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**REVIEW OF DOMESTIC ASBESTOS  
PROGRAM FOR  
ACT DEPARTMENT OF URBAN SERVICES**

by

S.K. Brown & A.K. Martin

August 1991

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# REVIEW OF DOMESTIC ASBESTOS PROGRAM FOR ACT DEPARTMENT OF URBAN SERVICES

S.K. Brown & A.K. Martin

## SUMMARY

A review of the Domestic Asbestos Program has been carried out for the ACT Department of Urban Services under specific terms of reference. These terms of reference related to the inclusion of pre-program removals in an additional reclean program and the degree of cleanliness being achieved under current Program specifications. Background documents relevant to the review were obtained from the Department and two DBCE Officers critically inspected several pre-program and Program removal homes. Their findings are presented in this review report.

## 1. INTRODUCTION

The Department of Urban Services, ACT Government, has a program underway in which it manages the removal of loose-fill asbestos fluff insulation (generally comprised of raw amosite asbestos) from the ceiling spaces of approximately 1050 ACT houses. This program is called the Domestic Asbestos Program. At the time of writing, the asbestos fluff has been removed from approximately 350 houses using a removal specification entailing a cost of \$56,000 per house. The Department of Urban Services has stated that this Program will continue to completion. However the Department has also included 41 houses in the Program (generally termed 'recleans') from which asbestos fluff was removed according to different removal specifications and at homeowners' expense prior to the Program.

Concern about the effectiveness of pre-program removals and the standard of 'clean' achieved by the current Program led the Department of Urban Services to request the Division of Building, Construction and Engineering (DBCE) to review these aspects of the program. The terms of reference for the review were as follows:

"With the health and safety of the Canberra community as a primary concern:

1. Briefly review the history of the program to date, including the decision to reclean houses treated with pre-1990 techniques.
2. Assess the adequacy/appropriateness of:
  - (a) selecting those houses which require recleaning;
  - (b) the removal technique used for recleaning houses.
3. Propose any changes to the method of selecting and recleaning those houses which had been treated with pre 1990 techniques.
4. Assess what, if any, criteria might be applied in future to assess the need for further asbestos removal work being conducted for those houses cleaned to the removal specification in use from 1990.
5. Report on the results of the review within two weeks".

In order to comply with these terms of reference, widely-based background documentation was gathered from the Department of Urban Services (Appendix I) and two DBCE Officers critically inspected the ceiling spaces of several houses for evidence of residual asbestos and sampled for airborne fibres. Review findings are presented in this report.

## 2. HISTORY OF DOMESTIC ASBESTOS PROGRAM

The history of the Program has been put into a chronological perspective based on the authors' existing knowledge of the asbestos fluff situation and information gathered from Program background documents.

- 1968-1979 – asbestos fluff was blown into the ceiling spaces of a large number of houses in the ACT and some surrounding NSW towns (e.g. Queanbeyan, Finley).
- 1978-1980 – ACT Board of Health measured airborne asbestos concentrations in living spaces of 16 houses insulated with asbestos fluff (sampling period approximately 4 hours, membrane filter method); concentrations were less than 0.01 f/mL in all cases (Mr W. Riley, ACTBH) and were considered to not present a health risk to occupants.
- 1983 – CSIRO had contact with a homeowner who had a sodium silicate encapsulant applied to the asbestos fluff (at a cost of \$1500 for 140 m<sup>2</sup>) but found it unsuccessful due to weak surface binding or pooling and staining on ceiling surfaces.
- 1984 – CSIRO had contact with a homeowner who removed the asbestos fluff himself (illegally) and others facing problems with building maintenance, reduced property values and inability to sell properties. Department of Territories and Local Government (DTLG) issued Building Note 40 'Asbestos Fluff Insulation in Buildings' which suggested remedial treatment and called for owners of affected homes to become registered. DTLG had no requirement for removal of asbestos fluff unless it became necessary because of impending demolition, extension, alteration or repair work; removal was then regulated by the Building Ordinance.
- 1987 – S. Brown inspected 3 ACT houses before, during and after removal of asbestos fluff at invitation of Asbestos Advisory Committee, DTLG. Removal was carried out by contractors within the ceiling space under negative air pressure after sealing with plastic sheeting draped across exterior of roof and under eaves – approximate cost \$10,000 to \$20,000 per house. DTLG had register of 250 houses insulated with asbestos fluff and 10 houses from which it was legally removed (and they suspect further illegal removals).
- 1988 – Federal Government decided to undertake asbestos fluff removal from ACT houses and established Asbestos Branch within ACT Administration to (a) undertake house-to-house inspection survey to determine presence of asbestos fluff (found that approximately 1050 houses affected with several containing crocidolite (blue asbestos)) (b) carry out temporary containment measures to prevent asbestos contamination of living spaces, and (c) remove asbestos fluff from all houses in a Domestic Asbestos Program. Program objectives were (i) to ensure affected houses were safe to live in and the roofspaces were safe to be visited occasionally by trades people, and (ii) to ensure worker health was protected. The overriding specification for the Program was that all visible and accessible asbestos shall be removed.
- June 1989 – Asbestos Branch developed Specification No: H8829 'Specification for the Removal of Loose Asbestos Insulation Material from Residential Dwellings Within the Australian Capital Territory'. Worksafes 'Asbestos: Draft Code of Practice and Guidance Notes' (1) was used as the primary guide, particularly its requirements to isolate the work area with impermeable sheeting when removing dry asbestos insulation and to remove all visible asbestos.

