UDC 629·73·023 4-419·5 : 669·71 : 620·1

Indian Standard

(Reaffirmed 1997)

SPECIFICATION FOR ALUMINIUM HONEYCOMB SANDWICH PANELS FOR CIVIL AIRCRAFT FLOORS

PART 2 METHODS OF TESTS

1. Scope — Prescribes the methods of tests for honeycomb type sandwich panel for civil aircraft floors.

2. Classification of Tests

2.1 The tests to be carried out are classified as follows:

a) Type approval tests, and
b) Quality assurance tests.

3. Type Approval Tests

3.1 For the type approval of civil aircraft floor panel to particulars of a part number, the type tests listed in Table 1 shall be carried out to ensure that the design requirements are met with as stipulated in IS : 11649 (Part 1)-1986 'Specification for aluminium honeycomb sandwich panel for civil aircraft floors: Part 1 General design criteria'.

TABLE 1 TYPE APPROVAL TESTS

Type of Test	Reference to Appendix
Static strength: Uniformly distributed load	A
Static stiffness	B
Static indentation strength: a) Concentrated load b) Roller load	C
Impact strength	D
Nobbly wheel fatigue test	E
Environmental tests: a) Human urine (applicable only to toilet floor panel) b) Water c) Humidity ageing	F
Flame resistance test: a) Horizontal b) Vertical	G
Stabilized compressive strength and modulus	H
Peel strength of adhesive	J
Three point bend test	K
Flatwise tensile test	M
Physical measurements for weight, thickness and warpage	*
NDT (Fokker bond)test	N

*By any approved standard test method.

4. Quality Assurance Test

4.1 To ensure that civil aircraft floor panels produced conform to the desired quality, the quality assurance tests listed in Table 2 shall be carried out. From each lot of panels one panel shall be selected and specimens as given in Table 2 shall be drawn for quality assurance testing. For the above purpose a lot will mean a group of panels of the same type fabricated and cured under the same conditions and manufactured in the same press. Lots will comprise batches not exceeding 20 panels.

Adopted 31 March 1986

Gr 7

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

4.1.1 All testing shall comply with the requirements of tests prescribed in Table 2. The mean value of not more than one of the assurance tests for any one batch will not be lower than 0·95 percent of the values agreed to between the purchaser and the supplier. In the event of any mean result falling below 95 percent of the values agreed to between the purchaser and the supplier, the panel from which the test piece was cut may be set aside and further test pieces cut from three other panels in the batch. If these three test pieces meet the requirements that is the average of the three exceeds the figure agreed to, and no single result is below 95 percent then the batch is acceptable; otherwise the batch is to be rejected.

TABLE 2 QUALITY ASSURANCE TEST

(*Clauses* 4.1 *and* 4.1.1)

Type of Test	Reference to Appendix	No. of Specimen
Stabilized compressive strength and modulus	H	3
Peel strength of adhesive	J	3
Static indentation strength (concentrated load)	C	3
Three-point bend test	K	3
Flatwise tensile test	M	3
NDT (Fokker bond) test	N	3

APPENDIX A

(*Table* 1)

STATIC STRENGTH TEST

A-1. The panel for this test shall be supported on frame as in the aircraft floor, using the same method of attachment to the frame as in the case of aircraft floor beams. The panel shall be loaded up to the limit load $K.n_z$ as specified in IS : 11649 (Part 1)-1986 in ten equal increments. Deflections shall be measured at the centre of each panel bay and it shall be verified that there is no permanent set in the panels up to the limit load.

APPENDIX B

(*Table* 1)

STATIC STIFFNESS MEASUREMENT

B-1. The panel for this test shall be supported on frames as in the aircraft floor using the same method of attachment to the frame as in case of aircraft floor beams. The frames for the test shall be stiffer when compared to the aircraft floor beams. The stiffness shall be determined by measuring the deflection of the panel at the bottom of centre of the bay when a load of 740 N (75·5 kgf) is applied by dead weights at the top through 60 mm diameter flat faced indentor located at the centre of the bay. The deflection measured at the centre shall not exceed 1/100 of the shorter span of the bay.

APPENDIX C

(*Tables* 1 *and* 2)

STATIC INDENTATION STRENGTH

C-1. Concentrated Load

C-1.1 A 9·5 mm diameter blunt indentor shall be used to make indentation into the walking surface of a 150 × 150 mm square panel fully supported as shown in Fig. 2A of Part 1 of this specification. Indentor may have an edge radius of 0·25 mm. Test shall be conducted on a strain rate controlled test machine, constant cross-head speed of 0·5 mm/min, with autographic load/extension recording equipment. Failing load recorded will be the maximum load shown on the autographic trace at the first load relaxation point.

C-2. Roller Load Test

C-2.1 A 305 mm square panel shall be supported on a frame giving 25 mm edge support (hardwood) all round the panel. At least three equi-spaced indentation shall be made using a representative 75 mm diameter foodcart wheel on the circumference of a 50 mm radius drawn at the centre of the panel as shown in Fig. 2B of IS : 11649 (Part 1)-1986. Load is applied at a constant cross-head speed of 1·0 mm/min. The test is applicable to Types B and C panels only.

APPENDIX D

(*Table* 1)

IMPACT STRENGTH TEST

D-1. The floor panel with the carpet and underlay shall be supported on frames as in the aircraft floor on beams with similar attachment. A weight of 88 N (9 kgf) shall be dropped from the required height, to the centre of the panel on to walking surface as shown in Fig. 1. The panel shall absorb the energy stipulated in **B-5** of Appendix B of Part 1 without failure of the panel. An excessive core crushing or puncturing of skin shall be deemed as failure.

