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RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS IN MULTI-DWELLING BUILDINGS

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RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS IN MULTI-DWELLING BUILDINGS

ABSTRACT

MJM ACOUSTICAL CONSULTANTS INC. has been retained by the CANADA MORTGAGE & HOUSING CORPORATION to conduct a research project on the noise isolation provided by access doors in multi-dwelling buildings. A total of nine Sound Transmission Loss (TL) tests were conducted on four 1 3/4" doors (one wood door and three metal doors) and one 2 1/4" wood door. This research project has also been used as a preliminary attempt to validate a simple method to measure the Sound Transmission Loss and Sound Transmission Class of a door when it is installed on site.

ACKNOWLEDGEMENTS

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RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS IN MULTI-DWELLING BUILDINGS

EXECUTIVE SUMMARY

MJM ACOUSTICAL CONSULTANTS INC. has been retained by the CANADA MORTGAGE & HOUSING CORPORATION to conduct a research project on the noise isolation provided by access doors in multi-dwelling buildings. A total of nine Sound Transmission Loss (TL) tests were conducted on four 1 3/4" doors (one wood door and three metal doors) and one 2 1/4" wood door. TABLE 1 below contains a resumé of the results obtained, expressed in terms of Sound Transmission Class (STC); it also contains other useful information relative to the doors such as their weight, their price, etc..

This research project has also been used as a preliminary attempt to validate a simple method to measure the Sound Transmission Loss and Sound Transmission Class of a door when it is installed on site. With one exception, the STC obtained using this method correlated within 1 STC point with those obtained in laboratory.

The analysis of the results of the tests indicates that:

- The Sound Transmission Class of the doors tested in this study varied from STC 27 to STC 32 when operable and from STC 31 to STC 37 when sealed to their frame.

- It appears that installing double perimeter gaskets and bottom seal on the 2 1/4 in. wood door and on the metal doors tested would improve the noise isolation which they provide. This can be achieved most easily by installing one seal between the door frame or sill and the door, and a second gasket on the door stop in the case of the perimeter seals and on the door in the case of the bottom seal. When equipped with double perimeter and bottom seals, it is estimated that the STC rating of the above mentioned doors would be superior to STC 30 when operable.

- Replacing a 1 3/4 in. door by a 2 1/4" wood door could lead to a maximum improvement of 2 STC points. Replacing a 1 3/4 in. solid core wood door with a 1 3/4 in. hollow core metal door could lead to a maximum improvement of up to 8 STC points.

- Filling the core of a 1 3/4 in. metal door with mineral fibre (1 psf) improved the 1/3 octave sound transmission loss of the doors by 2 to 9 decibels at frequencies above 1250 Hz, and resulted in an improvement of 1 STC point; below 1250 Hz no improvement was noticeable.

- When operational, the sound rated door supplied by BUMEDA provided a Sound Transmission Class of 32, which, although 4 points inferior to its rating of STC 36, is the highest Sound Transmission Class obtained by the operable doors tested in this study. When sealed to its frame, the Transmission loss curve of the rated door was comparable to that of the metal door of same thickness constructed with 18 Ga. sheet metal, with the core filled using mineral fibre. This suggest that the better performance obtained by the rated door when compared to the operable filled metal door is mainly due to the better performance of its perimeter and bottom gaskets.

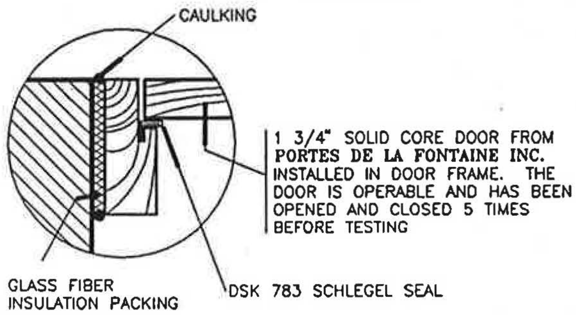
- In multi-dwelling buildings where the corridors are pressurized, it is recommended that an opening above the door be put in place and treated with a piece of lined duct or a silencer providing an insertion loss consistent with that of the door. Based on the TL provided by the best operable door measured in this study (STC 32), and taking into account a ventilation surface of roughly 36 sq inches (corresponding to a 1" gap at the bottom of the door), the approximate insertion loss required has been estimated as follows:

Frequency	125	250	500	1K	2K	4K
Insertion Loss	5	10	15	15	15	15

EXECUTIVE SUMMARY

TEST NO 1 — STC = 28

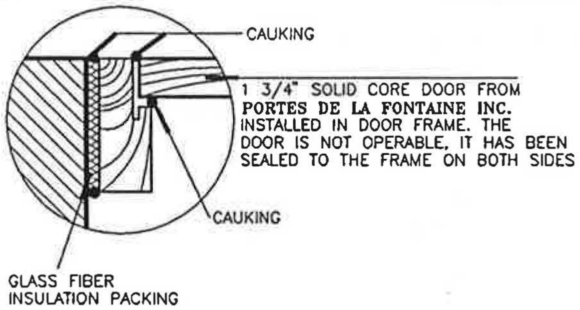
1 3/4 in. WOOD DOOR, OPERABLE



MANUFACTURER / SUPPLIER PORTES DE LA FONTAINE INC.	
SURFACE WEIGHT:	5.16 PSF
PRICE INCLUDING DOOR, FRAME, SILL, SCHLEGEL DSK 783 PERIMETER AND BOTTOM GASKET:	142.75 $

TEST NO 2 — STC = 31

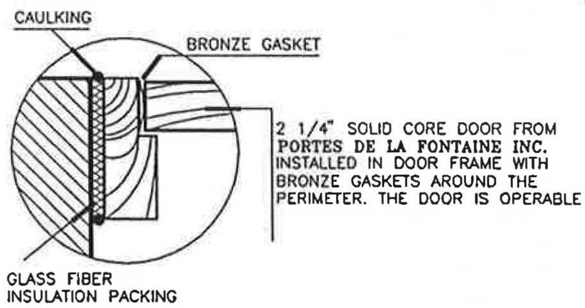
1 3/4 in. WOOD DOOR CAULKED TO ITS FRAME.



MANUFACTURER / SUPPLIER PORTES DE LA FONTAINE INC.	
SURFACE WEIGHT:	5.16 PSF
PRICE INCLUDING DOOR, FRAME, SILL, SCHLEGEL DSK 783 PERIMETER AND BOTTOM GASKET:	142.75 $

TEST NO 3 — STC = 28

2 1/4 in. WOOD DOOR, OPERABLE

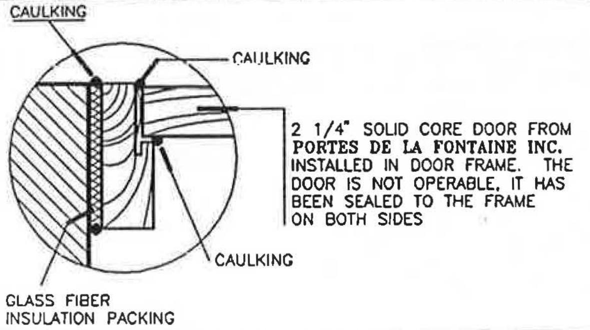


MANUFACTURER / SUPPLIER PORTES DE LA FONTAINE INC.	
SURFACE WEIGHT:	6.25 PSF
PRICE INCLUDING DOOR, FRAME, SILL, BRONZE GASKET (ZERO 119 WB)	214.75 $

TABLE 1

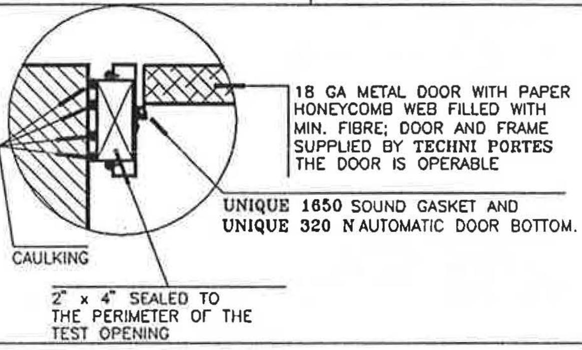
EXECUTIVE SUMMARY

TEST NO 4 STC = 33	2 1/4 in. WOOD DOOR CAULKED TO ITS FRAME.



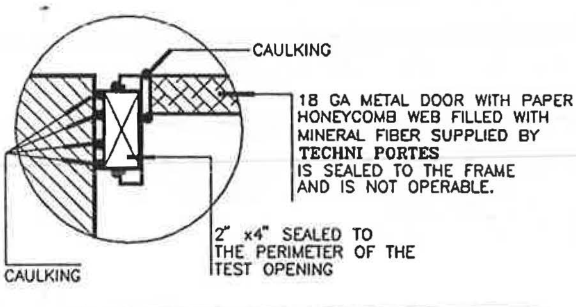
MANUFACTURER / SUPPLIER PORTES DE LA FONTAINE INC.	
SURFACE WEIGHT:	6.25 PSF
PRICE INCLUDING DOOR, FRAME, SILL, BRONZE GASKET (ZERO 119 WB)	214.75 $

TEST NO 5 STC = 27	1 3/4 in. FILLED METAL DOOR, OPERABLE.



MANUFACTURER / SUPPLIER TECHNI-PORTES INC.	
SURFACE WEIGHT:	6.5 PSF
PRICE INCLUDING DOOR, FRAME, MINERAL FIBER INFILL, PERIMETER GASKETS (UNIQUE 1650) AND BOTTOM SEALS (UNIQUE 320 V)	319.80 $

TEST NO 6 STC = 37	1 3/4 in. FILLED METAL DOOR, CAULKED TO ITS FRAME.

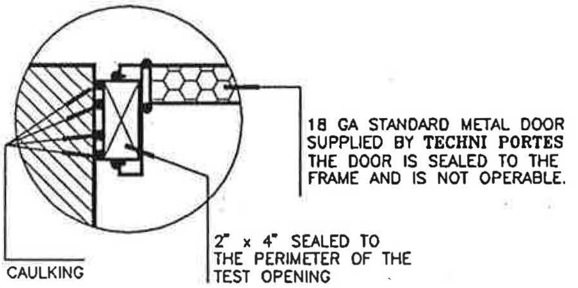


MANUFACTURER / SUPPLIER TECHNI-PORTES INC.	
SURFACE WEIGHT:	6.5 PSF
PRICE INCLUDING DOOR, FRAME, MINERAL FIBER INFILL, PERIMETER GASKETS (UNIQUE 1650) AND BOTTOM SEALS (UNIQUE 320 V)	319.80 $

TABLE 1 (cont'd)

EXECUTIVE SUMMARY

TEST NO 7 STC = 36	1 3/4 in. HOLLOW CORE METAL DOOR, CAULKED TO ITS FRAME.

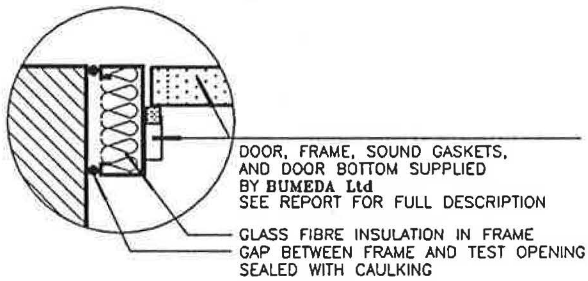


MANUFACTURER / SUPPLIER
TECHNI-PORTES INC.

SURFACE WEIGHT: 5.7 PSF

PRICE INCLUDING DOOR, FRAME, PERIMETER GASKETS (UNIQUE 1650) AND BOTTOM SEAL (UNIQUE 320 V) 309.80 $

TEST NO 8 STC = 32	1 3/4 in. SOUND AND FIRE RATED DOOR W/. SILICATE CORE, OPERABLE.

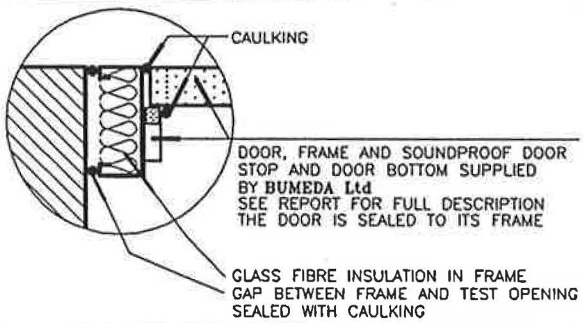


MANUFACTURER / SUPPLIER
BUMEDA LTD.

SURFACE WEIGHT: 8.0 PSF

PRICE INCLUDING DOOR, FRAME, PERIMETER GASKETS (PEMKO 320 N & CF10) AND BOTTOM SEALS (UNIQUE 50 SHD) 625.00 $

TEST NO 9 STC = 37	1 3/4 in. SOUND AND FIRE RATED DOOR W/. SILICATE CORE, CAULKED..



MANUFACTURER / SUPPLIER
BUMEDA LTD.

SURFACE WEIGHT: 8.0 PSF

PRICE INCLUDING DOOR, FRAME, PERIMETER GASKETS (PEMKO 320 N & CF10) AND BOTTOM SEALS (UNIQUE 50 SHD) 625.00 $

TABLE 1 (cont'd)

ISOLATION SONORE PROCURÉE PAR LES PORTES D'ACCÈS
DES LOGEMENTS DANS LES COLLECTIFS D'HABITATION

RÉSUMÉ

Les services de la firme MJM conseillers en acoustique inc. ont été retenus par la Société canadienne d'hypothèques et de logement en vue de mener une étude sur l'isolation sonore procurée par les portes d'accès des logements dans les collectifs d'habitation. En tout, neuf essais de perte de transmission sonore ont été menés sur quatre portes de 1 ¾ po (une porte en bois et trois en métal) et une porte en bois de 2 ¼ po. Le Tableau 1 résume les résultats obtenus en indices de transmission du son. Il renferme également des données utiles sur les portes, à savoir leur poids, leur prix, etc.

Cette étude a aussi servi d'essai préliminaire en vue de valider une méthode simple permettant de mesurer la perte de transmission sonore et l'indice de transmission du son d'une porte en service. Sauf une exception, l'indice de transmission du son obtenu au moyen de cette méthode correspond à un point près de l'indice mesuré en laboratoire.

L'analyse des résultats suit :

- L'indice de transmission du son des portes mises à l'essai dans le cadre de cette étude varie de 27 à 32 pour les portes en service et de 31 à 37 pour les portes scellées à leur encadrement.

- Il semble que la pose de joints périmétriques doubles et d'un joint d'étanchéité en partie inférieure de la porte en bois et des portes en métal de 2 ¼ po mises à l'essai peut améliorer l'isolation sonore qu'elles procurent. Cet assemblage est très facile à réaliser. Il suffit de poser un joint d'étanchéité entre la porte et son encadrement ou son bâti et un autre sur le butoir, dans le cas des joints périmétriques, et sur la porte même dans le cas du joint du bas. Lorsque les portes susmentionnées sont dotées de ce genre de joints en service, on estime que leur indice de transmission du son peut dépasser 30.

- Le fait de remplacer une porte de 1 ¾ po par une porte en bois de 2 ¼ po pourrait permettre une amélioration maximale de 2 points de l'indice de transmission du son. Le remplacement d'une porte en bois de 1 ¾ po à âme pleine par une porte de 1 ¾ po à âme creuse en métal pourrait entraîner une amélioration maximale de 8 points.

- En remplissant l'âme d'une porte en métal de 1 ¾ po avec de la laine minérale (1 lb/pi^2), on peut améliorer la perte de transmission sonore des portes, dans la bande de tiers d'octave, de 2 à 9 décibels à des fréquences supérieures à 1 250 Hz, ce qui entraîne une amélioration de 1 point de l'indice de transmission du son; sous les 1 250 Hz, aucune amélioration ne peut être mesurée.

- Dans le cas des portes en service, la porte à isolation sonore nominale fournie par la société Bumeda affiche un indice de transmission du son de 32, lequel, même s'il est de 4 points inférieur à sa valeur nominale de 36, représente le meilleur indice obtenu pour les portes en service mises à l'essai lors de cette étude. Lorsque la porte à isolation sonore nominale est scellée à son encadrement, la courbe de perte de transmission sonore est comparable à celle obtenue pour la porte de métal de même épaisseur fabriquée à partir de tôle d'épaisseur n° 18, dont l'âme est remplie de laine minérale. Ce résultat porte à croire que la meilleure performance obtenue par la porte à isolation sonore nominale, par comparaison avec la porte de métal en service à âme pleine, est principalement le fait d'une meilleure performance de ses joints à sa partie inférieure et sur son pourtour.

- Dans les collectifs d'habitation dont les corridors sont pressurisés, on recommande qu'une ouverture soit pratiquée au-dessus de la porte et qu'un conduit isolé ou un silencieux y soit placé pour réaliser une perte par insertion équivalente à celle de la porte. En se fondant sur la perte de transmission sonore obtenue avec la porte en service la plus performante à cet égard (32) et en prenant en considération une surface de ventilation d'environ 36 po² (correspondant à un dégagement de 1 po au bas de la porte), on évalue la perte par insertion approximative comme suit :

Fréquence	125	250	500	1K	2K	4K
Perte par insertion	5	10	15	15	15	15

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RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS IN MULTI-DWELLING BUILDINGS

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RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED
BY ACCESS DOORS IN MULTI-DWELLING BUILDINGS

1.0 INTRODUCTION

MJM ACOUSTICAL CONSULTANTS INC. has been retained by the CANADA MORTGAGE & HOUSING CORPORATION to conduct a research project on the noise isolation provided by access doors in multi-dwelling buildings. This report presents and discusses the results of the Sound Transmission Loss tests performed on different doors assemblies which included perimeter sound gaskets and bottom seals. All the tests were conducted in the acoustical laboratory of CONCORDIA UNIVERSITY under the supervision of Dr. Richard Guy, and under the direction of the undersigned.

2.0 OBJECTIVES OF THE STUDY

The objective of this research project was to investigate the sound attenuation properties of doors to be installed in low or medium cost multi-dwelling projects. The following factors were taken into consideration during the selection of the door assemblies to be tested:

- availability
- cost
- thickness
- weight
- durability
- aesthetic
- capacity to accept standard hardware

It was the author's intent to illustrate the relative contribution of the door itself and that of its perimeter and bottom gasketing, in the overall sound isolation provided by the door assemblies. Since the sound intensity mapping facility developed by Dr. Richard Guy of Concordia University seemed most appropriate to achieve this, the acoustical laboratory of this University was selected to perform the tests on the door assemblies.

Another objective of this study was to develop a simple method to evaluate the Sound Transmission Loss (TL) of doors installed on site. The results obtained with this method are discussed in item 5.0 of the current report and compared with those obtained by intensimetry in laboratory conditions.

3.0 STRUCTURE OF THE REPORT

This report is organized into an executive summary, a main report, and four annexes. The builders and construction professionals should find most of the information of interest to them in the **executive summary**, in **section 4.0** of the main report entitled ANALYSIS OF RESULTS, and in **ANNEX I** which contains the graphs pertaining to this section.

Acousticians can refer to **section 5.0** where the author describes a simple method which he has developed to measure the sound isolation of doors in the field; the graphs pertaining to this section have been grouped in **ANNEX II**. **ANNEX IV** which contains the sound intensity mapping information pertaining to all the assemblies tested may also be of interest; this annex was prepared by Dr. Richard Guy of the Centre for Building Studies, Concordia University.

For completeness we have attached in **ANNEX III** the test procedure which was sent to all participants. With the exception of item no 9 all the tests shown in this procedure were carried out as planned.

4.0 ANALYSIS OF RESULTS

A total of nine tests were conducted on four 1 3/4" doors (one wood door and three metal doors) and one 2 1/4" wood door; **TABLE 1** in the executive summary contains a resumé of the results obtained, expressed in terms of Sound Transmission Class (STC); it also contains other useful information relative to the doors: their weight, their price, etc.. The 1/3 octave Sound Transmission Loss (TL) curves of each of the nine door assemblies tested appear on **graphs 1 to 9** of **ANNEX I**; each graph also provides a sketch describing the door assembly tested.

The Sound Transmission Class of the doors tested varied from STC 27 to STC 32 when operable and from STC 31 to STC 37 when sealed to their frame.

4.1 1 3/4" SOLID CORE WOOD DOOR (tests no 1 and 2)

Access doors in multi-dwelling buildings must offer a minimum of security, and in most situation a fire resistance of at least 20 minutes. The most economical access door which can be installed in multi-dwelling buildings and which satisfies these requirements is a 1 3/4" thick painted solid door composed of a particle board core, with 1/8" thickness of high density masonite laminated to the core on each side of the door. These doors are most often delivered on construction sites premounted in frames equiped with perimeter sound gaskets and bottom seals. **Graph no 10** compares the acoustical performance of such a door when it is operable with properly adjusted sound gaskets (Schlegel DSK 783), and when it is sealed to its frame with caulking. The improvement provided by sealing the door to the frame is in the order of approximately 3 to 4 decibels at most frequencies with a minimum and a maximum improvement of respectively 2 and 6 decibels; the STC of the sealed door is 3 points superior to that of the operable door. An analysis of the intensity mapping of test no 1 and 2 located in **ANNEX IV** confirms that the sound energy transmitted through the seals is approximately equal to that transmitted through the door. This indicates that the maximum benefit by improving the performance of the perimeter and bottom gaskets will be in the order of 3 dB. Such an improvement would be considered marginal and not cost effective.

4.2 **2 1/4" SOLID CORE DOOR** (tests no 3 and 4)

In the mind of many builders, increasing the thickness of a solid core door from 1 3/4" to 2 1/4" represents an economical way to significantly improve the sound isolation provided by access doors. On **graph no 11** the acoustical performance of a 2 1/4" and 1 3/4" doors both sealed to their frame, are compared: as can be seen the TL values of the 2 1/4" door are comparable to that of the 1 3/4" door from 125 Hz to 315 Hz, slightly inferior from 315 Hz to 1000 Hz and clearly superior (5 to 12 decibels) above 1000 Hz. The Sound Transmission Class (STC) of the 2 1/4" door is only 2 points superior to that of the 1 3/4" door.

When both doors are operable (**graph no 12**), their STC are identical (STC 28) and their 1/3 octave Transmission Loss curves are comparable. It is worth noting that in the case of the 2 1/4" door a bronze gasket was used to seal the perimeter and bottom of the door. This type of gasketing which is concealed between the frame and the door seems to provide a performance equivalent to that of the Schlegel DSK 783 seal with the advantage that unlike the latter, it is not visible.

4.3 **1 3/4" FILLED METAL DOOR** (tests no 5 and 6)

Graph no 13 and 14 respectively compare the performance of an operable 1 3/4" metal door with the web filled with mineral fibre, to that of an operable 1 3/4" wood door and of an operable 2 1/4" wood door. The 1/3 octave band TL of the operable metal door and its STC are comparable to those of the wood doors.

When one looks at **graph no 15** on which the TL curve of the operable 1 3/4" filled metal door is traced with the TL curve obtained when this door is caulked to its frame, it becomes apparent that the performance of the door assembly is limited by the sound infiltration though the perimeter and bottom seals: the performance of the caulked door is much superior at all frequencies and its STC is 10 points greater than the STC of the operable door. This suggests that there would be a benefit in improving the sound gasketing of this metal door.

