| Name and Address of Certificate Holder: | Performance Appraisal Certificate No. |
|---|---|
| **M/s Sintex Industries Ltd.**<br>**Kalol (N. Gujarat) – 382721**<br>**Gandhinagar, India** | PAC No **1003-C/2011**<br>Issue No. **01**<br>Date of Issue: **29.06.2011** |

# Marshal Door

**User should check the validity of the Certificate** by contacting Member Secretary, BMBA at BMTPC or the Holder of this Certificate.


**Building Materials & Technology Promotion Council**
**Ministry of Housing & Urban Poverty Alleviation**
**Government of India**
Core 5A, First Floor, India Habitat Centre,
Lodhi Road, New Delhi – 110 003

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# PERFORMANCE APPRAISAL CERTIFICATE

## FOR

## MARSHAL DOOR

## ISSUED TO

## M/s SINTEX INDUSTRIES LTD

## STATUS OF PAC 1003–C/2011

| S. No. | Issue No. | Date of Issue | Date of renewal | Amendment | | Valid up to (Date) | Remarks | Signature of authorized signatory |
|---|---|---|---|---|---|---|---|---|
| | | | | No. | Date | | | |
| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. |
| 1 | 01 | 29-06-11 | 29 -06-13 | -- | -- | 28-06-13 | ---- | |
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## PART I CERTIFICATION

1.1 **CERTIFICATE HOLDER:** **M/s Sintex Industries Ltd.**
Kalol (N. Gujarat) – 382721
Gandhinagar, India
Phone No. 95-2764-253500
Fax No. 91-2764-253800

I.2 **DESCRIPTION OF PRODUCT**

I.2.1 **Name of the Product** – Marshal Door

I.2.2 **Brief Description** – Marshal doors are made out of GI Pre-coated sheet with an average wall thickness of 0.25mm on both sides. M.S. 'C' block having dimensions of 20x10mm is inserted along the hinge side of the door at three places at equal distance. Core of the door shutter is filled with high density Polyurethane Foam (PUF) injected with the help of hydraulic injection method. All four sides of the door are covered with same GI Pre-coated sheet. The polyester pre-coating on the GI sheets is provided for protection from corrosion. The hardware locations are reinforced with suitable wooden blocks for taking up necessary hardware. Stickers indicating the locations for fixing of hardware & accessories are pasted on the door at appropriate places. Marshal Doors are made out of Continuous Sandwich Panels only.

I.3 **ASSESSMENT**

I.3.1 **Scope of Assessment** –Suitability of these doors for built environment structures like offices, telecom shelters, schools etc. made of Continuous Sandwich Panels

**Shade**: Off white and other customized colours as per requirement

**Sizes:** These doors are available in sizes of 1.98mx0.76m (6'6" x 2'6"), 1.98m x 0.84m (6'6" x 2'9") & 2.13mx0.91m (7' x 3') & other customized sizes as per requirement of the customers and thickness of 25mm/ 30mm.

I.3.2 **Scope of Inspection** – Scope of inspection included verification of production, performance and testing facilities at the factory &

competence of technical personnel, status of quality assurance and testing in the factory.

**I.3.3 Assessment Summary**

**I.3.3.1** The assessment was done through inspection, laboratory testing and equipment at the factory, conducting the tests at the laboratory and field observations of the door shutters.

**I.3.3.2** **Manufacturing & test facilities** – Manufacturing and test facilities.ailable in the factory were found to be suitable & adequate to produce door shutters as per the desired specifications. The PAC holder maintains testing laboratory with necessary equipment for quality assurance.

**I.3.3.3** **Competence of Technical Personnel** – Persons involved in testing were found to be well conversant with testing procedures required for the quality control of the product.

**I.3.3.4** **Inspection in Actual use** – Eight door shutters installed at the factory and at Satyamev Jayate School in Ahmedabad during the year 2009 were inspected. They showed no distress & were found to be functioning satisfactorily. No complaints were reported. The level of maintenance of these doors was also satisfactory.

**I.3.3.5** **Quality Assurance Procedure** – The firm follows a defined Quality Assurance System for production of Marshal Doors. (See Quality Assurance Plan attached as Annexure)

## I.4 USES OF THE MARSHAL DOORS & THEIR LIMITATIONS

**I.4.1** **Design Data** – The data & information provided in Part II of this Certificate shall be used for selection of the type, size and thickness of these doors.

**I.4.2 Storage & handling at the user end before installation**

**I.4.2.1** **Storage** – At the user's end the shutters shall be stored/stacked one over the other to a maximum height of 1200 mm in order of the sizes with the largest at the bottom. They shall be stacked flat on bearer

strips properly covered to exclude moisture and inside a shed / building.

I.4.2.2 **Handling** – Marshal Doors shall be handled carefully during storage or installation in order to prevent occurrence of damage to the faces & edges. The shutters shall not be dragged along a stack or any surface but shall be lifted clear of a stack or any surface on which they are stored.

**I.4.3 Tests of the shutters**

I.4.3.1 The samples of the door shutters tested as per various Standards listed in Part V of this Certificate have met the requirements namely Shock resistance, Impact indentation test, Edge loading test, Buckling test; Fire propagation index, Overall Thermal and Sound transmission loss, Gravity etc. in accordance with the results given in the test reports of M/s CIPET, Ahmedabad and the assembled panels including doors got tested & checked against Seismic evaluation, wind & other loads and Stability by CBRI, Roorkee and IIT, Delhi which led to the conclusion that they can be used as shutters in offices, schools & telecom shelters etc. provided they are installed with appropriate frame and hardware in accordance with the manufacturer's instructions & guidelines.

**I.5 CONDITIONS OF CERTIFICATION**

I.5.1 **Technical conditions** –The raw materials and the finished door shutters shall conform to the requirements given in Clause II-2.2.

I.5.2 **Quality Assurance** – The Certificate Holder shall implement &maintain a quality assurance system in accordance with Quality Assurance Plan given in the Annexure attached with this Certificate.