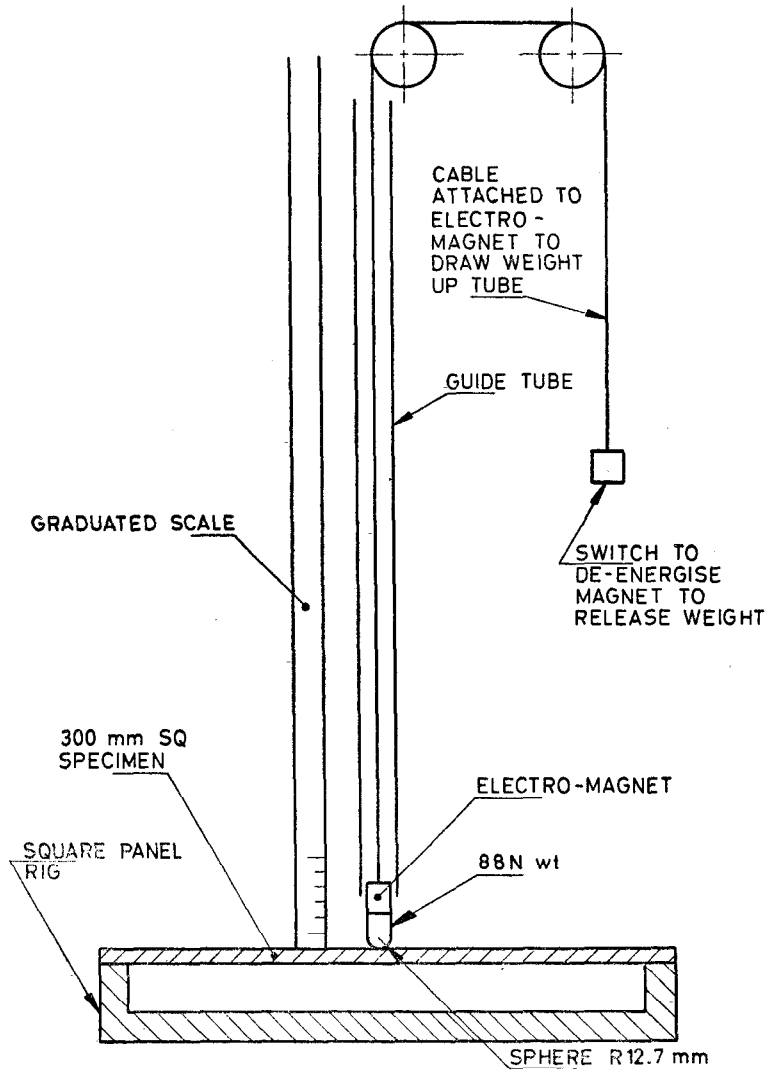


FIG. 1 LOADING ARRANGEMENT FOR IMPACT TESTS BY FREE FALLING WEIGHT

APPENDIX E

(*Table* 1)

NOBBLY WHEEL FATIGUE TEST

E-1. The fatigue rig supports a 380 mm diameter disc of floor panel on three equi-spaced wheels of 330 mm pitch circle diameter (*see* Fig. 2). Each wheel carry 12 blunt faced indentors of 9·5 mm diameter projecting from their periphery. Two of the wheels are supported on brackets and the third is driven through a gear box. This drives the floor panel at a mean speed of 40 rpm so that any particular area on the track of the wheels receives 120 impacts from the blunt indentors. The panel is loaded with lead discs. These rotate with the panel on the same spindle. The indentation of the panel shall not exceed 0·80 mm within the fatigue test time exposure and load applied as given below:

Type of Floor Panel	*Nobbly Wheel Fatigue Test [Load in N (kgf) and Time in hours]*	*Failure Check Time Interval*, h
A	216 (22) for 2 hours	0·25
B	304 (31) for 2 hours	0·25
C and D	392 (40) for 2 hours	0·25

Tests may be discontinued after five times qualifying fatigue test time.

APPENDIX F

(*Table* 1)

ENVIRONMENTAL TESTS

F-1. Panels both sealed and non-sealed shall be exposed to water, humidity and human urine as prescribed in **F-2**, **F-3** and **F-4**. Flat tensile strength test specimen and three-point bend test specimen shall be extracted from the panels exposed to the environmental conditions. Flatwise tensile strength, the flexural strength and stiffness so determined shall be compared with the values of specimen not exposed to environmental conditions.

F-2. Human Urine — (*Applicable only to toilet floor panels*). Panels with edges both sealed and non-sealed are immersed in human urine for 30 days at a temperature of 20 to 23°C. Following the exposure to human urine, specimens 50 mm in diameter are extracted and flatwise tensile strength determined as per Appendix M. For determining flexural strength and rigidity using the three point bend test, as per Appendix K, panels are immersed for 5 days in human urine held at a temperature of 20 to 23°C. Tests shall be conducted within 6 hours after exposure.

F-3. Water — For determining both flatwise tensile strength and flexural strength and stiffness, the specimens are fully immersed for 30 days in distilled water held at a temperature of 20 to 23°C. Tests shall be conducted within 6 hours after exposure as per Appendix M and K.

F-4. Humidity Ageing — Flatwise tensile strength as per Appendix M is to be determined with specimens subjected to an environment at 49 $\pm$ 3°C and 100 percent relative humidity for 30 days. Tests shall be conducted within 6 hours after exposure.

