מכון התקנים הישראלי

The Standards Institution of Israel

תקן ישראלי - ת"י 1839

דצמבר 1995

תוקן בתמוז תשנ"ח - יולי 1998

בטיחות במעבדות - מנדפים

Safety in Laboratories - Fume cupboards

תקן זה בא במקום
התקן הישראלי ת"י 1839 מדצמבר 1995
והוא כולל את תיקון מס' 1 מיולי 1998

תקן זה למעט השינויים והתוספות המצוינים בו
זהה לתקן האוסטרלי
AS 2243.8-1992
Amendment No.1 - July -1992

16/04/01 זג

מילות מפתח: מעבדות, בטיחות, מנדפים.

Descriptors: laboratories, safety, fume cupboards.

תקן זה הוכן על ידי א' נאמן

תקן זה אושר על ידי הוועדה הטכנית 1605 - בטיחות בתהליכי עבודה, בהרכב זה:

איגוד התעשייה הקיבוצית	-	מ' פולק
איגוד חברות הביטוח בישראל	-	י' אייזנברג
ארגון הממונים על הבטיחות	-	נ' שוחטוביץ
המוסד לבטיחות ולגיהות	-	מ' אייל
הרשות להגנת הצרכן	-	מ' בראונשטיין
התאחדות התעשיינים בישראל	-	מ' מויסה
חברת העובדים	-	ש' דאובר
לשכת המהנדסים	-	ש' נתנאל (יו"ר)
מכון התקנים הישראלי - אגף התעשייה	-	מ' הראל
משרד העבודה והרווחה	-	ש' מאירוביץ
צה"ל - חיל תחזוקה	-	א' מנור

רכז הוועדה - מ' לסקובסקי

בהכנת התיקון שבמהדורה זו השתתפו:

א' אוקסמן, ב' הרשקוביץ, מ' מויסה, ד' נתנאל (יו"ר), ד' פרופטה, ד' קרן

התיקון במהדורה זו אושר על ידי הוועדה הטכנית 1605 - בטיחות בתהליכי עבודה, בהרכב זה:

איגוד התעשייה הקיבוצית	-	ע' רייז
ארגון הממונים על הבטחון	-	נ' שוחטוביץ
המוסד לבטיחות ולגיהות	-	מ' אייל
המשרד לאיכות הסביבה	-	ר' גלעד
הרשות להגנת הצרכן	-	ר' זילכה
התאחדות התעשיינים בישראל	-	מ' מויסה
חברת העובדים	-	ש' דאובר
לשכת המהנדסים	-	ש' נתנאל (יו"ר)
מכון התקנים הישראלי - אגף התעשייה	-	א' תמרי
מקורות - חברת המים	-	נ' טל
משרד העבודה והרווחה	-	ש' מאירוביץ

רכז הוועדות - א' נאמן

תוכן העניינים

התקן האוסטרלי (תוכן העניינים של התקן האוסטרלי ראו שם)

Amendment No.1-July-1992

במהדורה זו של התקן הוכנסו שינויים ותוספות המעדכנים את המהדורה משנת 1995.
השינויים והתוספות (תיקון מס' 1 מ-1998) ממוסגרים במסגרת ⌐ ¬ .

הקדמה לתקן הישראלי

תקן זה הוא התקן האוסטרלי AS 2243.8-1992 משנת 1992, לרבות Amendment No.1-July-1992 שלו, שאושר בשפתו האנגלית כתקן ישראלי בשינויים ובתוספות.

בשפה העברית מובאים:

- פירוט השינויים והתוספות בסעיפי התקן האוסטרלי
- נספח א - תוכן העניינים של התקן האוסטרלי מתורגם לעברית
- נספח ב - פרקים 4, 5, 6 של התקן האוסטרלי מתורגמים לעברית

התקן האוסטרלי מובא כלשונו בשפה האנגלית.

שינויים ותוספות

Section 1 - Scope and General

1.1. Scope

הסעיף אינו חל, ובמקומו יחול:

חלות

תקן זה בא לקבוע את דרישות הבטיחות המינימליות הנוגעות למנדפים במעבדה.

1.2. Referenced documents

- ראו סעיף Referenced documents בתקן האוסטרלי.
- מקום חלק מהתקנים האוסטרליים באים תקנים ישראליים כלהלן:

התקן האוסטרלי המוזכר	התקן/המסמך הישראלי שבא במקומו
AS1482 AS1826	התקן הישראלי ת"י 786 - ציוד חשמלי לשימוש באטמוספירות נפיצות של גזים, על חלקיו.
AS1530	התקן הישראלי ת"י 755 - סיווג חומרי בנייה לפי תגובותיהם בשרפה.
AS2444	התקן הישראלי ת"י 1220 - מערכות גילוי אש, על חלקיו.
AS3000 AS2430.3	חוק החשמל הישראלי תשי"ד 1954 ותקנותיו המעודכנות.

- בסוף רשימת התקנים האוסטרליים יוסף:

תקנים ישראליים

ת"י 66 - מטפי קצף מיטלטלים

ת"י 74 - מטפי פחמה-חומצה מיטלטלים

ת"י 129 - מטפים מיטלטלים, על חלקיו

ת"י 318 - מטפי פחמן דו-חמצני מיטלטלים

ת"י 463 - מטפים מיטלטלים של אבקה יבשה ושל גז סניקה המוחסנים בנפרד

ת"י 483 - מאווררים תשמליים

ת"י 570 - מטפים מיטלטלים של אבקה יבשה ושל גז סניקה המוחסנים במשותף, על חלקיו

ת"י 987 - מטפי הלון מיטלטלים למילוי חוזר

ת"י 1300 - מטפים מיטלטלים של אבקה יבשה ושל גז סניקה לכיבוי מתכות בעירות

ת"י 1529 - עקרונות הנדסת אנוש בתחום חראייה: תאורת מקומות עבודה בתוך מבנים

ת"י 1530 - בטיחות אש במעבדות

מסמכים ישראליים

קובץ תקנות 4666 מיום 1984-07-01 - תקנות פיקוח על עבודה (תוכנית בטיחות) התשמ"ד-1984

Section 2 - Types services and components

.2.2 Services

.2.2.5 Lighting

הסעיף אינו חל, ובמקומו יחול:

תאורה

תאורה המתאימה לדרישות התקן של מכון התקנים הישראלי ת"י 1529.

.2.14 Fire protection

.2.14.3 Fire extinguishers

הסעיף אינו חל, ובמקומו יחול:

- מטפי כיבוי - מטפים המתאימים לדרישות תקנים ישראליים אלה:

ת"י 66, ת"י 74, ת"י 129, ת"י 318, ת"י 463, ת"י 570, ת"י 987, ת"י 1300.

Section 3 - Airflow, fume exhaust and dispersal

.3.2 Fume exhaust and dispersal

.3.2.4 Exhausts

הכתוב בסעיף אינו חל, ובמקומו יחול:

מערכת יניקה משני מנדפים או יותר באותו אזור אש, תחובר בשיטה של תעלת יניקה משותפת או בשיטה של תעלות נפרדות או בשילוב של שתי השיטות.

ביום פרסום תקן זה (ת"י 1839) נמצא התקן הישראלי ת"י 1530 בהכנה.

אבזרי בקרת הזרימה במערכת היניקה והמנדפים יהיו מסוג "רגיל-פתוח" (normally open - fail safe) כך שבמקרה של תקלה כלשהי במערכת, תעלות היניקה יהיו פתוחות לחלוטין למעבר אוויר.
חיבור כמה אזורי אש על ידי יניקה משותפת ייעשה בפיר סגור או מחוץ לבניין.
במנדפים המשמשים לאחד השימושים האלה:
- למעבר גזים מחמצנים במיוחד כמו תומצה על-כלורית;
- למעבר של כמה חומרים יחד, שערבובם עלול לגרום לפיצוץ או לתגובה אלימה אחרת;
- למעבר של חומרים רדיואקטיביים;
- למעבר חומרים בעלי רעילות גבוהה כמו חומרים מסרטנים.
שיטת החיבור של מערכת היניקה תתייחס לקיומם של סיכונים אפשריים אם יש, ותתאים לתקנות הפיקוח על עבודה (תוכנית בטיחות) התשמ"ד-1984.
תוכן רשימת חומרים המותרים לשימוש במנדפים המשותפים שתודבק על כל מנדף. כל שימוש בחומר שאינו ברשימה יחייב אישור של הממונה על הבטיחות.
יינקטו כל האמצעים למניעת זרימה הפוכה.

Fans .3.2.5

הסעיף אינו חל, ובמקומו יחול:

מאווררים חשמליים

מאווררים חשמליים המתאימים לדרישות התקן הישראלי ת"י 483.

Occupational exposure .3.2.7.4

NOTES

- ההערות אינן חלות.

Appendices

C - Related documents

הנספח אינו חל.

נספח א - תוכן העניינים של התקן האוסטרלי, מתורגם לעברית

(נספח זה אינו חלק מהתקן)

נספח ב - פרקים 4, 5, 6 של התקן האוסטרלי, מתורגמים לעברית

(נספח זה אינו חלק מהתקן)

פרק 4 - מיקום ואישור

4.1 מיקום מנדף

4.1.1 יש להביא בחשבון את מיקום המְנדפים במעבדות בשלבים הראשונים של תכנון מבנה חדש או לפני שינוי במבנה קיים. אם דרושים מנדפים נוספים במעבדה קיימת, המיקום והאישור יתאימו לדרישות תקן זה. המיקום הנבחר יתאים לדרישות בלימת התפשטות העשן, מידת שאיבת העשן ופיזורו, מצב אספקת האוויר לחדר, מערכת האִוורור, הבטיחות הסביבתית הכללית ונוחיות המפעיל.
קיים סיכון אש או התפוצצות במנדפים כאשר משתמשים בחומרים מסוכנים ולכן יש להעריך כל מקרה לגופו.

[א] לפי קביעת האקדמיה ללשון העברית תרגום המונח discontamination הוא: הסרת נגוע.

4.1.2 גובה משטח העבודה

גובה משטח העבודה שבמִנדף יהיה נוח לשימוש המיועד.

4.1.3 מניעת הפרעות לזרימת האוויר אל המנדף

4.1.3.1 מסלולי תנועה

המרחק בין החלון הקדמי של המנדף לבין כל מסלול תנועה במעבדה יהיה 1 מטר לפחות כדי ליצור אזור סגור לאנשים, למעט למפעיל. (ראו ציור 1 (א)). אם קיימת תנועה רבה במסלול התנועה במעבדה, המרחק המזערי יהיה 3 מטר.

4.1.3.2 משטחי שולחן מול המנדף

המרחק בין החלון הקדמי של המנדף לבין כל משטח שולחן הנמצא מולו יהיה 1.8 מטר לפחות. (ראו ציור 1 (ב)).

4.1.3.3 קירות נגדיים

לא יהיו קירות או מכשולים אחרים, העלולים להשפיע באופן ניכר על זרימת האוויר, בתחום של 1.8 מטר מהחלון הקדמי של המנדף (ראו ציור 1 (ג)).

4.1.3.4 מנדפים אחרים

מנדף לא יותקן במקום שבו הוא עלול להשפיע על זרימת האוויר למנדף אחר או להיות מושפע מזרימה כזאת. אין כל הגבלות לגבי מיקום מנדפים זה בצד זה, אולם, תתוכנן גישה מתאימה לצורכי תחזוקה לפי דרישות היצרן. המרחק בין תלונות קדמיים של מנדפים המוצבים זה מול זה לא יהיה קטן מ-3 מטר (ראו ציור 1 (ד)).

4.1.3.5 משכבי זרימת אוויר

משכבי זרימה של אספקת האוויר לחדר יתוכננו או ישונו כך שלא יגרמו לכל הפרעה לזרימת האוויר לתוך המנדף.

4.1.3.6 מכשולים ארכיטקטוניים

לא ימוקם מנדף כאשר אחד הדפנות הצדדיים שלו קרוב יותר מ-300 מ"מ לקיר או למכשול חלק דומה אחר (ראו ציור 1 (ה)).

המרחק בין מכשולים כאלה למנדף לא יהיה קטן מהמפורט בציור 1 (ו)).

פתחי דלתות יהיו במרחק של 1.5 מטר לפחות מהחלון הקדמי של המנדף או במרחק של 1 מטר לפחות מדופן (צדדי) של המנדף.

4.1.3.7 גישה לתחזוקה

תתוכנן גישה לתחזוקת המנדף לפי דרישות היצרן.

4.1.4 יציאות ונתיבי מילוט

יש להביא תמיד בחשבון אפשרות של שרפה או של התפוצצות במנדף ולכן להכין נתיבי מילוט מתאימים (ראו AS 2982).

4.2 מבחני אישור

4.2.1 כללי

עם גמר התקנת מנדף או לאחר ביצוע שינויים משמעותיים בו או בסביבתו (כגון אזור המעבדה והמבנים הסמוכים למעבדה), או במערכת הפליטה הקשורה למנדף או במערכת אספקת האוויר לתדר, תיבדק התאמה כללית של המערכת לתקן זה.

4.2.2 בדיקת עשן

בדיקת עשן מלאה תבוצע כחלק מתהליך האישור של המנדף. פרטים הקשורים לייצור העשן ובחינת העשן כאשר המנדף ריק ראו ב- Appendix G.

ציוד מחולל עשן ומחוללי עשן פירוטכניים יוצרים תצוגה חזותית של זרימת האוויר בסביבת המעבדה דרך מִפתח העבודה, דרך המנדף והנקודה שבה נפלט העשן לאוויר החיצוני. ניתן גם להשתמש בציוד כזה כדי לבדוק את שלמות מערכות הפליטה.

בכל בדיקות העשן, יש לשים לב במיוחד לכל זרימה הפוכה או לזרמי ערבולת, לקבוע את הסיבות להם וכן אם הן רגעיות או קבועות.

4.2.3 מהירות פָּנים

בדיקה מלאה של מהירות הפנים תיערך לפי Appendix E, כאשר המנדף ריק.

4.2.4 רמת הרעש

כאשר המנדף מסווג לפני AS 1469, מערכת מתוכננת היטב לא תגרום לרמת רעש גדולה מ-(a) 62 dB בעמדת המפעיל הן כשהחלון הקדמי של המנדף סגור לגמרי והן כשהוא פתוח לגמרי.

רמות לחץ הקול יימדדו לפי AS 1807.16.

4.2.5 תוצאות מבחני האישור

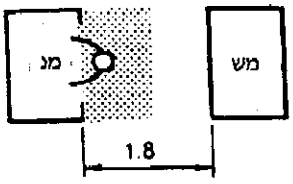
התוצאות של כל מבחני האישור יירשמו ועותקים יישמרו בספרי ההפעלה והתחזוקה הנמצאים בידי האחראי לעבודה כולה. עותקים של מבחני האישור יסופקו לבעלי המבנים והחדרים שבהם הותקן המנדף.

4.2.6 בדיקה

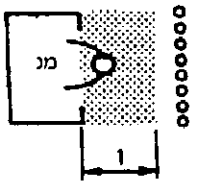
הבדיקה תיערך בידי אדם מוסמך.

4.2.7 הפעלה

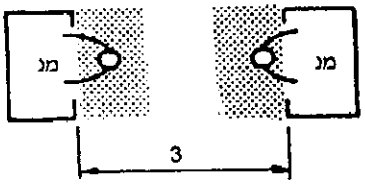
אין להפעיל את הציוד אלא אם הוא עומד בכל הדרישות המפורטות בסעיף 4.2.



