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COMISIÓN DE MATERIALES DE USO EN DUCTOS DE EVACUACIÓN DE GASES

INFORME FINAL

Conjunto de soluciones para el proyecto y construcción de ductos de evacuación de gases en aquellos edificios que en estos momentos se encuentran en proceso de construcción, ya sea en etapa de proyecto u obra gruesa

Agosto de 1997

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I.- INTRODUCCIÓN:

En el último tiempo se han producido problemas en la evacuación de gases producto de la combustión, a través de los ductos en edificios de departamentos de 3 o más pisos.

En el año 1995 se dictó el Decreto Supremo Nº222, el cual se encuentra vigente a la fecha. El día 6 de Junio de 1997 la Superintendencia de Electricidad y Combustibles dictó el Oficio Ordinario Nº1923 que vino a interpretar el Decreto Supremo 222/95, básicamente en el tema de los materiales.

Lo anterior ha llevado a una confusión o incertidumbre en la elaboración de proyectos y posterior construcción de edificaciones en altura (artículo Nº61 del D.S. Nº222/95).

Debido a todo lo anterior, la Cámara Chilena de la Construcción ha reunido a todos los agentes relacionados con el tema y formó 2 comisiones encargadas en primer lugar a dar soluciones transitorias a la aplicación del Decreto Supremo Nº222/95 y su complemento el Ordinario Nº1923.

Las comisiones tratan 2 materias, a saber, de diseño de los ductos y materiales que componen estos.

Estas Comisiones propondrán un conjuntos de soluciones transitorias que serán válidas hasta la entrada en vigencia de una nueva norma que se encuentra en estudio por parte del I.N.N.

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II.- PARTICIPANTES:

En la Comisión de Materiales han participado las siguientes personas:

INTEGRANTE	**EMPRESA**
Manuel Brunet Presidente	Constructora Rialto
Gabriel Rodríguez	IDIEM
Jorge Ramírez	DICTUC
Mauricio Muñoz	El Volcán
Juan Carlos Lazo	El Volcán
Juan Luis Vergara	Constructora Almagro
Mauricio Cordero	El Romeral
Sergio Castillo	Promat Chile
Ricardo Daly	Promat Chile
Rodrigo López	Constructora Los Corrales
Andrés Moltedo	Sandvik Chile S.A.
Cristóbal Prado	Cámara Chilena de la Construcción

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III.- OBJETIVOS:

El objetivo final de esta comisión es lograr definir un conjunto de soluciones para el proyecto y construcción de ductos de evacuación de gases en aquellos edificios que en estos momentos se encuentran en proceso de construcción, ya sea en etapa de proyecto u obra gruesa y que se han visto afectados por la aplicación del Oficio Ordinario Nº1923 de fecha 6 de junio de 1997 emitido por la Superintendencia de Electricidad y Combustibles.

En segundo lugar, se desea entregar una serie de recomendaciones para que sean tomadas en cuenta en la norma definitiva que entregará el Instituto de Normalización Nacional.

IV.- CONSIDERACIONES:

1.- Para un adecuado estudio de los materiales en relación a los ductos de ventilación es necesario precisar las siguientes ideas básicas:

a) Separar los materiales que debe tener el ducto propiamente tal del conjunto de elementos que debe formar el shaft que contiene al ducto de evacuación de gases. Siendo necesario por efectos de aislación y protección de los materiales componentes del shaft una separación de aire entre ambos de a lo menos de 20 mm.

b) Además, resulta necesario para poder plantear una solución a la temática que nos interesa, tener claro los materiales y las empresas proveedores de éstos. Por lo cual acompañamos un listado de los materiales, sus fabricantes o proveedores y en todos los casos copias de los certificados de ensaye de estos elementos.

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Este listado por las razones antes dadas se divide en dos, a saber: a) aquellos materiales aptos para ser usados en la construcción de los ductos y b) aquellos materiales que se ocuparán como shaft con el objeto de cumplir la características exigidas por el Decreto Supremo Nº222 de 1995.

2.- Otro punto necesario de abordar es el de la característica de **Resistencia al Fuego**. En efecto, la norma Nch 935/1 que define, mide y clasifica las resistencias al fuego se hizo para aplicar el criterio de compartimentación en el edificio para el caso de un eventual incendio.

En consecuencia mide el comportamiento de un elemento estructural o de cierre (Tabla del artículo 4.3.3. de la Ordenanza General de Urbanismo y Construcciones) frente a un incendio. No mide el comportamiento al fuego de los elementos sometidos a sucesivos e indefinidos números de ciclos de calentamiento - enfriamiento que sufre un ducto de humo, gases y su shaft.

Ahora bien, hay materiales que se comportan bien una sola vez y por tanto resultan ventajosos para el incendio, pero no sirven en ductos.

Es necesario pues, revisar el Decreto Supremo Nº222 de 1995 respecto a esta materia.

3.- A continuación, propondremos como conclusión de los puntos anteriores, soluciones de construcción de ductos y shaft que, a nuestro juicio, cumplirían con las características solicitadas por la norma vigente.

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4.- Otro aspecto, que necesariamente hay que pronunciarse es el de las viviendas sociales, específicamente en edificios de departamentos o bloques de hasta 4 pisos, en los cuales las soluciones deben ser de igual calidad y seguridad, pero deben contemplar la posibilidad de soluciones más económicas para que no afecten significativamente el costo de las viviendas.

5.- Por último, dedicaremos algunas líneas a entregar recomendaciones derivadas de las múltiples reuniones técnicas tenidas sobre la materia, que puedan servir al momento de estudiar la norma definitiva por parte del Instituto de Normalización Nacional.

V.- DESARROLLO:

A continuación, presentamos un conjunto de soluciones que se refieren por separado tanto a los ductos propiamente tales, como a los shaft.

1.- DUCTOS.-

1.1. ACERO INOXIDABLE.

Este deberá ser de un espesor mínimo de 0,8 mm de los tipos:
a) AISI 420 L, o
b) AISI 316 L.

Se debe consultar uniones de ductos secundarios y primarios estancas.

1.2. HORMIGÓN ARMADO.

Debe ser construido junto con la obra gruesa, en espesores de conformidad con la Ordenanza General de Urbanismo y Construcciones.

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2.- SHAFT.-

2.1. HORMIGÓN ARMADO.

Puede ser una sola unidad si se opta por punto 1.2.- anterior.

2.2. PREFABRICADOS.

Cualquier conjunto de materiales que cumpla con las características dadas por la norma vigente.

Ejemplos:

a) Planchas de Fibrosilicato.
b) Planchas de Yeso Cartón.
c) Placas de Hormigón Liviano.
d) Albañilería de ladrillo.
e) Albañilería de Yeso.

Los anteriores elementos deben cumplir, además, solicitaciones mecánicas frente a sismos.

2.3. SOLUCIONES ESPECÍFICAS.

Sin perjuicio de las soluciones generales antes señaladas, concretamente podemos considerar las soluciones específicas siguientes:

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a) **Tabique de Fibrosilicato Promatect-H.**
Tabique confeccionado con planchas de fibrosilicato Promatect-H de 12 mm. de espesor por ambas caras y estructura metálica de acero galvanizado en cuyo interior se rellena con lana mineral de densidad 100 Kg/m3. Espesor total 84 mm.
Ensayo Nº225.332 de IDIEM según norma chilena NCh 935-1 Of. 84.
Materiales: Plancha de fibrosilicato Promatect-H de 12 mm de espesor, perfiles de acero galvanizado 60 x 40 x 7 x 0,5 mm, perfiles tipo C 60 x 20 x 0,5 mm., lana mineral de densidad 100 kg/m3 y espesor de 50 mm. y tornillos autoperforantes.

b) **Albañilería Isomur.**
Albañilería autosoportante construido con bloques rectangulares de yeso "Isomur" de 700 x 500 x 60 mm., machihembrados y unidos entre sí con yeso. Una de las caras (la no expuesta al fuego) lleva como terminación una plancha de fibro-yeso "Romerit" de 10 mm de espesor unida a la albañilería con yeso. Espesor total de 70 mm.
Ensayo Nº213.305 de IDIEM según norma chilena NCh 935-1 Of. 84.

c) **Tabique Volcanita de 120 mm.**
Tabique formado con perfiles de acero galvanizado, forrado, por ambos lados, con dos planchas de Volcanita de 15 mm. de espesor cada una, pegada entre si y afianzadas a la estructura por medio de tornillos. Esta conformación deja espacios verticales libres dentro de la estructura de 60 mm. de espesor, en los cuales se deben colocar colchonetas de lana mineral de 50 mm de espesor. Espesor total 120 mm.
Ensayo Nº198.449 de IDIEM según norma chilena NCh 935-1 Of. 84.

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d) **Tabique Volcanita de 90 mm.**
Tabique formado por seis planchas de yeso-cartón (cada una de 15 mm.), unidas entre sí con un pegamento especial a base de yeso. Espesor total 90 mm.
Ensayo Nº207.774 de IDIEM según norma chilena NCh 935-1 Of. 84.

e) **Tabique Volcanita RF de 90 mm.**
Tabique formado por una estructura de perfiles de acero galvanizado tipo C, de 38 x 40 x 8 x 0,5 mm., distanciados entre ejes 0,4m, aproximadamente y de dos soleras (inferior y superior) de 39 x 20 x 0,5 mm. Esta estructuración debe forrarse por ambas caras con dos planchas de yeso cartón, "Volcanita RF" de 12,5 mm. de espesor cada una, atornilladas a la estructura. Tal configuración deja espacios libres en el interior del panel, los cuales se deben rellenar con lana mineral cuya densidad media debe ser de 40 Kg/m3. Espesor total 90 mm.
Ensayo Nº222.608 de IDIEM según norma chilena NCh 935-1 Of. 84.

f) **Tabique de Fibrosilicato Promatect-H. 12 mm.**
Tabique confeccionado con planchas de fibrosilicato Promatect-H de 12 mm. de espesor por ambas caras y canales metálicos de 48/0,6 según UNE-36130 en cuyo interior se rellena con lana mineral de densidad 100 Kg/m3. Espesor total 72 mm.
Ensayo F-1123 del Instituto Nacional de Investigaciones Agrarias, Laboratorio del Fuego, Ministerio de Agricultura, Pesca y Alimentación, España, según norma española UNE - 23.093-81.
Materiales: Plancha de fibrosilicato Promatect-H de 12 mm de espesor, canales de 48/0,6, lana mineral de densidad 100 Kg/m3 de 40 mm. de espesores, tornillos autorroscantes de 4,2 x 25 y pasta para juntas Promat.

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g) **Tabique de Fibrosilicato Promatect-H. 10 mm.**
Tabique confeccionado con planchas de fibrosilicato Promatect-H de 10 mm. de espesor por ambas caras y canales metálicos de 48/0,6 según UNE-36130 en cuyo interior se rellena con lana mineral de densidad 100 Kg/m3. Espesor total de 68 mm.
Ensayo F-1152 del Instituto Nacional de Investigaciones Agrarias, Laboratorio del Fuego, Ministerio de Agricultura, Pesca y Alimentación, España, según norma española UNE - 23.093-81 e ISO 834.
Materiales: Plancha de fibrosilicato Promatect-H de 10 mm. de espesor, canales y montantes de 48/0,6 y 46/0,6, lana mineral de densidad 100 Kg/m3 de 40 mm. de espesores, tornillos autorroscantes de 4,2 x 25 y pasta para juntas Promat .

Se acompañan en anexos copias de los Certificados de Ensaye emitidos por el organismo respectivo.

3.- VIVIENDAS SOCIALES.-

Analizado el tema de las viviendas sociales se llega a la conclusión de que para estos departamentos en edificios o bloques habitacionales se aplica íntegramente las soluciones dadas en el tema de los ductos y shaft en el caso de ser una solución por el interior de la edificación.

En el caso de estas viviendas se podrá consultar ductos de acero inoxidable, con las características señaladas en el capítulo V, de evacuación de gases por el exterior del edificio, forrados con lana mineral de 30 mm. de espesor y 80 Kg/M3 y con un recubrimiento exterior de planchas de acero galvanizado de 0,5 mm. de espesor.

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VI.- RECOMENDACIONES A CONSIDERAR EN LA NORMA DEFINITIVA:

Un punto necesario de recalcar es el de la característica de **Resistencia al Fuego** solicitada en el Decreto Supremo Nº222 de 1995. En efecto, la norma NCh 935/1 que define, mide y clasifica las resistencias al fuego se hizo para aplicar el criterio de compartimentación en el edificio para el caso de un eventual incendio y no para los ductos de ventilación.

En consecuencia mide el comportamiento de un elemento estructural o de cierre (Tabla del artículo 4.3.3. de la Ordenanza General de Urbanismo y Construcciones) frente a un incendio. No mide el comportamiento al fuego de los elementos sometidos a sucesivos e indefinidos números de ciclos de calentamiento - enfriamiento que sufre un ducto de humos y su shaft.

Por lo tanto, es necesario, revisar el Decreto Supremo Nº222 de 1995 respecto a esta materia.

Asimismo, se propone estudiar el tema de la estanqueidad en las uniones en los ductos, por la importancia del tema.

También, se propone revisar la norma chilena correspondiente de calefones y calderas.

Por último, se reitera la necesidad de que por efectos de aislación y protección de los materiales componentes del shaft se contemple una separación de aire entre el ducto y el shaft de a lo menos de 2 cm. La citada separación de aire no debe ser hermética.

MBB/CPL/GRJ/cpl
07.08.97

UNIVERSIDAD DE CHILE
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INSTITUTO DE INVESTIGACIONES Y ENSAYES DE MATERIALES

IDIEM

CERTIFICADO DE ENSAYE Nº 225.332

Informe sobre la resistencia al fuego de un elemento de construcción, enviado al Laboratorio de Incendios, Sección Física de la Construcción del Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por el Sr. Ricardo Daly, en representación de Promat Chile S.A., Av. Tobalaba Nº 1125, teléfono 2329771, Santiago.

1.- Finalidad del ensayo.

Se desea conocer la resistencia al fuego de un panel destinado a uso como elemento divisorio en edificios. Para este efecto se emplea la norma NCh 935/1 Of. 84 "Ensayo de resistencia al fuego - Parte 1: Elementos de construcción en general".

2.- Características del elemento de construcción.

El elemento de construcción está constituído por un cuadriculado metálico. Consta de cinco perfiles de acero galvanizado, de 60 x 40 x 7 x 0,5 (mm), los cuales están colocados en posición vertical y distanciados entre ejes cada 0,6 (m), apróximadamente (pie-derechos) y de dos perfiles de acero galvanizado tipo c, de 60 x 20 x 0,5 (mm), uno de los cuales está colocado en la base y el otro en la parte superior del muro (soleras). Esta estructuración metálica esta forrada por ambos lados con una doble faja de fibrosilicato "Promatect-H" de 12 mm de espesor cada una. Sobre estas fajas, el elemento lleva como terminación una plancha plana de fibrosilicato "Promatect-H" de 12 mm de espesor. Todo el conjunto está unido por medio de tornillos. Esta configuración deja espacios libres en el interior del elemento, los cuales están rellenos con lana mineral, cuya densidad media aparente es de 100 kg/m^3.

Para el ensayo se construyó un panel de 2,2 m de ancho por 2,4 m de altura. El espesor total resultó ser de 132 mm y el peso de 225 kilógramos.

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3.- Resistencia al fuego.

3.1 El ensayo consiste en exponer el panel bajo prueba y por una de sus caras, al calor de un horno de modo de imprimirle una temperatura, según la curva normalizada de tiempo-temperatura señalada en NCh 935/1 Of. 84, regida por la relación T = 345 log (8t + 1), donde T es la temperatura inicial y t es el tiempo transcurrido, expresado en minutos, como se muestra a continuación:

t, minutos	0	5	15	30	60	90	120	150	180
T, °C	20	576	739	842	945	1006	1049	1082	1110

3.2 De acuerdo a la norma, las condiciones de ensayo deben corresponder a un incendio real. Para cumplir con ello, el elemento en prueba debe ser de tamaño natural o bien de dimensiones relativamente grandes. Para tal efecto se dispone de un horno con quemador a gas licuado de una potencia cercana a las 500.000 kilocalorías por hora y de una boca capaz de admitir el elemento bajo ensayo.

3.3 Las temperaturas se miden por medio de termocuplas en la cara expuesta al fuego y por radiación infrarroja en la cara no expuesta.

3.4 La resistencia al fuego la determina el tiempo transcurrido en ascender la temperatura de la cara no expuesta hasta 180 °C puntual o 140 °C promedio por sobre la temperatura inicial o bien el deterioro mecánico del elemento o la pérdida de estanquidad.

3.5 Según la norma, el elemento bajo prueba se debe ensayar en condiciones normales de trabajo a fin de reproducir un sistema similar de empotramiento. Como este panel puede empotrarse de maneras distintas, según la solución constructiva de cada caso particular, este factor puede hacer variar los resultados obtenidos, desfavoreciendo la resistencia al fuego total del conjunto cuando el empotramiento es más débil que el panel mismo. "Por esta causa en el presente ensayo no se somete a prueba el sistema de empotramiento."

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4.- Resultados y observaciones.

4.1 La temperatura puntual máxima admisible de 200 °C en la cara no expuesta al fuego se produjo a los 125 minutos de iniciado el ensayo, lo que determinó el tiempo de resistencia al fuego, según lo expresado en 3.4.

La temperatura promedio en la cara no expuesta al fuego, en ese instante, fue de 148 °C.

4.2 Durante el desarrollo de la prueba, el panel sufrió leves deformaciones, las cuales no llegaron a ser causa de falla.

4.3 La cara expuesta al fuego se mantuvo intacta hasta el final del ensayo.

5.- Valores de referencia.

5.1 De acuerdo a la norma NCh 935/1 los elementos de construcción, una vez sometidos a ensayos de resistencia al fuego, se clasifican, de acuerdo a su duración, en las siguientes clases:

No resistente, duración inferior a 15 minutos
Clase F 15 mayor de 15 y menor de 30 minutos
Clase F 30 mayor de 30 y menor de 60 minutos
Clase F 60 mayor de 60 y menor de 90 minutos
Clase F 90 mayor de 90 y menor de 120 minutos
Clase F120 mayor de 120 y menor de 150 minutos
Clase F150 mayor de 150 y menor de 180 minutos
Clase F180 mayor de 180 y menor de 240 minutos
Clase F240 duración superior a 240 minutos.

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C.E. Nº 225.332

6.- Conclusiones y observaciones.

6.1 El elemento de construcción destinado a uso como elemento divisorio en edificios, enviado al Laboratorio de Incendios de la Sección Física de la Construcción del Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por Promat Chile S.A., objeto del presente certificado de ensaye Nº 225.332 presentó una resistencia al fuego de 125 minutos, según la norma NCh 935/1 Of. 84, bajo las condiciones de ensayo señaladas en el presente informe.

6.2 De acuerdo a los valores de referencia dados en la norma chilena NCh 935/1, Anexo A, el elemento de construcción se clasifica en clase F120 de resistencia al fuego.

6.3 Considerando lo señalado en la norma NCh 935/1 los resultados obtenidos son válidos sólo para el elemento ensayado y bajo las condiciones estipuladas, ya que el valor de resistencia al fuego puede variar si se cambian los detalles constructivos.

INSTITUTO DE INVESTIGACIONES Y ENSAYES DE MATERIALES - UNIVERSIDAD IDIEM FISICA DE LA CONSTRUCCION DE CHILE

Gabriel Rodríguez J.
Jefe Sección Física
de la Construcción.

Santiago, 18 de Noviembre de 1996.

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IDIEM

RUBEN GALECIO GOMEZ NOTARIO PUBLICO SANTIAGO

CERTIFICADO DE ENSAYE Nº 213.305

Informe sobre la resistencia al fuego de un elemento de construcción, enviado al Laboratorio de Incendios, Sección Física de la Construcción, Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por Compañía Minera Romeral Ltda., Amunátegui Nº 72, 4º piso, teléfono 6721907, Santiago.

1.- Finalidad del ensayo.

Se desea conocer la resistencia al fuego de un elemento que se utilizará para construir ductos de evacuación de gases en edificios. Para este efecto se emplea la norma NCh 935/1 Of. 84 "Ensayo de resistencia al fuego - Parte 1: Elementos de construcción en general".

2.- Características del elemento de construcción.

Se trata de un elemento formado por bloques rectangulares de yeso "Isomur" de 700 x 500 x 60 (mm), machihembrados y unidos entre sí con yeso. Una de las caras de este elemento lleva como terminación una plancha de fibro-yeso, "Romerit", de 10 mm de espesor.

Para el ensayo se construyó un muro de 2,2 m de ancho por 2,4 m de alto y 0,07 m de espesor. El peso de cada bloque de yeso resulta ser de 17,5 kilógramos, en promedio.

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INSTITUTO DE INVESTIGACIONES Y ENSAYES DE MATERIALES

IDIEM

C.E. Nº 213.305

RUBEN GALECIO GOMEZ 1 NOTARIO PUBLICO SANTIAGO

3.- Resistencia al fuego.

3.1 El ensayo consiste en exponer el muro bajo prueba y por una de sus caras, al calor de un horno de modo de imprimirle una temperatura, según la curva normalizada de tiempo-temperatura señalada en NCh 935/1 Of. 84, regida por la relación T = 345 log (8t + 1), donde T es la temperatura inicial y t es el tiempo transcurrido, expresado en minutos, como se muestra a continuación:

t, minutos	0	5	15	30	60	90	120	150	180
T, °C	20	576	739	842	945	1006	1049	1082	1110

3.2 De acuerdo a la norma, las condiciones de ensayo deben corresponder a un incendio real. Para cumplir con ello, el elemento en prueba debe ser de tamaño natural o bien de dimensiones relativamente grandes. Para tal efecto se dispone de un horno con quemador a gas licuado de una potencia cercana a las 500.000 kilocalorías por hora y de una boca capaz de admitir el elemento bajo ensayo.

3.3 Las temperaturas se miden por medio de termocuplas en la cara expuesta al fuego y por radiación infrarroja en la cara no expuesta.

3.4 La resistencia al fuego la determina el tiempo transcurrido en ascender la temperatura de la cara no expuesta hasta 180 °C puntual o 140 °C promedio por sobre la temperatura inicial o bien el deterioro mecánico del elemento o la pérdida de estanquidad.

3.5 Según la norma, el elemento bajo prueba se debe ensayar en condiciones normales de trabajo a fin de reproducir un sistema similar de empotramiento. Como este panel puede empotrarse de maneras distintas, según la solución constructiva de cada caso particular, este factor puede hacer variar los resultados obtenidos, desfavoreciendo la resistencia al fuego total del conjunto cuando el empotramiento es más débil que el panel mismo. Por esta causa en el presente ensayo no se somete a prueba el sistema de empotramiento.

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C.E. Nº 213.305

4.- Resultados y observaciones.

4.1 La temperatura puntual máxima admisible de 200 °C en la cara no expuesta al fuego (Plancha Romerit de 10 mm de espesor) se produjo a los 126 minutos de iniciado el ensayo, lo que determinó el tiempo de resistencia al fuego, según lo expresado en 3.4.

La temperatura promedio en la cara no expuesta al fuego, en ese instante, fue de 84 °C.

4.2 Al término del ensayo, los bloques, de yeso estaban seriamente dañados.

5.- Valores de referencia.

5.1 De acuerdo a la norma NCh 935/1 los elementos de construcción, una vez sometidos a ensayos de resistencia al fuego, se clasifican, de acuerdo a su duración, en las siguientes clases:

No resistente,	duración inferior a 15 minutos
Clase F 15	duración entre 15 y 29 minutos
Clase F 30	duración entre 30 y 59 minutos
Clase F 60	duración entre 60 y 89 minutos
Clase F 90	duración entre 90 y 119 minutos
Clase F120	duración entre 120 y 149 minutos
Clase F150	duración entre 150 y 179 minutos
Clase F180	duración entre 180 y 239 minutos
Clase F240	duración superior a 240 minutos.

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RUBEN GALECIO GOMEZ NOTARIO PUBLICO SANTIAGO

C.E. Nº 213.305

6.- Conclusiones y observaciones.

6.1 El elemento de construcción, cuyas características se mencionan en el punto 2 de este certificado, solicitado al Laboratorio de Incendios de la Sección Física de la Construcción del Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por Compañía Minera Romeral Ltda., objeto del presente certificado de ensaye Nº 213.305 presentó una resistencia al fuego de 126 minutos, según la norma NCh 935/1 of. 84, bajo las condiciones de ensayo señaladas en el presente informe.

6.2 De acuerdo a los valores de referencia dados en la norma chilena NCh 935/1, Anexo A, el elemento de construcción se clasifica en clase F120 de resistencia al fuego.

6.3 Considerando lo señalado en la norma NCh 935/1 los resultados obtenidos son válidos sólo para el elemento ensayado y bajo las condiciones estipuladas, ya que el valor de resistencia al fuego puede variar si se cambian los detalles constructivos.

INSTITUTO DE INVESTIGACIONES Y ENSAYES DE MATERIALES UNIVERSIDAD IDIEM FISICA DE LA CONSTRUCCION DE CHILE

Gabriel Rodríguez J.
Jefe Sección Física
de la Construcción.

CERTIFICO QUE LA PRESENTE COPIA FOTOSTATICA SE ENCUENTRA CONFORME CON SU ORIGINAL QUE HE TENIDO A LA VISTA Y DEVUELTO AL INTERESADO

Número de páginas 1

SANTIAGO, 10 de Enero de 1995.

UNIVERSIDAD DE CHILE INSTITUTO DE INVESTIGACIONES ENSAYES DE MATERIALES - PLAZA ERCILLA Nº 883 - TELEFONO 6982071 FAX (56-2) 6718979

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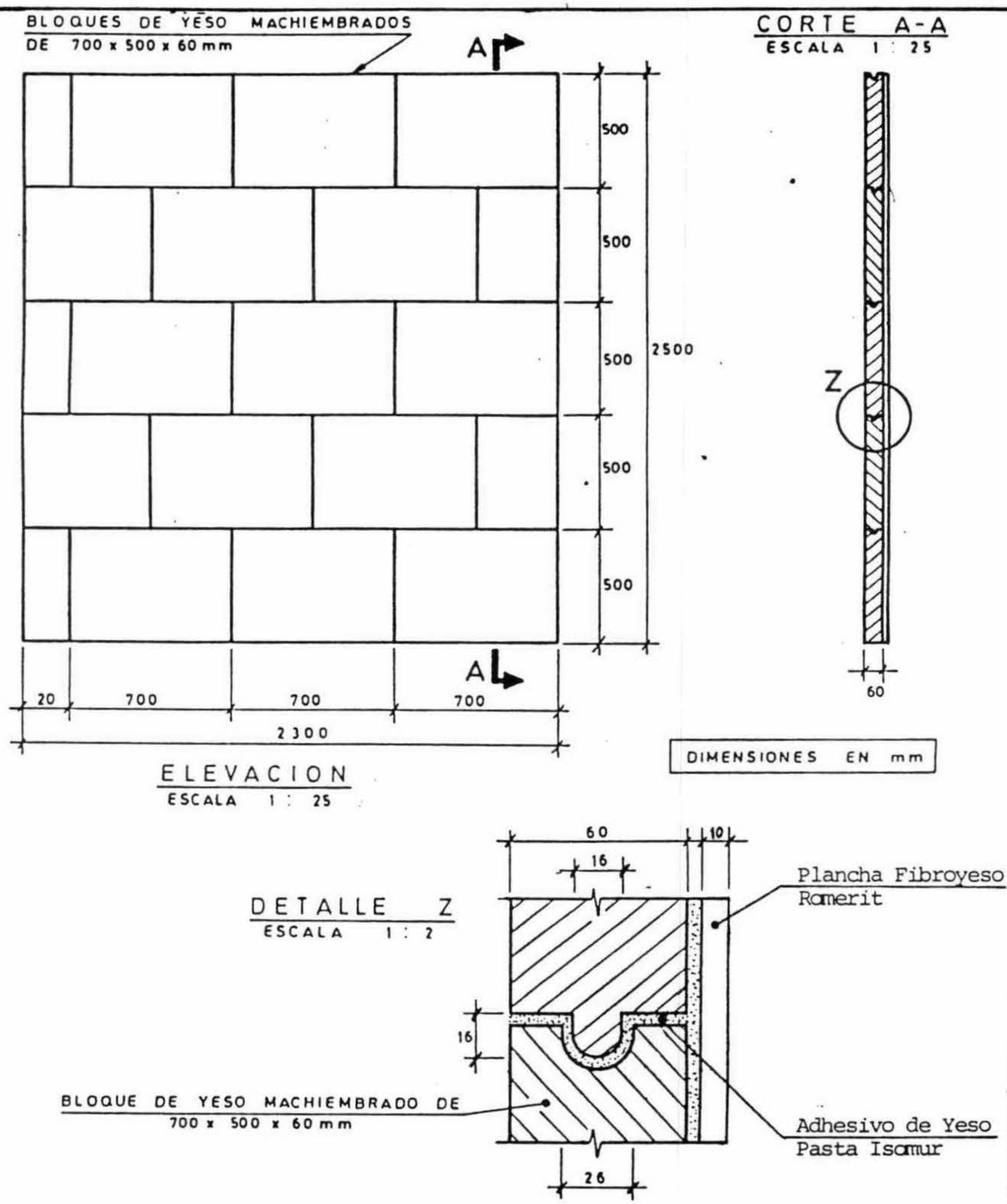

FIG. :_ ELEVACION, CORTE Y DETALLE DEL MURO.

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CERTIFICADO DE ENSAYE Nº 198.449

Informe sobre la resistencia al fuego de un elemento de construcción, enviado al Laboratorio de Incendios, Sección Física de la Construcción, Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por Compañía Industrial El Volcán S.A., Phillips 40, 4º piso, teléfono 396038, Santiago.

1.- Finalidad del ensayo.

Se desea conocer la resistencia al fuego de un elemento de construcción que se usará como muro divisorio en edificios. Para este efecto se emplea la norma NCh 935/1 Of. 84 "Ensayo de resistencia al fuego - Parte 1. Elemento de construcción en general".

2.- Características del elemento de construcción.

El elemento está formado por una estructura hecha con perfiles de acero galvanizados. Consta de siete piederechos, los cuales se afianzan a las soleras por medio de remaches. La estructura está forrada, por ambos lados, con dos planchas de Volcanita de 15 mm de espesor cada una, pegadas entre si y afianzadas a la estructura por medio de tornillos. Esta conformación deja espacios verticales libres dentro de la estructura de 60 mm de espesor, en los cuales se han colocado colchonetas de lana mineral de 50 mm de espesor. El peso total del elemento resultó ser de 321 kilógramos.

La estructuración y dimensiones del elemento se muestra en la figura siguiente:

Continúa en página 2 a 5

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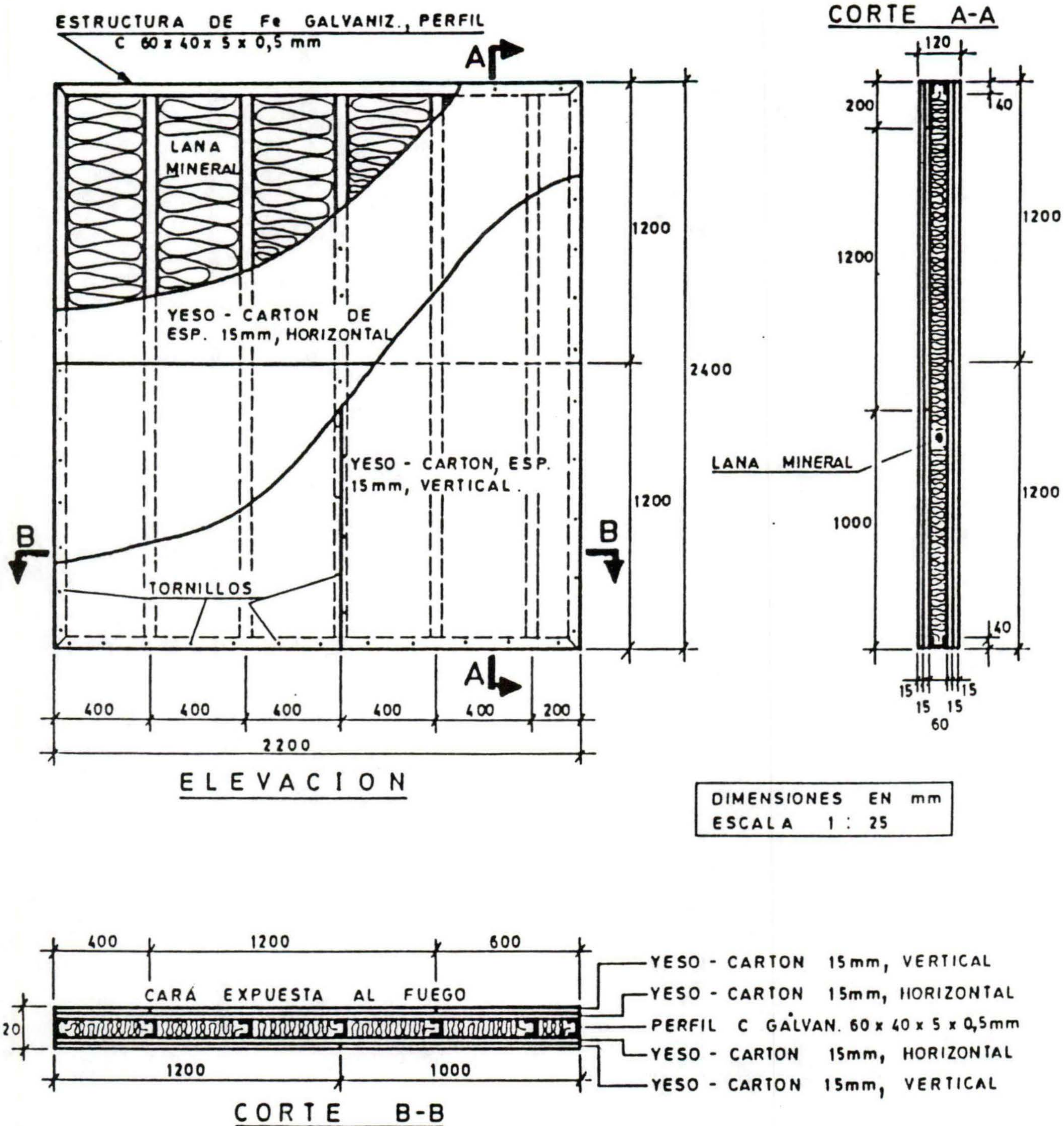

FIG.:_ ELEVACION Y CORTES DEL ELEMENTO.

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C.E. Nº 198.449

3.- Resistencia al fuego.

3.1 El ensayo consiste en exponer el elemento bajo prueba y por una de sus caras, al calor de un horno de modo de imprimirle una temperatura, según la curva normalizada de tiempo-temperatura señalada en NCh 935/1 Of. 84, regida por la relación T = 345 log (8 t + 1), donde T es la temperatura inicial y t es el tiempo transcurrido, expresado en minutos, como se muestra a continuación:

t, minutos	0	5	15	30	60	90	120	150	180
T, °C	20	576	739	842	945	1006	1049	1082	1110

3.2 De acuerdo a la norma, las condiciones de ensayo deben corresponder a un incendio real. Para cumplir con ello, el elemento en prueba debe ser de tamaño natural o bien de dimensiones relativamente grandes. Para tal efecto se dispone de un horno con quemador a gas licuado de una potencia cercana a las 500.000 kilocalorías por hora y de una boca capaz de admitir el elemento bajo ensayo.

3.3 Las temperaturas se miden por medio de termocuplas en la cara expuesta al fuego y por radiación infrarroja en la cara no expuesta.

3.4 La resistencia al fuego la determina el tiempo transcurrido en ascender la temperatura de la cara no expuesta hasta 180 °C puntual o 140 °C promedio por sobre la temperatura inicial o bien el deterioro mecánico del elemento, la pérdida de estanquidad o la producción de gases inflamables.

3.5 Según la norma, el elemento bajo prueba se debe ensayar en condiciones normales de trabajo a fin de reproducir un sistema similar de empotramiento. Como este panel puede empotrarse de maneras distintas, según las solución constructiva de cada caso particular, este factor puede hacer variar los resultados obtenidos, desfavoreciendo la resistencia al fuego total del conjunto cuando el empotramiento es más débil que el panel mismo. Por esta causa en el presente ensayo no se somete a prueba el sistema de empotramiento.

PLAZA ERCILLA 883 - CASILLA 1420 - TELEFONO: 6784156 - FAX: (56-2) - 6718979 - SANTIAGO DE CHILE

4.- Resultados y observaciones.

4.1 La temperatura puntual máxima admisible de 200 °C en la cara no expuesta al fuego se produjo a los 124 minutos de iniciado el ensayo, lo que determinó el tiempo de resistencia al fuego, según lo expresado en 3.4.

4.2 La temperatura promedio en la cara no expuesta al fuego, en ese instante, fue de 103 °C.

4.3 Durante el desarrollo de la prueba el panel sufrió deformaciones apreciables, las cuales no llegaron a ser causa de falla.

5.- Valores de referencia.

5.1 De acuerdo a la norma NCh 935/1 los elementos de construcción, una vez sometidos a ensayos de resistencia al fuego, se clasifican, de acuerdo a su duración, en las siguientes clases:

No resistente, duración inferior a 15 minutos
Clase F 15 duración entre 15 y 29 minutos
Clase F 30 duración entre 30 y 59 minutos
Clase F 60 duración entre 60 y 89 minutos
Clase F 90 duración entre 90 y 119 minutos
Clase F120 duración entre 120 y 149 minutos
Clase F150 duración entre 150 y 179 minutos
Clase F180 duración entre 180 y 239 minutos
Clase F240 duración superior a 240 minutos.

6.- Conclusiones.

6.1 El elemento de construcción destinado a uso como muro divisorio en edificios, enviado al Laboratorio de Incendios de la Sección Física de la Construcción del Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por Compañía Industrial El Volcán S.A., objeto del presente certificado de ensaye Nº 198.449, presentó una resistencia al fuego de 124 minutos según la norma NCh 935/1 Of. 84, bajo las condiciones de ensayo señaladas en el presente informe.

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6.2 De acuerdo a los valores de referencia dados en la norma chilena NCh 935/1, Anexo A, el elemento de construcción se clasifica en clase F120 de resistencia al fuego.

6.3 Considerando lo señalado en la norma NCh 935/1, los resultados obtenidos son válidos sólo para el elemento ensayado y bajo las condiciones estipuladas, ya que el valor de resistencia al fuego puede variar si se cambian los detalles constructivos.

Gabriel Rodríguez J.
Jefe Sección Física
de la Construcción.

Santiago, 10 de Julio de 1992.

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CERTIFICADO DE ENSAYE Nº 207.774

Informe sobre la resistencia al fuego de un elemento de construcción, enviado al Laboratorio de Incendios de la Sección Física de la Construcción del Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por Compañía Industrial El Volcán S.A., Phillips 40, 4º piso, teléfono 396038, Santiago.

1.- Finalidad del ensayo.

Se desea conocer la resistencia al fuego de un elemento de construcción que se usará como muro divisorio en edificios. Para este efecto se emplea la norma NCh 935/1 Of.84 "Ensayo de resistencia al fuego - Parte 1: Elementos de construcción en general".

2.- Características del elemento de construcción.

El elemento está constituído por seis planchas de yeso-cartón, unidas entre sí con un pegamento especial a base de yeso.

Para los efectos del ensayo se preparó un muro de 2,4 m de alto por 2,2 m de ancho y 0,095 m de espesor.