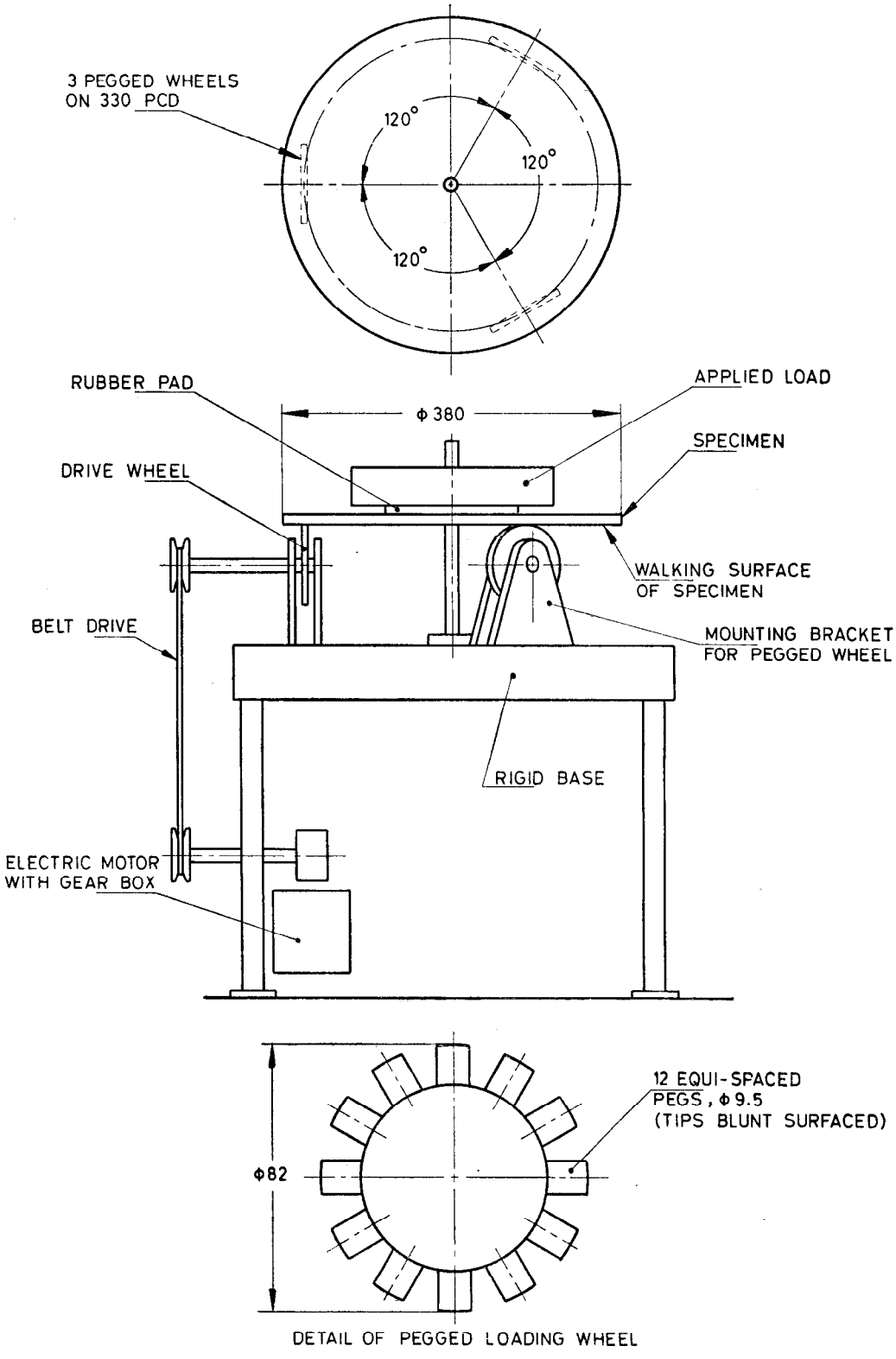
APPENDIX G

(*Table* 1)

FLAME-RESISTANCE TEST

G-1. Flame-resistance Tests — Two types of flame-resistance test are to be carried out:

a) Horizontal, and
b) Vertical.



All dimensions in millimetres.

Fig. 2 LOADING ARRANGEMENT FOR FATIGUE TEST ON NOBBLY WHEEL TESTING

G-1.1 *Test Specimen* — Flame-resistance tests are carried out on specimens 300 × 90 mm. The specimens are fully representative of a section cut from the aircraft floor panel and shall not contain any finished or projected edges.

G-2. Horizontal Test — The specimen shall be held in a metal frame so that two long edges and one end are held securely. The exposed material area shall be at least 50 mm wide and 297 mm long. The specimen shall be conditioned prior to testing till moisture equilibrium is reached. Testing shall be done under an ambient of 65 percent maximum humidity and at 18°C minimum temperature. The chamber for performing the horizontal flame test shall be of sheet metal. The dimensions shall be 200 to 225 mm long, 375-400 mm wide and 350-375 mm high. The top shall be removable with a 12·7 mm ventilating opening around 80 percent of the periphery and two suitably positioned observation ports for viewing the upper surface of the specimen during tests. The floor of the chamber shall be raised on legs to have 10 mm clearance underneath. There shall be five equally spaced 10 mm dia ventilating holes along each side on the bottom of the chamber. The chamber shall have a slot in one end through which the specimen holder is inserted to slide on a horizontal track to the test position.

G-2.1 Provision shall be so made that a thin sheet metal flame stopper can be installed across the specimen approximately 6·35 mm below and 75 mm from the ignited end to prevent the flame from flashing along the specimen under surface. The stopper shall be used only with double napped cloth. There shall be a glass window in the front of the chamber of a size and location which will permit viewing the top and bottom surfaces of the specimen under test; provision shall be made to measure accurately the rate of burning.

G-2.2 The specimen shall be positioned flatwise horizontally. The material side exposed to the air as installed in the aircraft shall be faced downward for the test. The specimen during ignition shall be aligned so that the lower edge of the exposed end is 10 mm above the top of the burner and is centred on the burner opening. The flame shall be provided for a Bunsen burner with a nominal 10 mm tube adjusted to give a flame 38 mm in height with air completely cut-off. The flame shall be provided for at least 15 seconds and then removed. The burn rate in centimetre per minute shall be determined. Timing of the burn rate shall start when the burning front reaches a point 38 mm from the ignition end and shall continue until the flame front is a minimum of 250 mm from the ignition end. The burning rate shall be reported as the average of three specimens.

G-2.3 If the specimens do not support combustion after the ignition flame is applied or if the flame extinguishes itself and subsequent burning without flame does not extend into the undamaged area, the material shall be acceptable.

G-3. Vertical Tests

G-3.1 Specimens (300 mm × 75 mm) shall be held in a metal frame so that two long edges and one end are held securely. The exposed material area shall be at least 50 mm wide and 287 mm long. The specimen shall be conditioned prior to testing until moisture equilibrium is reached. Testing shall be done under ambient limits of 65 percent maximum humidity and 15°C minimum temperature.

G-3.2 The chamber for performing the flame test shall be of sheet metal. Dimensions shall be 300 to 350 mm in width and 750 mm height. There shall be approximately 12 baffled holes of 12·7 mm diameter at the top of the chamber and also at the base for air ventilation. There shall be an observation port in one side of a size and location suitable for viewing the specimen under test. The flame shall be provided by a Bunsen burner with a nominal 10 mm inner dia tube adjusted to give a flame 38 mm in height with air completely cut-off.

G-3.3 The specimen shall be mounted vertically in the chamber. During ignition the specimen shall be so positioned that the exposed end of the specimen is 20 mm above the top of the burner and is centred on the burner opening. The flame shall be applied for a minimum of 60 seconds, and then removed. The elapsed time from removal of the burner to the extinguishing of the flame or burning of the specimen shall be measured. Three specimens shall be tested and the extinguishing time, burn length shall be reported individually.