- Sept 1989 – Meeting of Asbestos Branch and health experts on asbestos to discuss occupational and environmental risks associated with less costly alternatives to H8829, e.g. method proposed by Dr David Douglas. Agreement was reached that it may not be necessary to fully isolate the roof space but that field trials should be carried out for alternative procedures.
- October 1989 – Contract for removal from 100 houses at \$45,740 per house awarded to BRS Asbestos Removal Pty Ltd.
- Nov 1989 – Asbestos Branch commenced inspection of 53 houses from which asbestos fluff was removed prior to the Program. Most did not comply with the specification of 'no visible and accessible asbestos'.
- Jan 1990 – Mr R. Usback (Project Operations Manager, Asbestos Branch) prepared a report 'Review of Cost Saving Alternatives' which considered (a) the experience of pre-program removals with tiles in place, (b) a single field trial stated to be unsuccessful in cleaning tiles and battens in situ, (c) further expert advice, (d) legal and industrial relations aspects, and (e) alternative contractual arrangements. The Douglas proposal was concluded to be not viable.
- May 1990 – Minister for Urban Services announced that 37 houses would be re-cleaned using Program specifications. Asbestos Removal Program contract for 750 houses at \$56,000 per house was awarded to Gardner Perrott.
- July 1991 – Approximately 350 houses have had asbestos fluff removed under the Program (approximately 700 affected houses remain); 17 houses have been re-cleaned with 24 remaining to be re-cleaned

### 3. REVIEW PROGRAM

#### 3.1 Background information

Documentation was received from the Department of Urban Services, as summarised in Appendix I. Also the DBCE Officers were able to discuss the Domestic Asbestos Program with Asbestos Branch personnel (Mr D. Hyde, Mr T. Hodgson, Mr B. McKenzie, Mr G. Chambers), Mr B. Dockerill (Director, Department of Urban Services) and Mr J. Enfield (Public Service Commissioner/Institute of Engineers).

#### 3.2 Site inspections

The authors inspected and sampled asbestos residues at the following buildings:

- (a) site 1, a pre-program removal building in the process of being re-cleaned;
- (b) sites 2-4, three pre-program removal houses that were selected from a list of 21 houses remaining to be re-cleaned; and
- (c) sites 5-11, seven houses from which asbestos fluff had been removed in the previous 3 months according to Program specifications and which had not been reinsulated; 4 of these houses were selected from a list of 43 supplied by the Asbestos Branch and 3 were houses from which removal had recently been completed and which were ready for reoccupancy (these had to be selected since many occupants were found to be reluctant to allow further inspections).

Inspections were carried out at group (b) houses by removing several roof tiles at 3 to 4 locations to allow ceiling spaces, external wall cavities and eave areas to be viewed and for suspected asbestos residues to be sampled. In addition the subfloor spaces and grounds adjacent to

building perimeters were inspected. Observations made during inspection and sample collection were recorded on a standard form (Appendix II).

Inspections of group (c) houses were carried out by direct access into the ceiling spaces. Both DBCE Officers inspected each ceiling for periods of 70 to 90 minutes while wearing disposable coveralls and half-face respirators (AS 1715, class M filters) and taking the precaution of dampening themselves with a water spray before leaving the ceilings. These inspections employed several practices consistent with an ASTM draft standard under development, 'Standard Practice for Visual Inspection of Asbestos Abatement Projects', which were:

- (a) visual inspection should be carried out at close range, generally close enough to touch the surface,
- (b) all surfaces from which asbestos has been removed should be inspected,
- (c) visibility of residue should be enhanced using a strong, narrow-beamed flashlight to highlight surface-attached residue or residue which becomes airborne when touched,
- (d) 'aggressive' sampling for airborne asbestos fibres should be conducted with surfaces agitated by sweeping or air currents, and
- (e) a personal air sampler could be worn by the inspector while performing the final inspection to indicate exposure risk with typical activity in the area.

The DBCE Officers closely inspected 1/3 to 1/2 of the area of each ceiling and suspected asbestos residues were sampled for subsequent analysis. Residue sampling generally involved picking up a small piece of material with fine-tipped tweezers and placing it in a sealable plastic bag. In some cases a length of wire was used to sample residue which was in wall cavities. It was possible to inspect only gable end wall cavities from the ceiling space and so other external walls were inspected from the roof exterior by shifting tiles at 3 to 4 locations per house. Subfloor spaces were inspected also and it was possible to inspect lower areas of external walls from this location. Results from visual inspection and sample collection were recorded on a standard form (Appendix II).

### 3.3 Air sampling

Air sampling was carried out during inspection of group (c) buildings by two methods:

- (i) personal sampling (i.e. within the breathing zone) on both DBCE officers for the period of ceiling space inspection (70 to 90 minutes). Sampling details were: 25 mm diameter, 0.8  $\mu\text{m}$  Millipore AA filters held in open-faced, conductive cowls with flow rates of 2.0 to 3.3 L/minute for 70 to 90 minute periods (air sample volume 160 to 300 L, average 220 L). This sampling strategy employs greater sampling volumes than specified for occupational sampling in Worksafe's standard method (1) in order to extend the measurement limit below 0.05 f/mL. It is stressed that this personal monitoring was carried out to determine whether inspection activity within ceiling spaces can disturb residual asbestos. While asbestos exposures determined by this approach may indicate potential exposure levels to maintenance workers who enter the ceiling spaces in the future, accurate assessment of their occupational exposures would require a specific exposure monitoring program.
- (ii) brush erosion release of fibres from surfaces with potential asbestos contamination. This employed a method reported recently (2) in which surfaces were lightly brushed for 5 minutes, with dislodged material being captured on the same type of filters used in personal monitoring (Figure 1). This method has been shown to assess the effectiveness of encapsulants in preventing erosion of asbestos fibres from sprayed ('limpet') asbestos insulation. It was utilised in this review to investigate whether residual asbestos surface contamination could become airborne with physical disturbance.