Standard metal doors which are basically composed of two leafs of sheet metal separated by a paper honey-comb spacer, represent a double leaf partition. It is well documented that for equal surface weight a double leaf partition provides a noise isolation superior to that provided by a single leaf partition. The main factors influencing the performance of a double leaf partition such as a metal door are:

- the mass, rigidity and damping of the membranes composing the assembly;
- the depth of the cavity, and the presence of sound absorption in it.
- the amount of mechanical coupling between these membranes;

The filled metal door tested had an approximate surface weight of 6,5 psf compared to 5,15 psf and 6,25 psf respectively for the 1 3/4" and 2 1/4" wood doors. One can see on **graphs 16 and 17**, the metal door performs better than the wood doors above 500 Hz in the case of the 1 3/4" door (**graph 16**) and above 315 Hz in the case of the 2 1/4" door (**graph 17**).

4.4 1 3/4" FILLED METAL DOOR VS HOLLOW CORE METAL DOOR (tests no 6 and 7)

The benefit of adding mineral fibre (approximately 1 psf) inside the cavity of a paper web hollow core metal door is illustrated in **graph 18**, where one can see an improvement only above 1 250 Hz. The STC of the filled metal door is also 1 point superior to that of the hollow door. Although adding mineral fibre in the core of the door is inexpensive, it appears that is not worth doing unless one makes sure that the proper gasketing is installed to maintain the acoustical integrity of the door.

4.5 BUMEDA 1 3/4" SOUND & FIRE RATED DOOR

In some instances, sound rated doors are specified on projects. Such doors can be very expensive, very heavy and very thick if a high STC rating is to be achieved. We have selected for this study a relatively light, thin and inexpensive door made by BUMEDA which is sound rated STC 36 and which has a fire rating of two hours. This door tested STC 32 when operable and equiped with double gaskets at the perimeter and a single seal at bottom; when it was sealed to its frame a STC 37 was measured.

We have compared on **graph 19** the performance of the operable sound rated door (test no 8) with that provided by the operable 1 3/4" filled metal door (test no 5). When the door is operable, the Transmission Loss of the sound rated door is substantially higher than that of the filled metal door. When the doors are sealed to the frame (**graph 20**) however, the Transmission Loss and STC of the doors are equivalent. This suggests that the double perimeter gaskets and bottom seal installed on the sound rated door provide better isolation than the single gasket installed on the filled metal door.

4.6 PERIMETER AND BOTTOM SOUND GASKETING

In total four types of perimeter gaskets were investigated in this study:

- Schlegel DSK 783 extruded neoprene seals supplied by PORTES DE LA FONTAINE INC. (test no 1).
- Bronze gaskets 119 WB supplied by ZERO INTERNATIONAL (test no 3).
- UNIQUE 1650 aluminium/neoprene extruded seals (test no 5).
- Pemko 319N and CF10 supplied and installed by BUMEDA on their sound and fire rated door (test no 8).

For tests no 1 and 3, the perimeter gaskets were also installed at the bottom of the door and compressed on a sill. For test no 5 and 8 automatic door bottom were used: in the case of test no 5 a mortised Unique 320 V bottom seal was fitted to the door by TECHNI-PORTES; BUMEDA (test no 8) used a Unique 50 SHD surface mounted seal on its rated door.

As mentioned previously the acoustical performance of perimeter and bottom gasketing of doors generally governs the sound isolation provided by the door assembly. The results of tests no 1, 3 and 5 suggests that single perimeter gaskets and door bottoms used in this study provided a similar performance. Door no 8 equipped with double perimeter seals provided the best noise isolation performance of all the operable doors.

The results obtained in this study suggest that when the noise isolation provided by a door sealed to its frame is in the order of 5 STC points or greater than the noise isolation which it provides when operable and equipped with single seals, one could improve the performance of the operable door by doubling the seals at the perimeter and at the bottom of the door. This can be achieved most easily by installing one seal between the door frame or sill and the door, and another seal on the door stop for the perimeter seals, and on the door in the case of the bottom seal.

4.7 FRESH AIR INTAKE

In a number of recent multi-dwelling buildings, the corridors are pressurized. A positive pressure in the corridor confines odours inside dwellings, while supplying fresh air in the dwellings and compensating for the air exhausted by bathrooms and kitchen fans and by the clothes dryer. Mechanical engineers generally recommend that a gap of 1/2" to 1" be left at the bottom of the access doors to allow the infiltration of the air from the corridor to the dwelling. Such a practice is detrimental to the noise isolation provided by the doors. Instead, one should provide an opening above the door treated with a piece of lined duct or a silencer providing an insertion loss consistent with the noise isolation provided by the door. Based on the best performance of the operable door measured in this study (test no 8) and a ventilation surface of roughly 36 sq inch (1" at the bottom of the door), we have estimated as follows the approximate sound insertion loss required:

Frequency	125	250	500	1K	2K	4K
Insertion Loss	5	10	15	15	15	15

5.0 SIMPLE METHOD OF MEASURING THE SOUND ISOLATION OF A DOOR IN THE FIELD

The ASTM E 336 standard is generally used when one must determine the Sound Transmission Loss and Sound Transmission Class of a partition or floor/ceiling assembly in the field. For measuring the Sound Transmission Loss of an access door however, this method is often awkward, and expensive compared to the cost of the door. Consequently, the author has developed a normalized method to measure the sound insertion loss provided by doors which would not require that the ratio of the surface of the door versus the sound absorption in the receiving room be determined.

Here is the proposed procedure.

.1 Locate the microphone on the side of the source room (generally a corridor or a stair case) at 1 m of the door to be tested. After ensuring that the sound source is far enough from the door to create a relatively diffuse sound field, measure the 1/3 octave incident sound pressure levels when the door is open and close ($Lp_{(incident\ open)}$, $Lp_{(incident\ close)}$).

.2 Locate the microphone inside the receiving room at 1 m of the door; measure the 1/3 octave sound pressure levels transmitted to the receiving room with the door open and close ($Lp_{(rec.\ open)}$, $Lp_{(rec.\ close)}$).

With these measurements one can deduce the Insertion Loss of the door normalized in function of the sound pressure level in the source room (NIL) using the following equation:

$$NIL = (Lp_{(rec.\ open)} - Lp_{(rec.\ close)}) + (Lp_{(source\ close)} - Lp_{(source\ open)})$$

The first term in parenthesis represent the insertion loss provided by the door. The second term in parenthesis represent a normalization factor which takes into account the variation of the absorption in the source room when the door is open and closed. If the source room is very reverberant or if the door surface is large, this change in absorption could introduce a variation of the reverberant noise level in the source room sufficient to significantly affect the results of the measurement made in the receiving room.

Graphs no 1B, 2B, 5B, 7B and 9B compare the noise isolation measurements made using the sound intensimetry technique and to those made using the above described technique with only one point of measurement located in the centre of the door. As can be seen with the exception of **graph 5B** the results of these two methods are in relatively good agreement, with a difference of only 1 point between the STC ratings measured with both methods. Based on the results of the tests performed to validate the NIL method proposed above it seems:

a) that the accuracy of this method could be improved by simply taking a larger number of sampling points (up to approximately 24 samples per measurements instead of 4).

b) that the NIL quantity measured is equivalent to the TL since it represents the difference between the sound energy incident on a door and the sound energy transmitted through it.

6.0 CONCLUSIONS

6.1 The Sound Transmission Class of the doors tested in this study varied from STC 27 to STC 32 when operable and from STC 31 to STC 37 when sealed to their frame.

6.2 It appears that installing double perimeter gaskets and bottom seals on the 2 1/4 in. wood door and on the metal doors tested would improve the noise isolation which they provide. This can be achieved most easily by installing one seal between the door frame or sill and the door, and a second gasket on the door stop in the case of the perimeter seals and on the door in the case of the bottom seal. When equiped with double perimeter and bottom seals, it is estimated that the STC rating of the above mentioned doors would be superior to STC 30 when operable.

6.3 Replacing a 1 3/4 in. door by a 2 1/4 in. wood door could lead to a maximum improvement of 2 STC points. Replacing a 1 3/4 in. solid core wood door with a 1 3/4 in. hollow core metal door could lead to a maximum improvement of up to 8 STC points.

6.4 Filling the core of a 1 3/4 in. metal door with mineral fibre (1 psf) improved the 1/3 octave sound transmission loss of the doors by 2 to 9 decibels at frequencies above 1250 Hz, and resulted in an improvement of 1 STC point; below 1250 Hz no improvement was noticeable.

6.5 When operational, the sound rated door supplied by BUMEDA provided a Sound Transmission Class of 32, which, although 4 points inferior to its rating of STC 36, is the highest Sound Transmission Class obtained by the operable doors tested in this study. When sealed to its frame, the Transmission loss curve of the rated door was comparable to that of the metal door of same thickness constructed with 18 Ga. sheet metal, with the core filled using mineral fibre. This suggest that the better performance obtained by the rated door when compared to the operable filled metal door is mainly due to the better performance of its perimeter and bottom gaskets.

6.6 This research project has been used to validate simple method to measure the Sound Transmission Loss and Sound Transmission Class of doors when they are installed on site. With one exception, the STC obtained using this method correlated within 1 STC point with those obtained in laboratory.

6.7 In multi-dwelling buildings where the corridors are pressurized, it is recommended that an opening above the door be put in place and treated with a piece of lined duct or a silencer providing an insertion loss consistent with that of the door. Based on the TL provided by the best operable door measured in this study (test no 8), and taking into account a ventilation surface of roughly 36 sq inch (corresponding to 1" gap at the bottom of the door) the approximate insertion loss required has been estimated as follows:

Frequency	125	250	500	1K	2K	4K
Insertion Loss	5	10	15	15	15	15

Respectfully submitted

February 26, 1993

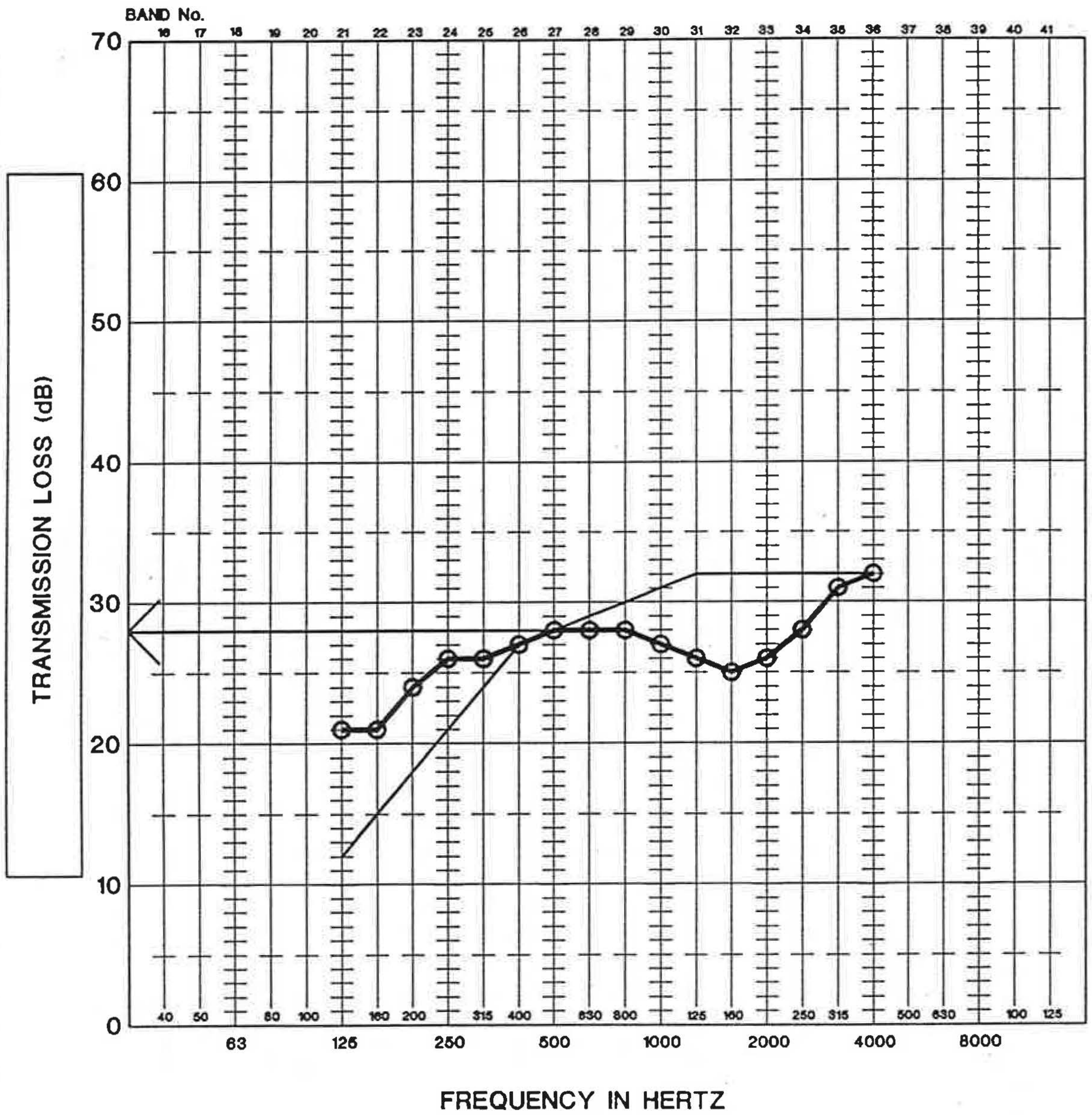
MJM ACOUSTICAL CONSULTANTS INC.

Michel Morin, architect

President

ANNEX I

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT



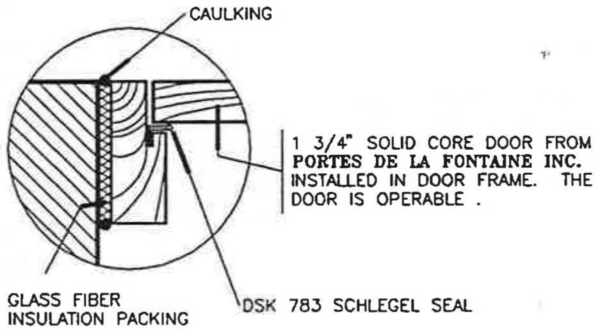
LEGEND

Transmission Loss (TL)

STC contour
(ASTM E 413-87)

Sound Transmission Class
STC = 28

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

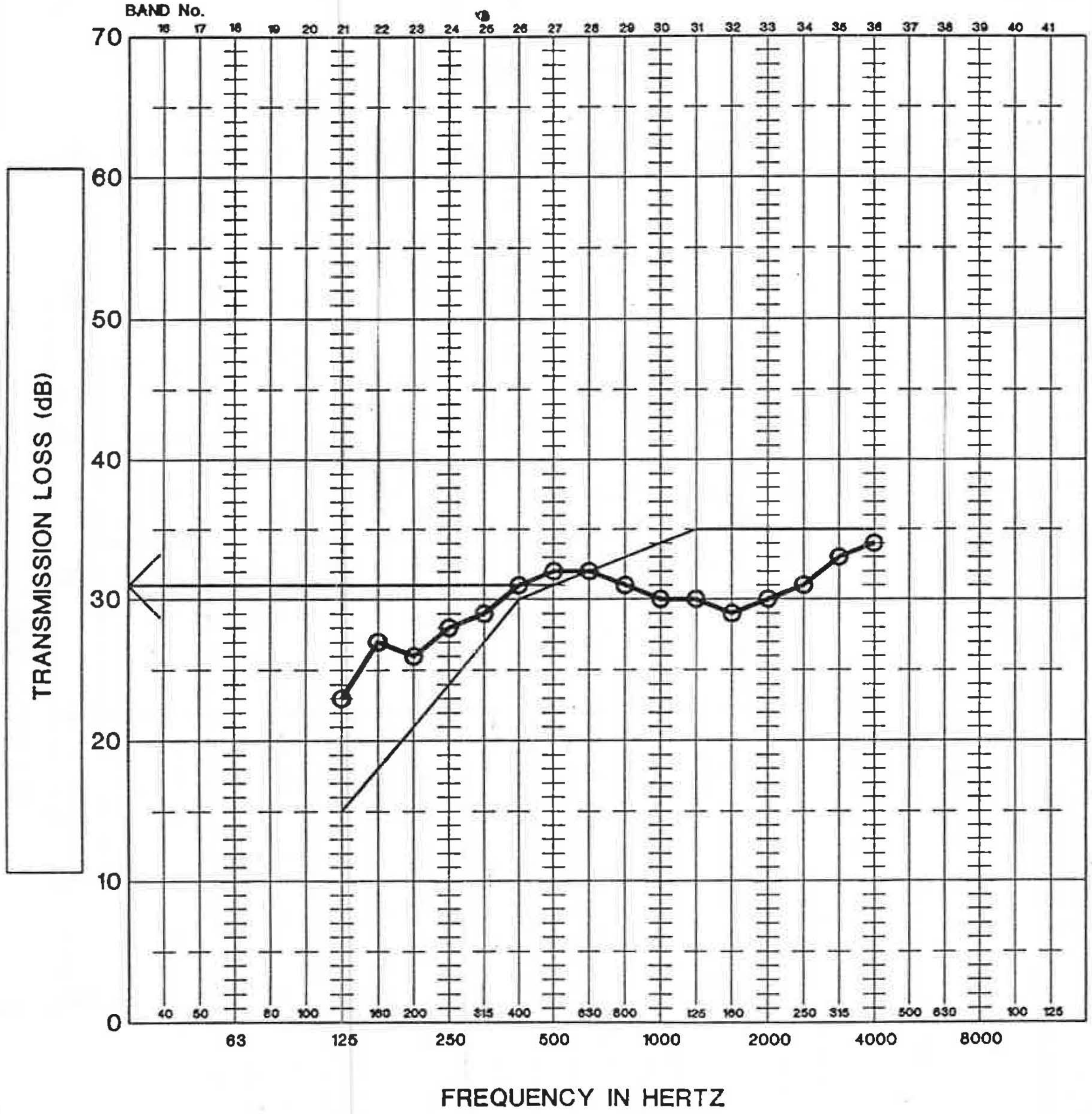
NOISE ISOLATION PROVIDED BY A 1 3/4 in THICK SOLID CORE DOOR; FRAME EQUIPED WITH SCHLEGEL DSK 783 SOUND GASKETS

GRAPH NUMBER 1

PROJECT NUMBER	DATE
177.911	92 12

MJM

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT



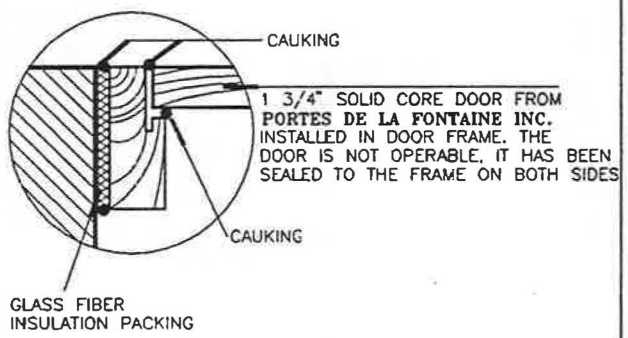
LEGEND

Transmission Loss (TL)

STC contour (ASTM E 413-87)

Sound Transmission Class
STC = 31

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

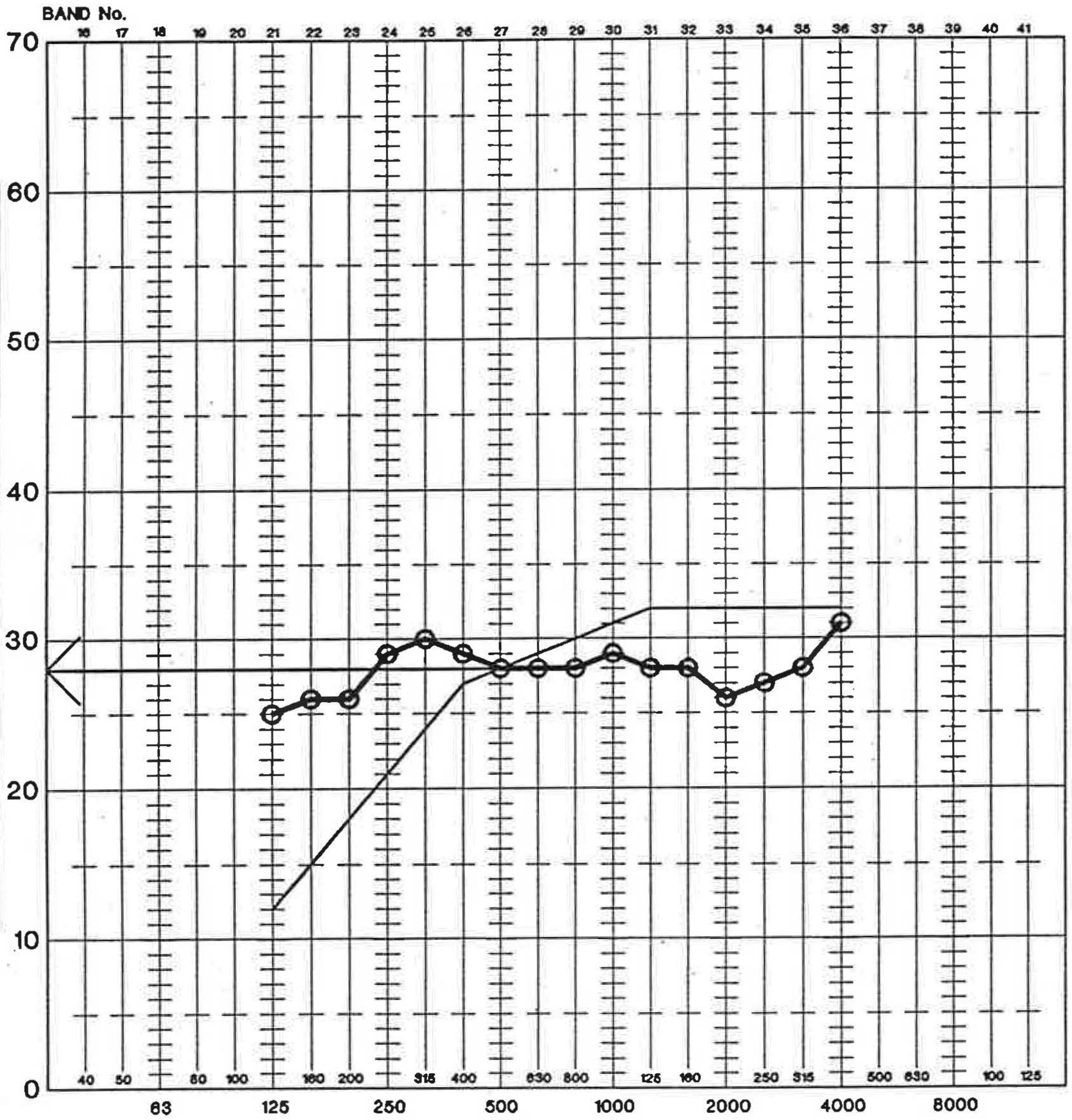
NOISE ISOLATION PROVIDED BY A 1 3/4 in THICK SOLID CORE DOOR; PERIMETER CAULKED WITH REMOVABLE CAULKING