G-3.4 Burn length is defined as the distance from the original edge to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring or embrittlement, but not including areas sooted, stained, warpped or discoloured nor areas where the panel has shrunk away from the heat source.

Brief requirements of vertical tests are:

a) minimum flame temperature of 845°C applied for 60 seconds,

b) average burn length not to exceed 150 mm,

c) flame time after removal of flame not to exceed 15 seconds, and

d) drippings may not continue to flame for more than 3 seconds after falling.

APPENDIX H

(*Tables* 1 *and* 2)

TEST METHOD FOR STABILIZED CORE COMPRESSIVE STRENGTH AND MODULUS

H-1. The method covers determination of the stabilized compressive strength and modulus of sandwich panels. This property is usually determined for design purposes in a direction along the axis of the core.

H-1.1 Test specimens shall be of sandwich construction (that is, stabilized core face sheets bonded to the core) and shall be of square or circular cross-section having areas not exceeding 10000 mm^2. For cells larger than 12mm, the area of specimen shall be minimum of 2 500 mm^2 or large enough to include at least one complete cell. The height of the specimen shall not be greater than four times the width or diameter. Not less than five specimens of a type shall be tested.

H-1.2 Prepare the test specimens so that the loaded ends will be parallel to each other and perpendicular to the sides of the specimen. In order to avoid local crushing of honeycomb cores at the ends, it is desirable to reinforce the ends with a suitable material. The ends may be cast or dipped in a thin layer of resin (epoxy, polyester or furane resin) and cured at room temperature or slightly elevated temperature. It has been found that a depth of resin as little as 2 mm will provide adequate support for many types of cores so as to prevent localized failures.

H-1.3 Any form of standard compression testing machine capable of operation at a constant rate of motion of the movable head, with self-aligning grips shall be used. A suitable means for measuring strains in honeycomb cores consists of filar microscope focussed on points of fine needles inserted in the core.

H-1.4 Apply the load to the specimen through a spherical loading block, perferably of the suspended, self-aligning type, in such a manner that the block distributes the load as uniformly as possible over the entire loading surface of the specimen. Apply the load at a constant rate of movable head of the testing machine (**Note** 1) and at such a rate that maximum load (**Note** *2*) shall occur between 3 and 6 minutes.

Note 1 — A suggested rate of head movement is 0·003 mm/min/mm of core height. For accurate determination of the properties of the core it is desirable to test under continuously applied load.

Note 2 — For cores that continue to compress and have no definite maximum load, the maximum load shall be the load at 2 percent strain or if head movement is measured the maximum load shall be the load at 10 percent total compression.

H-1.5 Data for stress-strain curves may be taken to determine the modulus of elasticity, proportional limit stress at 0·2 percent strain offset and the maximum load at 2 percent strain (*see* Note 2). Usually 12 readings are adequate to determine the curve, to the proportional limit. Measure deformations to the nearest 0·002 mm using filar microscope focussed on points of fine needles inserted in the core. The filar microscope shall measure strain over the central portion of the length of the specimen over a gauge length not exceeding two thirds of the length of the specimen.

H-1.6 *Test Report* — The report shall include the following:

a) Complete description of the test specimens including materials, resins, adhesives, type of end support;

b) Dimensions of test specimens;

c) Testing conditions, including temperature, relative humidity and speed of testing;

d) Stress-strain or load deformation diagrams;

e) Compressive strength and modulus (individual values and averages); and

f) Description of failed specimen, including location and type of failure.

APPENDIX J

(*Tables* 1 *and* 2)

TEST PROCEDURE FOR PEEL STRENGTH DETERMINATION

J-1. Scope — A method for determining the facet shee adhesion to a sandwich core when subjected to a peeling load is specified. The method is applicable when the facings being peeled are relatively thin.

J-1.1 The test is based on the measurement of torque required to achieve bond separation when the face sheet bonded to honeycomb core sample is wrapped around a traction drum. The measured force comprises of:

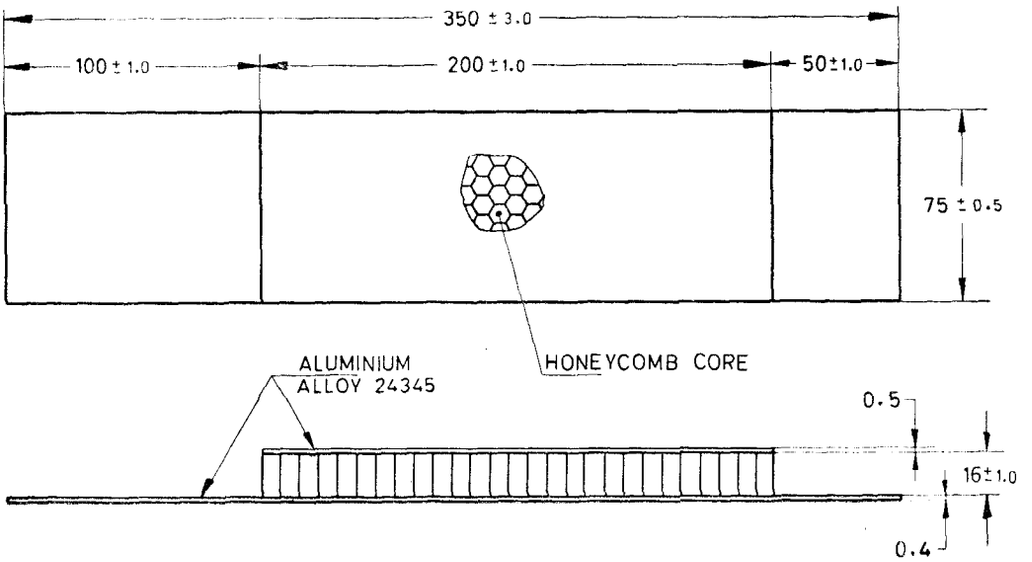
a) the force required to overcome the face sheet core bond,

b) the force required to bend the face sheet to the drum radius, and

c) the drum equilibrium force.

The required torque value is derived by calculation. This method is effective when the force required to achieve only face sheet bond separation exceeds approximately half the measured force. To achieve this condition the face sheet thickness shall be small and the mass of the drum and accessories shall weigh not more than 35·6N (3·63 kgf).