Filters from both methods were counted at DBCE by an accredited counter using equipment and counting procedures conforming to the standard method (1). Also, the proportion of straight needle-shaped fibres (as typically exhibited by amosite) was determined for each count. Personal sampling yielded an airborne asbestos concentration in fibres per millilitre of air (f/mL) and brush erosion assessment yielded a result in number of fibres per square millimeter of filter (f/mm<sup>2</sup>) by which to assess erodable surface contamination.

### **3.4 Asbestos identification**

Suspected asbestos residues which were sampled from the buildings were identified by the following techniques:

- (a) visual inspection – employed for large tufts, pieces and bulk residue which were clearly visually identical to amosite 'fluff';
- (b) infrared spectroscopy – employed for some tufts and specks of material of similar visual appearance to amosite 'fluff';
- (c) dispersion staining microscopy – employed as collaborative technique to (b) and for residues appearing to be mixed material.

## **4. SITE INSPECTION RESULTS**

### **4.1 Pre-program removal houses**

Results from inspection of sites 1 to 4 and analysis of residues are summarised in Table 1. The sites showed little or no evidence of coating with sealer when assessed by the appearance of building surfaces and the friable nature of asbestos residues. All sites showed asbestos contamination at most locations inspected although with wide variation in the quantity of residues. In general the external walls contained greatest quantities of asbestos. Asbestos in these external walls occurred as pieces attached to mortar dags and wall ties and as bulk material collected onto wall noggings. In one case this had led to substantial bulk asbestos falling down into the sub-floor space (Figure 2). Ceiling joists, battens and plasterboard were less contaminated than the roof beams (trusses, tile battens etc.) above them, possibly as a result of previous asbestos removal activities. At site 2, the asbestos residue on the top of roof tile battens and undersides of tiles was extensive (Figure 3) and it was considered possible for this material to fall down to lower areas and add to their contamination.

Site 4 exhibited much lower contamination than the other three sites. This building had new tiles and foil sarking installed but it was unknown if this was a factor in the better degree of cleaning.

### **4.2 Program removal houses**

Results from inspection of sites 5 to 11 are summarised in Table 2. None exhibited complete removal of asbestos fluff although all were considerably better cleaned than pre-program removals. All showed evidence of tufts, pieces or bulk of amosite fluff remaining in a high proportion of the internal walls that were inspected and generally no attempt had been made to seal this material. The asbestos had entered internal wall cavities through 5-20 mm wide gaps that occurred where wall linings failed to meet top wall plates or where electrical wiring passed through wall linings. It was found attached as tufts to plasterboard and wall studs and as pieces or bulk built up on noggings. It was accessible to DBCE Officers for sampling without great difficulty and would become much more accessible to removal contractors by cutting out the top sections of plasterboard (behind cornices) to enlarge existing gaps.

Other asbestos fluff residues found in the ceilings were generally trace amounts of specks and small tufts of residue remaining on timbers that had no sealer applied (Figure 4). Six of the seven sites inspected were found to have incomplete sealing of timber surfaces (Figure 5), generally the undersides of rafters and trusses and the sides of ceiling battens, but in some cases including the

sides of rafters and ceiling joists. In contrast, the sealer appeared to be more completely applied to external wall cavities, eave areas, ceiling surfaces and subfloor spaces.

In general the external walls were found to be completely clear of asbestos residue whether inspected from above or below (sub-floor). The exception was a gable wall at one site which contained several specks and tufts of asbestos with sealer applied.

Other residues described in Table 2 were found infrequently but are recorded for completion of the inspection. Examples of these were tufts behind cornices where plasterboard was not cut away, tufts/specks attached to the underside of tiles (together with many tufts of wood pulp possibly picked up when the tiles were passed through a water bath to exit the air-lock), and tufts attached to subfloor brickwork.

## **5. AIR MONITORING RESULTS**

### **5.1 Brush erosion release**

The brush erosion test was employed to determine whether visually clean surfaces had residual asbestos contamination which could become airborne with physical disturbance. The test was applied to sealed and unsealed surfaces within the ceiling spaces of Program removal houses (sites 5-11), especially the surfaces of roof and ceiling beams likely to be contacted by persons entering the ceiling. As described earlier, some of the unsealed surfaces had visible traces of asbestos contamination. However the brush erosion test was applied only to surface locations that were visibly free of asbestos contamination.

Brush erosion results are summarised in Table 3. Three of 11 tests on unsealed surfaces exhibited measurable fibre release, which is consistent with the visual finding of traces of asbestos on such surfaces. The level of release is comparable to that from weakly-bound asbestos products (e.g. insulation board). Note that the fibre counts on which these release measurements are based consisted of 75 to 90% straight needle-like fibres, indicating that the released fibres were likely to be asbestos and not other matter such as wood fibres. (Glasswool insulation fibres are excluded since none of the ceilings had been re-insulated prior to inspection).

No brush erosion release was detected from 15 sealed surfaces, indicating that sealing with PVA/acrylic was effective in inhibiting fibre release from residual surface contamination. This is consistent with laboratory findings that such sealants are effective in preventing brush erosion release of fibres from asbestos products provided sufficient application rates are employed (2).