GRAPH NUMBER 2

PROJECT NUMBER	DATE
177.911	92 12

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT



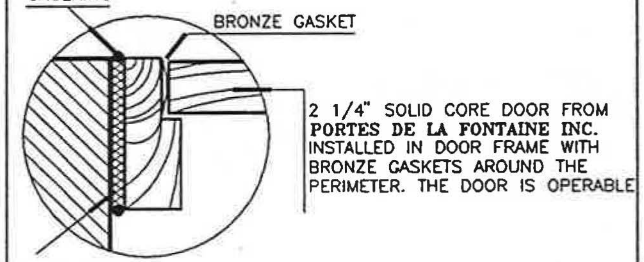
LEGEND

Transmission Loss (TL)

STC contour (ASTM E 413–87)

Sound Transmission Class
STC = 28

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

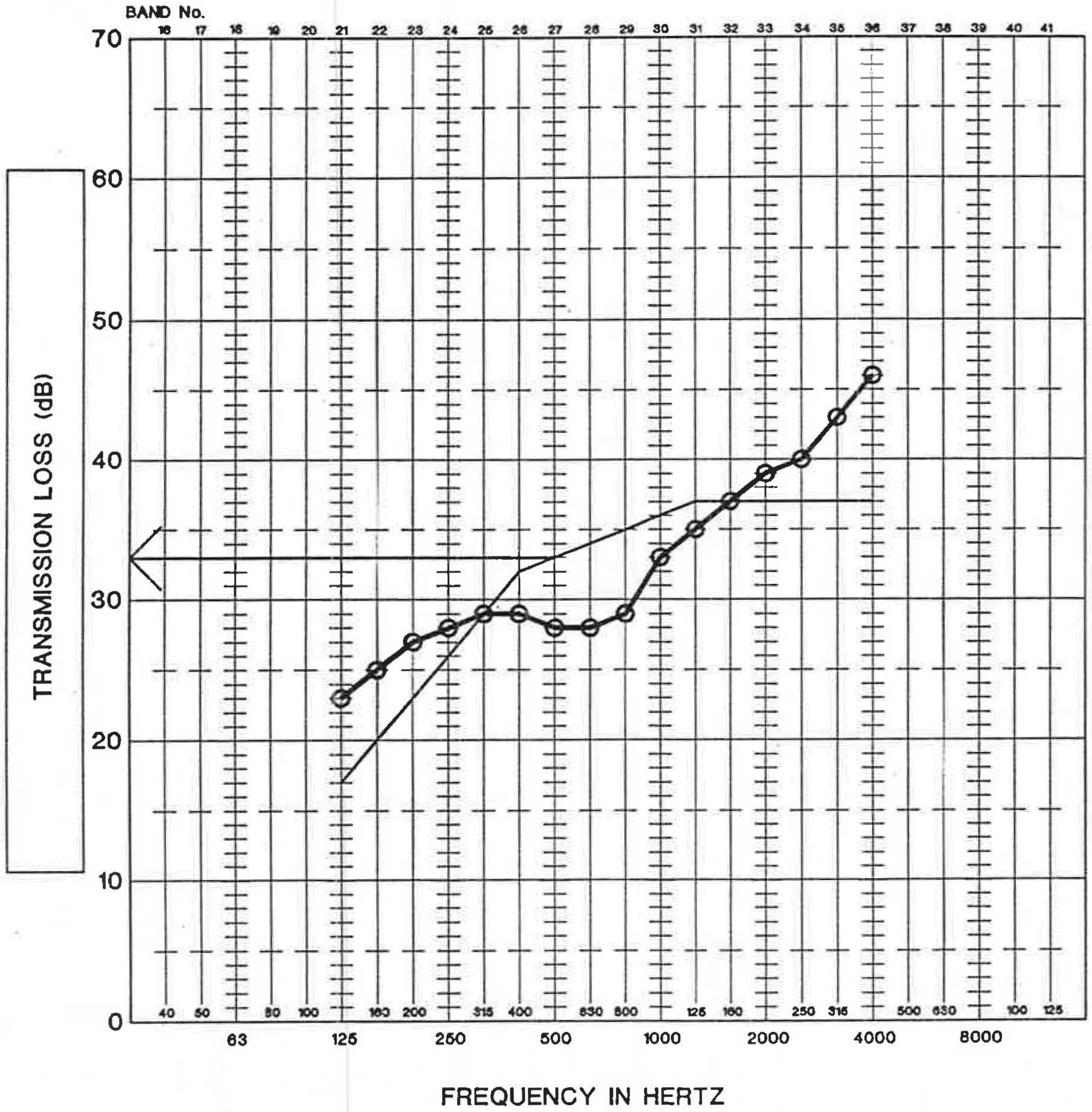
NOISE ISOLATION PROVIDED BY A 2 1/4 in THICK SOLID CORE DOOR; FRAME EQUIPED WITH ZERO 119WB BRONZE GASKETS

GRAPH NUMBER 3

PROJECT NUMBER	DATE
177.911	92 12

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT



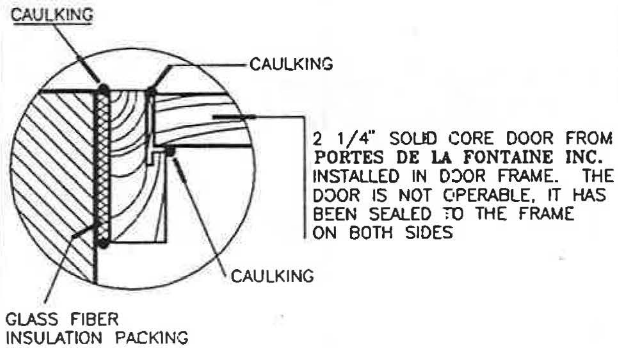
LEGEND

Transmission Loss (TL)

STC contour
(ASTM E 413-87)

Sound Transmission Class
STC = 33

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

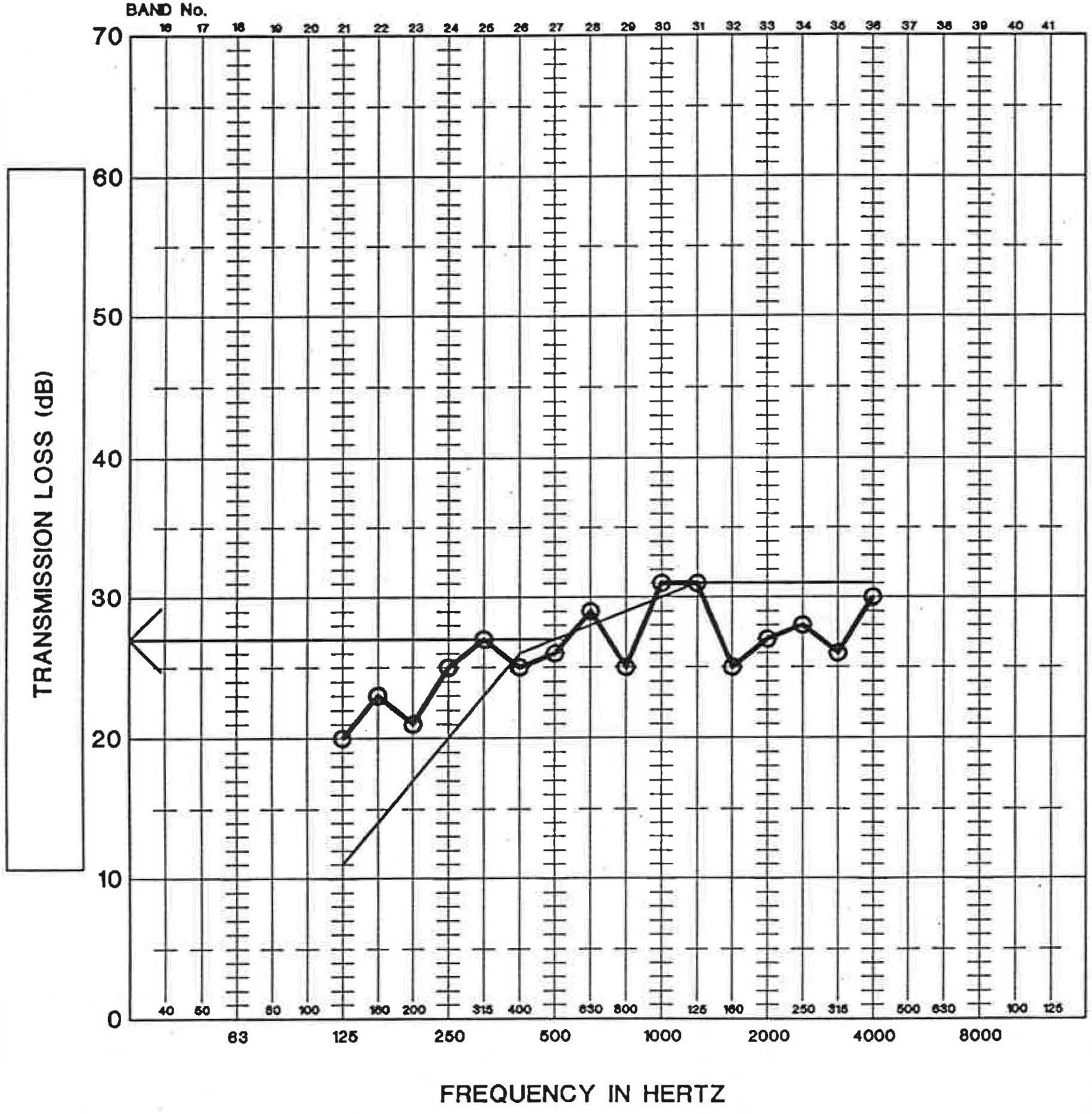
NOISE ISOLATION PROVIDED BY A 2 1/4 in THICK SOLID CORE DOOR; PERIMETER CAULKED WITH REMOVABLE CAULKING

GRAPH NUMBER 4

PROJECT NUMBER	DATE
177.911	92 12

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT



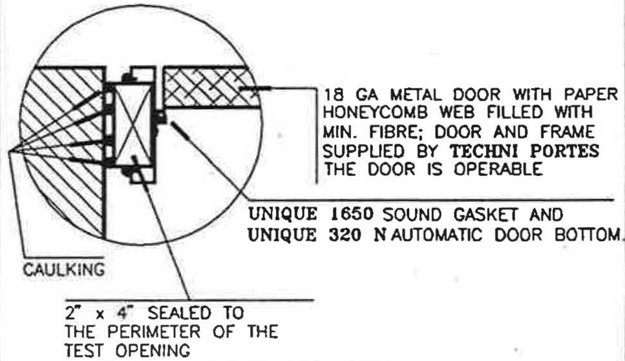
LEGEND

Transmission Loss (TL)

STC contour
(ASTM E 413-87)

Sound Transmission Class
STC = 27

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

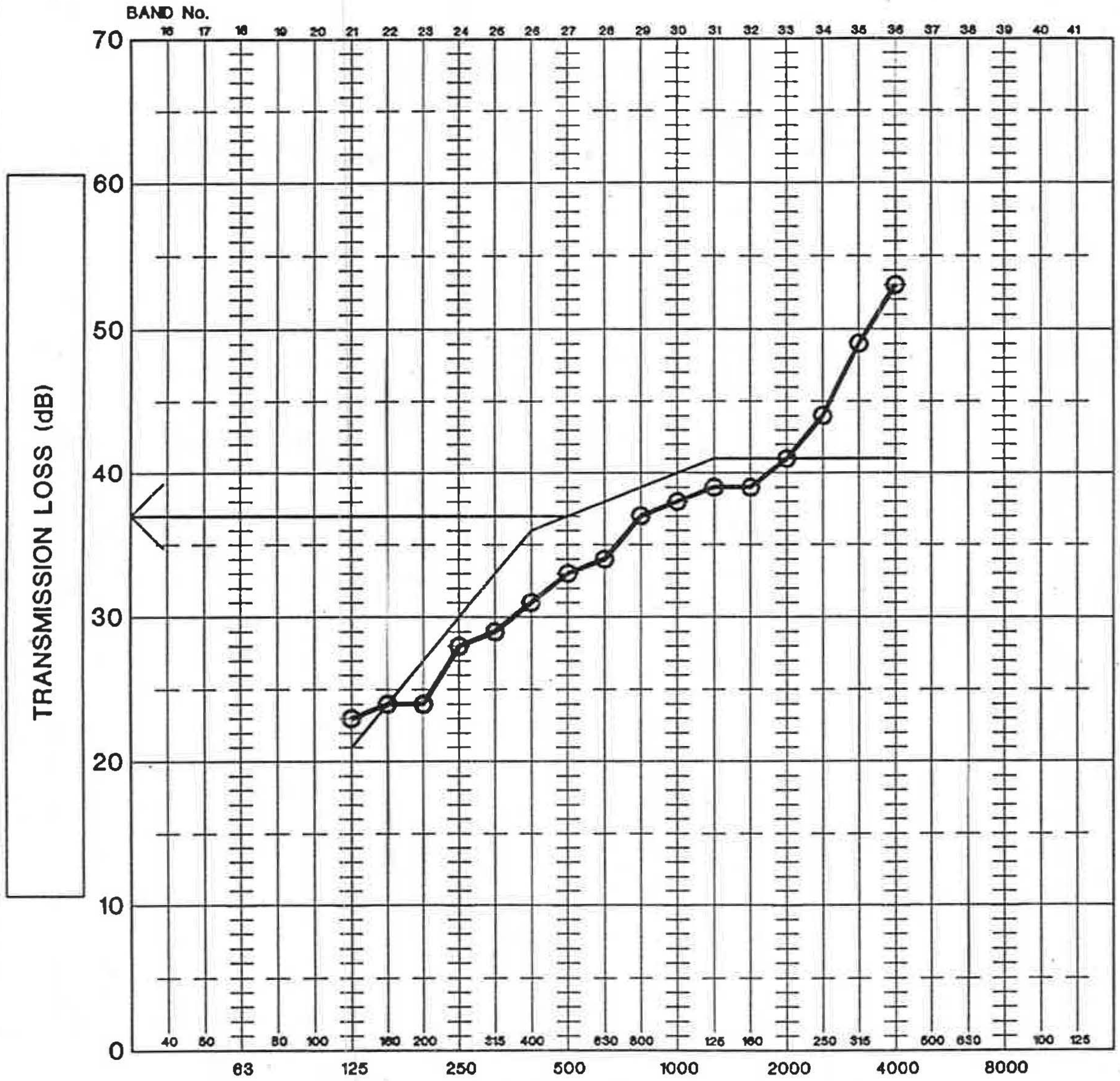
GRAPH TITLE

NOISE ISOLATION PROVIDED BY A 1 3/4 in METAL DOOR WITH MINERAL IN THE CAVITY, GASKETED AND OPERATIONAL.

GRAPH NUMBER 5

PROJECT NUMBER	DATE
177.911	92 12

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT



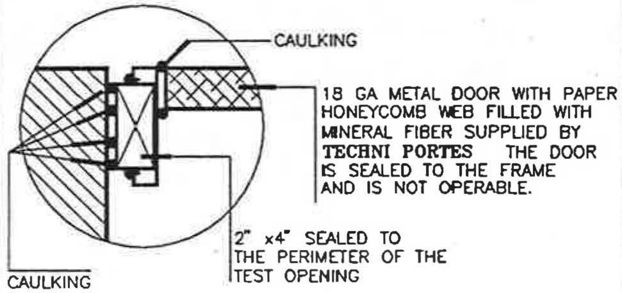
LEGEND

Transmission Loss (TL)

STC contour
(ASTM E 413-87)

Sound Transmission Class
STC = 37

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

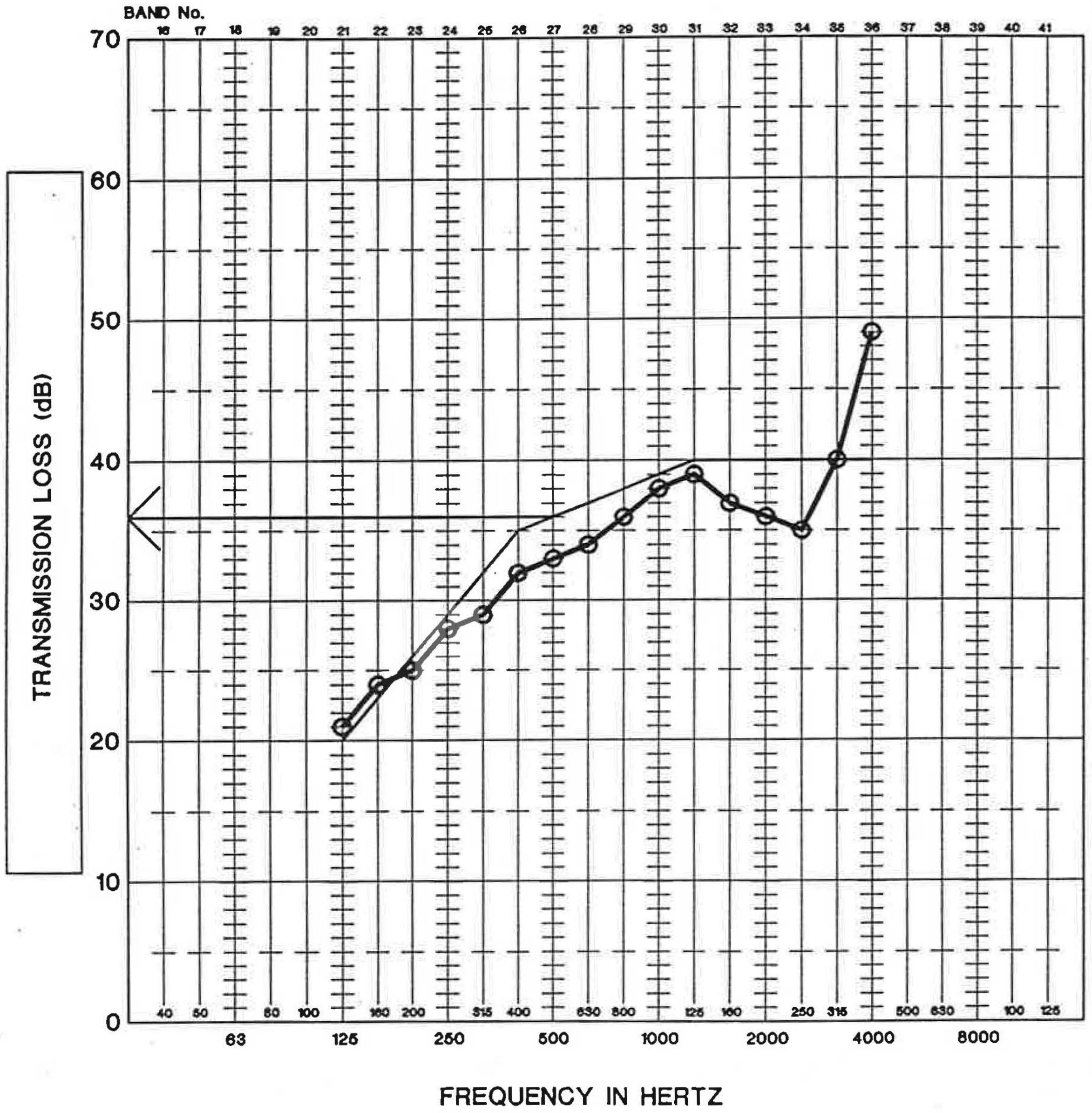
NOISE ISOLATION PROVIDED BY A 1 3/4 in METAL DOOR WITH MINERAL FIBER IN CAVITY AND PERIMETER CAULKED.

GRAPH NUMBER 6

PROJECT NUMBER	DATE
177.911	92 11

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT



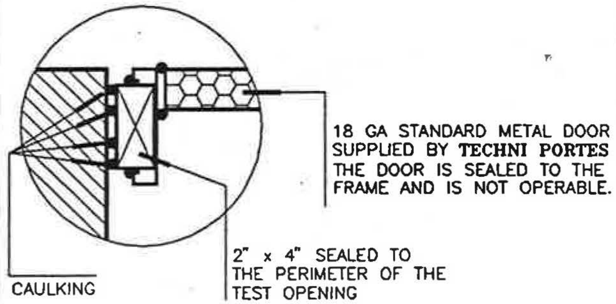
LEGEND

Transmission Loss (TL)

STC contour
(ASTM E 413-87)

Sound Transmission Class
STC = 36

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

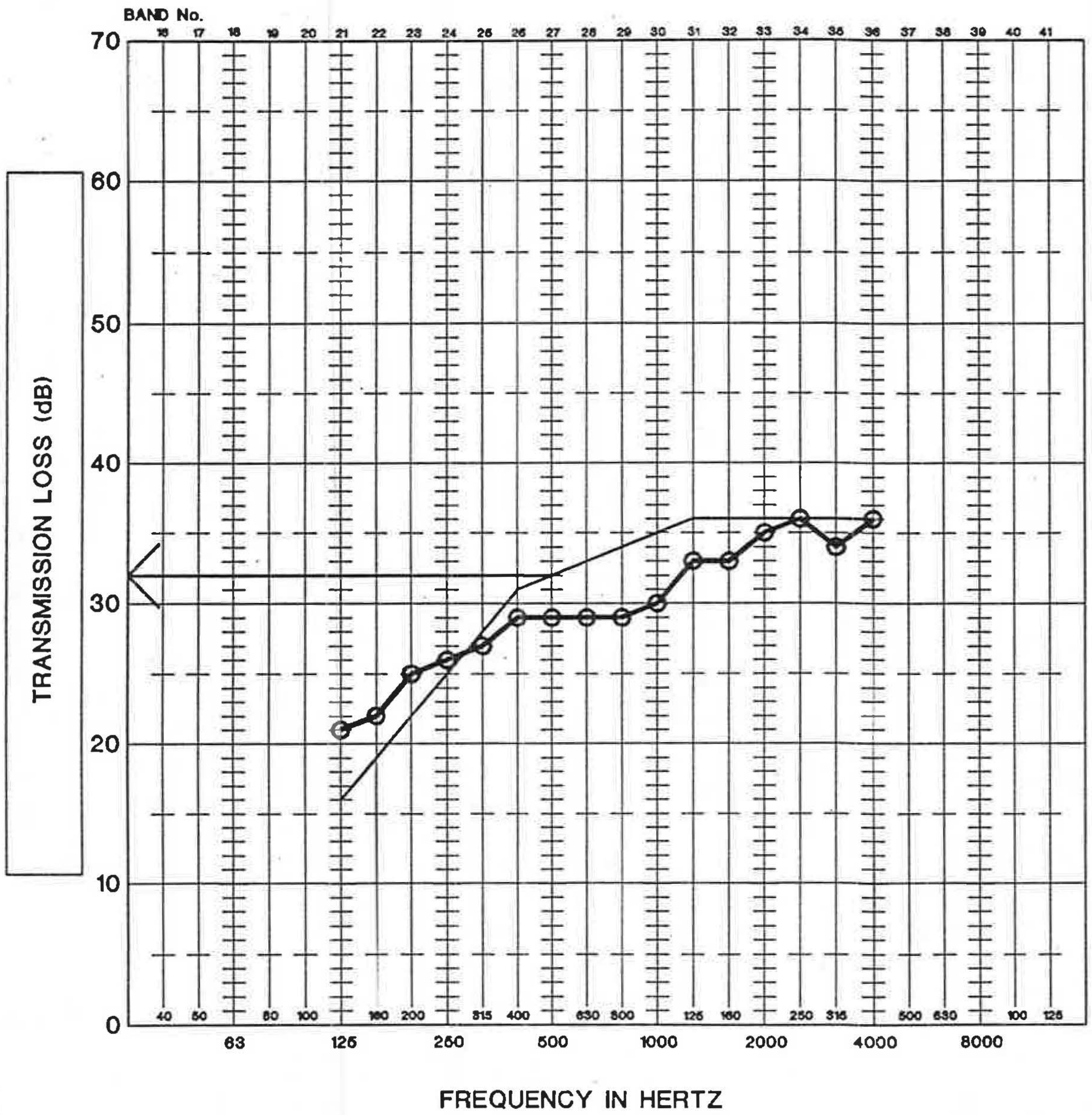
NOISE ISOLATION PROVIDED BY A 1 3/4 in METAL DOOR WITH UNFILLED HONEYCOMB PAPER WEB AND PERIMETER CAULKED