**I.5.3 Handling of User Complaints**

I.5.3.1 The Certificate holder shall provide quick redressal to consumer/user complaints proved reasonable & genuine and within the conditions of warranty provided by him to customer/purchaser.

I.5.3.2 The Certificate holder shall implement the procedure included in the SQA. As part of PACS Certification he shall maintain data on such complaints with a view to assess the complaint satisfaction and suitable preventive measures taken.

## I.6 CERTIFICATION

**I.6.1** On the basis of assessment given in Part III of this Certificate & subject to the conditions of Certification, use & limitations set out in this Certificate and if selected, installed & maintained as set out in Parts I & II of this Certificate, Marshal Doors covered by this Certificate conforms to the requirement of the specifications.

# PART II CERTIFICATE HOLDER'S TECHNICAL SPECIFICATIONS

## II.1 GENERAL

**II.1.1** The PAC holder shall manufacturer the door shutters in accordance with requirements specified in the relevant Standards and Clause II-2.3.

## II.2 SPECIFICATIONS OF THE PRODUCT

**II.2.1** **Specifications** – The specifications for raw materials and finished shutters are as per the performance criteria when tested in accordance with the relevant Standards listed in this Certificate.

**II.2.2** **Technical Specifications**

**II.2.2.1** **Raw Materials**

**(1) GI pre-coated Sheet**

(i) Chemical & Mechanical Properties-- Shall conform to IS 14246:1995

**(2) Polyurethane Foam--** Shall conform to IS 12436:1988

| | | |
|---|---|---|
| (i) | Isocyanate : Polyol ratio – | 1:1.25 |
| (ii) | Density of PUF | 40 ± 2 Kg/m³ |
| (iii) | Tensile strength of PUF | 2.32 Kg/m² min. |

**(3) Complete Marshal Doors**

| | | |
|---|---|---|
| (i) | Compressive Strength at10% | 1.15 Kg/m² min. |
| (ii) | Thermal Conductivity at 10°C | < 0.02 W/M° K |
| (iii) | Temperature Range | -80°C to + 100°C |

**II.2.2.2** **Construction & workmanship** –Marshal Door Shutters shall be made out of GI Pre-coated Sheet its outer & inner surfaces with core injected with high density polyurethane foam (PUF). The edges shall be covered with GI Pre-coated sheet profile section. As these doors are made out of Continuous Sandwich Panels, the same have been tested by CBRI, Roorkee for Fire Ignitability- 'P' category, Fire

propagation - index of 6.67 & Surface spread of flame – Class 1as per BS 476 (Parts 5,6,7) and can resist high wind pressure. These doors are suitable for built environment structures and the polyester pre-coating on the GI sheets is provided for protection from corrosion.

The outer & inner surfaces of the doors shall be reasonably smooth, free from any surface defects like scratches, dents, damages and with uniform pre-coating and shall also be free from any war page.

**II.2.2.3** **Design**– Marshal Doors are designed as per the requirement of the manufacturer.

**II.2.3** **Performance characteristics of Marshal Doors**– These door shutters shall meet the following performance criterion when tested in accordance with IS 4020:1998:

| S.No. | Performance Characteristics | Acceptable Criteria | Test Method |
|---|---|---|---|
| 1. | Dimensions | Normal width & height shall be within a tolerance of ± 5mm whereas the thickness has a tolerance of ±0.5mm | **IS 4020:1998** Part 2 |
| 2. | Squareness | Shall not exceed 1mm in 500mm | Part 2 |
| 3. | General Flatness | No warping, cupping | Part 3 |
| 4. | Local Plainness | Shall be max.0.5 mm | Part 4 |
| 5. | Impact Indentation Test | Shall not cause any visible damage and depth of depression shall not exceed 1.0 mm | Part 5 |
| 6. | Edge Loading Test | 1) At 100 Kg load, deflection shall not exceed 10.0 mm<br>2) Residual deflection shall not exceed 0.5 mm | Part 7 |
| 7. | Shock Resistance Test | Shall not cause any visible damages or deteriorations | Part 8 |
| 8. | Buckling Resistance Test | 1) At 40 Kg load, deflection shall not exceed 300 mm<br>2) Residual deflection shall not exceed 5.0 mm | Part 9 |

| | | | |
|---|---|---|---|
| 9. | Slamming Test | No permanent deformation allowed | Part 10 |
| 10. | Misuse Test | No permanent deformation with wooden slip at 20 Kg | Part 11 |
| 11 | Screw withdrawal Resistance Test | Withdrawal force shall not be less than 100 Kg | Part 16 |

**II.2.4** **Size & thickness** – Marshal Doors shall be made in sizes varying from 1.90m (6'3") to 2.13m (7'0") in length, 0.76m (2'6") to 0.91m (3'0") in width and 25mm & 35mm in thickness.

**II.2.5** **Marking** – Besides the identification mark of the PAC holder as manufacturer and any other marking he may use, type & batch number shall be marked suitably on each shutter.

**II.2.5.1** The location of lock block shall also be marked.

**II.2.6** **Packing details of packing of finished door for delivery**

**II.2.6.1** Each door shall be packed in suitably to ensure safe & defect free delivery to customers.

**II.3** **SELECTION & INSTALLATION**

**II.3.1** Marshal Doors forms a part of Continuous Sandwich Panels installation. However, the user/installer shall be responsible for proper installation at site as per manufacturer's instructions. In this regard the PAC holder shall provide proper guidance in writing.

**II.3.2** **Choosing type** – The type of shutter shall be chosen depending upon the requirement of the user. These shall be installed with appropriate frame and hardware in accordance with good engineering practice.

**II.3.3** **Choosing size & thickness** – Appropriate size & thickness of the shutter shall be chosen to suit the wall opening or conversely the door opening should be sized to the shutter size.

**II.3.4** **Handling** – Doors should be carefully handled during storage or installation in order to prevent occurrences of damage to the faces & edges. The shutters shall not be dragged along a stack or any surface, but shall be lifted clear of a stock or any surface on which they are stored.

II.3.5 **Good practice for installation & maintenance** - Good practice as per details provided by the manufacturer shall be followed for installing the shutters.

