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TESTING AND ASSESSMENT OF 'CIVIK' SPIRAL STAIRCASE TO BS 5395: 'STAIRS, LADDERS AND WALKWAYS :PART 2: 'CODE OF PRACTICE FOR THE DESIGN OF HELICAL AND SPIRAL STAIRS':1984

REPORT NO. BP 2383/1/IC/98

Prepared for:

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For the attention of: Mr Enzo Fontanot

Date: 28 September 1998

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SUMMARY

A 1600mm diameter self assembly modular spiral staircase named 'Civik', manufactured by Albini and Fontanot and intended for private dwellings only, has been tested and assessed and found to comply with the relevant requirements of BS 5395:Part 2: for spiral stairs. The 1600mm diameter 'Civik' is the largest size of this particular range, with 1500mm and 1400mm diameters also available.

As the product is modular for all three sizes, many of the tests carried out on the1600mm would be repeated on the two smaller sizes. Therefore, only the individual components unique to the 1500mm and 1400mm diameters been assessed to the relevant requirements of BS 5395:Part 2.

The 1500mm components would comply with the standard. The 1400mm would comply, except that the minimum clear width produced during complete assembly would be approximately 585mm. The minimum requirement of the standard is 600mm.

Neither a complete 1500mm or 1400mm spiral stair has been structurally load tested to the recommendations of the standard. This load testing was carried out on the 1600mm sample, which as for the smaller sizes with their cantilever treads, would be subjected to the most onerous combinations of loading. The 1600mm complied with the deflection limits of the standard.

A landing baluster kit produced by Albini and Fontanot has also been tested. For single dwelling domestic use the kit complies with the standard when a reaction leg is positioned no more than every six balusters and of a height greater than half the height of the baluster.

The system is supplied with an anti slip self adhesive tape for the landing. This must be applied in accordance with the manufacturers instructions and no more than at intervals of 25mm.

The results of this test programme apply to the samples tested in the laboratory only and cannot accommodate assemblies by the general public.

1. INTRODUCTION

Building Investigation and Testing Services (Redhill) Ltd were requested by Mr Enzo Fontanot, of Albini and Fontanot S.p.A, to test and assess a self assembly modular metal fabricated spiral staircase named 'Civik,' to the recommendations of BS 5395: 'Stairs, ladders and walkways: Part 2: 'Code of practice for the design of helical and spiral stairs'. We understand from the manufacturer that this staircase is intended for private domestic use, which is a Category A stair in accordance with the standard.

This work was carried out in July 1998 and was authorised by Albini and Fontanot fax dated 1/7/98. Our confirmation form also of 1/7/98 refers.