GRAPH NUMBER 7

PROJECT NUMBER	DATE
177.911	92 12

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT



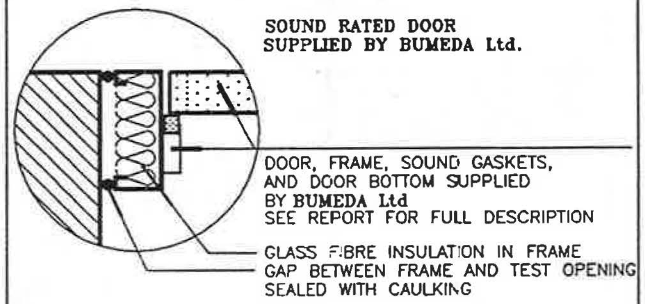
LEGEND

Transmission Loss (TL)

STC contour
(ASTM E 413-87)

Sound Transmission Class
STC = 32

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

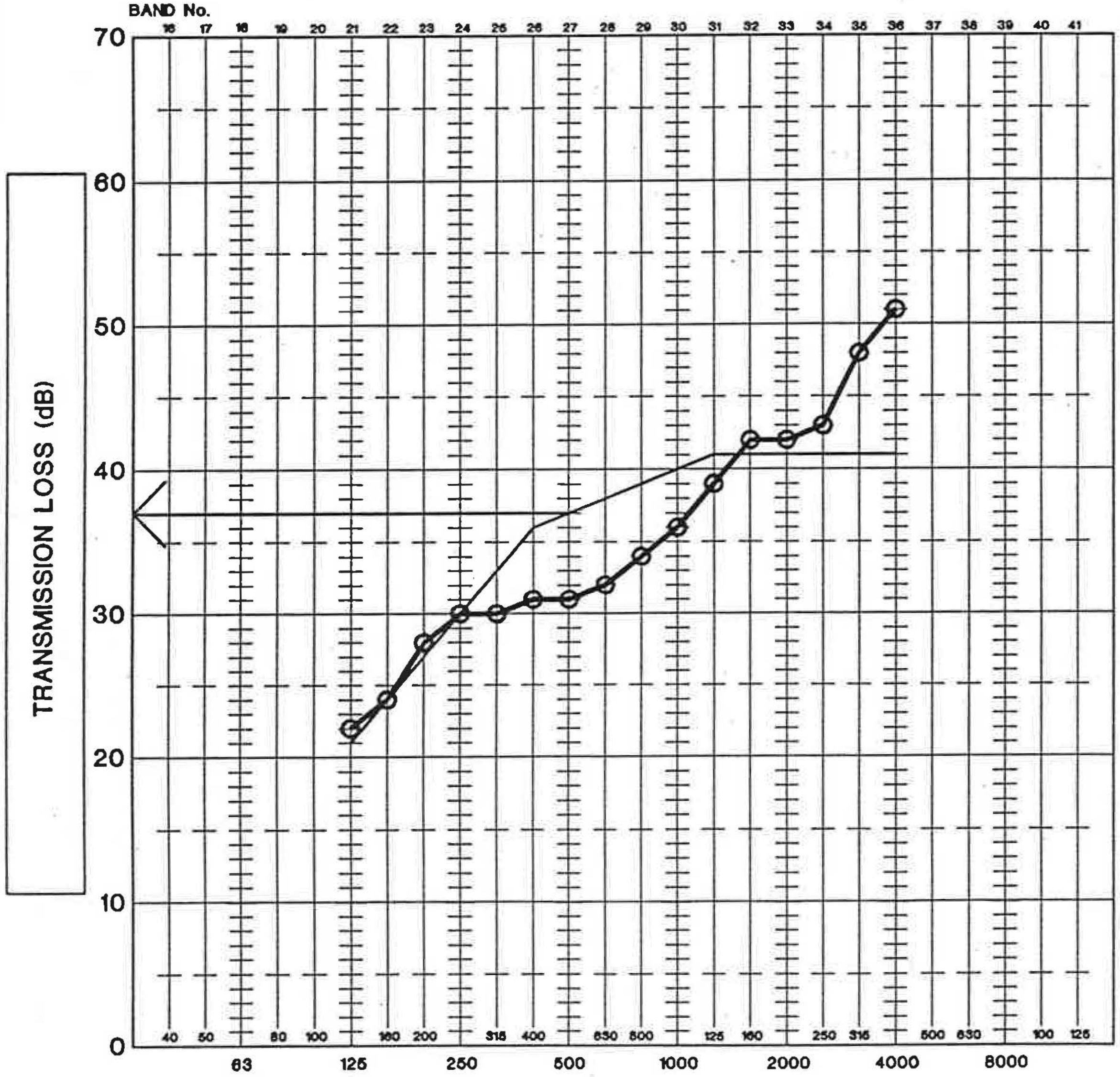
NOISE ISOLATION PROVIDED BY A SOUND RATED DOOR, FRAME AND SOUND GASKETS SUPPLIED BY BUMEDA; DOOR OPERABLE.

GRAPH NUMBER 8

PROJECT NUMBER	DATE
177.911	92 12

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT



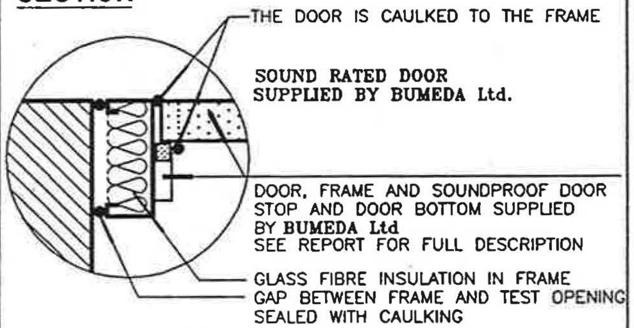
LEGEND

Transmission Loss (TL)

STC contour
(ASTM E 413-87)

Sound Transmission Class
STC = 37

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

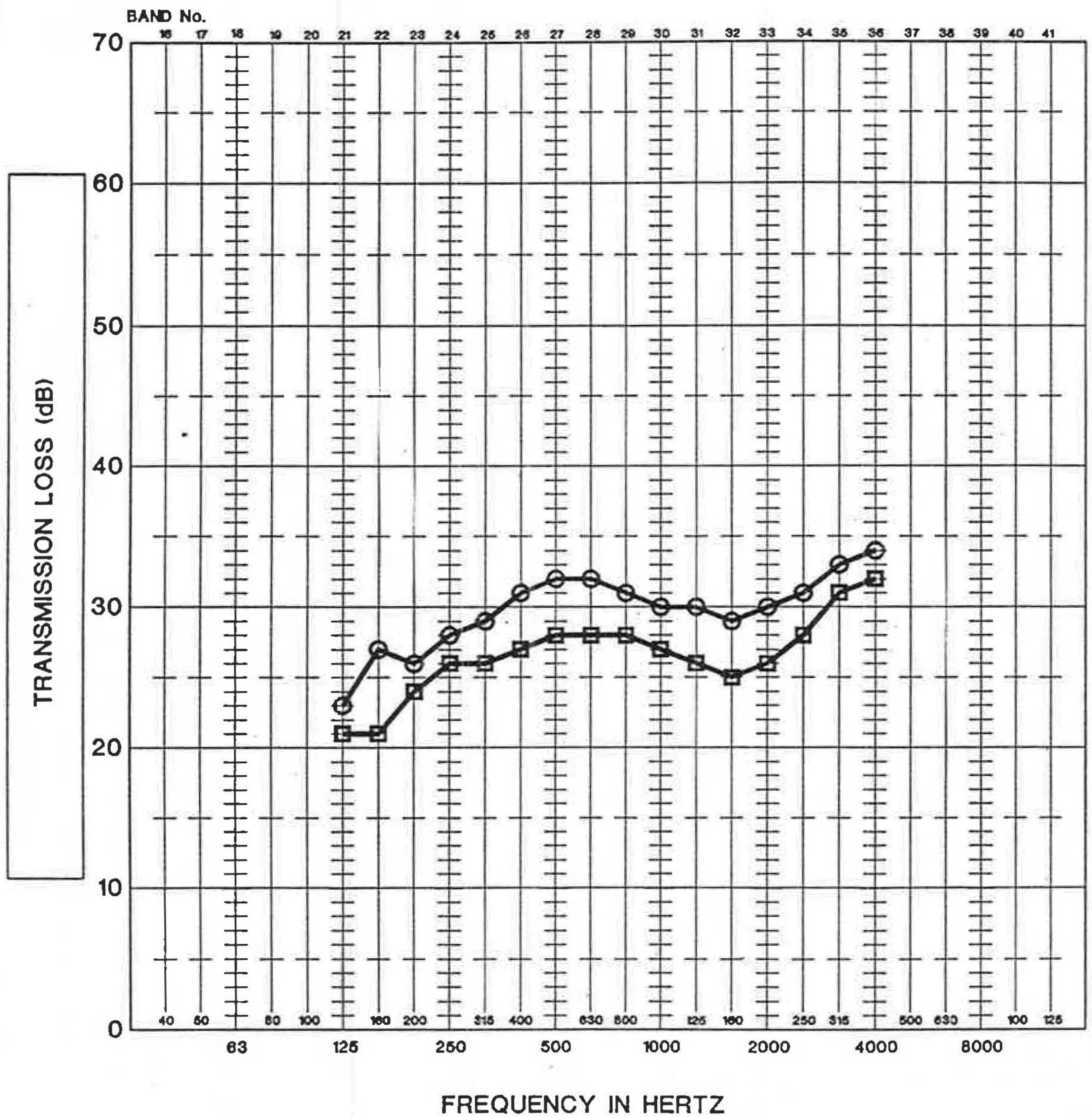
GRAPH TITLE

NOISE ISOLATION PROVIDED BY A SOUND RATED DOOR, FRAME AND SOUND GASKETS SUPPLIED BY BUMEDA; DOOR CAULKED..

GRAPH NUMBER 9

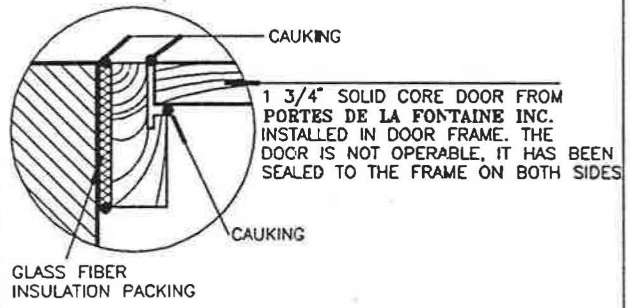
PROJECT NUMBER	DATE
177.911	92 12

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

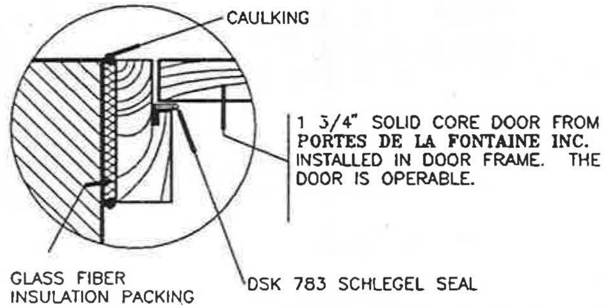


LEGEND

Transmission Loss (TL)
TEST NO 2: STC=31



Transmission Loss (TL)
TEST NO 1; STC=28



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

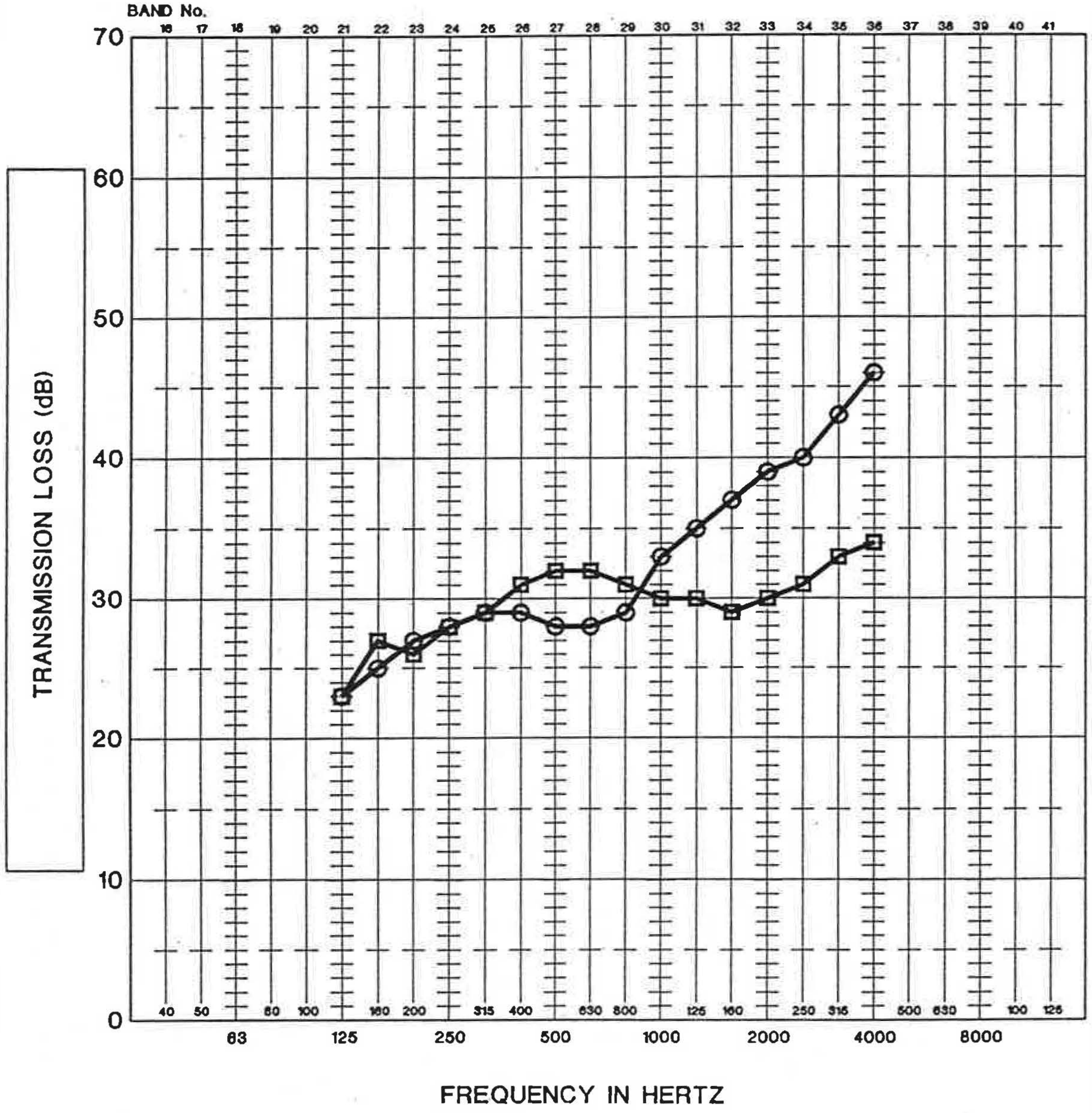
NOISE ISOLATION PROVIDED BY A 1 3/4 in CAULKED TO FRAME VERSUS SAME DOOR IN FRAME EQUIPED WITH DSK 783 GASKETS

GRAPH NUMBER 10

PROJECT NUMBER	DATE
177.911	92 11

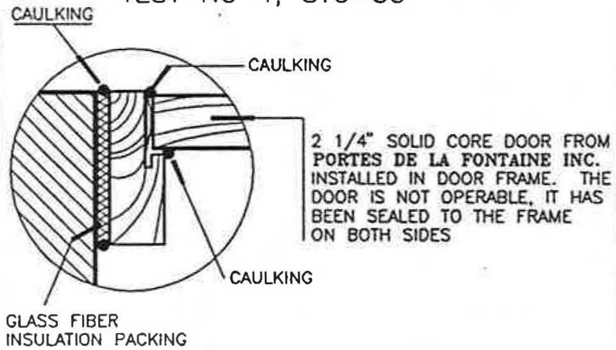
mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

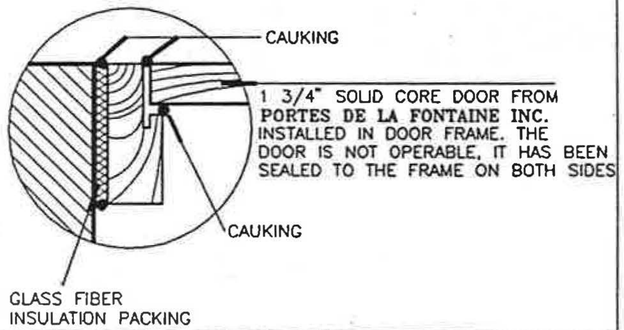


LEGEND

Transmission Loss (TL)
TEST NO 4; STC=33



Transmission Loss (TL)
TEST NO 2; STC=31



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

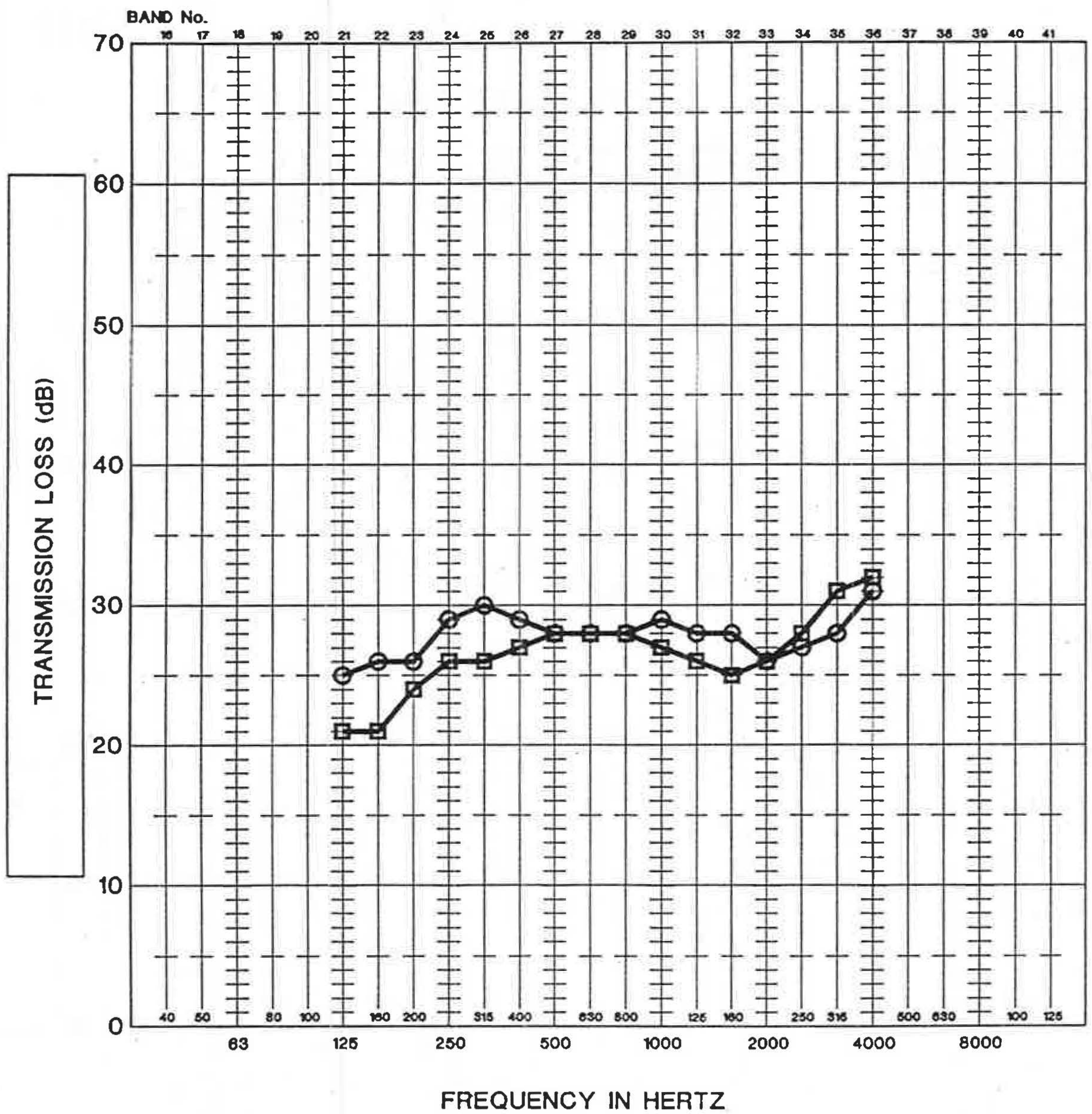
NOISE ISOLATION PROVIDED BY A 2 1/4 in VERSUS A 1 3/4 SOLID CORE DOOR WITH PERIMETER CAULKED TO FRAME.