II.3.6 **Hinges** – It is recommended that a minimum of three hinges equally spaced with top of the top hinge 100mm. from the top edge of the shutter, shall be used.

II.3.6.1 It is recommended that the hinges & hardware chosen shall satisfy the requirements of relevant Indian Standards.

II.3.7 **Other Hardware** – The shutter stiles shall take the hardware like hinges & locks. The construction inside is reinforced with suitable wooden blocks so that it shall also take hardware like hasp & staples (aldrop), sliding bolts (tower bolts) and nameplate screwed on to the face of the shutter.

II.3.8 **Finishing** -- Marshal Doors shall be available in varieties of finishes to match aesthetic needs. The edges of all type of shutters shall also be finished as recommended by the manufacturer. At first installation, immediately after the shutter has been hung, it shall be removed from the door frame and after removing all the hardware the surfaces and the four edges, as applicable, shall be finished as recommended in the literature of the manufacture.

A 5 mm gap shall be left between the bottom edge of the door shutter and the finished floor in locations where water can reach the door duct rain, washing of floor or otherwise.

## II.4 PRECAUTIONS FOR USE OF THE DOORS

II.4.1 This type of shutters used for external doors shall be protected by min. 0.75 m wide sunshade canopy, chhaja or yawning.

II.4.2 This type of door shutters are not recommended for terraces, backyard etc. though this may offer good performance in protected balcony.

II.4.3 For high-hazard areas susceptible to fungal attacks and attacks by biological agent, the manufacturer shall provide an additional thickness when notified by the user.

II.4.4 Continuously wet locations where water falls directly or indirectly on the door shutters or the area regularly water logged are considered as being of extra hazard. For use of these shutters in such locations, extra protections and preservatives & finishes shall be provided as agreed between the buyer and the manufacturer. Also the recommendations

of the manufacturer contained in its technical literature shall be followed.

**II.5 MAINTENANCE REQUIREMENTS**

**II.5.1** These shutters shall be maintained strictly as per the instructions given by the PAC holder.

**II.5.2** This type of door shutters especially those in exposed & wet locations all be refinished in accordance with the recommendations given by the PAC holder and the material manufacturer.

**II.6 SKILLS/TRAINING NEEDED FOR INSTALLATION**

**II.6.1** No special skills other than the normal skills of a good carpenter shall be needed for installing the shutters.

**II.7 GUARANTEES/WARRANTEES PROVIDED BY THE PAC HOLDER**-Marshal Doors shall be warranted for a period of at least one year from the date of supply against any genuine manufacturing defect provided the products are not subject to any damage whatsoever and shall not be abused/misused or wrongly installed. During the period of Warranty the products shall be serviced free of cost for any defect observed and subsequent to Warranty period services shall be done at a nominal service charge together with other incidental costs as mutually agreed by the PAC holder and the purchaser.

**II.8 SERVICES PROVIDED BY THE PAC HOLDER**

**II.8.1** No after sales & service shall be provided by the manufacturer. However, customers/users may obtain from the PAC holder details of the advice that may be provided to him.

**II.8.2** Users / customers shall ascertain from the PAC holder the type of service, the PAC holder is prepared to provide.

## PART III BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

**III.1 BASIS OF ASSESSMENT**

**III.1.1** The technical basis for assessment is as per the standards listed in Part V.

**III.1.2** The assessment is based on the results & reports of

(i) Inspection of the factory

(ii) Inspection of the test equipment used, test procedures followed and testing personnel involved in the laboratory of the factory

(iii) Assessment of quality assurance procedures implemented in the factory

(iv) Tests done in the factory in the presence of third party namely RITES on random samples of these doors taken by IO during inspection as per the performance characteristics given by the manufacturer

(v) Tests done in independent laboratories namely CIPET & CBRI on random samples of the finished shutters

(vi) Inspection of Marshal Door shutters in service

**III.2** **MANUFACTURING PROCESS** – GI Pre-coated Sheet shall be cut & bend to size as per the relevant drawings. Wooden reinforcement shall be cut into required size and positioned at different place. PU Foam shall be cut to required size and pressed on hydraulic press. Thereafter, finishing and pressing of the door on hydraulic press shall be done. Top and bottom rails shall be fabricated and assembled. All corners shall be screwed adequately and finished properly. These doors shall then be marked with stickers for placing hardware on each location.

**III.3 FACTORY INSPECTIONS**

**III.3.1** The factory was inspected by technical representative of the Council. During inspection the entire manufacturing process along with the equipment and machinery were inspected. The manufacturing process was found to confirm to the process description given by the manufacturer. The in-process inspection and the inspection of the finished shutters were in accordance with the SQA approved as a part of the requirements for grant of this PAC. It is the responsibility of the PAC holder to maintain and calibrate equipments for manufacturing and testing periodically to manufacture the door shutters in accordance with the specified parameters.

**III.4** **LABORATORY TESTS DONE FOR ASSESSMENT**

**III.4.1** **Testing of samples**

**III.4.1.1** **In the factory** – The tests listed in the report i.e. Measurement of dimensions & Squareness, General flatness, Local plainness, Impact indentation, Edge loading, Shock resistance (soft & light body and soft & hard body), Slamming, Buckling, Misuse & Screw Holding power were done in the presence of third party namely RITES in the

factory on random samples of shutters taken by IO for checking the product as well as the related test equipment. The tests were conducted using standard test methods covered by relevant Indian Standards listed in Part V of this Certificate. The samples passed in all the tests conducted.

**III.4.1.2** **In Independent Institutes** – The performance tests for door shutters specified in the relevant Standards and listed below have been got done on the samples in independent institutes namely CIPET, Ahmedabad and CBRI, Roorkee* by the manufacturer. The samples conform to the tests as per performance requirements and specifications given by the manufacturer.