Photo 1. 1600mm stair kit

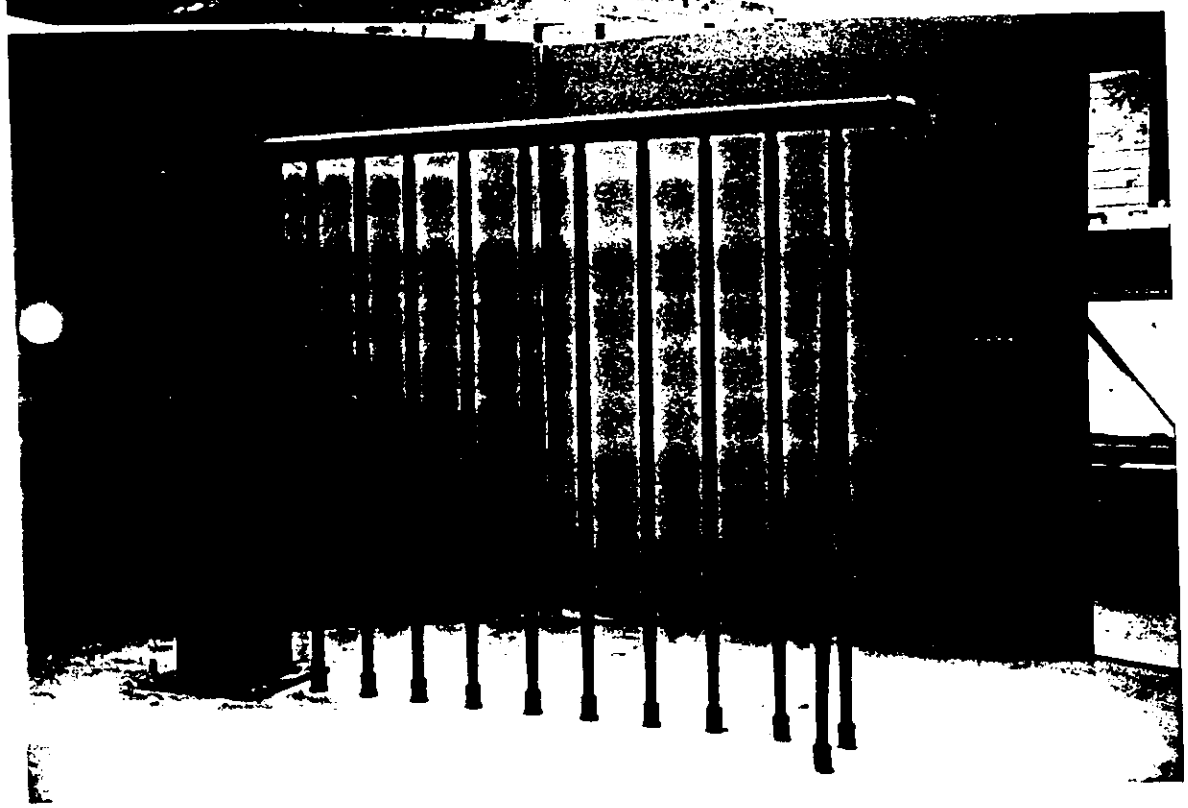


Photo 2. Landing baluster kit

2. SAMPLE SUBMITTED

A crated sample was received on 26/6/98. This consisted of a 1600mm diameter stair kit, an assembly video and assembly instructions (see appendix 1 for details). In addition a landing baluster kit was also supplied.

The stair kit supplied is one of three sizes that Albini and Fontanot produce. In addition to the 1600mm diameter there is also a 1500mm and 1400mm diameter stair kit. We were informed by Albini and Fontanot that all three kits are constructed identically the same, as the system is modular. The only difference is in the width of the treads and the landing size. For this project we were requested to test and assess one size of kit and to comment on the conformance of the 1500mm and 1400mm kits to the recommendations of BS 5395.

❖B.I.T.S❖ therefore selected the largest 1600mm diameter kit for testing, as this size would be subject to the most onerous test regime, i.e loading and deflections. For the 1500mm and 1400mm sizes of kit the components which varied from the 1600mm kit were selected for assessment. This included the receipt of a landing and a stair from each of the 1500mm and 1400mm kits.

3. TEST PROCEDURE

The stair kit was erected by Albini and Fontnot personnel in July 1998. The landing of the sample was secured to a timber shelf supplied by ❖B.I.T.S❖, (See photo 1), which was used to simulate an installation landing.The landing baluster kit was also installed by Albini and Fontanot). One end of this sample was fixed by ❖B.I.T.S❖to an upstand, to simulate the secure fixing to a wall, using the recommended manufacturers fittings (see photo 2). In practice both these kits would be connected to form a complete installation. However, as the laboratory is not built to a typical dwelling height these were installed separately.

The following programme was then carried out on these and the individual components supplied, to the recommendations of BS 5395: 'Stairs, ladders and walkways: Part 2: 'Code of practice for the design of helical and spiral stairs,' as is required in the Building Regulations for England and Wales;

a) 1600mm stair kit

Clause 5. Design

5.2) Relationship between rise and going	Calculation
5.3) Rise	Measurement
5.4) Going	Measurement
5.5) Clear headroom	Measurement
5.6) Clear width	Measurement
5.7) Landings	Measurement
5.8) Guarding of stairs and landings	Testing to BS 6180 100mm gap assessment Slip resistance testing
5.9) Passage of large objects	Observation only
5.10) Deflection	Review of results from 5.8) to relevant British material specifications.
5.11) Accuracy	Measurement and assessment to BS 5606
5.12) Nosings	Measurement

Clause 6. Fire

Assessment to BS 5395 and the Building Regulations for this Category A staircase.