### **5.2 Personal monitoring**

Results of personal monitoring of DBCE Officers while inspecting the ceiling spaces of Program removal houses are presented in Table 4. Six of 14 measurements were below the sampling detection limit of 0.02 - 0.03 f/mL. In other cases measurable exposure to asbestos dust occurred, with most concentrations ranging between 0.02 to 0.06 f/mL except in two cases where concentrations of 0.10 and 0.26 f/mL were recorded. The proportion of straight needle-like fibres in these measurements averaged 71%, which is consistent with the source of the counted fibres being amosite asbestos. Both of the higher exposures occurred on Officer 2 who spent several minutes at sites 8 and 9 gathering samples of bulk asbestos fluff from internal wall cavities. This activity is considered to be the factor responsible for these higher exposures.

As discussed earlier these measurements should not be used to derive levels of occupational asbestos exposure for maintenance workers in the ceiling spaces, but can indicate potential levels of exposure. Within the limits of the number of sites inspected, the results indicate that exposure was below detection when all surfaces were well sealed (e.g. site 11 cf site 5) and that potential existed for significantly increased exposure from activities that disturb bulk asbestos fluff in internal wall cavities (e.g. by installation of electrical wiring).

## 6. DISCUSSION

### 6.1 Pre-program removal houses

Inspection of 4 pre-program removal houses found that significant quantities of unsealed asbestos remained in the ceilings, external wall cavities and sub-floor spaces. Such buildings should be considered as highly contaminated with unsealed and friable asbestos in relation to future entry of maintenance workers into ceiling or sub-floor spaces or future building alterations. They do not meet the specification of the Domestic Asbestos Program that all visible and accessible asbestos should be removed and that residual contamination should be adequately sealed. While these ceilings were not entered by DBCE Officers in order to determine potential for personal asbestos exposure, it is considered probable that such entry by maintenance workers would entail unacceptably high exposure and clothing contamination. It is concluded that pre-program removal houses should be included in the current Program if they are to meet its specifications.

However, discussion with Asbestos Branch personnel found that not all of the pre-program removal houses will be recleaned since:

- (a) only houses from which asbestos fluff was legally removed prior to 1990 have been considered, and
- (b) inspection of 53 (legal) pre-program houses identified 6 houses that were considered to meet current Program standards.

Based on Departmental correspondence and previous DBCE information, it is considered probable that illegal removals occurred prior to the 1989 survey of ACT homes for the presence of asbestos fluff. While this survey should have identified these cases (and did so for the case referred to in Section 2) it is suggested that actions be taken to encourage remaining cases (if they exist) to come forward to be included in the Program.

Asbestos inspection reports of pre-program houses which were prepared by Asbestos Branch personnel were reviewed to derive information on possible asbestos residues in the 6 houses not included in the reclean program. This was necessary since the Asbestos Branch was unable to organise DBCE inspection of any of these buildings. A summary of the Asbestos Branch inspections is presented in Table 5. These inspections were made by removing tiles at several locations on each building and appear to have ignored areas such as gaps behind ceiling cornices, internal wall cavities and sub-floor spaces. At least 4 of the 6 buildings contained asbestos residues in external walls, whereas DBCE inspections of Program removals found this to be very uncommon. Also inspection of the ceiling space from outside is expected to be less critical than inspection with all tiles removed as under the Program. Statements by Asbestos Branch personnel that houses selected for reclean were found to contain more asbestos residues when tiles were removed than anticipated from original inspections are consistent with this suggestion. In consideration of these factors and in the absence of actual inspection of these buildings, this review must conclude that exclusion of these 6 houses from the reclean program may be inconsistent with Domestic Asbestos Program objectives.

### 6.2 Program removal houses

It is considered from inspection of these houses and comparison with asbestos-insulated houses and pre-program removal houses that the degree of asbestos removal meets the specified levels of cleanliness in most locations. It appeared that in difficult locations where the Program demanded significant effort for removal of all visible asbestos and application of sealant (e.g. external walls), this was an achievable target. However it is considered that the Program should extend this stringency to:

- (a) removal of asbestos fluff that has collected in internal wall cavities via gaps open to the ceiling space, and

- (b) binding of asbestos traces by applying sealer to all timber and other surfaces in the ceiling space.

The need for these actions is demonstrated by the finding of unbound traces of asbestos (visible or erodable) where sealer has not been applied and the measurable exposure of DBCE Officers to asbestos dust when inspecting some ceilings or disturbing asbestos fluff residues in internal wall cavities.

## **7. CONCLUSIONS**

- 7.1** Significant quantities of unsealed asbestos fluff remain in pre-program removal houses such that they fall considerably short of the cleanliness standards achieved by the Asbestos Removal Program.
- 7.2** Asbestos fluff residues in pre-program removal houses occur on the under-sides and laps of tiles, on the top of tile battens, on most surfaces of structural timbers and in external wall cavities, all of which are locations from which asbestos fluff would be difficult to remove without the complete removal of tiles as occurs in the current Program.
- 7.3** The possibility of remaining but unknown illegal removal houses and the exclusion of 6 pre-program removal houses from the reclean program may be inconsistent with stated Program objectives.
- 7.4** The stringent specifications of the Domestic Asbestos Program have been met with high degrees of cleanliness being achieved in most of the locations that were inspected. However the specifications were not fully met in two locations. Inspections should be extended to ensure that asbestos fluff residues are removed from internal walls and that sealer is applied to all surfaces in the ceiling spaces.

## **8. REFERENCES**

- (1) National Occupational Health and Safety Commission (1988). Asbestos: Code of Practice and Guidance Notes. AGPS, Canberra.
- (2) Brown, S.K. and Angelopoulos, M. (1991). Evaluation of erosion release and suppression of asbestos fibres from asbestos building products. Amer. Ind. Hyg. Assoc. J. (Sept).

