asbestos, which can be found in cement sheets, pipe insulation, break pads, and other roofing materials. Significant fibre release once these materials are disturbed is certain.

6. Data on occupational lung cancers and GDP

The costs of work-related cancers caused by asbestos are uncertain. The numbers of cases and the costs per case are the result of estimated modelling work and subject to uncertainty in their assumptions and the data used.

HSE estimate that during 2016-2020, there were around 2,400 mesothelioma deaths each year, with a similar number of lung cancer deaths linked to past exposures to asbestos. These deaths were caused by past working conditions – perhaps several decades in the past, given the latency of the cancers.

HSE produces cost estimates for cases of work-related cancer. These costs are present values of the costs of cases of cancer that could extend over several years.

We apply average cancer case costs to fatal cancers in this cost analysis, which will create an underestimate as the costs of a fatal cancer are greater than for a non-fatal cancer. However, the fatality rate in the average case of work-related cancer is 94% for lung cancer and 100% for mesothelioma, so this underestimate will be small.

Adjusted for 2021 costs, the total annual cost of the cases leading to deaths in 2016-2020 is estimated to be around £3.4bn for mesothelioma and around £3.1bn for lung cancer. These costs are predominantly (93%) non-financial human costs - a monetised estimate of 'pain, grief and suffering'. The remaining 7% accounts for productivity costs (3.2%), insurance (2.9%), health and rehabilitation (1.0%) and administration costs (0.2%).

7. Workplace Health Expert Committee

It is important that HSE's work is built on sound science and informed by the best available evidence. To this end, we have appointed the Workplace Health Expert Committee (WHEC) to provide independent, authoritative, impartial and timely expertise on workplace health. WHEC will provide independent expert opinion to the Health and Safety Executive, on:

- New and emerging workplace health issues;
- New and emerging evidence relating to existing workplace health issues;
- The quality and relevance of the evidence base on workplace health issues.

WHEC is a scientific and medical expert committee whose purpose is to consider the evidence linking workplace hazards to ill health. Appointments to WHEC are publicly advertised and subject to fair and open competition. Working under the leadership of an independent expert Chair, it considers chemical and physical hazards, and human, behavioural or organisational factors in the workplace (for example shift work) leading to

physiological and psychological ill health. It does not consider wellbeing, sickness absence management or rehabilitation as these issues are dealt with elsewhere in government. Nor is it able to consider individual cases of ill health. WHEC assesses the evidence base concerning health issues within its remit and will seek to effectively and appropriately communicate the resultant health risk ([Workplace Health Expert Committee \(WHEC\) \(hse.gov.uk\)](https://www.hse.gov.uk/workplace-health-expert-committee/)).

WHEC was not established as a tri-partite body but would welcome applications from Union Representatives who meet the appointment criteria when vacancies occur.

8. Modelling on volume of legacy asbestos in GB business premises, in all GB buildings and date at which it may all be removed

Being able to provide specific information about the scale of the asbestos legacy is difficult. Any estimate of buildings containing asbestos in Great Britain is highly uncertain as precise identification would require destructive sampling of all buildings constructed before 2000.

In 2002 the then Department of Environment Transport and the Regions produced a report estimating the number of domestic and commercial buildings containing asbestos - DETR: Asbestos and man-made mineral fibres in buildings. This estimated that there were 1,015,521 commercial buildings then in existence containing asbestos. DETR commercial estimates include the most common and risky asbestos-containing materials, so we expect these figures to have some underestimation. As part of the work for the 2022 Post Implementation Review (PIR) of the Control of Asbestos Regulations 2012 (CAR2012), HSE has reviewed these figures and applied a reasonable rate of attrition – buildings being demolished and buildings having their asbestos removed. Having applied this attrition rate the current provisional estimate of non-domestic premises containing asbestos was calculated as being within a range of 210,000 and 410,000 with a best estimate of 310,000.

Obtaining figures for the number of domestic properties that contain asbestos is harder. The 2017 CAR PIR reviewed Local Authority tax records for construction dates and the Valuation Office Agency figures for domestic homes in 2016, we estimated that 37% of the 25.2 million domestic premises could be constructed with asbestos-containing materials – though this should be considered an over estimation.