Detalles constructivos y dimensiones del elemento se observan en la figura siguiente:

Continúa en página 2 a 5

C.E. Nº 207.774

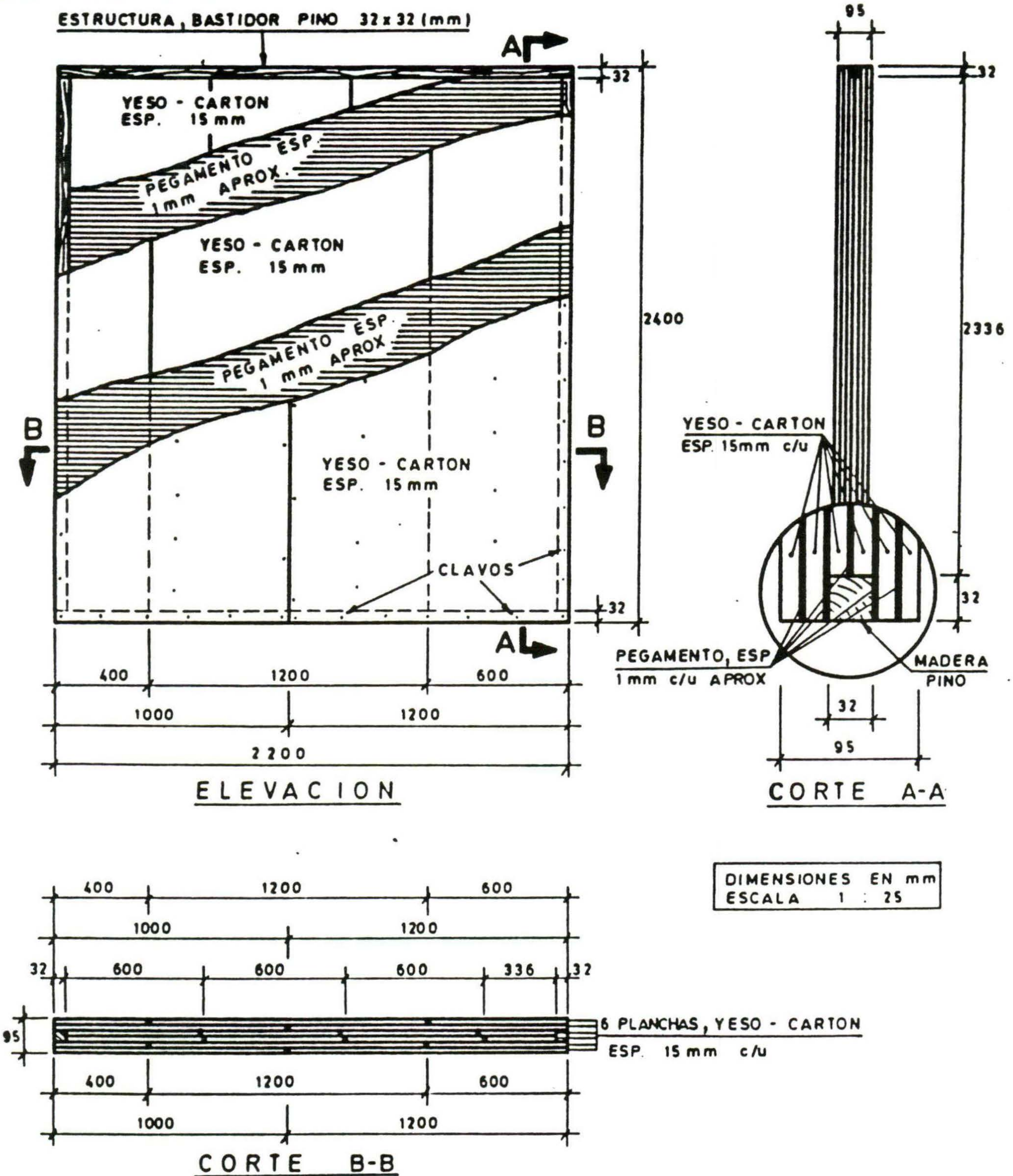

FIG. :_ ELEVACION Y CORTES DEL ELEMENTO.

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3.- Resistencia al fuego.

3.1 El ensayo consiste en exponer el muro bajo prueba y por una de sus caras, al calor de un horno de modo de imprimirle una temperatura, según la curva normalizada de tiempo-temperatura señalada en NCh 935/1 Of. 84 regida por la relación T = 345 log (8 t + 1), donde T es la temperatura inicial y t es el tiempo transcurrido, expresado en minutos, como se muestra a continuación:

t, minutos	0	5	15	30	60	90	120	150	180
T, °C	20	576	739	842	945	1006	1049	1082	1110

3.2 De acuerdo a la norma, las condiciones de ensayo deben corresponder a un incendio real. Para cumplir con ello, el elemento en prueba debe ser de tamaño natural o bien de dimensiones relativamente grandes. Para tal efecto se dispone de un horno con quemador a gas licuado de una potencia cercana a las 500.000 kilocalorías por hora y de una boca capaz de admitir el elemento bajo ensayo.

3.3 Las temperaturas se miden por medios de termocuplas en la cara expuesta al fuego y por radiación infrarroja en la cara no expuesta.

3.4 La resistencia al fuego la determina el tiempo transcurrido en ascender la temperatura de la cara no expuesta hasta 180 °C puntual o 140 °C promedio por sobre la temperatura inicial o bien el deteriodo mecánico del elemento, la pérdida de estanquidad o la producción de gases inflamables.

3.5 Según la norma, el elemento bajo prueba se debe ensayar en condiciones normales de trabajo a fin de reproducir un sistema similar de empotramiento. Como este panel puede empotrarse de maneras distintas, según la solución constructiva de cada caso particular, este factor puede hacer variar los resultados obtenidos, desfavoreciendo la resistencia al fuego total del conjunto cuando el empotramiento es más débil que el panel mismo. Por esta causa en el presente ensayo no se somete a prueba el sistema de empotramiento.

INSTITUTO DE INVESTIGACIONES Y ENSAYES DE MATERIALES - PLAZA ERCILLA Nº 883 - TELEFONO 6982071 FAX (56-2) 6718979

4.- Resultados y observaciones.

4.1 La temperatura puntual máxima admisible de 200 °C en la cara no expuesta al fuego se produjo a los 132 minutos de iniciado el ensayo, lo que determinó el tiempo de resistencia al fuego, según lo expresado en 3.4.

4.2 La temperatura promedio en la cara no expuesta al fuego, en ese instante, fue de 110 °C.

5.- Valores de referencia.

5.1 De acuerdo a la norma NCh 935/1 los elementos de construcción, una vez sometidos a ensayos de resistencias al fuego, se clasifican, de acuerdo a su duración , en las siguientes clases:

No resistente, duración inferior a 15 minutos
Clase F 15 duración entre 15 y 29 minutos
Clase F 30 duración entre 30 y 59 minutos
Clase F 60 duración entre 60 y 89 minutos
Clase F 90 duración entre 90 y 119 minutos
Clase F120 duración entre 120 y 149 minutos
Clase F150 duración entre 150 y 179 minutos
Clase F180 duración entre 180 y 239 minutos
Clase F240 duración superior a 240 minutos.

6.- Conclusiones y observaciones.

6.1 El elemento de construcción destinado a uso como muro divisorio en edificios, enviado al Laboratorio de Incendios de la Sección Física de la Construcción del Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por Compañía Industrial El Volcán S.A., objeto del presente certificado de ensaye Nº 207.774, presentó una resistencia al fuego de 132 minutos, según la norma NCh 935/1 Of. 84, bajo las condiciones de ensayo señaladas en el presente informe.

C.E. Nº 207.774

6.2 De acuerdo a los valores de referencia dados en la norma chilena NCh 935/1, Anexo A, el elemento de construcción se clasifica en clase F120 de resistencia al fuego.

6.3 Considerando lo señalado en la norma NCh 935/1, los resultados obtenidos son válidos sólo para el elemento ensayado y bajo las condiciones estipuladas, ya que el valor de resistencia al fuego puede variar si se cambian los detalles constructivos.

INSTITUTO DE INVESTIGACIONES Y ENSAYES DE MATERIALES - UNIVERSIDAD DE CHILE - IDIEM - FISICA DE LA CONSTRUCCION

Gabriel Rodríguez J.
Jefe Sección Física
de la Construcción.

Santiago, 11 de Enero de 1994.

UNIVERSIDAD DE CHILE
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CERTIFICADO DE ENSAYE Nº 222.608

Informe sobre la resistencia al fuego de un elemento de construcción, enviado al Laboratorio de Incendios, Sección Física de la Construcción del Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por Compañía Industrial El Volcán S.A., Phillips Nº 40, 4º piso, teléfono 6396038, Santiago.

1.- Finalidad del ensayo.

Se desea conocer la resistencia al fuego de un panel que se usará como elemento divisorio en edificios. Para este efecto se emplea la norma NCh 935/1 Of. 84 "Ensayo de resistencia al fuego - Parte 1: Elementos de construcción en general".

2.- Características del elemento.

El elemento está formado por una estructura metálica. Consta de siete montantes verticales (pie-derechos) hechos con perfiles de acero galvanizado tipo C, de 38 x 40 x 8 x 0,5 (mm), distanciados entre ejes 0.4 m. aproximadamente y de dos soleras (inferior y superior) de 39 x 20 x 0.5 (mm). Esta estructuración está forrada por ambas caras con dos planchas de yeso-cartón, "Volcanita RF" de 12,5 mm de espesor cada una, atornilladas a la estructura. Tal configuración deja espacios libres en el interior del panel, los cuales están rellenos con lana mineral cuya densidad media aparente es de 40 kg/m3.

Para el ensayo se preparó un elemento de 2.2 m de ancho por 2.4 m de alto y 0.088 m de espesor. El peso total del muro elemento resultó ser de 242 kilógramos.

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Continúa en página 2 a 4

C.E. Nº 222.608

3.- Resistencia al fuego.

3.1 El ensayo consiste en exponer el elemento bajo prueba y por una de sus caras, al calor de un horno de modo de imprimirle una temperatura, según la curva normalizada de tiempo-temperatura señalada en NCh 935/1 Of. 84 regida por la relación T = 345 log (8 t + 1), donde T es la temperatura inicial y t es el tiempo transcurrido, expresado en minutos, como se muestra a continuación:

t, minutos	0	5	15	30	60	90	120	150	180
T, °C	20	576	739	842	945	1006	1049	1082	1110

3.2 De acuerdo a la norma, las condiciones de ensayo deben corresponder a un incendio real. Para cumplir con ello, el elemento en prueba debe ser de tamaño natural o bien de dimensiones relativamente grandes. Para tal efecto de dispone de un horno con quemador a gas licuado de una potencia cercana a las 500.000 kilocaloría por hora y de una boca capaz de admitir el elemento bajo ensayo.

3.3 Las temperaturas se miden por medio de termocuplas en la cara expuesta al fuego y por radiación infrarroja en la cara no expuesta.

3.4 La resistencia al fuego la determina el tiempo transcurrido en ascender la temperatura de la cara no expuesta hasta 180 °C puntual o 140 °C promedio por sobre la temperatura inicial o bien el deterioro mecánico del elemento o la pérdida de estanquidad.

3.5 Según la norma, el elemento bajo prueba se debe ensayar en condiciones similares a las normales de trabajo. Como este elemento puede empotrarse de maneras distintas, según la solución constructiva de cada caso particular, este factor puede hacer variar los resultados obtenidos, desfavoreciendo la resistencia al fuego total del conjunto cuando el empotramiento es más débil que el mismo elemento.

En el presente ensayo no se somete a prueba el sistema de empotramiento.

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4.- Resultados y observaciones.

4.1 La temperatura puntual máxima admisible de 200 °C en la cara no expuesta al fuego se produjo a los 125 minutos de iniciado el ensayo, lo que determinó el tiempo de resistencia al fuego, según lo expresado en 3.4.

4.2 La temperatura promedio en la cara no expuesta al fuego, en ese instante, fue de 92 °C.

4.3 Durante el desarrollo de la prueba, el elemento sufrió deformaciones, las cuales no llegaron a ser causa de falla.

4.4 Al término del ensayo, el forrado expuesto al fuego quedó totalmente destruido.

5.- Valores de referencia.

5.1 De acuerdo a la norma NCh 935/1 los elementos de construcción, una vez sometidos al ensayo de resistencia al fuego, se clasifican, de acuerdo a su duración, en las siguientes clases:

No resistente, duración inferior a 15 minutos
Clase F 15 duración entre 15 y 29 minutos
Clase F 30 duración entre 30 y 59 minutos
Clase F 60 duración entre 60 y 89 minutos
Clase F 90 duración entre 90 y 119 minutos
Clase F120 duración entre 120 y 149 minutos
Clase F150 duración entre 150 y 179 minutos
Clase F180 duración entre 180 y 239 minutos
Clase F240 duración superior a 240 minutos.

PLAZA ERCILLA 883 - CASILLA 1420 - TELÉFONO: 6784156 - FAX: (56 - 2) - 6718979 - SANTIAGO DE CHILE

6.- Conclusiones y observaciones.

6.1 El elemento de construcción destinado a uso como elemento divisorio en edificios, enviado al Laboratorio de Incendios de la Sección Física de la Construcción del Instituto de Investigaciones y Ensayes de Materiales (IDIEM) de la Universidad de Chile, por Compañía Industrial El Volcán S.A., objeto del presente certificado de ensaye Nº 222.608 presentó una resistencia al fuego de 125 minutos, según la norma NCh 935/1 Of. 84, bajo las condiciones de ensayo señaladas en el presente informe.

6.2 De acuerdo a los valores de referencia dados en la norma chilena NCh 935/1, Anexo A, el elemento de construcción se clasifica en clase F120 de resistencia al fuego.

6.3 Considerando lo señalado en la norma NCh 935/1 los resultados obtenidos son válidos sólo para el elemento ensayado y bajo las condiciones estipuladas, ya que el valor de resistencia al fuego puede variar si se cambian los detalles constructivos.

Gabriel Rodríguez J.
Jefe Sección Física
de la Construcción.

Santiago, 25 de Junio de 1996.

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SGS European Quality Certification Institute
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QUALITY SYSTEM CERTIFICATE
Reg. No. QBE 92057

We state that the quality system of

ETERNIT N.V.
KAPELLE-OP-DEN-BOS - BELGIUM

is in compliance with the quality system standard

NBN EN ISO 9002

(Second edition; July 1994)

REGISTERED QUALITY SYSTEM ISO 9002 SGS EQCI

This certificate is applicable to

the production and sale of building materials for roofing, cladding and sheets for multi purpose use.

Period of validity: 01/09/95 - 31/10/98.
Originally certified : 08/09/94

Antwerpen,

24th August 1995

Director
Quality System Certification

Ir. [illegible]. De Coster

Certificate No. 0368 3233

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MINISTERIO DE AGRICULTURA, PESCA Y ALIMENTACION

INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS

INFORME DE RESISTENCIA AL FUEGO DE UN TABIQUE DE PLACAS PROMATECT-H, SOLICITADO POR PROMAT IBERICA, S.A.

Ref. F - 1152

Madrid, Julio 1991

Nº 1

La com... materiales ha sido suministr... y no

MINISTERIO DE AGRICULTURA, PESCA Y ALIMENTACION
CENTRO DE INVESTIGACION Y TECNOLOGIA
del
INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS

Departamento de Industrias Forestales

INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS - LABORATORIO DEL FUEGO

RD/dg.

INFORME DE RESISTENCIA AL FUEGO DE UN TABIQUE DE PLACAS PROMATECT-H, SOLICITADO POR PROMAT IBERICA, S.A.

<u>Ref. F - 1152</u>

1.- <u>ANTECEDENTES</u>

Con fecha 26/02/91, la firma PROMAT IBERICA, S.A., con domicilio en C/. Sagasta, 16, Bajo Dcha., Tfno. 448.10.00 (Ext. 242), MADRID, solicitó del Laboratorio del Fuego del INIA, ensayos de resistencia al Fuego, de acuerdo con la carta que se transcribe a continuación:

Muy señores nuestros:

Rogamos nos confirmen la posibilidad de realizar ensayos en su laboratorio del fuego, con Paneles PROMATECT, para distintas soluciones, según Normas UNE, para su clasificación.

Los ensayos a realizar son los siguientes:

1.- Horno horizontal. Ensayo de una viga sometida a carga, y varias sin carga.

2.- Horno vertical. Ensayo de un tabique.

3.- Horno vertical. Ensayo de un tabique.

Así mismo, les agradeceríamos nos diesen su valoración.

Sin otro particular, aprovechamos la ocasión para saludarles.

Muy atentamente".

El presente informe corresponde al apartado 3 de la anterior carta.

2.- INFORME

2.1.- Finalidad del ensayo

Se pretende, con este ensayo, determinar la resistencia al fuego (RF) de un sistema separador no portante, formado por placas PROMATECT-H, según procedimiento de ensayo especificado en la Norma UNE 23.093-81 e ISO 834.

2.2.- Descripción de la muestra

La descripción ha sido suministrada por el solicitante, transcribiéndose la misma como sigue:

"El ensayo se realiza en horno vertical de 3.12 x 3,20 m, siendo el resto de superficie de muro compuesto por dos ladrillos de doble hueco de 10 cm y revestido, por ambas caras, de yeso, resultando una pared de 24 cm.

Para el montaje del tabique se utilizaron perfiles fabricados en tren de perfilación, a partir de chapa galvanizada, de espesor 0,6 mm, según Norma UNE-36130, y de característi-cas Z350N40 (Z define el tipo de estrella del galvanizado, 350 se refiere al número de gramos/m² del revestimiento de cinc, N define la composición y características del acero base y 40 se refiere a la resistencia de este acero en kg/mm²).

*Para el montaje se utilizaron dos perfiles, marca **PROMAT**, canales de 48 y montantes de 46, montados según plano adjunto.*

En el interior de los perfiles se colocó un panel de lana mineral de 100 kg/m3, de 40 mm de espesor, denominado PROMAPIN-40.

*Se colocaron, por la cara anterior y posterior del tabique, placas de **PPROMATECT-H** de 10 mm de espesor, atornilladas a los perfiles mediante tornillos autorroscantes de 4,2 x 25.*

La composición de los materiales ha sido suministrada por el solicitante y no comprobada por este Instituto.

A las juntas de los paneles se las protegió con pasta de Juntas "PROMAT".

Como ampliación a esta descripción, véase croquis del ANEXO I y fotografías ANEXO IV.

2.3.- Horno vertical

Está construido con una estructura metálica y ladrillo refractario, siendo el revestimiento interior de material aislante y refractario.

Posee tres quemadores de impulsión, de 600.000 Kcal/h, cada uno, colocados verticalmente en el lado derecho del horno, de forma que la muestra a ensayar no reciba directamente la acción de la llama.

La regulación térmica del horno se realiza mediante un microprocesador al que se ha incorporado el programa térmico normalizado.

El control de temperaturas del horno se consigue mediante termopares colocados de acuerdo con el documento EUR 8750.

La medición de temperaturas de la probeta se consigue automáticamente mediante termopares situados en su superficie y conectados a un ordenador, efectuándose una medida cada minuto.

Para los ensayos bajo carga va dotado de una prensa de carga máxima 157 Tn.

Una vez estabilizado el ensayo, el horno funciona en depresión hasta 1/3 de la altura de la boca y en sobrepresión por encima de este punto, tal y como indica el documento EUR 8750. El control y regulación de la presión interior se consigue mediante dos captadores adecuados, según el documento EUR 8750, unidos a un microprocesador, que se encarga de la regulación automática del tiro.

La boca útil del horno es de 3,10 x 3,10 m².

2.4.- Montaje e instalación

Se construyó toda la muestra ensayada sobre un marco de perfiles de acero en U, "ad hoc", conjunto que cerraba la boca del horno durante el ensayo.

Sobre la cara no expuesta se situaron siete termopares distribuidos de acuerdo a lo indicado por la Norma de ensayo (fotografía nº 5). También se situó en el centro geométrico de la misma, un dispositivo para medir la evolución de la deformación, durante el ensayo (fotografía nº 6).

En el interior del horno, existen ocho termopares que controlan la evolución de la temperatura interior del mismo.

2.5.- Evolución de los ensayos

TIEMPO	OBSERVACIONES
0 min. 0 seg.	Inicio del ensayo. Fecha: 24/05/91. Tª inicial = 19°C.
16	Apertura fisura superficial vertical en placa zona inferior, en cara expuesta.
60	Tª media termopares cara no expuesta: 55,6°C.
63	Apertura grieta cara no expuesta (véase fotografía nº 7).
74	Aumento tamaño fisura (véase fotografía nº 8).
120	Las temperaturas registradas por los termopares de la cara no expuesta fueron las siguientes: Tp nº 1 = 115°C; Tp nº 2 = 108°C; Tp nº 3 = 107°C; Tp nº 4 = 69°C; Tp nº 5 = 76°C; Tp nº 6 = 57°C; Tp nº 7 = 107°C. No hubo paso de llama, ni inflamación de gases en la cara no expuesta. El valor de deformación máximo era de 168.8 mm.
126	Fin del ensayo por acuerdo mutuo.

2.6.- Clasificación

En base a la Norma UNE 23.093 y tomando como criterio la temperatura máxima y media alcanzada en la cara no expuesta, este tabique se puede clasificar como:

= DOS HORAS CORTAFUEGOS, PARALLAMAS Y ESTABLE AL FUEGO =

(RF - 120)

Madrid, 24 de julio de 1991

EL JEFE DE GRUPO DEL FUEGO — POR EL LABº. DEL FUEGO

P. A.

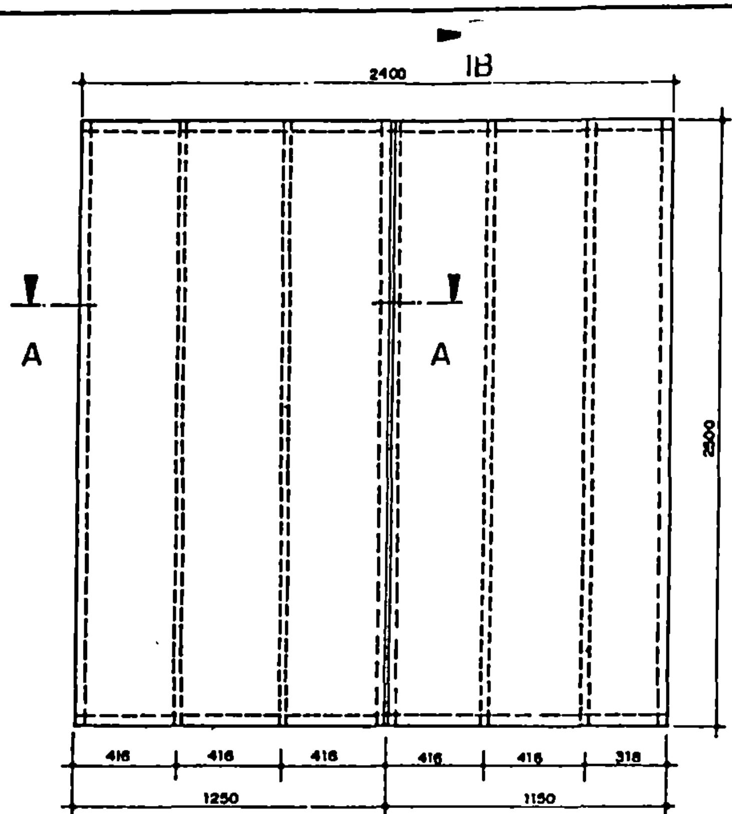
Fdo. R. Díez Barra — Fdo. F.J. Jiménez Peris

Vº. Bº.
EL JEFE DEL DEPARTAMENTO DE
INDUSTRIAS FORESTALES

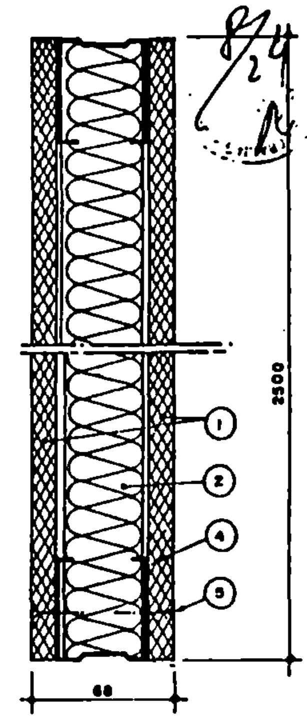
Fdo. A. Sereres

ANEXO I

GRAFICOS Y CROQUIS

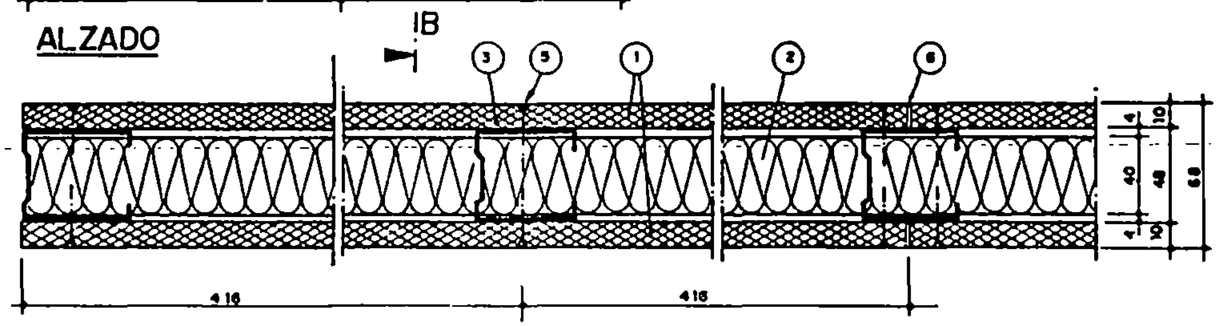


ALZADO



SECCION B-B

1. PROMATECT- H , d=10 mm.
2. Lana mineral d=40mm. Densidad 100 kg/m^3
3. Canales de 48/0,6 segun UNE-36130
4. Montante de 46/0,6
5. Tornillo autorroscante 4,2 x 25
6. Pasta de juntas PROMAT



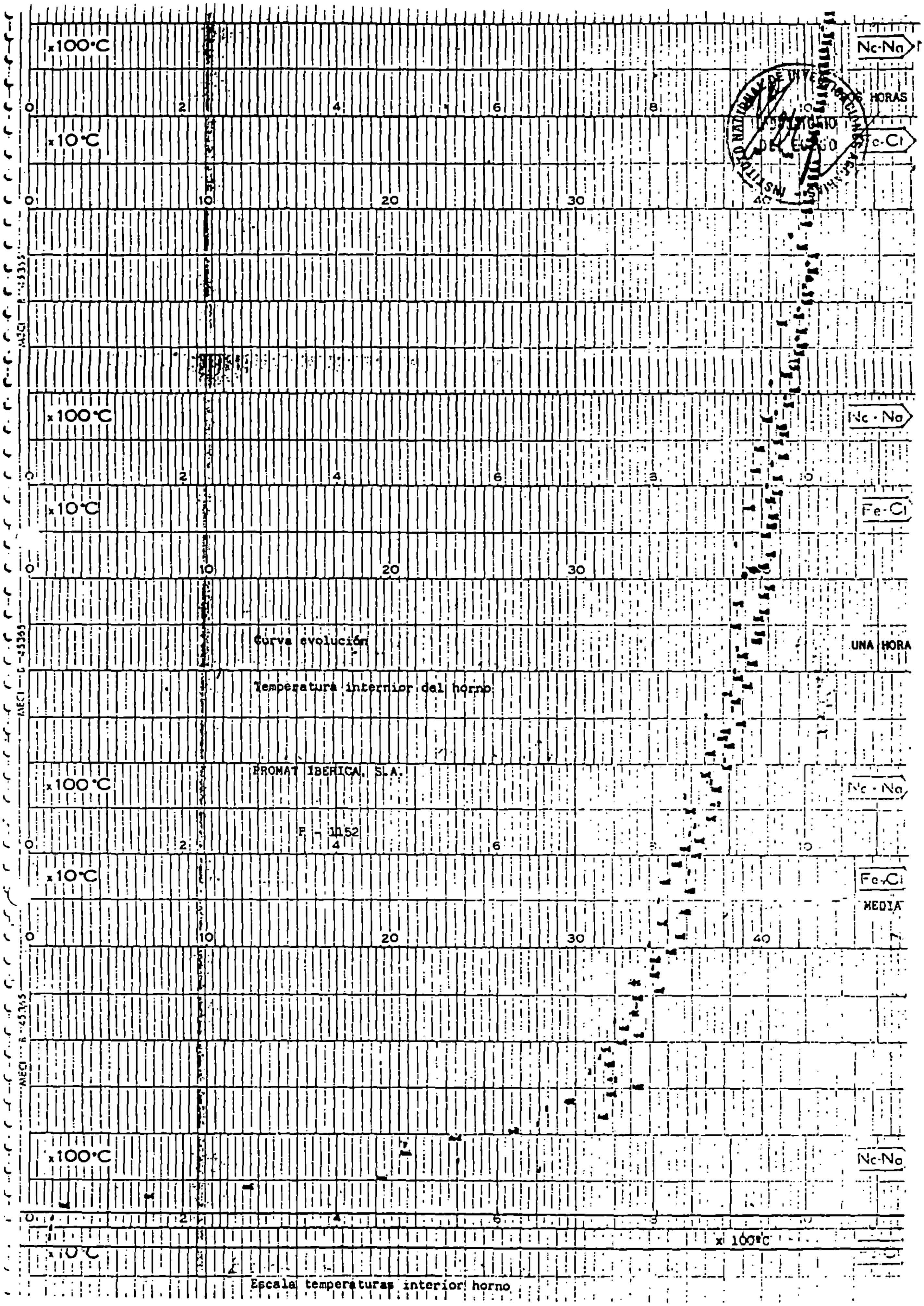
SECCION A-A

Promat	TABIQUE				Cliente Nº:
Promat Ibérica, S.A Mejía Lequerica, 10 28004 MADRID Telf: (91) 448 10 00 593 37 40 Fax: (91) 593 42 00	Escala:	Fecha: 24.5.91.	Dibujado:	Grupo:	Pedido Nº:
	- ESPAÑA -				Plano Nº:

9/24

ANEXO II

CURVAS CALENTAMIENTO DEL HORNO
ESTADILLOS NUMERICOS


x100°C
Nc-Na
0
2
4
6
8
10
HORAS
x10°C
Fe-Ci
0
10
20
30
40
UNA HORA
Curva evolución
Temperatura interior del horno
PROMAT IBERICA, S.A.
P - 1152
MEDIA
x 100°C
Escala temperaturas interior horno

CAN= 1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CAN= 2	[illegible]	[illegible]	65	65	66	66	67
CAN= 3	54	55	55	56	57	58	59
CAN= 4	47	47	48	48	48	49	50
CAN= 5	45	46	47	47	48	48	49
CAN= 6	45	45	45	46	45	46	47
CAN= 7	56	57	56	59	60	61	61
CAN= 8	17	17	17	17	17	17	17
CAN= 9	17	17	17	17	17	17	17
CAN= 10	17	17	17	17	17	17	17
CAN= 11	18	18	18	18	18	18	18
CAN= 12	18	18	18	18	18	18	18
CAN= 13	18	18	18	19	19	19	16
CAN= 14	17	17	17	17	17	17	17
CAN= 15	960	949	971	936	956	971	947
CAN= 16	950	937	959	938	955	969	941
CAN= 17	975	976	1002	955	1001	1006	975
CAN= 18	911	924	913	906	917	930	909
CAN= 19	931	919	925	924	931	945	924
CAN= 20	17	17	17	17	17	17	17

Pasar pagina pulsar (V)   Volver al MENU pulsar (F)

PR=F1152 TA= 19 C HI= 11 : 20 : 10 HF= 13 : 24 : 2 FI= 24 / 5 FF= 24 / 5

T/t	5100s	5160s	5220s	5280s	5340s	5400s	5460s
CAN= 1	96	97	99	100	101	102	103
CAN= 2	89	91	93	94	96	97	98
CAN= 3	76	77	78	79	81	82	84
CAN= 4	64	65	67	67	68	68	70
CAN= 5	61	61	62	63	64	65	65
CAN= 6	63	64	64	65	65	67	68
CAN= 7	82	83	85	88	89	90	91
CAN= 8	17	17	17	17	17	17	17
CAN= 9	17	17	17	17	17	17	17
CAN= 10	17	17	17	17	17	17	17
CAN= 11	18	18	18	18	18	18	18
CAN= 12	18	18	18	18	18	18	18
CAN= 13	18	19	18	18	18	19	19
CAN= 14	17	17	17	17	17	17	17
CAN= 15	953	1000	1004	1007	1012	1010	967
CAN= 16	959	931	996	998	1004	1005	962
CAN= 17	975	1031	1049	1003	1044	1048	931
CAN= 18	930	961	966	969	973	976	943
CAN= 19	951	974	973	902	995	999	914
CAN= 20	17	17	17	17	17	17	17

Pasar pagina pulsar (V)   Volver al MENU pulsar (F)

PR=F1152 TA= 19 C HI= 11 : 20 : 10 HF= 13 : 24 : 2 FI= 24 / 5 FF= 24 / 5

T/t	7200s	7260s	7320s	7380s	7440s	7500s	7560s
CAN= 1	115	116	117	118	119	[illegible]	[illegible]
CAN= 2	109	110	111	111	111	111	0
CAN= 3	107	108	108	108	109	109	0
CAN= 4	69	70	70	69	69	69	0
CAN= 5	75	75	75	75	75	75	0
CAN= 6	57	57	57	57	57	57	0
CAN= 7	107	109	109	110	111	111	0
CAN= 8	17	17	17	17	17	17	0
CAN= 9	17	17	17	17	17	17	0
CAN= 10	17	17	17	17	17	17	0
CAN= 11	18	18	18	18	18	18	0
CAN= 12	18	18	18	18	18	18	0
CAN= 13	18	18	18	18	18	18	0
CAN= 14	17	17	17	17	17	17	0
CAN= 15	[illegible]	[illegible]	[illegible]	[illegible]	1022	[illegible]	0
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Pasar pagina pulsar (V)   Volver al MENU pulsar (F)

PR=F1152 TA= 19 C HI= 11 : 20 : 10 HF= 13 : 24 : 2 FI= 24 / 5 FF= 24 / 5

R=F1152 TA= 19 C HI= 11 : 20 : 10 HF= 13 : 24 : 2 FI= 24 / 5 FF= 24 / 5

T/t	60S	120S	180S	240S	300S	360S	420S
CAN= 1	18	18	18	18	18	18	18
CAN= 2	18	18	18	18	18	18	18
CAN= 3	18	18	18	18	18	18	18
CAN= 4	18	18	18	18	18	18	18
CAN= 5	17	17	17	17	17	17	17
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CAN= 7	17	17	17	17	17	17	17
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CAN= 9	17	17	17	17	17	17	17
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CAN= 14	17	17	17	17	17	17	17
CAN= 15	172	382	631	669	444	507	573
CAN= 16	183	394	600	654	469	494	558
CAN= 17	147	396	655	661	418	541	598
CAN= 18	[illegible]	388	[illegible]	[illegible]	[illegible]	432	[illegible]
CAN= 19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CAN= 20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

CAN= [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CAN= 7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CAN= 8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CAN= 9	[illegible]	17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CAN= 10	[illegible]	17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CAN= 11	18	18	18	[illegible]	18	18	18
CAN= 12	18	18	18	18	18	18	18
CAN= 13	18	18	18	18	18	18	18
CAN= 14	17	17	704	1581	17	17	[illegible]
CAN= 15	900	877	863	907	855	910	[illegible]
CAN= 16	886	869	866	893	859	898	[illegible]
CAN= 17	[illegible]	[illegible]	876	934	857	925	[illegible]
CAN= 18	837	[illegible]	831	844	819	852	[illegible]
CAN= 19	[illegible]	[illegible]	844	860	841	870	[illegible]
CAN= 20	17	[illegible]	18	19	18	18	[illegible]

[illegible]

INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS - DEL FUEGO

ANEXO III

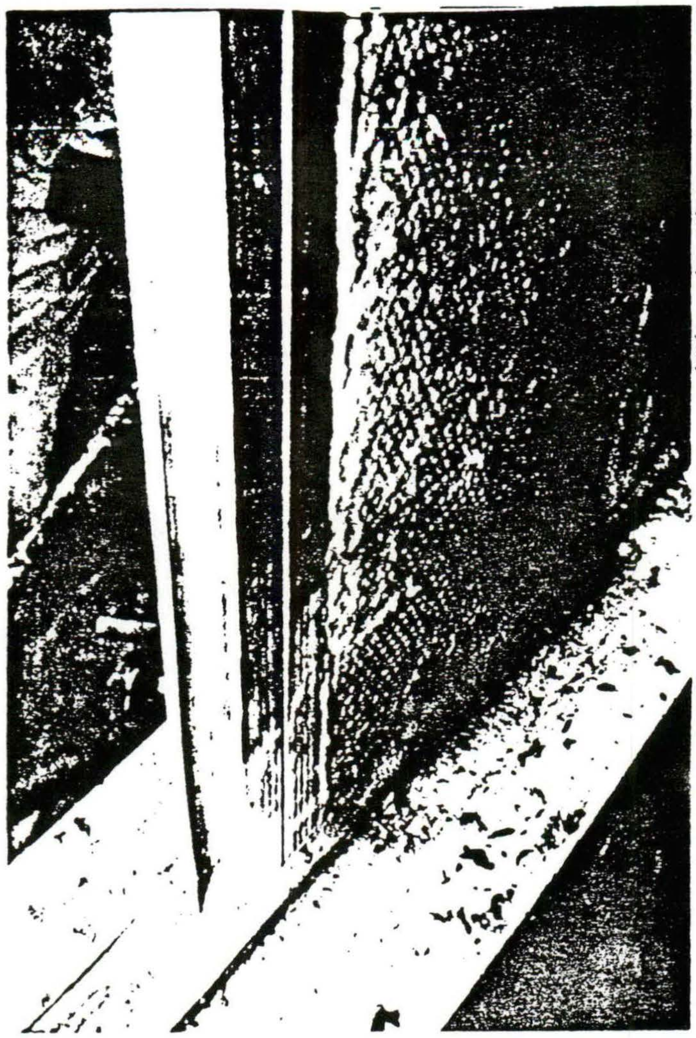
ESTADILLO EVOLUCION DEFORMACION

SOLICITANTE	REF. LABORATORIO	FECHA ENSAYO
PROMAT	1.152	24/05/91
NUM. INFORME	NATURALEZA DEL ELEMENTO DE ENSAYO	
	TABIQUE	
REF. SOLICITANTE	OBSERVACIONES	