**Table 1. Site inspection results for pre-program removal houses**

| Site Number | Rating for Sealer Applic. <sup>a</sup> | Residual Contamination <sup>b</sup> at Location |              |              |            |               |                 |           |               |                |               |
|-------------|--|---|--------------|--------------|------------|---------------|-----------------|-----------|---------------|----------------|---------------|
|             |  | roof tiles                                      | tile battens | foil sarking | roof beams | ceiling beams | ceiling surface | eave area | internal wall | external wall  | sub-floor     |
| 1*          | 0                                      | –   | 1/u          | not used     | 0          | 0             | 3/u             | 5/u       | not inspected | 6/u            | not inspected |
| 2           | 0                                      | 4/u   | 4/u          | "            | 4/u        | 2/u           | 5/u             | 4/u       | "             | 5/u            | 6/u           |
| 3           | 2                                      | 2/u   | 4/u          | "            | 4/u        | 2/u           | 3/u             | 3/u       | "             | 6/u            | 6/u           |
| 4           | 2                                      | new   | new          | new          | 2/u        | 2/u           | 1/u             | 0         | 5/u           | not accessible | 0             |

- <sup>a</sup> 0 = no sealer applied  
2 = little evidence of sealer

- <sup>b</sup> 0 = no visible residue  
1 = occasional specks (asbestos residue smaller than 3 mm)  
2 = many specks  
3 = tufts (asbestos residue 3 to 10 mm in size)  
4 = film of asbestos fluff on surface  
5 = pieces (asbestos residue 10 to 50 mm in size)  
6 = bulk (asbestos residue greater than 50 mm in size)  
u = unsealed  
s = sealed

\* in process of recleaning

Table 2. Site inspection results for Program removal houses

| Site Number | Rating for Sealer Applic. <sup>a</sup> | Residual Contamination <sup>b</sup> at Location |              |              |            |               |                 |               |               |               |           |
|-------------|--|---|--------------|--------------|------------|---------------|-----------------|---------------|---------------|---------------|-----------|
|             |  | roof tiles                                      | tile battens | foil sarking | roof beams | ceiling beams | ceiling surface | eave area     | internal wall | external wall | sub-floor |
| 5           | 4                                      | 0   | new          | not used     | 1/u        | 1/s           | 0               | 0             | 3,6/u         | 0             | 0         |
| 6           | 6                                      | 0   | "            | "            | 0          | 1/u           | 1/u             | 0             | 3/s,u         | 0             | 3/u       |
| 7           | 6                                      | 0   | "            | "            | 1/u        | 2/u           | 0               | 0             | 3/u           | 0             | 1/u       |
| 8           | 6                                      | 3/u   | "            | "            | 0          | 0             | 0               | 0             | 5,6/u         | 0             | 0         |
| 9           | 6                                      | not inspected                                   | "            | new          | 1/u        | 1/u           | 1/u             | not inspected | 3,6/u         | 3/s           | 3/s,u     |
| 10          | 8                                      | 2/u   | "            | not used     | 1/u        | 0             | 3/s             | 0             | 5/u           | 0             | 0         |
| 11          | 10                                     | 0   | "            | "            | 0          | 1/s,u         | 0               | 0             | 5/u           | 0             | 0         |

- <sup>a</sup> 10 = all or nearly all surfaces sealed  
 8 = small proportion of surfaces unsealed  
 6 = moderate proportion of surfaces unsealed (e.g. underside of roof beams)  
 4 = high proportion of surfaces unsealed (e.g. sides & undersides of roof beams)  
 2 = little evidence of sealant  
 0 = no sealant applied

- <sup>b</sup> 0 = no visible asbestos residue  
 1 = occasional specks (asbestos residue small than 3 mm)  
 2 = many specks  
 3 = tufts (asbestos residue 3 to 10 mm in size)  
 4 = film of asbestos fluff on surface  
 5 = pieces (asbestos residue 10 to 50 mm in size)  
 6 = bulk (asbestos residue greater than 50 mm in size)  
 u = unsealed  
 s = sealed

**Table 3. Brush erosion fibre release from surfaces in ceiling spaces of Program removal houses**

| Site Number | Brush Erosion Fibre Release <sup>a</sup> (f/mm <sup>2</sup> ) |            |               |                 |               |                  |
|-------------|---|------------|---------------|-----------------|---------------|------------------|
|             | Unsealed surfaces   |            |               | Sealed surfaces |               |                  |
|             | roof tiles  | roof beams | ceiling beams | roof beams      | ceiling beams | ceiling surfaces |
| 5           | -   | ND         | -             | ND              | -             | -                |
| 6           | -   | ND,ND      | -             | ND              | ND            | -                |
| 7           | -   | ND         | 21            | ND              | ND            | -                |
| 8           | ND  | ND         | -             | ND              | ND            | -                |
| 9           | -   | 35         | -             | ND              | ND            | ND               |
| 10          | ND  | ND         | -             | ND              | ND            | -                |
| 11          | -   | 16         | -             | -               | ND,ND,ND      | -                |

<sup>a</sup> ND = non-detectable

**Table 4. Personal asbestos exposures measured during inspection of ceiling spaces of Program removal houses**

| Site Number | Asbestos Concentration (f/mL) by personal monitoring of |           |
|-------------|---|-----------|
|             | Officer 1   | Officer 2 |
| 5           | 0.04  | 0.06      |
| 6           | <0.03   | <0.03     |
| 7           | 0.02  | 0.05      |
| 8           | <0.02   | 0.26      |
| 9           | 0.04  | 0.10      |
| 10          | <0.02   | 0.03      |
| 11          | <0.02   | <0.03     |