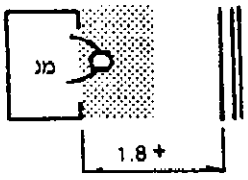
(2) מרווח דרוש כאשר מפעיל אחד משתמש במנדף ובמשטח שולחן או כשצפויה תנועה קלה בלבד



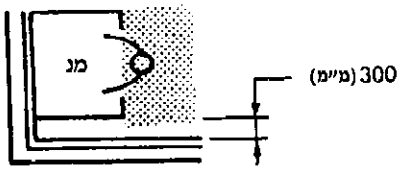
(1) חפרדת האוור למניעת הפרעה של מסלולי תנועה



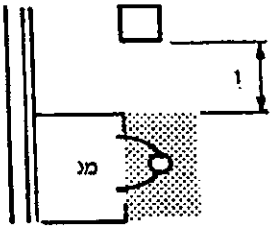
(4) מרווח הנקבע לפי דרישות זרימת אוויר



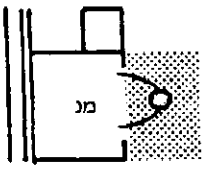
(3) מרווח הנקבע לפי דרישות זרימת אוויר



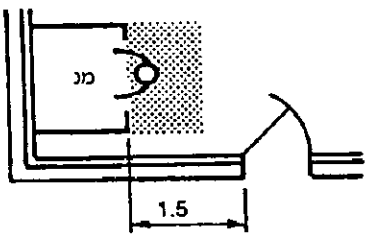
(5) מרחק מזערי למניעת הפרעה למנדף ולמפעילו



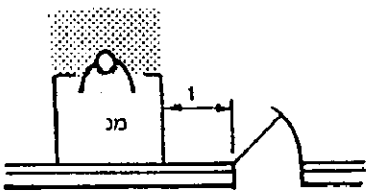
(6.2) חזית של עמוד הנמצאת לפני מישור החלון (של המנדף)



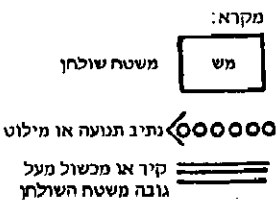
(6.1) חזית של עמוד שאינה נמצאת לפני מישור החלון (של המנדף)

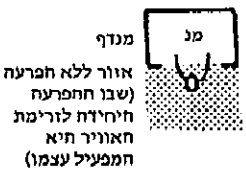


(6.4) פתח דלת מאחורי מישור המפעיל



(6.3) פתח דלת קרוב למישור האחורי של המנדף





ציור 1 - מרווחים מינימליים למניעת הפרעות לזרימת אוויר

(המידות במטרים אם לא מצוין אחרת)

פרק 5 - תחזוקה ובדיקות

5.1 כללי

המערכת כולה, החל במנדף וכלה בארובת הפליטה, יעמדו בבדיקות תקופתיות ויהיו נתונים לתחזוקה תקופתית. תוכן תוכנית תחזוקה ויישמרו רשומות של בדיקות. תהיה גישה מתאימה למערכת הפליטה, לרבות משככים, יחידות ניקוי, מסננים ומניפה. גישה קשה משמעותה תחזוקה לקויה או חוסר תחזוקה.

5.2 אחריות המשתמש

המשתמש במנדף יכול להקטין את הצורך בתחזוקה על ידי שימוש תדיר באמצעי השטיפה, אם הותקן אמצעי כזה, כך שחומרים משתכים יורחקו מתוך המנדף לפני שיגרמו לנזק.

5.3 טיהור

קצין הבטיחות או המפקח על הבטיחות יידעו את הצוות העוסק בפעולות תחזוקה באשר לצורך בנוהלי טיהור במנדף ובציוד הנלווה אליו, אשר יבוצעו לפני ביצוע כל נוהל תחזוקה.

5.4 גישה לאזורים מסוכנים

קצין הבטיחות או המפקח על הבטיחות יוודאו שהאזור שבו תבוצע התחזוקה הוא בטוח (כגון עבודה על גגות ליד נקודות הפליטה).

5.5 לוח זמנים לתחזוקה ובדיקות

5.5.1 כללי

תוכנית התחזוקה והבדיקות המפורטת להלן משמשת כהנחיה לדרישות מינימליות בלבד.

אם המנדף פועל ברציפות, עשויות פעולות התחזוקה להידרש לעיתים קרובות יותר.

בזמן ביצוע הבדיקות או שירות התחזוקה, יבודד המנדף ממתח חשמלי כדי למנוע את הפעלתו. בזמן ביצוע התחזוקה, יסומן המנדף בשלט "המערכת בתחזוקה - אסור להשתמש בה" ויורחקו כל החומרים הכימיים מהמנדף.

5.5.2 תחזוקה שבועית

אמצעי סינון האוויר אם ישנם, ייבדקו ויתוחזקו לפי ספרי התחזוקה, ומזהמים למיניהם שנלכדו שם - יורחקו באופן בטיחותי.

5.5.3 תחזוקה חצי-שנתית

התחזוקה תכלול פעולות אלה:

א. בדיקת עשן מקוצרת לפי Appendix G. אם התגלתה בעיה (ראו סעיף 3.1.2) תיערך בדיקת עשן מלאה לפי Appendix G.

ב. בדיקת מהירות פָּנים מקוצרת לפי Appendix E. אם התגלתה בעיה, תיערך בדיקה מלאה לפי Appendix E.

ג. בדיקת המניפות ותחזוקתן, לרבות מנועים, יחידות הינע (כולל רצועות) ומסבים. סיכה לפי הצורך.

ד. וידוא שיחידות הניקוי ומתקני השטיפה, אם הותקנו, פועלים ביעילות.

ה. בדיקת משכך האש ומנגנון השחרור, אם הותקנו, והחלפת חוליית הנתיך, לפי הצורך.

ו. וידוא שכל אמצעי סינון אוויר, אם מותקן, פועל ביעילות, וביצוע פעולות תחזוקה לפי הצורך.

ז. בדיקת מצב הגלאי התרמי וראשי המתזים, אם הותקנו.

5.5.4 תחזוקה שנתית

נוסף על פעולות התחזוקה המפורטות בסעיף 5.5.3, יבוצעו פעולות התחזוקה האלה:

א. הסרת המחיצות וניקוי המחיצות והמשטח האחורי של התא.

ב. רחיצת כל המשטחים הפנימיים של התא בתמיסת דטרגנט מדוללת ותיקון פגמים לפי הצורך.

ג. בדיקת מצב מערכות השירות של המנדף ווידוא שכולן מזוהות ותקינות.

ד. בדיקת יציבות ארובות הפריקה, ובדיקת מצבן.

ה. בדיקת מצב מובלי הפליטה, בכל מקום שאפשר, במיוחד בחיבורים, ווידוא שנקודות הניקוז אינן סתומות.

ו. בדיקת האיזון בין האוויר הנפלט מהתדר לבין האוויר הנכנס אליו.

ז. בדיקת מצבה של מערכת המנדף ובדיקת תקינות פעולתה.

ח. בדיקת פעולת מנתק החירום ובדיקת מידת הניתוק של מערכות השירות של המנדף (ראו סעיף 2.2.4)

ט. בדיקת פעולת המנתק האוטומטי על ידי אספקה לא-תקינה של זרימת אוויר למנדף (ראו סעיף 2.2.4).

י. הדבקת מדבקה למנדף המציינת את תאריך הבדיקה, שם הבודק ומספר הדוח.

פרק 6 - הפעלת המנדף

6.1 לפני הפעלה

יבוצעו נהלים אלה:

א. וידוא שהמנדף מתאים לשימוש המיועד, כלומר, המנדף ומערכת הפליטה מצוידים במערכת טיפול בגזים הזורמים, המתאימה לטיפול במוצרים ובתהליך.

ב. וידוא שמתקן השטיפה (אם מותקן) תקין.

ג. וידוא שהמנדף נקי ואין בו מזהמים מסוכנים.

ד. וידוא שיש מקום מספיק במנדף כדי שניתן יהיה לבצע את התהליך הדרוש.

ה. מיקום המכשור והחומרים בחלק האמצעי והאחורי של המנדף כדי למזער את ההפרעה לזרימת האוויר בפתחי העבודה.

ו. סגירת כל הדלתות והחלונות המפחיתים את ביצועי המנדף. וידוא שרשתות האוורור נקיות ושהאוורור פועל. וידוא שהתנאים סביב המנדף דומים לאלה ששררו בזמן מבחני האישור, כלומר, אין זרמי אוויר חזקים מתנגשים או ממשכי אוויר מצטלבים ממזגנים, ממניפות, ממחממים, מדלתות או מחלונות פתוחים.

ז. וידוא באמצעות מחוון זרימת אוויר, שהמנדף פועל כראוי. אין די בידיעה שמתג החשמל של האוורור הופעל.

ח. וידוא שמטפה כיבוי אש מתאים זמין כאשר משתמשים בתמיסות דליקות.

ט. הנחת כל הדרוש לעבודה בתוך המנדף לפני התחלת העבודה, כאשר הדבר מעשי.

הערה:

ניתן להקטין את הסיכונים הכרוכים בכל תהליך באמצעים המפורטים להלן:

1. הנמכת החלון הקדמי הסוגר את המנדף;
2. שימוש בכמויות מופחתות של חומרי תהליך;
3. שימוש במהירות תגובה נמוכה, וכתוצאה מכך -
4. הקטנת כמות החומר המשוחרר לזרם האוויר.

6.2 בזמן הפעולה:

יבוצעו נהלים אלה:

א. החלון הקדמי יימצא במצבים אלה:

1. פתוח לגמרי כדי לאפשר גישה להצבת המכשירים או החומרים;
2. פתוח חלקית בזמן טיפול בחומרים מסוכנים בתוך המנדף;
3. סגור ככל האפשר בזמן התהליך (במצב הנמוך ביותר האפשרי).

ב. השימוש בחומרים מסוכנים ייעשה בכמות המינימלית הדרושה לביצוע התהליך.

ג. התגובה תיעשה במהירות שתקטין למינימום סיכונים כגון התפתחות אדים מסוכנים או חום רב.

ד. נטילת חומרים מסוכנים מצובר תיעשה באמצעות מתקן נטילה מיוחד מצויד במערכת פליטה מקומית.

הערה:

מתקן נטילה מיוחד כולל מגש רשת שמתחתיו כיור בעל דפנות מונעי התזה המצוי סמוך למפעיל ורצוי גם בעל מערכת פליטה עצמאית. הכיור מתנקז למכל דילול לפני הניקוז לביוב.

6.3 לאחר השימוש

יבוצעו פעולות אלה:

א. הרחקת פסולת מעבדה לפי נוהלי הבטיחות במעבדה וחוקי המדינה שבתוקף, הדנים בהרחקת חומרים מסוכנים.

ב. הנמכת החלון הקדמי במידה מספקת כדי למזער את השפעת ההפרעות החיצוניות בעוד שמתאפשרת זרימת אוויר תקינה.

ג. וידוא שהמנדף נקי ואין בו כל מזהמים.

6.4 כימיקלים מסוכנים

חומרים רעילים גורמי גירוי, מתלקחים או משתכים, יוחסנו בארונות אחסון המאווררים ברציפות, והמתוכננים במיוחד למטרות אלה. אין להשתמש במנדף להחסנת כימיקלים מסוכנים. אין להחסין יחד חומרים העלולים להגיב זה עם זה (ראו AS 2243.2).

הערה:

החסנת חומרים מתלקחים במנדף הפועל לעיתים קרובות היא מסוכנת במיוחד. אש או תגובה כימית חריפה בתוך המנדף עלולים לגרום למצב חמור יותר מהצפוי בשימוש תקין בחומרים אלה.

בפעולה עם חומצה פֶּרכלורית, מתקן ניקוי האדים יפעל ברציפות. עם השלמת התהליך הכרוך בחומצה פרכלורית, יופעל מתקן השטיפה במשך 15 דקות. משקעים, נתזים והצטברויות של אבק במשטחים הפנימיים של המנדף, יישטפו ברסס עדין של מים קרים. אפשר לחזור על הפעלת הריסוס במים כאמצעי שטיפה בטיחותי.

Australian Standard®

Safety in laboratories

Part 8: Fume cupboards

STANDARDS AUSTRALIA

This Australian Standard was prepared by Committee CH/26, Safety in Laboratories. It was approved on behalf of the Council of Standards Australia on 13 December 1991 and published on 16 March 1992.

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Australian Government Analytical Laboratories
Australian Institute of Petroleum
Chemical Confederation of Australia
Department of Agriculture and Rural Affairs, Victoria
National Association of Testing Authorities, Australia
The Workcover Authority, New South Wales

Additional interests participating in preparation of Standard:

Australian Construction Services
Australian National University
Australian Nuclear Science and Technology Organization
Commonwealth Fire Board
Fume cupboard manufacturers
Fume cupboard testing organizations
Independent consultants
Queen Elizabeth II Medical Centre, WA
University of Western Australia

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Safety in laboratories

Part 8: Fume cupboards

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PREFACE

This Standard was prepared by the Standards Australia Committee on Safety in Laboratories under the direction of the Multitechnics Standards Board to supersede AS 2243.8—1986.

Other Parts in the AS 2243 series are as follows:

Part 1: General
Part 2: Chemical aspects
Part 3: Microbiology
Part 4: Ionizing radiations
Part 5: Non-ionizing radiations
Part 6: Mechanical aspects
Part 7: Electrical aspects
Part 9: Recirculating fume cabinets

CONTENTS

FOREWORD

The primary reason for using a fume cupboard is to provide safe working conditions for the operator and other laboratory personnel. The fume cupboard provides a mechanical means of capturing, diluting and exhausting all fume, especially that which is hazardous or noxious.

The efficiency and safety of a fume cupboard depends upon the smooth entry of air, effective containment and scavenging of fumes from the chamber, its siting with respect to air movement and laboratory ventilation, the materials used in its construction, the complete fume exhaust system, and the safe and remote dispersal of fumes to the atmosphere.

Existing fume cupboard installations will, in many instances, not comply with this Standard and consequently should not be used for applications that could create a hazard. In the interests of laboratory safety, a high priority should be allocated to the preparation of a program for upgrading sub-standard fume cupboard installations to meet the requirements of this Standard. Fully ducted fume cupboards that do not comply with this Standard should be upgraded to the required levels as soon as practicable.

STANDARDS AUSTRALIA

Australian Standard
Safety in laboratories

Part 8: Fume cupboards

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE This Standard specifies safety requirements for fume cupboards and the methods of test to be used to determine their performance. Appendix A describes typical materials used in the construction of fume cupboards and includes recommendations and requirements on material suitability.

Fume cupboards covered by this Standard are intended primarily for use in general chemical operations but may be used for the special applications set out in Appendix B, provided that the additional relevant features described therein are incorporated.

Recirculating fume cabinets (which recirculate air and do not extract to the outside atmosphere) are not included in this Standard (see AS 2243.9).

NOTE: Appendix C lists documents relating to the subject of this Standard. Appendix D provides recommendations for the procurement of a fume cupboard.