More detail about these figures and modelling of how the numbers of premises containing asbestos will be published within the PIR after they have been cleared by Ministers, the Regulatory Policy Committee and within HSE. We are planning to use the forthcoming Ordnance Survey data on building age, when it becomes available in 2023, to refresh these estimates and refine the data. The Ordnance Survey will improve identification of buildings that could contain asbestos by date of construction, but the presence of asbestos will remain uncertain.

9. Deterioration timeframe for asbestos

There are different types of asbestos material which have been used over time with some being more friable than others. Asbestos by its very nature doesn't degrade or corrode (which was one of its foreseen benefits when used originally). The question of how long

asbestos can stay safely in buildings would therefore be dependent on a number of factors such as;

- the type of ACMs (friability)
- their use/location in buildings (easily accessible ACM are more easily damaged)
- their history (i.e. what damage have they suffered - water, heat, physical, whether interior or exterior etc)

Cement products would have a longer lifetime than sprayed products but in most cases, where the products are sealed, enclosed and remain undamaged they would be expected to last the lifetime of the building and therefore it's use, without releasing fibres. This is why the regular inspection is so important.

Asbestos regulations in several countries**France:**

Type(s) of asbestos: The most common ACM is asbestos cement, much as roofing. Chrysotile most commonly used, though amosite used for thermal insulation and crocidolite for specialised applications requiring mechanical strength/acid resistance [1]. From 1945-1988, 97% of asbestos used was chrysotile. From 1988 only chrysotile used [2].

Surveys: For any pre-July 1st 1997 building, the owner must ensure a survey is done by a certified contractor. This must 1) look (non-destructively) for ACMs, 2) record their type and location, 3) evaluate their condition. When potential ACMs are found, samples are taken and analysed by an accredited lab. The survey report recommends a course of action [3].

Removal: Asbestos-containing materials (ACMs) can stay in place if in good condition and do not emit fibres (checked by air monitoring). Otherwise, the options are encapsulation or removal. Before work begins, risk assessment (RA) must be done taking into account all stakeholders [4]. ACMs are classified into risk categories A (greatest), B & C, with different rules for each [5]. A work plan, with measures to reduce worker exposure to the lowest technically possible level, must be in place before work begins and must be available on site [6]. Preceding containment/removal work, precautions must be taken to keep occupant exposure below 5 f/L. Work must start within 12 months and be complete within 36 months of survey results. After completion (and dismantling of enclosures) air monitoring must achieve <5 f/L clearance [3].

Management in-situ: If category A ACMs are found in survey, possible recommendations are (dependent on condition): 1) reassess within 3 years, 2) take an air measurement within 3 months, 3) containment or removal work. If the air result is <5 f/L, reassessment within 3 years (or when any substantial change). If 5 f/L, containment or removal work required. If category B ACMs, if they are degraded or there is risk of degradation, the report will give management recommendations designed to protect occupants [3].

Schools: No specific rules for schools.

Inventories/databases/information: No centralised inventory. When a report recommends air monitoring or removal, a copy is sent to the office of the region's prefect [3].

Owners of private parts of a collective residence (e.g. apartments) which contain ACMs, must get, keep and update an "asbestos private parts file" (DAPP). This contains the initial inspection report and any other inspections, tests or work. It must be shared with relevant officials or anyone carrying out work in the building [7]. It must identify any list A ACMs [3].

Owners of common areas of collective residences, and any other buildings except single-family houses, must get, keep and update an "asbestos technical file" (DTA). This contains the initial inspection report, other tests/work, general safety recommendations for the materials and a summary sheet. Must be shared on requests with any occupants (incl. employers) and with relevant officials. Summary sheet is sent 1 month after creation or changes to all occupants of the building [7]. Owners must have an inventory of all list A & B ACMs present [3].

Owners of any building must have an inventory of all list A & B ACMs to sell, or all list A, B & C ACMs to demolish the building [3].