**Table 5. Summary of Asbestos Branch inspections of 6 pre-program removal houses which are not included in reclean program**

| Asbestos Branch No. | Residual Contamination at Location |                   |            |                      |            | Comment                    |
|---------------------|------------------------------------|-------------------|------------|----------------------|------------|----------------------------|
|                     | Roofspace                          | Roofspace timbers | Eaves      | Wall cavities        | Tile laps  |                            |
| 9                   | clean                              | clean             | no visible | no visible           | no visible | nil visible and accessible |
| 14                  | clean generally                    | no visible        | no visible | bulk in lower cavity | no visible | --                         |
| 16                  | clean                              | clean             | clean      | traces               | new tiles  | no further work required   |
| 18                  | clean                              | clean             | clean      | traces               | nil        | sarking under tiles        |
| 33                  | clean                              | clean             | clean      | traces               | new tiles  | no further action          |

report unavailable for sixth case

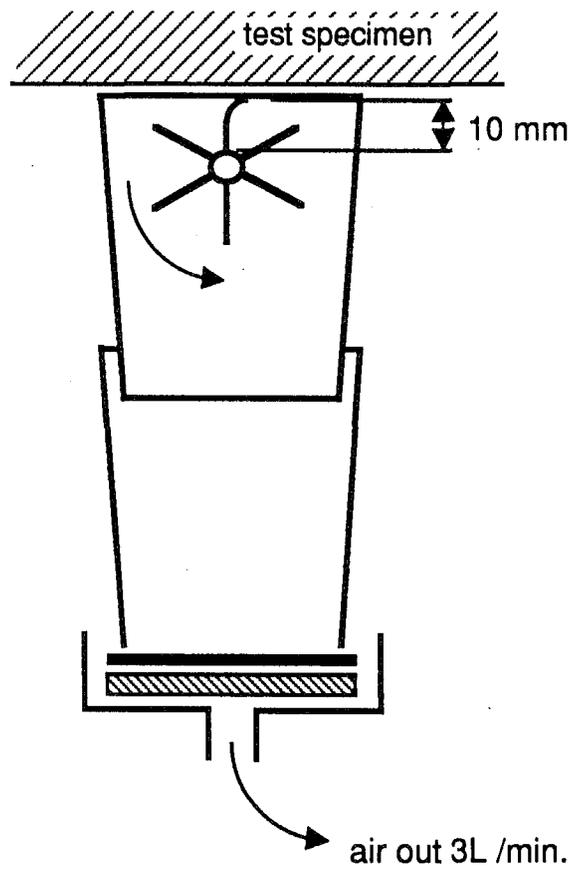
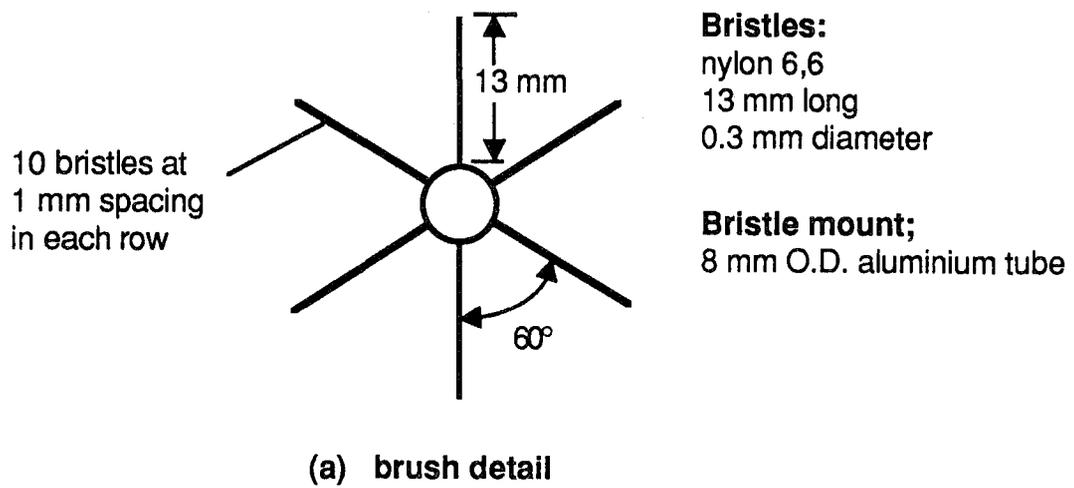


Figure 1. Brush erosion test device



Figure 2. Bulk asbestos fluff residues in subfloor space of site 3.