1.2 REFERENCED DOCUMENTS The following Standards are referred to in this Standard:

AS
1345 Identification of the contents of piping, conduits and ducts (incorporating Amdt 1)
1444 Wrought alloy steels—Standard and hardenability (H) series
1449 Wrought alloy steels—Stainless and heat-resisting steel plate, sheet and strip
1469 Acoustics—Methods for the determination of noise rating numbers
1482 Electrical equipment for explosive atmospheres—Protection by ventilation—Type of protection v
1530 Methods for fire tests on building materials, components and structures
1530.3 Part 3: Simultaneous determination of ignitability, flame propagation, heat release and smoke release
1668 The use of mechanical ventilation and air conditioning in buildings
1668.2 Part 2: Mechanical ventilation for acceptable indoor-air quality
1682 Fire dampers
1807 Cleanrooms, workstations and safety cabinets—Methods of test
1807.16 Part 16: Determination of sound level in cleanrooms
1826 Electrical equipment for explosive atmospheres: Special protection—Type of protection s
2208 Safety glazing materials for use in buildings (human impact considerations)
2243 Safety in laboratories
2243.2 Part 2: Chemical aspects
2243.3 Part 3: Microbiology
2243.4 Part 4: Ionizing radiations
2243.9 Part 9: Recirculating fume cabinets
2430 Classification of hazard areas
2430.3 Part 3: Specific occupancies
2444 Portable fire extinguishers—Selection and location
2982 Laboratory construction
3000 SAA Wiring Rules
3689 Automatic fire extinguishing systems using halogenated hydrocarbons
3689.1 Part 1: Halon 1301 total flooding systems

SAA
HB13 Electrical equipment for hazardous areas

DIN
12920 Colour code for fluids on handlevers and handwheels of laboratory taps

1.3 DEFINITIONS For the purpose of this Standard, the definitions in AS 2982 and those below apply.

1.3.1 Air

1.3.1.1 *Make-up air*—air needed to replace that exhausted from the room by laboratory fume cupboards and other air-exhaust devices.

1.3.1.2 *Fume cupboard auxiliary air*—air delivered directly adjacent to a laboratory fume cupboard to reduce consumption of conditioned room air.

1.3.2 Air pressure

1.3.2.1 *Negative air pressure*—air pressure lower than atmospheric pressure.

1.3.2.2 *Positive air pressure*—air pressure higher than atmospheric pressure.

1.3.3 Baffle—one or more readily removable plates incorporated at the rear or top of the working chamber to form a plenum between the working chamber and the exhaust duct connection to promote uniform scavenging of fume from the working chamber.

1.3.4 Exhaust system—all exhaust air ductwork, fan and associated equipment installed between the point of connection to the fume cupboard and the point of discharge.

1.3.5 Face velocity—velocity of the air passing through the working aperture measured in the plane of the sash (see Appendix E).

1.3.6 Fume (as used in the term 'fume cupboard')—airborne contaminants in the form of gases, vapours, aerosols or particulate matter.

1.3.7 Fume cupboard—a partially enclosed workplace that—

(a) is designed to prevent the spread of fume to operators and other personnel;

(b) is ventilated by an induced flow of air through a sash opening or working aperture that may be adjusted;

(c) dilutes the fume; and

(d) by means of an exhaust system, provides for the safe and remote discharge of the fume outside the building.

NOTE: A fume hood is a device mounted over a workplace to receive or capture fumes. It may provide little or no enclosure for the workplace and is therefore unable to attain containment as high as a fume cupboard.

In American usage, a 'laboratory hood' means a laboratory fume cupboard.

1.3.8 Laminar airflow—a non-turbulent airstream of constant velocity, substantially uniform over its cross-section of flow, with a variation of not more than 20%.

1.3.9 Radiotoxicity—the toxicity attributable to ionizing radiation emitted by a radionuclide (and its decay products) incorporated in the human body.

1.3.10 Sash—a transparent safety screen in the working aperture of a fume cupboard, which can be positioned between the working chamber and the operator for protection, and which can be adjusted either vertically or horizontally to vary the size of the working aperture.

1.3.11 Sash opening—the dimension of opening in the direction of the sash movement. This is sometimes referred to as the working aperture.

1.3.12 Services—supplies of lighting, electricity, water, vacuum, compressed air, gas or other special requirements to the fume cupboard.

1.3.13 Shall, should and may—the use of the word 'shall' indicates that a statement is mandatory, the word 'should' indicates that a statement is a recommendation, whereas the word 'may' indicates an option.

1.3.14 Sump—a recess in the base of the fume cupboard capable of containing liquids spilled within the fume cupboard. The sump may be connected to a drain or a closed receptacle.

SECTION 2 TYPES, SERVICES AND COMPONENTS

2.1 FUME CUPBOARD TYPES

2.1.1 Walk-in fume cupboards Walk-in fume cupboards are designed for large-scale work that cannot successfully be executed in a bench-type fume cupboard. These larger types usually have the sash in two or more pieces. Any portion of the working area may be reached simply by sliding the sashes. When the work involves larger apparatus, one of the sashes may be removed temporarily. Sections of the sash can also be used as a safety shield.

2.1.2 Bench-type fume cupboards Benchtop operations form the majority of chemical work undertaken within fume cupboards and thus the majority of fume cupboards are of this type. The enclosure is usually constructed so that work can be enclosed by pulling down a vertically sliding sash on the front of the cupboard. The fume cupboard may be provided with a by-pass system to moderate increase in face velocity that otherwise occurs as the sash is closed.

Where there is a need for a fume cupboard to enclose a tall apparatus (e.g. a chromatography column), the enclosing cupboard may be adapted to suit the use, having a sliding sash covering the front portion of the cupboard.

2.1.3 Downdraught fume cupboards A downdraught fume cupboard allows air to be exhausted across or through the base of the fume cupboard. This type of fume cupboard is used in applications where heavier than air fumes are generated.

2.1.4 Recirculating fume cabinets Recirculating fume cabinets (sometimes incorrectly called ductless fume cupboards) are not recommended for unrestricted use. The use of these cabinets shall be in accordance with AS 2243.9.

2.1.5 By-pass fume cupboard—a fume cupboard that allows a variable portion of the room air to flow into the working chamber, other than through the working aperture (sash opening), with the objective of preventing excessively high face velocities at low sash openings and allowing a constant total exhaust air flow irrespective of sash position.

NOTE: At small sash openings, in the absence of a by-pass, the air velocity may be so high (e.g. much greater than 1.5 m/s) that it has an adverse effect on the work being performed.

2.2 SERVICES

2.2.1 Electrical services The electrical service outlets, lighting and controls shall be in accordance with AS 3000, for area classifications specified in AS 2430.3 for laboratory fume cupboards, and the requirements of this Standard.

Electrical services outlets shall not be positioned within the fume cupboard chamber as they create an ignition hazard, are susceptible to corrosion from acid fumes and preclude the use of any fume cupboard wash-down facility.

NOTE: Requirements for fume cupboards in which no more than 2 L of flammable liquid is used, classified as non-hazardous areas by AS 2430.3, are shown in Appendix F.

2.2.2 Other services The outlets to other services (e.g. gas, water) should be located on the inner surface of the fume cupboard. Service outlets should be colour-coded to match control valves in accordance with AS 1345 or DIN 12920.

2.2.3 Controls All services, other than electrical, shall be individually controlled and the controls shall be located on the outer surface of the fume cupboard or the supporting structure. Control knobs or handles should not protrude beyond the line of the face of the fume cupboard. Controls should be colour-coded in accordance with AS 1345 or DIN 12920.

2.2.4 Emergency isolation The following emergency isolators shall be provided for each fume cupboard:

(a) A single means (e.g. master switch) of simultaneously isolating—

  (i) electrical power to any general purpose outlets located on the cupboard; and

  (ii) flammable gas supply to any gas outlets located inside the cupboard. The gas supply isolation facility shall be the manually reset type.

  The emergency isolator shall be suitably identified by a label, e.g. 'fume cupboard emergency isolator'. The operation of the emergency isolator shall not interrupt supply to the exhaust system. When the isolator operates under fault conditions, i.e. low airflow, low solution level in the scrubber, or power failure, it shall indicate operation by an audible and visual signal.

(b) A means of automatic isolation of the electrical power (see AS 1482 and AS 2982) and gas supply at the fume cupboard in the event of inadequate airflow, i.e. when the face velocity falls below 0.4 m/s. The form of isolation shall be the manually reset type and may be combined with the emergency isolator specified in Item (a) above.

  A delay of 1 min is required from establishment of adequate airflow before gas and electricity supplies are made available to the fume cupboard. The fan shall operate for at least 20 min after the fan is switched to the off position.

2.2.5 Lighting Lighting capable of providing illumination at the work surface shall be not less than 400 lx, and shall be either—

(a) located outside the fume cupboard working chamber behind a non-opening transparent or translucent panel, sealed from the interior of the chamber; or

(b) flameproof, corrosion-proof and installed inside the fume cupboard (see AS 1826).

Access shall be provided for maintenance and cleaning of the light and, where fitted, translucent panel.

2.3 BASE The fume cupboard base shall be sealed, and shall incorporate a means, e.g. a raised lip or a sump, of minimizing the hazardous effects of spillage toward the fume cupboard operator.

2.4 SINK Any sink fitted to a fume cupboard shall comply with relevant local water authority requirements.

2.5 SUMP Any sump fitted to a fume cupboard shall be impervious to materials used in the fume cupboard, be of 10 mm minimum depth and have a minimum capacity of 5 L.

2.6 CHAMBER The chamber of the fume cupboard shall have a smooth interior finish with no places in or on which residues can collect.

2.7 SASH

2.7.1 General Transparent, easily movable, horizontally sliding or vertically rising panels of adequate strength that will substantially close off the cupboard face shall be provided. A vertically rising sash shall be counterbalanced. Each sash shall move easily and quietly, yet remain in place wherever it is stopped. Components of sash guides, internal sash surfaces and counterbalance mechanism, where fitted, that are exposed to corrosive fumes shall be of corrosion-resistant material or finish.

2.7.2 Maximum working sash opening The maximum working sash opening shall be stated by the manufacturer in literature provided with the fume cupboard, and shall be limited by a physical stop that prevents the sash being opened further.

It shall not be possible to open the sash beyond the maximum working sash opening except by means of a key or tool, and any physical stop shall be reset automatically when the sash is lowered.

2.7.3 Minimum sash opening An operating fume cupboard shall have a minimum sash opening—

(a) designed to limit the development of excessively high face velocities in fume cupboards that do not incorporate a by-pass or air extraction rate controlled by the sash opening; and

(b) to ensure adequate airflow through the sash opening to dissipate heat and dilute fume generated within the fume cupboard. The minimum airflow shall be not less than five cupboard-volume air changes per minute.

2.7.4 Vertically rising sashes For vertically rising sashes, stops shall be fitted to provide a minimum opening of at least 50 mm below the sash. These stops provide operator protection in the event that one or more of the sash suspending cords, or equivalent devices, fail. Failure of an individual sash suspension system shall not allow the sash to fall freely.

2.7.5 Sash handles Sash handles shall be provided unless the sash is power operated. Power-operated sashes shall incorporate a manual override. It shall be demonstrated by smoke testing (see Appendix G) that the sash handles do not generate an eddy in the plane of the sash opening.

2.7.6 Design of sash opening The sash opening may incorporate aerodynamic features to promote non-turbulent entry of room air into the working chamber.

2.8 BAFFLES

2.8.1 General Removable baffles are usually fitted at the rear or at the top of the fume cupboard chamber for the purpose of minimizing variation in face velocity over the working aperture and to ensure scavenging of fume from the fume cupboard chamber.

2.8.2 Construction Baffles shall be constructed from impervious material capable of withstanding removal and cleaning operations. Fastenings shall be suitable for repeated removal and replacement of baffles and shall not be affected by fume.

2.8.3 Baffle setting Baffles shall be set at fume cupboard commissioning to ensure that face velocities are within the limits of Clause 3.1. Once set, baffles shall not be adjusted and their removal and replacement for cleaning shall not alter the set point.

2.9 SUPPORT STRUCTURE The support structure shall be constructed to carry the weight of the fume cupboard, working equipment and materials, and to withstand the temperatures that will arise in the proposed use.

2.10 FUME SCRUBBERS AND WASH-DOWN FACILITIES Efficient fume scrubbers and wash-down facilities are essential fittings on fume cupboards designed for work with such substances as perchloric acid (see Appendix B). Their installation may be desirable or mandatory on other fume cupboards where highly corrosive substances are in use, or where there are problems with safe discharge of gaseous effluent.

The fume scrubber should be designed to fit directly onto or into the fume cupboard in order to minimize length of ducting requiring continuous cleaning. Any nozzles should be of corrosion-resistant material, and be easily removed for inspection and cleaning.

The scrubbing solution shall effectively scrub all fumes passing from the fume cupboard into the ductwork. The wash-down facility, if fitted, shall clean all concealed surfaces, especially behind any rear baffles, if fitted, and all internal surfaces of the duct below the fume scrubber. The spray pattern within the scrubber shall be observable while in operation. It shall be possible to inspect all surfaces of the duct between fume cupboard and scrubber for possible buildup of dust deposits as a check on the cleaning performance of wash-down sprays.

2.11 HEAT SHIELDS Heat shields, where fitted, shall be designed to provide adequate protection for inner surfaces of the fume cupboard. They shall be easily removable for cleaning. Heat shields shall not be positioned so that they compromise the safe and efficient operation of the fume cupboard.

2.12 WARNING LABEL A warning label shall be fixed to the cupboard that—

(a) specifies the maximum quantity of flammable liquid that may be introduced into the cupboard at any one time. The quantity should not be in excess of 2.5 L; and

(b) directs that in event of a liquid spill or fire, the emergency isolator shall be activated.

2.13 IDENTIFICATION LABEL A permanent label shall be affixed, in a prominent position, on each fume cupboard, giving the following information:

(a) Identification number of the fume cupboard.

(b) Model number of fume cupboard and name of manufacturer.

(c) List of air-cleaning devices associated with the fume cupboard.

Permanent labels shall also be affixed, in prominent positions, on all fume cupboard system units such as fans, air-cleaning devices and ductwork, indicating the identification number of the fume cupboard, and its laboratory location, with which they are associated.

2.14 FIRE PROTECTION

2.14.1 Fixed fire protection (See also Appendix A for information on fire-retardant materials for use in fume cupboards.) Where the building has an automatic fixed water sprinkler system for fire protection, a sprinkler head should be located on the ceiling of the room within 1 m of the centre of the face of the fume cupboard. Should significant fire or heat escape from the fume cupboard, the sprinkler will help to minimize the spread of fire to adjacent laboratory areas.

A separate water sprinkler, designed to create a misting effect when operated, should be fitted in the fume cupboard throat to protect the exhaust duct by cooling hot gases being drawn into the exhaust. If fitted, these sprinkler heads shall be—

(a) protected against corrosion or made from corrosion-resistant materials;

(b) fitted with a manual cut-off;

(c) operated by the thermal detector specified in Clause 2.14.2; and

(d) maintained in an operable state and inspected at least annually.

In specialized cases, protection by a foam system, a dry powder system or a fixed, gas flooding system may be required. The installation of such systems shall comply with AS 3689.1. Canisters of extinguishant shall be installed outside the fume cupboard chamber to avoid corrosion of the canisters. Care should be taken to ensure that discharge velocities of extinguishing systems are not so great as to create a further hazard by displacing materials within the fume cupboard.

2.14.2 Thermal detectors Detectors located in the exhaust throats of fume cupboards and exhaust ducts shall be corrosion resistant and should activate at a temperature not more than 60°C, in order to detect any fire in its early stages. (For example, an exhaust flow of 400 L/s will increase in temperature by approximately 2°C for each kilowatt of heat release within the fume cupboard.)