**Tests done by CIPET**

| S.No. | Parameters | Test Method/ Requirements | Results obtained |
|---|---|---|---|
| 1. | Dimensions, mm<br>(a) Height<br>(b) Width<br>(c) Thickness | **IS4020:1998** Part 2<br>Shall be within a tolerance of ± 5 mm<br>Within tolerance of ± 0.5mm | <br>1982 mm<br>762 mm<br>25.2 mm |
| 2. | Squareness | Part 2 -- Shall not exceed 1mm in 500mm | 0.3 mm in 500 mm |
| 3. | General flatness<br>(a) Twisting<br>(b) Cupping<br>(c) Warping | Part 3<br>There shall be no twisting, cupping & warping | <br>No Twist<br>No Cupping<br>No Warping |
| 4. | Local Plainness | Part 4 – Shall be 0.5 mm max. | Depth of depression 0.5 mm |
| 5. | Impact indentation (Steel ball impact) | Part 5 -- Shall not cause any visible damage and depth of depression shall not exceed 1.0 mm | No abnormal defects such as cracking, tearing and no depression observed |
| 6. | Edge loading Test | Part 7<br>(i)At 100 kg load deflection shall not exceed 10.0mm<br>(ii)Residual deflection shall not exceed 0.5 mm | At 100 Kg load, 3.5 mm deflection observed<br>Residual deflection 0.2mm |
| 7. | Shock resistance<br>(a) Soft & light body impact | Part 8<br>Shall not cause any visible damages or deteriorations | <br>No permanent deformation or |

| | | | |
|---|---|---|---|
| | (b) Soft & hard body impact | | deterioration observed |
| 8. | Buckling Test | Part 9<br>(i)At 40 kg load, deflection shall not exceed 300 mm<br>(ii)residual deflection shall not exceed 5.0 mm | Initial deflection 41mm under 40 Kg load observed Residual deflection 3.6 mm after 15 min. of unloading |
| 9. | Slamming Test | Part 10 – No permanent deformation allowed | No visible damage observed |
| 10. | Misuse Test | Part 11<br>No permanent deformation with widen slip at 20 kg | No permanent deformation observed |
| 11. | Screw Withdrawal Resistance Test | Part 16<br>Withdrawal force shall not be less than 100 kg | Screw withdrawal force is more than 100 Kg |

**Tests done by CBRI**

| S.No. | Parameters | Test Method | Results obtained |
|---|---|---|---|
| 1. | Density | IS 12436:1988 | 39 Kg/m² |
| 2. | Weight | -- | 10.71Kg/m² |
| 3. | Water absorption after 24 hours – with sealing edge<br>--without sealing edge | ASTMD 570-1998 | Nil<br>7.20% |
| 4. | Dimensional Stability (%) | IS11239:2009 | Negligible |
| 5. | Flexural Strength | IS 9162:1979 | 5.60 MPa |
| 6. | Pressure Head Test | IS13826:1993 | No leakage |
| 7. | Water penetration test | IS 2645:1975 | No seepage |
| 8. | Fire propagation index | BS 476 (Part 6) | 6.67 |
| 9. | Load test (260 Kg/m²) | As per Appendix | Deflection-<br>At loading 6.70mm<br>Afterloading1.01mm<br>Recovery after 24 hrs 0.45mm |
| 10. | Overall Thermal transmittance – U value | IS 3346:1980 | 0.49 W/m²K (50mm thick) |
| 11. | Sound transmission loss | As per appendix | 22.64 dB (Average) |

***Excerpts of the CBRI Report attached as Appendix**

**III.4.1.3** Moreover, a shelter including doors for M/s BSNL made out of these panels have also been tested for Gravity and Wind load and found safe & adequate in accordance with relevant Indian Standards by IIT, Delhi.

**III.5** **INSPECTION & SUPPLY OF MARSHAL DOORS:** Eight Marshal Door shutters in the factory and at Satyamev Jayate School in Ahmedabad installed during the year 2009 were inspected. None of them showed any distress & were functional. Details of the door shutters supplied by the manufacturer during the period 2009-2010 are given below:-

| S.No. | Supplied to | Location of Building | When Supplied |
|---|---|---|---|
| 1. | GUDM<br>Aryan Enterprise | Gandhinagar, Gujarat | 2009-2010 |
| 2. | ABG Shipyard | Jageshwar, Distt. Bharuch, Gujarat | 2009 |
| 3. | Boriavi Nagar Palika | Boriavi, Anand Gujarat | 2009-2010 |
| 4. | Central University of Jharkhand | Ranchi, Jharkhand | 2009-2010 |
| 5. | Uttar Pradesh Rajkiya Nirman Nigam Ltd. | Sitapur Road, Lucknow | 2008-2009 |

## PART – IV STANDARD CONDITIONS

This certificate holder shall satisfy the following conditions:

**IV-1** The certificate holder shall continue to have the product reviewed by BMBA.

**IV-2** The product shall be continued to be manufactured according to and in compliance with the manufacturing specifications and quality assurance measures which applied at the time of issue or revalidation of this certificate. The Scheme of Quality Assurance separately approved shall be followed.

**IV-3** The quality of the product shall be maintained by the certificate holder.

**IV-4** The product user should install, use and maintain the product in accordance with the provisions in this Certificate.

**IV-5** This certificate does not cover uses of the product outside the scope of this appraisal.

**IV-6** The product is appraised against performance provisions contained in the standards listed in Part-V. Provisions of any subsequent revisions or provisions introduced after the date of the certificate do not apply.

**IV-7** Where reference is made in this Certificate to any Act of Parliament of India, Rules and Regulations made there under, statutes, specifications, codes of practice, standards etc. of the Bureau of Indian Standards or any other national standards body and the International Organization for Standardization (ISO), manufacturer's company standards, instruction/manual etc., it shall be construed as reference to such publications in the form in which they were in force on the date of grant of this Certificate (and indicated in Part V to this Certificate)

**IV-8** The certificate holder agrees to inform BMBA of their distributors / licensees whenever appointed by him and agrees to provide to BMBA a six monthly updated list thereof.

**IV-9** The certificate holder agrees to provide to BMBA feedback on the complaints received, the redressal provided, and the time taken to provide redressal on complaint to complaint basis as soon as redressal is provided. BMBA agrees to provide the certificate holder the user feedback received by it, if any.