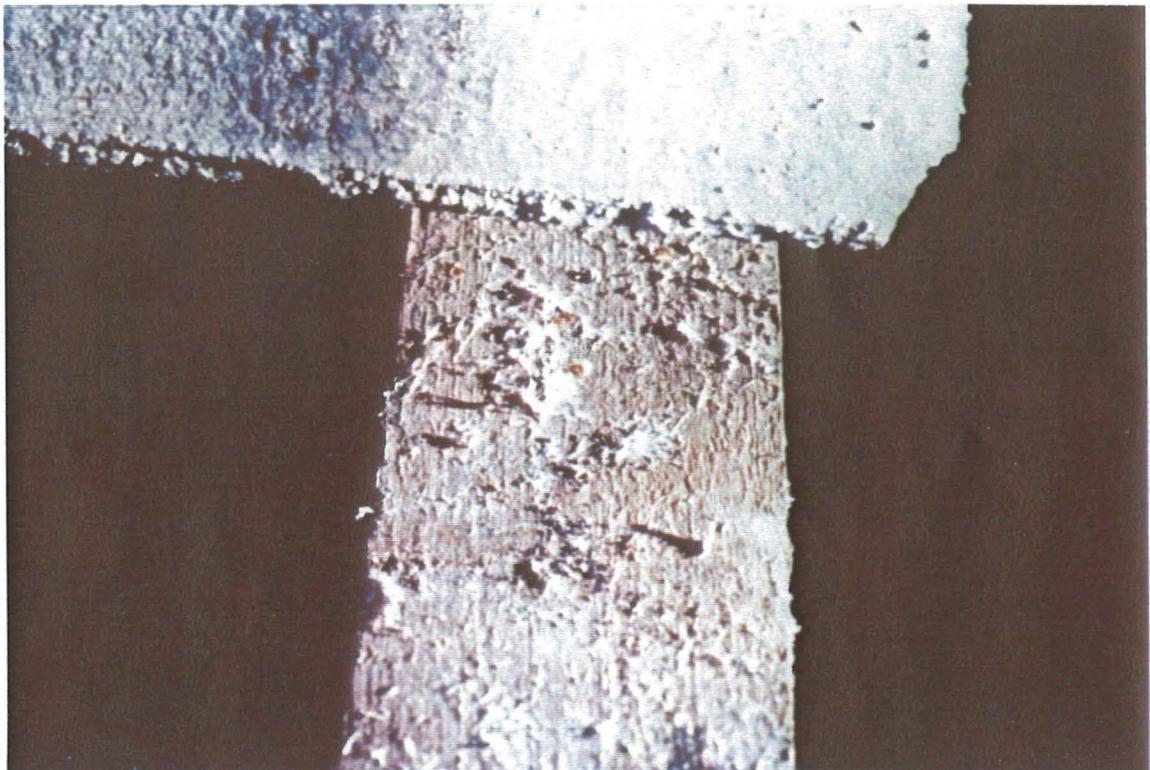


Figure 3. Layer of asbestos fluff residues on underside of tiles and on top of tile battens at site 2.



Figure 4. Specks of asbestos fluff residue on unsealed underside of roof truss and infrared spectra of residues from Program removal sites.

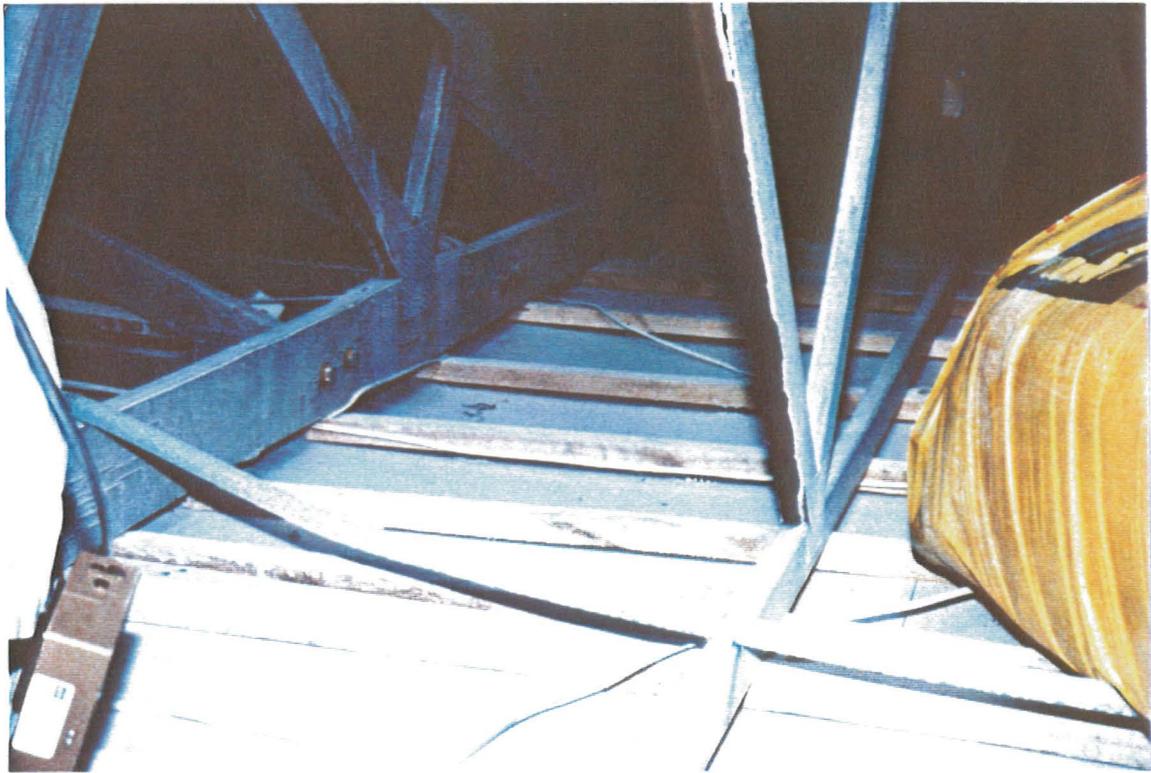
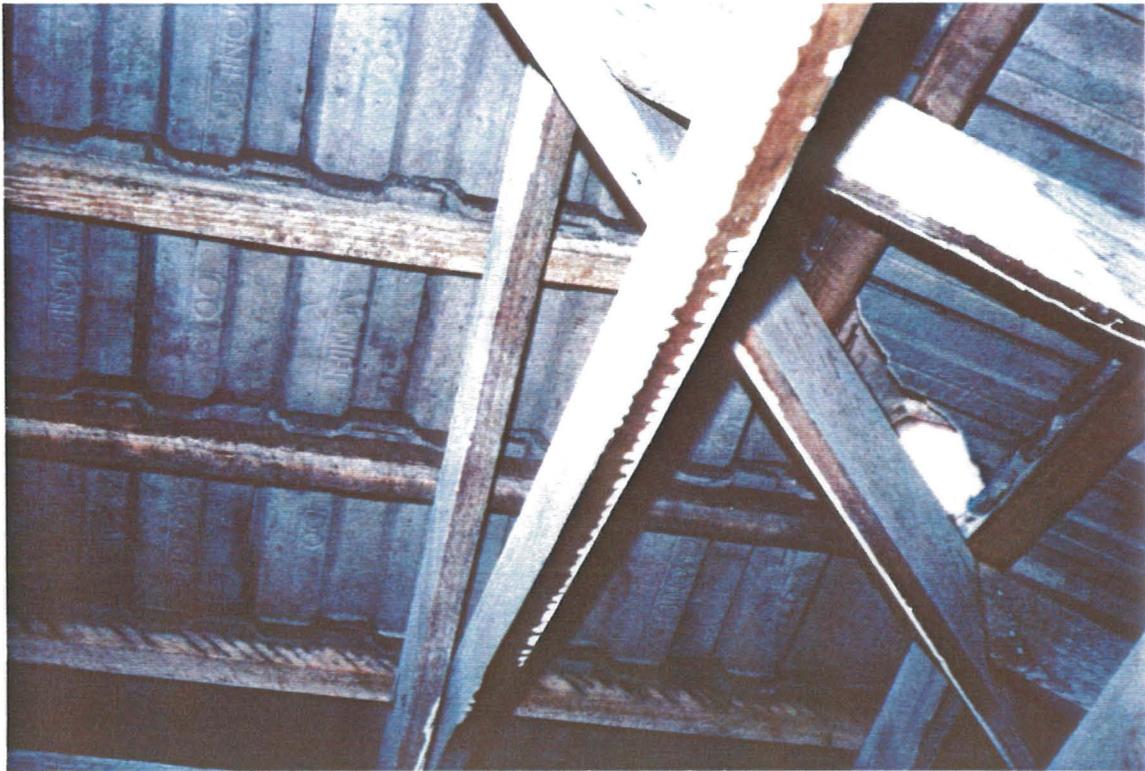