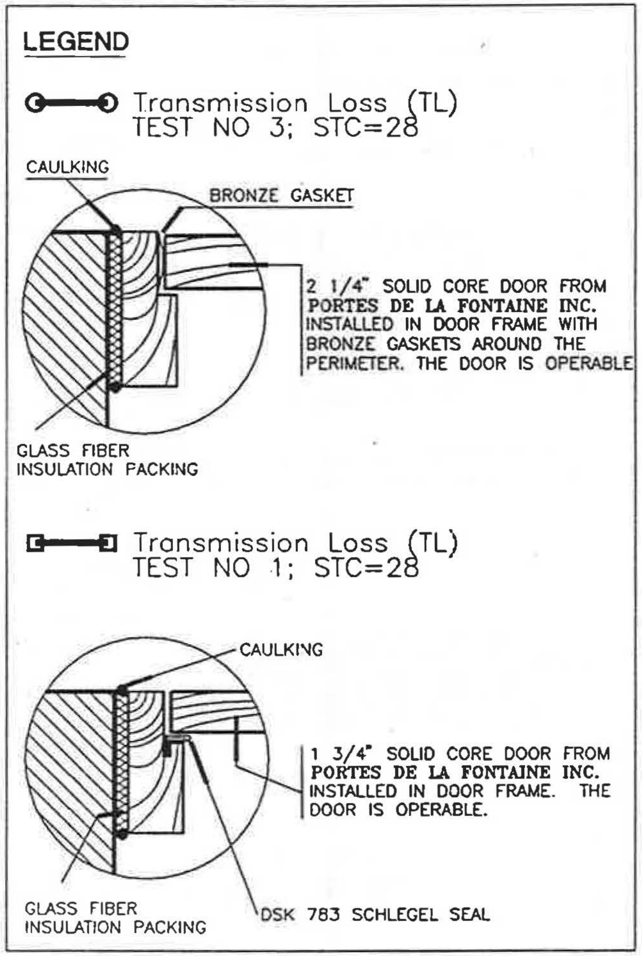
GRAPH NUMBER 11

PROJECT NUMBER	DATE
177.911	92 12

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT





PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

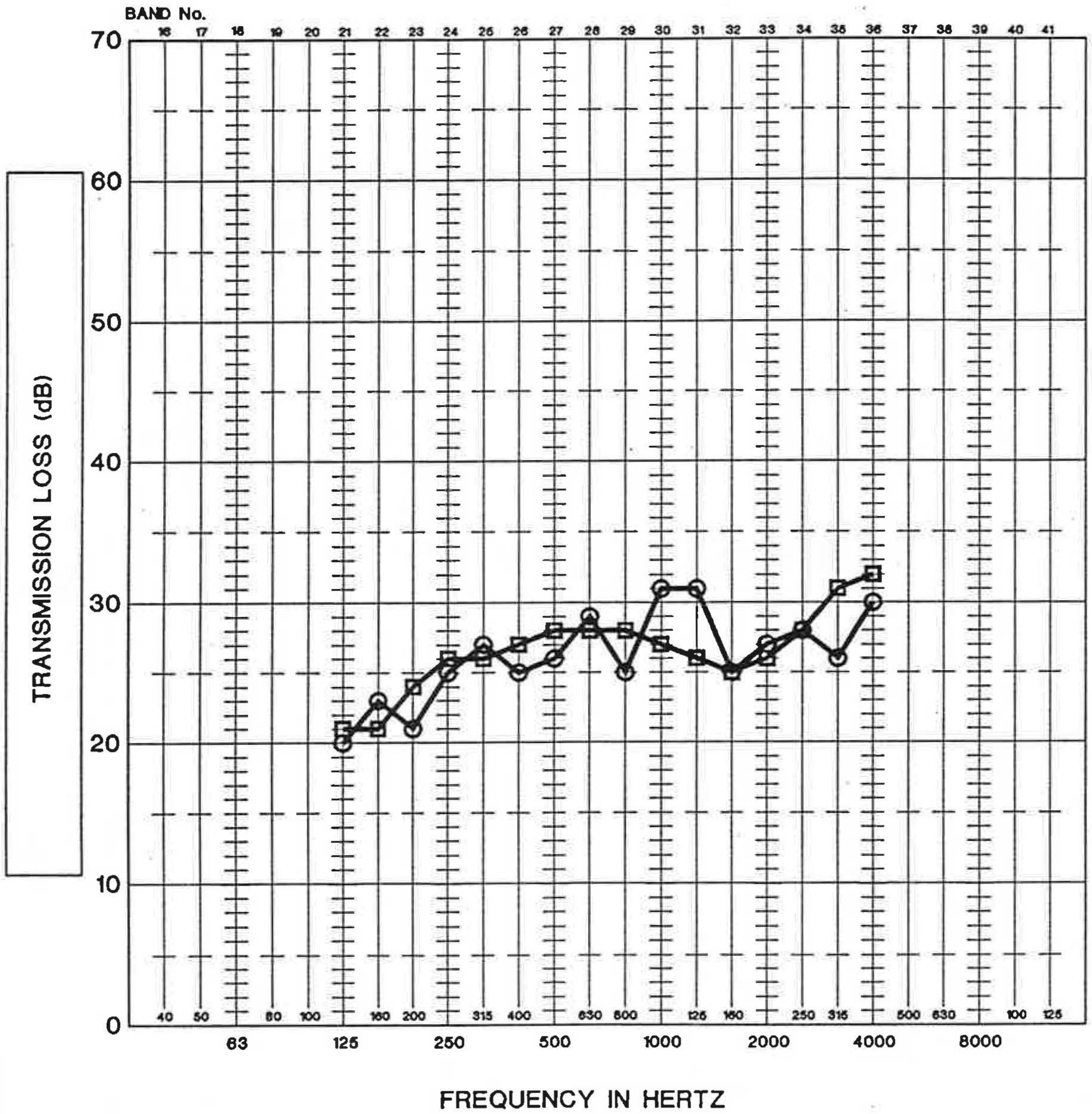
NOISE ISOLATION PROVIDED BY A 1 3/4 in SOLID CORE DOOR W/. SHLEGEL SEALS VS. 2 1/4 in. DOOR W/. BRONZE GASKETS.

GRAPH NUMBER 12

PROJECT NUMBER	DATE
177.911	92 12

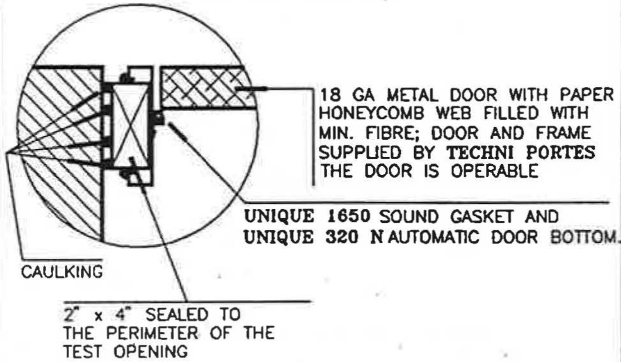
mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

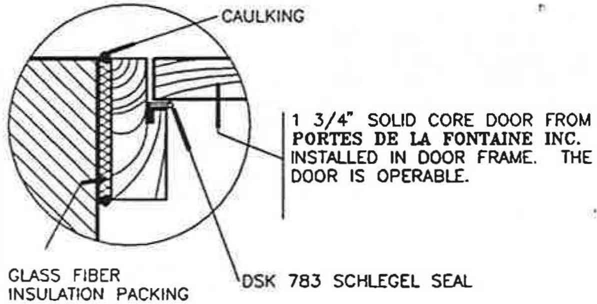


LEGEND

Transmission Loss (TL)
TEST NO 5; STC=27

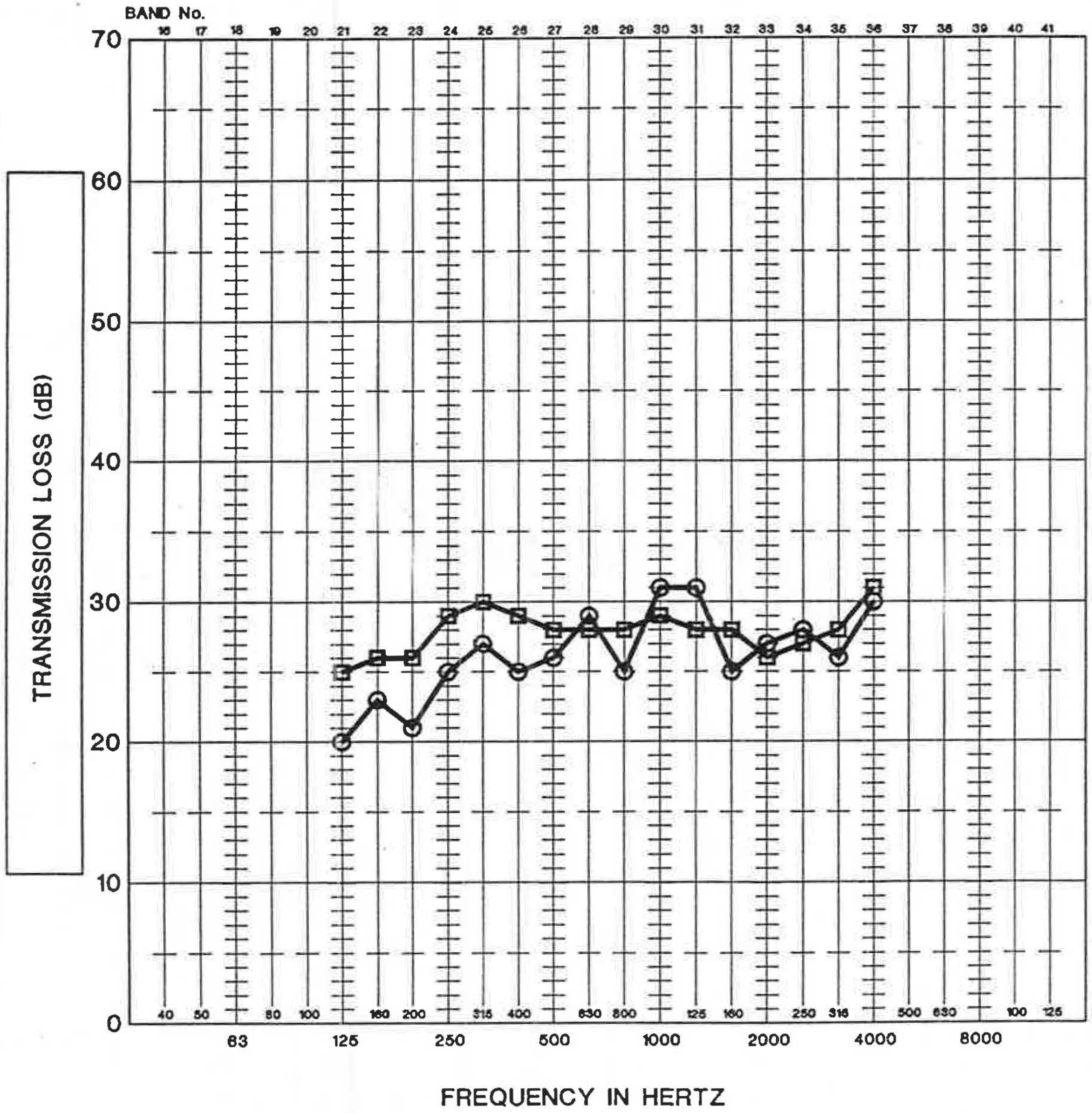


Transmission Loss (TL)
TEST NO 1; STC=28



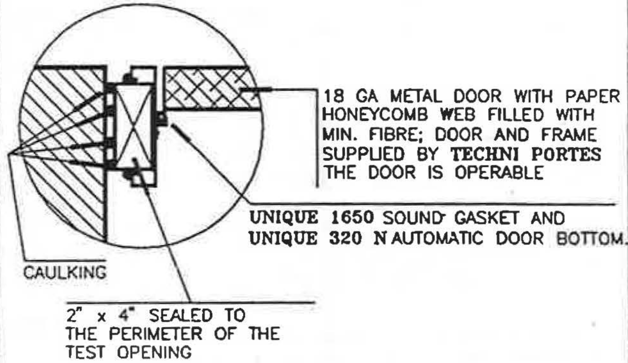
PROJECT DESCRIPTION RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS	
GRAPH TITLE NOISE ISOLATION PROVIDED BY A 1 3/4 in GASKETED FILLED METAL DOO VS THAT OF A 1 3/4 in. GASKETED WOOD DOOR.	
GRAPH NUMBER 13	
PROJECT NUMBER 177.911	**DATE** 92 12

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

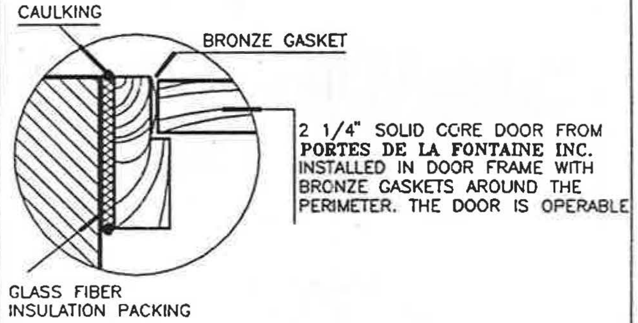


LEGEND

Transmission Loss (TL)
STC = 27



Transmission Loss (TL)
STC = 28



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

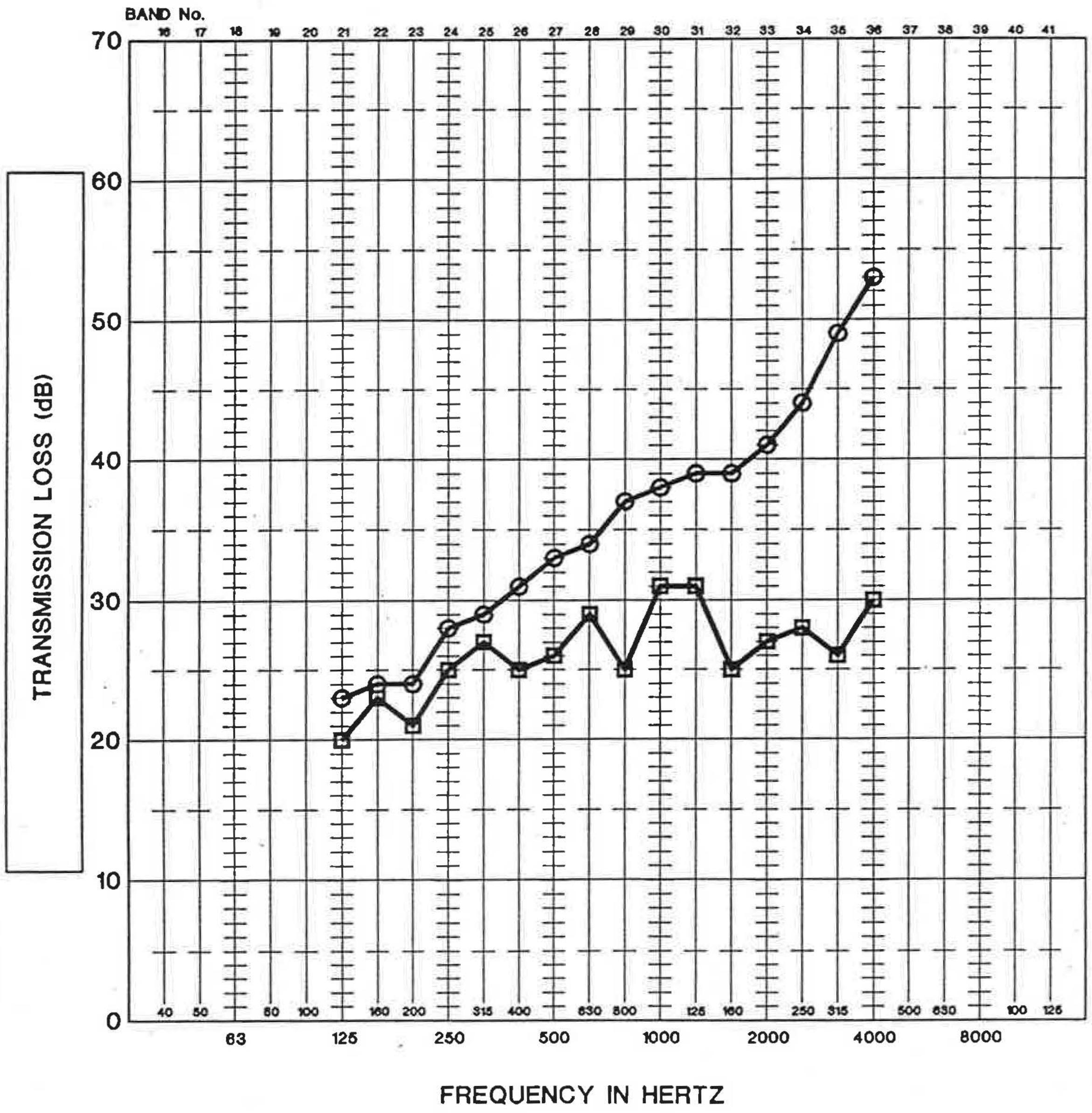
GRAPH TITLE

SOUND TRANSMISSION LOSS OF A 2 1/4 SOLID CORE WOOD DOOR AND A 1 3/4 in. METAL DOOR; BOTH GASKETTED.

GRAPH NUMBER 14

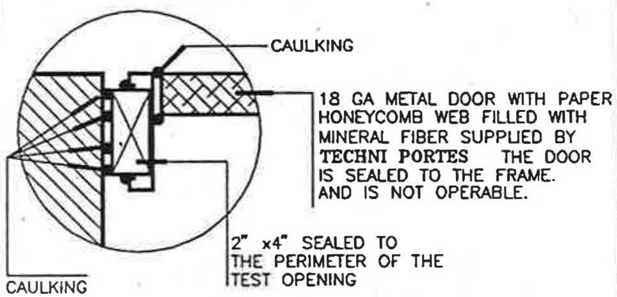
PROJECT NUMBER	DATE
177.911	92 12

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

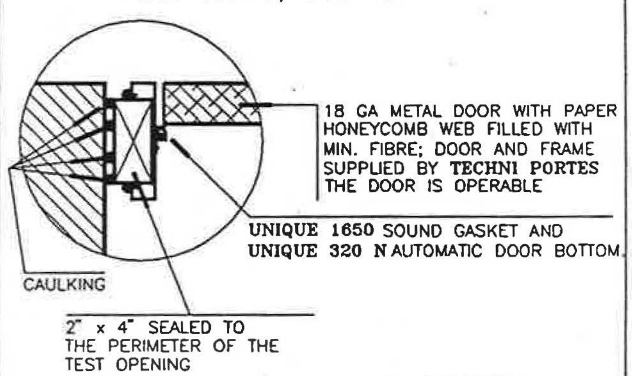


LEGEND

Transmission Loss (TL)
TEST NO 6; STC=37



Transmission Loss (TL)
TEST NO 5; STC=27



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

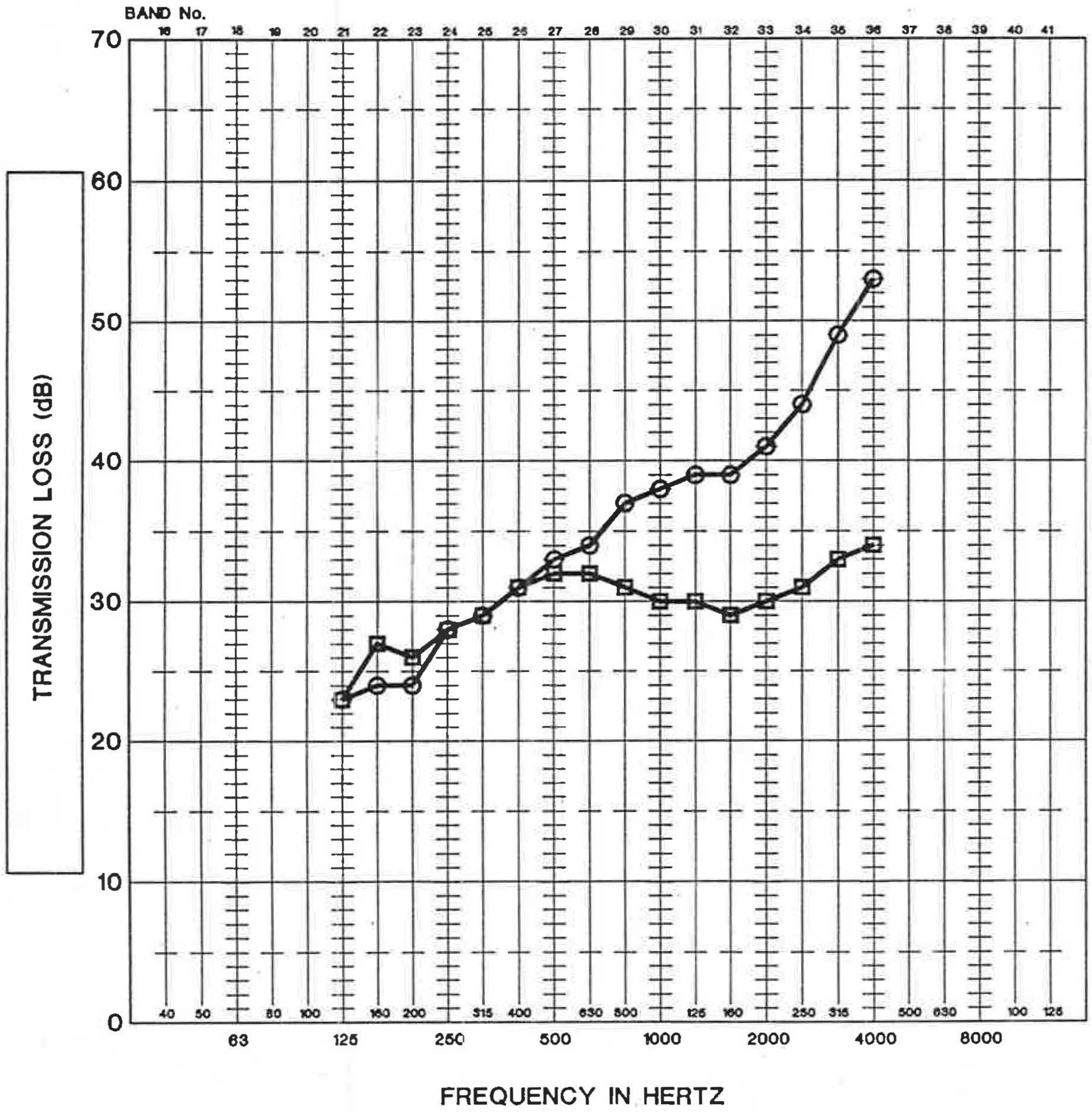
NOISE ISOLATION PROVIDED BY A 1 3/4 in METAL DOOR W/. GASKETS VS CAULKING AT PERIMETER AND BOTTOM.