**IV-10** If at any time during the validity period, PACH is unable to fulfill the conditions in his PAC, he should on his own initiative suspend using the PAC and notify Chairman, TAC the date from which he has suspended its use, the reason for suspension and the period by which he will be able to resume. He shall not resume without the prior permission of BMBA. He shall also inform, simultaneously, his agents, licensees, distributors, institutional, government, public sector buyers, other buyers and all those whom he has informed about his holding the PAC. He shall also inform all those who buy his product(s) during the period of suspension. He shall provide to BMBA at the earliest the list of who have been so informed by him.

**IV-11** In granting this Certificate, BMBA takes no position as to:

(a) The presence or absence of patent or similar rights relating to the product;

(b) The legal right of the Certificate holder to market, install or maintain the product;
(c) The nature of individual installations of the product, including methods of workmanship.

**IV-12** BMTPC and the Board of Agreement of BMTPC (BMBA) take no position relating to the holder of the Performance Appraisal Certificate (PACH) and the users of the Performance Appraisal Certificate (PAC) respecting the patent rights / copy rights asserted relating to the product / system / design / method of installation etc. covered by this PAC. Considerations relating to patent / copy rights are beyond the scope of the Performance Appraisal Certification Scheme (PACS) under which this PAC has been issued. PACH and users of this PAC are expressly advised that determination of the Claim / validity of any such patent rights / copy rights and the risk of infringement of such rights are entirely the responsibility of PACH on the one hand and that of the users on the other.

**IV-13** It should be noted that any recommendations relating to the safe use of the product which are contained or referred to in this Certificate are the minimum standards required to be met with when the product is installed, used and maintained. They do not purport in any way to restate or cover all the requirements of related Acts such as the Factory Act, or of any other statutory or Common Law duties of care, or of any duty of care which exist at the date of this Certificate or in the future, nor is conformity with the provisions of this Certificate to be taken as satisfying the requirements of related Acts.

**IV-14** In granting this Certificate, BMTPC and BMBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the use of this product.

**IV-15** The certificate holder indemnifies BMBA, its officers and officials involved in this assessment against any consequences of actions taken in good faith including contents of this certificate. The responsibility fully rests with the certificate holder and user of the product.

**IV-16** The responsibility for conformity to conditions specified in this PAC lies with the manufacturer who is granted this PAC. The Board (BMBA) will only consider requests for modification or withdrawal of the PAC.

**IV-17** The PAC holder shall not use this certificate for legal defense in cases against him or for legal claims he may make from others

Place: New Delhi
Date of issue_____

Chairman TAC & for and on behalf of
Member Secretary, BMBA

Dr. Shailesh Kr. Agarwal
Chairman, TAC
& Member Secretary, BMBA
Building Materials and Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation, (Govt. of India)
Core 5A, 1st Floor, India Habitat Centre, Lodhi Road,
New Delhi-110 003

## PART – V LIST OF STANDARDS & CODES USED IN ASSESSMENT

**Part - V.1** **Standards** -- These Standards are referred for carrying out particular tests only and do not specify the requirement for the whole product as such.

**Part – V.1.1** **IS 875 (Part 3):1987** – Code of practice for Design loads (other than earthquake) for Buildings & structures

**Part – V.1.2** **IS 1893 (Part 1):2002** – Criteria for earthquake resistant design of structures – General provisions & buildings

**Part – V.1.3** **IS 2380:1977** –

**Part --V.1.4** **IS 3346: 1980** – Method of determination of Thermal Conductivity of thermal insulation materials

**Part -- V.1.5** **IS 4020(Parts 1-16):1998** – Door shutters – Method of tests

**Part – V.1.6** **IS 9162:1979** – Method of tests for Epoxy resins, Hardeners and Epoxy resin composition for floor toppings

**Part -- V.1.7** **IS 11239 (Part 3):2009** – Method of test for rigid cellular thermal insulation of materials.

**Part – V.1.8** **IS 13826(part 4):1993** – Bitumen based felts – Method of test for Pressure head test

**Part -- V.1.9** **IS 12436:1988** – Specifications for Performed Rigid Polyurethane foam for thermal insulation

**Part – V.1.10** **IS 14246:1995** – Specifications for continuously pre-painted galvanized steel sheets and coils

**Part -- V.1.11** **ASTM C 177** – Standard Test Method for Thermal Conductivity of Polyurethane Foam

**Part -- V.1.12** **ASTM D 570:1998** -- Standard test method for water absorption of Plastics

**Part - V.1.13** **ASTM D 792:2000** – Standard test Method for Density and Specific gravity of Plastics

**Part – V.1.14** **BS 476 (Parts 5, 6, 7)** -- Fire Tests on Building Materials & Structures – Method of test of Fire Ignitability, Fire Propagation & Surface spread of flame of Products

**Part – V.2** **Company Standards of the PAC holder** – The branded design and specifications of the raw materials and finished products are as specified by manufacturer. The PAC holder has to make available the company standards to the consumers according to which testing have been done.

## CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **Marshal Door** bearing the mark Manufactured by M/s Sintex Industries is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No.1003-C/2011** is awarded to **M/s Sintex Industries**.

The period of validity of this Certificate is as shown on Page 1 of this PAC. This Certificate consists of pages 1 to 32.


Embossing Seal of BMBA

On behalf of BMTPC Board of Agreement

New Delhi, India
Place
Date

Chairman, Technical Assessment Committee (T AC) of BMBA & Member Secretary, BMTPC Board of Agreement (BMBA) Under Ministry of Housing and Urban Poverty Alleviation, Government of India

Dr. Shailesh Kr. Agarwal
Chairman, TAC
& Member Secretary, BMBA
Building Materials and Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation, (Govt. of India)
Core 5A, Ist Floor, India Habitat Centre,Lodhi Road,
New Delhi-110 003

## PART -- VI ABBREVIATIONS

### Abbreviations

| | |
|---|---|
| BMBA | Board of Agreement of BMTPC |
| BMTPC | Building Materials and Technology Promotion Council |
| CPWD | Central Public Works Department |
| ED | Executive Director of BMTPC |
| IO | Inspecting Officer |
| MS | Member Secretary of BBA |
| PAC | Performance Appraisal Certificate |
| PACH | PAC Holder |
| PACS | Performance Appraisal Certification Scheme |
| SQA | Scheme of Quality Assurance |
| TAC | Technical Assessment Committee (of BMBA) |

## Performance Appraisal Certification Scheme - A Brief

Building Materials & Technology Promotion Council (BMTPC) was set up by the Government of India as a body under the Ministry of Housing &Urban Poverty Alleviation to serve as an apex body to provide inter-disciplinary platform to promote development and use of innovative building materials and technologies laying special emphasis on sustainable growth, environmental friendliness and protection, use of industrial, agricultural, mining and mineral wastes, cost saving, energy saving etc. without diminishing needs of safety, durability and comfort to the occupants of buildings using newly developed materials and technologies.