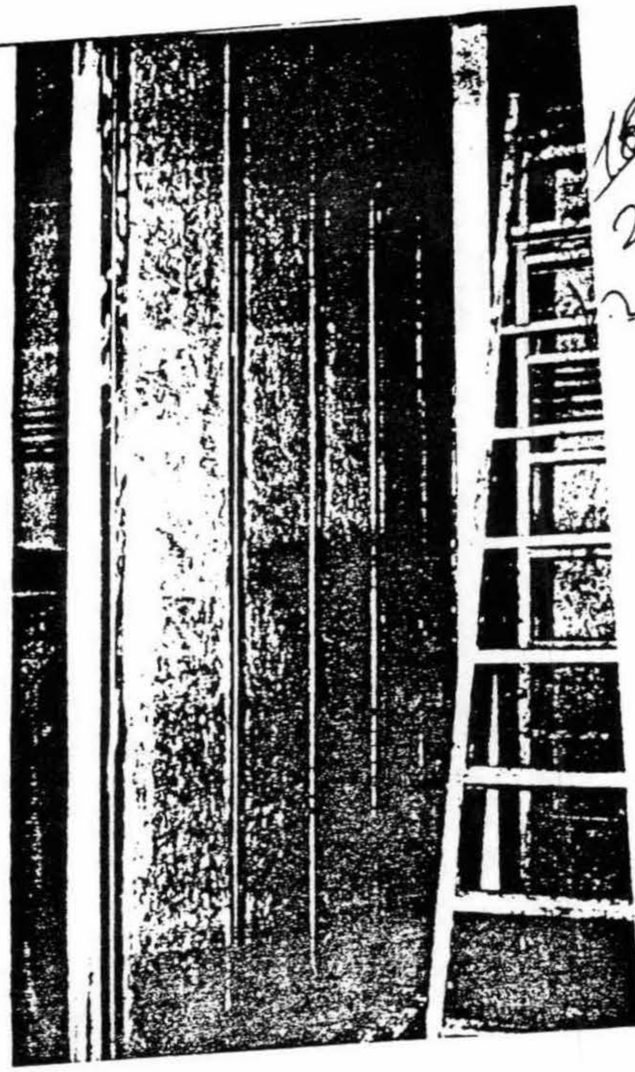
TIEMPO	mm	FLECHA
0'0"	100,6	
10	106,0	5,4
22	120,9	14,9
31	141,0	20,1
40	153,5	12,5
50	158,7	5,2
61	161,1	2,4
68	162,7	1,6
73	163,7	1,0
76	164,2	0,5
80	164,8	0,6
85	165,3	0,5
90	165,6	0,3
95	166,2	0,6
100	166,5	0,3
105	166,9	0,4
110	167,4	0,5
115	168,0	0,6
120	168,8	0,8
125	169,6	0,8

ANEXO IV

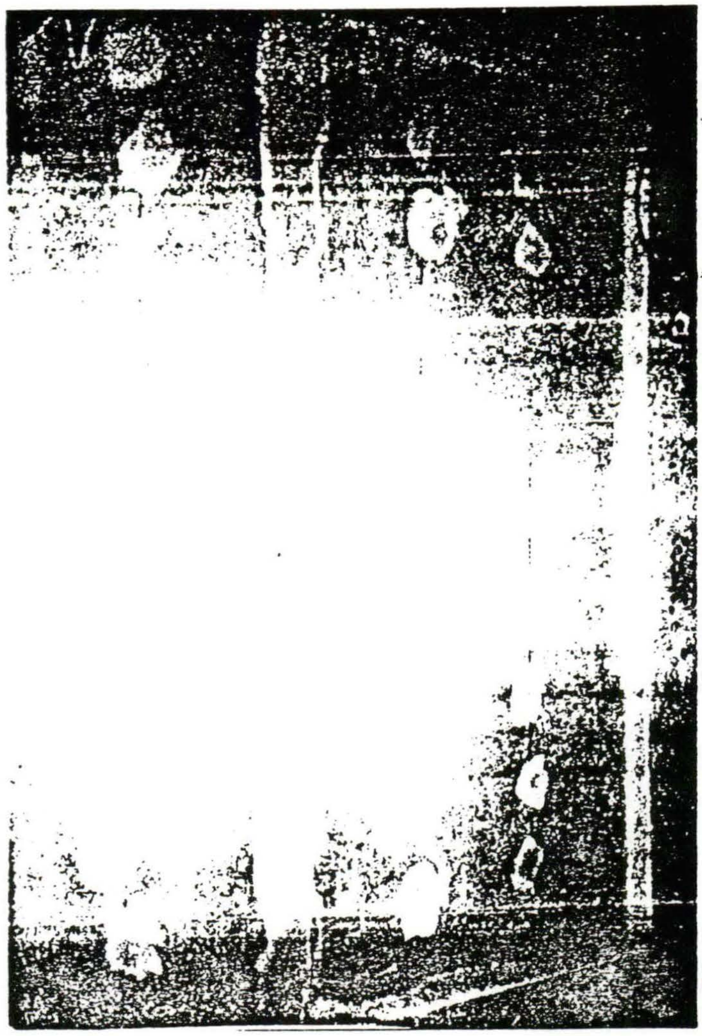
FOTOGRAFIAS



Fotografía nº 1.-
Montaje de la
muestra



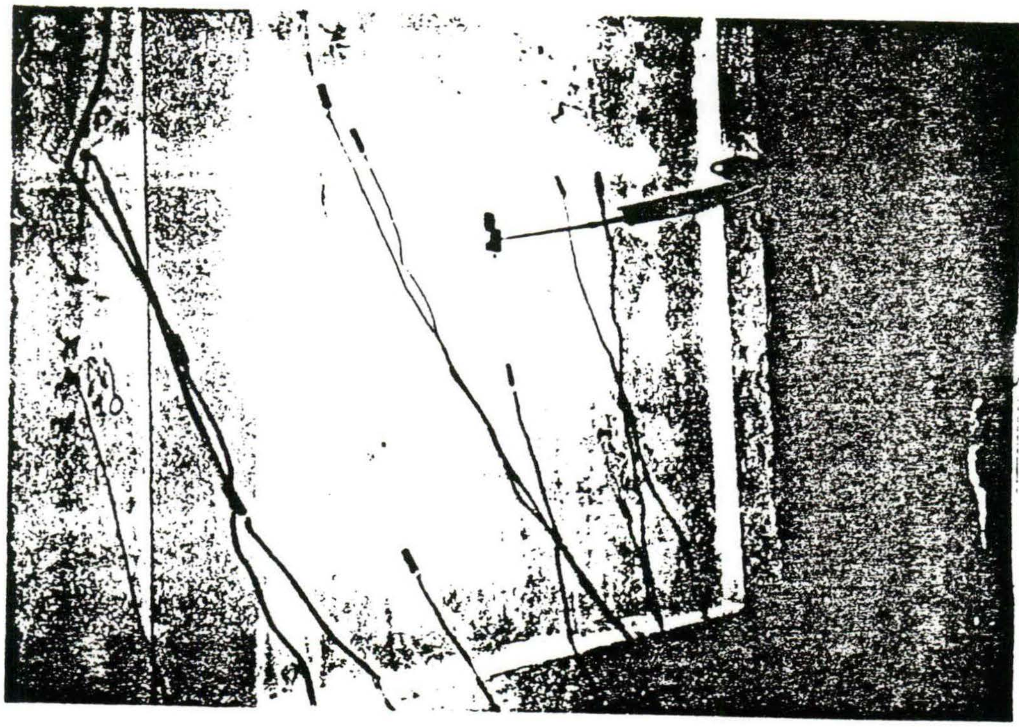
Fotografía nº 2
Otra fase del montaje
de la muestra



Fotografía nº 3
Cara expuesta antes
del ensayo

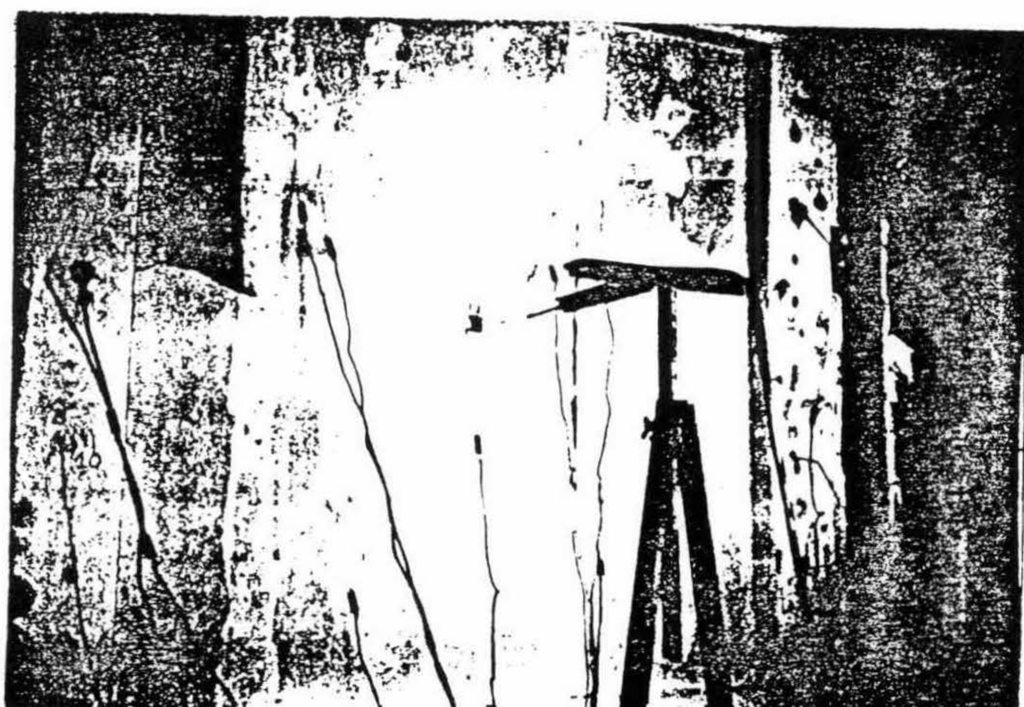
Fotografía nº 4
Cara no expuesta
antes del ensayo

Fotografía nº 5
Distribución termopares
en cara no expuesta

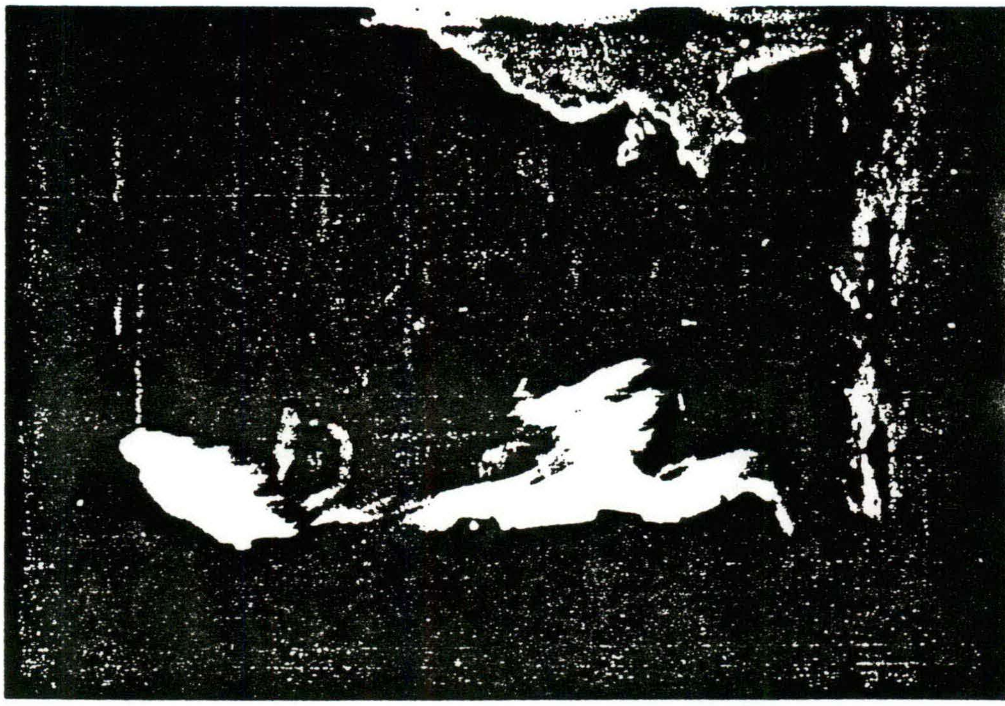


Fotografía nº 6
Sistema medición de-
formación del tabique

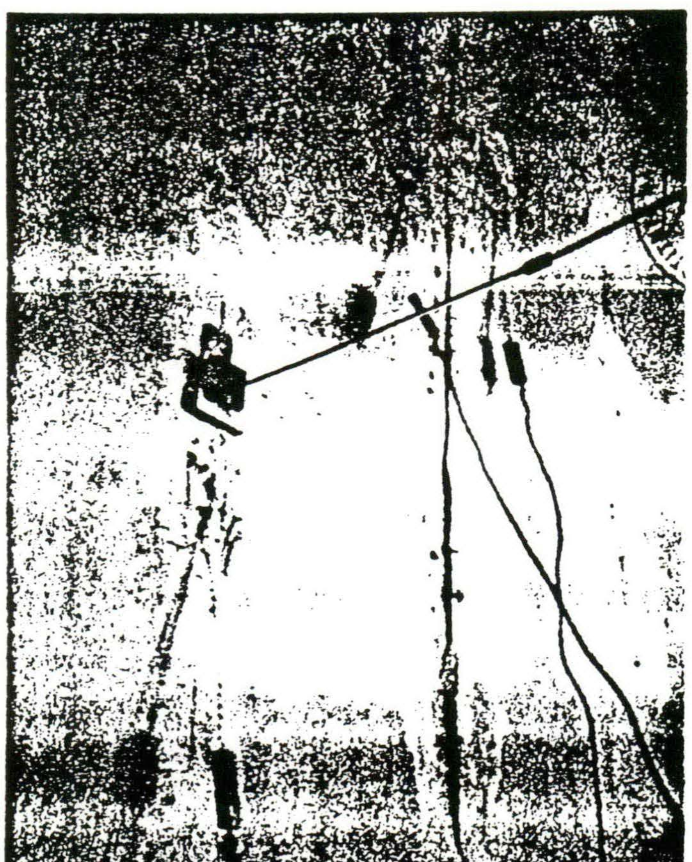
Fotografía nº 7
Comprobación de la inmaflabilidad de los gases



Fótografía nº 8
Fisura en cara no expuesta durante el ensayo

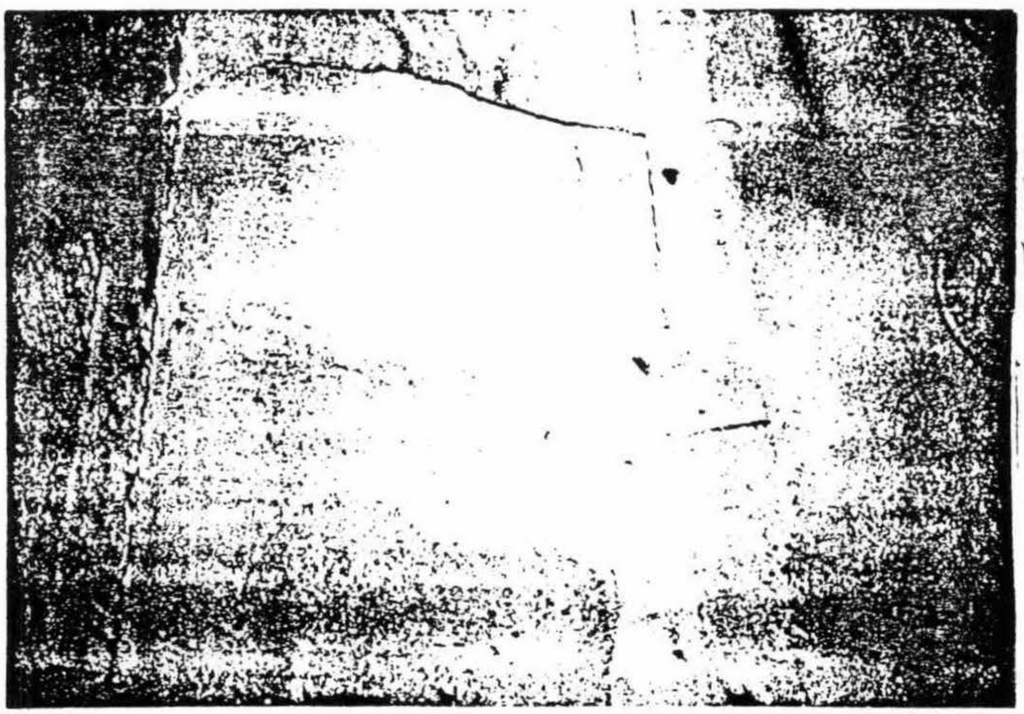


Fotografía nº 9
Cara expuesta durante
el ensayo



Fotografía nº 10
Detalles sensor medi-
ción deformación

Fotografía nº 11
Cara expuesta después
del ensayo



Fotografía nº 12
Cara no expuesta des-
pues del ensayo

OBSERVACIONES SOBRE ENSAYOS A EFECTUAR

1.- IDENTIFICACION

1.1.- Respecto al material o estructura a ensayar

El solicitante deberá aportar al Laboratorio la siguiente información, si desea que figure en el informe final:

a) Memoria descriptiva
b) Croquis de montaje y colocación en el horno, que refleje la que vaya a tener el elemento en la realidad
c) Planos de fabricación o constitución
d) Cuantos datos estime oportunos para la identificación.

1.2.- Respecto al material o estructura a ensayar y su correspondencia

Los ensayos se refieren al material o estructura presentado en el laboratorio, sin que de ello pueda presumirse el comportamiento al fuego de fabricado en serie o puesto en obra.

Es responsabilidad del solicitante la justificación de que el material o estructura presentado en Laboratorio, tiene las mismas características que el fabricado en serie y el presentado en obra o mercado, así como que los datos que aporta para identificarlo corresponden a aquel.

2.- IGNIFUGANTES

El Laboratorio no conoce la duración del efecto de la ignifugación. Los datos de los ensayos se refieren al momento actual.

Mientras no pueda establecerse la correspondencia entre el envejecimiento artificial y el natural, el solicitante podrá conocer la permanencia de la ignifugación ensayando a los 1, 3, 5 y 10 años probetas del mismo lote, siendo de su parte la justificación de ésta última circunstancia.

MINISTERIO DE AGRICULTURA, PESCA Y ALIMENTACION
CENTRO DE INVESTIGACION Y TECNOLOGIA
del
INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS

Departamento de Industrias Forestales

INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS
LABORATORIO DEL FUEGO

FJVP/dg.

INFORME DE RESISTENCIA AL FUEGO DE UN TABIQUE CON PANELES "PROMATECT", SOLICITADO POR PROMAT IBERICA, S.A.

Ref. E 1123

1. ANTECEDENTES

Con fecha 22/11/90, la firma PROMAT IBERICA, S.A., C/ Sagasta, 19, bajo Dcha., 28004 - Madrid, Tfno. (91) 5932740/5932800, FAX (91) 4452412, solicitó al Laboratorio del Fuego del INIA, la realización de un ensayo de Resistencia al Fuego de un tabique, según carta que se transcribe a continuación:

"Muy señores nuestros:

Les rogamos nos confirmen la posibilidad de realizar en su Laboratorio del Fuego, el ensayo de un tabique con Paneles PROMATECT, para protección contra el fuego, según Normas UNE 23, para su homologación.

Sin otro particular, aprovechamos la ocasión para saludarles.

Muy atentamente"

2. INFORME

2.1. Finalidad del ensayo

Determinar en función del método de ensayo preconizado por la Norma UNE 23.093, la resistencia al fuego de un tabique formado por paneles "PROMATECT".

La composición de los materiales ha
sido suministrada por el solicitante y no
comprobada

Avda. del Padre Huidobro, s/n. - 28040 Madrid - Apartado 8.111 - 28080 Madrid
Teléf. (91) 357 22 86 - Telex 47308 INIA E - Fax (91) 357 22 93

2.2.- <u>Descripción de la muestra</u>

La descripción ha sido suministrada por el solicitante, transcribiéndose la misma como sigue:

"El ensayo se realiza en horno vertical de 3,12 x 3,20 m. siendo el resto de superficie de muro compuesto por dos ladrillos de doble hueco de 10 cm. y revestido por ambas caras de yeso, resultando una pared de 24 cm.

Para el montaje del tabique se utilizaron perfiles fabricados en tren de perfilación, a partir de chapa galvanizada, de espesor 0,6 mm, según Norma UNE 36130, y de característica Z250NJ10 (Z define el tipo de estrella del galvanizado, 250 se refiere al número de gramos/m2 del revestimiento de cinc, N define la composición y características del acero base y 10 se refiere a la resistencia de este acero en kg/mm2).

*Para el montaje se utilizaron dos perfiles, marca **PROMAT**, canales de 48 y montantes de 46, montados según plano adjunto.*

*En el interior de los perfiles se colocó un panel de lana mineral de 100 kg/m3, de 40 mm de espesor, denominado **PROMAPIN-40**.*

*Se colocaron por la cara anterior y posterior del tabique placas de **PROMATECT-H** de 12 mm de espesor, atornilladas a los perfiles mediante tornillos autorroscantes de 3,9 x 25.*

*A las juntas de las paneles se les protegió con pasta de juntas **PROMAT**".*

2.3.- <u>Modalidad den ensayo</u>

Se ha realizado aplicando el programa térmico normalizado en UNE 23 093/81, definido por la expresión:

$$T - T_0 = 345 \lg (8t + 1)$$

modelo matemático que representa la elevación de temperatura en el horno en grados centígrados en función del tiempo en minutos.

La composición de los materiales ha sido suministrada [illegible] y no comprobada por este instituto.

2.4. Horno vertical

Está construido con una estructura metálica y ladrillo refractario, siendo el revestimiento interior de material aislante y refractario.

Incorpora tres quemadores de impulsión, de 600.000 Kcal/h cada uno, colocados verticalmente en el lado derecho del horno, de forma que la muestra a ensayar no recibe directamente la acción de la llama.

La regulación térmica del horno se realiza mediante un microprocesador que incorpora el programa térmico normalizado.

El control de temperaturas del horno se consigue mediante termopares situados en su superficie y conectados a un ordenador, efectuándose una medida cada minuto.

Para los ensayos bajo carga está dotado de una prensa de carga máxima 157 Tn.

Una vez establecido el ensayo, el horno funciona en depresión hasta 1/3 de la altura de la losa y en sobrepresión por encima de este punto, tal y como indica el documento EUR 9750. El control y regulación de la presión interior se consigue mediante dos captadores adecuados, según el documento EUR 9750, unidos a un microprocesador que se encarga de la regulación automática del tiro.

La boca útil del horno es de [illegible],10 x [illegible],10 m²

2.5.- Identificación del producto

Es realizada por el solicitante, aportando solamente el nombre comercial de la placa: PROMATECT-H

2.6. Medidas efectuadas

2.6.1. Medidas de temperaturas ambientales del horno

Las medidas de temperatura han sido realizadas por termopares Nickel-Chromel/Nickel-Allié, de soldadura caliente desnuda, hilos de diámetro 0,7 mm y la soldadura realizada en el centro un disco de cobre de 12 mm y 0,2 mm de espesor.

El termopar nº 12 del registrador del cuadro medía temperaturas ambientales del horno (Gráfico nº 1, Anexo II).

2.6.2.- Medidas de temperatura de la muestra

La situación de los termopares en las muestras y su numeración se reflejan en el gráfico nº 2, Anexo II.

2.6.3.- Variaciones dimensionales

Ha sido realizada en el centro de la luz observándose variación de la flecha durante el ensayo.

2.6.4.- Medida de la presión interna del horno

Se ha realizado a 3/4 de la altura de la cámara del horno, habiendo estado regulada a 10 ± 2 pa.

2.7.- Observaciones

2.7.1.- Observaciones antes del ensayo

Fecha de ensayo: 12-12-1990.

Temperatura inicial del laboratorio = 11ºC

(

2.7.2.- Observaciones durante el ensayo

Tiempo	Observaciones
0	Inicio ensayo
22'	Aparición de una pequeña fisura por la cara expuesta al fuego
[illegible]	Las temperaturas registradas por los termopares de la cara no expuesta fueron las siguientes: Termopar nº 1 = 50°C " " 2 - 48°C " " 3 - 45°C " " 4 - 45°C " " 5 - 45°C " " 6 - 50°C " " 7 - 46°C " " 8 - 50°C
[illegible]	Ligero aumento de la fisura detectada a los 22 min.
[illegible]	Lecturas de los termopares Termopar nº 1 - 58°C " " 2 = 57°C " " 3 = 57°C " " 4 - 51°C " " 5 - 56°C " " 6 = 71°C " " 7 - 77°C " " 8 - 69°C
105'	Se abre fisura superficial en zona A (gráfico nº 2. Anexo II). En ella se mide 116°C de temperatura
120'	Termopar nº 1 - 69°C " " 2 - 58°C " " 3 - 60°C " " 4 = 52°C " " 5 = 70°C " " 6 = 85°C " " 7 = 90°C " " 8 = 89°C En la grieta A se mide

	115°C de temperatura
150'	Lectura de termopares Termopar nº 1 = 90°C " " 2 = 70°C " " 3 = 69°C " " 4 = 76°C " " 5 = 79°C " " 6 = 145°C " " 7 = 111°C " " 8 = 113°C Buena estabilidad del tabique. Valor flecha=19 mm.
180'	Las temperaturas registradas por los termopares de la cara no expuesta a las 3 horas de ensayo eran las siguientes: Termopar nº 1 = 103°C " " 2 = 89°C " " 3 = 101°C " " 4 = 83°C " " 5 = 85°C " " 6 = 158°C " " 7 = 119°C " " 8 = 148°C Temperatura en la figura = 121°C Temperatura media= 92,2°C (termopares 1 al 5). Temperatura máxima (Tp6) = 158°C
185'	Buena estabilidad mecánica Flecha máxima = 25 mm FIN DEL ENSAYO POR ACUERDO MUTUO.

La composición de los materiales ha sido suministrada [illegible] y no comprobada por este Instituto.

LABORATORIO DEL FUEGO — INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS

3. CONCLUSIONES Y CLASIFICACION

En base a los resultados, la presente estructura de función separadora, ensayada se puede clasificar como:

=TRES HORAS CORTAFUEGOS, PARALLAMAS Y ESTABLE AL FUEGO=

(RF 180)

Madrid, [illegible] de febrero de [illegible]

EL JEFE DE GRUPO DEL FUEGO	POR EL LABº. DEL FUEGO EL INGENIERO DE MONTES
Fdo. R. Díez Barra	Fdo. F.J. Jiménez Peris

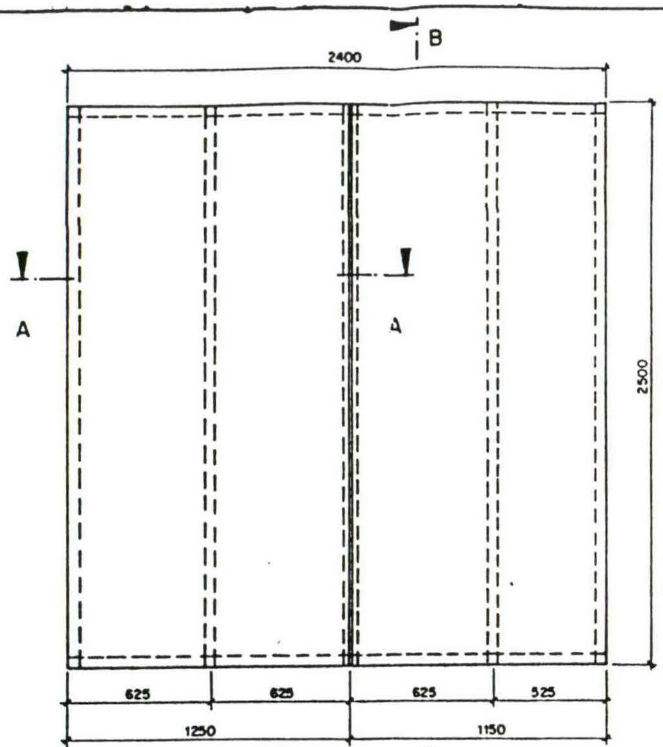
VO. BO.
EL JEFE DEL DEPARTAMENTO DE
INDUSTRIAS FORESTALES

LABORATORIO DEL FUEGO — INSTITUTO NACIONAL DE INVESTIGACIONES AGRARIAS

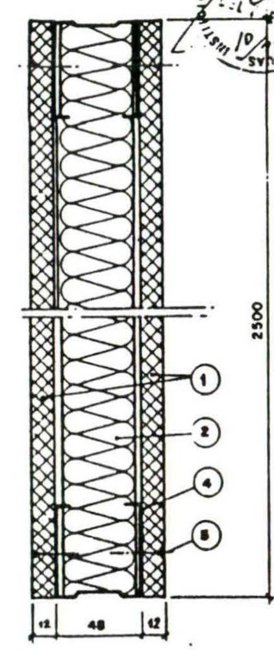
Fdo. [illegible]

NO ES [illegible] LA
[illegible]

La comp[illegible]s ha
[illegible] y no
comprobada por [illegible]

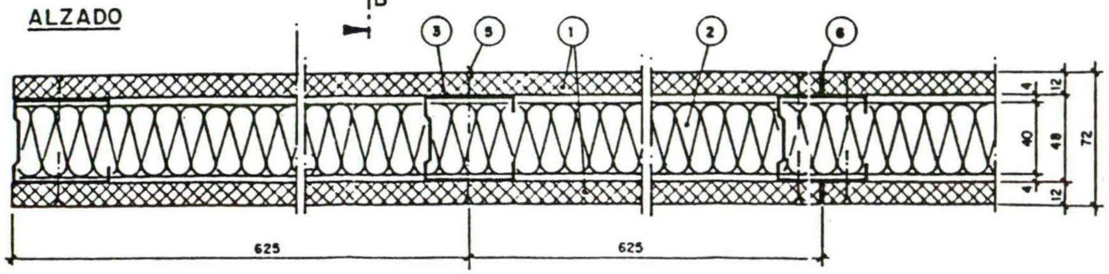


ALZADO



SECCION B-B

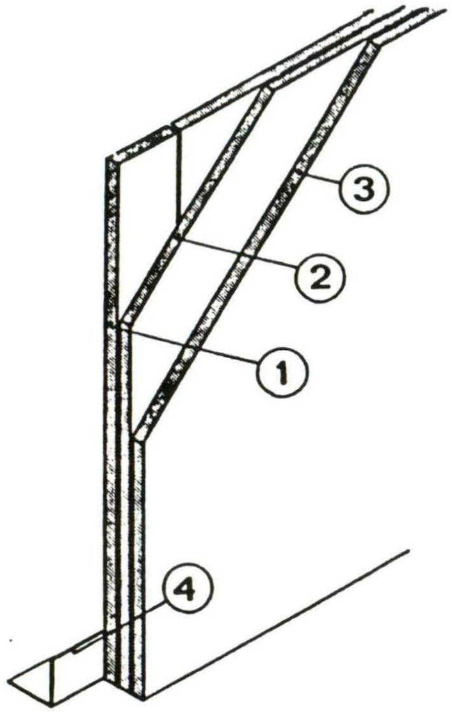
1. PROMATECT - H, d= 12 mm.
2. Lana mineral d= 40 mm. Densidad 100 Kg/m^3
3. Canales de 48/0,6 según UNE-36130.
4. Montante de 46/0,6.
5. Tornillo autorroscante 4,2 x 25.
6. Pasta de juntas PROMAT

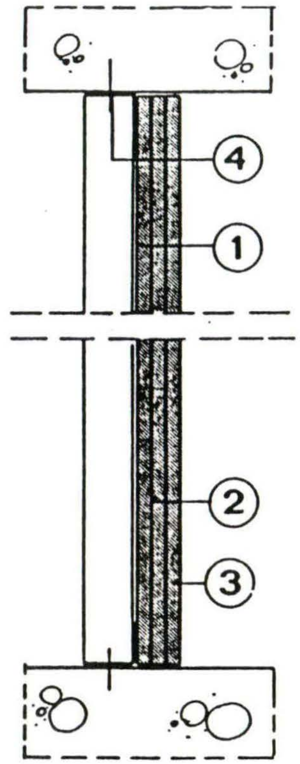


SECCION A-A

Promat	TABIQUE				Oferta Nº:
	Escala: 1:20, 1:2.5	Fecha: 12-11-90	Dibujado:	Grupo:	Pedido Nº:
Promat Ibérica, S.A. Segovia, 16, bajo Dcha. 28004 MADRID Tels.(91) 593 37 40 593 36 00 Fax (91) 445 34 21	- ESPAÑA-				Plano Nº: BW 36.11.90

Tramezzo autoportante - R.E.I. 120





Legenda tecnica

① PROMATECT®H, spessore = 15 mm, fissato su profili metallici a L, con viti di acciaio da 35 mm, a testa fresata, poste ad un interasse di 250 mm.

② PROMATECT®H, spessore = 15 mm, fissato sulla prima lastra per mezzo di viti in acciaio da 25 o 35 mm a testa fresante, poste ad un interasse di 250 mm.

③ PROMATECT®H, 15 mm, fissato sulla seconda lastra per mezzo di viti in acciiao da 25 o 35 mm, a testa fresante, poste ad un interasse di 250 mm.

④ Profilo metallico a L da 50x50x3 mm, fissato alla muratura per mezzo di viti e tasselli in acciaio da 6 x 40 mm, posti ad un interasse di 500 mm

Certificato

I.T.L. 234/1/86 - R.E.I. 120'
PROMATECT®H, 15 + 15 + 15 mm

Descrizione per capitolati

Parete a pannello resistenza al fuoco R.E.I. 120'
Costituita da:
STRUTTURA METALLICA realizzata con profilati metallici zincati aventi spessori pari a mm 3 e più precisamente:

- traverse (profili con sezione ad L aventi dimensioni pari a mm 50 x 50) fissate al pavimento ed al soffitto mediante tasselli metallici,
- montanti (profili con sezione ad L aventi dimensioni pari a mm 50 x 50) fissati alle pareti mediante tasselli metallici.

RIVESTIMENTO realizzato con lastre a base di silicati e a matrice cementizia, esente da amianto, denominata PROMATECT®H ed omologate in classe 0.

Tali lastre, di spessore minimo pari a mm 15, dovranno essere avvitate fra di loro,nel numero di tre, come segue:

- la prima lastra fissata alla struttura metallica a mezzo di viti autosvasanti, con punta a trapano, zincate, ad un interasse di mm 250;
- la seconda lastra fissata alla prima a mezzo di viti autosvasanti zincate, poste ad un interasse di mm 250;
- la terza lastra fissata alla seconda a mezzo di viti autosvasanti zincate, poste ad un interasse di mm 250.

COSTRUZIONI PROMAT
ALCUNE CERTIFICAZIONI UFFICIALI NEL MONDO

LA SCELTA MIGLIORE É SCEGLIERE PROMAT

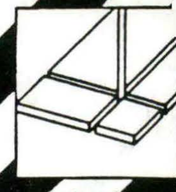
Fire-Rating	Standard	Test Report No.	Test Institute	Country
2-hrs	BS 476	F 87/215	Building R.C.	U.K.
60 minutes	Italian	15871	Instituto Giordano	Italy
90 minutes	Italian	234/3/86	Instituto Giordano	Italy
120 minutes	Italian	12451	Instituto Giordano	Italy
120 minutes	Italian	234/4/86	Inst. Tec. del Legno	Italy
180 minutes	Italian	22226	Instituto Giordano	Italy
90 minutes	France	86.23.313	CSTB	France
2-hrs	France	86.23.315	CSTB	France
1 1/2 hrs	ASTM E119	Design U471	U.L. Northbrook	U.S.A.
30 minutes	N B N	3298	R.U.G.	Belgium
60 minutes	N B N	3872	R.U.G.	Belgium
2-hrs	N B N	3891	R.U.G.	Belgium
30 minutes	NEN 3884	B-80-379	T.N.O.	Netherlands
60 minutes	NEN 3884	82-BV-3813	T.N.O.	Netherlands
90 minutes	NEN 3884	82-BV-2880	T.N.O.	Netherlands
120 minutes	NEN 3884	B-82-736	T.N.O.	[illegible]
2-hrs	France	86.23.314	CSTB	[illegible]
4-hrs	France	86.23.314	C[illegible]	[illegible]
30 minutes	DIN 4102	42771/[illegible]	[illegible]	[illegible]
30 minutes	DIN 4102	[illegible]	[illegible]	[illegible]
30 + 90 min	D[illegible]	[illegible]	[illegible]	F.R.G.
up to 90 [illegible]	[illegible]	[illegible]	[illegible]ick	F.R.G.
[illegible]	[illegible]	[illegible]	FIRTO	U.K.
[illegible]	[illegible]	[illegible]177	Warrington R.C.	U.K.
[illegible]	[illegible]	WRC 34780	Warrington R.C.	U.K.
[illegible]	BS 476	WRC 38435	Warrington R.C.	[illegible]
[illegible]	BS 476	WRC 34229	Warrin[illegible]	[illegible]
2-h[illegible]	BS 476	BRE letter	[illegible]	[illegible]
1-hr	France	84.21[illegible]	[illegible]	[illegible]
2-hrs	France	[illegible]	[illegible]	[illegible]ance
30 minutes	N B N	[illegible]	[illegible]U[illegible]	[illegible]
60 [illegible]	[illegible] B N	[illegible]	[illegible]UG	[illegible]
[illegible]	[illegible]N	[illegible]	[illegible]UG	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]UG	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]UG	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]RADA	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]RE	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]UG	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]UG	[illegible]
[illegible]	N[illegible]	[illegible]	[illegible]UG	[illegible]
[illegible]	NEN	[illegible]	[illegible]NO	Netherlands
[illegible]	NEN	[illegible]	[illegible]NO	Netherlands
[illegible]	CSTB	[illegible]	CSTB	France
[illegible] hr	BS 476	[illegible]GG	B.R.E.	U.K.
[illegible] hr	BS 476	FRO 430/25	B.R.E.	U.K.
[illegible]/2 hr	BS 476	TE 5767	FIRTO	[illegible]
[illegible] to 1 hr	BS 476	FRO 430/25	B.R[illegible]	[illegible]
[illegible]p to 1 hr	BS 476	MRR/GG	[illegible]	[illegible]
[illegible]p to 1 1/2 hr	BS 476	[illegible]	[illegible]	[illegible]
[illegible]p to 2-hrs	BS [illegible]	[illegible]	[illegible]	[illegible]
[illegible]p to 2 [illegible]	[illegible]	[illegible]	[illegible]	U.K.
[illegible]	[illegible]	[illegible]	[illegible]RE	U.K.
[illegible]	[illegible]	[illegible] 88	B.R.E.	U.K.
[illegible]	[illegible]	FRO 430 F 88	B.R.E.	U.K.
[illegible]	[illegible]476	TE 6371	FIRTO	U.K.
[illegible]	BS 476	CC10403 RHE	Loss Prev Council	U.K.
[illegible]	BS 476	FRO 430/25	B.R.E.	U.K.
[illegible]	BS 476	FRO A 747	B.R.E.	U.K.
[illegible] to 2-hrs	BS 476	WRCS/ 34999	Warrington R.C	U.K.
[illegible] to 2-hrs	BS 476	MRR/6G	B.R.E	U.K.
[illegible]hr	ASTM E119	Design U306	U.L. Northbrook	U.S.A.
[illegible]hrs	[illegible]STM E119	Design U036	U.L. Northbrook	U.S.A.
[illegible] minutes	[illegible] 4102	44553/1	EMPA Dübendorf	CH/F.R.G.
[illegible] minutes	[illegible]EN 3884	85-BV-2508	T N O	Netherlands
[illegible] - 180 min	DIN 4102	85 1242	TU Brunswick	F R G
[illegible] minutes	DIN 4102	42771/3	EMPA Dübendorf	CH/F.R.G.
[illegible] to 4-hrs	BS 476	WRC 38476	Warrington R.C.	U.K.
[illegible] to 2-hrs	BS 476	FRO A 747 GG	Warrington R.C	U.K.
[illegible] to 4-hrs	BS 476	FRO A 747 RQ	B.R.E	U.K.
[illegible] to 4-hrs	BS 476	FRO A 747 GG	B.R.E	U.K.
[illegible]hrs	N B N	5058	N B N	Belgium
[illegible]0 minutes	Italian	89/1/87	I.T.L.	Italy
[illegible]0 minutes	Hydrocar	B-89-024	T.N.O	Netherlands

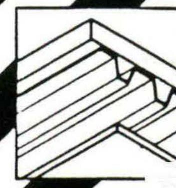
[illegible]minutes	DIN 4102	231222884-1	MPA Dortmund	F.R.G.
[illegible]minutes	DIN 4102	230630385-1	MPA Dortmund	F.R.G.
[illegible]minutes	DIN 4102	230467480	MPA Dortmund	F.R.G.
[illegible]minutes	DIN 4102	230467480	MPA Dortmund	F.R.G.
[illegible]minutes	DIN 4102	230620382	MPA Dortmund	F.R.G.
[illegible]minutes	DIN 4102	230466880	MPA Dortmund	F.R.G.
[illegible] to 4-hrs	BS 476	WRC 37767	Warrington R.C	U.K.
[illegible] to 4-hrs	BS 476	TE 5916	Warrington R.C	U.K.
[illegible] to 4-hrs	BS 476	WRC C 43561	Warrington R.C	U.K.
[illegible] to 4-hrs	BS 476	TE 5917	Warrington R.C	U.K.