J-1.2 The test specimen shall conform to the general form and dimensions shown in Fig. 3. A shallow saw cut at the base of the honeycomb cores shall be used to initiate the bond separation.



All dimensions in millimetres.

FIG. 3 TEST SPECIMEN FOR CLIMBING PEEL DRUM TEST

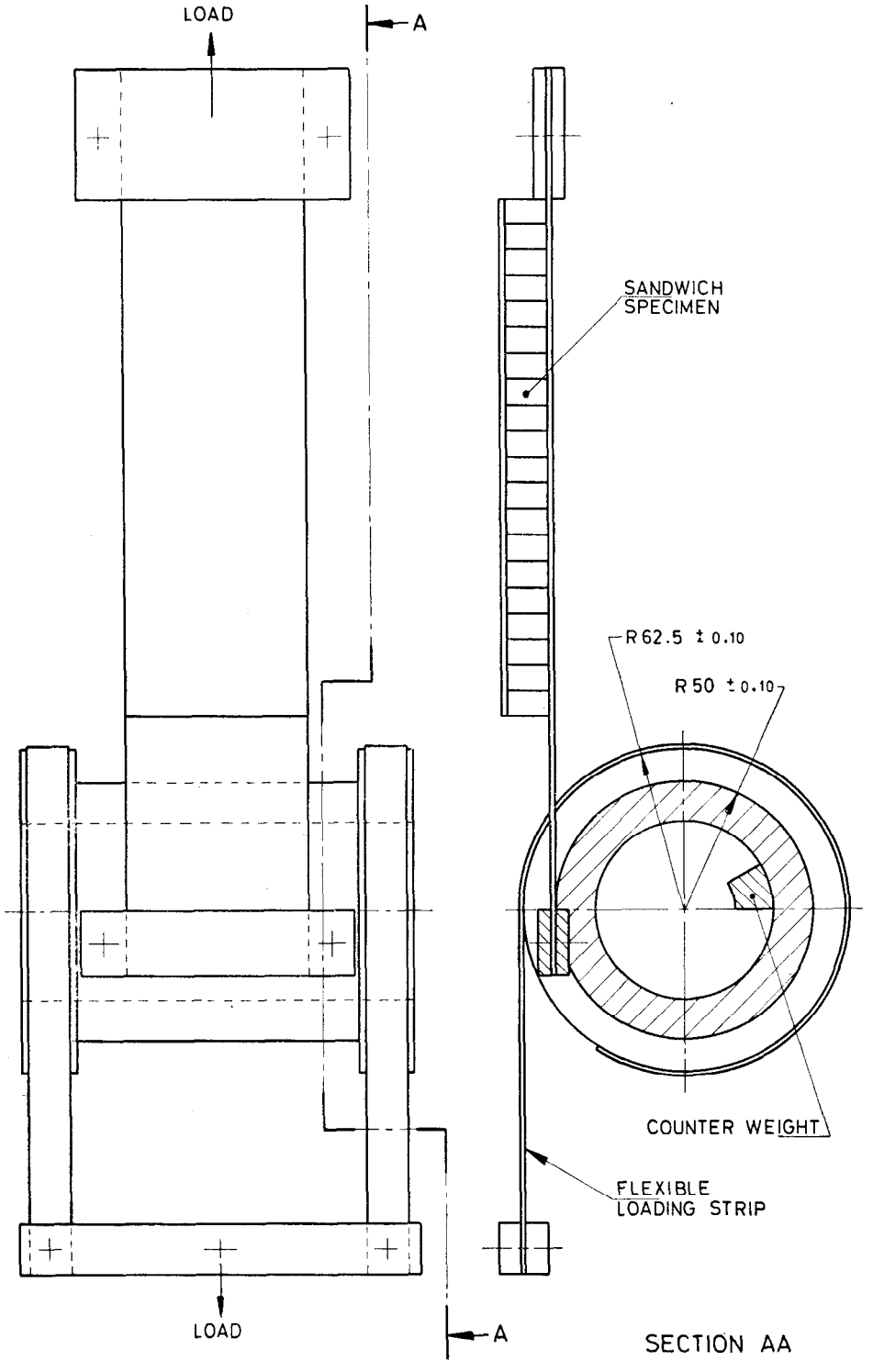
J-1.3 A winding device (*see* Fig. 4) shall comprise of a cylindrical drum with a 50 ± 0·1 mm radius fitted at either end with an over size flange on which is coiled a steel strip (strap). The radius of these flange shall be such that the distance from the taut strap to the centre of the drum shall be 62·5 ± 0·1 mm when the drum is at mid-rotational travel position. The drum shall be fitted with an eccentric clamp after the lower end of the specimen and with a counterweight to achieve static balance of the drum assembly about its rotational axis and eccentric clamp assembly for the upper end of the test specimen and a device for applying a tensile load on the force end of the strap wound around the drum flanges. These two devices shall be mounted in the machine jaws.

J-1.4 *Room Temperature Testing*

Secure the specimen to the drum and suspend the assembly from the upper jaws of the testing machine.

Balance out loads to zero.

Secure the straps to the lowerclamp of the test machine.



All dimensions in millimetres.

FIG. 4 CLIMBING PEEL DRUM TEST FIXTURE

Select the load range so that the maximum recorded load is between 20 and 80 percent of full scale.

Select a jaw displacement speed of 25 mm/min or if not possible the nearest speed.

Record the load versus displacement curve.

J-1.5 A typical load *vs* displacement curve obtained from the honeycomb sandwich climbing peel drum test is shown in Fig. 5.