Appendix A

1) Uniformly distributed load to each tread.	Measure deflections.
2) Load lower 180° segment of stairs.	Measure deflections.
3) Double load application to centre tread only	Measure deflections.
4) Load each tread with two 91kg loads.	Measure deflections.

BS 5395:Part 1.

In addition to the requirements of BS 5395:Part 2, the stairs have to satisfy the recommendations of the following (where applicable):

Clause 11.2 Accuracy	Measurement and assessment to BS 5606
Clause 12 Safety	Assessment to Building Regulations
	Accident potential
	Safety measures
	Treads and goings
	Steps
	Guarding
	Windows and doors
	Surface finish
Clause 14 Acoustics	Comment only
Clause 15 Lighting	Comment only
Clause 16 Durability	General assessment

b) Landing baluster kit

To be tested to BS 6180 'Code of practice for Barriers in and about buildings':1995, in accordance with BS 5395 and the Building Regulations.

c) 1500mm and 1400mm stair kits

Clause 5. Design

5.6) Clear width	Measurement
5.7) Landings	Measurement
5.11) Accuracy	Measurement and assessment to BS 5606

The above work was carried out at the ❖B.I.T.S❖laboratories, except for the fire assessment and the slip resistance testing which was carried out independently by Roger Perryman Ltd and SGS UK Ltd respectively.

For the loading tests to Appendix A, we understand from the manufacturer that the 1600mm diameter stairs would have two wall brackets securing the balusters of the stairs to the surrounding wall structure. These would be positioned at approximately a third of the way up the stair and a third of the way from the top of the stair. These brackets are used to reduce oscillation of the stair and provide support for the cantilever treads. We understand from the manufacturer that for the 1500mm and 1400mm stairs, only a single wall bracket is used at the mid point of the stairs at midheight of a baluster. It was agreed with Mr Giangolini of Albini and Fontanot that this same single bracket installation would be used for the 1600mm to a) simulate this a worst case installation and b) use the results to cover the installation method for the two smaller diameters, which in theory should deflect less with their shorter cantilever treads. For this wall bracket ❖B.I.T.S❖ provided a steel upstand to simulate a wall and to facilitate fixture.

4. RESULTS

BS 5395 requirement	Result	Comment
Clause 5 Design Clause 5.1 General. Except where shown in 5.2 to 5.12 in BS 5395: Part 2, the recommendations for straight stairs in clauses 11.2,12,14,15 and 16 of BS 5395:Part 1, shall be followed.		
BS 5395:Part 1 11.2.3 Accuracy BS 5606 lists the permissible deviations that may be expected to occur in practice.	See later section page 15	See later section
12. Safety 12.3 Safety measures The going for every tread has to remain constant. The tread has to be horizontal and should be firmly fixed and have a nosing that does not become slippery when in use.	System is modular and constant for each tread. The treads are horizontal and adhered firmly to the metal of the steps. The nosing was tested and confirmed to be suitable.	Satisfactory
There shall be not fewer than three and not more than 16 risers in any one flight.	12 risers	Complies
Where a stair has open rises, the nosing of the tread of any step or landing has to overlap, on plan, the back edge of the step below by not less than 16mm.	Minimum overlap = 85mm	Complies
In stairs having open rises or part rises and use regularly by children, no opening between adjacent treads should be large enough to permit a sphere of 100mm diameter to pass through it.	The system uses a horizontal riser barrier in the open gap forming the riser. The resulting gaps were measured between 89mm and 93mm. A 100mm sphere could not pass through the gaps.	Complies