Construction	Fire-Rating	Standard	Test Report No.	Test Institute	Country
Ventilation duct for kitchen extraction	up to 4-hrs	BS 476	WRC C 42071	Warrington R.C.	U.K.
Ventilation duct self-supporting	up to 4-hrs	BS 476	BRE letter	Building R.C.	U.K.
Ventilation duct	2-hrs	BS 476	FRO FT 86/85	Building R.C.	U.K.
Cable tray 4" x 24" with 12% fill	1 + 3-hrs	ANI/MAERP	01-2298-001	Southwest R.I.	U.S.A.
Cable tray 4" x 24" with 0% fill	1 + 3-hrs	ANI/MAERP	01-2298-001	Southwest R.I.	U.S.A.
Conduit 1" with 2 x 1" Promat-H	ANI/MAERP	01-2298	001	Southwest R.I.	U.S.A.
Airdrops with 2 x 1" Promat H	1-hr	ANI/MAERP	01-2298-001	Southwest R.I.	U.S.A.
Cable tray 4" x 24" with Promat-L	3-hrs	ANI/MAERP	8806-88005	Omega Point Lab	U.S.A.
Cable tray 4" x 2" with Promat-H/-L	3-hrs	ANI/MAERP	8806-88005	Omega Point Lab	U.S.A.
Conduit with Promat-L, Promat-H	3-[illegible]	[illegible]MAERP	8806-88005	Omega Point Lab	U.S.A.
Free standing cond. with Prom[illegible]	[illegible]	[illegible]AERP	8806-88005	Omega Point Lab	U.S.A.
Airdrop with 3 layers [illegible]	[illegible]	[illegible]ERP	8806-88005	Omega Point Lab	U.S.A.
Ampacity [illegible]	[illegible]	[illegible]	8806-88005	Omega Point Lab	U.S.A.
[illegible]	[illegible]	[illegible]	8806-88005	Omega Point Lab	U.S.A.
[illegible]	[illegible]minu[illegible]	[illegible]	230467480	T.N.O.	Belgium
[illegible]al duct	60 minutes	[illegible]	230466880	T.N.O.	Belgium
[illegible]-supporting	60 minutes	[illegible]	[illegible]30620382	T.N.O.	Belgium
[illegible] duct self-supporting	2-hrs	[illegible]	[illegible]30473079	T.N.O.	Belgium
Ventilation duct self-supporting	30 minutes	[illegible]	[illegible]467480	T.N.O.	Belgium
Ventilation duct self-supporting	60 minutes	[illegible]	[illegible]66880	T.N.O.	Belgium
Ventilation duct with sheet metal duct	30 + 60 min.	D[illegible]	[illegible]1056	T N O	Netherlands
Ventilation duct [illegible]	60 + 120 min.	Du[illegible]	[illegible]055	T N O	Netherlands
Venti[illegible]	[illegible]minutes	Dutc[illegible]	[illegible]150	T N O	Netherlands
[illegible]	[illegible]	France	[illegible]	CTICM	France
[illegible]	[illegible]	France	[illegible]	CTICM	France
[illegible]	[illegible]	France	[illegible]	CSTB	France
[illegible]test L)	[illegible]	France	[illegible]	CSTB	France
[illegible]test L)	[illegible]	France	[illegible]	CSTB	France
[illegible]test L)	[illegible]	France	[illegible]	CSTB	France
5 EL[illegible]TS					
Cab[illegible]	[illegible]	DIN 4102	8[illegible]	[illegible] Brunswick	F.R.G.
Cab[illegible]	[illegible]in	DIN 4102	86[illegible]	[illegible]Brunswick	F.R.G.
Cable d[illegible]	[illegible]	BS	FRO[illegible]	[illegible]ng R.C.	U.K.
[illegible]	[illegible] to 120 min	[illegible]	B-84-[illegible]	[illegible]	Netherlands
[illegible]duc[illegible]	up to 60 min	[illegible]	B-85-1[illegible]	[illegible]	Netherlands
[illegible]ucti[illegible]side	up to 120 min.	[illegible]	[illegible]	[illegible]	Netherlands
[illegible] PROMATECT®-H	30/60 min	N B[illegible]	[illegible]	[illegible]	Belgium
Penetration PROMATECT®-H	60 min[illegible]	[illegible]	[illegible]	[illegible]	Belgium
Penetration PROMATECT®-H	[illegible]	[illegible]	[illegible]	[illegible]UG	Belgium
Penetration PROMATECT[illegible]	[illegible]	[illegible]	[illegible]	R.U.G.	Belgium
Penetration PRO[illegible]	[illegible]	[illegible]	3997	R.U.G.	Belgium
PRO[illegible]	[illegible]	[illegible]B N	4985	R.U.G.	Belgium
[illegible]					
[illegible]ystem	90 minutes	DIN 4102	337/3238	TU Brunswick	F.R.G.
[illegible] Collar System	90 minutes	DIN 4102	577/3262	TU Brunswick	F.R.G.
[illegible]STOP® Pipe Collar System	90 minutes	DIN 4102	2067/3414	TU Brunswick	F.R.G.
PROMASTOP® Pipe Collar System	up to 2-hrs	BS 476	TE 6701	FIRTO	U.K.
PROMASTOP® Pipe Collar System	up to 2-hrs	BS 476	TE 6702	FIRTO	U.K.
PROMASTOP® Bulkhead Sys.,Type A	2-hrs	BS 476	FRO letter	Building R.C	U.K.
PROMASTOP® Bulkhead Sys.,Type D	90 minutes	DIN 4102	1986/3169	TU Brunswick	F.R.G.
PROMASTOP® Bulkhead Sys.,Type D	90 minutes	DIN 4102	1986/3170	TU Brunswick	F.R.G.
PROMASTOP®-Cable Block	90 minutes	DIN 4102	23 0795 788	MPA Dortmund	F.R.G.
Fire stop system for plastic pipes	180 minutes	Italian	23816	I.G.	Italy
-"- for electric cables (Mortar)	180 minutes	Italian	23872	I.G.	Italy
-"- for electric cables (Mineral wool)	180 minutes	Italian	23872	I.G.	Italy
-"- for electric cables (Brick)	180 minutes	Italian	23872	I.G.	Italy
7 PROMAGLAS®					
PROMAGLAS® F 30	30 minutes	DIN 4102	Z 19 14-269	IfBt Berlin	F.R.G.
Steel frame glazing partition	30 minutes	DIN 4102	23 1032 086	MPA Dortmund	F.R.G.
In timber stud partition	30/60 min	N B N	30017-085	U.L.G.	Belgium
8 PROMA-XIT®					
Ventilation brick in structural wall	30 - 120 min	DIN 4102	84 058	TU Brunswick	F.R.G.
Ventilation brick in partitions	30 - 120 min.	DIN 4102	85 354	TU Brunswick	F.R.G.
Ventilation brick in walls	30 - 120 min.	DIN 4102	2218/8570	TU Brunswick	F.R.G.
Ventilation brick in partitions	30 - 90 min	DIN 4102	2218/8570	TU Brunswick	F.R.G.
Joint Sealants	90 - 180 min	DIN 4102	85 035	TU Brunswick	F.R.G.
9 SPECIAL CONSTRUCTIONS					
Protective Box for Roof Lamps	120 minutes	Italian	25244	I.G.	Italy
Removable PROMATECT®-H	30 minutes	N B N	3998	R.U.G.	Belgium
Removable PROMATECT®-H	60 minutes	N B N	3999	R.U.G.	Belgium
Quick-fix-fasteners PROMATECT®-H	30 minutes	N B N	35-248	U.L.G.	Belgium
Quick-fix-fasteners PROMATECT®-H	60 minutes	N B N	5671	R.U.G.	Belgium
Glas PROMATECT®-H	30 minutes	N B N	35-248	U.L.G.	Belgium
Glas PROMATECT®-H	60 minutes	N B N	35-248	U.L.G.	Belgium
Access door PROMATECT®-H	60 minutes	N B N	33-239	U.L.G.	Belgium
Pipe Penetrations PROMATECT®-H	120 minutes	N B N	32242177	U.L.G.	Belgium
Parapet	120 minutes	NEN 3884	B-83-373	T.N.O.	Netherlands
Chimney for open fireside	120 minutes	NEN 3884	85-BV-1258	T.N.O.	Netherlands
Chimney for closed central heating	120 minutes	NEN 3884	B-84-614	T.N.O.	Netherlands

All information has been compiled to the best of our knowledge
Errors and omissions cannot be excluded

Promat


Controso[illegible]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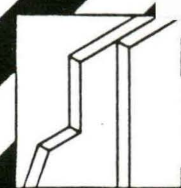
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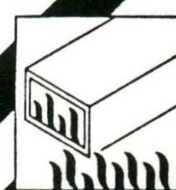
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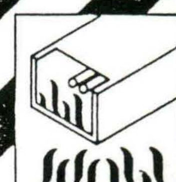
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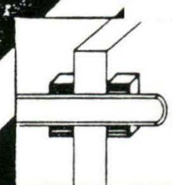
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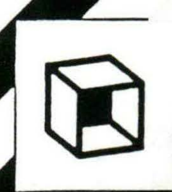

[illegible]plicazio[illegible]li

Columns (PROMATECT®-H)	up to 4-hrs	ASTM E119	X 309	Underwriters Lab.	U.S.A.
Columns (PROMATECT®-L)	up to 4-hrs	ASTM E119	X 310	Underwriters Lab.	U.S.A
Columns (PROMATECT®-H)	up to 4-hrs	N B N	3877	R.U.G.	Belgium
Columns (PROMATECT®-L)	up to 4-hrs	N B N	3014	R.U.G.	Belgium
Columns (PROMATECT®-H)	up to 4-hrs	NEN 3884	B-84-342	T.N.O	Netherlands
Columns (PROMATECT®-L)	up to 4-hrs	NEN 3884	B-79-224	T.N.O.	Netherlands
Columns (PROMATECT®-H)	up to 2-hrs	CSTB	86.24.124	CSTB	France
Columns (PROMATECT®-H)	30 minutes	Norwegian	156-042,	Sintef, Trondheim	Norway
Columns (PROMATECT®-H)	60 minutes	Norwegian	156-042,	Sintef, Trondheim	Norway
Columns (PROMATECT®-H)	90 minutes	Norwegian	156-042,	Sintef, Trondheim	Norway
Columns (PROMATECT®-L)	60 minutes	Norwegian	156-043,	Sintef, Trondheim	Norway
Columns (PROMATECT®-L)	90 minutes	Norwegian	156-043,	Sintef, Grondheim	Norway
Columns (PROMATECT®-L)	120 minutes	Norwegian	156-043,	Sintef, Trondheim	Norway
b) Beams (PROMATECT®-H)	up to 3-hrs	DIN 4102	82 549,	TU Brunswick	F.R.G.
Beams (PROMATECT®-L)	up to 3-hrs	DIN 4102	782044,	TU Brunswick	F.R.G.
Beams (PROMATECT®-H)	up to 2-hrs	BS 476	WRC 35024,	Warrington R.C.	U.K.
Beams (PROMATECT®-L)	up to 4-hrs	BS 476	WRC 35564,	Warrington R.C.	U.K.
Promalit	up to 4-hrs	BS 476	WRCI 31224,	Warrington R.C.	U.K.
Beams (PROMATECT®-H)	up to 4-hrs	N B N	B 80-373	T N O	Belgium
Beams (PROMATECT®-L)	up to 4-hrs	N B N	3501	R.U.G.	Belgium
Beams (PROMATECT®-H)	up to 4-hrs	NEN 3884	B-84-342	T.N.O.	Netherlands
Beams (PROMATECT®-L)	up to 4-hrs	NEN 3884	B-79-244	T.N.O.	Netherlands
PROMAPYR®-400	up to 4-hrs	NEN 3884	B-83-144	T.N.O.	Netherlands
PROMAPYR®-400 + glue	up to 4-hrs	NEN 3884	B-83-144	T.N.O.	Netherlands
Beams (PROMATECT®-H)	90 minutes	Italian	12712/A	I.G.	Italy
Beams (PROMATECT®-L)	120 minutes	Italian	12712/B	I.G.	Italy
Wood. beam Prot. PROMATECT®-L	180 minutes	Italian	15836	I.G.	Italy
Beams (PROMATECT®-L)	up to 2-hrs	CTSB	86.24.124	CSTB	France
Beams (PROMATECT®-H)	30 minutes	Norwegian	156-042,	Sintef, Trondheim	Norway
Beams (PROMATECT®-H)	60 minutes	Norwegian	156-042,	Sintef, Trondheim	Norway
Beams (PROMATECT®-H)	90 minutes	Norwegian	156-042,	Sintef, Trondheim	Norway
Beams (PROMATECT®-L)	60 minutes	Norwegian	156-043,	Sintef, Trondheim	Norway
Beams (PROMATECT®-L)	90 minutes	Norwegian	156-043,	Sintef, Grondheim	Norway
Beams (PROMATECT®-L)	120 minutes	Norwegian	156-043,	Sintef, Trondheim	Nor[illegible]
Beams (PROMATECT®-H)	1 - 3 hrs	ASTM E 119	Design U 306	U.L. Northbro[illegible]	[illegible]

EILINGS AND ROOFS

a) Timber Joist Ceiling	30 minutes	DIN 4102	23088[illegible]	[illegible]	[illegible]
Timber Joist Ceiling	60 minutes	DIN 4102	[illegible]	[illegible]	[illegible]
Timber Joist Ceiling	90 minutes	[illegible]	[illegible]	[illegible]	CH/F.R.G.
Timber Joist Ceiling	up to [illegible]	[illegible]	[illegible]	[illegible]nswick	F.R.G.
Timber Joist Roofs	[illegible]	[illegible]	[illegible]	TU Brunswick	F.R.G.
Timber Joist Roofs	[illegible]	[illegible]	[illegible]67	TU Brunswick	F.R.G.
Timber Joist Ceiling	[illegible]	[illegible]	WRC 34456	Warrington R.C.	U.K.
Timber Joist Ceiling	[illegible]	BS 476	TE 5775	FIRTO	U.K.
Timber Joist Ceiling	[illegible]nutes	BS 476	FR 1055	TRADA	U.K.
Timber Joist Ceiling	[illegible]0 min.	BS 476	FR 6056	[illegible]	U.K.
Timber Joist Ceiling	[illegible] hr	BS 476	War[illegible]	[illegible]	U.K.
Timber Joist Ceiling	[illegible] hr	BS 476	F 87[illegible]	[illegible]	U.K.
Timber Joist Ceiling (upgr. fr. a[illegible]	[illegible]	BS 476	FRO[illegible]	[illegible]	[illegible]K.
Timber Joist Ceiling (upgr. fr. abo[illegible]	[illegible]	BS 476	FRO[illegible]	[illegible]	[illegible]
Timber Joist Ceiling (upgr. fr. above[illegible]	[illegible]	BS 476	Warr[illegible]	[illegible]	[illegible]
Timber Joist Ceiling (upgr. fr. above)	[illegible]	BS 476	FRO [illegible]	[illegible]	[illegible]
Timber Joist Ceiling (upgr. fr. above)	[illegible]	[illegible]S 476	FRSA[illegible]	[illegible]	[illegible]
Timber Joist Ceiling (upgr. fr. below)	[illegible]	[illegible] 476	Warr[illegible]	[illegible]	[illegible]
Timber Joist Floor	3[illegible]	[illegible]N	BV 80[illegible]	[illegible]	[illegible]
Timber Joist Floor	60[illegible]	[illegible]	BV 79[illegible]	[illegible]	[illegible]
Timber Joist Floor	120[illegible]	[illegible]	BV 80[illegible]	[illegible]	B[illegible]
Timber Joist Floor	60 m[illegible]	[illegible]	3994	[illegible]	Belgium
Timber Joist Floor	30 min[illegible]	[illegible]	B-80-[illegible]	[illegible]	Belgium
Timber Joist Floor	60 minu[illegible]	[illegible]	B 81-[illegible]	[illegible]O.	Belgium
Timber Joist Floor	60 minute[illegible]	[illegible]	4853	R.U.G.	Belgium
Timber Joist Floor	60 minutes	[illegible]	4739	R.U.G.	Belgium
Timber Joist Floor	30 minutes	[illegible]	[illegible]B 80-374	T.N.O.	[illegible]
Timber Joist Floor	30 minutes	[illegible]	[illegible]988	R U G	[illegible]
Timber Joist Roof	30 minutes	[illegible]	[illegible]71	[illegible]	[illegible]
Timber Joist Roof	60 minutes	N[illegible]	[illegible]	[illegible]	[illegible]
Timber Joist Ceiling	up to 3-hrs	Fra[illegible]	[illegible]	[illegible]	[illegible]
Ceiling on wooden frame	180 minutes	Italia[illegible]	[illegible]	[illegible]	Italy
Nobranda/Promina	30 minutes	NEN 3[illegible]	[illegible]	[illegible]	Netherlands
PROMATECT®-H	30 minutes	NEN 38[illegible]	[illegible]	T.N.O.	Netherlands
PROMATECT®-H upside timber	30 minutes	NEN 3884	[illegible]-374	T.N.O.	Netherlands
PROMATECT®-H between beams	30 minutes	NEN 3884	B-80-376	T.N.O.	Netherlands
PROMATECT®-H between beams	60 minutes	NEN 3884	B-81-129	T.N.O.	Netherlands
PROMATECT®-H	60 minutes	NEN 3884	B-79-219	T.N.O.	Netherlands
PROMATECT®-H	120 minutes	NEN 3884	B-80-375	T.N.O.	Netherlands
PROMATECT®-H fire on upside	60/90 min.	NEN 3884	B-84-140	T.N.O.	Netherlands
Nobranda/Promina + plaster	60 minutes	NEN 3884	B-84-5	T.N.O.	Netherlands

Lay-in Ceiling, fire from below	30 minutes	DIN 4102	230525480-2	MPA L
Suspended Ceiling fire from below	90 minutes	DIN 4102	230654076-1	MPA D
Suspended Ceiling fire from above	90 minutes	DIN 4102	230551381	MPA D
Suspended Ceiling fire from below	60 minutes	Norwegian	156-044	Sintef,
Suspended Ceiling fire from below	90 minutes	Norwegian	156-045	Sintef,
Lay-in Ceiling	90 minutes	DIN 4102	230590080	MPA D
Lay-in Ceiling with visible grid system	30 minutes	DIN 4102	851106	TU Br.
Lay-in Ceiling with visible grid system	90 minutes	DIN 4102	84 1106	TU Br.
Suspended Ceiling	30 minutes	BS 476	WRC 36739	Warrin
Suspended Ceiling	60 minutes	BS 476	WRC 37128	Warrin
Suspended Ceiling	120 minutes	BS 476	TE 5763	FIRTO
Suspended Ceiling uninsulated	120 minutes	BS 476	BRE F 87/216	Buildir
Suspended Ceiling	120 minutes	Italian	12290	I.G.
Suspended Ceiling	120 minutes	Italian	25024	I.G.
Suspended Ceiling (Lay-in ceiling)	30 minutes	N B N	4887	R.U.G.
Suspended Ceiling (Lay-in ceiling)	60 minutes	N B N	4987	R.U.G.
Suspended Ceiling (Lay-in ceiling)	60 minutes	N B N	3993	R.U.G.
Suspended Ceiling	up to 1/2 hr	BS 476	Warres 367739	Warrin
Suspended Ceiling	up to 1/2 hr	BS 476	FRO 430 MRR	B.R.E.
Suspended Ceiling	up to 1-hr	BS 476	FRO 430 MRR	B.R.E.
Suspended Ceiling	up to 1-hr	BS 476	FRO 430 MRR	B.R.E.
Suspended Ceiling	up to 1 1/2 hr	BS 476	TE 5700	FIRTO
PROMATECT®-L (independ. ceiling)	30 minutes	N B N	4239	R.U.G.
PROMATECT®-L (independ. ceiling)	60 minutes	N B N	4740	[illegible]
PROMATECT®-L (independ. ceiling)	120 minutes	N B N	5163	[illegible]
Lay-in Ceiling	60 minutes	NEN 3884	[illegible]	[illegible]
Suspended Ceiling	60 minutes	NE[illegible]	[illegible]	[illegible]
Tunnel Ceiling	120 m[illegible]	[illegible]	[illegible]	[illegible]
Tunnel Ceiling	[illegible]	[illegible]	[illegible]	T.N.O.
Metal pan ceiling fire fr[illegible]	[illegible]	[illegible]	[illegible]38	TU Bru
Metal pan cei[illegible]	[illegible]	[illegible]	85 355	TU Brur
Meta[illegible]	[illegible]	DIN 4102	85 970	TU Bru
[illegible]	[illegible]minutes	DIN 4102	85 1169	TU Br
[illegible]elow	30 minutes	DIN 4102	86 813	[illegible]
[illegible] above/below	30 minutes	DIN 4102	1086/[illegible]	[illegible]
[illegible]ceiling fire from above	30 minutes	DIN 4102	2047/3[illegible]	[illegible]
[illegible]esign ceiling fire from above	30 minutes	[illegible]	587/326[illegible]	[illegible]
c) Trapezoidal metal roof	up[illegible]	[illegible]	[illegible]5	[illegible]
Trapezoidal metal roof	[illegible]	[illegible]	[illegible]	[illegible]
Trapezoidal metal roof	[illegible]	[illegible]	[illegible]	[illegible]
Trapezoidal metal roof	[illegible]	DIN 4[illegible]	[illegible]	[illegible]
[illegible]etal ro[illegible]	[illegible]	DIN 41[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]B[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	F[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	R.[illegible]
[illegible]oidal me[illegible]	[illegible]	[illegible]	5553	R.U[illegible]
[illegible]e ceili[illegible]	[illegible]	[illegible]gian	156-044	Sinte[illegible]
[illegible]	90[illegible]	[illegible]an	156-045	Sintef,
[illegible]	90 [illegible]	[illegible]	156-056	Sintef,

[illegible]ALLS

[illegible]	30 min[illegible]	DIN 4102	41 409/1	EMPA D
[illegible]	90 minutes	DIN 4102	41 409/2	EMPA[illegible]
[illegible]	90 minutes	DIN 4102	230660076	[illegible]
[illegible]	60 + 90 min.	BS 476	BR[illegible]	[illegible]
[illegible]tion	2-hrs	BS 476	[illegible]	[illegible]
Solid partition	up to 4-hrs	[illegible]	[illegible]	[illegible]
Solid partition	1[illegible]	[illegible]	[illegible]	[illegible]G.
Solid partition	[illegible]	[illegible]	[illegible]	R.U.G.
Solid partition	[illegible]	[illegible]	B-80-381	T.N.O.
Solid pa[illegible]	[illegible]	[illegible]3885	B-80-74	T.N.O.
[illegible]	[illegible]	NEN 3885	B-82-523	T.N.O.
[illegible]	30 minutes	NEN 3884	82-BV-3814	T.N.O.
[illegible]	60 minutes	NEN 3884	B-80-249	T.N.O.
[illegible]	60 minutes	Italian	234/2/86	I.T.L.
[illegible]artition	2-hrs	Italian	234/1/86	I.T.L.
Solid partition	3-hrs	Italian	128/84	I.T.L.
Solid partition	2-hrs	France	86.23.313	CSTB
Solid partition	3-hrs	France	86.23 313	CSTB
Solid Wall	1 1/2 hrs	ASTM E119	Design U471	U.L. No
Solid Wall	2-hrs	ASTM E119	Design U523	U.L. Nor
Internal partition (Steel Stud)	90 minutes	DIN 4102	42 771/1	EMPA D
Internal partition (Steel Stud)	30 minutes	DIN 4102	42 771/3	EMPA D
Internal partition (Steel Stud)	90 minutes	DIN 4102	230654778	MPA Do
Internal partition (Steel Stud)	30 minutes	BS 476	BRE letter	Buildin
Internal partition (Steel Stud)	60 minutes	BS 476	BRE letter	Buildin
Internal partition (Steel Stud)	2-hrs	BS 476	WRC 34999	Warring
Internal partition (Steel Stud)	4 + 6 hrs	BS 476	TE 6371	FIRTO

LA SCELTA MIGLIORE É SCEGLIERE PROM

SGS ICS S.r.l.
Servizi di Certificazione Internazionale

Certificate N° 95.054

This is to certify that the Quality Management System of:

PROMAT S.p.A.

C.so Paganini, 39-3 - 16125 GENOVA - Italy

has been assessed and registered as meeting the requirements of:

ISO 9001 / UNI EN ISO 9001 - Ed. 1994

Scope of registration:

Design, manufacture and distribution of passive fire protection systems.

QUALITY ASSURED FIRM
ISO 9001
SGS

SGS ICS S.r.l. - Authorized Representative

QUALITY ASSURED FIRM
UNI EN ISO 9001
SGS

First issue: 18/10/1995
Last issue: 18/10/1995

Valid until 18/10/1998 *subject to satisfactory surveillance.*

TE 5957

7 November 1986

Fire resistance test

Promatect partition 50mm thick

Promat Fire Protection Company Limited

FIRTO

Fire resistance test of a Promatect partition, 3050mm x 3050mm x 50mm thick, comprising three layers of Promatect board panels screwed together and restrained within a test frame by 50mm x 50mm mild steel angle section, 1mm-thick, around the perimeter of the specimen

Technical Evaluation

Report to Promat Fire Protection Company Limited,
P O Box 476, Royston, Herts, SG8 5RH.

SUMMARY

A Promatect partition, 3050mm x 3050mm x 50mm thick, was subjected to a fire resistance test, conducted in accordance with B.S. 476 : Part 8 : 1972, on 7 November 1986. The specimen comprised three layers of Promatect board panels screwed together and restrained within a test frame by mild-steel angle section, 50mm x 50mm, nominally 1mm thick, around the perimeter of the construction on the exposed side of the specimen.

The partition satisfied the requirements of the standard as follows:

Stability	:	125 minutes
Integrity	:	125 minutes
Insulation	:	124 minutes

The partition therefore achieved a fire resistance of 124 minutes in the orientation tested.

THE LOSS PREVENTION TECHNICAL CENTRE
Incorporating
FIRE INSURERS' RESEARCH AND TESTING ORGANISATION
Melrose Avenue, Borehamwood, Hertfordshire, WD6 2BJ
Telephone: 01-207 2345 Telex: 291835

1 OBJECTIVE

To determine at the request of Promat Fire Protection Company Limited, the fire resistance of a Promatect partition in accordance with B.S. 476 : Part 8 : 1972[1].

2 CONSTRUCTION

2.1 General

The partition comprised three layers of Promatect board panels screwed together using 4mm-diameter self-drilling, self-tapping screws and restrained within a heavily reinforced concrete test frame, of nominal size 3050mm x 3050mm, by mild-steel angle-section, 50mm x 50mm x 1mm thick, around the perimeter of the construction on the exposed side of the specimen. The layers were prepared from panels nominally 2500mm high x 1250mm wide, with two layers of nominal thickness 15mm and a third of nominal thickness 20mm on the exposed side of the specimen, joints between panels were staggered on successive layers.

2.2 Assembly

The perimeter angle-sections were installed within the test frame with 6mm bolts at approximately 500mm centres. The Promatect board panels were cut to form the three layers of the construction. The sizes to which the panels were cut and their arrangement in successive layers is shown in Figure 1.

The first layer, of 20mm-thick board, was secured using 30mm screws to the perimeter angles at 200mm centres.

The second layer, of 15mm-thick board, was secured by 30mm screws to the first layer around the perimeter of panels of the first layer at 300mm centres and around the perimeter of panels of the second layer at 450mm centres.

The 15mm-thick panels of the third layer were secured around their perimeters by 45mm screws at 300mm centres.

The overlap of sucessive joints is shown in Figure 2.

The exposed and unexposed faces of the specimen before testing are shown in Plates 1 and 2 respectively.

3 CONDITIONING

The components for the specimen were delivered to the LPC laboratories on 3 November 1986 and the construction of the specimen completed on 6 November 1986. The test was carried out on 7 November 1986.

Between 3 and 7 November 1986, the average temperature and relative humidity of the air of the furnace building were 14°C and 69% respectively.

By oven-drying a sample of the panels, the moisture content on the day of the test was calculated to be approximately 4.3% of the oven-dry weight. The density of the oven-dried board was approximately 873kg/m^3.

4 TEST PROCEDURE

4.1 General

The test was carried out on 7 November and was witnessed by Mr N J Macdonald and Mr J Pilkington representing the sponsor. The ambient temperature at the start of the test was 14°C.

4.2 Furnace control

The furnace temperature was measured by means of sixteen thermocouples arranged symmetrically in the furnace in four rows of four with their measuring junctions 100mm from the exposed face of the partition. The furnace was controlled so that the average temperature followed the time/temperature relationship specified in B.S. 476 : Part 8 : 1972[1]. The average temperature is plotted against time in Figure 3 with the specified curve for comparison.

4.3 Specimen temperature

The temperature of the unexposed face of the partition was measured by ten thermocouples soldered to copper discs and covered with 30mm-square millboard pads. The positions of the thermocouples are shown in Figure 2.

5 RESULTS

5.1 Observations

Observations made during the test are given in Table 1.

Table 1 Observations

Time min	Observations
0	Test started.
13	Some steam issuing from near top of vertical joints on unexposed face.
19	Some darkening along sides of joints on exposed face.
35	Steam issuing from more locations on vertical joints on unexposed face.
40	Upper portions of vertical joints on exposed face appear to be widening, approximately 4mm.
72	Discolouration of surface in small patches adjacent to some joints on unexposed face.
82	Reduction in small quantities of steam issuing from joints.
97	More areas adjacent to joints on unexposed face darkening.
125	Test terminated.

5.2 Deflection of unexposed face

The deflection of the unexposed face of the specimen was measured at approximately mid-height and at three locations, approximately ¼, ½ and ¾ the width of the specimen. These measurements were recorded at various times during the course of the test and are presented in Figure 4.

5.3 Observations after test

Examination of the specimen after test revealed that all the panels were retained in place. The exposed face of the specimen bowed outwards slightly and all its panels had a few cracks between 2-3mm wide. The gap between adjacent panels was approximately 5mm.

5.4 Specimen temperatures

The mean of the temperatures recorded by thermocouples 2, 3, 7, 8 and 9 (located at the centre and at the centre of the four quarters of the unexposed face) is shown plotted against time in Figure 5 as is the maximum temperature recorded by all the thermocouples attached to the unexposed face.

The mean and maximum temperature rise limits, of 140°C and 180°C respectively, were both exceeded after 124 minutes.

6 CLASSIFICATION

B.S. 476 : Part 8 : 1972[1] states that the fire resistance of an element of construction shall be the time in minutes from the start of the test until failure first occurs under any of the following criteria or, if no failure occurs, until the test is terminated.

Stability : Failure is deemed to occur when collapse of the specimen takes place.

Integrity : Failure is deemed to occur when cracks or other openings exist through which flame or hot gases can pass which would cause flaming of a cotton wool pad.

Insulation : Failure is deemed to occur when the mean temperature of the unexposed surface of the specimen increases by more than 140°C above the initial temperature, or the temperature of the unexposed surface increases at any point by more than 180°C above the initial temperature.

Resolution No.15 of the Fire Test Study Group[2] states that the results to B.S. 476 : Part 8 : 1972 shall be expressed to the nearest minute.

7 CONCLUSION

A Promatect insulated partition, as described in this report, satisfied the requirements of B.S. 476 : Part 8 : 1972 as follows:

Stability : 125 minutes
Integrity : 125 minutes
Insulation : 124 minutes

Therefore, the partition was found to have a fire resistance of 124 minutes in the orientation tested.

8 REFERENCES

1 Fire tests on building materials and structures. Part 8. Test methods and criteria for the fire resistance of elements of building construction. British Standard 476 : Part 8 : 1972. British Standards Institution, London, 1972.

2 List of FTSG (UK) Resolutions. Fire Test Study Group (UK), Borehamwood, 1983.

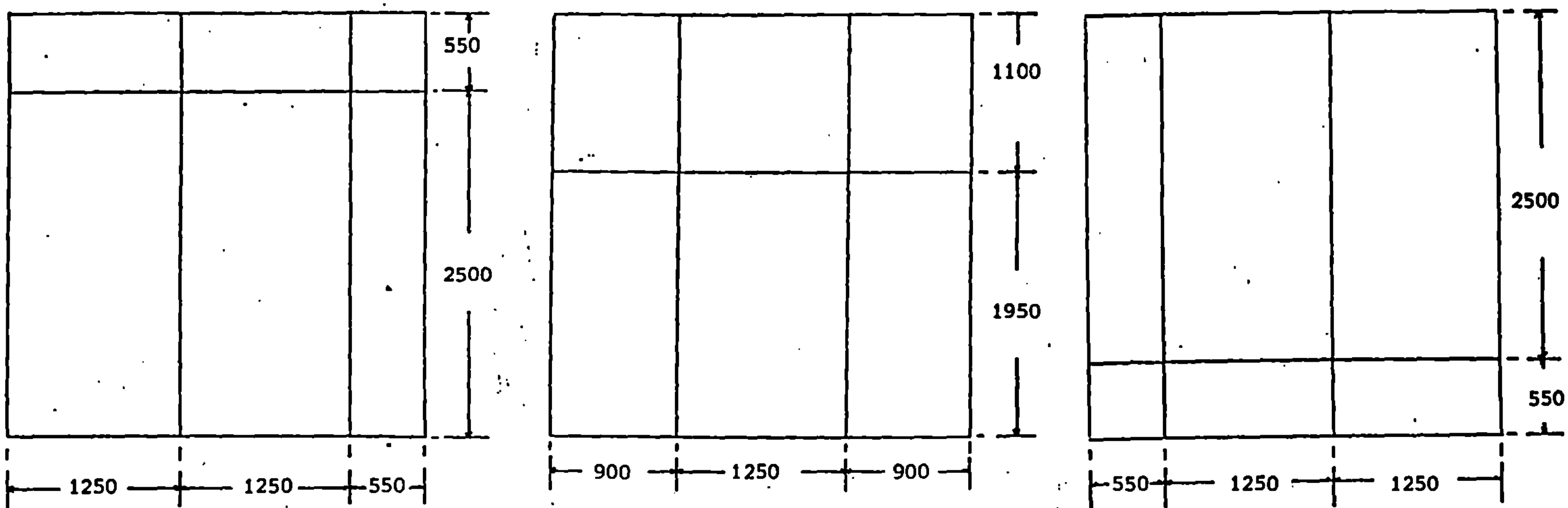
Test and report by:

R.J. Giorgi
Technical Officer

Approved by:

T. Day
Head of Construction Division

RJG/ASF
3 February 1987



1st Layer (nearest furnace)
20mm-thick Promatect panels

2nd Layer
15mm-thick Promatect panels

3rd Layer (unexposed face)
15mm-thick Promatect panels

All views from unexposed side

Dimensions in mm

Figure 1. Arrangement of Promatect board panels.

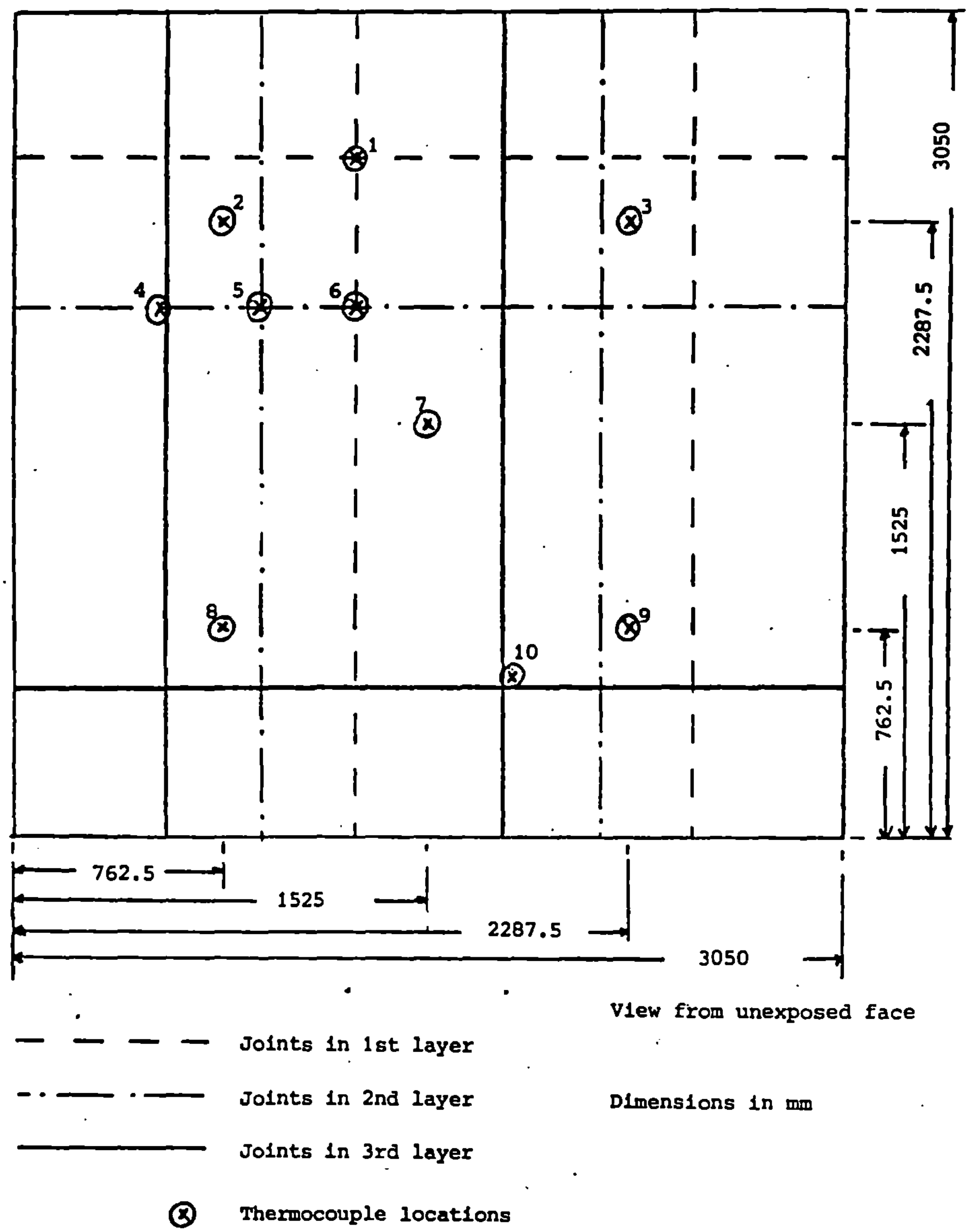


Figure 2. Overlap of panel joints and location of surface thermocouples.