2.14.3 Fire extinguishers In addition to fire extinguishers provided in accordance with AS 2444, an extinguisher of 5B rating (for light hazard) shall be available at a distance of 4 ±1 m from the fume cupboard. The fire extinguisher shall not be installed on the outside of the fume cupboard as heat or smoke may prevent its use.

SECTION 3 AIRFLOW, FUME EXHAUST AND DISPERSAL

3.1 REQUIREMENTS FOR AIRFLOW INTO THE CUPBOARD

3.1.1 General A fume cupboard shall draw any fumes released from operations in the cupboard away from the operator to the exhaust from the working chamber of the cupboard. Ideally, airflow through the cupboard should be free from turbulence in order that total containment of the fume is achieved. Leading edges of the cupboard, the sash window, and the apparatus in the cupboard all contribute to the formation of turbulent eddies within the cupboard. These eddies may transport some of the fumes close to the face of the cupboard, where other eddies or draughts within the room may draw some of the fumes into the working area in front of the cupboard. The turbulence within the cupboard may be reduced by aerodynamic entries to fume cupboard fascias, an aerofoil entry sill and correct design and positioning of baffles. The latter also assist in scavenging heavy vapours.

Containment of the fume cupboard shall be verified by smoke testing carried out in accordance with Appendix G.

3.1.2 Face velocity Following installation of the fume cupboard and exhaust system, face velocity shall be measured in accordance with Appendix E. Face velocity shall be as uniform as possible throughout the sash opening with the sash fully opened, and the average value shall not be less than 0.5 m/s. Individual measurements shall be within ±20% of the average. Reserve capability of at least 20% shall be designed into the extraction system to cover loss of performance in service.

Face velocities in excess of 1 m/s through the fully open sash can lead to local turbulence in front of an operator and generate overall instability of the airflow. High flow rates through the aperture lead to wastage in energy by exhausting an unnecessary amount of conditioned air from the laboratory.

3.1.3 Make-up air

3.1.3.1 *Provision of make-up air* A fan-assisted source of make-up air should be filtered and heated, cooled or otherwise treated to maintain the environmental conditions specified for the laboratory. When there is a significant change in the rate of air extraction from the room by the fume cupboard installation, fan-assisted make-up air rate should be correspondingly adjusted to restore airflow balance.

3.1.3.2 *Distribution system* A make-up air distribution system shall not disturb the fume cupboard airflow pattern or reduce its operational containment level. Ceiling air diffusers or grilles shall not discharge directly toward a fume cupboard. Cross-draughts at the face of the fume cupboard should not exceed 0.2 m/s for optimum containment.

Sufficient openings, louvres or transfer grilles shall be provided in walls and doors for part or all make-up air to infiltrate into the room from its surroundings. Openings should conform with the requirements of AS 2982 and may need to be closeable for fire isolation purposes. The practice of opening windows shall not be relied upon for supplying of make-up air, as draughts from windows in the vicinity of a fume cupboard often prevent the containment level required.

Drawing in contaminated air, e.g. from adjacent laboratories, shall be avoided and the general quality of air drawn in shall be consistent with the achievement of the environmental conditions specified for the laboratory.

3.1.4 Air-conditioned laboratories In some air-conditioned laboratories, the air is subject to greater turbulence than is strictly necessary to avoid thermal stratification. If maximum rotational speed in the eddies at the face of the fume cupboard exceeds average inward face velocity, transient reversals of flow will occur, with consequent reduction in containment. In such circumstances increased face velocities would be required to restore fume cupboard performance. However, if velocities greater than 0.5 m/s are required for adequate containment, it will usually be simpler and more satisfactory to restore the performance by reducing excessive turbulence in front of the fume cupboard rather than increasing airflow.

3.1.5 Energy conservation

3.1.5.1 *Auxiliary air supply* Auxiliary air supply systems shall not be fitted to fume cupboards as no completely satisfactory system has been devised. Such systems have been the primary cause of many fume containment problems. Historically, auxiliary air systems delivered a flow of outside unconditioned air across the entire width of the working aperture, immediately above the sash window, either inside or outside the fume cupboard chamber. Auxiliary air systems have been superseded by sensor/control systems which proportionately reduce the air drawn from the laboratory into the fume cupboard as the sash is partially closed.

3.1.5.2 *Variable flow systems* The amount of laboratory air exhausted through a fume cupboard may be proportionately reduced as the sash is partially closed by means of face velocity controls, sash position sensors or similar means. These permit the rate at which air is exhausted from the laboratory through the fume cupboard to be adjusted by fan speed control, the operation of dampers or other means. Such systems shall maintain the face velocity within the specification of Clauses 2.6.3(b) and 3.1.2, as well as complying with the requirements of Clauses 3.2.7.2 and 3.2.7.3. Provision may be made to boost the exhaust flow rate above the face velocity requirements of Clause 3.1.2 by a manual override control.

Where make-up air is provided in accordance with Clause 3.1.3 it should also be proportionately reduced as the sash is partially closed.

3.1.6 Recirculation of air Air extracted through a fume cupboard shall not be recirculated to other rooms. Air from air-conditioned office areas may be used as make-up air for laboratories.

3.1.7 Improving containment Containment of fume may be improved in the following ways:

(a) Increasing face velocity into the cupboard. This has only a limited effect since it increases turbulence, both in the cupboard and in the room, as well as increasing energy consumption for heating and cooling.

(b) Reducing turbulence in the cupboard by aerodynamic leading edges and aerofoils. Service controls should not be located on the surface of the inlet where they may disturb airflow into the fume cupboard. However, weak eddies are still created behind the sash and any bulky apparatus in the cupboard.

(c) Fitting correctly designed baffles to improve the scavenging of fume generated.

(d) Reducing turbulence in the room, eliminating impinging air jets, redirecting draughts away from the fume cupboard, or reducing the velocity of cross-draughts. Turbulence is often created by air conditioners and fans and also traffic in the workplace, which should be kept clear of the working area in front of the cupboard. Poor airflow patterns in front of the fume cupboard are a frequent cause of inadequate containment.

(e) Reducing the size of the working aperture by partially closing the sash. This prevents the largest eddies from penetrating the aperture and often increases the effective face velocity.

(f) Balancing the exhaust/supply flow ratio with the fume cupboard operating to achieve an air pressure in the laboratory that is only just below atmospheric, preferably within 10 Pa. This reduces the velocity of uncontrolled air leaking into the laboratory, since this may be a source of excessive air turbulence. Ingress of air into sensitive regions should be prevented by sealing any leaks in these areas.

3.2 FUME EXHAUST AND DISPERSAL

3.2.1 General The primary function of the fume exhaust system is to safely contain and convey potentially dangerous or noxious fumes from the fume cupboard to an outside discharge point from which fumes can be safely and adequately dispersed at the point of discharge at a concentration level acceptable to the relevant State or Territory regulatory authority.

The exhaust system comprises a connection to the fume cupboard, ductwork, a fan and a discharge flue. It may also include equipment for preventing the spread of fire and smoke and may also need to include fume filtration, fume scrubbing, heat recovery, condensate collection, washdown and drainage.

3.2.2 System pressure To prevent hazards arising from leaks, the exhaust system within the building shall be at a negative pressure when in use. Exhaust fans and all runs of positively pressurized ducting from the fans should be external to the building and well clear of any air inlets. If plant rooms are used to house the fans of the ventilation system, the supply plant room shall be completely separate from the exhaust plant room, preferably with no common wall. The exhaust plant room should be maintained at a slight negative pressure, with respect to the surrounding areas, by mechanical ventilation.

3.2.3 Airflow requirements Specifications for the ductwork (and its resulting resistance to the passage of air) and specification for the fan should satisfy the maximum airflow requirement at operating temperatures for the fume cupboard served by the system. Exhaust system capabilities should exceed maximum operating requirements by at least 20% when new. Where highly toxic materials are handled, automatic changeover to a standby fan in the event of fan failure may be desirable.

3.2.4 Exhausts To prevent mixing of types of fume that could give rise to an unacceptable hazard such as fire or explosion, exhausts from different fume cupboards shall not be combined. Each fume cupboard shall be separately ducted to its individual exhaust fan. To prevent reverse flow re-entry of exhausted fume, all fume cupboards in the one room should be switched on simultaneously or the laboratory should incorporate a variable air supply system.

3.2.5 Fans

3.2.5.1 *Fan type* Appropriately selected fans of the centrifugal type should be considered as a first choice, as they are generally more efficient and generate less noise than other types. They can also operate over a wide range of airflow without instability. Where particular performance requirements and other extract system design constraints (e.g. cost, space) preclude the use of such fans as a first choice, other types should be considered carefully. For quiet operation, the fan outlet velocity when installed should be between 5.5 m/s and 7.5 m/s.

3.2.5.2 *Fan components* All parts of the fan likely to come into contact with fume or condensate should be resistant to them and be able to withstand the maximum operating temperature expected in its location.

3.2.5.3 *Drainage* A permanently plumbed-in drain should be connected to the lowest point of each fan casing to permit disposal of condensate, rainwater and liquid used for cleaning the exhaust system.

3.2.5.4 *Construction and installation* Construction and installation of the fan shall permit access for cleaning all parts of the fan in contact with fumes. Permanent warning labels shall be affixed to the fan for the protection of maintenance staff, indicating precautions that need to be taken before cleaning and whether a permit is required before commencing work.

3.2.5.5. *Fan operation* Exhaust fans shall remain in operation whenever the cupboard is in use, and shall not be switched off in the event of fire, except when the discharge of a gaseous fire suppressant is activated.

3.2.6 Ductwork

3.2.6.1 *General* Ductwork shall have a smooth, non-absorbent, obstruction-free interior surface and shall be unreactive to any exhaust fumes passing through it. All penetrations or joins in ductwork shall be completely sealed to avoid attack by exhaust fumes.

3.2.6.2 *Air velocity within ducts* For noise control, air velocities within the ducts should not exceed 7.5 m/s. Where low noise levels are required, air velocity should not exceed—

(a) 5 m/s for internal ducts; and

(b) 6 m/s for external ducts.

3.2.6.3 *Route of ducting* Ductwork should follow the most direct route from fume cupboard to point of discharge. Bends should be kept to a minimum and have the largest radii practicable. There should be a minimum of horizontal runs and, where these are unavoidable, they shall have an in-built slope toward a drainage point. Drainage points should be provided at all low points of the extract system. The minimum radius of bends should be equal to twice the diameter of the duct at that point.

3.2.6.4 *Jointing* The ductwork shall be leakproof, and gaskets, where fitted, shall be resistant to fumes and condensate. Ductwork shall be designed to accommodate thermal expansion and contraction.

3.2.6.5 *Fire isolation of exhaust ducts* Where fume cupboard exhaust ducts pass through more than one fire compartment, the ducts shall be protected to achieve a fire rating of not less than the rating of compartments penetrated. Fire protection may be achieved by fitting fire-rated ducts, enclosing ducts within individual fire compartmented accommodation ducts or by running the ductwork outside the building.

The installation of fire-isolation devices should be avoided as, when activated, they interfere with the extraction of fumes and smoke. Fire-isolation devices, if used, shall—

(a) be corrosion-resistant;

(b) comply with AS 1682;

(c) have blades and mechanisms that are clear of the airflow; and

(d) be accessible for inspection and maintenance.

3.2.7 Fume discharge

3.2.7.1 *General* The desirable objective is to ensure that a minimum amount of pollutants is discharged to the atmosphere. Pollutants should be collected for safe disposal rather than be dispersed into the atmosphere. Health risk and environmental impact shall be minimized by appropriate fume discharge arrangements which incorporate the recommendations and requirements of Clauses 3.2.7.2 to 3.2.7.8.

3.2.7.2 *Reduction of discharge of fume* All operations within a fume cupboard shall be designed and carried out to minimize emission of fume at source by controlling the types, quantities and release rates of materials used in the fume cupboard.

Where a further reduction of fume is required, a suitable air cleaning device, such as a filter, scrubber, adsorber or incinerator, should be provided for the system.

3.2.7.3 *Discharge of contaminants* Exhaust fumes discharged shall not contain contaminants in excess of levels specified by the appropriate regulatory authority.

3.2.7.4 *Occupational exposure* Persons shall not be exposed to contaminants from fumes re-entering the building of origin or entering nearby buildings or occupied sites in concentrations exceeding the air quality requirements appropriate for those occupied areas.

NOTES:

1 National guidelines on controlling the emission of air pollutants are available from the National Health and Medical Research Council (NH&MRC)* and Exposure Standards from atmospheric contaminants in the occupational environment are available from Worksafe Australia†. Air quality goals for the environment are being developed by the NH&MRC. Specialist advice may be necessary in the interpretation of the above.

2 Lower levels of exposure to contaminants may apply to members of the public residing in nearby houses or flats, where permissible concentrations are reduced by a factor of 50 for 168 h per week occupancy. Still lower concentrations may apply to hospitals where patients are in a compromised state of health.

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* NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL. *National guidelines for control of emission of air pollutants from new stationary sources, Recommended methods for monitoring air pollutants in the environment*, Canberra: Australian Government Publishing Service, 1986.

† WORKSAFE AUSTRALIA. *Exposure standards for atmospheric contaminants in the occupational environment*, Canberra: Australian Government Publishing Service, May 1990.

3.2.7.5 *Discharge velocity* The fume discharge should be at a minimum velocity of 10 m/s to minimize downwash on the leeward side of the stack for wind velocities below 5 m/s.

NOTE: The regulatory authorities may require that specific stack discharge velocities are met.

3.2.7.6 *Height and location of discharge point* The point of discharge should be above the aerodynamic wake of the building and shall be vertically upward, located as remote from air intakes as possible and in accordance with AS 1668.2.

The minimum discharge height shall be 3 m above both the roof at the point of penetration and any access walkway. This is particularly important at walkways where there are multiple discharge flues as the emissions could be antagonistic or synergistic.

Where multiple discharge flues are incorporated inside a windshield for support, to minimize trapping of the exhaust fumes into the lee wake of the windshield, all individual flues should protrude above the top of the windshield by three diameters of the largest flue.

The exhaust dispersion pattern can be affected considerably by the building shape, presence of other nearby large buildings or structures, topography and vegetation. This may necessitate use of tracer and modelling studies to determine the optimum discharge height and location.

NOTES:

1 The simple provision of an exhaust stack of 3 m height, without other measures of fume treatment, and the use of tracer gas or modelling studies may not ensure that the exhaust is discharged in a satisfactory manner.

2 The aerodynamic wake typically extends to at least 125% of the building height above the ground.

3.2.7.7 *Air cleaning devices* The use of air cleaning devices is recommended where a single or a narrow range of contaminants is envisaged. Where incompatible contaminants may be released, the possibility of reactions between contaminants within the air cleaning device and the exhaust system should be taken into account and possible changes in the efficiency of such devices should be assessed

3.2.7.8 *Trapped contaminants* Trapped contaminants in a fume disposal system shall be disposed of safely.

SECTION 4 SITING AND COMMISSIONING

4.1 SITING A FUME CUPBOARD

4.1.1 General The siting of fume cupboards in laboratories should be considered at the initial stages in the planning of a new building or before modification of an existing building. When additional fume cupboards are required in an existing laboratory, siting and commissioning shall comply with this Standard. The sites selected shall comply with requirements for containment, fume extraction and dispersal, room make-up air, ventilation, general environmental safety and operator comfort. There is a potential risk of fire or explosion in fume cupboards where hazardous materials are used, therefore each case shall be individually assessed.