BS 5395 requirement	Result	Comment
Guarding of stairs and landings. Guarding can take the form of a securely fixed balustrade or railing or a wall and should extend vertically above the pitch line for a height of not less than 840mm in stairs within a single dwelling and not less than 900mm in other cases.	Both the stair landing and the landing baluster kit were measured at a finished height of 1010mm.	Complies
In buildings which are likely to be frequented by small children, gaps in the stair or landing balustrade should not be such as to permit the passage of a sphere of 100mm diameter and balustrades should not provide a toe hold that would enable a small child to climb them.	Gaps between balusters were measured at 93mm to 96mm. A 100mm diameter sphere could not pass between the balusters. There were no horizontal elements that could provide a toe hold for small children.	Complies Complies
It is recommended that every flight of stairs having an aggregate rise of more than 600mm should have a continuous handrail fixed securely at a height of not less than 840mm or more than 1000mm, measured vertically above the pitch line.	Continuous handrail of stair climb measured at 970mm, from pitch line through nosing of treads.	Complies
The handrail section which provides the most comfortable grip is circular and between 45mm and 50mm in diameter.	Handrail section measured at 43mm in diameter.	43mm is just under what is deemed to be the most comfortable grip. Satisfactory.
What ever the shape, the handrail section should be capable of being readily gripped by the hand and sharp arrises should be avoided.	Handrail made of grippable polyurethane. No sharp arrises.	Complies
Stairs and landings should be usable at all times without risk of tripping or slipping. A minimum coefficient of friction of 0.4 between the finishes of steps or landings and the sole of the shoe is required if slipping is to be avoided. Unless the surface is rough, many surfaces that have a good slip resistance when dry will tend to become slippery and unsafe when wet.	Steps - Plastic preformed treads Greater than 0.4 dry. Nosing achieves minimum of 0.4 when wet. Landing - self adhesive tape Greater than 0.4 wet. For full details see independent reports in Appendix 2.	Complies Complies. Tape must be applied as per manufacturers instructions to comply.(See appendix 1)

BS 5395 requirement	Result	Comment
Clause 14. Acoustics Stairs of lightweight construction will give rise to more noise under foot than stairs of heavy construction. Open treads of stiff construction tend to resonate disturbingly. Care should be taken in the design and construction of stairs so that they do not vibrate and thus cause excessive noise.	With the application of the plastic anti slip treads the noise from foot traffic is noticeably reduced. The erection in a dwelling situation will probably reduce any noise further with the prescence of internal walls and soft furnishings. No excessive noise caused by stair deflection.	Satisfactory.
Clause 15. Lighting Windows and artificial lights should be situated so that they light towards the stairs with the light directed roughly at right angles to the pitch line.	Will depend upon each installation. It is assumed that the installer will have common sense to ensure there is sufficient light to enable safe passage using the stairs.	Dictated by end user
Clause 16. Durability Stairs are expected to withstand a considerable amount of wear and tear and often abuse. The materials should be sufficiently resistant to deterioration and wear, having regard to the conditions to which they will be subjected and the intended life of the building and the stair.	Materials and construction of the system appears to be well made and likely therefore to satisfy the requirement of the standard.	Satisfactory

BS 5395 requirement	Result	Comment
Clause 5.2 Relation between rise and going The rise and going should be determined using values for (2r +g). Where r = rise and g = going From table 2 of the standard a Category A stair should have a minimum value of 480mm and a maximum value of 800mm.(For the 1600mm diameter sample this could be calculated from measurements. For the 1500mm and 1400mm diameters one step only was received. As the system is modular a second step was made from cardboard using the relevant steps as templates. The steps were then positioned over each other as would occur and measurements made of the goings.)	1600mm The riser and goings measured provide values between the limits. 1500mm and 1400mm The risers would be as for the 1600mm. The goings measured plus the riser would provide values between the limits	Complies Complies
Clause 5.3 Rise Recommended rises for this Category of stair is 170mm to 220mm. Maximum number of risers = 16	1600mm Measured at 210mm on sample installed. 1500mm and 1400mm Modular system, would be the same as for the 1600mm 12 risers	Complies Complies Complies

BS 5395 requirement	Result	Comment
Clause 5.4 Going From table 2 of the standard. Minimum inner going = 120mm Minimum centre going = 145mm Maximum outer going = 350mm	1600mm Inner going = 148mm Centre going = 178mm Outer going = 209mm 1500mm Inner going = 156mm Centre going = 175mm Outer going = 199mm 1400mm Inner going = 145mm Centre going = 152mm Outer going = 164mm	All three going measurements comply. All three going measurements comply. All three going measurements comply.
Clause 5.5 Clear headroom The clear headroom should not be less than 2000mm.	1600mm Clear headroom between landing and floor = 2485mm 1500mm and 1400mm System is modular, the same value should apply to both these sizes also.	Complies Complies
Clause 5.6 Clear width From table 2 of the standard. Minimum clear width = 600mm	1600mm Measured at 675mm minimum 1500 and 1400mm Measured using samples received with components of test sample. 1500mm = 633mm 1400mm = 585mm	Complies Complies Non compliance
Clause 5.7 Landings Landings at storey levels should subtend an angle of not less than 60° at the geometric centre on plan.	All three sizes measured at 60°	Complies