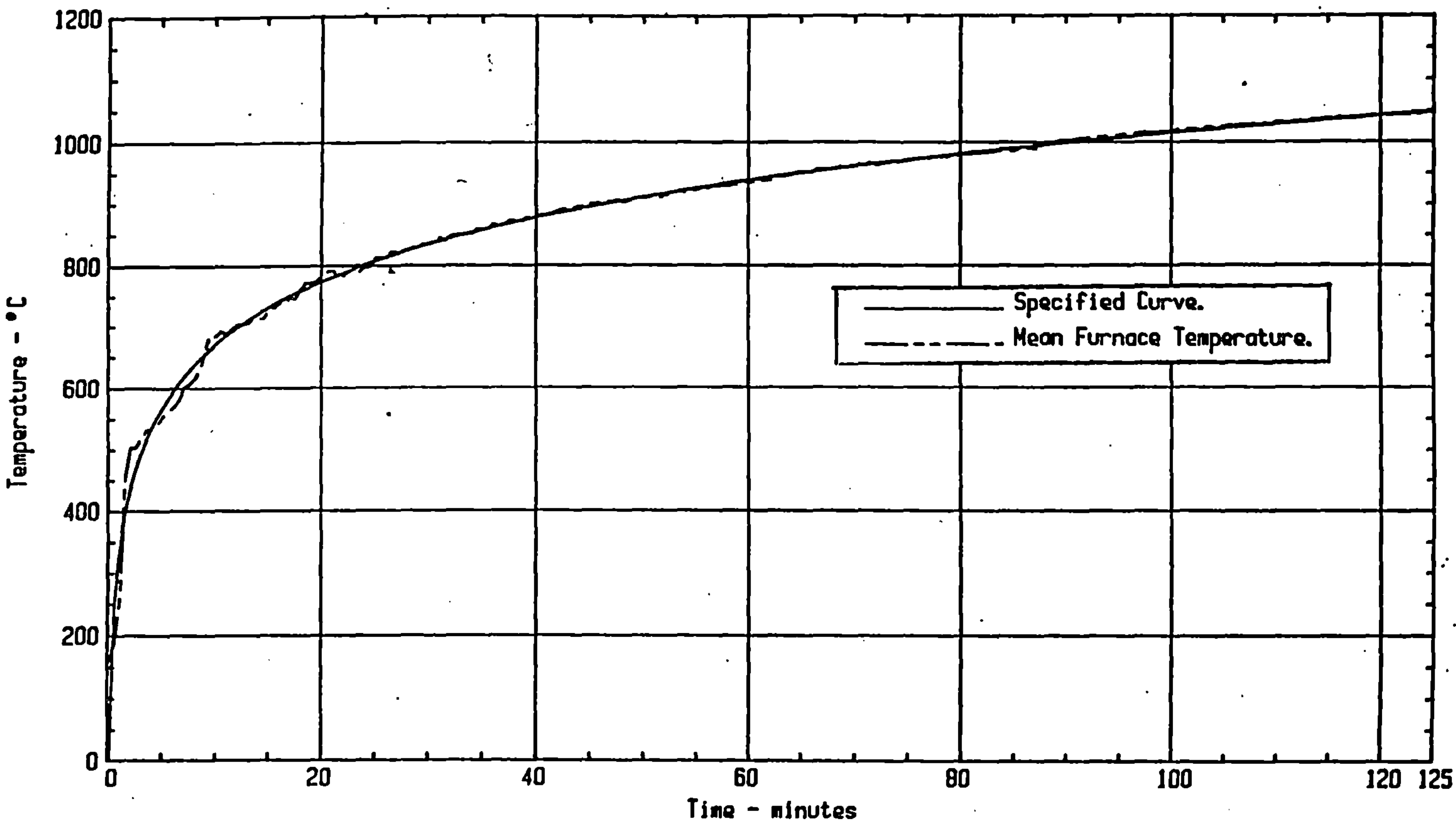


Figure 3. Furnace temperatures.

FIRTO TE 5957

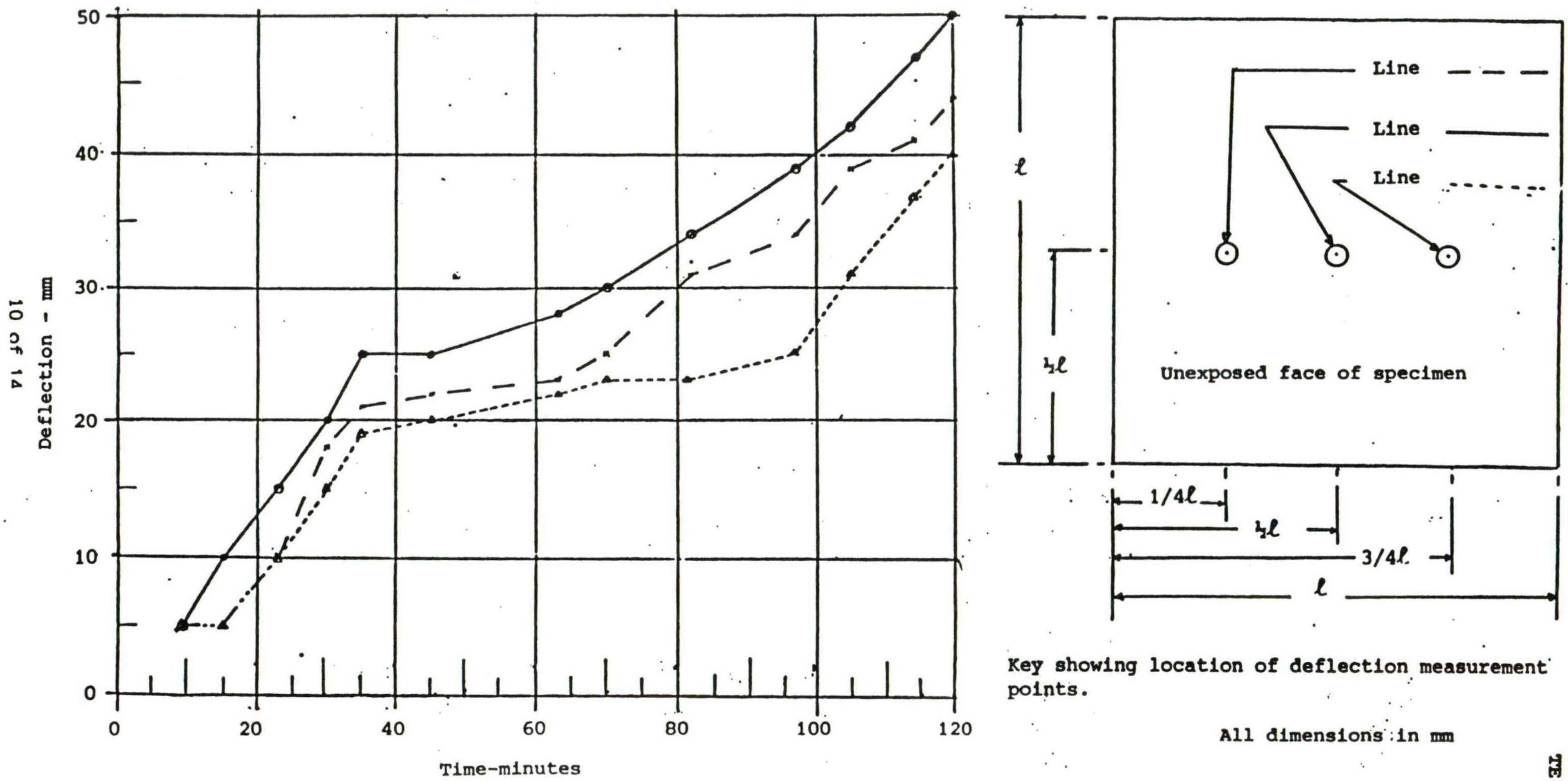


Figure 4. Deflection towards furnace of unexposed face of specimen.

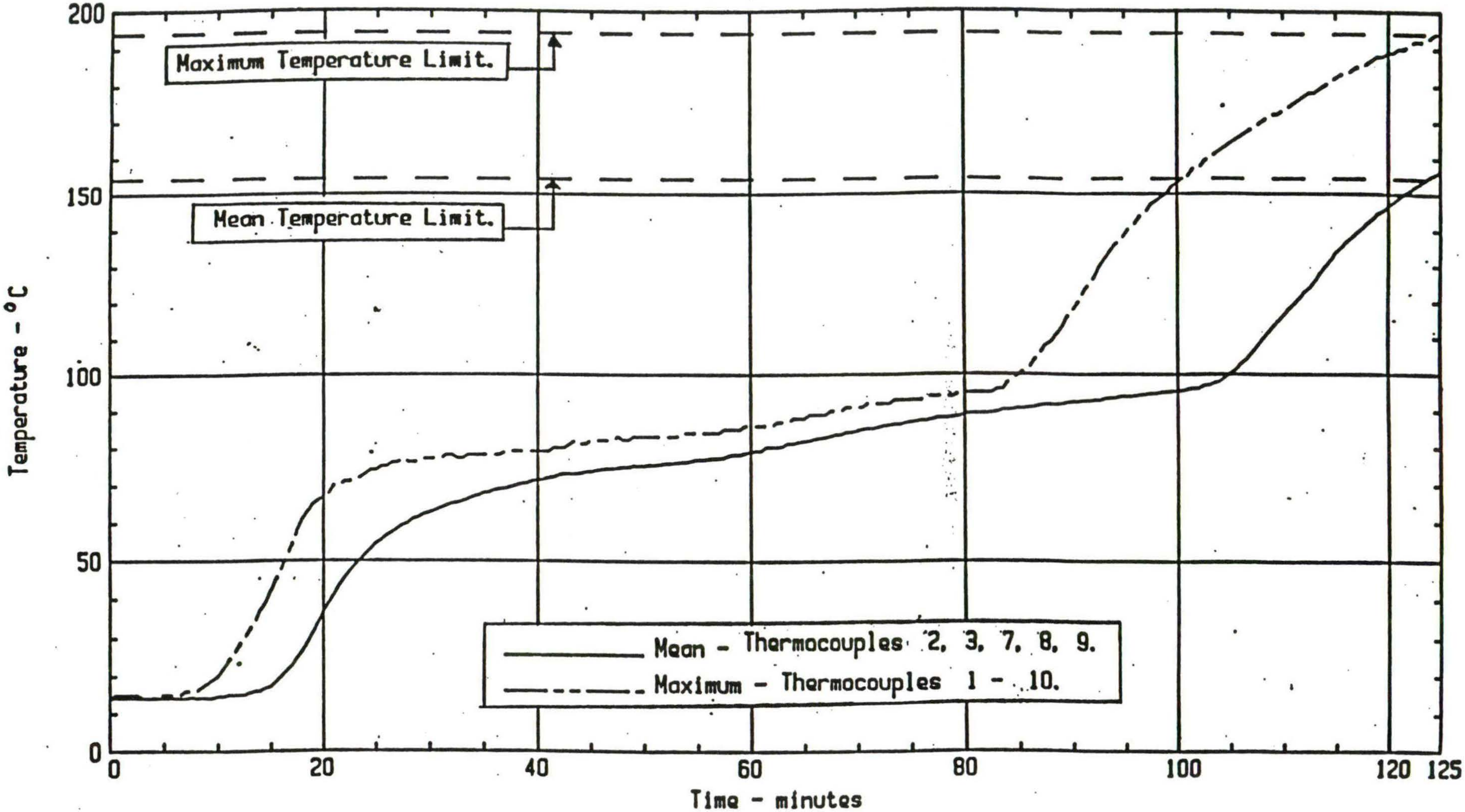


Figure 5. Unexposed face temperatures

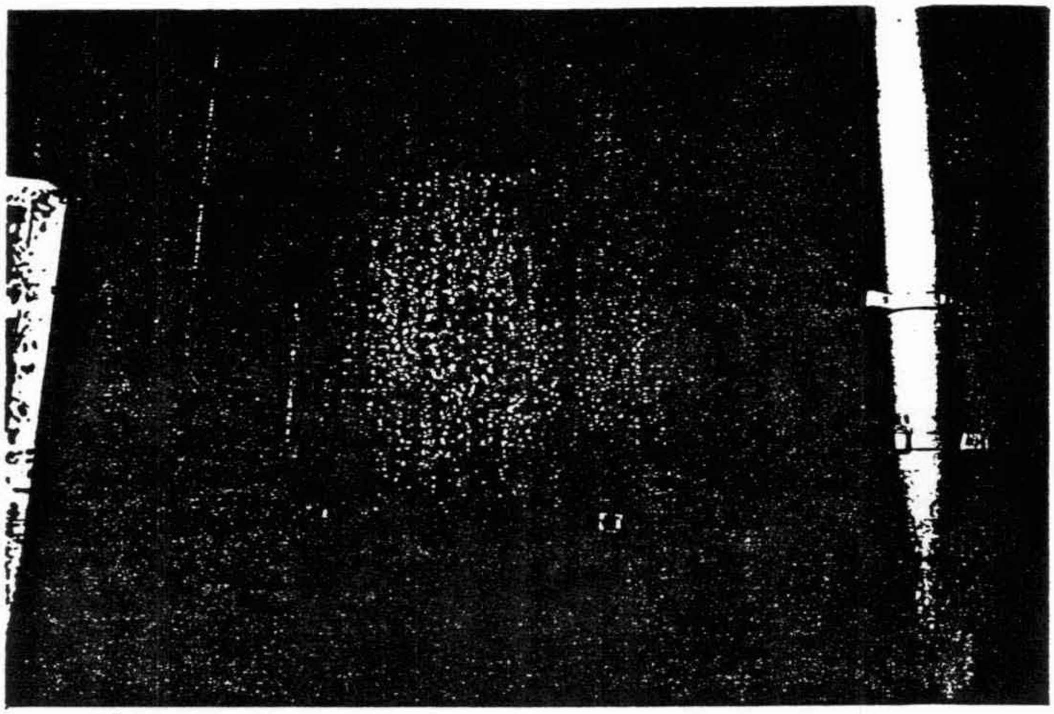


Plate 1 Exposed face of specimen before test
(Neg. No. 15/39/1)

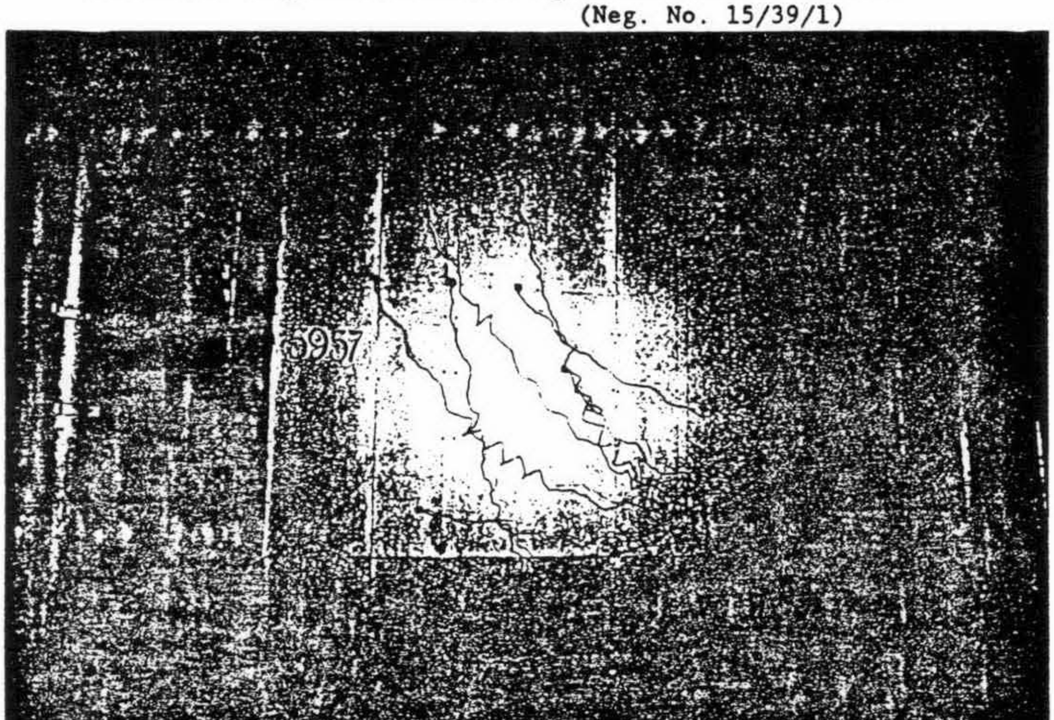


Plate 2 Unexposed face of specimen before test
(Neg. No. 15/39/4)

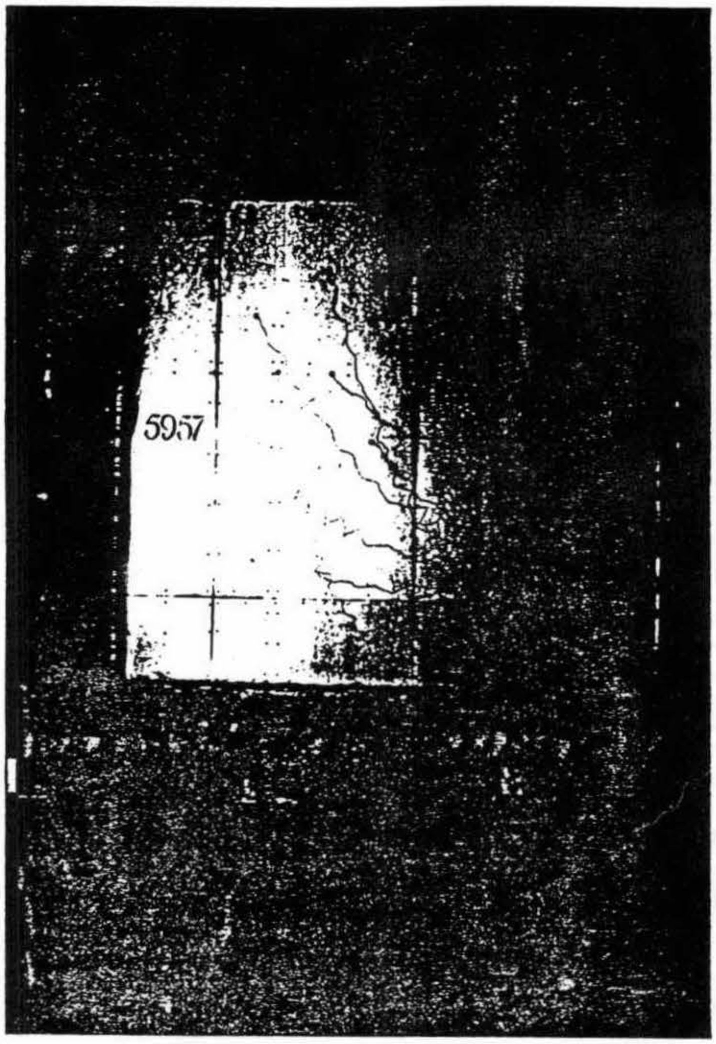


Plate 3 Unexposed face of specimen after test
(Neg. No. 15/39/8)

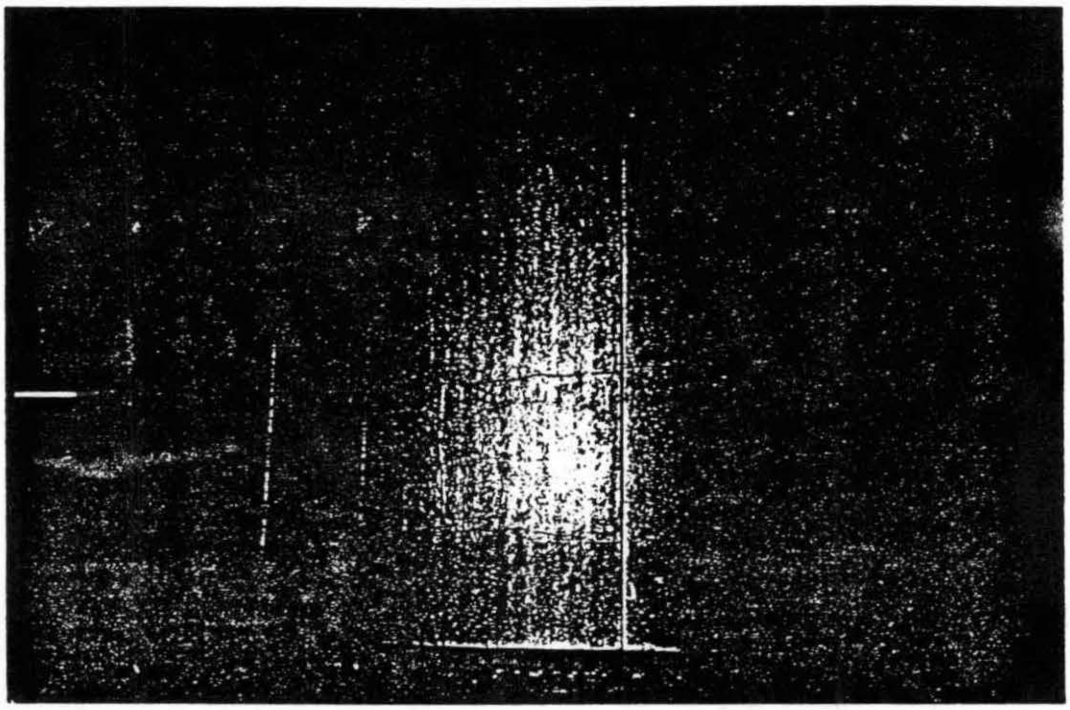


Plate 4 Exposed face of specimen after test
(Neg. No. 15/39/5)

Nederlandse

norm

Ontwerp

NEN-EN 1366-8

prEN 1366-8

Publicatie uitsluitend voor commentaar

Beproeving van de brandwerendheid van installaties in gebouwen. Deel 8: Rookafvoervoorzieningen

Fire resistance tests on service installations in buildings.
Part 8: Smoke extraction ducts

november 1996
ICS 13.220.50

Commentaar voor 1 april 1997

De European Committee for Standardization (CEN), waarin de nationale normalisatie-instituten van 18 Europese landen samenwerken, heeft gepubliceerd het Europese normontwerp:

prEN 1366-8 Fire resistance tests on service installations in buildings. Part 8: Smoke extraction ducts

Definitief vastgestelde Europese normen zullen als Nederlandse norm gelden. Daarom wordt dit normontwerp in Nederland voor commentaar gepubliceerd. Op het ontwerp ingebracht commentaar zal aan de bevoegde normcommissie worden voorgelegd die hiermee rekening zal houden bij de bepaling van de Nederlandse stem. Indien er geen bezwaar bij het NNI wordt ingebracht, kan dat leiden tot ongewijzigd definitieve vaststelling van het ontwerp als norm.

Van Europese normen bestaan drie officiële versies: Engels, Frans, Duits. Voor Nederland zal de Engelse versie gelden, tenzij voor een geautoriseerde versie in het Nederlands wordt gekozen.

Normcommissie 351 007 "Brandbeveiligheid van gebouwen"

Prijsklasse 30

Nederlands Normalisatie-instituut

Kalfjeslaan 2, Postbus 5059, 2600 GB Delft, Telefoon (015) 2 690 390, Fax (015) 2 690 190

EUROPEAN STANDARD

NORME EUROPEENNE

EUROPAISCHE NORM

DRAFT
prEN 1366-8

October 1996

ICS

Descriptors :

English version

Fire resistance tests for service installations in buildings - Part 8: Smoke extraction ducts

'sai de résistance au feu des ınstallations de service dans les bâtiments - Partie 8: Conduits d'extraction de fumées

Feuerwiderstandsversuche an Installationen in Gebäuden - Teil 8: Entrauchungsleitungen

This draft European Standard is submitted to the CEN members for CEN enquiry. It has been drawn up by Technical Committee CEN/TC 127 .

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation ·nder the responsibility of a CEN member into its own language and notified .. the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. prEN 1366-8:1996 E

SMOKE EXTRACTION DUCTS

Contents: **Page**

Foreword

This Part of this European Standard has been prepared by CEN/TC127 'Fire safety in buildings'. It has been prepared because a method of test for fire resisting smoke extraction ducts has become necessary to evaluate the ability of fire resisting ducts already tested to prEN 1366-1 to function adequately as smoke extraction ducts.

It should be read in conjunction with EN1363-1-1 and EN 1366-1.

1. Scope

This Part of this European Standard specifies the test methods for fire resisting smoke extraction ducts and is currently restricted to smoke extraction ducts that pass through into other fire compartments. It represents fire exposure of a fully developed fire.

This test has been designed to cover both vertical and horizontal smoke extraction ducts.

This method of test is only suitable for ducts constructed from non-combustible materials.

This method of test is only applicable to fire resisting ducts that have been tested to prEN 1366-1 (ducts A and B). For the purposes of the test described in this standard, the duct is referred to as duct C.

2. Normative references

This Part of this European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to, or revisions of, any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1363-1, Fire resistance tests - general principles.

EN 1366-1, Service installations - fire resisting ducts.

ISO 5167, Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits running full.

ISO 5221, Air distribution and air diffusion - rules to methods of measuring air flow rate in an air handling duct.

3. Definitions

For the purposes of this Part of this standard, the following definitions apply:

3.1 fire resisting duct: A duct used for the distribution or extraction of air and designed to satisfy the appropriate criteria of EN 1366-1.

3.2 fire resisting smoke extraction duct: A fire resisting duct which satisfies the appropriate criteria of this draft European standard.

3.3 suspension devices: The components used for suspending and fixing a duct from a floor or supporting a duct from a wall.

3.4 supporting construction: The wall, partition or floor which the duct passes through in the test.

3.5 compensator: A device that is used to prevent damage from the forces generated by expansion, or by movement due to contraction, from the effects of fire on materials used to protect the duct.

3.6 self supporting duct: A duct constructed totally from fire resisting boards

4. Principle

The test method described in this Part of this standard provides a means of classifying the performance of fire resisting ducts intended to extract smoke out of a building. Leakage is measured at both ambient and elevated temperatures. During the tests, air/gases are drawn through the duct at a differential pressure selected from table 1. Leakage is determined at ambient temperature by sealing the openings in the duct located in the furnace and taking flow measurements through a flow measuring device located just before the extraction fan. With respect to determining leakage at elevated temperatures, O_2 measuring techniques are used.

Table 1: Differential pressures for smoke extraction ductwork

Pressure level	Operating Differential pressure (Pa) at Ambient Temperature	Differential pressure (Pa) for fire test
1	-500	-150
2	-1000	-300
3	-1500	-500

5. Apparatus

5.1 Furnace, complying with the requirements of EN1363-1.

5.2 **Calibrated perforated plate**, to control the flow through the duct so that one of the required differential pressures specified in table 1 can be achieved. The plate shall be mounted in the position shown in figure 1. (For fine control see 5.5). The perforated plate shall be manufactured from heat resisting steel complying with the following specification:

Cr content 19% min
Ni content 11% min

A full specification of the individual calibrated perforated plate is given in figures 4 and 5. The perforated plate shall be positioned 250mm±50mm from where the duct passes through the furnace wall.

5.3 **Inlet nozzles (fire test)**, inlet nozzles, each having an internal dimension of 160mm (suitable for the standard sizes of ducts specified in 7.1.2), in accordance with ISO 5167/ISO 5221, shall be suitably mounted to the end of the duct, connected to appropriate differential pressure measuring equipment. The measuring device shall be capable of measuring to an accuracy of ± 5%.

5.4 **Small venturi (ambient leakage test)** small venturi, or other suitable device, in accordance with ISO 5167/ISO 5221, shall be suitably mounted to the end of the duct, connected to appropriate differential pressure measuring equipment. The measuring device shall be capable of measuring to an accuracy of ± 5%.

5.5 **Differential pressure fine control device**, flow control damper to provide a fine control for maintaining the required differential pressure or other suitable device such as variable speed fan. Flow control damper to be attached to the extract fan connecting duct (see 5.7).

5.6 **Welded connecting box**, designed to provide a suitable gas tight connection between the inlet nozzles and the O_2 measuring probes.

5.7 **Extract fan connecting duct**, a duct assembly, designed to connect between the connecting box and the extraction fan. An inlet opening may be provided if a flow control damper is used for fine control of the differential pressure (see 5.2).

5.8 **Extraction fan**, for extracting gas under test with a suction capacity of at least
2 x V_n (required capacity: V_n = 2m/s x 1m x 0.25m = 0.5m^3/s for standard duct).

The characteristic curves of the fan shall be horizontal for the actual air flow. The capacity of the fan shall not change by more than 10% in the event of a drop in the pressure of up to 50Pa.

5.9 **Furnace temperature measurement**, for measuring and recording the furnace temperature shall be in accordance with EN13631.

5.10 **Furnace pressure measurement**, for measuring and recording the furnace pressure shall be in accordance with EN1363-1.

5.11 **Thermocouples**, for measuring the gas temperature adjacent to the nozzles by a 1.5mm sheathed thermocouple

5.12 **Surface thermocouples**, for measuring surface temperature and at the locations specified in EN 1366-1. *(this is for information only and should not be used for classification, compliance with the insulation criteria will be based on the duct B test described in EN 1366-1)*

5.13 **Oxygen measuring equipment**, a single paramagnetic cell analyser, which includes for the gases to be filtrated, cooled and dried, shall be used, together with appropriate connecting tubes, sensors and a suitable arrangement for switching between the sensor mounted inside the duct near the furnace wall (see figure 1) and the sensor located just after the nozzles(see figures 7 and 8). The 90% response time of the complete system should be 20 sec maximum. The accuracy should be better than
± 0.1%.

5.14 **Restraint equipment** for applying restraint as for duct B in EN 1366-1.

6 Instrumentation

6.1 Furnace temperature and pressures: The positions of the furnace thermocouples shall be as shown in figures 9 - 10.

Furnace pressure shall be measured in accordance with EN 1363-1 and the pressure probe(s) located at a position 100mm below the roof of the furnace.

6.2 Measurement of temperature of test specimens: Guidance on thermocouples at the point of penetration of the duct through the wall or floor is shown in figure 11 for a typical penetration detail. Additional thermocouples T1 shall be located in positions on the outer surface of the fire protection material to coincide with all joints (inner layer joints as well). Thermocouples T2 shall be used to determine the mean temperature rise and thermocouples T1, T2 and Ts shall be used for determining maximum temperatures. Additional thermocouples should be located at the seal between the duct and the supporting construction.

6.3 Measurement of gas temperature adjacent to nozzles: The gas temperature adjacent to the nozzles should be measured with the thermocouples (see 5.9) arranged pointing downwards to allow for draining moisture with its measuring junction located at the centre line of the each nozzle and at a distance equal to twice the diameter of the measuring duct downstream from the entrance to the flow measuring device. An alternative thermocouple can be used provided it can be shown to have equivalent response time.

6.4 Oxygen measurements: A sensor manufactured from stainless steel tube, having approximate dimensions 6mm outside diameter and 5mm internal diameter, will be located inside the duct 100mm upstream from the perforated plate on the centre line of the duct. A second sensor will be located after the nozzles at a distance of 100mm on the centre line of the connecting box. See figures 7 and 8 for details. Both sensors will be connected by suitable pipework to a single oxygen measuring instrument.

7 Preparation of test specimens

7.1 Dimensions:

7.1.1 The following shall be the minimum dimensions of the parts of the test specimen exposed:

(a) in the furnace (see figures 1 and 2.):

horizontal ducts: length 3.0m,
vertical ducts: height 2.0m

(b) outside the furnace:

horizontal ducts: length 4.25m,
vertical ducts: 4.25m

7.1.2 The following sizes of ducts shall be tested:

Rectangular ducts: 1000mm wide by 250mm high

Circular ducts: 560mm diameter

Note: Smaller ducts can be tested for specific applications.

7.2 Conditioning

Conditioning of the specimen shall be in accordance with EN1363-1. It is permissible to condition materials before assembly or on a complete assembly.

8 Test arrangements

8.1 Details of test specimens: The test shall be made on a test specimen representative of the complete duct assembly, including integral or intended insulation on which information is required. Each type of duct requires a different approach and an attempt shall be made to reproduce the edge conditions and the method of fixing or support inside and outside the furnace representative of that used in practice. The distance between hangers or supports shall be representative. Where compensators are used in practice than they shall be incorporated in the test specimen. In this case the compensator shall be located outside the furnace approximately 500mm from the perforated plate.

The fire-stopping at the penetration through the supporting construction shall be as intended in practice following established manuals of good practice for field installation, and shall be specified by the manufacturer. If the width of the gap for fire-stopping around the duct at the furnace penetration point is not specified, a width of 50mm shall be used.

Parts of the ducts within the furnace shall normally be exposed to fire from all sides over their whole length. Ducts shall only be exposed on less than four sides if this is likely to occur in practice. Where vertical ducts are not in practice to be fixed to each floor, then the weight of ducts above shall be reproduced in the test. The number of storeys and the weight represented shall be stated in the test report.

8.2 Standard supporting constructions: A standard supporting construction shall be selected from the specifications detailed in EN 1366-1.

Where the duct passes through an opening in the furnace wall or roof, than the opening shall be of sufficient dimensions to allow for the supporting construction to surround all faces of the duct by at least 200mm.

It is important that the supporting construction and furnace roof is well sealed where it contacts the furnace wall and does not deflect.

8.3 Duct arrangement:

8.3.1 A single duct may be tested in the furnace, or alternatively, two or more ducts may be tested in the same furnace, provided that there is sufficient space to do so, in accordance with the dimensions shown in figures 1 and 2.

8.3.2 Ducts shall be arranged as shown in figures 1 and 2. The end of the ducts within the furnace shall be closed independently of any furnace enclosure by materials and construction similar to the remainder of the duct.

8.3.3 Vertical ducts (see figure 2) shall be tested standing on the furnace floor and penetrating the furnace roof slab/supporting construction; the ducts shall be fixed at the furnace roof level as they would be fixed in practice when penetrating a floor. (As specified by the sponsor)

8.3.4 For horizontal and vertical ducts, the test arrangement shall include at least one joint inside the furnace and at least one joint outside it. There shall be at least one joint both inside and outside the furnace in every layer of fire protection material, and in any steel duct. Outside the furnace, there should be a joint in the outer layer of the fire protection material no further away than 700mm from the supporting construction but it should not be within 100mm of thermocouples T_2. Inside the furnace, the joint in the outer layer of fire protection material shall be located at approximately mid-span/mid-height. The distance between joints and hangers shall not be less than that intended in practice. If the minimum distance has not been specified, hangers shall be arranged so that the joint at mid-span lies midway between them. Centres of the hangers should be specified by the manufacturer and shall be representative of practice.

8.3.5 For horizontal ducts, two openings shall be provided, one on each vertical side of the duct inside the furnace. The openings shall be positioned 500mm from the furnace wall. For vertical ducts two openings shall be provided, the openings shall be positioned opposite each other and 200mm below the furnace roof (see figure 1 and 2). In both vertical and horizontal ducts the openings shall have the same breadth/height ratio as the cross-section of the duct and have a total opening area of 50% of the cross-sectional area of the duct. (Each opening will have an area of 25% of the cross sectional area of the duct).

8.3.6 There shall be a clearance of (500 ± 50)mm between the top of the duct and the ceiling, and also at least 500mm between the underside of the duct and the floor. Similarly, there shall be a clearance of at least 500mm between the sides of ducts and furnace walls, except in the case of assemblies of ducts as shown in figures 1 and 2.

8.4 Restraint of ducts:

8.4.1 Inside the furnace: Where in practice the duct is fixed at floor levels, then a vertical duct C shall be fixed where the duct penetrates the floor as specified by the sponsor.

All ducts will be fully restrained in all directions at the furnace wall or floor remote from the penetration point. Where there is a possibility of the furnace wall moving than the fixings shall be made to be independent of the furnace structure.

8.4.2 At the penetration point: Where in practice the duct is fixed at floor levels, then a vertical duct C shall be fixed where the duct penetrates the floor as specified by the sponsor.

8.4.3 Outside the furnace: The horizontal duct is to be restrained outside the furnace. The restraining point will be located at a position (500 ±50)mm from the end of the duct and will provide restraint on movement in horizontal directions but will allow movement in vertical directions (see figure 12). The frame used to apply the restraint shall be rigid and have sufficient strength to resist all horizontal forces.

Vertical ducts will be unrestrained outside the furnace.

8.5 Perforated plate: The perforated plate shall be located 250mm±50mm from the external face of the furnace wall. Provision shall be provided for the plate to be removed if necessary during the pre-test calibration described in clause 9.2.

9. Pre-test calibration

9.1 Oxygen measuring instrument: The measuring instrument shall be calibrated just prior to the fire test.

9.2 Perforated plate: Switch on the extract fan. Check that both the required differential pressure and an air velocity of 2m/s are obtained under ambient conditions. Provided the air velocity is within ± 15% and the differential pressure is within ± 1%, then the requirements of this standard are satisfied. However, if these values cannot be achieved, switch off the fan, remove the perforated plate and as appropriate, drill additional holes or seal some holes. Replace the perforated plate and repeat the procedure until the required values have been achieved.

Note: The initial check on the perforated plate should be undertaken on a duct section provided for the purpose and not the test specimen where the removal of the plate may create problems

10. Leakage measurement at ambient temperature

10.1 Seal the two openings in the duct that are located inside the furnace.

10.2 Switch on the extract fan, making any fine adjustments so that the differential pressure reading is within ±1% of the prescribed value given in table 1 (column 2) throughout the time over which the leakage measurements are taken. The pressure level may be selected by the sponsor, alternatively it is possible to progressively work up from pressure level 1 to pressure level 3, subject to compliance with 12.2.

10.3 Switch on measuring equipment related to the small venturi.

10.4 For a period of 5 minutes measure and record the pressure through the small venturi at the selected pressure level. Where information is required on leakage at other pressure levels, repeat the procedure described in 10.2 to 10.4. Calculate the air-flow in accordance with ISO 5167/ISO 5221.

10.5 Switch off measuring equipment and the extraction fan.

10.6 Remove sealing from openings.

11. Fire test

11.1 Switch on extraction fan and make any adjustments to the damper or fan to maintain the differential pressure at the selected pressure level given in table 1 (column 3).

11.2 Ignite the furnace and switch on all measuring equipment.

11.3 Throughout the test, maintain the furnace conditions to comply with the requirements of EN 1363-1. Make any adjustments necessary to maintain the differential pressure readings inside the duct to within ±1% of the appropriate value given in the third column of table 1 after 5 minutes of the start of the test.

11.4 Record all temperatures and pressures at the intervals specified in EN 1363-1.

11.5 After the first fifteen minutes of the test, start recording the oxygen measurements, readings being taken alternatively at the furnace location and then at the nozzle location. Each measurement shall be taken 60 seconds after the previous reading, with the switching over to the other channel taking place immediately after the previous reading has been taken.

11.6 Take observations on the general behaviour of the duct throughout the test, in particular observe for collapse of any part of the duct that would effect its ability to maintain its intended function.

11.7 For self supporting ducts only, take measurements around the top and bottom outside surface of the duct to determine any reduction in cross-section of the duct. These measurements shall be taken at three locations outside the furnace between the perforated plate and the end of the furnace.