During the years government, public and private sector organizations independently or under the aegis of BMTPC have developed several new materials and technologies. With liberalization of the economy several such materials and technologies are being imported.

However, benefits of such developments have not been realized in full measure as understandably the ultimate users are reluctant to put them to full use for want of information and data to enable them to make informed choice.

In order to help the user in this regard and derive the envisaged social and economic benefits the Ministry of Housing &Urban Poverty Alleviation has instituted a scheme called Performance Appraisal Certification Scheme (PACS) under which a Performance Appraisal Certificate (PAC) is issued covering new materials and technologies. PAC provides after due investigation, tests and assessments, amongst other things information to the user to make informed choice.

To make the PACS transparent and authentic it is administered through a Technical Assessment Committee (T AC) and the BMTPC Board of Agreement (BMBA) in which scientific, technological, academic, professional organizations and industry interests are represented.

The Government of India has vested the authority for the operation of the Scheme with BMTPC through Gazette Notification No. 1-16011/5/99 H-II in the Gazette of India No. 49 dated 4th December, 1999.

Builders and construction agencies in the Government, public and private sectors can help serve the economic, development and environmental causes for which the people and Government stand committed by giving preference to materials and technologies which have earned Performance Appraisal Certificates.

Further information on PACS can be obtained from the website: www.bmtpc.org

ANNEXURE

## BUILDING MATERIALS & TECHNOLOGY PROMOTION COUNCIL

## QUALITY ASSURANCE PLAN FOR MARSHAL DOORS

| S.No | PARAMETER TO BE INSPECTED | REQUIREMENT SPECIFIED | TEST METHOD | FREQUENCY OF TESTING |
|---|---|---|---|---|
| **I.** | **RAW MATERIALS: G I Pre-coated Sheet** | | | |
| I.1 | Visual | Shall be free from any surface defects with proper marking & printing | Visual | 5% in every lot |
| I.2 | Mechanical, Chemical & Coating properties | Shall conform to IS 14246:1995 | Conform to IS14246:1995 | Verifying Manufacturer's Test Certificate |
| **II.** | **FINISHED MARSHAL DOORS** | | | |
| II.1 | Visual Inspection | Shall be free from any defect like improper finishing, all types of surface defects | Visual | 5% in every lot |
| II.2 | Overall Dimensions | Shall be ± 5mm in dimensions<br>And ± 0.5mm in thickness | Measuring tape / vernier caliper/ any measuring instrument | ---do -- |
| II.3 | Density | Shall be not less than 36 $Kg/m^3$ | Conform to IS 12436: 1988 | ----do--- |
| **III. PERFORMANCE TEST** | | | | |
| III.1 | Dimensional and Squareness Test | ± 5 mm in dimensions and ± 0.5 mm in thickness. Squareness shall not exceed 1mm in 500mm | **Conform to IS-4020:1998** (Part-2) | 3 nos. at the time of initial validation |
| III.2 | General Flatness Test | No warping, cupping | (Part-3) | -do- |
| III.3 | Local Plainness test | Shall be less than 0.5 mm | (Part-4) | -do- |
| III.4 | Impact Indentation Test | Shall not cause any visible damage and depth of depression shall not exceed 1.0 mm | (Part-5) | -do- |
| III.5 | Edge Loading | 1) At 100 kg. test load, | (Part-7) | -do- |

| | | | | |
|---|---|---|---|---|
| | Test | deflection not to exceed 10.0 mm<br>2)Residual deflection shall not exceed 0.5 mm | | |
| III.6 | Shock Resistance Test | Shall not cause any visible damages or deteriorations | (Part-8) | -do- |
| III.7 | Buckling Resistance Test | 1) At 40 kg. full test load deflection not to exceed 300 mm<br>2) Residual deflection not to exceed 5 mm | (Part-9): | -do- |
| III.8 | Slamming Test | No permanent deformation allowed | (Part-10) | -do- |
| III.9 | Misuse Test | No permanent formation with wooden slip at 20 Kg | (Part-11) | -do- |
| III.10 | Screw withdrawal Resistance Test | Withdrawal force shall not be less than 100 Kg. | (Part-16) | -do- |

APPENDIX

# EXERPTS FROM THE CBRI REPORT ON CONTINUOUS SANDWICH PANELS

## A. SCOPE OF WORK

### A.1 Physio- mechanical properties

Density, Water absorption, Water penetration, Dimensional stability, Water pressure head test, Impact properties (indentation, falling hammer impact, impact load and large and soft body impact) slamming.

The physio-mechanical properties of sandwich panels are given in Table 1. The density of panels is 0.4 g/cm3 and its weight is 11 kg/$m^2$. When seal edged samples are immersed in water, there is no weight gain after 24 hours. The dimensional stability of samples is assessed at 70°C for 7 days. It is found that samples are stable and there is no change in length and volume. During screw holding power, it is very difficult to screw the samples because of their steel facing. During water penetration and pressure head test, no seepage or leakage are noticed. During three point bending, the panels there is not brittle failure noticed. In some samples, delamination between the core foam and GI face is observed. The samples have screw withdrawal of 440 N. Slight embossing on the surface of panels is noticed. The load is carried out by only face material.

### A.2 Performance characteristics

Loading test, Seismic evaluation, Thermal and sound insulation, load bearing and fire (ignitability, fire propagation index and surface spread of flame.