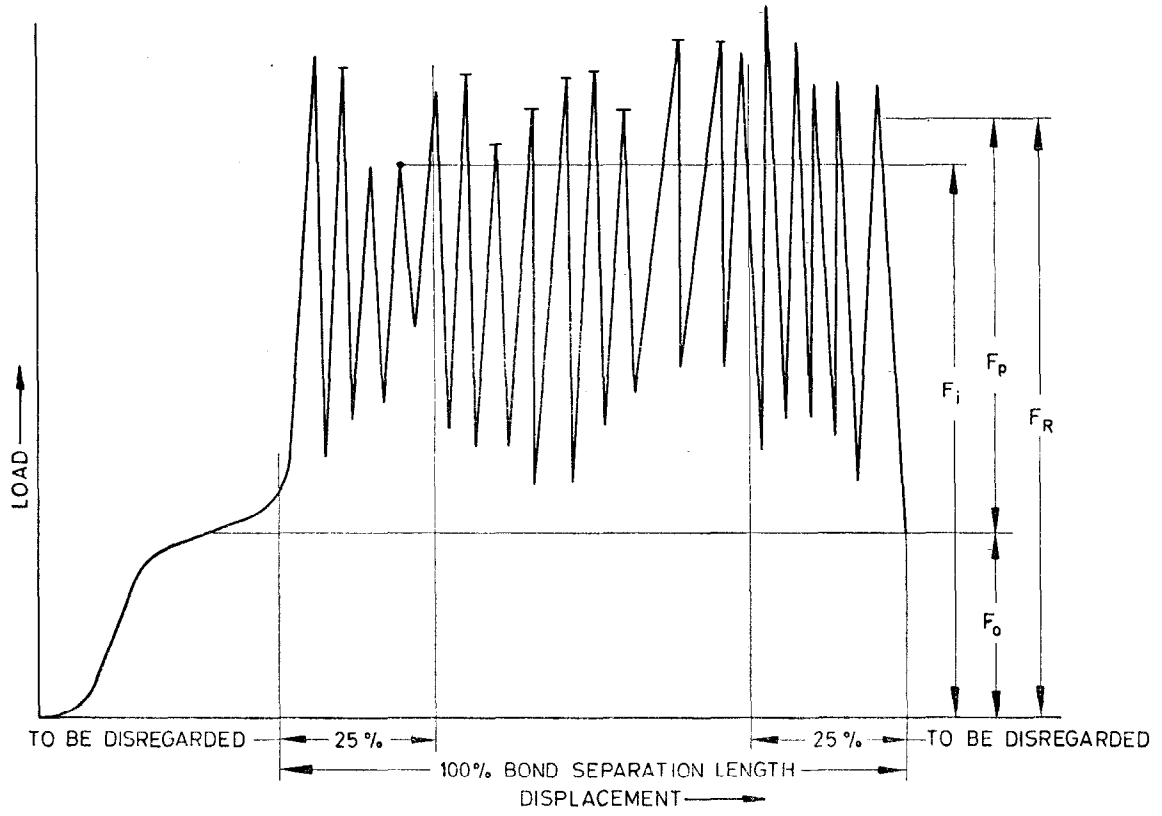


FIG. 5 TYPICAL LOAD-DISPLACEMENT CURVE (CLIMB PEEL DRUM TEST)

Base line load F_O (N) — This value represents the sum of the loads in newtons required to drive the drum and to wrap the face sheet around the drum.

Resisting load F_i — Disregard the first and last 25 percent of the curve. Mark and count the peaks in the remaining half of the curve. The number of peaks shall be designated '*n*'. If *n* is an odd number, note *F* values for the $K = \frac{n+1}{2}$ peaks with the lowest amplitude. If *n* is an even number, note the *F* values for $K = \frac{n}{2}$ peaks with the lowest amplitudes. Calculate the resisting force, F_R from the formula,

$$F_R = \frac{\Sigma F_i}{K} \text{ where } K = \frac{n}{2} \text{ or } \frac{n+1}{2} \text{ as applicable}$$

Peel load, $F_p = F_R - F_O$

where, F_R is average resisting load in newtons.

F_O is the sum of loads required to drive the drum and to wrap a face sheet around the drums expressed in newtons.

Unit peeling torque, C_P (kg-mm/mm) is obtained by

$$C_P = \frac{F_P \times (D_o - D_1)}{2b}$$

where

D_o = ϕ_o + strap thickness,

D_1 = ϕ_1 + face sheet thickness,

ϕ_o = strap winding dia of drum,

ϕ_1 = face sheet winding dia of drum, and

b = specimen width.

J-1.6 *Test Report* — shall include the following:

a) Number of specimens tested;

b) Full identification of the material;

c) Peel load F_p;

d) Peeling torque C_p;

e) Test temperature;

f) Type of failure, for example, adhesive or cohesive failure; and

g) Mean values obtained for each homogeneous group.

APPENDIX K

(*Tables* 1 *and* 2)

PROCEDURE FOR THREE-POINT BEND TEST (FLEXURE) FOR HONEYCOMB SANDWICH FLOOR PANEL SPECIMENS

K-1. Scope — This method covers determination of the properties of flat sandwich construction subjected to flatwise flexure. Flexure tests on flat sandwich specimens may be conducted to determine flexural and shear stiffness of construction, shear modulus and shear strength of core (Note 1). Tests to evaluate core shear strength may also evaluate bonds between core and facings in as much as core shear stress values may be lower than actual core shear strength thus indicating that failure initiated in the bond. In the test described the core shear properties are assessed.

K-1.1 *Test Specimens* — The test specimen shall be rectangular in cross-section. The depth of the specimen shall be equal to the thickness of the sandwich construction (aircraft honeycomb floor panel) and width shall not be less than twice the total thickness, not less than three times the dimension of a core cell, nor greater than one half the span length. The specimen length shall be equal to the span plus 50 mm or plus one half the sandwich thickness whichever is greater. The actual width, depth and span shall be measured to the nearest 0·5 percent. The span length shall be approximately determined as follows:

$$a_1 = \frac{2f\,F}{S}$$

where

a_1 = span length, mm;

f = facing thickness, mm;

F = allowable facing stress, Pascals; and

S = allowable core shear stress, Pascals.

K-1.2 Any form of deflection testing machine capable of operation at a constant rate of motion of the movable head shall be used. Round steel bars or pipes having a diameter not less than one half the core thicknesses and not greater than one and a half times the sandwich thickness shall be used in loading as shown in Fig. 6. They shall be circular in cross-section to within 1 percent of their diameter and shall be straight to within 0·5 percent of their length.

K-1.3 Arrange the test set up as shown in Fig. 6 so that initial twist of the specimen will be accommodated. Apply the load to the specimen through the steel bars. If after a trial test, it is found that local failures occur under load points, it will be permissible to place thin, narrow plates at these points to prevent such failure. Apply the load, preferably through a constant rate of movement of the movable head of the testing machine, and at such a rate that the maximum load will occur between 3 and 6 minutes. Data for load deflection curves may be taken to determine core shear modulus. Deflections shall be measured at each reaction to the nearest 0·01 mm by apparatus supported on pins located on the neutral axis of the sandwich.