4.1.2 Height of working surface The fume cupboard working surface should be at a comfortable height for the intended use.

4.1.3 Avoidance of airflow disturbances to the fume cupboard

4.1.3.1 *Traffic routes* The distance from the sash to any traffic route shall be at least 1 m so as to preserve a zone undisturbed by anyone other than the operator (see Figure 1(a)). If the traffic route within the laboratory is in frequent or continual use, the minimum distance should be 3 m.

4.1.3.2 *Opposing bench tops* The distance between the sash and any bench opposite it should be at least 1.8 m (see Figure 1(b)).

4.1.3.3 *Opposing walls* There should be no opposing wall or other major obstruction likely to significantly affect the air flow within 1.8 m of the sash (see Figure 1(c)).

4.1.3.4 *Other fume cupboards* A fume cupboard shall not be installed in a position where it is likely to affect, or be affected by, the airflow into another fume cupboard. There are no restrictions on positioning fume cupboards side by side, however, allowance shall be made to permit adequate access for maintenance according to the manufacturer's requirements. The distance between sashes of opposing fume cupboards should not be less than 3 m (see Figure 1(d)).

4.1.3.5 *Air supply registers* Room air supply registers shall be designed or modified so that they do not compromise the airflow into the fume cupboard.

4.1.3.6 *Architectural obstacles* A fume cupboard should not be positioned with either side wall closer than 300 mm to a wall or similar smooth obstruction (see Figure 1(e)).

Obstructions should be no closer to the fume cupboard than those shown in Figure 1(f).

Doorways should not be within 1.5 m of the sash or within 1 m of the side of a fume cupboard.

4.1.3.7 *Maintenance access* Allowance shall be made to permit adequate access for maintenance and to meet the manufacturer's requirements.

4.1.4 Exits and escape routes The possibility of a fire or explosion in a fume cupboard should always be considered, therefore adequate safe escape routes shall be provided (see AS 2982).

4.2 COMMISSIONING TESTS

4.2.1 General On completion of the installation or major changes to a fume cupboard or its environment (i.e. the laboratory area and adjacent buildings to the laboratory) and the associated fume exhaust and make-up air supply, the system shall be tested for overall compliance with this Standard.

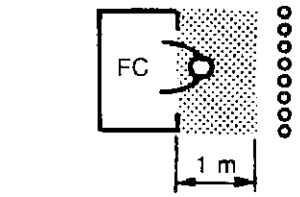
4.2.2 Smoke test A full smoke test shall be carried out as part of the fume cupboard commissioning tests. Details relating to smoke generation and smoke testing with the fume cupboard empty are described in Appendix G.

Smoke-generating equipment and pyrotechnic smoke generators provide a visual demonstration of the airflow in the laboratory environment, through the working aperture, inside the fume cupboard, and at the point of discharge to the atmosphere. They can also be used to check the integrity of the exhaust systems.

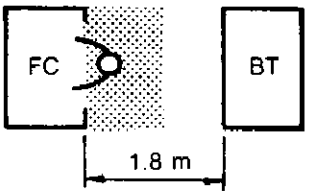
In all smoke tests, particular notice should be taken of any flow reversals and eddies, and whether these may be attributed to any particular causes and associated with any momentary escapes.

4.2.3 Face velocity A full test of face velocity shall be carried out in accordance with Appendix E, with the fume cupboard empty.

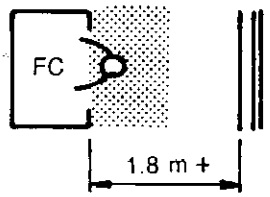
4.2.4 Noise level When rated in accordance with AS 1469, a well designed system should not produce noise levels in excess of 62 dB(A) at the operator's position for both fully open and fully closed sash positions. The sound pressure levels shall be measured in accordance with AS 1807.16.



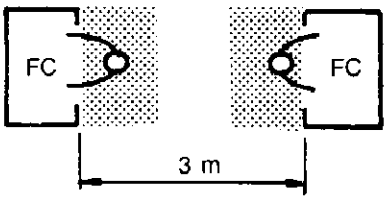
(a) Separation of undisturbed zone from traffic routes



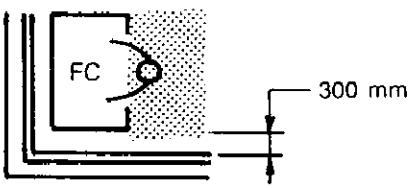
(b) Spacing where same operator uses FC and BT or where occasional traffic only is anticipated



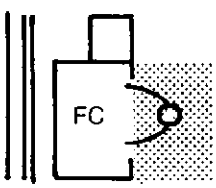
(c) Spacing determined by air flow requirements



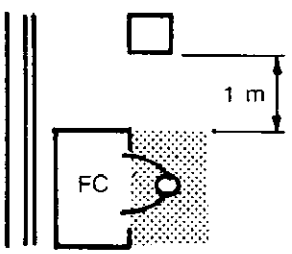
(d) Spacing determined by air flow requirements



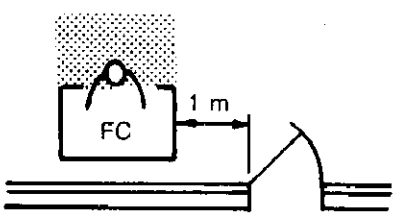
(e) Maximum distance for avoiding disturbance to the fume cupboard and its operator



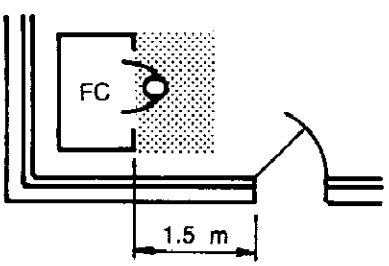
(f)(i) Face of column not in front of plane of sash



(f)(ii) Face of column in front of plane of sash

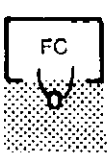


(f)(iii) Doorway close to plane of rear of FC



(f)(iv) Doorway behind plane of operator

KEY TO ABOVE DIAGRAMS



Fume cupboard

Undisturbed zone (area in which air should be undisturbed by onyone other than the operator)

Bench top

Traffic or escape route

Wall or obstruction above work top height

FIGURE 1 MINIMUM SPACINGS THAT AVOID UNDUE DISTURBANCE OF AIRFLOW

4.2.5 Results of commissioning tests Results of all commissioning tests shall be recorded and copies retained within the operating and maintenance manuals held by the person responsible for the completed work. Copies of commissioning tests shall be supplied to the owner of the premises in which the fume cupboard is installed.

4.2.6 Testing Testing shall be carried out by a competent person.

4.2.7 Placing in service The equipment should not be placed in service unless all the requirements of Clause 4.2 have been met.

SECTION 5 MAINTENANCE AND TESTING

5.1 GENERAL The whole system, from cupboard to discharge stack, shall be subject to periodic inspection and maintenance. A maintenance program shall be instituted and records of maintenance and tests shall be kept. There should be adequate access to the exhaust system including dampers, scrubbers, filters and fan as difficult access means little or no maintenance will be carried out on the system.

5.2 USER RESPONSIBILITY The user of the fume cupboard can reduce the need for maintenance by regularly using the washdown facility, if fitted, so that corrosive substances are removed from the interior before damage occurs.

5.3 DECONTAMINATION Staff engaged in maintenance operations shall be advised, through the laboratory safety officer or supervisor, of the need for any decontamination procedures on the fume cupboard and its ancillary equipment, which shall be implemented before any maintenance is commenced.

5.4 ACCESS TO HAZARDOUS AREAS The safety officer or supervisor shall ensure that the area in which maintenance is to be performed is safe (e.g. work on roofs near exhaust discharge points).

5.5 MAINTENANCE AND TESTING SCHEDULE

5.5.1 General The following maintenance and testing schedule should be used as a guide for minimum requirements only. More frequent maintenance may be required where the fume cupboard is in continual use.

When inspection or maintenance service is being carried out, the fume cupboard shall be isolated from the power supply to prevent it being operated. During maintenance, the fume cupboard shall be tagged 'system under maintenance—do not use' and all chemicals in the fume cupboard shall be removed.

5.5.2 Weekly Inspect and maintain air cleaning devices, if installed, in accordance with maintenance manuals, and safely dispose of trapped contaminants.

5.5.3 Six-monthly The following maintenance and testing operations should be carried out:

(a) Perform an abbreviated smoke test in accordance with Appendix G. If a problem is evident (see Clause 3.1.2), perform a full smoke test in accordance with Appendix G.

(b) Perform an abbreviated face velocity test in accordance with Appendix E. If a problem is evident, perform a full test in accordance with Appendix E.

(c) Inspect and maintain fans, their motors, drives (including belts) and bearings. Lubricate where appropriate.

(d) Check that the scrubber and washdown facility, if fitted, is functioning efficiently.

(e) Inspect the fire damper and the release mechanism, if fitted, and replace fusible link, if required.

(f) Check that any air cleaning device, if fitted, is operating efficiently and maintain if required.

(g) Check the condition of the thermal detector and sprinkler heads, if fitted.

5.5.4 Annual maintenance In addition to those specified in Clause 5.5.3, the following additional maintenance operations shall be carried out:

(a) Remove any baffles and clean both the baffles and the rear of the chamber.

(b) Wash entire interior surface of the chamber including the aerofoil, if fitted, with dilute detergent solution and repair defects as necessary.

(c) Check condition of the services to the cupboard and ensure that all are properly identified and operational.

(d) Check stability and condition of the discharge stack.

(e) Inspect condition of the exhaust ducting, where possible, particularly the joints and ensure drain points are clear.

(f) Check make-up air balance.

(g) Check condition and satisfactory operation of the fume cupboard system.

(h) Check operation of the emergency isolator and isolation of services (see Clause 2.2.4).

(i) Check operation of the automatic isolator by providing inadequate air flow conditions to the fume cupboard (see Clause 2.2.4).

(j) Attach a self-adhesive label to the fume cupboard showing the inspection date, name of inspector and report number.

SECTION 6 USE OF FUME CUPBOARDS

6.1 BEFORE USE The following procedures should be carried out:

(a) Check that the fume cupboard is suitable for intended use, i.e. the cupboard and exhaust system is fitted with an effluent treatment system that is adequate for the safe use of the products and the process.

(b) Ensure that the wash-down facility (where fitted) is operable.

(c) Check that the fume cupboard is clean and free from dangerous contamination.

(d) Ensure that there is enough space in the cupboard to enable the proposed process to be carried out.

(e) Position apparatus and materials toward the centre and back of the cupboard to minimize disturbance to the airflow at the working aperture.

(f) Close any doors or windows that reduce the performance of the fume cupboard. Check that ventilation grilles are unobstructed and that the ventilation is working. Ensure that the conditions surrounding the fume cupboard are similar to those occurring during the commissioning tests, i.e. no impinging air jets or crossdraughts from air-conditioners, fans, heaters, open doors or windows.

(g) Check that the fume cupboard is working correctly, using an airflow indicator. It is not enough to know that the fan is switched on.

(h) Check that a suitable fire extinguisher is at hand especially if using flammable solvents.

(i) Where practicable, place everything required inside the cupboard before starting operations.

NOTE: Risks associated with any process may be reduced by—

(i) lowering the sash;

(ii) using reduced quantities of the substances involved;

(iii) using a slower reaction rate; and

(iv) reducing the amount of substances released into the air flow.

6.2 DURING USE The following procedures shall be carried out:

(a) Use the following sash positions—

(i) full open to provide access for setting up apparatus process or reagents;

(ii) partially open when handling hazardous substances inside the fume cupboard; and

(iii) lowered as far as practicable when the process is in operation.

(b) Use the minimum quantity of hazardous substances necessary for the particular process.

(c) Use reaction rates that minimize hazards such as evolution of copious fumes or heat.

(d) Use a decanting bench fitted with a local exhaust for the decanting of hazardous substances from bulk stocks.

NOTE: A decanting bench consists of a grid tray under which is fitted a sink with a non-splash surface nearest to the operator and preferably a local exhaust system. The sink drains to a dilution pot before draining to waste.

6.3 AFTER USE The following shall be carried out:

(a) Dispose of laboratory waste in accordance with safe laboratory procedures and relevant Commonwealth, State or Territory regulations.

(b) Lower the sash enough to minimize the effect of outside disturbances while allowing a satisfactory air flow.

(c) Ensure that the fume cupboard is clean and free from contaminants.

6.4 HAZARDOUS CHEMICALS Toxic, noxious, flammable and corrosive substances shall be stored in storage cabinets, e.g. continuously vented cabinets, designed for the particular purpose. A fume cupboard should not be used for the storage of dangerous chemicals. Mutually reactive substances shall not be stored together (refer AS 2243.2).

NOTE: Storage of flammable substances in a fume cupboard that is in frequent use is dangerous. A fire or violent reaction inside such a fume cupboard could result in a situation more serious than expectd with the reagents being used.

For perchloric acid operations, the fume-scrubbing facility shall be run continuously. On completion of the operation with perchloric acid, the wash-down facility shall be operated for 15 min and any condensate, spills or dust deposits shall be manually washed from the interior of the fume cupboard chamber by means of a hand-held gentle spray of cold water. Such a spray may double as a safety shower facility.

APPENDIX A
MATERIALS OF CONSTRUCTION
(Normative)

A1 GENERAL The materials of construction of those parts of the fume cupboard (including service outlets and exhaust ducts) that are likely to come into contact with fume shall be selected to satisfy the nature of chemicals to which materials are to be exposed and the requirements of the user.

All materials used in the construction of the fume cupboard shall be tested in accordance with AS 1530.3, to determine the ignition time, fume propagation time, the heat release integral and the smoke released. Wherever possible, fire-retarded materials shall be used for the interior of the fume cupboard.

Processes carried out within most fume cupboards change with time. Fume cupboards should therefore be designed and constructed to meet a wider range of conditions than originally anticipated.

Where the fume cupboard is likely to be used for work with highly toxic or aggressive substances, or both, e.g. concentrated mineral acids, the chamber interior shall be free from crevices and ledges, so that decontamination may be effected efficiently. All corners and joints shall be welded or sealed and be made smooth. Corners shall have a generous radius to aid decontamination.

For information on materials of construction for fume cupboards intended for specialized work, e.g. use of perchloric acid or radioactive materials, see Appendix B. The following is a list of materials used for fume cupboard construction. It refers to commonly used materials and does not cover all materials that are available. Materials should be tested for resistance to abrasion and chemical attack.

A2 STAINLESS STEEL (See AS 1444 and AS 1449.) Stainless steel may be used when very high air temperatures are envisaged. For ease of decontamination the metal should be buffed to a smooth finish. Certain commonly used acids attack some grades of stainless steel quite readily. The most suitable grades are as follows:

(a) *Type 316* (Cr 17%, Ni 12%, Mo 2.2%, Co 07%.) This type is resistant to certain corrosive conditions particularly those causing pitting. It is not susceptible to inter-crystalline corrosion, therefore sheets may be welded without subsequent heat treatment. It should not be used for temperatures above 300°C.

(b) *Type 317* (Cr 19%, Ni 13%, Mo 3.2%, Co 07%.) This type is similar to Type 316 but has improved corrosion resistance against cold dilute sulphuric and hydrochloric acids, brines and halogen salts. It is also resistant to phosphoric, lactic and acetic acids under all conditions.