11.8 For protected steel ducts only, as soon as possible after the end of the fire test, remove sufficient of the apparatus to allow the inside of the tested duct to be observed so that an measurement can be made of the reduction in cross-section.

11.9 After the fire test re-calibrate the oxygen measuring instrument. If there are any differences between the calibrated values then the corrected measured values may be interpolated between the two sets of calibrated values.

11.10 Using the values recorded just prior to switching from one sensor to the other, calculate the leakage from the O_2 measurements as follows:

m_L = Leakage mass flow (kg/s)
m_{G2} = Mass flow at point G2 near inlet nozzles (kg/s)
c_{G1} = Oxygen content of furnace (vol-%)

c_{G2} = Oxygen content measured near inlet nozzle (vol-%)
ρ_{L0} = Density of dry air at 0°C/1013 hPa (= 1.293 kg/m^3)
ρ_L = Density of dry air at 20°C/1013 hPa (= 1.2 kg/m^3)
V_L = Leakage volume flow (m^3/s)

$$m_L = \frac{Corr \times m_{G2} \times (c_{G2} - c_{G1})}{21 - c_{G1}}$$

Corr is determined as follows:

Corr = Correction factor

L_{min} = minimum stoichiometrical air needed (m^3/kg fuel) at standard temperature and pressure
C = carbon content in fuel (kg/kg fuel)
H = hydrogen content in fuel (kg/kg fuel)
S = sulphur content in fuel (kg/kg fuel)
c_{G2} = Oxygen content measured near inlet nozzle (vol-%)

$$Corr = \frac{0.79xL_{min} + 1.85xC}{0.79xL_{min} + 1.85xC + (0.21 - c_{G2})x52.9xH}$$

L_{min} is determined as follows:

$$L_{min} = 8.88 \times C + 26.44 \times H + 3.33 \times S$$

$$V_L = \frac{m_L}{\rho_L}$$

V_L shall be used to determine compliance with the leakage criteria stated in 12.3

12 Performance criteria

12.1 General requirements: Under the specified pressure conditions given in table 1, the fire resisting smoke extraction duct shall satisfy the leakage requirements given in 12.2 and 12.3, maintain its cross-section within the limits given in 12.3.2 and shall not collapse.

Smoke extraction ductwork shall be made of non-combustible materials.

Three pressure levels are distinguished for smoke extraction ductwork. In the course of testing smoke extraction ductwork in accordance with clause 11, the pressure levels defined in table 1 shall be observed.

12.2 Criteria at ambient temperature: Smoke extraction ductwork of all categories intended for installation outside the enclosed space from which smoke is to be extracted, shall not have a leakage exceeding $10 m^3/h$ per $1 m^2$ of total internal surface area of the complete duct (inside and outside the furnace) when tested in accordance with clause 10.

12.3 Criteria under fire conditions:

12.3.1 General: When tested in accordance with clause 11 smoke extraction ductwork for use in combination with smoke exhaust fans and which is intended outside the enclosed space from which smoke is to be extracted, shall comply with the following:

12.3.2 Leakage: The duct shall not have a leakage exceeding $10 m^3/h$ per $1 m^2$ of internal surface area. This shall be related to the surface area of the duct from the perforated plate to the end of the duct by the inlet nozzles.

12.3.3 Integrity: The integrity at the seal/penetration between the duct and the supporting construction shall be judged in accordance with EN 1363-1.

12.3.4 Reduction in cross-section: The internal dimensions of the smoke extracting ductwork shall not decrease by more than 10% during the test. This shall be by the measurements taken in accordance with 11.6 and 11.7.

12.3.5 Mechanical Stability: No complete part of the duct within or outside the furnace shall collapse during the fire test.

12.3.6 Insulation: Compliance with this will based on the test results from prEN 1366-1.

Note for CEN TC127: *Whilst surface temperatures are measured during the test, the provision of the perforated plate may mean that the measured values are not truly representative. Until experience is gained, it cannot be established how significant this affect may be. If the affect is not significant, it may be possible to ultimately replace the duct B test in EN 1366-1 by the duct C method.*

13 Test report

The test report shall include the following information:

(a) name of testing laboratory;

(b) name of sponsor;

(c) date of test;

(d) name of manufacturer and the trade name (if any) of the product;

(e) details of the construction and conditioning of the test specimens, including detailed information on the relevant physical and mechanical properties of the materials used, together with drawings illustrating the essential features and including the number of sides of the test specimens exposed to fire in the furnace;

(f) the method of fixing, support and mounting, as appropriate for the type of specimen, and a description of the method and materials used to seal the gap between the duct and opening provided in the wall or floor to accommodate the duct, the details of the supporting construction,where vertical ducts are loaded, the number of storeys that this represents ;

(g) the force recorded at the restraint point in horizontal duct B, as a function of time, presented as a graph;

(h) the thermal elongation or shortening of horizontal duct A;

(j) other observations made during the test according to 9.3, including a complete record of the following test parameters as a function of time:

furnace temperature
furnace pressure
all surface mounted thermocouple temperatures
volume flow measuring station gas temperatures
volume flow measuring station pressure differential
calculated volume flow rate.

(k) performance achieved in relation to clause 10. Where the test is terminated before the occurrence of failure under the relevant criteria, this shall be reported.

(l) any deviations from the full test procedure shall be clearly described

(m) where steel ducts are used, the thickness, leakage class to EN?????, and whether any external stiffening or internal stiffeners were incorporated.

14. Direct field of application of test results

14.1 General: The rules given in this section are only applicable provided the system has been previously tested to EN 1366-1, (duct A and B).

14.2 Vertical and horizontal ducts: A test result obtained for horizontal smoke extraction ducts is applicable to horizontal smoke extraction ducts only.

A test result obtained for vertical smoke extraction ducts is applicable to vertical smoke extraction ducts.

A test result obtained for horizontal smoke extraction ducts is applicable to vertical fire resisting smoke extraction ducts provided the vertical ducts is to the same design and vertical duct A and B to EN 1366-1 has been tested.

14.3 Sizes of ducts: A test result obtained for the standard sizes of duct specified in 7.1.2 is applicable to all dimensions up to the size tested and to sizes above that subject to the following limits:

Table 2: Applicability of duct size tested to other sizes

	Rectangular Width mm	**Rectangular Height mm**	**Circular Diameter mm**
Duct C			
Standard size:	1000	250	560
Up to:	1250	1000	1000
minus:	No limit	No limit	No limit

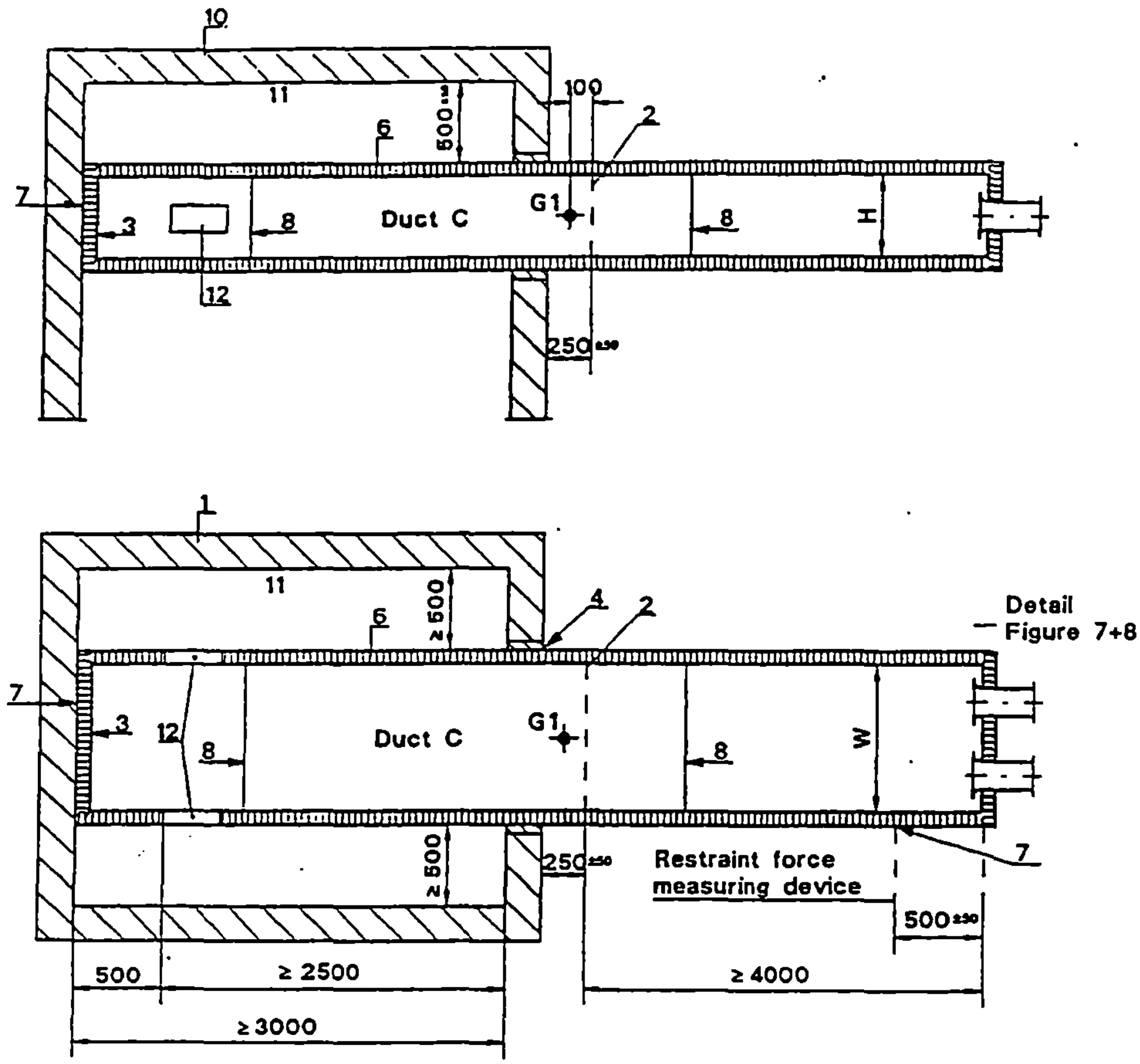
For ducts tested with smaller sizes than the specified standard sizes, no extrapolation to larger sizes can be allowed. For sizes larger than the allowable upper limits for extrapolation, no extrapolation rules covering larger sizes are included in this draft standard. If a circular duct is protected by an independent rectangular protection system, the internal dimensions of the protection system shall be used to validate the field of application.

14.4 Pressure difference:

14.4.1 A test result obtained for the differential pressure of 500 Pa(150 Pa fire test conditions) in duct C is applicable to an underpressure and an overpressure up to the same value.

14.4.2 A test result obtained for the differential pressure of 1000 Pa(300 Pa fire test conditions) in duct C is applicable to an underpressure up to the tested underpressure and to an overpressure of 500 Pa.

14.4.3 A test result obtained for the differential pressure of 1500 Pa(500 Pa fire test conditions) in duct C is applicable to an underpressure up to the tested underpressure and to an overpressure of 500 Pa.



NOTE - The sealed end shall be independent of the furnace wall.

1 Furnace wall

2 Perforated plate

3 Sealed end
(May pass through furnace wall)

4 Fire stopping as in practice

6 Insulation

7 Rigid restraint

8 Joints

10 Furnace roof

11 Furnace chamber

12 Openings: total cross section 50% of duct cross section Duct C

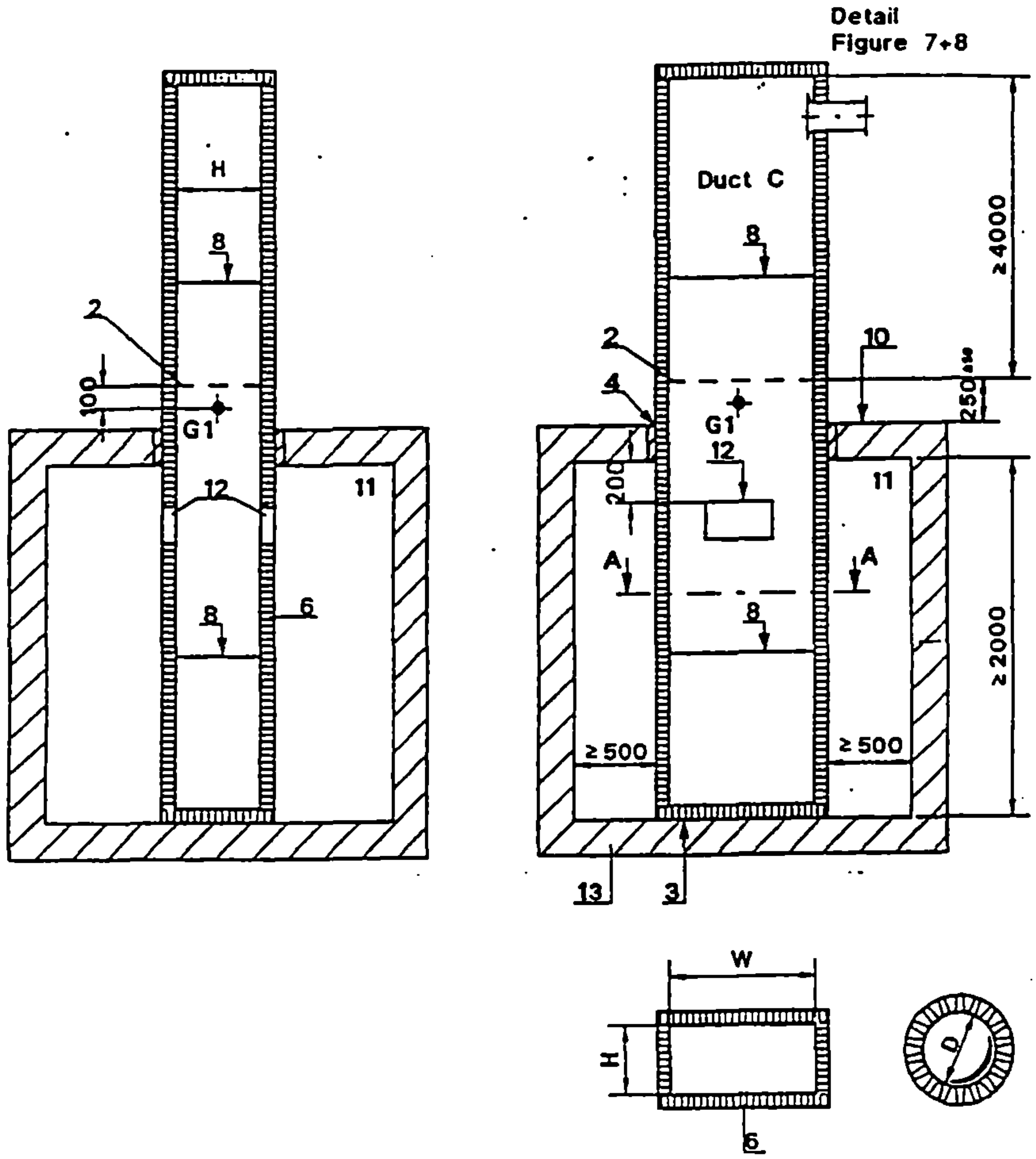
W Width

H Height

G1 Gas sample sensor at the perforated plate

Figure 1 Test arrangement for horizontal ducts

Dimensions in mm



1 Furnace wall

2 Perforated plate

3 Sealed end

4 Fire stopping as in practice

6 Insulation

8 Joints

10 Furnace roof

11 Furnace chamber

12 Openings: total cross section 50% of duct cross section Duct C in the ratio of 1:4 for rectangular ducts

13 Furnace floor

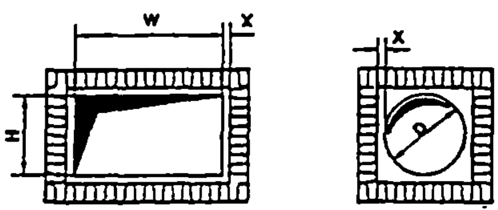
W Width

H Height

D Diameter

G1 Gas sample sensor at the perforated plate

Figure 2 - Test arrangement for vertical ducts



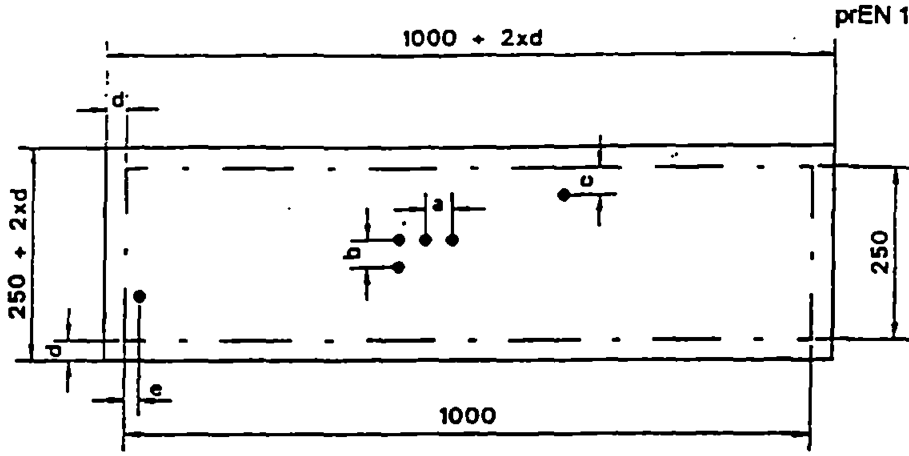
W Width

H Height

D Diameter

X Clearance as tested

Figure 3 - Dimensions of steel sheet ducts with protective fire board cladding



Thickness: 2,5mm

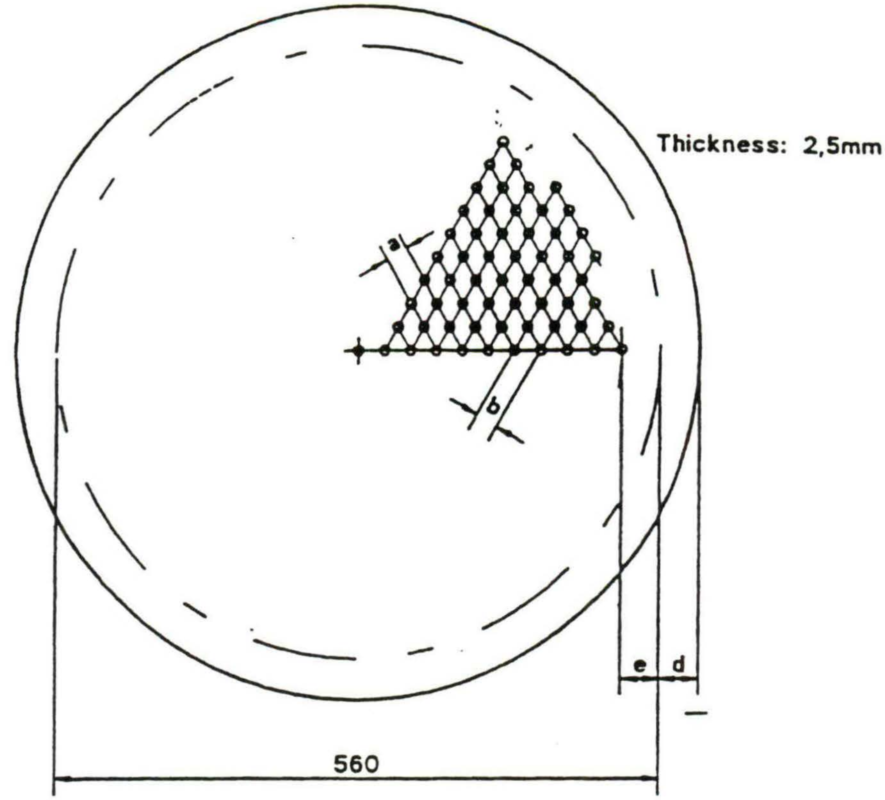
Material: Heat resisting steel
Percentage of Chrom minimum 19%
Percentage of Nickel minimum 11%

NOTE: For d see figure 6

Pressure stage	1	2	3
Pressure differential at ambient temperature (Pa)	-500	-1000	-1500
Pressure differential for pre calibration at ambient temperature (see 9.2)(Pa)	-150	-300	-500
Pressure differential during the fire test (Pa)	-150	-300	-500
Diameter of hole (mm)	10	10	10
Number of holes horizontal (piece)	50	37	36
Number of holes vertical (piece)	11	11	9
Number of holes (piece)	550	407	324
Distance rim horizonal e (mm)	15	15	20
Distance rim vertical c (mm)	15	15	20
Mounting hole a separation (mm)	19,8	26,9	27,4
Mounting hole b separation (mm)	21,8	22	26,3

NOTE: The table given in value for standard rectangular duct size 1000 mm x 250 mm.
For smaller sizes the number of holes will be reduced proportional to the smaller cross section.

Figure 4 - Detail perforated plate for test duct C with dimensions width x height = (1000 x 250) mm



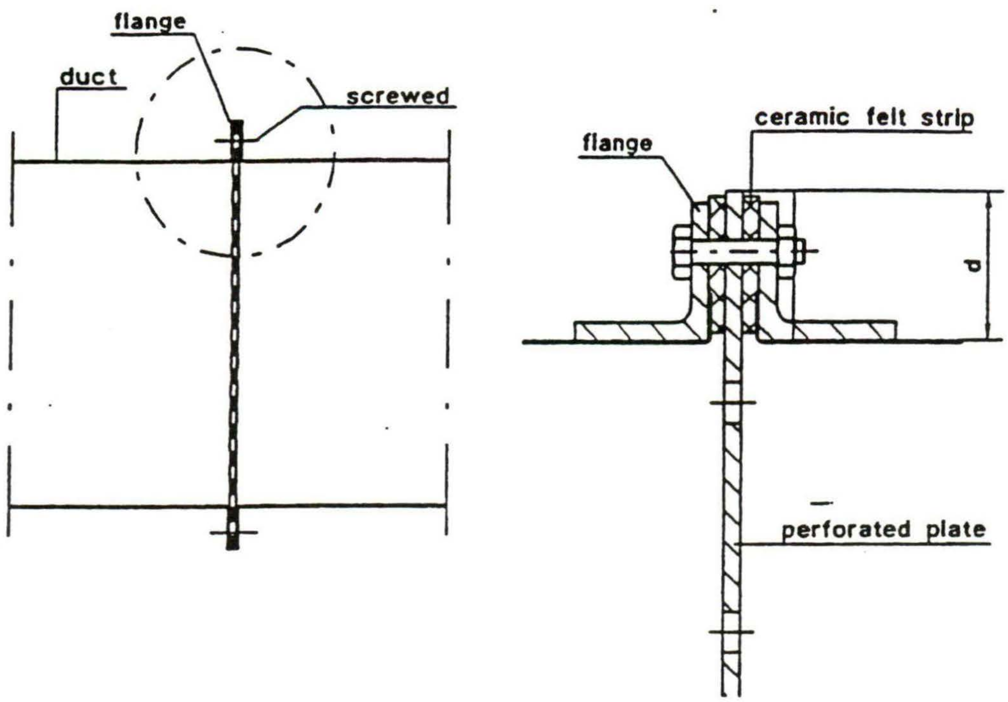
Material: Heat resisting steel
Percentage of Chrom minimum 19%
Percentage og Nickel minimum 11%

Pressure stage	1	2	3
Pressure differential at ambient temperature (Pa)	-500	-1000	-1500
Pressure differential for pre calibration at ambient temperature (see 9.2)(Pa)	-150	-300	-500
Pressure differential during the fire test (Pa)	-150	-300	-500
Diameter of hole (mm)	10	10	10
Number of holes (piece)	541	403	319
Distance rim e (mm)	30	35	35
Mounting hole a separation (mm)	20,8	22,2	27,5
Mounting hole b separation (mm)	20,8	22,2	27,5

NOTE - The table given in value for standard circular duct size diameter 560 mm.
For smaller sizes the number of holes will be reduced proportional to the smaller cross section.

Figure 5 - Perforated plate for test duct C with diameter = 560 mm

Installation of the perforated plate into the steel sheet duct



Installation of the perforated plate into the duct of fire resisting boards

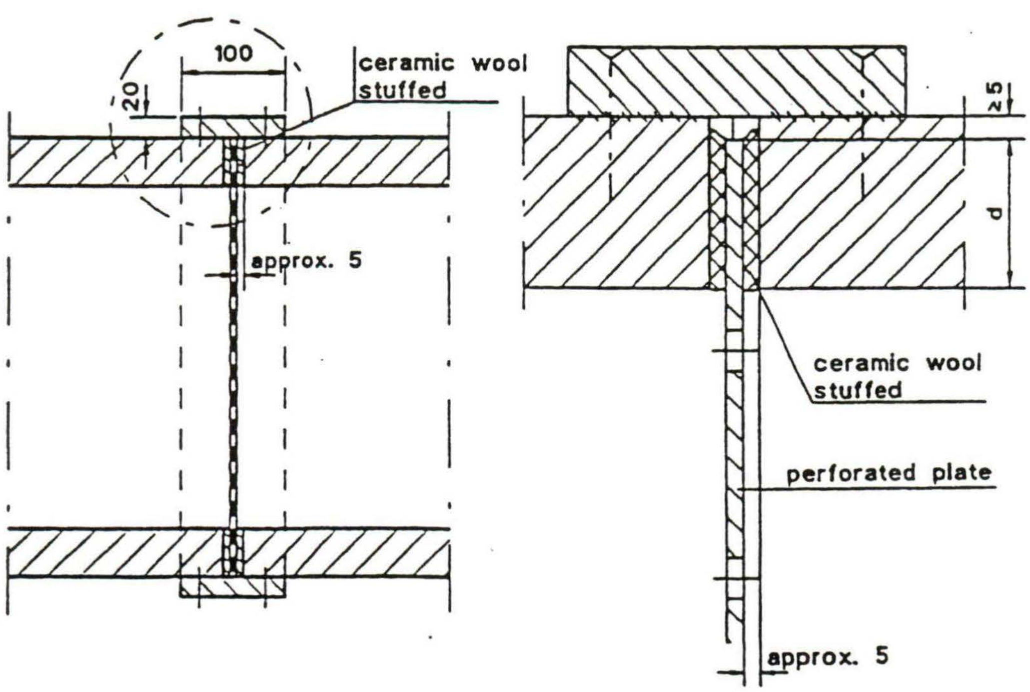
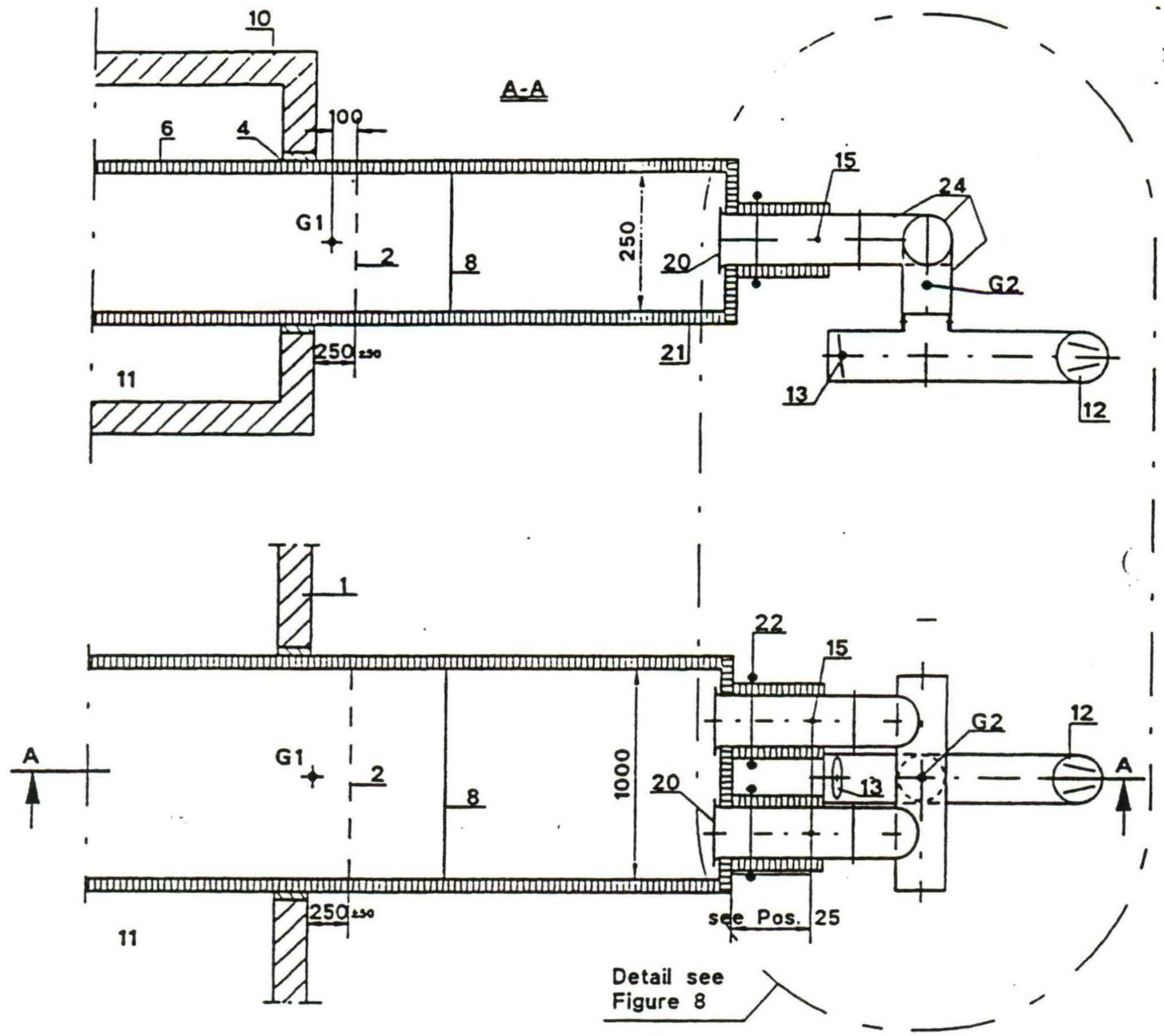


Figure 6 - Example of an assembly for the perforated plates



1 Furnace wall

2 Perforated plate

4 Fire stopping as in practice

6 Insulation

8 Joints

10 Furnace roof

11 Furnace chamber

12 Fan

13 Pressure control, dilution damper

15 Thermocouple 1,5mm diameter

20 Inlet nozzle

21 Test duct C

22 Piezometric ring

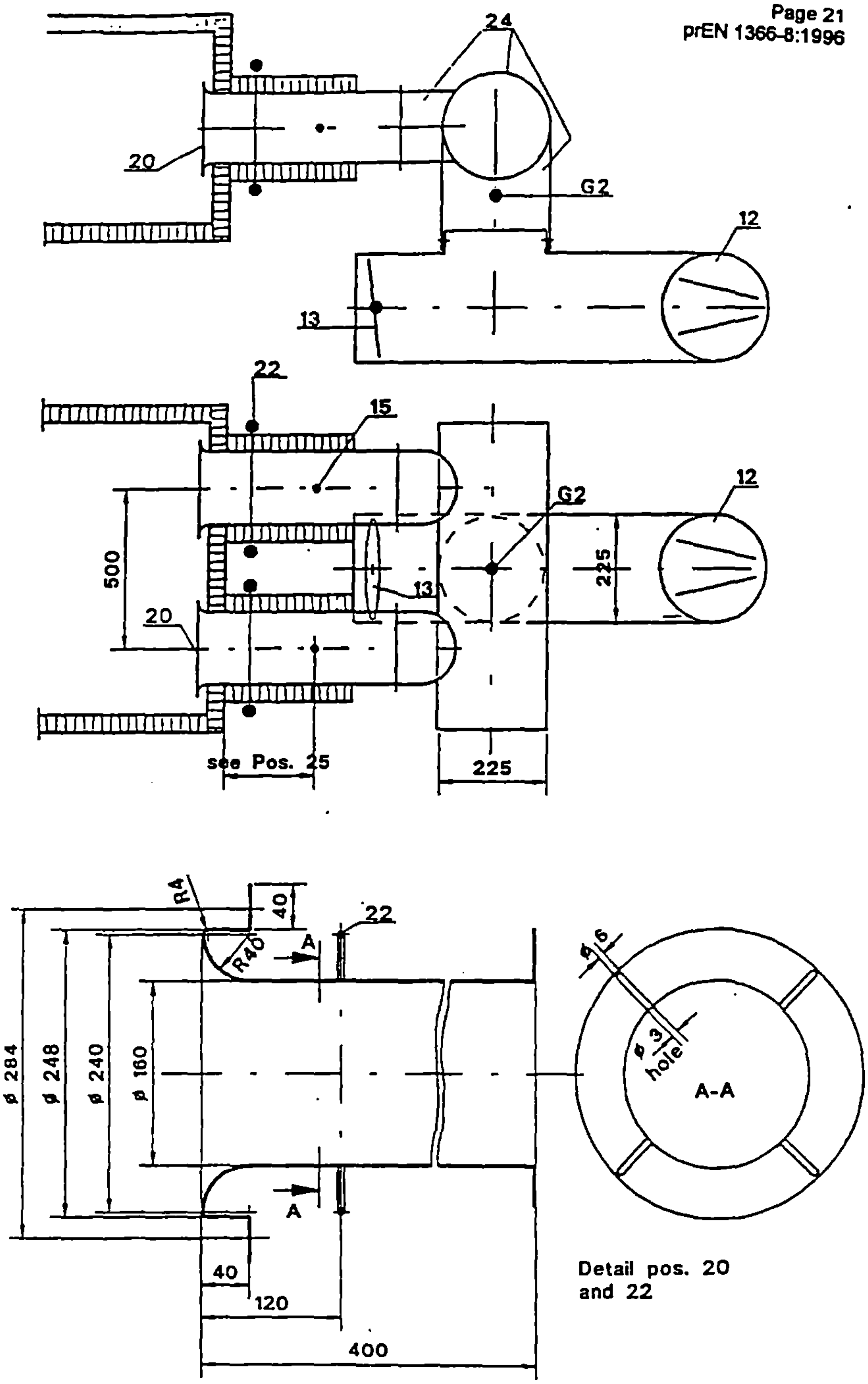
24 Connecting tube

25 Distance: Inlet nozzel to thermocouple = 2d

G1 Gas-testing probe at the perforated plate

G2 Gas-testing probe

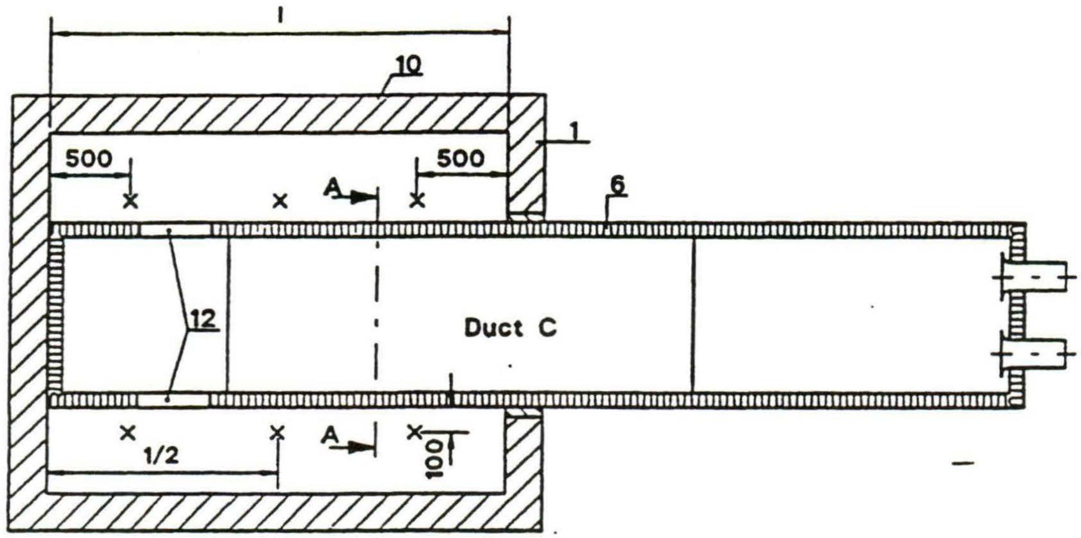
Figure 7 - Arrangement of gas-testing probes



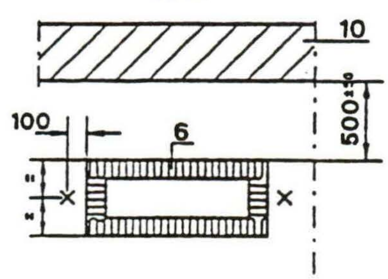
24 Connecting tube (tightly welded, inlet nozzles Pos. 20 welded on)