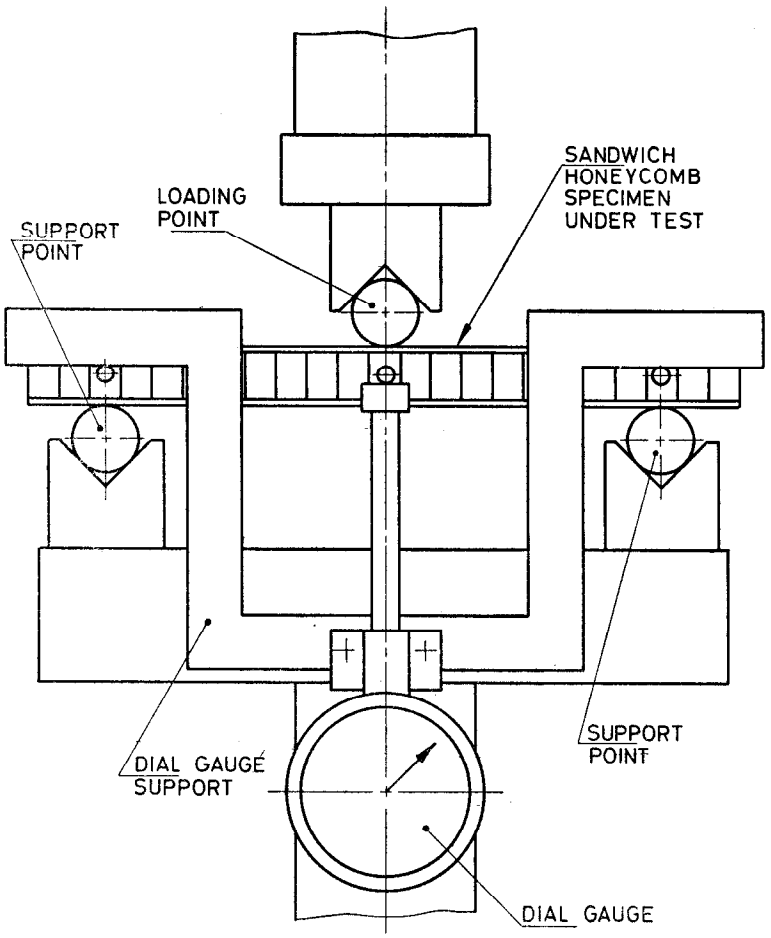


FIG. 6 THREE-POINT BEND (FLEXURE) TEST

K-1.4 The core shear stress for the sandwich loaded with load P_1 at the midpoint of the span length a_1 is given by:

$$S = \left[\frac{P^1}{(h + c)\, b} \right]^k$$

where

S = core shear stress;
h = sandwich thickness, mm;
c = core thickness, mm;
b = sandwich width, mm; and
k = 1.

K-1.4.1 The midspan deflection is calculated as follows:

$$W_1 = \frac{P_1 a_1^3}{48 D} + \frac{P_1 a_1}{4 N}$$

where

W_1 = midspan deflection;
D = sandwich flexural stiffness calculated from the equation:

$$D = \frac{E.b\,(h^3 - c^3)}{12\, L}$$

where

$L = 1 - \nu^2$;

ν = Poisson's ratio of facings;

E = modulus of elasticity of facings;

N = sandwich shear stiffness obtained from the equation:

$$N = \frac{G\,(h + c)^2 b}{4\,c};$$

G = effective core shear modulus.

K-1.5 *Test Report* — shall include the following:

a) Complete description of test specimen including facings, core material and adhesives;

b) Complete description of exact testing procedure and apparatus used to obtain desired information;

c) Core shear strength and modulus, load deflection diagram, facing stresses; and

d) Complete description of specimen failure, whether failure occurred in facings, core, bond, or a combination of these. If possible the order in which failures began should be noted.

Note — Core shear modulus and core shear strength are best determined in shear test in flatwise plane of flat sandwich construction.

APPENDIX M

(*Tables* 1 *and* 2)

FLATWISE TENSILE TEST

M-1. This method covers the determination of the strength in tension, flatwise of the core or of the bond between core and facings.

M-2. The loading fixures shall be self-aligning and shall not apply to eccentric loads. A satisfactory type of apparatus is shown in Fig. 7. The loading blocks shall be sufficiently stiff to keep the bonded facings essentially flat under load. Loading blocks not thinner than the cross-sectional dimension of the specimens have been found to be satisfactory.

M-3. Test specimens shall be square or round and equal in thickness to the thickness of the structural sandwich panel. All dimensions shall be measured to an accuracy of ± 0·5 percent. The test specimens shall have the minimum area of 2 500 mm².

M-4. The loading fixture shall be bonded to the facing of the test specimen by a suitable method which shall not appreciably affect the existing bond between facing and core. The bonding pressure shall not be greater than the original facing to core bonding pressure. The assembly temperature shall be room temperature or at least 28°C lower than that at which the sandwich was originally bonded.

M-5. Not less than three specimens shall be tested.

M-6. The test specimens shall be conditioned to constant weight before testing in a conditioning room with temperature and humidity control and make the tests preferably in a room under the same conditions. A temperature of 23 ± 1·1°C and a relative humidity of 50 ± 2 percent are recommended.

M-7. Apply tensile load at a constant rate of head movement of the testing machine and at such a rate that the maximum load will occur between 3 and 6 minutes.

M-8. Flatwise tensile strength $= \dfrac{\text{Maximum load}}{\text{Gross cross-sectional area}}$

M-9. Test report shall include the following:

a) Description of test specimens, including facings, core and adhesive;

b) Dimensions of test specimens;

c) Description of method used to attach fixture to test specimen;

d) Ultimate tensile strength flatwise; and

e) Description of failure whether progressive or sudden and percentage of area of failure in core, adhesive or facing.