Photo 3. Baluster being tested at mid height

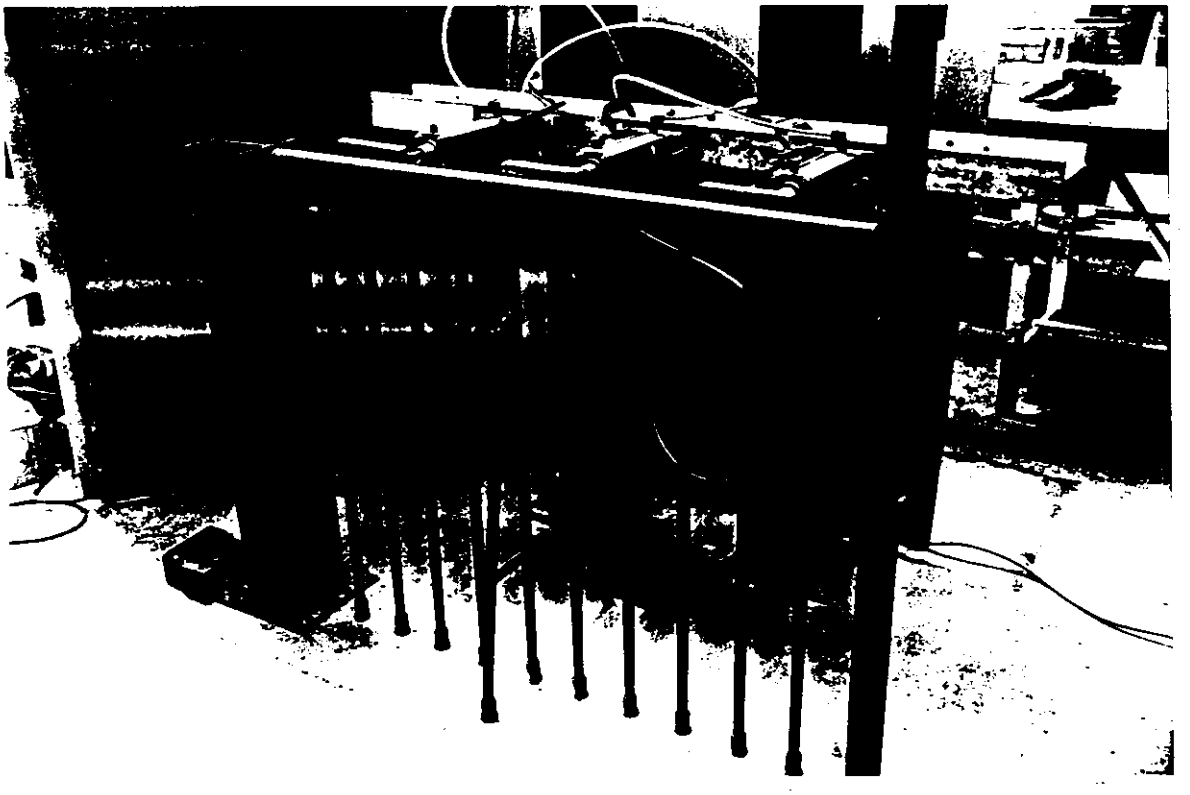


Photo 4. Landing baluster kit sample set up.
(Note reaction leg in middle of sample length.
During test free end of rail at right was restrained)