A3 COATED MATERIALS Materials of construction coated with a continuous protective layer are only acceptable provided that the coating is undamaged, is fully reacted and thick enough to be durable. Such protective coatings can be easily damaged during installation or subsequent use, rendering the exposed underlying material liable to chemical attack.

A4 PLASTICS MATERIALS Plastics materials used in the construction of fume cupboards and duct systems may constitute a fire hazard owing to flammability and loss of strength at high temperatures.

Before using any polymeric materials, the polymer manufacturer or supplier should be consulted as to which grade is the most suitable for the intended use. Some suitable polymeric materials are as follows:

(a) *Unplasticized PVC (polyvinyl chloride)* Unplasticized PVC has good resistance to most chemicals. Care should be taken with spillage of certain solvents. It begins to soften at about 60°C but does not readily burn; however, the products of combustion contain significant quantities of hydrochloric acid which will damage electrical equipment and is injurious to health. Its strength and thermal resistance will be improved by external lamination with glass-fibre reinforced polyester resin. However, this will not improve its fire resistance.

Transparent PVC may be an alternative to glass in the construction of the sash.

(b) *Polypropylene* Polypropylene has slightly better thermal resistance than PVC but it burns and it drips as it burns. It is resistant to most solvents.

(c) *Glass-fibre reinforced plastics (GRP)* Any GRP used in the construction of a fume cupboard shall be of fire-retardant grade.

To maintain the impervious chemically resistant surface, it is important that GRP be contact-moulded to ensure an unbroken gel coat. Where glass fibres come to the surface, either from wear, physical damage or from use of a non-contact-moulding technique, capillary transmission of chemicals, e.g. perchloric acid, into the body of the GRP can occur. Appropriate additives can also be incorporated into the gel coat resins to reduce flammability but this may also reduce chemical resistance. An isophthalate resin has much better chemical and corrosion resistance than an orthophthalate resin.

(d) *Polymethylmethacrylate* Polymethylmethacrylate may be used for viewing panels. It has better impact resistance than glass but softens at about 60°C. It has limited chemical resistance and is flammable.

(e) *Polycarbonate* Polycarbonate may be used for viewing panels and has very high mechanical strength and better impact resistance than polymethylmethacrylate, but has less chemical resistance. It has better thermal resistance, softening at about 150°C.

(f) *Melamine-formaldehyde laminates* Melamine-formaldehyde laminates provide suitable working surfaces if thicker than 6 mm supported or 10 mm unsupported. These laminates are fire-resistant.

A5 GLASS

A5.1 General Glass is attacked by hydrofluoric acid, its vapour and acidic fluorides as well as by organic compounds containing fluorine. It is resistant to other chemicals and vapours for long periods. The hazard from broken glass may be minimized by the use of a transparent plastics film on its outer surface. Reference should be made to AS 2208 for additional information.

A5.2 Plate glass Plate glass shall not be used in the construction of fume cupboards.

A5.3 Wired glass Wired glass shall not be used in fume cupboard construction. If it is struck, pieces that have the sharp edges characteristic of annealed glass are dislodged from the opposite side.

A5.4 Laminated glass Laminated glass has similar disadvantages to wired glass as a material for fume cupboard construction and shall not be used.

A5.5 Toughened glass Toughened glass is a safety glass that provides good mechanical protection and, when fractured, produces small, relatively harmless pieces. When broken, the pieces expand, effectively locking them within any surrounding frame. Where framing is provided, it should not affect the smooth, aerodynamic entry of air into the cupboard.

The edges of toughened glass are vulnerable and edge protection by suitable framing and glazing material is recommended. Toughened glass is resistant to thermal shock of 250°C and to temperature gradients of 260°C/6 mm thickness. Maximum allowable working temperature is 300°C. It has much better resistance to wind loading than wired glass or laminated glass of the same thickness.

A5.6 Transparent plastics materials Though some transparent plastics materials have higher impact resistance than glass and are not etched by hydrogen fluoride, their temperature resistance and surface hardness are inferior to glass. Some may shatter dangerously in an explosion. These materials may have limited uses in special circumstances and the manufacturer should be consulted on their suitability.

A6 COATED COMPRESSED FIBRE CEMENT A range of compressed fibre cement products is available having certain mechanical properties and zero indices for ignitability, spread of flame and heat evolved, when tested in accordance with AS 1530.3. This material shall be compressed, autoclaved and finished with a suitably resistant surface coating to prevent adsorption of chemicals. This material can be moulded or fabricated into various shapes giving smooth, crevice-free finishes which can be easily cleaned. Uncompressed fibre cement materials shall not be used for the interior or working surface of a fume chamber.

A7 CERAMICS High-density unglazed ceramic tiles and modern heat-resisting ceramic materials are suitable for work surfaces. Jointing and bonding compounds for these materials should be chosen carefully. Acid-resistant epoxy or furfural resin cements are generally satisfactory.

A8 TIMBER Timber is not recommended for general purpose fume cupboards. Any timber surfaces that may come into contact with fumes shall be thoroughly protected by an impervious surface coating, which shall be regularly maintained. Timber shall not be used in fume cupboards for use with perchloric acid, other highly corrosive substances or radioactive substances. Heat sources capable of operation above 100°C shall not be used in timber fume cupboards. Timber fume cupboards shall not be used with wet or condensing humidity environments.

APPENDIX B

FUME CUPBOARDS FOR SPECIAL APPLICATIONS

(Normative)

B1 GENERAL Although fume cupboards intended for special applications are not covered in this Standard, general-purpose fume cupboards may be used for the applications described in Paragraphs B2 to B6, provided that additional considerations are taken into account.

B2 RADIOACTIVE MATERIALS The quantity of radioactive material that can be safely handled in a fume cupboard is limited by the radiotoxicity and the physical state of the nuclide. The amount of lead shielding required may also be a limiting factor. Large quantities of highly radioactive material are normally handled in either glove-boxes or heavily shielded cells, maintained at a negative pressure with respect to the outside atmosphere by a continuous, filtered exhaust.

Fume cupboards for use with radioactive materials require the working surfaces to be smooth and crevice-free, with rounded corners for easy cleaning and decontamination. Tile bases are not recommended for this reason. Some strengthening of the framework and base of the fume cupboard may be necessary to take the weight of lead pots and lead shielding enclosures. Filters may also need to be fitted (see also AS 2243.4).

B3 PERCHLORIC ACID

B3.1 General The use of concentrated perchloric acid in the laboratory gives rise to special hazards, because almost all metal and organic perchlorates are explosive and some of them are extremely shock sensitive (particularly copper perchlorate). In addition, after exposure to perchloric acid, some organic materials, such as timber or rag, spontaneously ignite when they dry.

Hot perchloric acid is a strong oxidizing agent and oxidizes all forms of organic material, but it loses its oxidizing properties entirely when cooled and diluted with water.

Materials of construction of the fume cupboard, its supporting framework, ductwork, exhaust fan, adjacent cupboards and the immediate laboratory floor are of critical importance.

Absorbent organic materials such as timber shall be prohibited from these areas. The fume cupboard should stand on an impervious floor graded to a floor waste drain so that any spillages may be diluted and safely washed away with water. The floor should not be waxed in front of the fume cabinet.

B3.2 Materials of construction The following properties should govern the choice of material of construction of the fume cupboard for perchloric acid use:

(a) Chemical resistance. Materials of construction of the fume cupboard shall be shown to be compatible with concentrated perchloric acid by passing a test similar to the Hooker Chemical Corporation's 'Explosion and Flammability Test Procedures for the Acceptance of Materials for Perchloric Acid'*.

(b) Working temperature and thermal stability.

(c) Flammability.

(d) Smoothness of surface for easy decontamination.

(e) Resilience.

(f) Impermeability.

(g) Easy workability to mould smooth crevice-free joints and curves.

Unfortunately, there is no material with all the properties desirable in constructing a fume cupboard for use with perchloric acid and some compromises may be necessary. There may be merit in the use of different materials for different parts of the fume cupboard.

The following comments on different materials should be borne in mind:

(i) *Stainless steel* (e.g. Types 316 and 317) was favoured in the past but these steels readily corrode (especially in the presence of hydrofluoric acid) and react to form explosive iron perchlorate, which must be washed away.

(ii) *Unplasticized PVC* is chemically inert, readily welded and moulded to give simple shapes and curves only burns when in contact with a flame but gives off dense toxic smoke when it does so. It begins to soften at about 60°C, so heat shields of glass or suitable ceramic are often required to avoid distortion when hot plates are in use in a PVC fume cupboard.

(iii) *Glass-fibre reinforced plastics* (epoxy, isophthalic, bisphenol, chlorindic or vinyl ester resins) are acceptably inert as long as the surface is covered by an unbroken gel coat containing no excess or unreacted hardener, are easily moulded in quite complex shapes with smooth easily cleaned corners, have good thermal characteristics and fire-retardant additives give excellent flammability properties. They may be suitable for the chamber or liner of a fume cupboard (especially if the critical surfaces are continuously washed) but they are not suitable for the working base, owing to the danger of abrasion of the gel coat.

* GRAF, F.A. Jnr. Safe handling of perchloric acid. *Chemical engineering progress*. American Institute of Chemical Engineers. Vol 62, No. 10, October 1966, pp 109 to 114.

(iv) *Coated compressed fibre cement* may be used for the fume chamber or working surface as it is acceptably inert provided that the surface is covered by a hard wearing, chemical-resistant coating. It can be easily moulded or fabricated into smooth, complex shapes with easily cleaned corners and has zero indices for ignitability, spread of flame and heat evolved, when tested in accordance with AS 1530.3. Only compressed fibre cement with a density in excess of 1500 kg/m^3 should be used.

(v) *Toughened glass* is suitably inert with good thermal properties, but cannot be moulded or shaped and is brittle; suitable for heat shields and may be suitable for the working base with proper support.

(vi) *Ceramic tiles* are suitably inert, but also require an inert grouting. They are sometimes used as the working base, but the surface is uneven and difficult to clean and decontaminate.

(vii) *Melamine-formaldehyde laminates* may be suitable as work bases as they are non-absorbent and have good thermal properties. Any spills on the base, however, should be diluted and washed away immediately.

(viii) *Vinyl-coated steel* is not satisfactory because of the ease with which the coating can be damaged and thus allow explosive iron perchlorates to form under the damaged coating.

Materials of construction for the sash window shall not create an additional hazard in the event of an explosion or a fire in the fume cupboard. Suitable materials are rigid PVC or polycarbonate sheet or stainless steel-framed toughened glass with an adherent plastics film on the outside surface (see Paragraph A5).

B3.3 Design and operation Perchloric acid fume cupboards shall have a crevice-free, impervious, smooth-finished interior with the base rounded into the walls and with built-in washdown facilities (see Clause 2.8). The work surface should have an integral trough at the rear to collect washdown water and the washings from any spillages within the cupboard. Perchloric acid mist and vapours shall be scrubbed from the exhaust gas as close to the fume cupboard as possible to minimize the length of ducting in which dangerous build-up of solid perchlorates could occur. Ductwork with rounded corners is required for ease of decontamination.

At the end of each day's work, the interior of the fume cupboard shall be washed down thoroughly with a water spray to prevent build-up of dust deposits that might react with the perchloric acid. The condensate shall be washed from behind the baffles and the ductwork up to the scrubber. This final cleansing operation may be performed automatically with the mist or spray functioning for a period of 15 min before the fume cupboard exhaust shuts down on a time delay. A hand-held gentle water spray to dilute and wash away spills within the cupboard is desirable. This spray may also be used as an emergency shower in cases of acid splashes reaching the operator. If baffles or heat shields are fitted, they shall be easily removed to facilitate decontamination and should not create crevices or pockets to trap condensate. It may be advantageous, for ease of cleaning and safety, to design the fume cupboard without a rear baffle.

The fan shall be located outside the building, be acid-resistant and be driven by a motor located outside the ductwork. The fan housing should be drained through a line connected to the laboratory plumbing to cope with water carry-over from the scrubber and any rainwater entering the system. If the fan requires lubrication, a fluorocarbon grease shall be used.

Each perchloric fume cupboard should have an individual exhaust system with a vertical run. Horizontal runs and sharp bends should be avoided. The exhaust from the fume cupboard shall not be combined with the exhaust from any other type of fume cupboard. Perchloric acid vapour and flammable gases may form violently explosive mixtures.

Before any maintenance is carried out on any part of the ductwork, fan or exhaust stack from a perchloric fume cupboard, all internal surfaces of the entire exhaust system shall be thoroughly washed by means of a gentle but copious water spray for 24 h. This should be borne in mind at the design stage. Non-ferrous tools should be used wherever possible and hammer blows or the use of impact tools avoided.

Fume cupboards for use with perchloric acid shall be so labelled and all work with significant amounts of perchloric acid shall be performed in such a designated fume cupboard. Occasional use of small amounts of hot concentrated perchloric acid may be permitted in non-designated fume cupboards only if the work is performed under reduced pressure in an apparatus fitted with a water scrubbing tower to prevent all releases of fume and vapour to the fume cupboard. Chemicals incompatible with perchloric acid shall not be stored or used in fume cupboards designated as perchloric acid fume cupboards.

B3.4 Safety controls on the operation of fume cupboards In addition to the safety controls listed in Clause 2.2.4, the following safety controls are required:

(a) To eliminate the possibility of discharging corrosive fumes to the atmosphere, the fume scrubber pump motor and the exhaust fan motor shall be electrically interlocked.

(b) The control of electric power and heating gas supplies to the fume cupboard shall be such that the use of gas or electric heating shall not be possible without operation of the exhaust fan.

(c) The flow of gas to heating equipment shall be controlled by a flame failure pilot device or low pressure controller.

(d) An alarm on the fume cupboard shall be activated by a low solution level in the scrubber.

(e) The period of the spray wash, if fitted, shall be controlled through a timer and solenoid valve.

The controls as detailed shall be achieved by the use of auxiliary contacts on relays, solenoid valves, gas flame sensors and timers.

NOTE: It is generally accepted that the fume cupboard should operate continuously. This helps to maintain air-conditioning system balance and also clears the air generally from the laboratory.

B4 ORGANIC SOLVENTS Where large volumes of organic solvents are used, e.g. column and paper chromatography, solvent extraction processes, the fume cupboard interior surfaces shall be resistant to the solvents used and all internal corners shall be smooth and free from any crevices or pockets which could trap vapours. If removable bases are fitted above a sump, care shall be taken to ensure that the waste pipe (if fitted) does not become blocked, thus enabling liquid solvents to be trapped under the base and creating a flammability hazard. The fume cupboard design shall be such that when the fume cupboard is in operation, the area between the working base and the sump is adequately exhausted so that heavy vapours cannot accumulate in this area. Fume cupboard ducting shall be fire rated in accordance with Clause 2.12.1. The following precautions shall also be taken:

(a) Solvents shall not be left in the sump of the fume cupboard.

(b) Electrical apparatus used in the fume cupboard shall be of the flame-proof type or other explosion protection type (refer to AS HB13).

(c) Ignition sources shall not be placed in the fume cupboard when flammable solvents are in use.

(d) Solvents shall not be stored in the fume cupboard.

B5 MICROBIOLOGICAL WORK Microbiological work should not be carried out in a general purpose fume cupboard (refer to AS 2243.3).