GRAPH NUMBER 15

PROJECT NUMBER	DATE
177.911	92 12

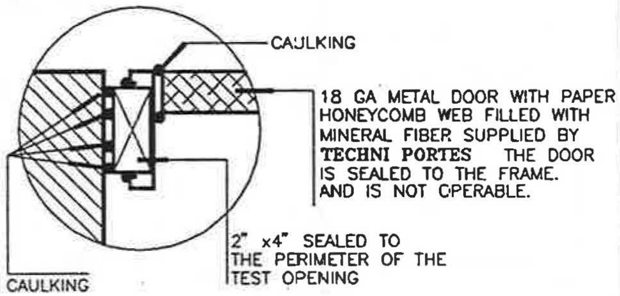
mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

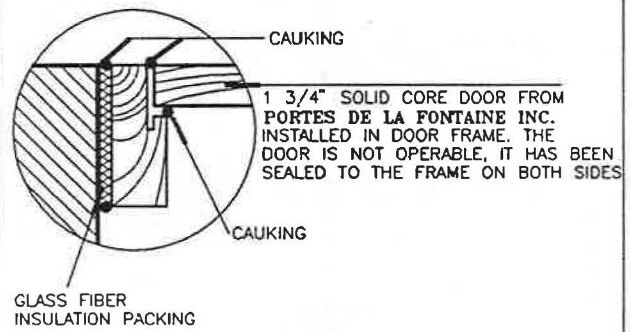


LEGEND

Transmission Loss (TL)
TEST NO 6; STC=37



Transmission Loss (TL)
TEST NO 2; STC=31



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

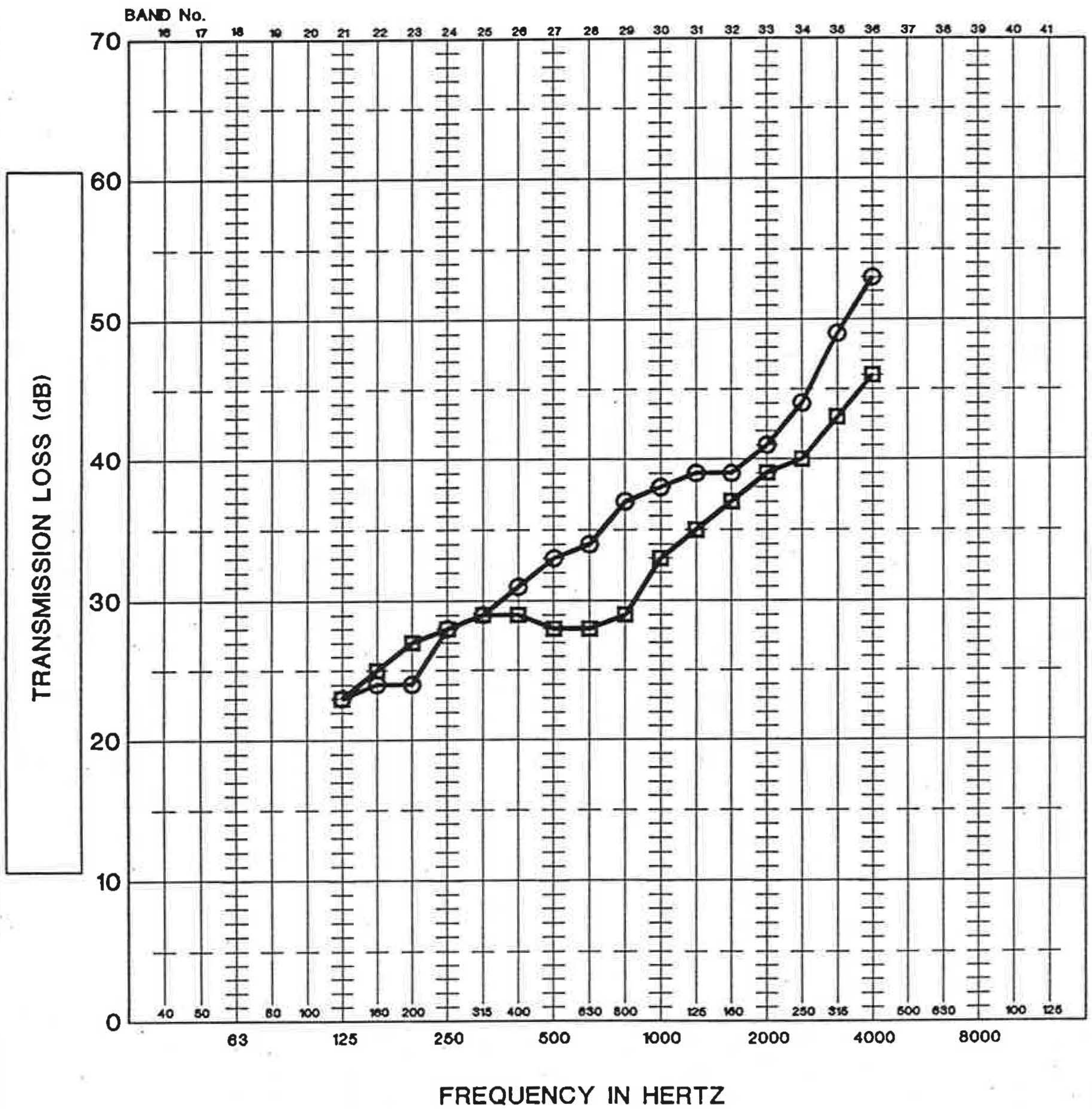
NOISE ISOLATION PROVIDED BY A 1 3/4 in METAL DOOR VS SOLID CORE WOOD DOOR; BOTH DOORS CAULKED TO FRAME..

GRAPH NUMBER 16

PROJECT NUMBER	DATE
177.911	92 12

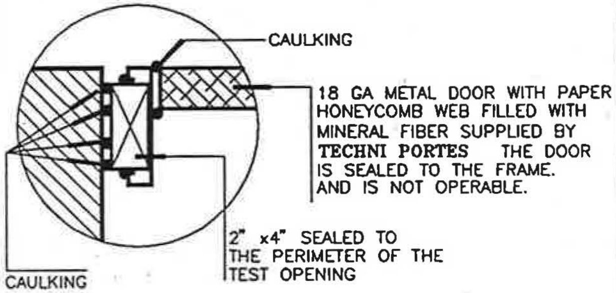
mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

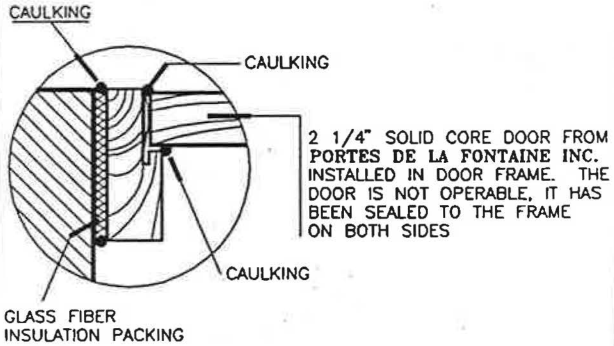


LEGEND

Transmission Loss (TL)
TEST NO 6; STC=37



Transmission Loss (TL)
TEST NO 4; STC=33



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

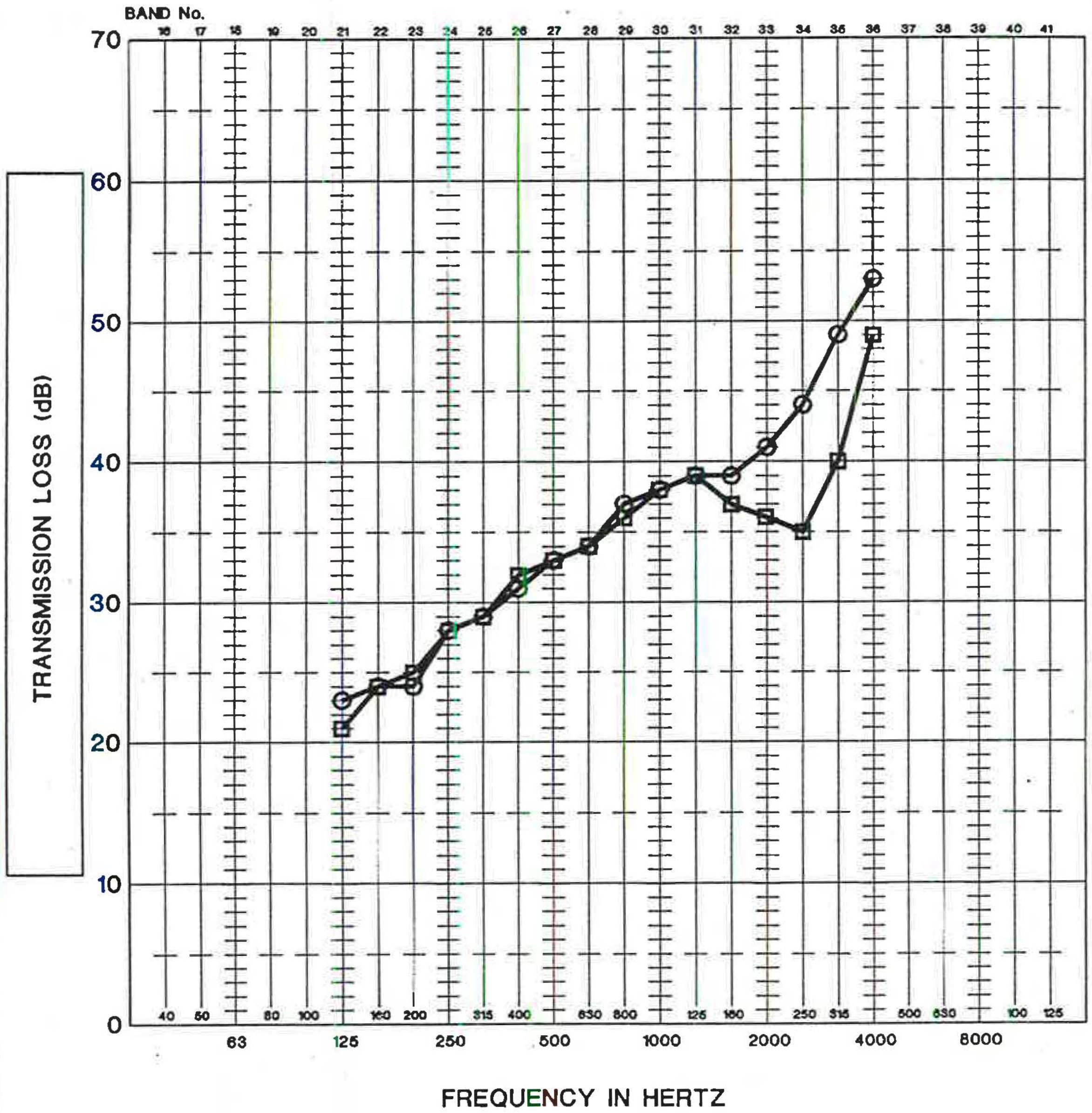
GRAPH TITLE

NOISE ISOLATION PROVIDED BY A 1 3/4 in METAL DOOR VS A 2 1/4 in. WOOD DOOR BOTH DOORS CAULKED TO FRAME..

GRAPH NUMBER	17
PROJECT NUMBER 177.911	**DATE** 92 12

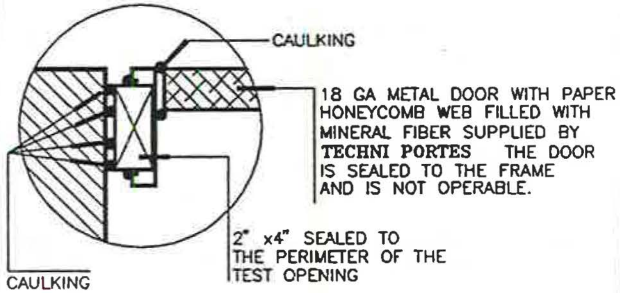
mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

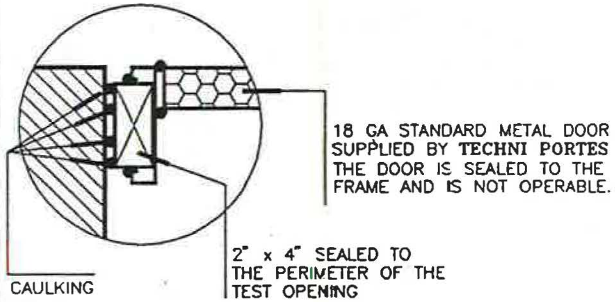


LEGEND

Transmission Loss (TL)
TEST NO 6; STC=37



Transmission Loss (TL)
TEST NO 7; STC=37



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

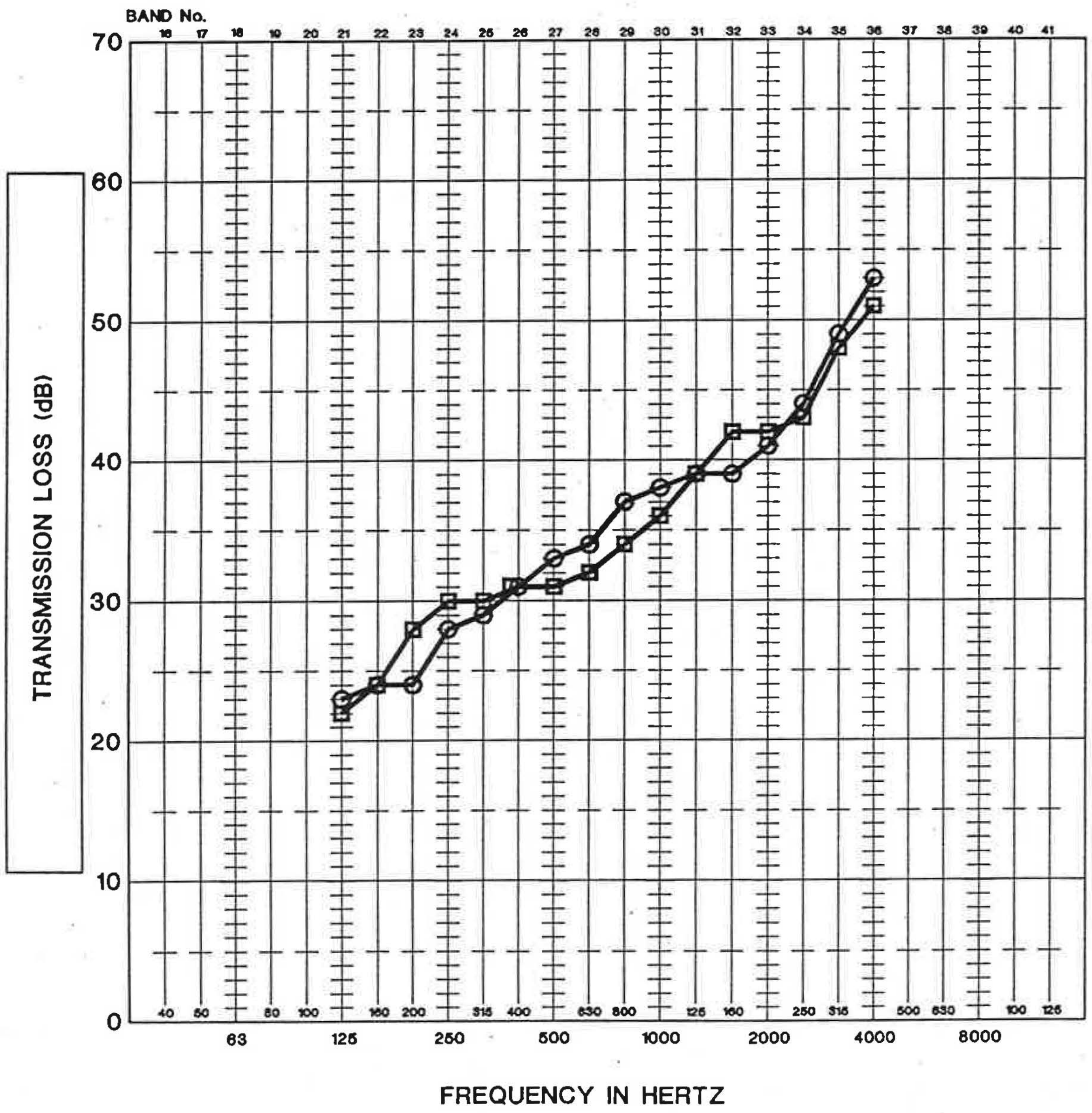
NOISE ISOLATION PROVIDED BY 1 3/4 in METAL DOORS, WEB FILLED AND UNFILLED W/. MIN. FIBER; CAULKED TO FRAME.

GRAPH NUMBER 18

PROJECT NUMBER	DATE
177.911	92 12

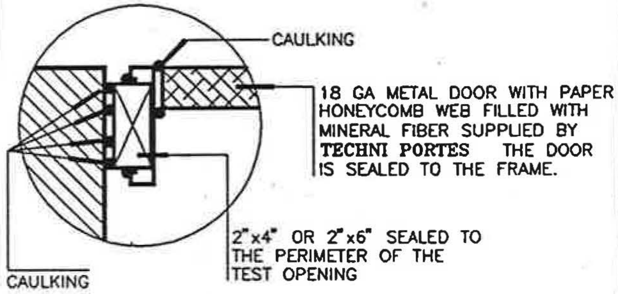
mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

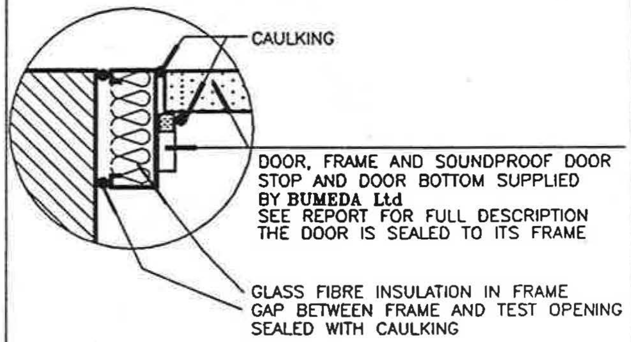


LEGEND

Transmission Loss (TL)
TEST NO 6; STC=37



Transmission Loss (TL)
TEST NO 9; STC=37



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

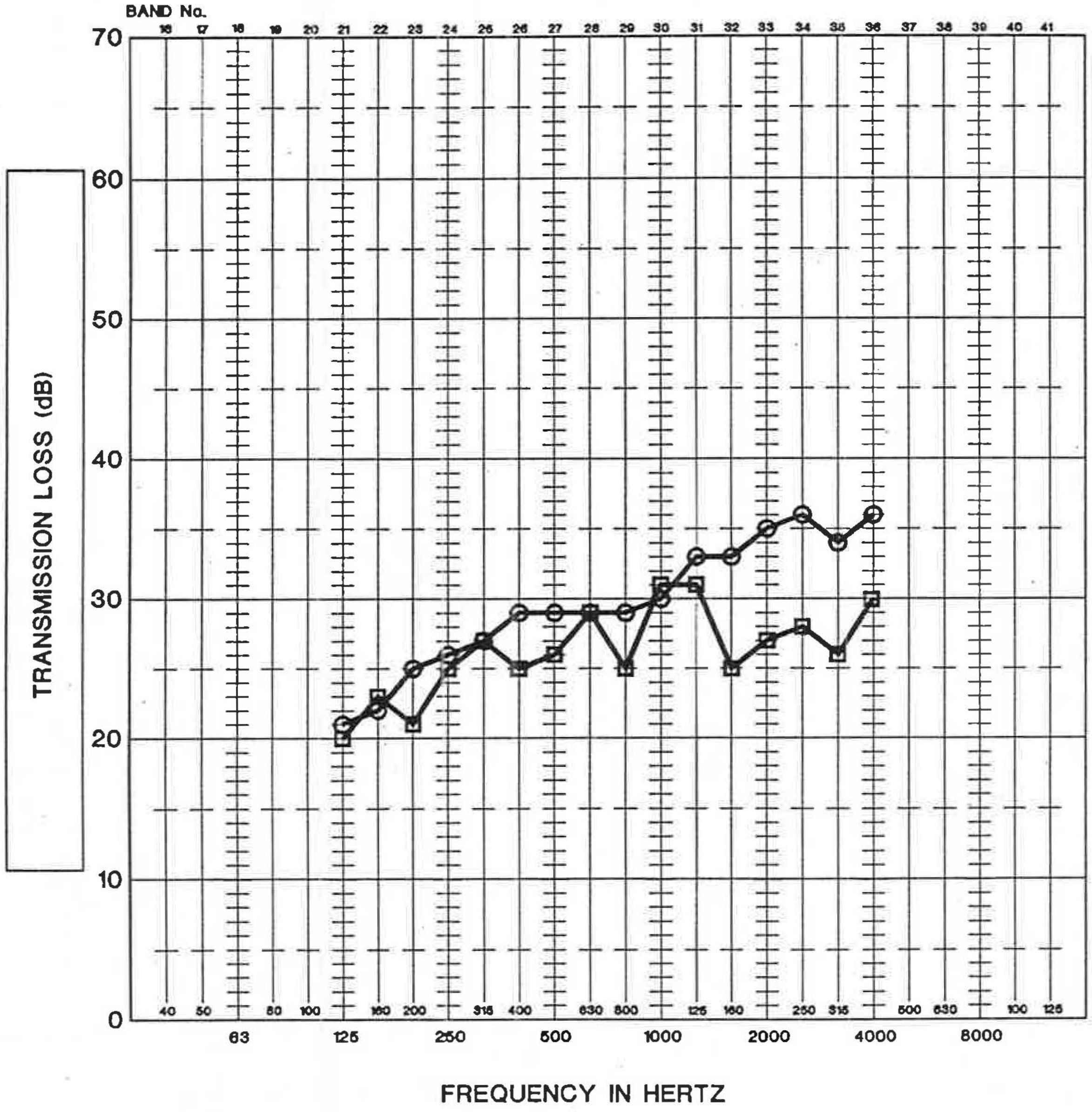
NOISE ISOLATION PROVIDED BY 1 3/4 in METAL DOORS, WEB FILLED W/. MIN. FIBER VS SILICATE CORE.

GRAPH NUMBER 20

PROJECT NUMBER	DATE
177.911	92 12

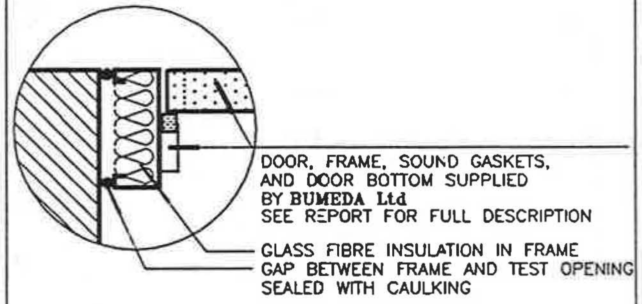
MJM

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

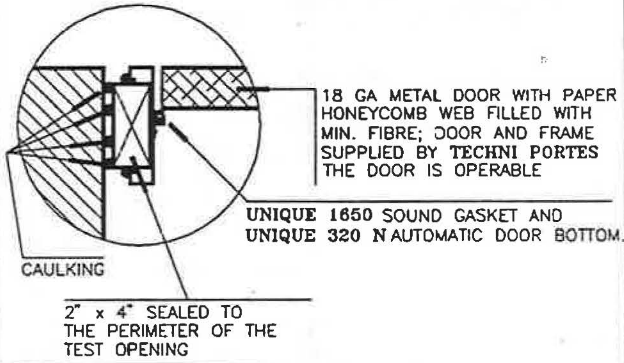


LEGEND

Transmission Loss (TL)
TEST NO 8; STC=32



Transmission Loss (TL)
TEST NO 5; STC=27



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

NOISE ISOLATION PROVIDED BY A 1 3/4 in METAL DOOR W/. GASKETS VS CAULKING AT PERIMETER AND BOTTOM.