Training/licensing of asbestos workers: Initial survey and reassessments must be carried out a certified contractor. To become certified, theory and practical exam. Certifying bodies are accredited to ISO 17024 [8]. Labs carrying out air sampling/analysis (by analytical TEM) must be accredited by the Comité français d'accréditation (COFRAC). Requirements set out in LAB-REF-26 (assessing buildings) [9] and LAB-REF-28 (personal sampling) [10]. Removal/remediation companies must be certified by accredited certification bodies [11]. Any workers likely to be exposed to asbestos must first receive specific training relevant to their work [11]. Training is carried out by a certified training organization and a certificate of competence is issued [6].

Exposure limits: In general buildings, 5 f/L limit. If exceeded, remediation or removal work required [3]. For asbestos workers: OEL = 10 f/L (8 hr time-weighted average (TWA)) [12]. All analyses to be carried out by analytical TEM [3] [6]. Asbestos fibres >5µm long, <3µm wide, aspect ratio >3:1 to be counted [13].

Germany:

Type(s) of asbestos: No known asbestos mines. From 1950-1990, 4.35m tons imported (to Federal Republic of Germany (FRG) and German Democratic Republic (GDR) combined). Of this almost 3m tons to FRG and 1.4m tons to GDR. Per capita consumption was <1kg/y in FRG, ~2.8kg/y in GDR. Chrysotile ~96%, crocidolite ~3%, amosite ~1%. In 1970s, FRG used 73% of asbestos in asbestos cement, other uses floor tiles, construction materials, car parts etc. GDR used 59% in asbestos cement sheets, 21% asbestos cement pipes, 8% in fire protection, 5% in filters. Total ~43m tons asbestos cement and ~2.8m tons weakly-bound asbestos products made [14].

Surveys: Only required when carrying out maintenance/renovation/demolition [15] [16]. If such work is planned, investigation must be obtained by whomever initiates the work (can be building owner, builder, tenant etc.). Risks considered case-by-case. In a building constructed before 31/10/1993, or if work will not affect existing components, risk can be assumed negligible and no further investigation before work may start [16]. Testing is not necessary if a) following a “low-emission processes”, as listed in TGRS 519, certified as emitting <10000 f/m³ [15], or b) if all materials are treated as asbestos [15] [16]. Otherwise any potential ACMs to be disturbed during work must be tested by an approved lab [16].

Removal: No national law requiring or specifying a timescale for removal of ACMs. Policies may be published individually by each Land (Federal State) [17]. When any activity that could disturb potential ACMs happens (maintenance/renovation/demolition), a risk-assessment must cover the chance of asbestos release. Whether “weakly-bonded” asbestos is present must be considered, and if so more stringent. If no asbestos, must be evidenced [15].

Management in-situ: The Asbest-Richtlinie (Asbestos Guidelines) regulate assessment and treatment of weakly-bound asbestos in buildings. 3 risk tiers are defined: (I) immediate need of removal/remediation; (II) reassess in <2 years; (III) reassess in <5 years. If tier (I) work needed but cannot be done immediately, interim solutions to prevent indoor fibre exposure must be put in place [14] [18].

Schools: No specific rules for schools.

Inventories/databases/information: No centralised inventory. For any work with ACMs to take place, the “competent authority” must be notified 7 days before, including: location of site, type & quantity of ACMs, activities, no. of workers, start date and duration, measures to limit release/exposure, waste disposal. Workers and their reps must also have access to this [14] [15].

Training/licensing of asbestos workers: Any work with “weakly-bound” ACMs (except certified “low emission processes”) must only be carried out by certified companies. Must have sufficient personnel and safety equipment to be certified. Subcontractors must also be certified. Companies must designate roles: 1) Responsible Person: must have expertise and authority to instruct colleagues; 2) Supervisor: during work, at least one competent person authorized to issue instructions must act as supervisor on site; 3) Qualified Person: company must have a qualified person who regularly checks safety equipment; 4) Coordinator: if employees of other companies are also at risk, the coordinator must produce a joint risk assessment (they must be authorized to instruct all parties). Individual workers must take training course for activities with ACMs and pass exam. Certificates are valid for 6 years [15]. For analysis of material samples, competent laboratories (which can provide evidence of extensive asbestos analyses or are professionally recognized) should be used. They should use procedures meeting current national/international standards [16].