B6 HIGH TEMPERATURE WORK If the fume cupboard is to be used for high temperature work, selection of the material from which the interior of the fume cupboard is constructed shall be determined by its time/temperature response to the heat source. Plastics materials can withstand high temperatures for short periods but fail at lower temperatures if subjected to prolonged heating. If necessary, interior surfaces should be protected by shields of heat-resisting materials, e.g. metal, calcium silicate sheets.

B7 HEAVY VAPOUR WORK Heavy vapour work shall only be undertaken in a specially designed containment enclosure with fume extraction. The air flow shall be directed downward to an absorption filter, before being exhausted from the building.

Depleted filters should be disposed of in a safe manner. Typical examples of heavy liquids are tetrabromoethane and diiodomethane.

APPENDIX C
RELATED DOCUMENTS
(Informative)

AS	
1076	Code of practice for selection, installation and maintenance of electrical apparatus and associated equipment for use in explosive atmospheres (other than mining applications)
1288	Glass in buildings—Selection and installation
1668	SAA Mechanical Ventilation and Air Conditioning Code
1715	Selection, use and maintenance of respiratory protective devices
1716	Respiratory protective devices
2118	SAA Code for Automatic Fire Sprinkler Systems
2444	Portable fire extinguishers—Selection and location
2293	Emergency evacuation lighting in buildings
2293.1	Part 1: Design and installation
2567	Cytotoxic drug safety cabinets

APPENDIX D

GUIDE TO PROCUREMENT OF FUME CUPBOARD AND ASSOCIATED EXHAUST SYSTEMS

(Informative)

D1 SCOPE This Appendix sets out recommendations for the procurement of a fume cupboard.

D2 RECOMMENDATIONS

D2.1 Prime contractor Tenders should be accepted only from prime contractors prepared to undertake the responsibility for the supply, installation and commissioning of the fume cupboard.

NOTE: Where the fume cupboard and the exhaust system are procured separately, it should be ensured that the complete system complies with all applicable Standards.

D2.2 Compliance with safety standards and performance standards Tenderers and suppliers (if different parties) should be aware of compliance requirements with all statutory regulations regarding—

(a) operator health and safety;

(b) pollution compliance;

(c) electrical safety approval; and

(d) disposal of effluent.

D2.3 Marking of sub-assemblies It is strongly recommended that the date of commissioning of the fume cupboard system be indelibly marked on the manufacturer's label.

Procurers should state if they require any items to be marked, e.g. model and serial numbers of components, fans, scrubbers.

D2.4 Documentation Documentation should include the following:

(a) Installation requirements.

(b) Commissioning and acceptance tests.

(c) Operator's handbook.

(d) Maintenance procedures or references to publicly available documentation, e.g. Australian Standards.

D2.5 Guarantee period and conditions

D2.6 Service availability The tenderer should state the name and address of the organization providing service for the equipment.

D2.7 Packing, delivery and insurance Tenderers should be made aware that the final payment for the fume cupboard will not be made until the acceptance documents have been signed by the procurer's representative.

D2.8 Use The procurer is obliged to inform tenderers of all substances (types/classes) for which the cupboard is to be used.

D2.9 Physical dimensions The procurer should nominate preferred sizes internal or external and any constraints that might affect the design (hence cost) of the total installation.

D2.10 Services The procurer should ensure that the required services (vacuum, compressed air, gas, water, waste disposal) are available for connection at the installed site, or state that their provision is part of the procurement contract.

D2.11 Controls To avoid confusion, procurers should nominate the functions and services for which controls are required, and the isolation requirements if different from this Standard.

D2.12 Supplementary equipment Where supplementary equipment, e.g. a scrubber, is required, the tenderer should provide documentary certification of performance in an acceptable form.

APPENDIX E
METHOD FOR DETERMINING FACE VELOCITY
(Normative)

E1 SCOPE This Appendix sets out an abbreviated method and a full method for determining the face velocity of a fume cupboard.

E2 PRINCIPLE Air flow face velocity readings are measured at the sash opening of the fume cupboard using an anemometer. For an abbreviated face velocity test, readings are taken at five points. For a full face velocity test, readings are taken at a series of equally spaced points. The readings obtained from an abbreviated face velocity test may determine the need to perform a full face velocity test.

E3 APPARATUS

Anemometer A calibrated thermal anemometer is the preferred instrument for measuring air velocity. Care should be taken in selecting an anemometer with an appropriate scale.

Vane anemometers should be used with care, since they may under-read in the region below 0.4 m/s owing to friction in the bearing. They also have a slow response, which must be allowed for in taking readings, but they are occasionally useful in providing average readings of face velocity, provided they are regularly checked against a calibrated thermal anemometer.

WARNING: GLOWING HOT-WIRE ANEMOMETERS SHALL NOT BE USED IN COMBUSTIBLE ATMOSPHERES.

E4 PROCEDURE The procedure shall be as follows:

(a) Open the sash window to the maximum face opening.

(b) In order not to disturb the airflow, stand back approximately 0.5 m from the face of the cupboard, and to one side.

(c) Measure the air velocity in the plane of the sash at a position 100 mm in from each corner and, for the—

  (i) full test, at other positions as indicated by the grid pattern in Figure E1 (where grid point positions are equally spaced, the spacings shall be not greater than 250 mm vertically and 500 mm horizontally); and

  (ii) abbreviated test, at the other position indicated in Figure E2.

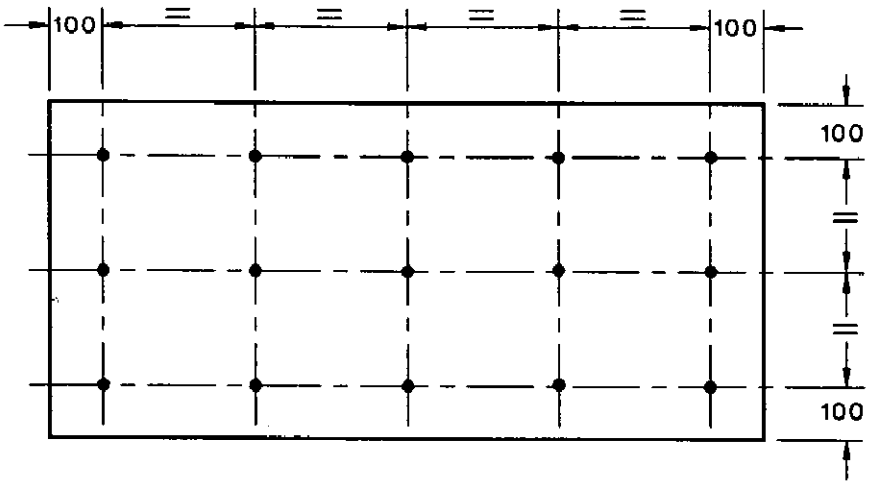
(d) Swivel the head of the anemometer to check that the highest readings are obtained when the anemometer is normal to the plane of the sash opening.

NOTE: The anemometer should be held steady, as false readings can be obtained by movement or vibration of the instrument head.

(e) Read the anemometer velocity for at least 15 s at each point. Calculate and record the mean in the velocity test report when fluctuations are less than 20%. Fluctuating velocity (i.e. velocities that vary by 20% or more) should be observed for long enough to determine maxima and minima. These readings shall be recorded in a velocity test working sheet which shall be retained. The instrument calibration correction factor shall be applied to the velocity readings and the mean calculated before reporting the results as in Table E1.

NOTE: For extremes of turbulence, it may be difficult to estimate the mean using the hot-wire anemometer. However, in such cases of high turbulence, the containment of a fume cupboard is not likely to pass the smoke test.

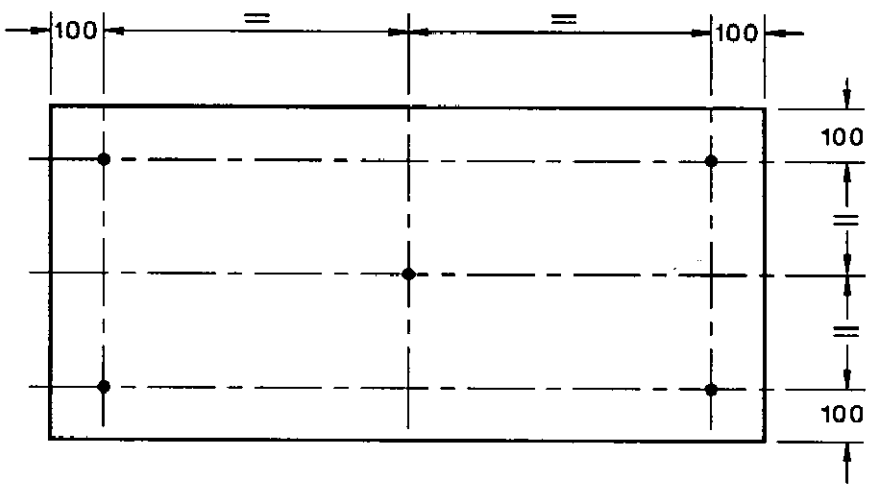
E5 REPORTING OF RESULTS Report the high and low readings and the average of the mean velocities for the measurement points.



NOTE: Where equal spacings are indicated, the spacings should not be greater than 250 mm vertically and 500 mm horizontally.

DIMENSIONS IN MILLIMETRES

FIGURE E1 TYPICAL GRID PATTERN FOR FULL TEST



DIMENSIONS IN MILLIMETRES

FIGURE E2 GRID PATTERN FOR ABBREVIATED TEST

TABLE E1
REPORTING OF VELOCITY TEST RESULTS

LOCATION: _____

F/C NUMBER: _____ TYPE: _____

FACE OPENING WIDTH: _____ No OF READINGS: _____

INSTRUMENT: _____ SERIAL No: _____

NOTE:
1 All readings in m/s.
2 Calculate average face velocity to two decimal places.
3 All figures reported include calibration correction factor.

Results	A	B	C	D	E	F	G	H	I	J	K	L	M	N	0
High															
Low															
Mean															

TOTAL MEAN VALUE _____ No OF POINTS _____ AVERAGE FACE VELOCITY _____

.A	.D	.G	.J	.M
.B	.E	.H	.K	.N
.C	.F	.I	.L	.O

For number and position of readings to be taken, refer to grid pattern as detailed in Figure C1

COMMENTS/CONCLUSIONS: _____

TESTED BY (print): _____ SIGNED: _____ DATE: _____

APPENDIX F

FUME CUPBOARDS CLASSED AS NON-HAZARDOUS AREAS

(Informative)

F1 SCOPE This Appendix sets out requirements for fume cupboards that are to be classified as a non-hazardous areas for the purposes of AS 2430.3.

NOTE: Some of the requirements of this Appendix (i.e. Paragraphs F4(a) and F7) differ from the requirements of this Standard.

F2 EMERGENCY ISOLATOR A single means (e.g. master switch) shall be provided for each cupboard that will simultaneously isolate—

(a) electrical power to any general purpose outlets located inside the cupboard; and

(b) gas supply to any gas outlets located inside the cupboard.

The gas supply isolation facility required by Item (b) above shall be of the manually reset type.

The emergency isolator shall be suitably identified by a label, e.g. 'FUME CUPBOARD EMERGENCY ISOLATOR'.

The operation of the emergency isolator shall not interupt supply to the exhaust system.

F3 POWER FAILURE DISCONNECT DEVICE Means shall be provided for the automatic isolation of electrical power and gas supply in the event of electrical power failure.

Such means shall be of the manually reset type and may be combined with the emergency isolator required by Paragraph F2.

F4 WARNING A warning label shall be fixed to the cupboard which would—

(a) specify the maximum quantity of flammable liquid which may be introduced into the cupboard at any one time, such quantity never to be in excess of 2 L;

(b) direct that in event of a liquid spill or fire, the emergency isolator be turned off; and

(c) prohibit the placement of any ignition source within the sump.

F5 SUMP The cupboard shall be provided with an impervious sump having—

(a) a minimum depth of 10 mm;

(b) its front lip designed to minimize overflow of flammable liquid in the event of a spill; and

(c) a capacity of at least twice the quantity specified on the warning label required by Paragraph F4(a).

F6 EXHAUST SYSTEM An exhaust system shall be provided which would—

(a) provide a linear air velocity of at least 0.5 m/s at the face of the cupboard with the sash open at any point within its normal operating limits;

(b) monitor air flow (in accordance with AS 1482) and isolate electrical and gas supply in the event of inadequate air flow;

(c) ensure that the power and gas supplies remain isolated until the fan has been in operation for at least 1 min and that the fan operates for a period of at least 20 min after the isolator operates; and

(d) extract air from the cupboard from both high and low levels, with a major part being taken from a low level register located just above the upper limit of the sump.

NOTES:

1 The air flow required to comply with Step (a) above should be as uniform as possible throughout the face opening.

2 The isolation device required by Step (b) above should be of the manually reset type.

3 The requirement for a 20 min run-on period as specified in Step (c) above does not apply where the exhaust system operates continuously.

F7 INSTALLATION OF GPOs Any general purpose outlet (GPO) installed inside the cupboard shall be located at least 300 mm above the upper limit of the sump.

WARNING: ALTHOUGH THE REQUIREMENTS SPECIFIED ABOVE COULD BE EXPECTED TO MINIMIZE THE EXPLOSION HAZARD, ATTENTION IS DRAWN TO THE FACT THAT IN THE EVENT OF A SPILL THE FIRE HAZARD IS REDUCED BUT NOT ELIMINATED.

APPENDIX G
METHOD FOR CONDUCTING A SMOKE TEST
(Normative)

G1 SCOPE This Appendix sets out both a full method and an abbreviated method for smoke testing a fume cupboard and suggests suitable equipment.

G2 PRINCIPLE Smoke from an appropriate generator is released in and around the fume cupboard and the visual pattern of airflow and eddies is observed to determine the efficiency of the exhaust system. The abbreviated smoke test provides a spot check on operating efficiency and determines the need for a full smoke test.

G3 APPARATUS AND MATERIALS Apparatus and materials required to produce the smoke may be chosen from Table G1. The relative merits of each are listed to enable the user to choose the appropriate apparatus for a given situation.

TABLE G1
APPARATUS AND MATERIALS FOR CONDUCTING A SMOKE TEST

Apparatus and materials	Advantages	Disadvantages	Other comments
Air current tubes	Dense white smoke. Visible for a distance of about 5 m. Neutral buoyancy.	SO_3 (sulfur trioxide) released. Corrosive. Toxic.	Simplest and most convenient method of making sufficient smoke to test a fume cupboard.
Hydrolysis of $TiCl_4$ (titanium tetrachloride) vapour	Very dense white smoke. Visible for a distance of about 20 m. Neutral buoyancy.	HCl vapour released. Corrosive in stainless steel cupboards. Both aerosol and vapour are toxic.	Simple method to produce copious smoke by reaction with atmospheric water vapour.
Solid CO_2 (carbon dioxide) in warm water	Non-corrosive. Non-toxic.	Fog disappears very quickly.	Negative buoyancy simulates some heavy vapours.
Ammonia plus acid	Smoke has neutral buoyancy.	Requires mixing of two vapours. Toxic.	
Cigarette or glowing taper	Non-corrosive. Simple. Low toxicity. Neutral buoyancy.	Smoke disappears quickly. Not suitable where there are flammable solvents.	
Pyrotechnic match	Dense smoke.	Uncontrollable production rate. Toxic. Not suitable where there are flammable solvents,	Smoke slightly buoyant.
Pyrotechnic candle	Very dense smoke. Visible for a distance of about 40 m.	Uncontrollable. Messy. Toxic. Not suitable where there are flammable solvents.	Smoke buoyant and much heat may be liberated. Not suitable where there are flammable solvents.
Fogger*	Low toxicity. Volume of fog controllable. Sufficient to test a room or stack.	Fog emitted with high velocity, which may alter airflow pattern.	Fogger may be used in short bursts to minimize effect on airflow pattern.