Figure 5. Incomplete sealing of ceiling space timbers at Program removal sites.

**APPENDIX I****Background documents obtained from Department of Urban Services**

- (1) Asbestos Removal Manual, Building Section, Department of Territories (the only control document in force in the ACT prior to 1990).
- (2) Letter of advice from Dr Albert Rooms, Environmental Health and Consumer Protection Department, Manchester City Council, 19 September 1989.
- (3) Record of Meeting of Health Experts on Asbestos, 29 September 1989.
- (4) Asbestos Branch Minute Papers – Asbestos Removal Program, 13 November 1989, Asbestos Removal from ACT House, 10 November 1989, 6 December 1989.
- (5) Asbestos Removal – Review of Cost Cutting Considerations, R. Usback, Manager Asbestos Operations, 30 January 1990.
- (6) Specification for the Removal of Loose Asbestos Insulation Material from Residential Dwellings within the Australian Capital Territory. Revised Specification, BRS Asbestos Removal Pty Ltd, 14 June 1989.
- (7) Specification for the Removal of Loose Asbestos Insulation Material from Residential Dwellings within the Australian Capital Territory. Revised Specification, Gardner Perrott Contract, 14 June 1989.
- (8) ACT Government Asbestos Testing Laboratory, Laboratory Manual, Chapter 9: Sampling, Chapter 10: Experimental Procedures, 27 March 1991.
- (9) Asbestos Inspection Forms prepared in 1989-90 by inspectors of Asbestos Branch for 47 dwellings from which asbestos fluff was removed pre-1990.
- (10) Domestic Asbestos Removal – Recleans Strategy, Trevor Wheeler, A/g General Manager, Asbestos Branch, 26 April 1990.
- (11) Asbestos Operations. Quality Assurance Checks, Glen Chambers.

## APPENDIX II

## Format for Recording Visual Inspection of Sites

CSIRO ASBESTOS INSPECTIONSSite No:Address:Date:Photographs:

| Area Inspected                         | Quantity of Contamination<br>(no visible → bulk) | Condition<br>bound/unbound | Sample<br>No. |
|--|--|----------------------------|---------------|
| Tiles – laps<br>– underside            |  |                            |               |
| Battens                                |  |                            |               |
| Foil – top surface<br>– bottom surface |  |                            |               |
| Roof Trusses                           |  |                            |               |
| Ceiling Joists                         |  |                            |               |
| Ceiling Surface (upper)                |  |                            |               |
| Eave areas                             |  |                            |               |
| Wall cavity – mid height<br>– bottom   |  |                            |               |
| Subfloor                               |  |                            |               |
| Building Interior                      |  |                            |               |
| Building Exterior                      |  |                            |               |

Quantity descriptors

0. No visible material (inspected at 30 cm distance)
1. Trace (visible occasional specks)
2. Contaminated surface (many visible specks)
3. Tufts (size greater than 3 mm but less than 10 mm)
4. Layer of fluff (layer of asbestos fluff but of insufficient bulk to move around)
5. Pieces (individual separate pieces 10-50 mm in size)
6. Bulk (material thicker than fine layer and greater than 50 mm in size)

Condition descriptors

Bound  
Unbound } judge by finger contact if not otherwise apparent; be descriptive if needed

Sample number

As per pre-numbered bags