Exposure limits: Clearance value of 500 f/m³ (0.5 f/L, 0.0005 f/cm³) must be confirmed in work area by Scanning Electron Microscopy (SEM) according to VDI 3492 method [19] for low-emission jobs after work is complete, and for other jobs before enclosures are dismantled. The upper Poisson value must also not exceed 1000 f/m³. Exhaust air from enclosure may not exceed 1000 f/m³ [15]. Exhaust air from industrial premises may not exceed 10000 f/m³ [20]. OEL = 10000 f/m³; if exceeded, suitable PPE must be provided and worn [15]. Workplace exposure assessment must be carried out by SEM according to the BGI 505-46 method [21]. Asbestos fibres >5µm long, <3µm wide, aspect ratio >3:1 to be counted [13].

The Netherlands:

Type(s) of asbestos: Chrysotile most common, >90% of use. Amosite and crocidolite also used (~10% combined) [22]. Approx. 80% of asbestos imported was processed into asbestos cement

products (e.g. corrugated sheets, water pipes), other applications incl. brake/friction materials, insulation, heat resistant textiles, fire resistant plates, floor underlays, gaskets, filters. Approx. 3500 different asbestos-containing products thought to have been used in the Netherlands [23].

Surveys: Anyone 1) breaking up a structure/object that may contain ACMs, 2) removing ACMs or 3) clearing up materials that may contain ACMs after an incident, must ensure that an asbestos inventory is done first (exceptions for buildings constructed from 1994 onwards, removal of brakes, roads, water/gas/sewer pipes and various small components; plus specified low-risk tasks [24]. Three types of asbestos inventory: Type A – desk research, visual inspection (inc. light destructive testing), sampling of suspected ACMs, assessment of material condition, determination of potential risk, lab analysis of samples and reporting; Type B – same as type A plus destructive testing to find non-visible asbestos (if type A suggests non-visible ACMs may be present, type B required before demolition); Type G – same as type A plus additional risk assessment to consider building use, and preparation of an asbestos management plan (according to NEN-EN-ISO/IEC 2991:2005). If no inventory available, a limited (type 0) inventory (research, no destructive testing) may be used as a short-term starting point. Inventory reports remain valid as long as representative (no fixed expiry time) [25]. Each ACM will be classified as risk class 1, 2 or 2A (1 being the lowest risk) [26]. An electronic tool (Substances Manager Asbestos Risk Technology, SMA-rt) is available to assist with risk assessment [27].

Removal: No legal obligation to remove ACMs if they were lawfully used at the time (only exception is asbestos-containing roads, which must be removed) [28]. Govt. campaign since 2000 to incentivise ACM roof removal by providing information about the particular risks (wind and weather damage over time [29]), funding towards removal and subsidised solar panels on new roofing [30]. A publicly viewable National Asbestos Roof Map contains information from municipalities on locations and total area of ACM roofing [31]. For any work involving ACMs to take place, an asbestos inventory must have been done. For risk class 1 ACMs, activities must be recorded in the SZW Inspectorate web portal [32]; for risk classes 2 and 2A, must be recorded in the National Asbestos Tracking System (LAVS) [33]. An individual may remove asbestos from their own property only if: <35m² total, removed whole, undamaged, loose or held only with screws, not broken or cut for transport. A demolition report must be sent to the municipality and permission received. Though legally permissible, govt. websites recommend against this. Any other ACM removal/remediation must be done by a certified company. Once hired, the company handles the entire process, reporting to the municipality, safe ACM removal/disposal and clearance check [34].

Management in-situ: Not always necessary to remove ACMs immediately. Risk assessment for each ACM; if suitable to remain in place an asbestos management plan must be made showing how building can safely be used. This must contain: location of all ACMs; restrictions on use (e.g. no drilling walls); a manual for maintenance workers; an emergency plan to prevent accidents/damage spreading asbestos; people involved, their responsibilities and knowledge; periodic checks required; what to do if checks reveal concerns; overview of tasks; contact details for responsible/competent people. Any remaining ACMs must have periodic checks, frequency (minimum annually) and possible requirement for dust/air analysis by a certified company, dependent on the RA [35].