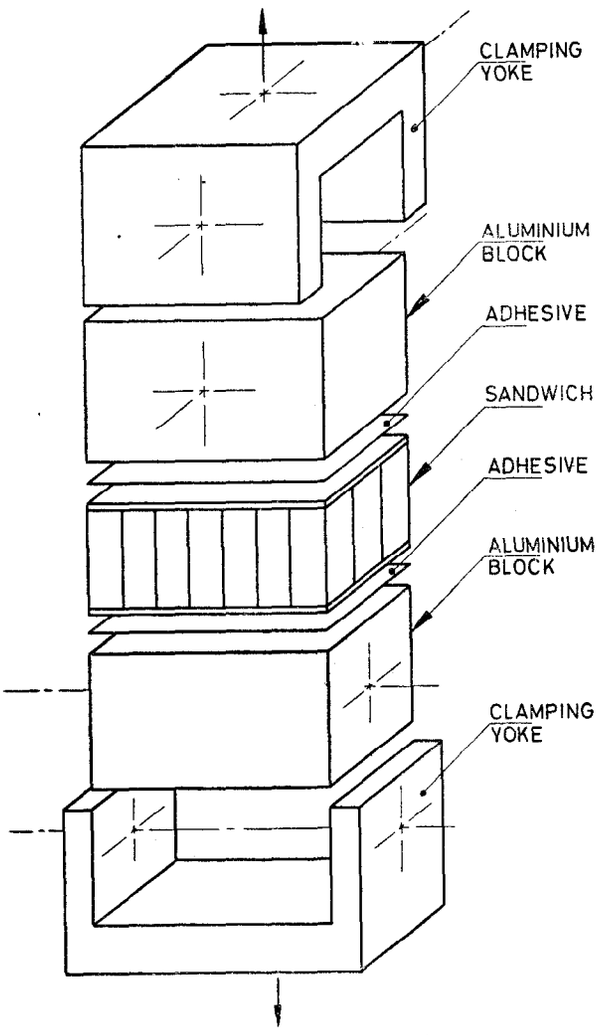


FIG. 7 LOADING ARRANGEMENT FOR TESTING FLATWISE TENSILE SPECIMEN

APPENDIX N

(*Tables* 1 *and* 2)

NON-DESTRUCTIVE TEST FOR BONDING

N-1. Scope — Covers the ultrasonic testing method to assess the bonding quality between face sheet and core using a Fokker bond tester.

N-2. Test Specimens — At least three specimens shall be tested for bond quality. Specimens for flatwise tensile strength test as in Appendix M may also be considered for evaluating the bond quality.

N-3. Test Procedure — Calibrate the bond quality by experimentally varying amplitudes. Care shall be taken to ensure that the results are consistent. The flatwise tensile strength *vs* B scale readings are taken for the calibration curves. Repeat the tests and plot curves as shown in Fig. 8. The required limits for various classes can be derived from Fig. 8.

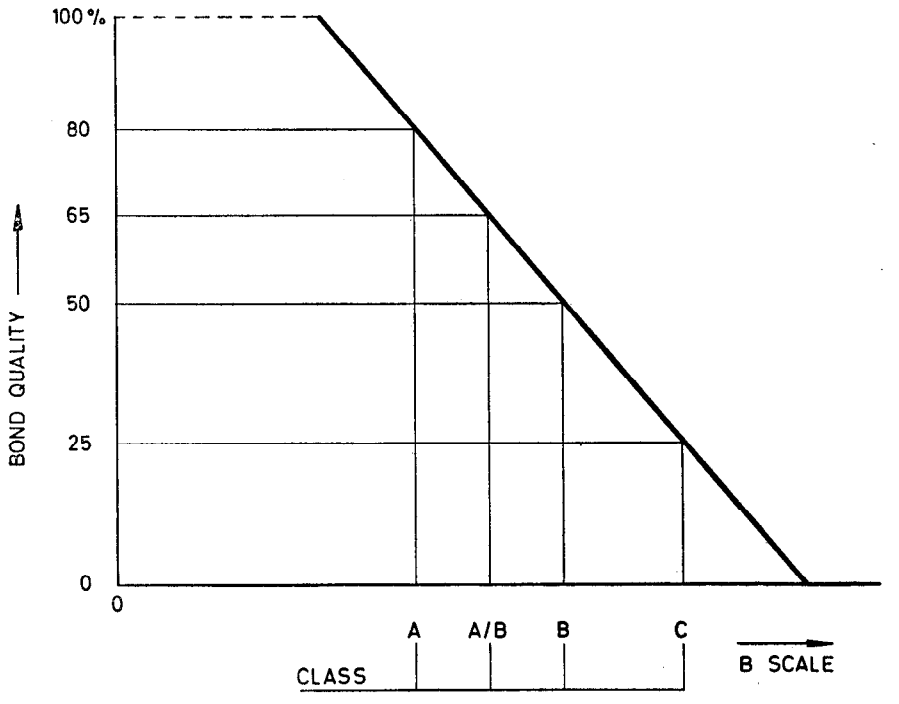


FIG. 8 QUALITY CONTROL CHART FOR USING FOKKER BOND TESTER

N-4. Test Results — To simplify the classification of bonding quality, acceptable limits for core sheet bond and the tolerance limit factors are categorized as below:

Classification	*Percentage of Quality*
Class A	better than 80
Class A/B	better than 65
Class B	better than 50
Class C	better than 25

While using the Fokker bond tester, the flatwise tensile strength value at which core failure occurs shall be taken to represent 100 percent bond quality.

N-4.1 *Tolerance Limit Factor* (K_A) — The tolerance limit factor for various sizes of samples is indicated below:

Size of sample	5	10	15	20	30	50	100
Tolerance limit factor, K_A	5·741	3·981	3·520	3·295	3·064	2·862	2·680

N-5. Honeycomb floor panels shall conform to Class A/B.

EXPLANATORY NOTE

In the preparation of this standard considerable assistance has been derived from the following:

ADE/PR(I)/80-40 Aircraft floor panels, March 1981

MIL-STD-401B Sandwich construction and core materials, General test methods

ASTM-C-363-57 Delamination strength of honeycomb type of materials

ASTM-C-365-57 Flatwise compressive strength of sandwich cores

ASTM-C-393-62 Flexure test of flat sandwich construction

Test schedule No. TS-06-02-07 issue — carbon fibre sandwich panels for aircraft flooring, 1972 (BCME Specification).

Fokker bond tests operation manual, issued by RNAF, Netherlands.

IS : 11649 (Part 1)-1986 of the specification covers the design criteria for honeycomb sandwich floor panels.

Specification for core and its method of test are covered separately.

Printed at Printrade, New Delhi, India