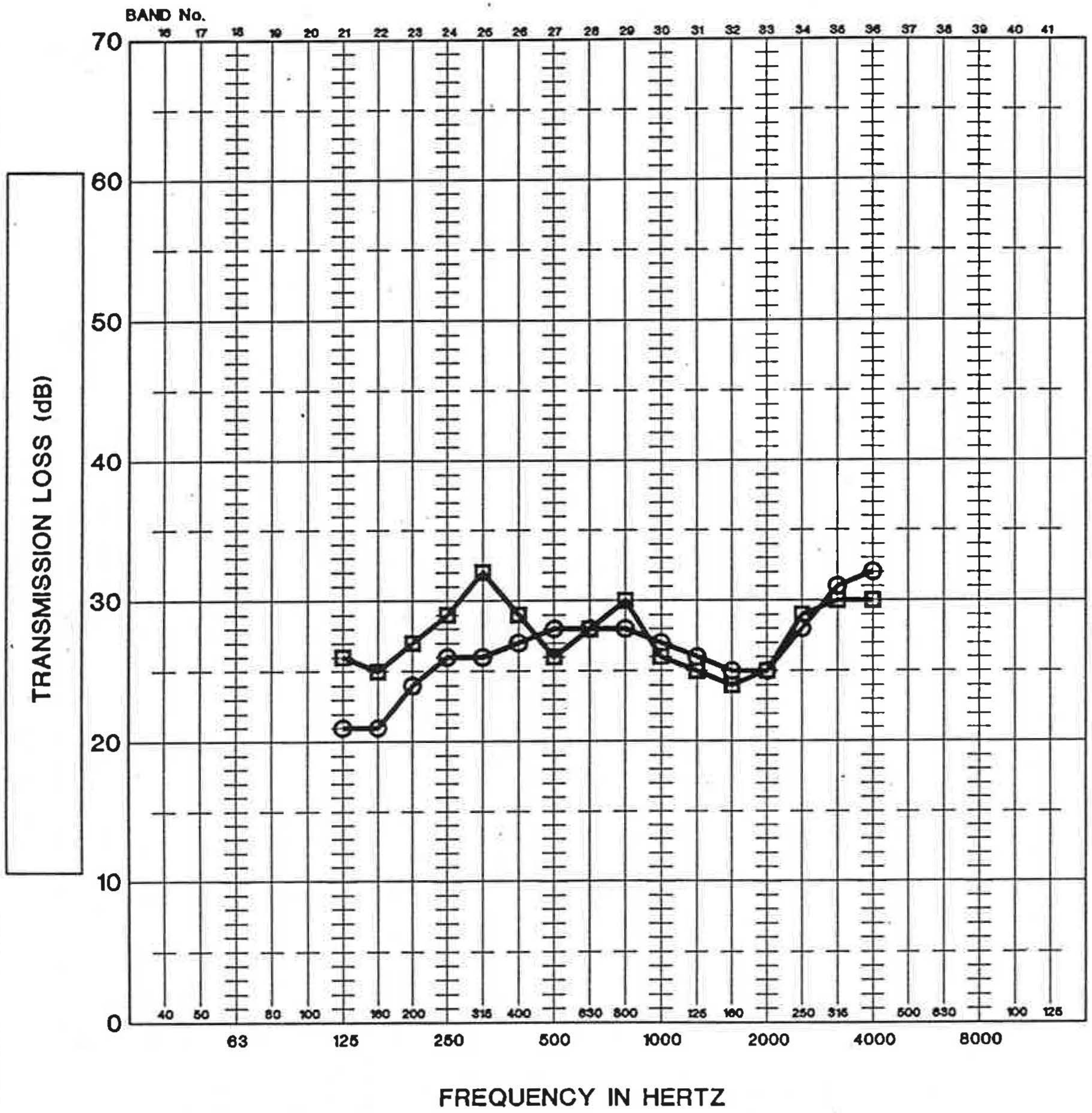
GRAPH NUMBER 19

PROJECT NUMBER	DATE
177.911	92 12

MJM

ANNEX II

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

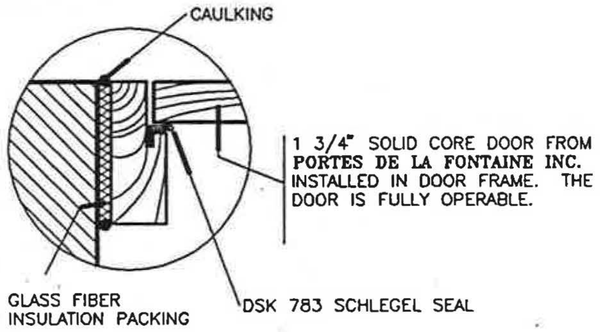


LEGEND

Transmission Loss (TL)
STC = 28

Transmission Loss estimated using the procedure presented in this report
STC = 27

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

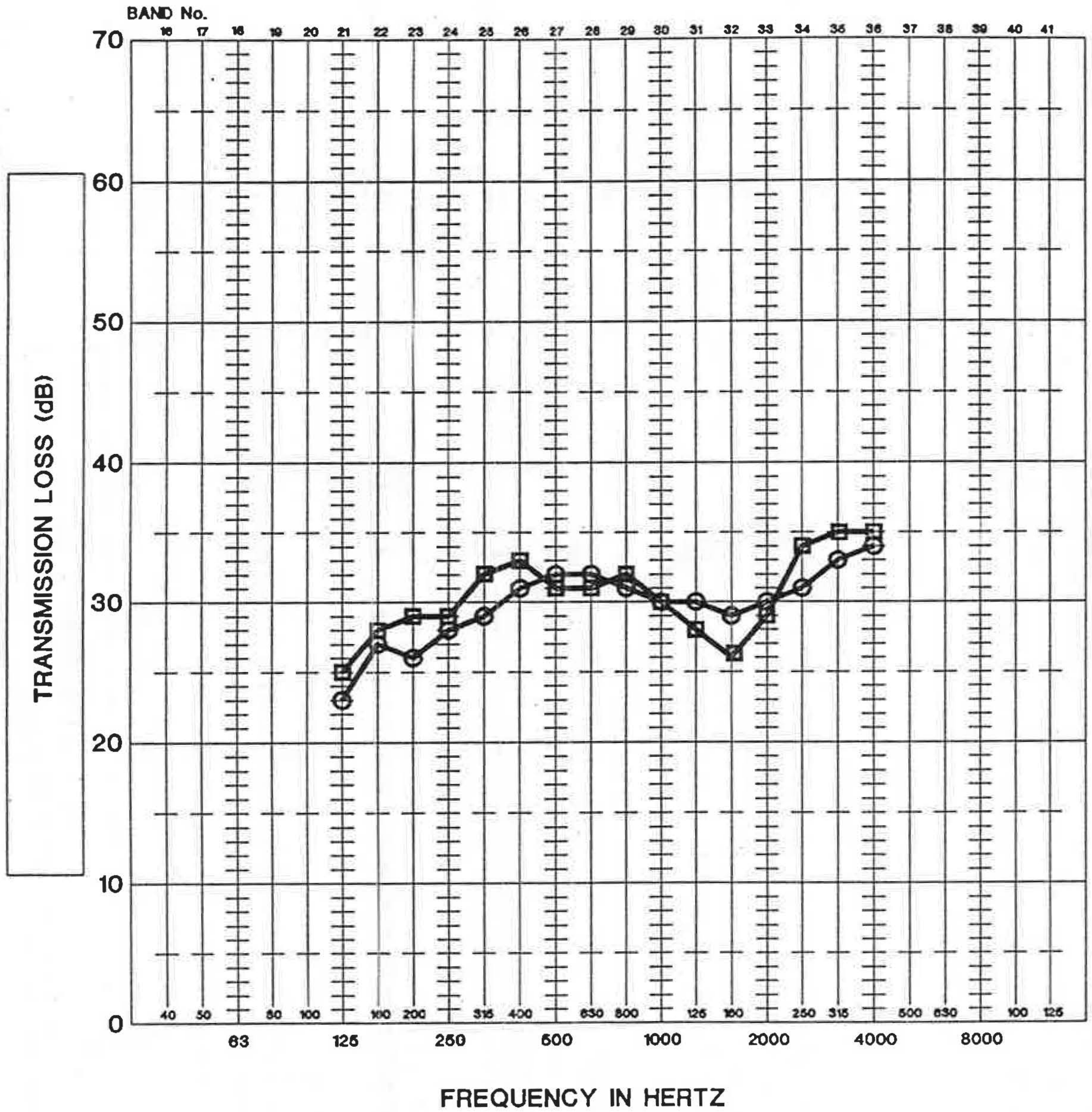
NOISE ISOLATION PROVIDED BY A 1 3/4 in THICK SOLID CORE DOOR; FRAME EQUIPED WITH SCHLEGEL DSK 783 SOUND GASKETS

GRAPH NUMBER 1B

PROJECT NUMBER	DATE
177.911	92 11

MJM

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

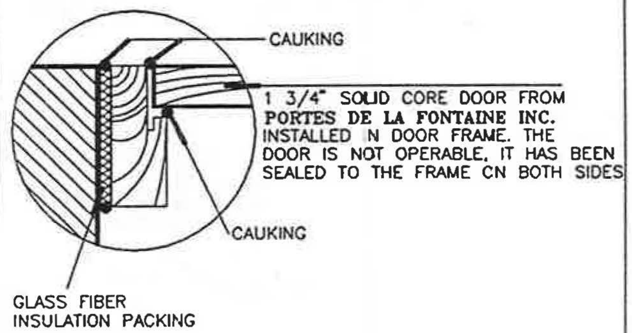


LEGEND

Transmission Loss (TL)
STC = 31

Transmission Loss estimated using the procedure presented in this report
STC = 30

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

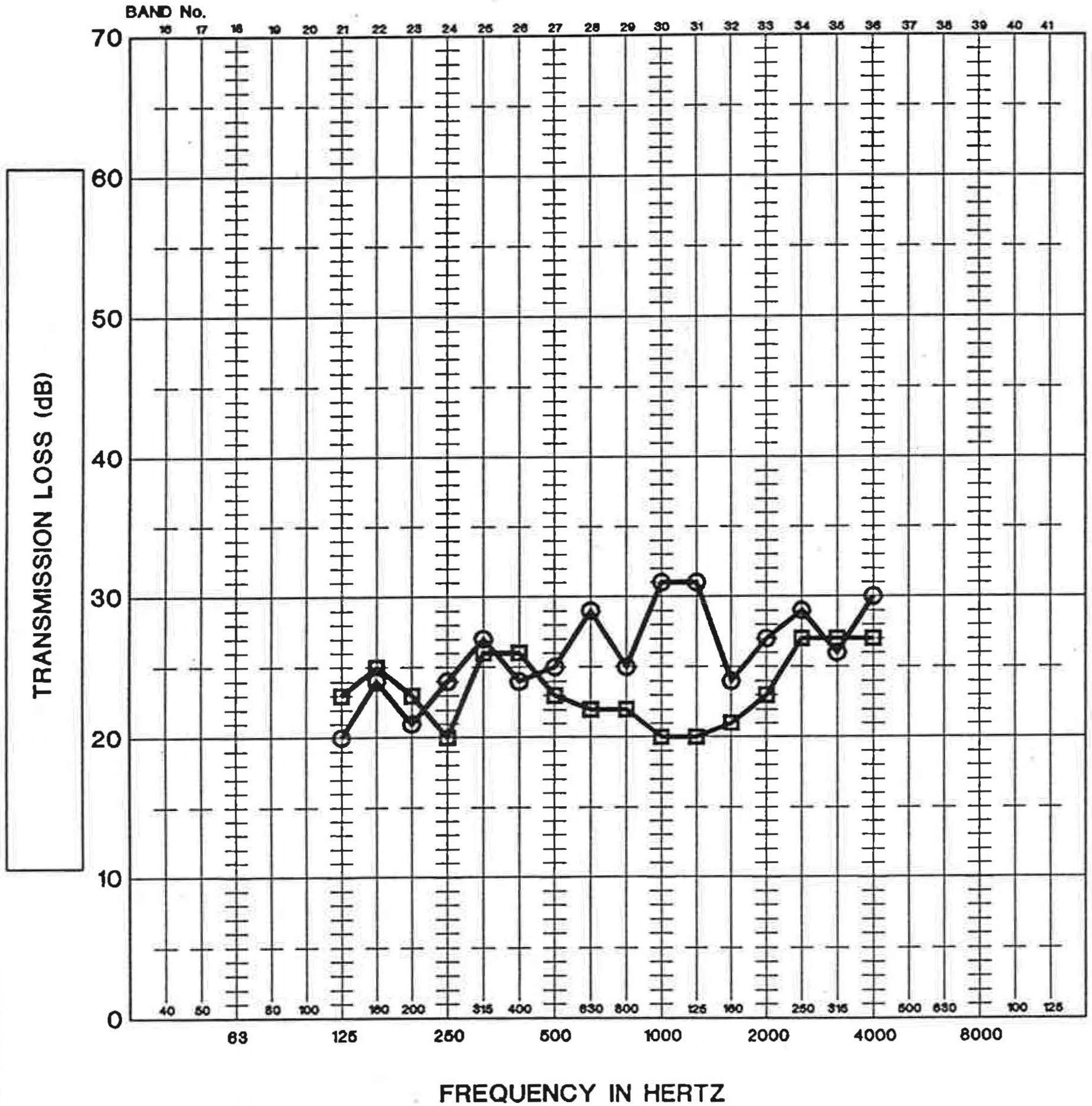
NOISE ISOLATION PROVIDED BY A 1 3/4 in THICK SOLID CORE DOOR; PERIMETER CAULKED WITH REMOVABLE CAULKING

GRAPH NUMBER 2B

PROJECT NUMBER	DATE
177.911	92 12

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

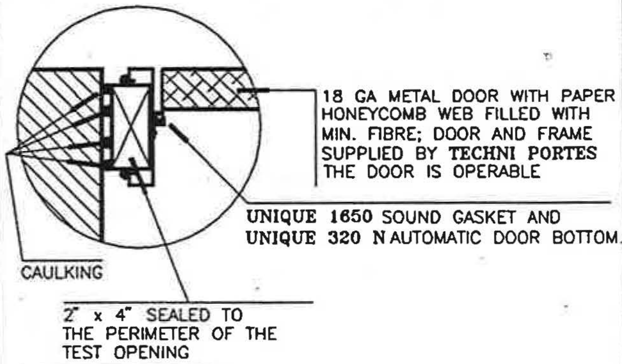


LEGEND

Transmission Loss (TL)
STC = 27

Transmission Loss estimated using the procedure presented in this report
STC = 23

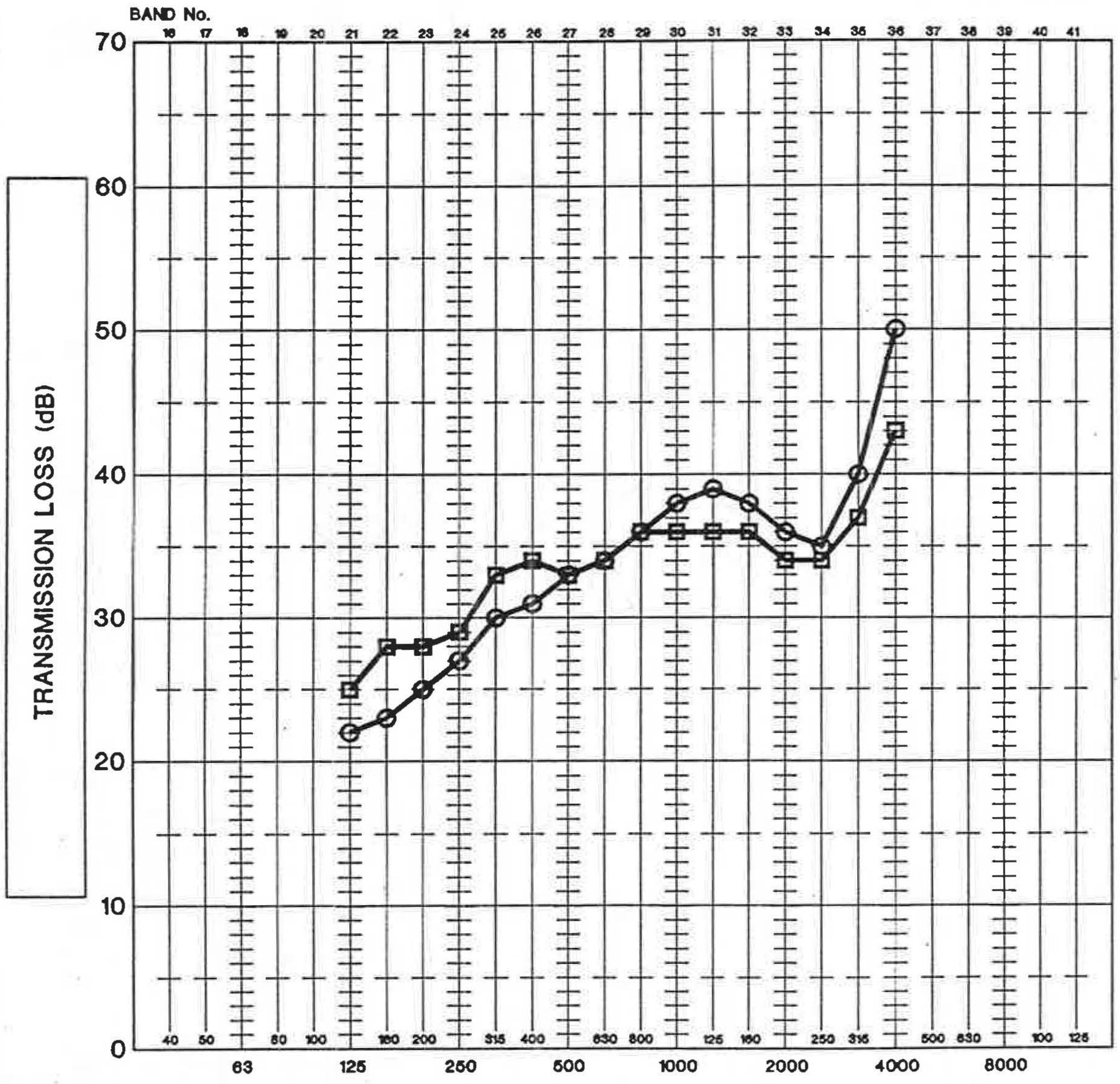
SECTION



PROJECT DESCRIPTION	
RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS	
GRAPH TITLE NOISE ISOLATION PROVIDED BY A 1 3/4 in METAL DOOR WITH FILLED HONEYCOMB PAPER WEB AND SOUNDPROOF DOOR STOP	
GRAPH NUMBER 5B	
PROJECT NUMBER 177.911	**DATE** 92 12

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

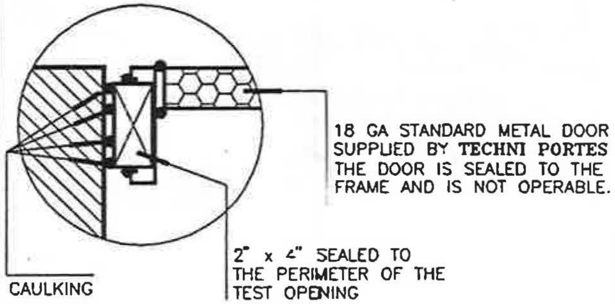


LEGEND

Transmission Loss (TL)
STC = 36

Transmission Loss estimated using the procedure presented in this report
STC = 35

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

GRAPH TITLE

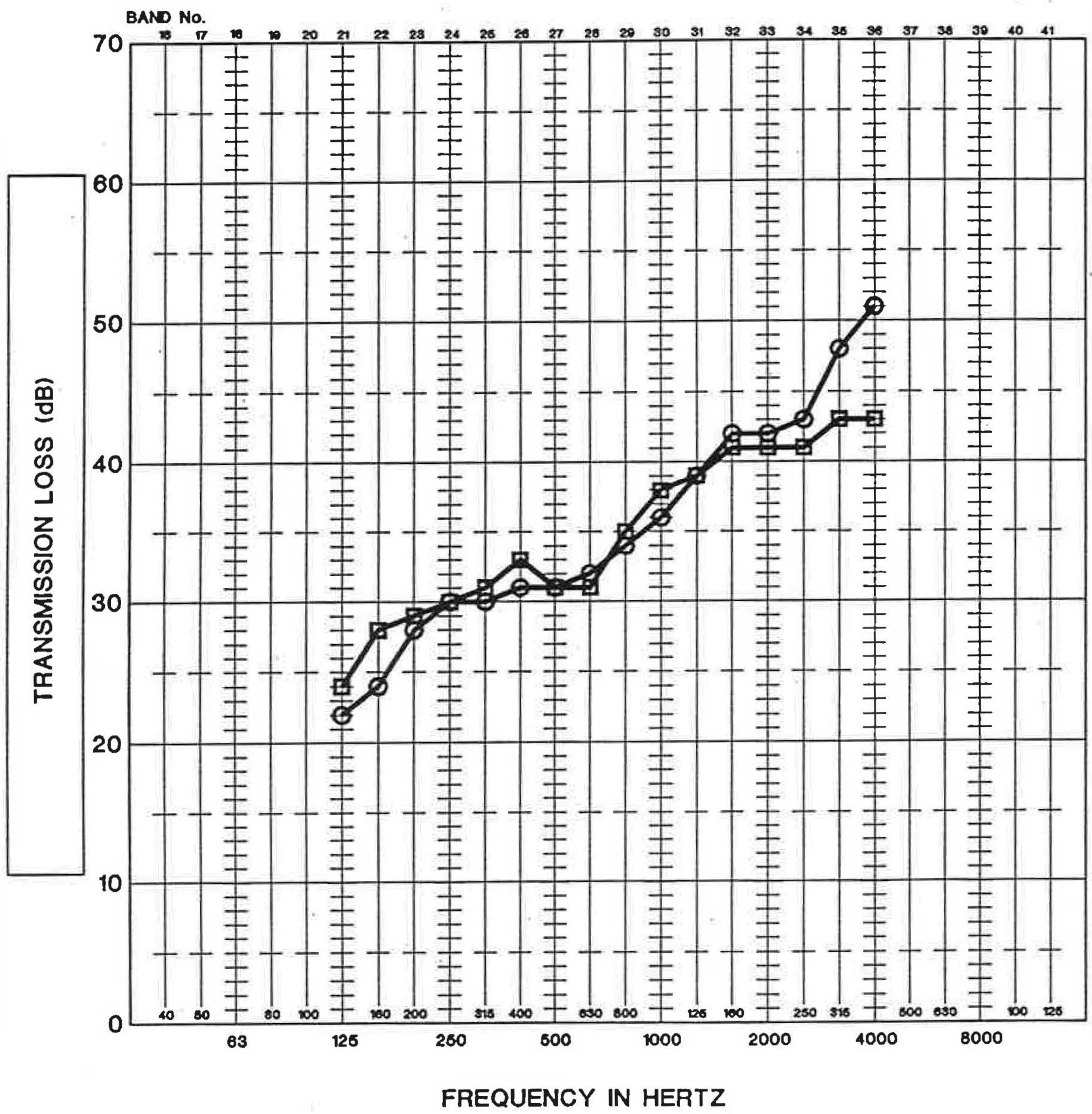
NOISE ISOLATION PROVIDED BY A 1 3/4 in METAL DOOR WITH UNFILLED HONEYCOMB PAPER WEB AND PERIMETER CAULKED

GRAPH NUMBER 7B

PROJECT NUMBER	DATE
177.911	92 12

mjm

NOTE: THIS GRAPH ALONE DOES NOT REPRESENT A COMPLETE REPORT

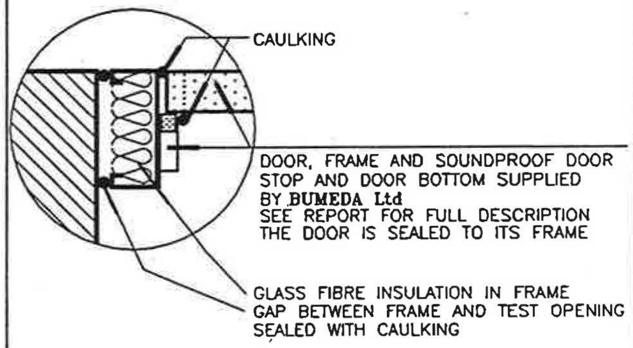


LEGEND

Transmission Loss (TL)
STC = 37

Transmission Loss estimated using the procedure presented in this report
STC = 37