Figure 8 - Detail to Figure 7

Dimensions in mm



A-A



1 Furnace wall

6 Insulation

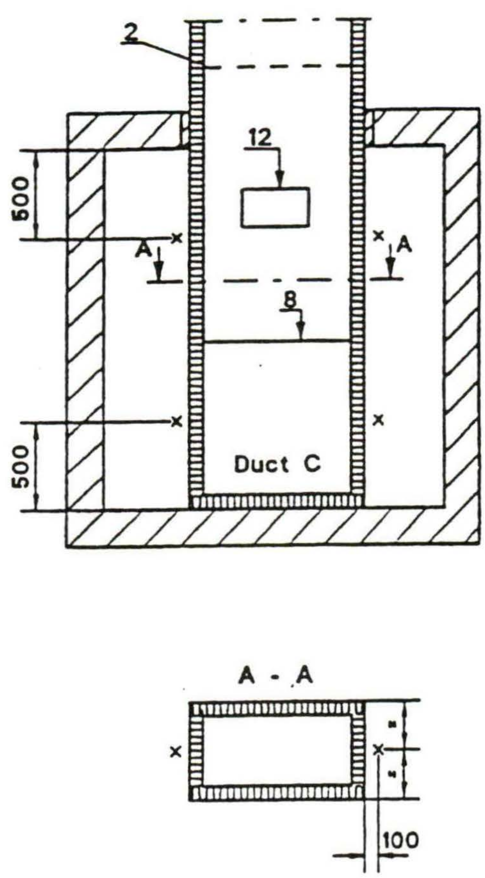
10 Furnace roof

12 Openings: total cross section 50% of duct section Duct C

x Thermocouples

Figure 9 - Arrangement of furnace thermocouples in case of horizontal ducts

Dimensions in mm



1 Furnace wall

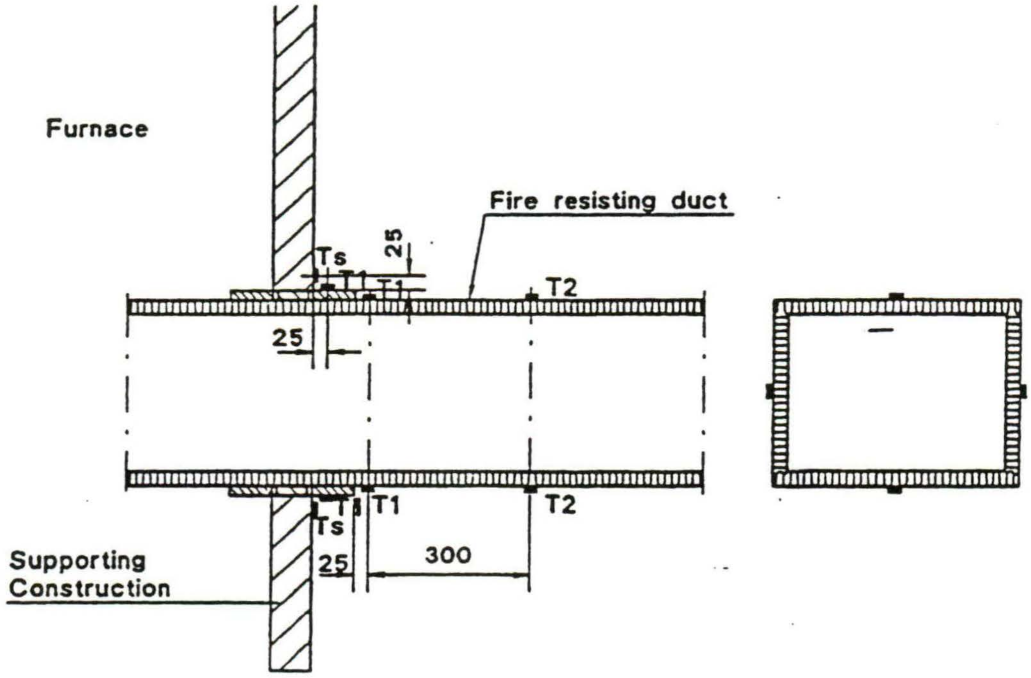
2 Perforated plate

10 Furnace roof

12 Openings: total cross section 50% of duct cross section Duct C in the ratio of 1:4 for rectangular ducts

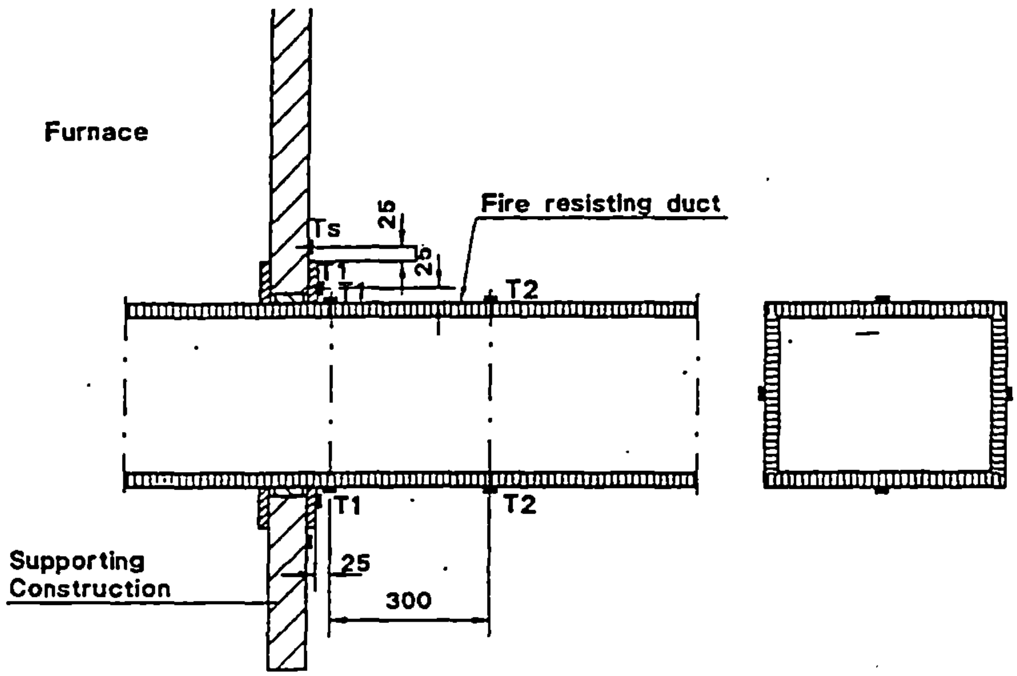
13 Furnace floor

Figure 10 - Location of furnace thermocouples for ducts in vertical position (see also figure 1)



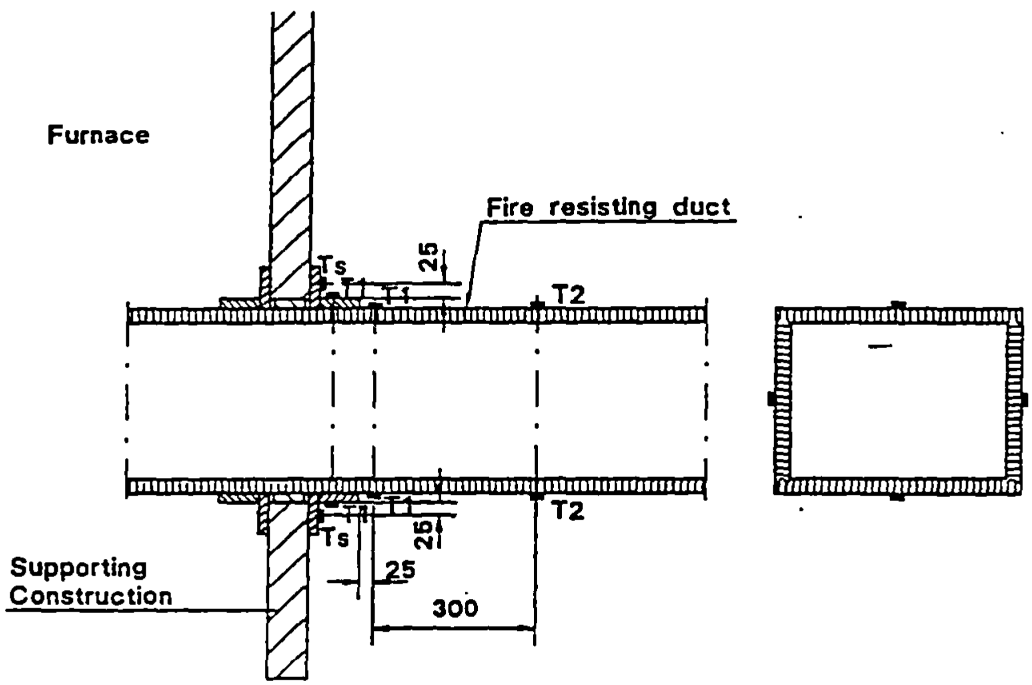
Ts	Maximum surface on supporting construction
T1	Surface thermocouples for determinig maximum temperature
T2	Surface thermocouples for determining average and maximum temperature
Ts, T1, T2	Minimum of on each side of the duct
▬	Surface thermocouples
Note	Supporting construction and location of surface thermocouples to fire resisting ducts that have been testet to duct B

Figure 11 - Location of surface thermocouples
(only for information)



Ts	Maximum surface on supporting construction
T1	Surface thermocouples for determinig maximum temperature
T2	Surface thermocouples for determining average and maximum temperature
Ts, T1, T2	Minimum of on each side of the duct
▬	Surface thermocouples
Note	Supporting construction and location of surface thermocouples to fire resisting ducts that have been testet to duct B

Figure 12 - Location of surface thermocouples
(only for information)



Ts	Maximum surface on supporting construction
T1	Surface thermocouples for determinig maximum temperature
T2	Surface thermocouples for determining average and maximum temperature
Ts, T1, T2	Minimum of on each side of the duct
▬	Surface thermocouples
Note	Supporting construction and location of surface thermocouples to fire resisting ducts that have been testet to duct B

Figure 13 - Location of surface thermocouples
(only for information)

Dimensions in mm

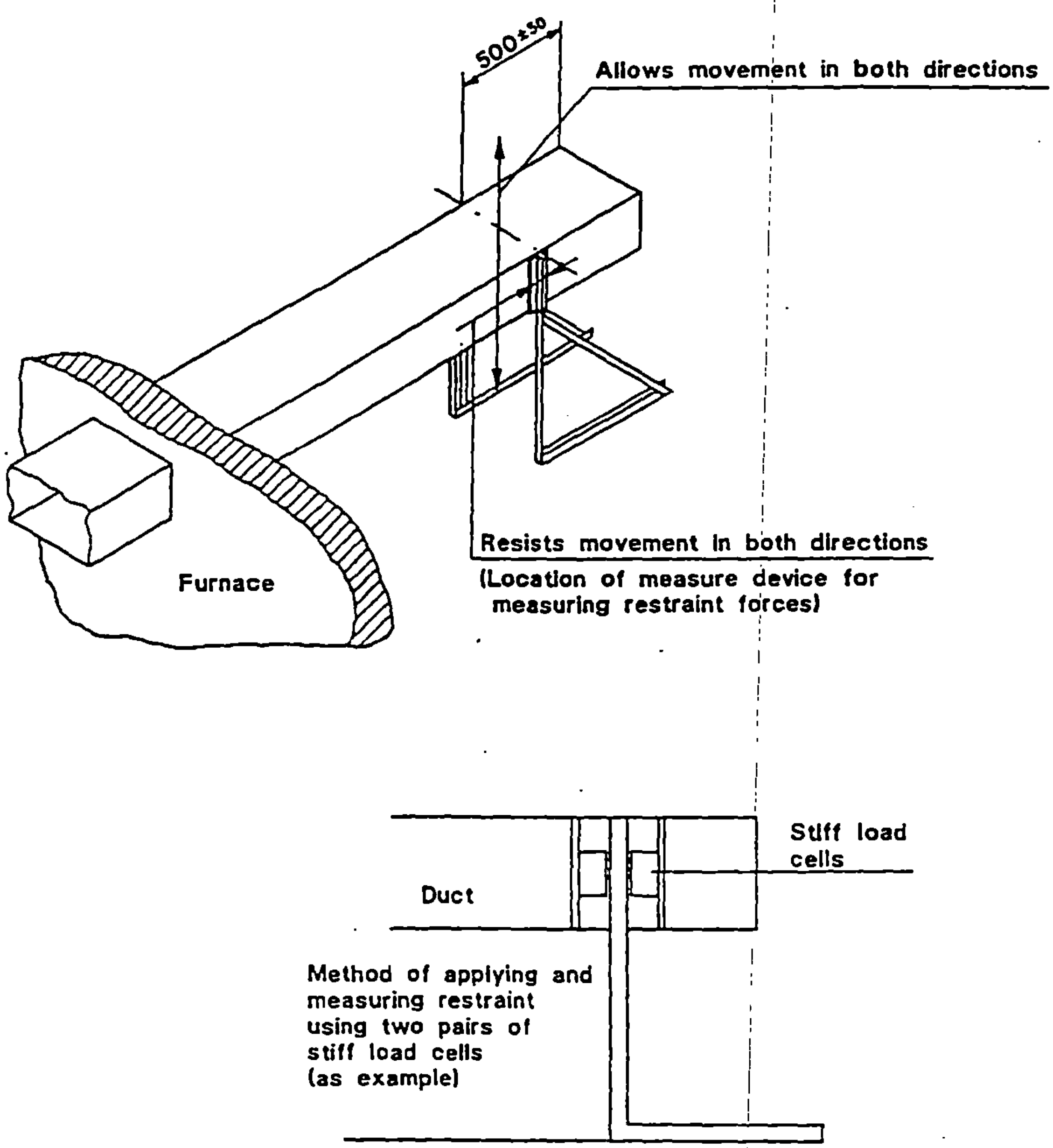


Figure 14 - Restraint of Duct C outside the furnace

Document CEN/TC 127

N1073

British Standards Institution

Secretariat of CEN/TC127

1996-10-31

CEN/TC127
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prEN 1366 FIRE RESISTANCE TESTS FOR SERVICE INSTALLATIONS

PART 1 DUCTS

(This is the revised text taking into account comments received during the six month enquiry and decisions made in considering EN 1363-1).

Contents

Foreword

This Part of this European Standard has been prepared by Technical Committee CEN/TC127 'Fire safety in buildings'. The text of the draft Standard was submitted to the formal vote and was approved by CEN as EN1366-1 on 199X-XX-XX.

This Part of this European Standard has been prepared under a Mandate given to CEN by the Commission of the European Communities and the European Free Trade Association, and supports essential requirements of the Construction Products Directive.

This Part of this European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by [month] 199X and conflicting national standards shall be withdrawn at the latest by [month] 199X.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this Part of this European Standard.

Drafting note As work is still proceeding in adhoc 14 on furnace calibration, further changes may be made to this text as a result of the adhoc 14 recommendations.

Introduction

The purpose of this test is to measure the ability of a representative duct or duct assembly that is part of an air distribution system to resist the spread of fire from one fire compartment to another with fire attack from inside or outside the duct. It is applicable to vertical and horizontal ducts, with or without branches, taking into account joints and exhaust openings, as well as suspension devices and penetration points.

The test measures the length of time for which ducts, of specified dimensions, suspended as they would be in practice, satisfy defined criteria when exposed to fire from (separately) both inside and outside the duct.

All ducts are fully restrained in all directions where they are inside the furnace. Outside the furnace, ducts exposed to fire from the outside are tested unrestrained, while ducts exposed to fire from the inside (horizontal only) are tested restrained.

The test takes into account the effect of fire exposure from the outside where a 300 Pa underpressure is maintained in the duct as well as the effect of fire entering the ducts in conditions where forced air movement may or may not be present by maintaining a velocity of 3m/s.

Ducts exposed to fire from the inside are supplied with air in a manner which is indicative of the "fan off" and "fan on" situations which could arise in practice.

Caution

The attention of all persons concerned with managing and carrying out this fire resistance test is drawn to the fact that fire testing may be hazardous and that there is a possibility that toxic and/or harmful smoke and gases may be evolved during the test. Mechanical and operational hazards may also arise during the construction of the test elements or structures, their testing and disposal of test residues.

An assessment of all potential hazards and risks to health shall be made and safety precautions shall be identified and provided. Written safety instructions shall be issued. Appropriate training shall be given to relevant personnel. Laboratory personnel shall ensure that they follow written safety instructions at all times.

1 Scope

This Part of EN 1366 specifies a method for determining the fire resistance of vertical and horizontal ventilation ducts under standardized fire conditions. The test examines the behaviour of ducts exposed to fire from the outside (duct A) and fire inside the duct (duct B). This Standard shall be read in conjunction with EN 1363-1.

The informative annex A provides general guidance and gives important background information.

This European Standard is not applicable to:

a) ducts whose fire resistance depends on the fire resistance performance of a ceiling;

b) ducts containing fire dampers at points where they pass through fire separations;

c) doors of inspection openings, unless included in the duct to be tested;

d) two or three sided ducts;

e) fixing of suspension devices to floors or walls.

For evaluation of fire dampers see EN 1366-2.

For evaluation of smoke extraction ducts see EN 1366-8.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1363	Fire resistance tests Part 1: General requirements
EN 1363	Fire resistance tests Part 2: Alternative and additional procedures
EN 1366	Fire resistance tests tests for service installations Part 2: Dampers
EN 1366	Fire resistance tests tests for service installations Part 8: Smoke extraction ducts
EN 1507	Ventilation for buildings - Ductwork - Rectangular sheet metal air ducts - Strength and leakage - Requirements and testing
ISO/IEC	Guide 52 Fire tests - Vocabulary
ISO 898	Mechanical Properties of fasteners Part 1: Bolts, screws and studs
ISO 5167	Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits
ISO 5221	Air distribution and air diffusion - Rules to methods of measuring air flow rate in an air handling ducts

3 Definitions

For the purposes of this Part of EN 1366, the definitions given in EN 1363-1 and ISO/IEC Guide 52, together with the following, apply:

3.1 fire resisting duct: A duct used for the distribution or extraction of air and designed to provide a degree of fire resistance.

3.2 suspension devices: The components used for suspending and fixing a duct from a floor or supporting a duct from a wall.

3.3 supporting construction: The wall, partition or floor which the duct passes through in the test.

3.4 compensator: A device that is used to prevent damage from the forces generated by expansion.

4 Test equipment

4.1 General

In addition to the test equipment specified in EN 1363-1, and if applicable EN 1363-2, the following is required:

4.2 Furnace

This shall be capable of subjecting ventilation ducts to the standard heating and pressure conditions specified in EN 1363-1 and be suitable for testing ducts in the vertical (see figure 1) or horizontal (see figure 2) orientation.

4.3 Fan A

This shall be able to produce at the start and throughout the test an underpressure of (300 ± 15) Pa within duct A (see figure 3) and shall be connected either directly, or by a suitable length of flexible ducting, to the measuring station described in 4.5.

4.4 Fan B

This shall be able to produce an air velocity when extracting gas from duct B (see figure 4), of at least 3m/s measured at ambient temperature in the duct before the test. It shall be connected either directly, or by a suitable length of flexible ducting, to the velocity measuring station described in 4.8. The fan shall be provided with a by-pass vent that can be opened prior to the damper described in 4.7 being shut.

4.5 Volume flow measuring station

This shall consist of a venturi, orifice plate, or other suitable device and (where necessary) an air flow straightener, installed in straight lengths of pipe, all sized to ISO 5167/ISO 5221. It shall be connected to the end of duct A outside the furnace to determine the volume flow rate of gas passing through duct A during the test. The measuring device shall be capable of measuring to an accuracy of ± 5%. Regardless whether vertical or horizontal ducts are being tested, the volume flow measuring station shall always be used in a horizontal orientation.

4.6 Condensing unit

This shall be installed between the end of duct A and the flow measuring device and shall allow for drainage. The gas temperature adjacent to the flow measuring device shall be measured by a 2mm sheathed thermocouple with an insulated hot junction, arranged pointing downwards to allow for draining moisture. Its measuring junction shall be located at the centre line of the measuring duct and at a distance equal to twice the diameter of the measuring duct downstream from the flow measuring device. The temperature measured by this thermocouple shall not exceed 40° C.

4.7 Damper

This shall be installed between the fan and the velocity measuring station to shut off the air flow in duct B during evaluation of integrity in the "fan-off" condition.

4.8 Velocity measuring station

This shall determine air velocity in duct B and shall consist of one or two inlet nozzle(s), or other suitable device, installed in a straight length of pipe sized to ISO 5167 / ISO 5221, connected to the end of both the vertical and horizontal duct B outside the furnace.

4.9 Thermocouples

Thermocouples for measuring the internal and external temperatures of the test specimens shall be provided as described in 9.1. If necessary, a roving thermocouple shall also be provided see 10.2.2.

4.10 Equipment for measuring gas pressure

This shall be provided in the furnace and inside duct A.

4.11 Thermal movement measuring device

This shall be provided for measuring expansion/contraction of duct A and shall have an accuracy of ±1mm.

4.12 Force measuring device

This shall be provided for measuring forces at the point of applying restraint in duct B (see figure 5).

5 Test conditions

The heating conditions and the furnace atmosphere shall conform to those given in EN 1363-1, or if applicable, EN 1363-2.

The furnace pressure shall be controlled to (15 ± 3) Pa throughout the test at the mid-height position of the ducts.

Details of test conditions within the ducts during the test are given in clause 10.

6 Test specimen

6.1 Size

6.1.1 Length

The the minimum lengths of the parts of the test specimen inside and outside the furnace shall be as given in table 1. (see also figures 1 and 2):

Table 1 Minimum length of test specimen

Orientation	Minimum length (m)	
	Inside furnace	Outside furnace
Horizontal	4.0	2.5
Vertical	2.0	2.0

6.1.2 Cross-section

The standard sizes of ducts given in table 2 shall be tested unless only smaller cross-sections are used in practice:

Table 2 Cross section of test specimens

Duct	Rectangular		Circular
	width (mm)	height (mm)	diameter (mm)
A	1000±10	500±10	800 ± 10
B	1000±10	250±10	630 ± 10

6.2 Number

One test specimen shall be tested for each type of installation to be evaluated.

6.3 Design

6.3.1 General

The test shall be made on a test specimen representative of the complete duct assembly on which information is required. The edge conditions and the method of fixing or support inside and outside the furnace shall be representative of that used in practice.

Ducts shall be arranged as shown in figures 1 and 2.

6.3.2 Minimum separation

There is no limit to the number of ducts that may be tested in the same furnace, provided that there is sufficient space to do so, in accordance with the dimensions shown in figures 1 and 2.

There shall be a separation of (500 ± 50)mm between the top of the horizontal duct and the ceiling. A minimum separation of 500 mm shall be provided between the underside of the horizontal duct and the floor. Similarly, there shall be a minimum separation of at least 500mm between the sides of ducts and furnace walls.

6.3.3 Configuration of duct A

The horizontal duct A shall include one sharp bend, a T-piece and a 500mm long length of duct to form a short branch duct having a cross-section of 250mm x 250mm, and shall be arranged as shown in figure 2. All specimens including this branch shall be mounted with the suspension or fixing devices as would be intended in practice.

6.3.4 Openings in duct B

Two openings shall be provided, one on each vertical side of the duct inside the furnace. For horizontal ducts the openings shall be positioned (500 ± 25)mm from the furnace wall. For vertical ducts the openings shall be positioned (200 ± 10)mm below the furnace roof (see figure 1 and 2).

In both vertical and horizontal ducts the openings shall have the same breadth/height ratio as the cross-section of the duct and have a total opening area of (50 ± 10)% of the cross-sectional area of the duct, i.e. each opening shall have an area of (25 ± 5)% of the cross sectional area of the duct.

6.3.5 Joints in horizontal ducts

The test configuration shall include at least one joint inside the furnace and at least one joint outside it.

There shall be at least one joint every layer of fire protection material, both inside and outside the furnace and in any steel duct.

Outside the furnace, the joint in the outer layer of the fire protection material shall be no further than 700mm from the supporting construction and no nearer than 100mm to thermocouples T_2. Inside the furnace, the joint in the outer layer of fire protection material shall be located at approximately mid-span.

The distance between joints and suspension devices shall not be less than that intended in practice. If the minimum distance has not been specified, suspension devices shall be arranged so that the joint at mid-span lies midway between them. Centres of the suspension devices shall be specified by the manufacturer and shall be representative of practice.

6.3.6 Joints in vertical ducts

The test configuration shall include at least one joint inside and one joint outside it (see figure 1).

There shall be at least one joint every layer of fire protection material, both inside and outside the furnace and in any steel duct.

Outside the furnace, the joint in the outer layer of the fire protection material shall be no further than 700mm from the supporting construction and no nearer than 100mm to thermocouples T_2. Inside the furnace, the joint in the outer layer of fire protection material shall be located at approximately mid-span.

6.3.7 Support for vertical ducts

These shall be supported on the furnace floor and penetrate through the furnace roof slab/supporting construction (see figure 1); the ducts shall be fixed at the furnace roof level as they would be fixed in practice when penetrating a floor. This shall be as specified by the sponsor.

6.3.8 Compensators

Only where compensators are used in practice shall they be incorporated in the test specimen. Where a compensator is to be tested it shall be located within the furnace for duct A and for duct B outside the furnace approximately 500mm from the wall or floor.

6.3.9 Steel ducts

Where steel ducts are used, these shall have class A leakage in accordance with EN 1507.

7 Installation of test specimen

7.1 General

The test specimen shall be installed, as far as possible, in a manner representative of its use in practice.

7.2 Supporting construction

The supporting construction selected shall be a wall, partition or floor of the type to be used in practice and have fire resistance greater than the required fire resistance of the duct being tested.

Where the duct passes through an opening in the furnace wall or roof, then the opening shall be of sufficient dimensions to allow for the supporting construction to surround all faces of the duct by at least 200mm.

Where the type of supporting construction to be used in practice is not known then the standard supporting constructions in tables 3 and 4 shall be used.

Table 3 Standard wall constructions

Type of construction	Thickness mm	Density kg/m³	Test duration h
Normal concrete/ masonry	110 ± 10	2200 ± 200	≤ 2
	150 ± 10	2200 ± 200	> 2 ≤ 3
	175 ± 10	2200 ± 200	> 3 ≤ 4
Aerated concrete[1)]	110 ± 10	650 ± 200	≤ 2
	150 ± 10	650 ± 200	> 2 ≤ 4

Note: Information on standard gypsum board walls, insulated with mineral wool, is given in EN 1366-3.

Table 4 Standard floor constructions

Type of construction	Thickness mm	Density kg/m³	Test duration h
Normal concrete	110 ± 10	2200 ± 200	≤ 1.5
	150 ± 10	2200 ± 200	> 1.5 ≤ 3
	175 ± 10	2200 ± 200	> 3 ≤ 4
Aerated concrete[1)]	125 ± 10	650 ± 200	≤ 2
	150 ± 10	650 ± 200	> 2 ≤ 4

[1)] This supporting construction is made from blocks, bonded together with mortar or adhesive, or panels, joined together with tongue and groove type joints.

7.3 Restraint of ducts

7.3.1 Inside the furnace

All ducts shall be fully restrained in all directions at the furnace wall or floor remote from the penetration point. Where there is a possibility of the furnace wall moving then the fixings shall be made to be independent of the furnace structure.

7.3.2 At the penetration point

Where in practice the duct is fixed at floor levels, then both vertical ducts A and B are to be fixed where the duct penetrates the furnace roof/supporting construction as specified by the sponsor.

7.3.3 Outside the furnace

Only horizontal duct B is to be restrained outside the furnace. The restraining point shall be located at a position (2000 ±50)mm from the furnace wall and shall provide restraint on movement in horizontal directions but shall allow movement in vertical directions (see figure 5). The frame used to apply the restraint shall be rigid and have sufficient strength to resist all horizontal forces. All other ducts shall be unrestrained outside the furnace.

7.3.4 Closure

The end of the ducts within the furnace and the end of any branch duct attached shall be closed independently of any furnace enclosure by materials and construction similar to the remainder of the duct.

7.3.5 Fire stopping

The fire-stopping at the penetration through the supporting construction shall be as intended in practice. If the width of the gap for fire-stopping around the duct at the furnace penetration point is not specified, a width of 50mm shall be used.

7.3.6 Unsupported vertical ducts

Where, in practice, vertical ducts are not fixed to each floor, then the test specimen shall be suitably loaded to simulate the weight of the remaining height of unsupported ducting.

8 Conditioning

Conditioning of the test construction shall be in accordance with EN 1363-1. Care should be taken to allow supporting constructions which have a high water content to dry to avoid damage to the specimen o alter its performance.

9 Application of instrumentation

9.1 Thermocouples

9.1.1 Furnace thermocouples

The positions of the furnace thermocouples shall be as shown in figures 6 and 7.

9.1.2 Unexposed surface thermocouples

9.1.2.1 General

The temperature of the test specimens shall be measured with thermocouples as described in EN 1363-1. The position of thermocouples at the point of penetration of the duct through the wall or floor is shown in figures 8 to 11 for a number of different penetration details.

9.1.2.2 Average temperature rise

Thermocouples T_2 shall be used to determine the average temperature rise.

9.1.2.3 Maximum temperature rise

Thermocouples T_1, T_2 and T_3 shall be used for determining maximum temperature rise.

Additional thermocouples T_1 for determining maximum temperature rise shall be located in positions on the outer surface of the fire protection material to coincide with all joints (inner layer joints as well).

9.1.2.4 Kitchen extract ducts/combustible linings

For kitchen extract ducts or where combustible internal linings are used, four additional thermocouples, reference T3, shall be fixed inside duct A, at a position of approximately mid-span within the part of the duct exposed within the furnace. The thermocouples shall be fixed to the inside face of the duct at the locations shown in figure 11. The thermocouples shall not coincide with joints or cover strips. The thermocouples shall be used to determine the average and maximum temperature rises.

9.1.2.5 Compensating devices

Where compensating devices have been incorporated, thermocouples shall be located on the outer surface of the compensator in duct B. These shall be used to check compliance with the maximum temperature rise limits only.

9.1.2.6 Suspension device

Where steel suspension devices are protected, then their temperatures shall be measured. A thermocouple shall be positioned on each component of at least two suspension device systems.

9.2 Pressure

Furnace pressure shall be measured in accordance with EN 1363-1 and the pressure probe(s) located at a position 100mm below the roof of the furnace.

10 Test procedure

10.1 Control of conditions to permit assessment of integrity

10.1.1 Duct A

Control the underpressure inside duct A (see figures 1 and 2) to (300 $\pm$ 15)Pa below the ambient (laboratory) pressure at the beginning of the test and maintain it at this value throughout the test.

10.1.2 Duct B

Prior to the start of the test stabilise the air velocity in duct B (see figure 1 and 2) to 3m/s. Adjust the fan during the "fan on" parts of the test to maintain the velocity of (3 $\pm$ 0.45)m/s.

25 minutes after the start of the test, open the fan by-pass vent and then shut the damper whilst leaving the fan running. Allow two minutes for the conditions to stabilise in duct B.

Make an assessment of integrity of the duct assembly outside the furnace to be carried out under stable conditions in the simulated "fan off" situation for a period of 3 min. Then re-open the damper and close the by-pass vent. The damper shall be opened or shut in not less than 10s and not more than 20s. Check that velocity of the fan is within the limits defined above.

Repeat this procedure five minute before the completion of every 30 min period of the test. Make assessments of integrity in the damper open position (fan-on situation) at all other times.

10.2 Test measurements and observations

10.2.1 Integrity

10.2.1.1 For ducts A and B including where the ducts pass through the wall or floor:

Evaluate the test specimen for integrity as given in EN 1363-1. Table 5 summarises the evaluation required to assess integrity.

Table 5 Summary of appropriate integrity evaluation

DucT	Within Furnace	Outside Furnace
Duct A (Fire outside duct)	Volume flow rate	Volume Flow Rate Cotton Pad Openings Flaming
Duct B (Fire inside duct)	——	Cotton Pad Openings Flaming

10.2.1.2 For duct A only:

Record the pressure differential across the venturi, orifice plate, etc. at not more than two minute intervals throughout the test.

Calculate the leakage from the recorded pressure differential from the venturi, orifice plate, etc. using the formulae for volume flow rates given in ISO 5167/ISO 5221.

10.2.2 Insulation

Measure the average and maximum temperatures of the unexposed faces of the test specimens as specified in EN 1363-1. Use a roving thermocouple to locate points of high temperature not covered by the fixed thermocouples.

10.2.3 Restraint forces and thermal elongation or shortening

Measure and record the restraint force in horizontal duct B on the outer surface (see figure 5) at the point of application of the restraint outside the furnace.

Measure and record the thermal elongation or shortening of horizontal duct A (see figure 2) at the penetration point.

Measure the restraint forces in duct B using the device described in 4.12. In duct A, measure thermal movement by the transducer specified in 4.11.

10.2.4 Additional observations

Throughout the test, make observations of all changes and occurrences which do not affect the performance criteria but which could create hazards in a building, including, for example:

a) deflections; this shall cover the general behaviour of the duct e.g. the direction in which it is deflecting. Precise measurements are not required.

b) the emissions of smoke from the unexposed face of the duct. This may, for example, be attributable to its coverings and/or lining. Only limited observations may be possible in view of the highly subjective nature of such observations.

c) the time when the suspension or fixing devices can no longer retain a duct in its intended position or when sections of the duct collapse.

d) the expansion/contraction of each layer of protection material and the duct, at the end of horizontal duct A.

10.3 Termination of the test

Terminate the test for the reasons given in EN 1363-1.

11 Performance criteria

11.1 Integrity

Integrity failure shall be deemed to have occurred if any of the following are observed:

a) integrity failure as defined in EN 1363-1,

b) the volume flow rate measured in duct A exceeds 15 m^3/m^2 hour at normal temperature and pressure, related to the internal surface area of the duct inside the furnace.

11.2 Insulation

11.2.1 General

Insulation failure shall be as defined in EN 1363-1.

> NOTE: Only thermocouples T_2 shall be used to determine the average temperature rise, (see 9.1.2.5).

11.2.2 Kitchen extract and ducts with internal combustible linings only

Insulation failure shall be as defined in EN 1363-1.

> NOTE: Thermocouples T_3 shall also be used to determine the average and maximum temperature rise, (see 9.1.2.4).

11.3 Smoke Leakage

Failure of this criterion shall have occurred if the flow rate in duct A during the test exceeds 10 m^3/m^2 hour, at normal temperature and pressure, related to the internal surface area of the duct inside the furnace.

12 Test report

In addition to the items required by EN 1363-1, the following shall also be included in the test report.

a) the number of sides of the test specimens exposed to fire in the furnace;

b) the method of fixing, support and mounting, as appropriate for the type of test specimen;

c) a description of the method and materials used to seal the gap between the duct and opening provided in the wall or floor to accommodate the duct;

d) the details of the supporting construction and, where vertical ducts are loaded, the number of storeys that this represents;

e) a graph of the force recorded at the restraint point in horizontal duct B against time;

f) the thermal elongation or shortening of horizontal duct A;

g) other observations made during the test according to 10.2.4, including a complete record of the following test parameters as a function of time:

- i) volume flow measuring station gas temperatures
- ii) calculated volume flow rate.

h) performance achieved in relation to 11.3.

i) where steel ducts are used, the thickness, leakage class to EN 1507, and whether any external stiffening or internal stiffeners were incorporated.

13 Field of direct application of test results

13.1 Vertical and horizontal ducts

A test result obtained for horizontal ducts A and B is applicable to horizontal ducts only.

A test result obtained for vertical ducts A and B is applicable to vertical ducts without branch.

A test on horizontal duct A which includes a branch duct also covers the use of branches on previously tested vertical ducts.

13.2 Sizes of ducts

A test result obtained for the standard sizes of duct A and duct B specified in tables 1 and 2 is applicable to all dimensions up to the size tested together with the increases given in table 6.

Table 6 Increase in dimensions permitted under direst application

	Rectangular width mm	Rectangular height mm	Circular diameter mm
Duct A	+ 250	+ 500	+ 200
Duct B	+ 250	+ 750	+ 270

For ducts tested with smaller sizes than the specified standard sizes, no extrapolation to larger sizes can be allowed.

For ducts tested larger than the allowable upper limits for extrapolation, no extrapolation to larger sizes are allowed.

If an independent protection system is used, the internal dimensions of the protection system shall be used to validate the field of application.

13.3 Pressure difference

13.3.1 A test result obtained for the standard underpressure of 300 Pa in duct A is applicable to an underpressure and an overpressure up to the same value providing that the integrity criteria during the duct B test was satisfied.

13.3.2 A test result obtained for a higher underpressure (minimum 500 Pa) in duct A is applicable to an underpressure and to an overpressure of 500 Pa providing that the integrity criteria during the duct B test was satisfied. Where higher overpressures are possible, an additional test may be needed. Guidance is given in A.5.5.

13.4 Height of Vertical Ducts

13.4.1 Ducts supported at each storey

The test results are applicable to any number of storeys provided:

i) the distance between supporting constructions does not exceed 5m

ii) limitations on buckling are satisfied (see 13.4.3)

13.4.2 Self loadbearing ducts

Test results obtained from ducts with additional load are applicable to ducts with an overall height corresponding to the load applied in the fire test. Limitations on buckling shall also be satisfied. (see 13.4.3)

13.4.3 Limitations on buckling

In order to prevent damage to the fire protection of material from buckling of vertical ducts, the test results are only applicable to situations where the ratio between the length of the duct exposed in the compartment to the smallest lateral dimension across the outside face of the duct (or outer diameter) does not exceed 8:1, unless additional supports are provided.

In cases where additional supports are provided, the ratio of the distance between the additional supports, or the distance between the supports and the supporting construction and to the smallest lateral dimension across the outside face of the duct (or outer diameter) shall not exceed 8:1.

13.5 Suspension devices for horizontal ducts

13.5.1 As the test configuration does not allow an assessment of the loadbearing capacity, the suspension devices shall be made of steel and be sized such that the calculated stresses do not exceed the values given in table 7.

Table 7 Maximum values of stresses in suspension devices depending on duration of fire resistance.

Type of load	Maximum stresses (N/mm²)	
	≤ 60 min	> 60 ≤ 120 min
Tensile stress in all vertically orientated components	9	6
Shearing stress in screws of property class 4.6 to ISO 898-1	15	10

Note: Stress is calculated from supported load only (and ignores assembly stresses)

13.5.2 The elongation in mm of the suspension devices of the test ducts can be calculated on the basis of temperature increases and stress levels. For unprotected steel suspension devices, the temperature used shall be the maximum furnace temperature. For protected steel suspension devices, the maximum recorded suspension device temperature shall be used. The value calculated represents the elongation limit for suspension devices with a greater length than in the test. (For unprotected suspension devices of approximately 1.5m length an elongation of 40mm can be expected).

13.5.3 The largest distance between suspension devices used in the test construction cannot be exceeded.

13.5.4 If suspension devices have been used at all joints within the furnace, than suspension devices shall be located at all joints in practice.

13.5.5 In cases where the lateral dimension between the outer vertical surface of the duct and the centre line of the suspension device is less than 50mm, the test result shall apply up to 50mm. The lateral dimension shall not exceed 50mm unless demonstrated by test.

13.5.6 The horizontal loadbearing component of the suspension device system shall be sized so that the bending stress does not exceed that applied to the equivalent member in the test.

13.6 Supporting construction

A test result obtained for a fire resisting duct passing through a supporting construction made of masonry, concrete or partition (without any cavity) is applicable to the same type of supporting construction with a thickness and density equal to or greater than that of the supporting construction used for the test.

13.7 Steel ducts

The test results shall apply to those ducts having lower leakage values provided that the steel duct tested represents the highest leakage value (class A, EN1507).

Test results on a steel duct that has been stiffened shall only apply to ducts that are also stiffened in a similar manner.

The applicability of results to ducts of lower leakage values only applies when the lower leakage rate is not achieved by means of combustible seals.

ANNEX A - INFORMATIVE

GENERAL GUIDANCE

A.1 General

The following explanatory notes are intended to serve as guidance for the planning, performance and reporting of a fire resistance test carried out in conformity with this European Standard.

A.2 Notes on apparatus

A.2.1 Volume flow measuring station

A condensing device has been included as the gas flow measurements can be affected by the presence of steam. The content of steam is dependant on the material used in the test specimen. The use of a condensing device should exclude the influence of steam.

To ensure that the condensing device meets this objective a requirement has been introduced that the temperature at the measuring device should not exceed 40°C. It is for the test laboratory to provide a condensing device of adequate capacity to meet this requirement.

A.2.2 Extraction fan

A fan which can provide up to $600m^3/h$ air flow, at up to 500°C, and 1000Pa pressure should meet the requirements given in this European Standard.

A fan for extracting gas from duct B, with a suction capacity of at least twice the velocity in the cross-section of the duct (required capacity : V_a = 3m/s x 1m x 0.25m = $0.75m^3/s$), is sufficient to produce the required air velocity in the ducts of 3m/s.

It may be necessary to provide a supply of fresh air (dilution air) into the extract fan to enable the hot gases to be cooled before passing through the fan. Irrespective of this, the fan shall be capable of extracting gases up to 300°C.

The fan shall be able to provide sufficient gas flow even when deformation of the duct reduces its cross-sectional area by up to 25%. Any larger decreases in cross-sectional area will almost inevitably be accompanied by an integrity failure and therefore this can be disregarded for determining the fan capacity.

The regulation of the gas flow can be achieved by installing a flow rate controller just before the fan.

A.3 Notes on test specimens

A.3.1 Design

The test specimen should be representative of duct installations in practice.

The cross-section sizes have been selected so as to cover the most common sizes of ducts used in air distribution systems.

It is recommended that ducts should be tested with compensators where expansion or contraction is likely to be significant. This means that joints, suspension and fixing devices, bolts, etc., should be included and mounted in accordance with the manufacturer's instructions. The distance separating joints and the span between supports should be sufficient to enable interpolation within a range of other smaller dimensions to be made.

In some situations, the furnace may be too small to reproduce a relevant fire exposure in a particular duct assembly. This means that the duct assembly to be used in practice may need to be modified in order to fit it into the furnace.