Schools: “Asbestos in Schools” project launched approx. 2010. Knowledge centre Infomil collated: age of each school building, presence of asbestos inventories, ACMs and asbestos management plans [36]. The Atlas Leefomgeving website maps and colour-codes all primary and secondary school buildings: Green: built after 1994, no suspected asbestos; Yellow: building inspected, inventory produced; Orange: pre-1994 but no asbestos inventory. Map originally populated by school surveys in 2011/2012, updates twice a year. Public can contact relevant school board to request inventory report [37].

Inventories/databases/information: The LAVS is a web-based system where the asbestos surveying/management/removal process is registered and may be tracked by all involved parties, intended to simplify procedures and allow transparency. Surveyors upload the asbestos inventory; removers/remediators upload confirmation of work done; results of laboratory analysis are uploaded. The building owner receives certification of completion. Relevant govt. departments (SZW and CKI) receive notifications to allow supervision of the process [38]. The National Asbestos Roof Map allows provinces/municipalities (272 of 355 at time of writing) to record/share inventories of asbestos roofs in their area [31]. The Atlas Leefomgeving website maps and colour-codes all primary and secondary

school buildings: Green: built after 1994, no suspected asbestos; Yellow: building inspected, inventory produced; Orange: pre-1994 but no asbestos inventory. Map originally populated by school surveys in 2011/2012, updates twice a year [37].

Training/licensing of asbestos workers: Asbestos inventories must be carried out by a certified company [39]. A national directory of certified companies and people is available [40]. One certificate is required for companies which survey, another for companies which remove or remediate ACMs. Personal certificates are also required by professional asbestos removers (3 levels: DAV-1 (in-training); DAV-2 (professional remover); DTA (supervisor)). The Ministry of Social Affairs and Labour (SZW) has approved several certification bodies [41].

Exposure limits: OEL: 0.002 fibres/cm³ (8 hr TWA). Asbestos fibres >5µm long, <3µm wide, aspect ratio >3:1 to be counted [13].

Poland:

Type(s) of asbestos: Asbestos-containing products made with raw materials from former Soviet Union, Canada, Italy, Australia and the UK. No commercial asbestos mines. Over 90% chrysotile, with <10% crocidolite and amosite [42]. Of asbestos products, 88% corrugated asbestos cement sheets (mostly roofing), 8% flat sheets, 2% pipes/connectors, 2% other [43].

Surveys: Owners of ACMs (incl in properties) obliged to assess quantity/type of ACMs and submit information within a year to local govt. office, then uploaded to national database [44]. Owners carry out assessment themselves following “Information on asbestos-containing products” form from govt. website. An urgency level is assigned, which decides what action must be taken [45].

Removal: National plan “Programme for Asbestos Abatement in Poland 2039-2032” to proactively remove all asbestos [46]. Removal is the owner’s responsibility, but financial aid (variable from 20-100% of cost) allocated by localised municipal programmes [43]. Progress slower than intended: plan forecasted 28% of total known asbestos removed in 2009-2012, whereas from 2009-2017 only 7.8% (0.65 million t) was removed [43].

Management in-situ: “Level of urgency” determined by initial assessment. Level I: urgent removal/protection required; level II: reassess asbestos condition within 1 year; level III: reassess within 5 years [45].

Schools: Within wider asbestos removal strategy, schools (and other public amenities, public utility areas and former asbestos manufacturing sites) are on a high-priority building list from which removal should happen as soon as possible [46].

Inventories/databases/information: National “Asbestos Base” database, launched 2017, info on types/quantities of ACMs at each property held centrally and publicly searchable [44]. Interactive maps available in the GeoAzbest portal showing every property listed as containing or having contained asbestos. Buildings with asbestos are assigned an urgency level (3 tiers) for removal [47].