* Suitable foggers may be hired from most theatrical suppliers, if the purchase of such equipment cannot be justified.

NOTE: Many of the smokes are toxic. Respiratory protection for both particulate matter and acid vapours may be advisable when used for testing airflow patterns in the room.

G4 METHOD FOR SMOKE TESTING FUME CUPBOARD PERFORMANCE

G4.1 General With the fume cupboard operating at normal working conditions, including bulky apparatus located in the fume cupboard, the procedure of Paragraph G4.2 shall be used for a full smoke test, and the procedure of Paragraph G4.3 shall be used for an abbreviated smoke test. For acceptance testing of a new installation the procedure of Paragraph G4.2 shall be used for an empty fume cabinet.

G4.2 Full smoke test The procedure shall be as follows:

(a) Raise the sash to the maximum working height.

(b) Draw the smoke generator away from the fume cupboard and record the distance at which the smoke is no longer reliably collected. Watch for signs of turbulence in the area where the operator will be working.

(c) Observe the behaviour of the smoke released approximately 300 mm in front of the sash opening, in the centre and each corner. The smoke should flow smoothly into and through the fume cupboard. The occurrence of looping or eddying indicates the presence of room turbulence.

(d) Release smoke around any equipment, apparatus, tanks or sinks, if installed, within the fume cupboard. Watch for eddies carrying smoke to the front of the fume cupboard.

(e) Release smoke along the floor of the front of the fume cupboard. Watch for eddies, especially along the sides of the base, carrying smoke to the fume cupboard. If a removable base is fitted above a sump in the fume cupboard, observe that the area between the sump and the base does not have reverse flow out of the sump.

(f) Release smoke along the internal walls of the fume cupboard. Watch for eddies carrying smoke to the front of the fume cupboard.

(g) Release smoke behind and close to the sash at several points across the width of the opening. Watch for eddies developing under or in front of the sash, fed from inside the fume cupboard.

(h) Lower the sash to the half-way position.

(i) Release smoke behind and close to the sash at several points across the width of the opening. Watch for eddies developing under and in front of the sash, fed from inside the fume cupboard.

(j) The performance of a fume cupboard may be affected by abnormal conditions such as doors opening and closing, windows, air-conditioning, ventilation, traffic flow and other equipment. Spot checks shall be carried out to determine if any of these external influences affect the containment of the smoke within the fume cupboard and, if affected, Steps (d) to (j) inclusive shall be repeated and recorded under those circumstances.

(k) If the fume cupboard is built in to the walls of the laboratory, release smoke along all joints, service penetrations and around the sash window and the opening to check for air leaks. High-speed jets of air leaking into the fume cupboard from either the wall cavity or ceiling space can be harmful to a fume cupboard's performance.

(l) Briefly record observations of satisfactory and unsatisfactory smoke distribution.

G4.3 Abbreviated smoke test The procedure shall be as follows:

(a) Raise the sash to the maximum working height.

(b) Draw the smoke generator away from the fume cupboard and record the distance at which the smoke is no longer reliably collected. Watch for signs of turbulence in the area where the operator will be working.

(c) Observe the behaviour of the smoke released approximately 300 mm in front of the sash opening, in the centre and each corner. The smoke should flow smoothly into and through the fume cupboard. Any looping or eddying occurring indicates the presence of room turbulence.

(d) Release smoke around any equipment, apparatus, tanks or sinks, if installed, within the fume cupboard. Watch for eddies carrying smoke to the front of the fume cupboard.

(e) Release smoke along the floor of the front of the fume cupboard. Watch for eddies, especially along the sides of the base, carrying smoke to the fume cupboard. If a removable base is fitted above a sump in the fume cupboard, observe that the area between the sump and the base does not have reverse flow out of the sump.

(f) Release smoke along the internal walls of the fume cupboard. Watch for eddies carrying smoke to the front of the fume cupboard.

(g) Release smoke behind and close to the sash at several points across the width of the opening. Watch for eddies developing under or in front of the sash, fed from inside the fume cupboard.

(h) Briefly record observations of satisfactory and unsatisfactory smoke distribution.

G5 REPORTING OF RESULTS Table G2 may be used to report the results of the smoke tests. The results shall be interpreted as follows:

(a) *Good*—smoke travels straight to exhaust without reverse flow or eddies. This rating is a requirement where high toxicity materials are used.

(b) *Fair*—reverse flow or eddies may be present but not to the extent where the smoke can escape from the confines of the fume cupboard or be blown back over any part of the operator. This rating is satisfactory for general purpose use.

(c) *Dangerous*—reverse flows or eddies can escape from the confines of the fume cupboard or cause the smoke to contact the operator in normal operation.

G6 ASSESSMENT A fume cupboard shall be assessed according to its worst score. The cupboard shall be deemed unsafe if any result is recorded as dangerous.

TABLE G2
REPORTING THE RESULTS OF SMOKE TEST

LOCATION FUME CUPBOARD NUMBER TYPE

SMOKE USED AVERAGE FACE VELOCITY m/s

Test	Result		
	Good	Fair	Dangerous
Room turbulence			
Cupboard turbulence			
Reverse flow along bottom of cupboard			
Reverse flow along walls of cupboard			
Eddy at the top with sash fully raised			
Eddy at the top with sash half lowered			
Eddy under sash of minimum opening			
Fume escape under abnormal conditions (i.e. open door, open windows, change in normal traffic)			
*Built-in fume cupboard containment			

(Tick the appropriate box)

* May not be applicable

NOTES:

Good—smoke travels straight to exhaust without reverse flow or eddies. This rating is a requirement where high toxicity materials are used.

Fair—reverse flow or eddies may be present but not to the extent where the smoke can escape from the confines of the fume cupboard or be blown back over any part of the operator. This rating is satisfactory for general purpose use.

Dangerous—reverse flows or eddies can escape from the confines of the fume cupboard or cause the smoke to contact the operator in normal operation.

COMMENTS/CONCLUSIONS:

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GG

STANDARDS AUSTRALIA

Amendment No. 1
to
AS 2243.8—1992
Safety in laboratories
Part 8: Fume cupboards

CORRECTION

The 1992 edition of AS 2243.8 is amended as follows; the amendments should be inserted in the appropriate place.

SUMMARY: This Amendment applies to Clause 3.1.5.2 and Figure 1.

Published on 13 July 1992.

AMDT No. 1 JULY 1992

Page 10 Clause 3.1.5.2, Line 5

Delete 'Clauses 2.6.3(b)' and *substitute* 'Clauses 2.7.3(b)'.

AMDT No. 1 JULY 1992

Page 15 Figure 1

Delete existing figure and *substitute* the following figure.

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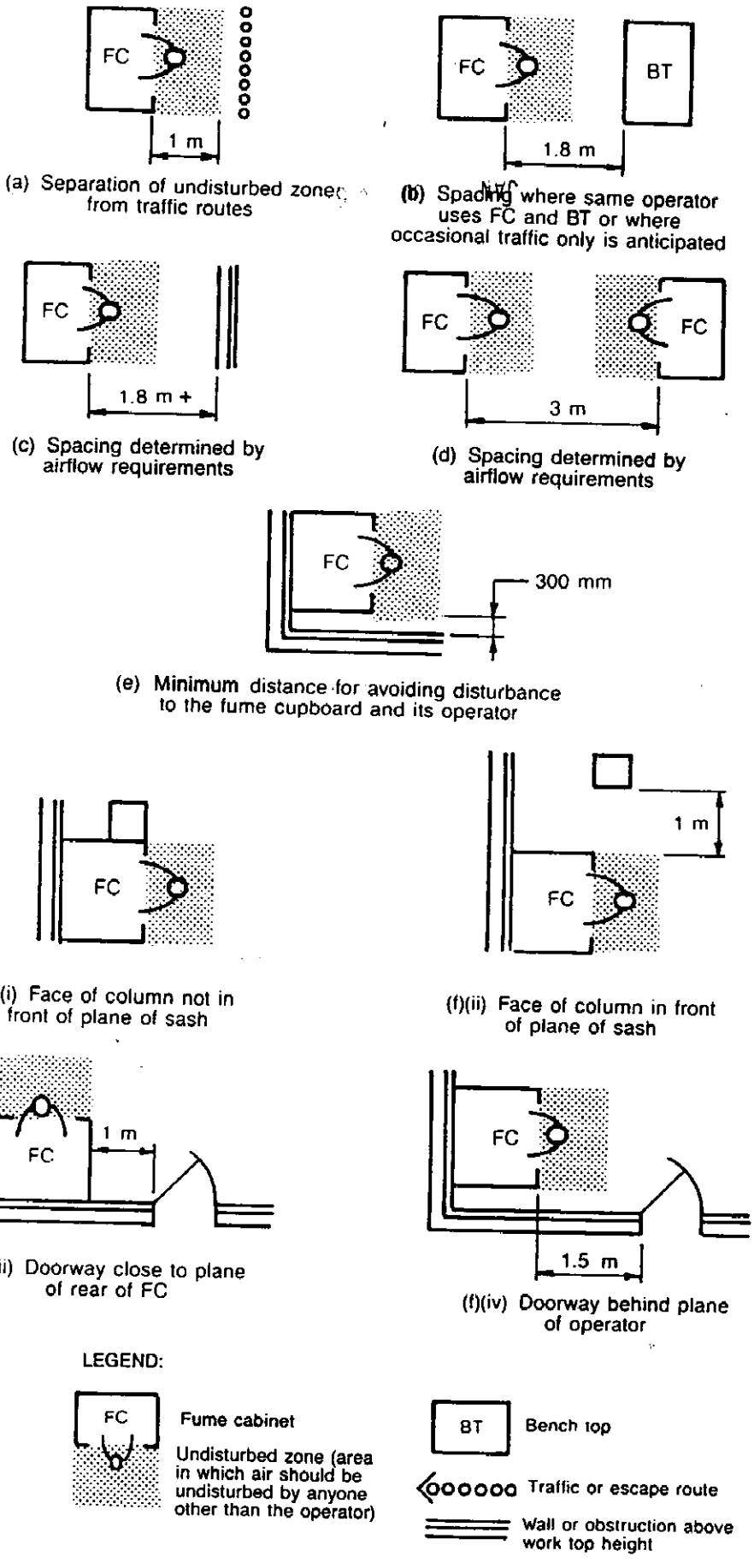

FIGURE 1 MINIMUM SPACINGS THAT AVOID UNDUE DISTURBANCE OF AIRFLOW

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התקן הישראלי ת"י 1839 מדצמבר 1995
תיקון מס' 1 מיולי 1998

סעיף 2.2.5. Lighting

הסעיף חל בתוספת זו:

בכל מקרה של התקנת גוף תאורה בתוך חלל המנדף, גוף התאורה יהיה מוגן מפני התפוצצות.

סעיף 3.1.2. Face velocity

הסעיף חל בתוספת זו:

על אף האמור לעיל, אפשר שמהירות הפנים על פני פתח המנדף תקטן עד 0.3 מטר לשנייה (60 רגל לדקה), בתנאי שאין נוכחות אדם בחזית המנדף.

שינוי המהירות כאמור יהיה חלק אינטגרלי ממערכת הפיקוד של המנדף, והוא יבוצע אוטומטית, ובלבד שהמנדף מצויד בציוד בקרה.

סעיף 4.1.3.2. Opposing bench tops

הסעיף חל בשינויים ובתוספות אלה:

- המידה 1.8 מ' אינה חלה, ובמקומה יחול:

$$1.8 \pm \begin{matrix}0\\0.3\end{matrix}$$ מ'

- בסוף הסעיף תוסף הערה כמפורט להלן:

הערה:
במעבר חד-כיווני מותר מרחק של 1.5 מ' לפחות. במעבר דו-כיווני יהיה המרחק 1.8 מ'.

SI 1839
December 1995

Amendment No.3
August 2009

תקן ישראלי ת"י 1839
דצמבר 1995

גיליון תיקון מס' 3
אלול התשס"ט – אוגוסט 2009

בטיחות במעבדות: מנדפים

Safety in Laboratories: Fume cupboards

מכון התקנים הישראלי
The Standards Institution of Israel

רח' חיים לבנון 42, תל-אביב 69977, טל' 03-6465154, פקס' 03-6412762, www.sii.org.il

גיליון תיקון זה הוכן ואושר על ידי הוועדה הטכנית 1605 - בטיחות בתהליכי עבודה, בהרכב זה:

אגף הפיקוח על העבודה (משרד התמ"ת)	-	מרסל לייזר
איגוד התעשייה הקיבוצית	-	אבי פורן
ארגון הממונים על הבטיחות	-	נילי זרחין
המוסד לבטיחות ולגיהות	-	שלמה איציקובסקי
התאחדות התעשיינים בישראל	-	עדינה פישמן, עמוס גלרט
לשכת המהנדסים והאדריכלים	-	שמואל נתנאל (יו"ר)
מקורות – חברת המים הלאומית	-	אלכסנדר דרוט
מכון התקנים הישראלי – אגף התעשייה	-	צבי קרן
רשות ההסתדרות לצרכנות	-	מאיר אלבז

עמי אברבנאל ריכז את עבודת הכנת גיליון התיקון.

הודעה על גיליון תיקון

גיליון תיקון זה מעדכן את

התקן הישראלי ת"י 1839 מדצמבר 1995

תיקון מס' 1 מיולי 1998

גיליון התיקון מס' 2 מאוגוסט 2005

עדכניות התקן

התקנים הישראליים עומדים לבדיקה מזמן לזמן, ולפחות אחת לחמש שנים, כדי להתאימם להתפתחות המדע והטכנולוגיה.
המשתמשים בתקנים יוודאו שבידיהם המהדורה המעודכנת של התקן על גיליונות התיקון שלו.
מסמך המתפרסם ברשומות כגיליון תיקון, יכול להיות גיליון תיקון נפרד או תיקון המשולב בתקן.

תוקף התקן

תקן ישראלי על עדכוניו נכנס לתוקף החל ממועד פרסומו ברשומות.
יש לבדוק אם התקן רשמי או אם חלקים ממנו רשמיים. תקן רשמי או גיליון תיקון רשמי (במלואם או בחלקם) נכנסים לתוקף 60 יום מפרסום ההודעה ברשומות, אלא אם בהודעה נקבע מועד מאוחר יותר לכניסה לתוקף.

סימון בתו תקן

כל המייצר מוצר, המתאים לדרישות התקנים הישראליים החלים עליו, רשאי, לפי היתר ממכון התקנים הישראלי, לסמנו בתו תקן:

מכון התקנים הישראלי

Referenced documents 1.2

לסעיף יוסף:

תקנים אירופיים

EN 14175-2: May 2003 - Fume cupboards - Part 2: Safety and performance requirements

APPENDIX A

MATERIALS OF CONSTRUCTION

GLASS A5

Laminated glass A.5.4

הכתוב בסעיף יושמט, ובמקומו יחול:

ניתן להשתמש בזכוכית רבודה, ובלבד שהזכוכית תתאים לדרישות התקן האירופי EN 14175-2: May 2003, סעיפים 6.2 - "Glass components" ו-6.3 - "Sash".