In most cases the largest ducts are likely to be tested are those which can be accommodated in the furnace whilst maintaining the specific velocity in the duct of 3m/s. Unjustifiable extrapolation to ducts restrained in a different manner, supported at greater intervals or of a larger size, should not be made. Care should be taken when making any assessment of the performance of ducts which do not entirely conform in practice with the conditions represented in the test. Larger cross-sections of ducts may be tested provided any surface of the duct is not closer than 500mm to the furnace walls, floor or roof.

Distortion of rectangular ducts is generally more severe than distortion of square or round ducts. The longest side of the horizontal specimen should normally be orientated horizontally in the furnace.

This European Standard requires the testing of a minimum length of 4.0m for horizontal ducts and 2.0m for vertical ducts inside the furnace and 2.5m and 2.0m respectively outside the furnace. These lengths have been chosen in order to use the fire test furnaces available in most countries.

A.3.1 Thermal elongation, shortening and restraint forces

A.3.1.1 Effect on supporting constructions

During fire exposure the ducts can expand or shrink due to high temperatures. This may cause premature failure of a non-loadbearing lightweight partition if the duct is fixed to it or butts against it. The expansion or shrinkage of the duct will apply a force to the supporting construction.

A.3.1.2 Effect on joints, attachments, etc

During a fire test, joints, attachment devices and a representative wall or floor with fire-stopping are considered as being parts of the duct system being evaluated. Alternative joints, attachment devices, fire-stopping, etc., should not be used unless it can be shown that the performance in respect to integrity will not be worse and that the force on the wall or floor resulting from expansion or shrinkage will not be greater.

A.3.1.3 Restraint

In some end use situations horizontal ducts, with or without applied fire protection outside the fire compartment, are subject to rigid constraint against elongation. This may result from building works e.g. a wall against which the duct abuts, or because the rest of the duct assembly outside the fire compartment will itself provide restraint e.g. ducts with short, rigid supports.

In these situations full restraint is reproduced in duct B. This is provided (2000 ± 50)mm from and outside the furnace and also at the end of the duct inside the furnace. The restraint in the furnace is provided by either by the furnace wall or by an independent structure.

If an independent structure is used that requires the sealed end of the duct to pass through the wall of the furnace, any seals provided between the duct and the furnace wall for this purpose are not subject to evaluation against the criteria of integrity or insulation.

A.4 Notes on test conditions

A.4.1 Temperature-time development

If the ventilation ducts are assumed to be subject to a fully developed fire, the temperature-time curve according to EN 1363-1 is chosen. For information on other temperature regimes see EN 1363-2.

A.4.2 Anticipated pressure ranges

The movement of air in a duct passing through a compartment on fire, and which has no openings to that compartment, may create an underpressure on the duct walls which may encourage the fire to exploit any cracks which develop in the duct. An underpressure of (300 ± 15)Pa in horizontal duct A has been chosen as being realistic in this "worst case" situation and is the underpressure at which any integrity failure of the specimen within the furnace shall be measured. Applications for higher pressure levels should be assessed on an individual basis.

A.5 Notes on procedure

A.5.1 Air velocity in duct B

The velocity in the duct will be determined by multiplying the velocity recorded in the velocity measuring station by the cross-sectional area ratio between the measuring station and the duct.

A.5.2 Evaluation of duct in overpressure conditions

The method of test does not describe a procedure for evaluating ducts in overpressure conditions. The field of direct application allows the result of a test to apply up to an overpressure conditions of 300 Pa. If in practice, part of a duct system is to be subjected to higher overpressure, than an additional evaluation may be carried out. This may be undertaken by reversing the fan and subjecting an additional duct A specimen to the specified overpressure. All other procedures and requirements for duct A should be followed.

A.5.3 Insulation and integrity

The procedure includes periods during which the fans are running, interrupted by periods when the "fan off" situation is simulated (duct B). The regime is used to enable a check of the insulation and integrity properties to be made in various typical circumstances, but it is not representative of conditions in practice as far as any one duct is concerned.

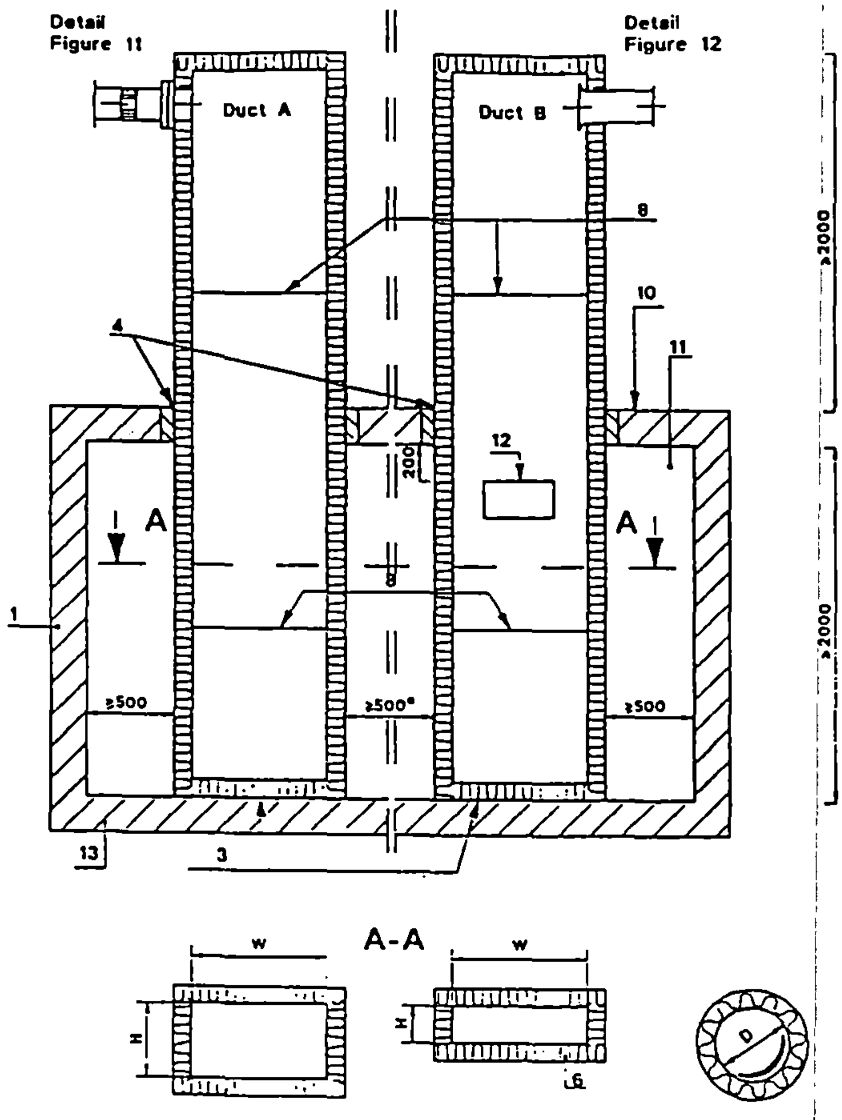
Assuming cut-out of the ventilation fan in the event of a fire, the temperature of the gases within an insulated duct exposed on the exterior to fire conditions, will rise due both to heat transfer through the duct wall and to any failure in integrity.

In the event of a fan continuing to operate, the overpressure from a supply fan will normally exceed the buoyancy pressure of the fire, preventing fire gases entering the system; any negative pressure differential maintained by an extraction fan will only serve to assist the evacuation of hot gases to the atmosphere.

A.6 Notes on performance criteria

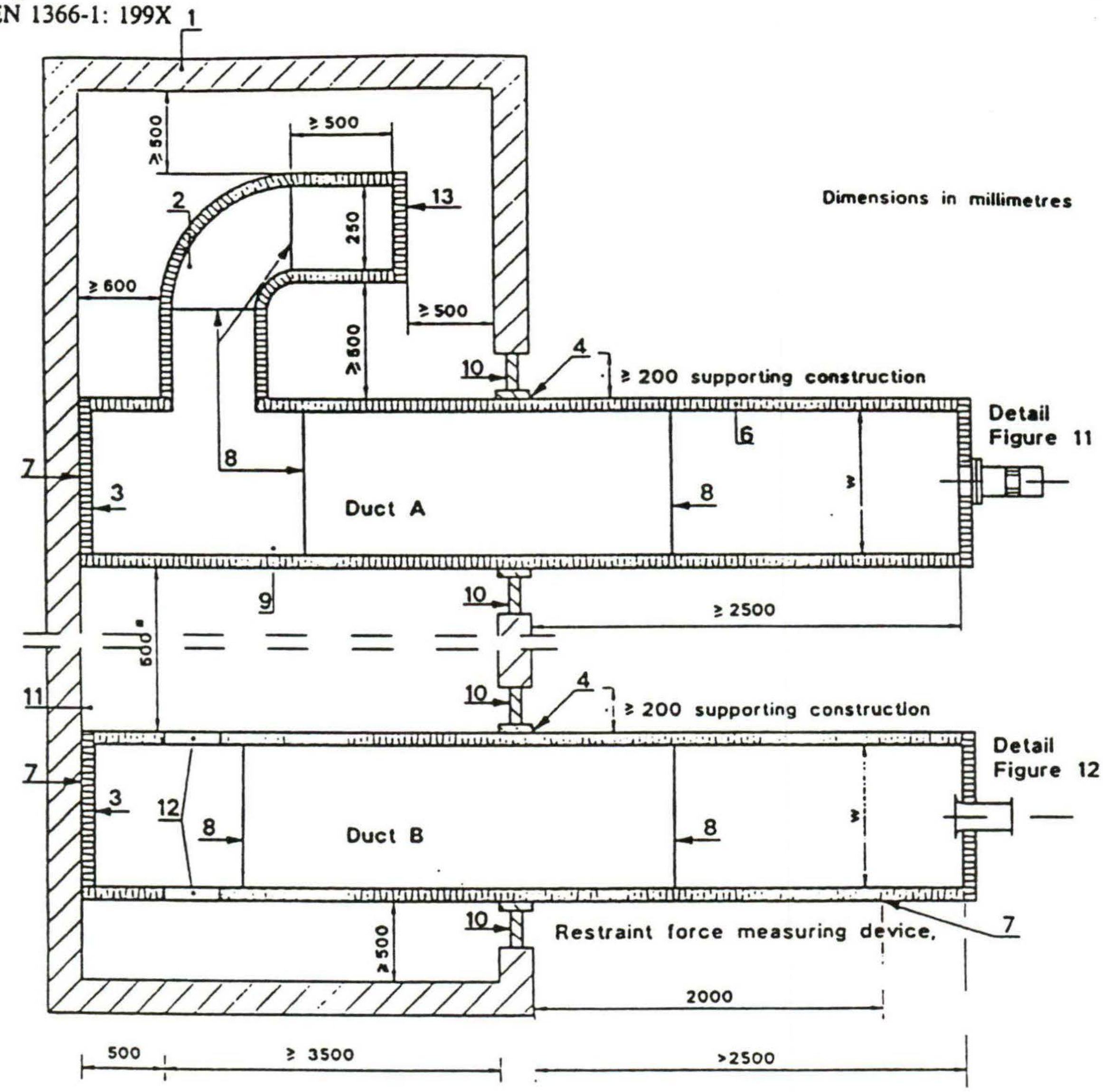
The importance of the various failure criteria of integrity, insulation and leakage may vary according to whether the duct is a normal ventilation duct or a "kitchen extract" duct as described above. For kitchen extraction ducts or where internal combustible linings are used additional temperature measuring points have been specified, together with a criteria of 140°C/180°C, to reduce the possibility of ignition of combustible materials inside the duct igniting when the duct is exposed to an external fire.

Dimensions in millimetres



1	Furnace wall	12	Opening: cross section 50% of duct cross section Duct B in the ratio of 1:4 for rectangular ducts (see 7.2.6)
3	Sealed end	13	Furnace floor
4	Fire-stopping as in practice	W	Width
6	Insulation	H	Height
8	Joints	D	Diameter
10	Furnace roof / supporting construction	*	When duct A and duct B tested in one test
11	Furnace chamber		

Figure 1 - Test arrangement for vertical ducts



NOTE - The sealed end shall independent of the furnace wall.

1 Furnace wall

2 Duct with 90° elbow, cross section 12,5% of cross section Duct A

3 Sealed end (May pass through furnace wall)

4 Fire-stopping as in practice

6 Insulation

7 Rigid restraint

8 Joints

9 T-piece

10 Supporting constuction

11 Furnace chamber

12 Openings: cross section 50% of duct cross section Duct B

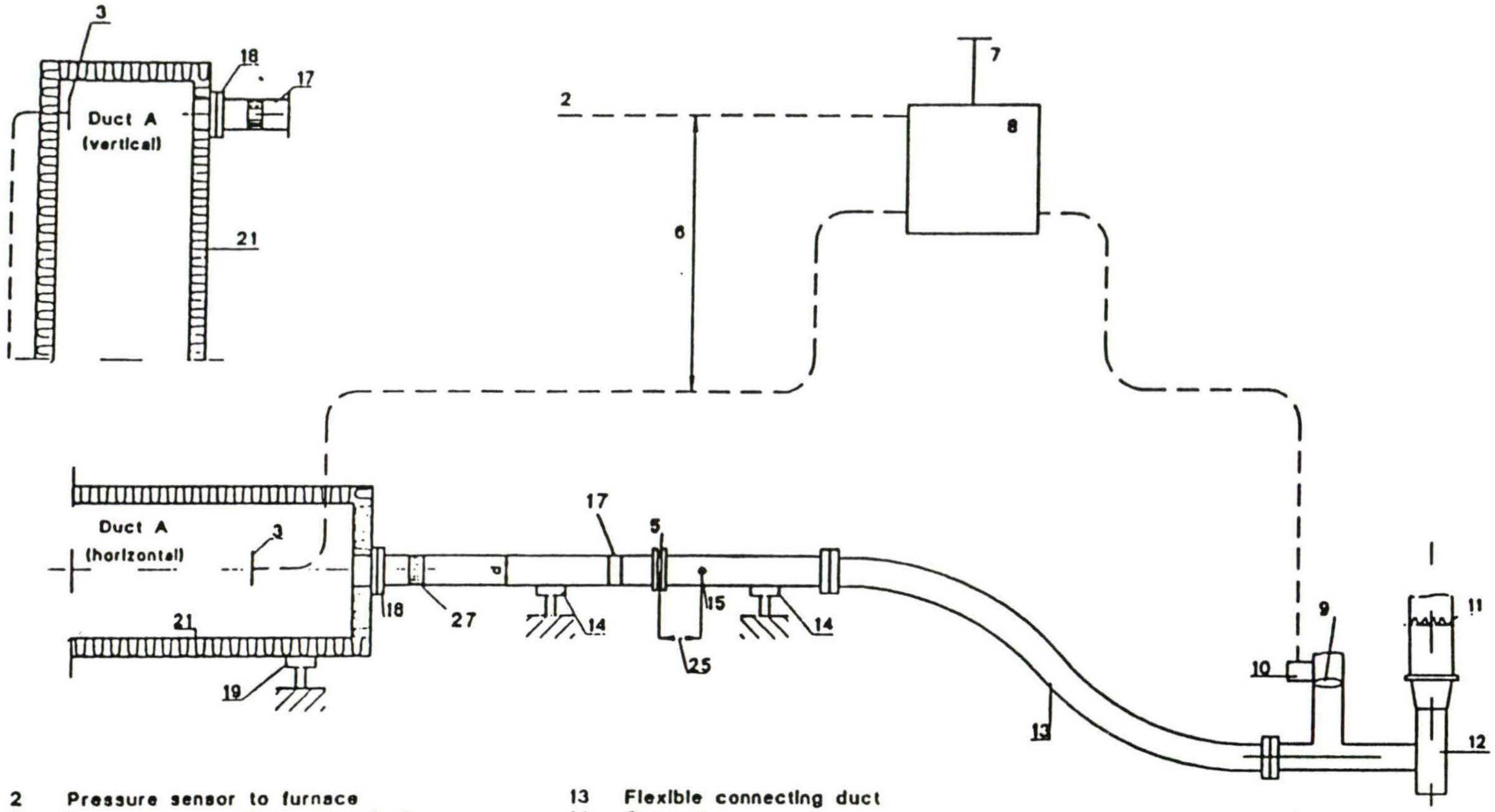
13 Sealed end of elbow

W Width

D Diameter

* When duct A and duct B tested in one test

Figure 2 - Test arrangement for horizontal ducts



2 Pressure sensor to furnace
3 Pressure sensor (on centre line)

5 Orifice plate venturi, or similar
6 Pressure differential (300 Pa)
7 Pressure sensor in laboratory
8 Pressure differential control box
9 Pressure control dilution damper
10 Pneumatic actuator or manual control
11 Balancing damper
12 Fan

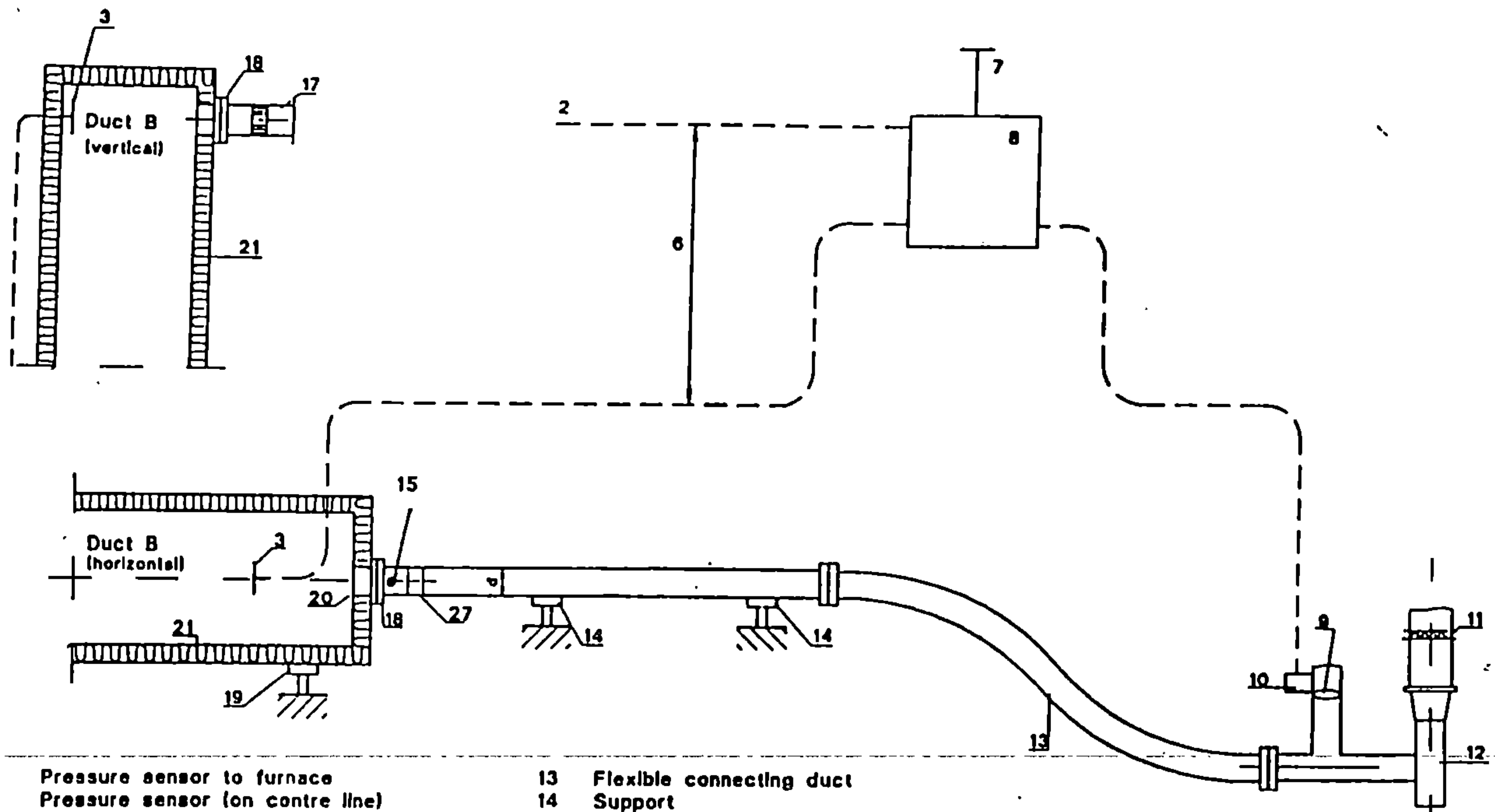
13 Flexible connecting duct
14 Support
15 Thermocouple, 1,5mm diameter

17 Flow staightener (where necessary)
18 Flange
19 Support

21 Test duct

25 Distance: thermocouple - orifice plate : 2d
27 Condensing device

Figure 3 - Leakage measuring stat'_n for duct A



2 Pressure sensor to furnace
3 Pressure sensor (on contre line)

7 Pressure sensor in laboratory
8 Pressure differential control box
9 Pressure control dilution damper
10 Pneumatic actuator or manual control
11 Balancing damper
12 Fan

13 Flexible connecting duct
14 Support
15 Thermocouple, 1,5mm diameter
16 Support
18 Flange
19 Support
20 Inlet nozzle
21 Test duct
22 Piezometer
23 Velocity of air flow eqipment

26 Switch-off damper

Figure 4 - Gas velocity measuring station for duct B

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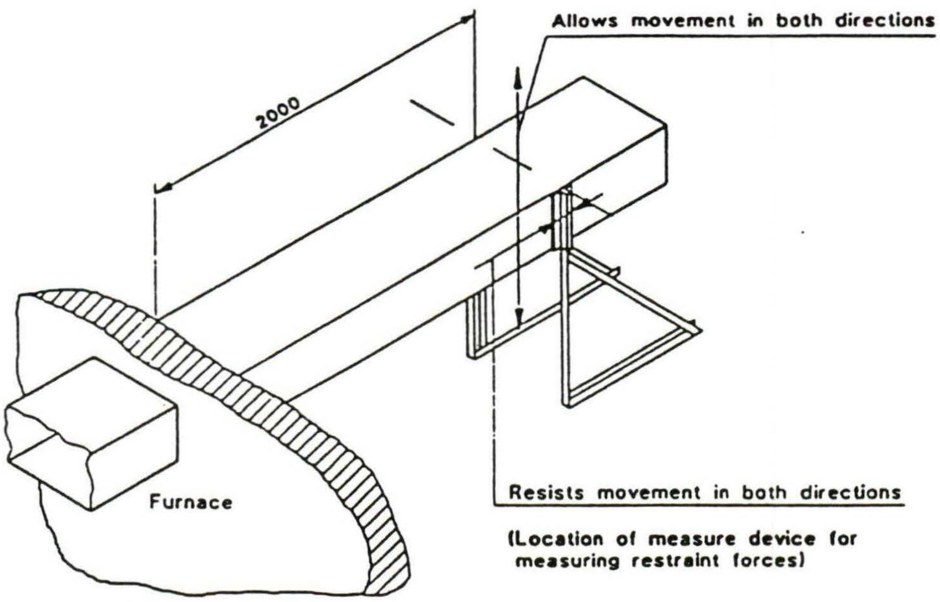
Dimensions in millimetres



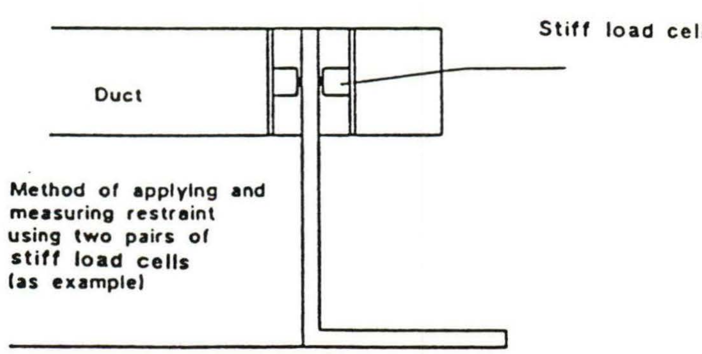
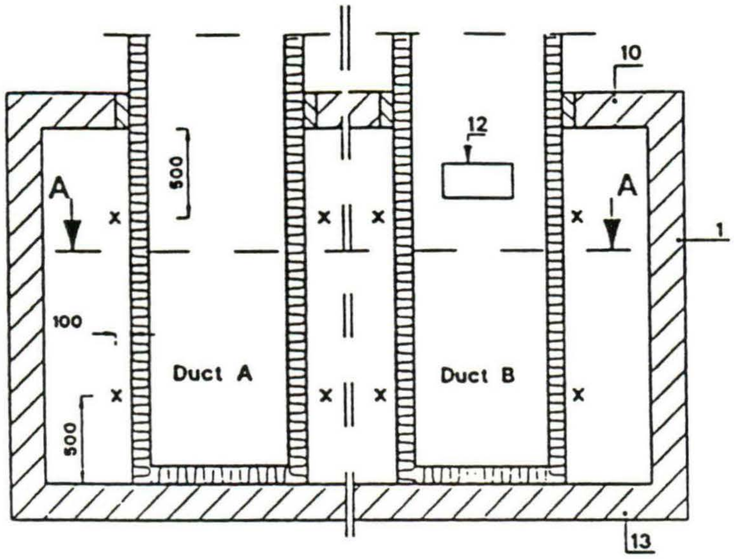
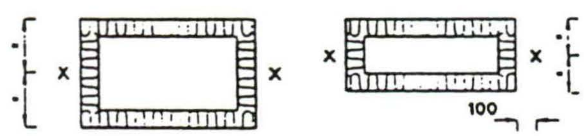


Figure 5 - Restraint of Duct B outside the furnace

Dimensions in millimetres



A-A



1 Furnace wall

10 Furnace roof

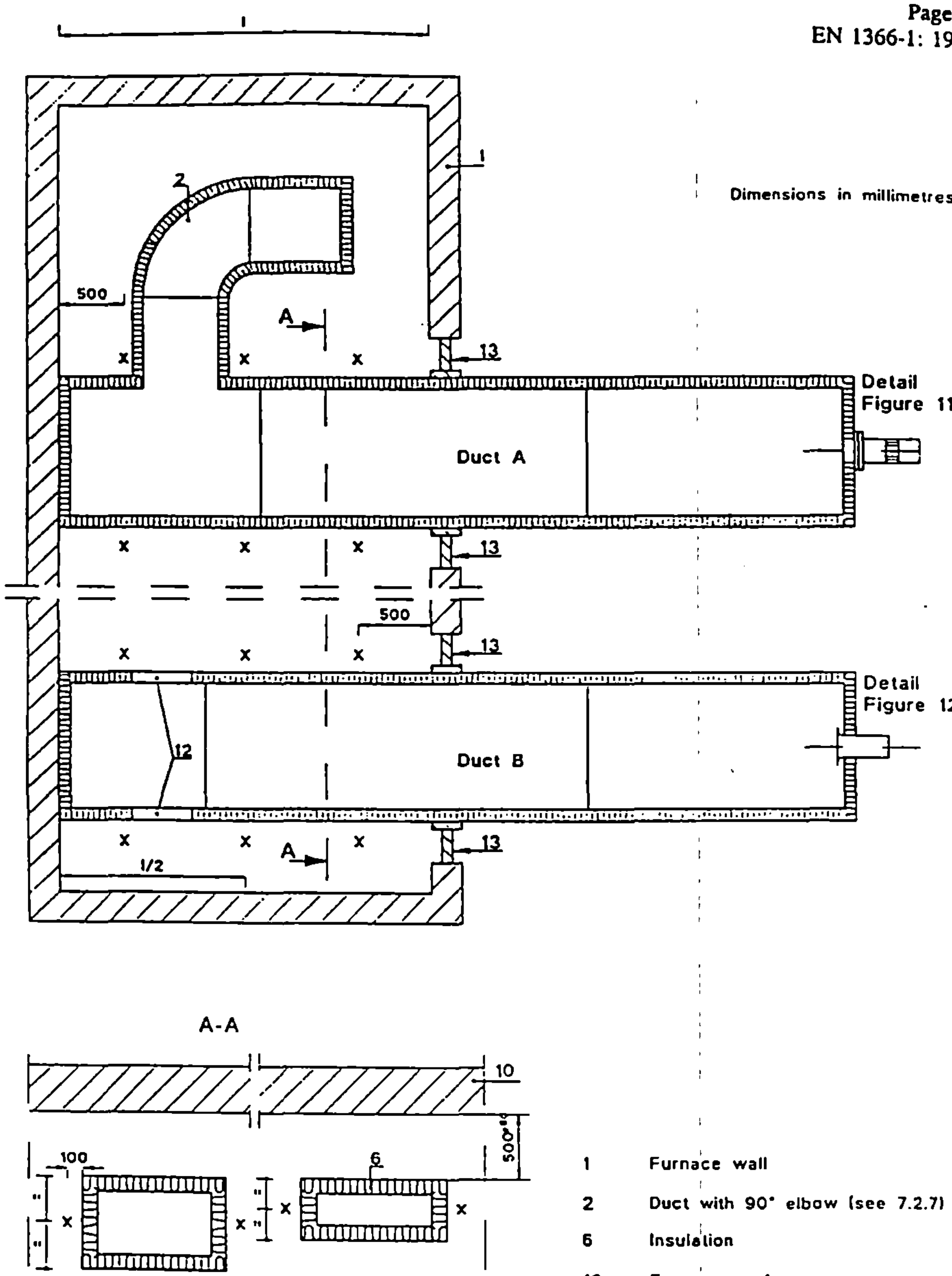
12 Openings: cross section ·
50% of duct cross section Duct B
In the ratio of 1:4 for rectangular ducts

13 Furnace floor

Figure 6 - Location of furnace thermocouples for ducts in vertical position (see also figure 1)

96/540674

Dimensions in millimetres



1 Furnace wall

2 Duct with 90° elbow (see 7.2.7)

6 Insulation

10 Furnace roof

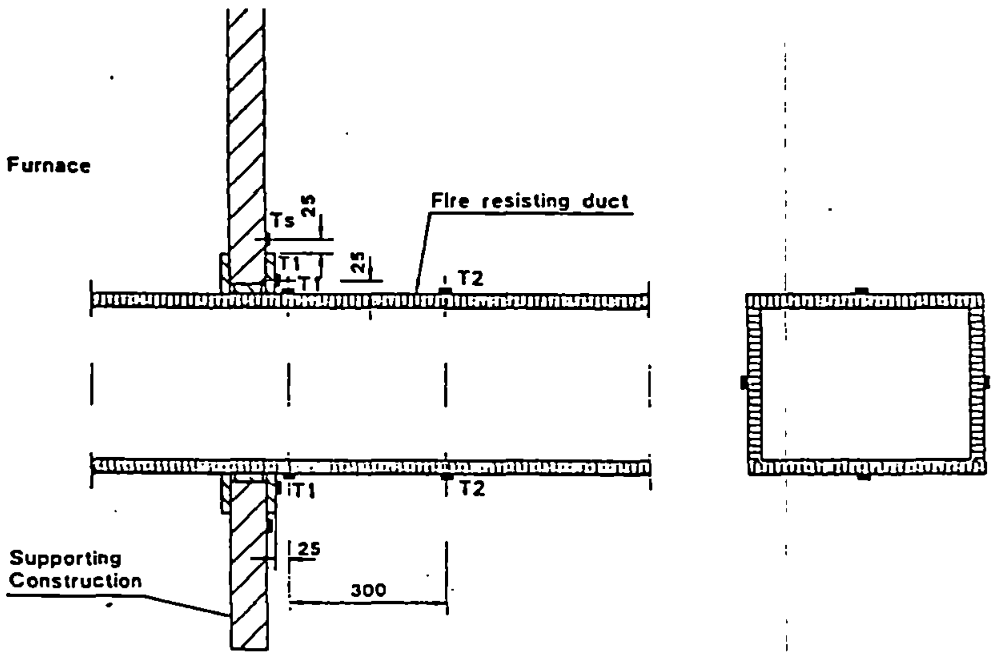
12 Openings: total cross section 50% of duct cross section Duct B

13 Supporting constuction

x Thermocouples

Figure 7 - Location of furnace thermocouples for ducts in horizontal position (see also figure 2)

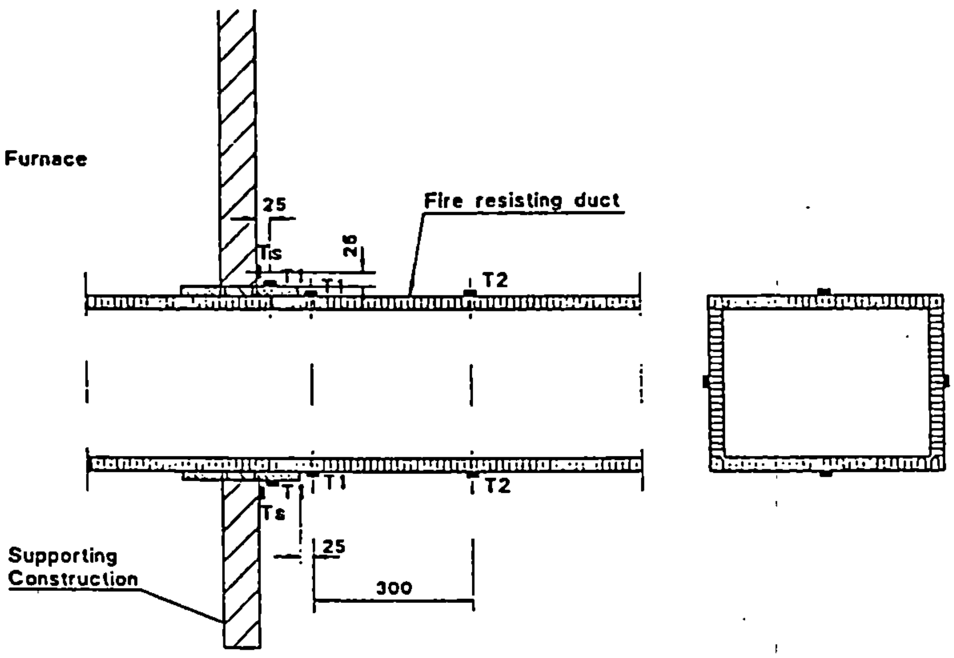
Dimensions in millimetres



Ts	Maximum surface temperature on supporting construction
T1	Surface thermocouples for determining maximum temperature
T2	Surface thermocouples for determining average and maximum temperature
Ts,T1,T2	Minimum of one on each side of the duct
▬	Surface thermocouples

Figure 8 - Location of surface thermcouples

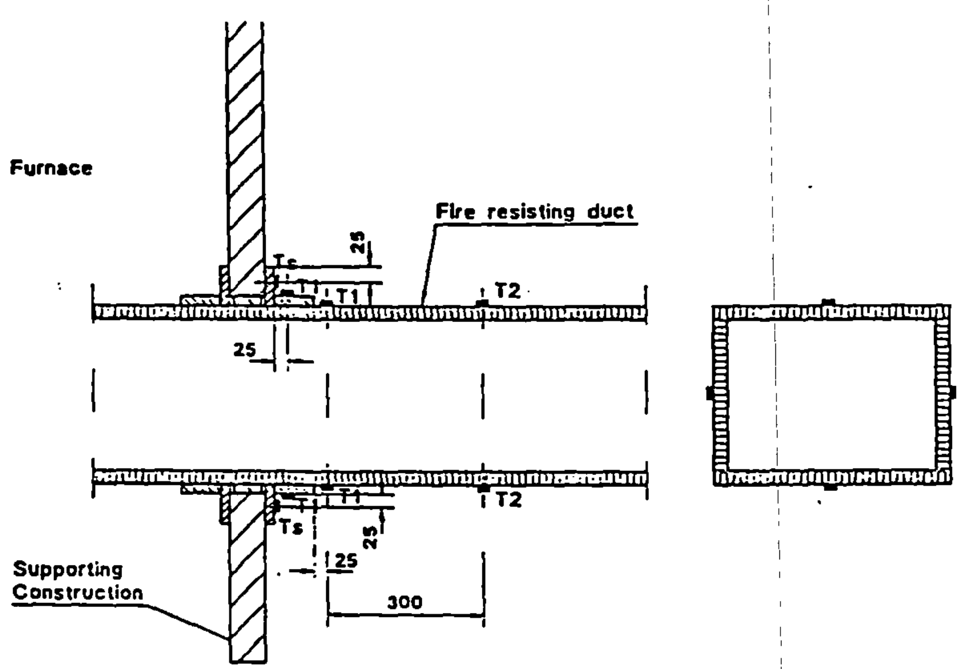
Dimensions in millimetres



Ts	Maximum surface temperature on supporting construction
T1	Surface thermocouples for determining maximum temperature
T2	Surface thermocouples for determining average and maximum temperature
Ts,T1,T2	Minimum of one on each side of the duct
▬	Surface thermocouples

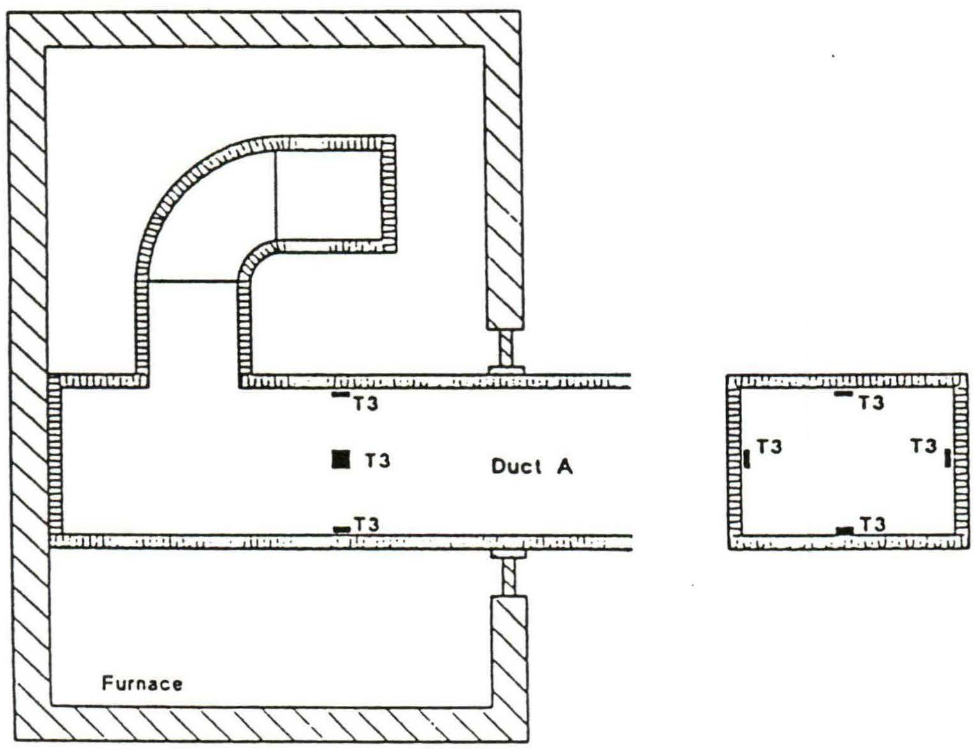
Figure 9 - Location of surface thermocouples

Dimensions in millimetres



Ts	Maximum surface temperature on supporting construction
T1	Surface thermocouples for determining maximum temperature
T2	Surface thermocouples for determining average and maximum temperature
Ts,T1,T2	Minimum of one on each side of the duct
▬	Surface thermocouples

Figure 10 - Location of surface thermocouples



T3 Thermocouples for determining average and maximum temperature

Figure 11 - Interior surface thermocouples for kitchen extract/combustible internal lining ducts

La composición de los materiales ha sido suministrada [illegible] y no comprobada por este Instituto.