SECTION



PROJECT DESCRIPTION

RESEARCH PROJECT ON THE NOISE ISOLATION PROVIDED BY ACCESS DOORS

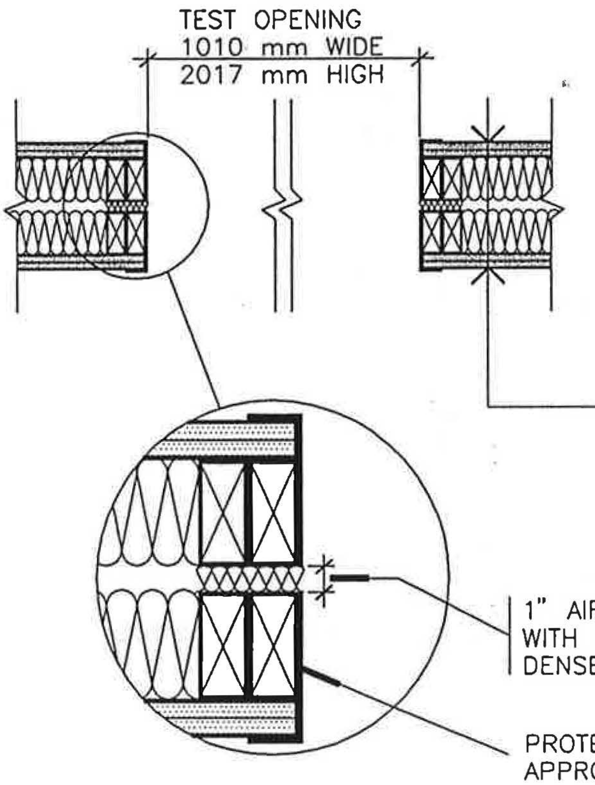
GRAPH TITLE

NOISE ISOLATION PROVIDED BY METAL DOOR AND FRAME SUPPLIED BY BUMEDA WITH PERIMETER CAULKED

GRAPH NUMBER 9B

PROJECT NUMBER	DATE
177.911	92 12

ANNEX III



TEST FACILITIES

TEST OPENING
1010 mm WIDE
2017 mm HIGH

PARTITION COMPOSITION

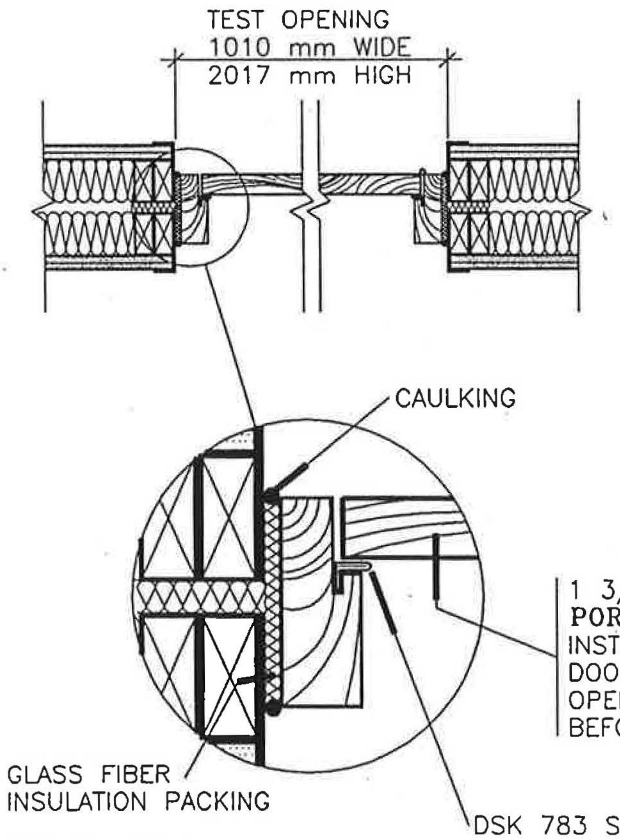
- 2 LAYERS OF 1/2" GYPSUM BOARD
- 2"x4" WOOD STUDS
- 3 1/2" (APPROX.) THICK GLASS FIBER
- 1" AIR GAP
- 2"x4" WOOD STUDS
- 3 1/2" (APPROX.) THICK GLASS FIBER
- 2 LAYERS OF 1/2" GYPSUM BOARD

TEST NO : (1)

PROCEDURE

1) INSTALL 1 3/4" SOLID CORE DOOR AND FRAME FROM **PORTES DE LA FONTAINES INC.** WITH DSK 783 SCHLEGEL SEALS ON THE DOOR FRAME

2) TEST



PROJET 177.911
177911A

TEST NO : (2)

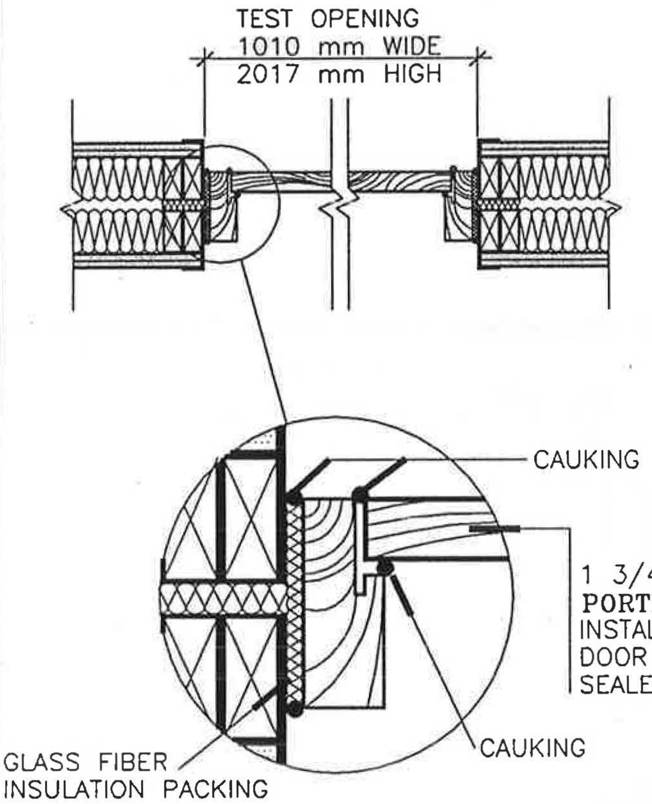
PROCEDURE

EXECUTE AFTER TEST NO 1

1) REMOVE SCHLEGEL DSK 783 GASKET

2) CAULK PERIMETER OF DOOR USING CAULKING SUCH AS **ZIP** REMOVEABLE CAULKING

3) TEST



1 3/4" SOLID CORE DOOR FROM **PORTES DE LA FONTAINE INC.** INSTALLED IN DOOR FRAME. THE DOOR IS NOT OPERABLE, IT HAS BEEN SEALED TO THE FRAME ON BOTH SIDES

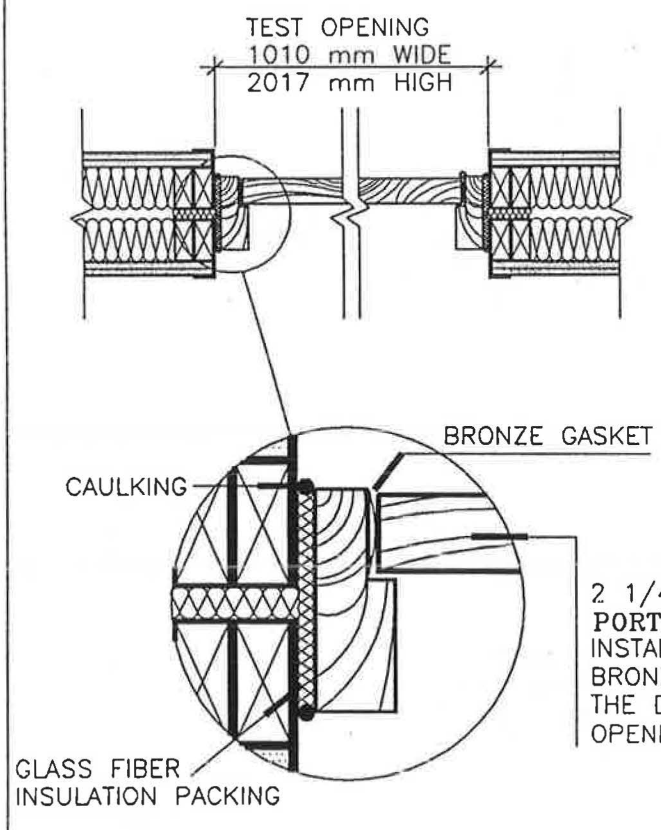
TEST NO : (3)

PROCEDURE

EXECUTE AFTER TEST NO 2

1) REPLACE 1 3/4" DOOR AND FRAME WITH 2 1/4" SOLID CORE DOOR AND FRAME WITH **ZERO 119 WB** BRONZE GASKETS

2) TEST WITH DOOR OPERABLE



2 1/4" SOLID CORE DOOR FROM **PORTES DE LA FONTAINE INC.** INSTALLED IN DOOR FRAME WITH BRONZE GASKETS AROUND THE PERIMETER THE DOOR IS OPERABLE AND HAS BEEN OPENED AND CLOSED FIVE TIMES

PROJET 177.911
177911B

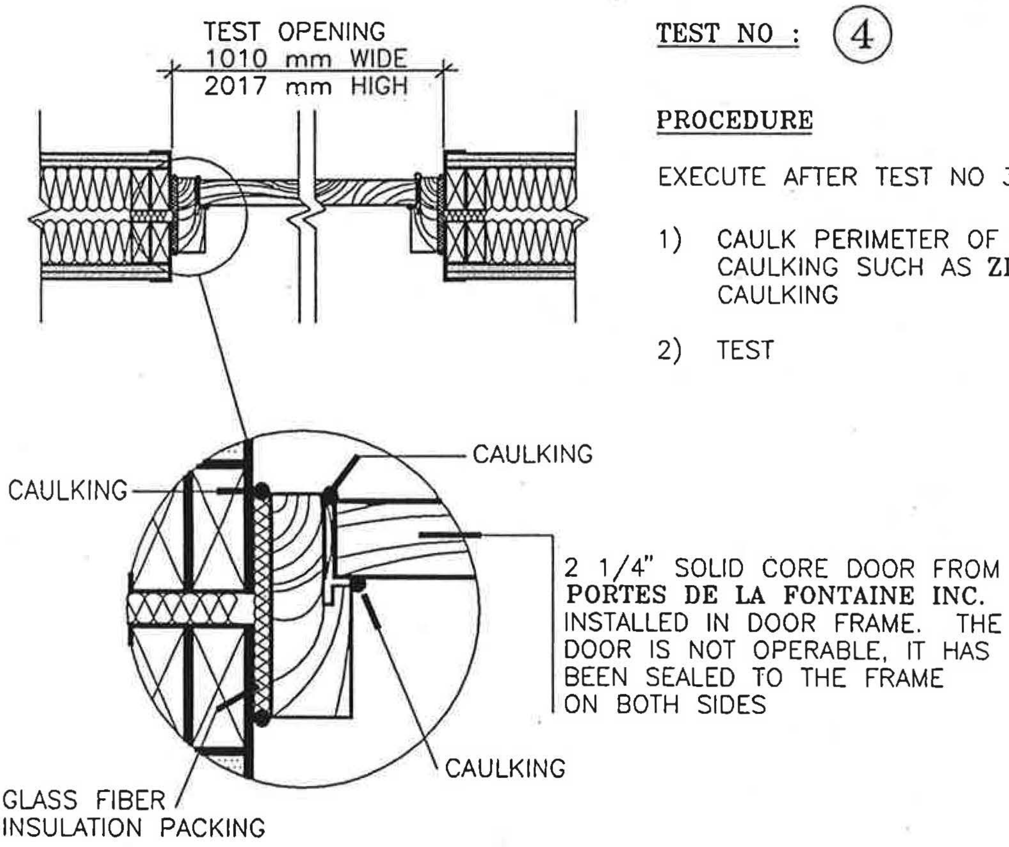
TEST NO : (4)

PROCEDURE

EXECUTE AFTER TEST NO 3

1) CAULK PERIMETER OF DOOR WITH CAULKING SUCH AS **ZIP** REMOVEABLE CAULKING

2) TEST



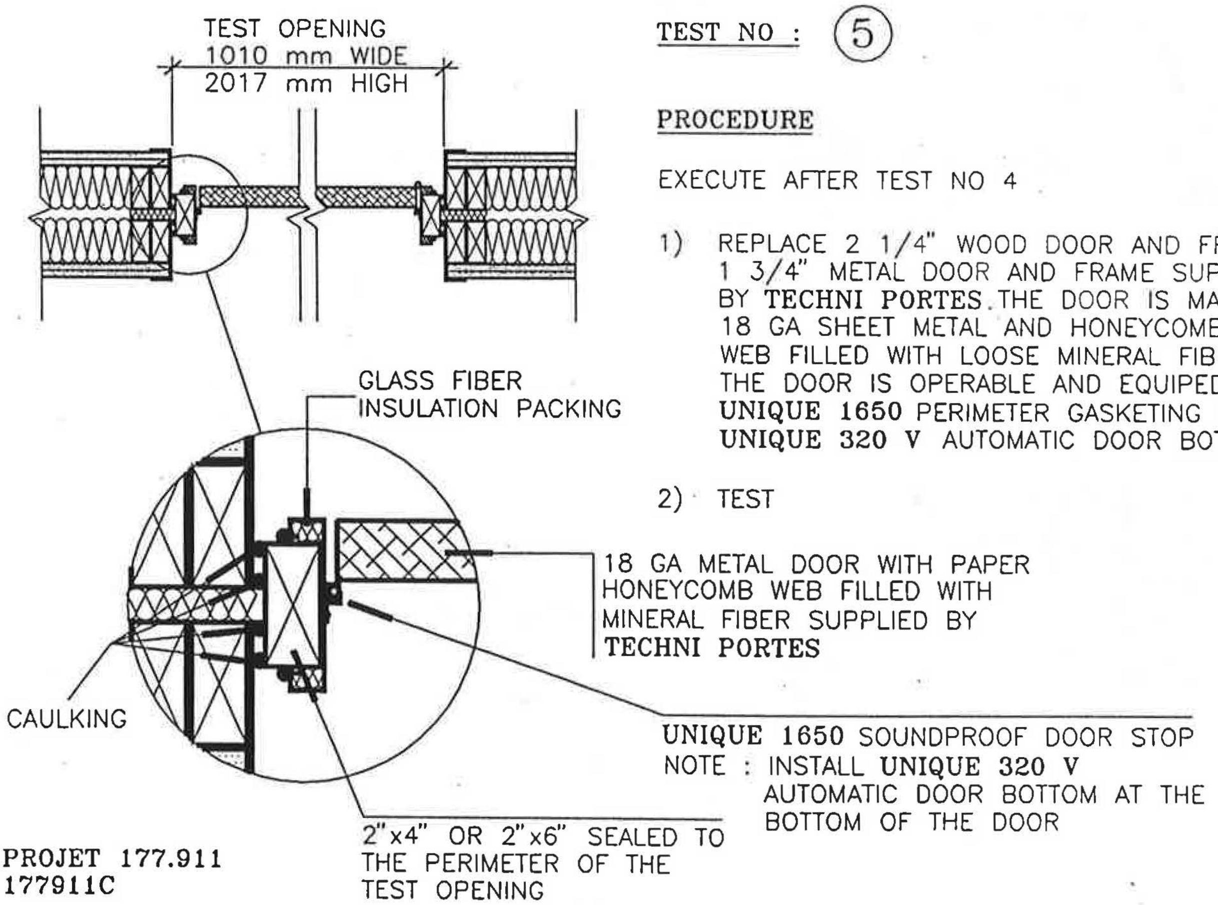
TEST NO : (5)

PROCEDURE

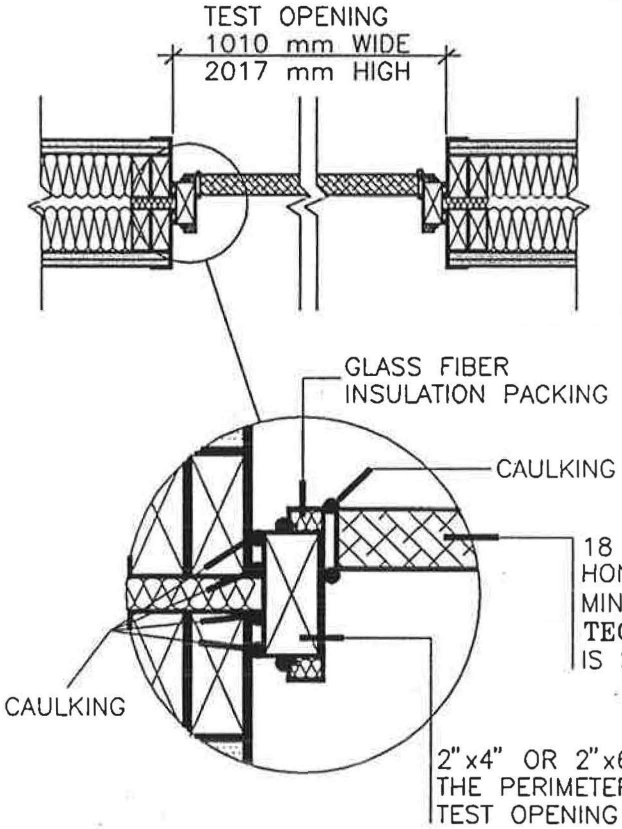
EXECUTE AFTER TEST NO 4

1) REPLACE 2 1/4" WOOD DOOR AND FRAME BY 1 3/4" METAL DOOR AND FRAME SUPPLIED BY **TECHNI PORTES**. THE DOOR IS MADE OF 18 GA SHEET METAL AND HONEYCOMB PAPER WEB FILLED WITH LOOSE MINERAL FIBER. THE DOOR IS OPERABLE AND EQUIPED WITH **UNIQUE 1650** PERIMETER GASKETING AND **UNIQUE 320 V** AUTOMATIC DOOR BOTTOM

2) TEST



PROJET 177.911
177911C

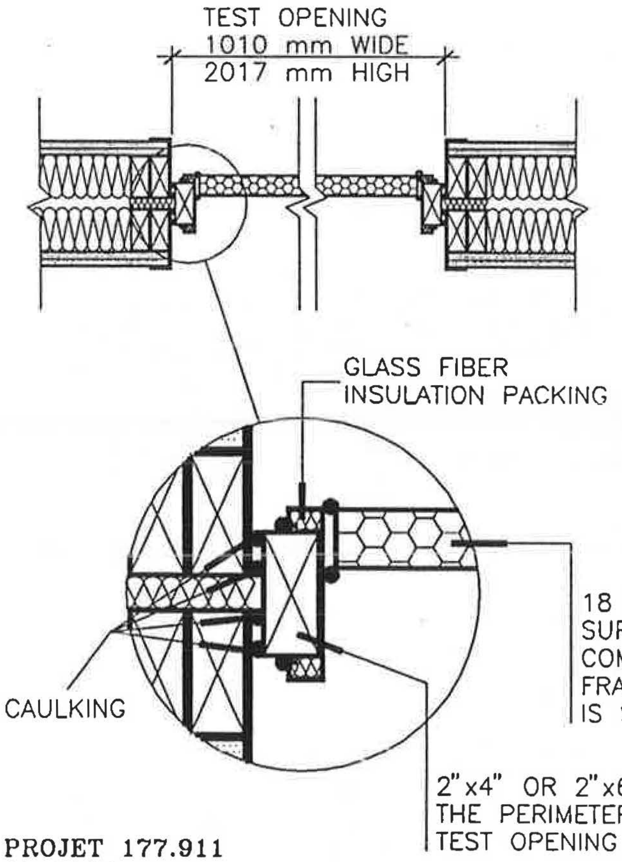


TEST NO : (6)

PROCEDURE

EXECUTE AFTER TEST NO 5

1) REMOVE DOOR STOP AND AUTOMATIC DOOR BOTTOM TESTED IN 5
2) CAULK PERIMETER OF DOOR WITH CAULKING SUCH AS **ZIP** REMOVEABLE CAULKING
3) TEST



TEST NO : (7)

PROCEDURE

EXECUTE AFTER TEST NO 6

1) REPLACE THE METAL DOOR FILLED WITH MINERAL FIBER TESTED IN 4 AND 5 WITH 1 3/4" METAL DOOR HAVING UNFILLED PAPER HONEYCOMB WEB SUPPLIED BY **TECHNI PORTES**
2) CAULK PERIMETER OF DOOR WITH CAULKING SUCH AS **ZIP** REMOVEABLE CAULKING
3) TEST

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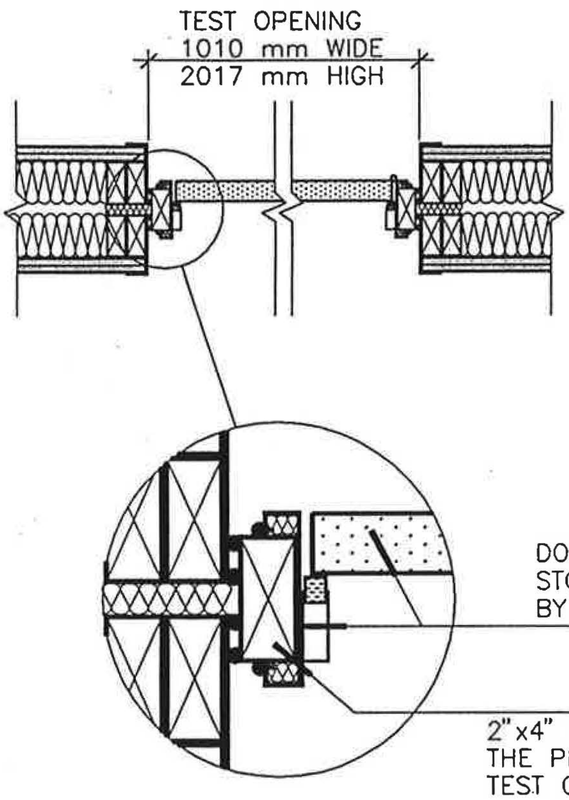
177911D

TEST NO : (8)

PROCEDURE

1) INSTALL IN TEST OPENING SOUND AND FIRE RATED DOOR AND FRAME PROVIDED BY **BUMEDA Ltd**

2) TEST

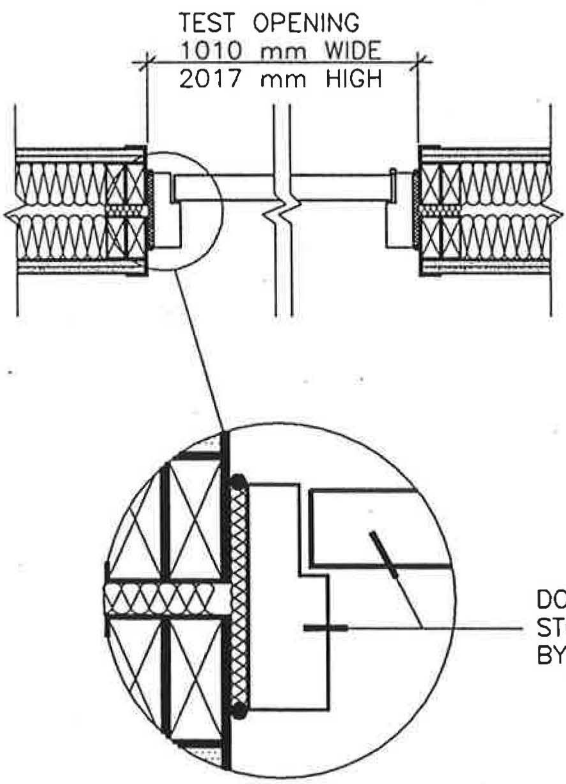


TEST NO : (9)

PROCEDURE

1) INSTALL IN TEST OPENING DOOR AND FRAME PROVIDED BY **INSONORISATION GLH inc.**

2) TEST



ANNEX IV

"Sound Transmission Intensity Mapping on a Series of Doors" produced by
Dr. R.W. Guy
Centre for Building Studies
Concordia University

is available on a loan basis only. To arrange a loan, please contact your local, public, university or business library.