**A.3 General Properties** of continuous sandwich panels are given in Table 2. The panels are free from visual defects such as cracking, tearing, pin holes etc. They have adequate squareness property when tested as per IS 4020. The samples mounted horizontally on the frame have not shown any twist, warping and cupping. The samples withstand against shocks of 5 kg and 30 kg sand filled leather balls after several blows from the specified height. The samples have not received any damaged when they fall from their own weight 50 times. In central point load deflection, the sandwich panels showed a deflection 0.03 mm at the center of the panels for 24 hrs.

**A.4 Impact properties** – The impact properties of continuous sandwich panel are given in Table 3. During impact indentation, dropping a steel ball (500 gm of dia 50 mm) on panel from 75 cm height exhibited no cracking, tearing
or delamination . During impact load, the samples were not failed or holed when a 2.5 kg hemispherical ended striker steel ball dropped room 1.5 m height. On increase of drop height up to 2 m, there is not failure in the panels. Under falling hammer test, samples do not show any sign of puncture or a visual fracture at the bottom of the specimen. The weight of stri8ker was 1.2 kg. In another test, when the panel is shocked 5 times with 5 kg sand filled leather ball, there is no visual damage observed on the panel surface. During heavy body impact test, the blow of 30 kg sand filled leather ball showed no damage on both the sides of panel. The results indicate that samples have adequate resistance against various kind of impact loads.

**A.5 Loading test** – Experiment on bending resistance of sandwich panels is carried out equivalence to the max. wind load ( 55m/sec wind speed zone) according to IS 875(Part 3):1987. Outside structural facing of composite panels is fixed in the steel frame as to be fixed in the actual conditions and placed horizontally on a test frame without any restraining force. Dial gauges were provided at three important locations such as central and quarter points respectively. The test load was applied in four increments through bricks. Deflections were observed at every increment of load, 24 hours of loading immediate after unloading condition and after 24 hours of unloading as presented in table 4. The surface of panels has not shown any cracking/ crushing on both the sides of loaded and unloaded surfaces. The core materials consisted of PUP are completely intact. The central deflection the panels is in the order of 6 – 7 mm at a time of lading after shows that continuous sandwich panel has sufficient ductility in terms of deflections after applying 260 kg load. Its bending strength is 56 kg / $cm^2$ when tested as per ASTM D790. This indicates that the sample has an adequate toughness and good resistance to bending action. The composite panel also exhibited very good recovery even after 24 hrs continuous loading while the wind load will only act for very small duration. It is found that the continuous sandwich panel can be suitably used as an external / internal infill walls in windy and seismic zones for taking wall panels in building from structural point of view.

**A.6 Seismic evaluation** – Seismic resistance is not an important criteria in design of non-load bearing walls. Since continuous sandwich panels are new composite materials to be used as wall panels in buildings, hence tested for

max. earthquake load calculated according to IS 1893 (Part 1): 2002. Non-load bearing walls are vertically subjected to their dead weight only, and in case of continuous sandwich panel construction, the bottom most panel will be subjected to max. seismic weight. Assuming the building is situated in very severe seismic intensity zone i.e. Seismic Zone V, it was observed that the max. earthquake force acting on continuous sandwich panel is much less than the seismic weight acting on the bottom most panel.

**A.7 Fire tests** – The fire tests such as ignitability, surface spread of flame and propagation index of sandwich panels are given in Table 5. During ignitability test, the samples showed no flame and no extension of burring after removal of ignition source. This indicates that the sample belongs to 'not easily ignitable' and its performance is indicated by 'P' category as per BS 476(Part 5). The surface spread of flame test indicates the flame spread on the sample does not exceed the limit assigned for the class. No flaming droplets were observed. This indicates that samples possess no tendency to support the spread of flame across their surface. As per BS 476 (Part 7), sample belongs to class 1 category. The fire propagation test is carried out to measure contribution of material to the growth of fire. The difference between the values of temperature recorded for the materials and those obtained during the calibration run are used for the computation of a fire propagation index. The time-temperature data indicates that the sub index is 2.74 for 1 – 3 minutes, the sub index $i_2$ 2.37 for 4 – 10 minutes and $i_3$ 1.56 for 12 – 20 minutes. The overall fire propagation index of sandwich panel is 6.67. The low value of propagation index indicates that samples have less effect on accelerating the growth of a fire.

**A.8 Overall thermal transmittances** (U) of sandwich panels are given Tables 6 & 7. The U decreases while thermal resistance (R) increases with the increase of thickness of the panels. This indicates that samples have satisfactory thermal performance. The computed U value of panels meet the minimum requirement of IS: 3792 for non AC non-industrial building (U value roof = 2.33; wall= 2.56 $W/m^2K$). As per National Building Code, samples also meet the requirement of Air conditioned residential building (in case of roofs, panels should be more than 40 mm) – (U value roof = 0.58; wall = 1.16 w / $m^2$ K). For commercial building, the minimum thickness of panels should be in the range of 60 – 70 mm to meet the requirement of Energy Conservation Building Code (U value roof = 4.409; wall 0.44 $W/m^2K$). The sound transmission loss decreases with the increase of frequency. The average sound transmission loss is 22.64 dB showing adequate sound insulation property (Table 8). The results indicate that

sandwich panels possess adequate thermal acoustic behavior to be used as a external / internal reinforcement walling material.

**B Conclusion and Recommendation**

- Results indicate that continuous sandwich panels perform satisfactory against various loads, seismic evaluation, impact, thermal & acoustic and reaction to fire. The panels have been found suitable as wall/ roof panels for use in prefabricated buildings and also use in existing building for various functions.