Training/licensing of asbestos workers: Directory of certified asbestos removal/surveying companies held on Asbestos Base site [48]. Removal companies must provide training in OSH and asbestos removal to workers [17] [49]. Employees of State Sanitary Inspection, National Labour Inspectorate, General Inspectorate of Construction Supervision and/or Local Govt. units may inspect/supervise work with asbestos. E-learning material is available for these staff (registration required to view) [50].

Exposure limits: 0.1 f/cm³ (8 hr time-weighted average) for fibres >5µm long, <3µm and aspect ratio >3:1 [13] [46]. Particular method of analysis not specified (though PCM predominantly used) [51] [52].

USA:

Type(s) of asbestos: Sale of most asbestos-containing products is still legal. The Environmental Protection Agency (EPA) banned most products in 1989, but overturned on appeal in 1991, few products remain banned [53]. Consumption predominantly chrysotile (now and historic) [54] [55], though approx. 5% of ACMs in buildings contain amosite [56].

Surveys: Dept. of Labor Occupational Health and Safety Administration (OSHA) regulations state that building/facility owners must determine presence, location & quantity of ACMs at any workplace. Must be available to any employers/employees at that site [57].

Removal: Managed in-situ where possible. Where renovation, demolition or removal (> threshold quantity) of ACMs occurs (except residences with <4 dwelling units), the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations specify mandatory work practices to control/reduce release of fibres [58]. Must always be at least one onsite representative trained in NESHAP compliance, refresher training every 2 years [59].

Management in-situ: Schools covered by separate legislation: AHERA [60]. Management of in-situ ACMs via an Operations and Maintenance program is advised (guidance provided), but not mandatory by federal law [61]. Some state laws exceed federal regulations [62]. Building owners must determine presence, location & quantity of ACMs at any workplace and provide this information to any employers/employees on site. Employers must ensure no employee is exposed to airborne asbestos exceeding the 8hr TWA or 30-min excursion limits. Any areas exceeding these must be demarcated, access limited to authorized personnel only, respirators provided and certain activities (eating/drinking etc.) prohibited in such areas [57].

Schools: Public and non-profit private schools covered by AHERA, legal requirements based on in-situ management: Initial inspection to detect ACMs, then any ACMs found to be reinspected every 3 years, all by licensed companies; management plan must be made, updated and a copy kept at the school; annual notifications to parent/teacher/employee organizations notifying availability of management plan and any related actions taken/planned; designated contact person must ensure proper implementation; 6-monthly checks of known ACMs by someone who has had asbestos awareness training [60] [63].

Inventories/databases/information: No centralised asbestos database. Workplace owners must keep records of ACMs at their site, share with employers/employees on site and pass on to subsequent owners [57]. For schools, public school districts and non-profit private schools must make, update and keep at each site a copy of the management plan. Must contain building details, type and location of ACMs. Must be available to parents, teachers, school employees and their representatives within 5 days of request [60].

Training/licensing of asbestos workers: The EPA Asbestos Model Accreditation Plan (MAP) [64], (issued under AHERA) requires accredited companies used to conduct asbestos inspections/actions at schools, public and commercial buildings. MAP sets out 5 required training disciplines: Worker, Contractor/supervisor, Inspector, Management planner and Project designer. State training programs must be at least as stringent as the MAP. States maintain their own lists of accredited courses. After initial training, annual refresher is necessary (may be online if approved by accrediting state) [65]. After AHERA, the National Institute of Standards and Technology (NIST) developed an accreditation program for air/bulk asbestos testing labs [65]. NIST's National Voluntary Laboratory Accreditation Program (NVLAP) maintains an online directory of accredited labs [66]. AHERA-related samples from schools must be analysed by a NVLAP lab. For other analyses, accredited labs are recommended but not mandatory [65].

Exposure limits: Employees may not be exposed to levels exceeding either 0.1 f/cm³ (8-hr TWA) or 1.0 f/cm³ over 30 minute sampling period (excursion limit). Unless employer can demonstrate exposure cannot occur under expected conditions, initial monitoring must take place. Monitoring every 6 months for workers where exposures could exceed either limit, or sooner if changes to work [57]. Air samples to satisfy these requirements taken from breathing zone and analysed by PCM by latest version of either OSHA method ID-160 [67] or NIOSH method 7400 [68].

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