BS 5395 requirement	Result	Comment
Clause 5.8 Guarding of stairs and landings		
Protection against falling should follow the recommendations of 12.3 of BS 5395: Part 1.	(See in this report page 7)	Complies
For safety reasons any gap between the end of a tread and the centre of the column of a stair should never exceed 100mm.	Not applicable for this design. End of added plastic tread to column = 75mm.	Complies
In areas frequented by children, the widest gap in a balustrade should not permit a sphere of 100mm diameter to pass through.	Maximum gap measured = 96mm. Sphere could not pass through any openings.	Complies
Balustrades and handrails should follow the recommendations of BS 6180.		
BS 6180		
Clause 6.3 Loading		
Building use categories and barrier loads from annex A; Category 1A = Single family dwelling (house, maisonette, etc). a) UDL = 0.36 kN/m length of handrail b) Concentrated load = 0.25 kN	Appendix 3 gives full details of these results. The results of this testing are summarised below.	
6.3.4 Infill panels and balusters		
Each baluster should be designed to resist half the concentrated load in annex A, when applied at mid height.	Loading = 0.25/2 = 0.125kN Deflections Stair baluster = 2.70mm Baluster kit = 4.51mm (free one end). (see photo 3)	Complies. No damage. Maximum deflection allowed 25mm

BS 5395 requirement	Result	Comment
6.4 Deflection A barrier for the protection of people that is structurally safe should not possess sufficient flexibility to alarm the building users when subjected to normal use.	There is some flexibility in the system. Not unduly sufficient to cause alarm	Complies
The horizontal displacement of any part of the barrier should not exceed 25mm.	Baluster kit handrail (see photo 4 of set up) Maximum deflection = 12.23mm	Complies
	Stair handrail Maximum deflection = 24.06mm	Complies
	Landing rigid handrail Maximum deflection = 20.49mm	Complies
6.6 Safety details The finished barrier shall have no sharp edges or projections that may cause injury to persons or damage to clothing.	No sharp edges.	Complies
Infill panels and balusters are intended to provide support and protection to the user and should be designed to restrain people without causing additional injury from sharp edges, thin sections, projecting details, etc	No sharp edges.	Complies
Clause 5.9 Passage of large objects Designers should consider whether the minimum clear width of 600mm and a headroom of 2000mm are sufficient for large objects such as furniture, coffins, etc	Purely a design consideration	No comment

BS 5395 requirement	Result	Comment
Clause 5.10 Deflection Helical and spiral stairs should be designed to be rigid enough to give confidence to the user, since they can be subject to oscillations. Stairs should be designed to limit deflections under working conditions to the maximum values given in the appropriate standard.	For this sample the relevant standard would be BS 5950 for steel work in buildings. Assuming that each individual tread and landing acts as a cantilever then the standard recommends a deflection limit, with an unfactored load , of length /180	To assess the stairs Appendix A of the standard provides recommended loading tests for assessment. The results of this testing are given later in this report
Clause 5.11 Accuracy The maximum permissible deviation for any size should not exceed the appropriate value of table 2 of BS 5606.	A selection of components were selected for measurement. The results of these measurements were compared with the manufacturers drawings. The relevant dimensions assessed were the length of the steel components and the location of holes within the component. All dimensions measured were within the tolerance and accuracy requirements of BS 5606.	Complies
Consistency of rise and going are of prime importance for user confidence and safety	Sample uses a modular system which automatically provides consistency.	Complies
Clause 5.12 Nosings Nosings should be horizontal and straight between the pitch lines corresponding to the inner and outer goings.	Measured as virtually horizontal. The nosings were straight between goings.	Complies

BS 5395 requirement	Result	Comment
Clause 6 Fire protection and means of escape Stairs in most buildings form the main escape vertical escape routes and are often in the first protected areas reached by people escaping in fire. The recommendations for planning, construction and protection of escape routes to prevent rapid spread of fire are given in BS 5588:Part 1. In addition the requirements of the most current Building Regulations have been referred to.	With the small private stair category classification, it is intended that the stair is not the main fire escape for a small number of people. It has been concluded that the Civik stair complies with the recommendations of BS 5395. See Appendix 4 for full independent assessment report.	Although there is no requirement in the Building Regulations, it has been recommended that the landing is tested for surface spread of flame. This is because it may be considered that when erected the landing forms a type of ceiling, which has a requirement.