**Table 1 Physio – mechanical properties of Continuous sandwich panels.**

| Property | Method | Value |
|---|---|---|
| Density ($g/cm^3$) | ASTM D 792:2000 | 0.39 |
| Weight $Kg/m^2$) | | 10.71 |
| Water absorption (%) after 24 hrs<br>With sealing edge<br>Without sealing edge | ASTM D 570:1998 | <br><br>Nil<br>7.20 |
| Dimensional Stability (%) ($70^oC$ for days) | IS11239:2009 | Negligible |
| Flexural strength (MPa) | IS 9162:1979 | 5.6 |
| Pressure head test | IS 13826:1993 | No leakage |
| Water penetration test (pressure 8 $kg/cm^2$) | IS 2645:2003 | No seepage |
| Fire propagation index | BS 476 (Part 6) | 6.67 |
| Load test (260 kg/m2) | IS 875(Part3):1987 | Deflection-<br>At loading 6.70 mm<br>After unlading 1.01 mm<br>Recovery after 24 hrs 0.45 mm |
| Overall thermal transmittance – U values (W/m2k) | IS 3346:1980 | (0.49 (50 mm thick) |

**Table 2 Typical properties of Continuous sandwich panels**

| Property | Acceptability criteria | Obtained value |
|---|---|---|
| General (IS: 4020-98 Part 1) | Free from visual defects | Free from visual defects |
| Dimension and Squarness (IS: 4020-98 Part 2) | Squareness Deviation more that 1 mm in a length of 500 mm | 1000 mm x 1000 mm the samples possess squareness property |
| General Flatness (IS: 4020-98 Part 3) | Twist < 1.5 mm Cupping < 1.5 mm Warping < 1.5 mm | The samples mounted horizontally has shown no twist, warping and cupping |
| Slamming (IS: 4020-98 Part 10) | No visible damage caused in any part of ht panel by fifty drops | After 50 times falling of its own dead weight, no visible damage observed on outside sandwich panel facing |
| Screw withdrawal (IS: 4020- 98 Part 16) | No visible damage to the surface either by delamination, or extra chipping off a the points of withdrawal | 440N,No embossing/ chipping noticed at the time of withdrawal from sandwich panel |
| Centre point load test (40 Kg load with 30 mm bearing) | Passed the average deflection of 15 mm | Deflection = 0.03 mm |

**Table 3 Various Impact tests conducted on Continuous sandwich panels**

| Property | Acceptability criteria | Value |
|---|---|---|
| Impact Indentation (IS : 4020) | No defects such as cracking, tearing or delamination | Only depression at a point of falling |
| Falling hammer impact (IS: 2380) | Puncture or visible fracture at the bottom of the specimen | No puncture at the bottom |
| Impact load | Average failure height of 50 samples should not be less than 1.5 m | No failure |
| Impact shock (soft and light body - IS: 4020) | No visible damage in any part of panel after 25 blows | Damage free |
| Impact thrust bearing (soft and heavy body – IS: 4020) | Withstand without and significant permanent deformation and without deterioration | Damage free |

**Table 4 Deflection in Continuous sandwich panels before and after loading**

| | Deflection (mm) | | | | | Deflection(mm) | |
|---|---|---|---|---|---|---|---|
| | Loading | | | | | Unloading | |
| Dial gauge | 65 kg/m² | 130 kg/m² | 195 kg/m² | 260 kg/m² | After 24hrs | Immediate | After 24hrs |
| 1. | 1.734 | 3.020 | 4.354 | 5.502 | 5.848 | 0.800 | 0.390 |
| 2. | 1.840 | 3.460 | 5.010 | 6.300 | 6.690 | 0.880 | 0.660 |
| 3. | 1.720 | 3.080 | 4.360 | 5.518 | 5.864 | 0.788 | 0.398 |

**Table 5 Fire tests on Continuous sandwich panels**

| Test | Requirement | Value |
|---|---|---|
| Ignitability (BS476 part 5) | 'P' not easily ignitable<br>Or<br>'X' easily ignitable | 'P' category |
| Fire propagation ( BS 476 part 6) | Higher value of I & $i^1$, more hazardous, more easily ignitable & more rapid burning | $i^1 = 2.74$<br>$i^2 = 2.37$<br>$i^3 = 1.56$<br>I = 6.67 |
| Surface spread of flame (BS 476 part 7) | Classification based on flame spread: Class 1, 2, 3 & 4 | Class 1 (low flame spread) |

**Table 6 Density and Thermal conductivity of Continuous sandwich panels**

| S.No. | Name of material | Density $Kg/m^3$ | Thermal conductivity W/m K |
|---|---|---|---|
| 1. | Steel | 7850 | 52 |
| 2. | PUF | 56.66 | 0.027 |

**Table 7 Derived thermal properties of Continuous sandwich panels**

| **Property** | **Sandwich panel (Polyurethane Foam)** | | | | | |
|---|---|---|---|---|---|---|
| | **2.5 cm** | **3.5 cm** | **4.0 cm** | **5.0 cm** | **6.0 cm** | **7.5 cm** |
| Resistance (R) | 0.92 | 1.30 | 1.480 | 1.85 | 2.22 | 2.77 |
| Overall thermal transmittance | 0.92 | 0.68 | 0.60 | 0.49 | 0.42 | 0.34 |
| Volumetric heat capacity | 15.02 | 15.76 | 16.13 | 16.87 | 17.60 | 18.71 |
| Decrement factor ($\lambda$) | 0.57 | 0.50 | 0.47 | 0.42 | 0.38 | 0.32 |
| Phase lag($\Phi$) | 4.26 | 5.22 | 5.67 | 6.54 | 7.38 | 8.59 |

**Table 8 Sound transmission loss of Continuous sandwich panels**

| S. No. | Frequency (Hz) | Sound transmission loss (dB) |
|---|---|---|
| 1. | 100 | 10.00 |
| 2. | 125 | 13.02 |
| 3. | 160 | 16.30 |
| 4. | 200 | 20.30 |
| 5. | 250 | 22.80 |
| 6. | 315 | 24.30 |
| 7. | 400 | 25.00 |
| 8. | 500 | 26.60 |
| 9. | 630 | 28.00 |
| 10. | 800 | 29.30 |
| 11. | 1000 | 31.60 |
| 12. | 1250 | 27.00 |
| 13. | 1600 | 24.60 |
| 14. | 2000 | 24.40 |
| 15. | 2500 | 21.10 |
| 16. | 3150 | 18.00 |
| **Average Sound transmission loss** | | **22.64** |