Photo 5. Stair loaded with 4kN/m².
Note manufacturers single wall bracket fixed to metal upstand to simulate actual installation details
(testing witnessed by Mr C.Giangolini of Albini and Fontanot)

BS 5395 requirement	Result	Comment
Appendix A The following procedure may be used to test helical and spiral stairs.	See Appendix 5 indicating dial gauge positions and detailed test results.	Allowable deflection see note 1 = 3.86mm
a) Apply a uniformly distributed load of 3 kN/m² to 5kN/m²* to each tread. Check deflections and displacements. *This range of udl is taken from BS 6399:Part 1 and should be chosen to suit the stair category and the intended function of the stair. From BS 6399 this has been taken as 4kN/m² for 'stairs and landings in all other buildings'.	Deflection of landing 3.82mm Deflection of 7th tread 1.96mm Deflection of 4th tread 1.64mm (Deflections after 5 minutes at full load)	Complies
b) Remove the load from all treads forming the lower 180° segment of the stair. Check deflections and displacements.	Deflection of landing 1.64mm Deflection of 7th tread 1.55mm Deflection of 4th tread 1.35mm	Complies
c) Remove the load from all remaining treads except one tread at mid height. Increase load on this tread to double the previous load. Check deflections and displacements.	Deflection of landing 0.35mm Deflection of 7th tread 2.01mm (at centre of tread) Deflection of 4th tread 0.28mm	Complies
d) Check individual treads by placing on them two loads of 0.9kN spaced 300mm apart and placed symmetrically about the centre line of the tread.	A number of treads were selected and loaded. The maximum deflection noted was 5.0mm. There was no visible signs of any failure of distress.	Complies

Note 1

From clause 5.10 of BS 5395: Part 2 and detailed earlier in this report, the maximum allowable deflection for a cantilever structure is length/180, which for the landing and treads of the 1600mm diameter stair is 695/180 = 3.86mm. (This distance was measured between the centre column and the centre line of the stair balusters).

Note 2
The deflections in the table have been adjusted to allow for any slight movement at the column, so the cantilever deflection is given only.

5. DISCUSSION

The complete testing and assessment of the 1600mm diameter spiral stairs has shown that the system would satisfy the requirements of BS 5395. For general public installation the following should be noted and applied;

a) At least one wall to stair baluster bracket should be used at approximately the centre height of the stair for increasing rigidity.
b) The kit comes with plastic preformed treads for slip resistance. For the landing the anti slip self adhesive tape should be applied at 25mm intervals as shown in the manufacturers literature.
c) For the landing baluster kit a reaction leg should be fitted no more than every 6 balusters. The height of this leg to be greater than half way up the baluster its fitted to.

The same items noted would also apply to the 1500mm and 1400mm diameter stairs.

6. CONCLUSION

A 1600mm diameter self assembly modular spiral staircase named 'Civik' has been tested and assessed and found to comply with the requirements of BS 5395, for use in private dwellings.

Components of two smaller sizes, namely the 1500mm and 1400mm diameter staircases, unique to these stairs have been assessed to BS 5395 and in our opinion comply with the standard with one exception. The minimum clear width of the 1400mm diameter would be 585mm. The recommended minimum clear width of BS 5395 is 600mm.

The results of this test programme apply to the samples as tested. For assembly by the general public the following should be applied;

a) At least 1 wall to stair baluster bracket should be used at approx. centre height for increasing rigidity.
b) The kit comes with plastic preformed treads for slip resistance. For the landing the anti slip self adhesive tape should be applied at 25mm intervals as shown in the manufacturers literature.
c) With the installation of any landing baluster kit a reaction leg should be fitted no more than every 6 balusters. The height of this leg to be greater than half way up the baluster fitted to.

The same items noted would also apply to the 1500mm and 1400mm diameter stairs.

REPORTED AND AUTHORISED BY .....

I COLLINS
Building Consultant

CHECKED AND APPROVED BY .....R. Fryer.....

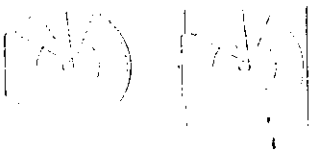
R FRYER
Building Consultant

APPENDIX 1

Manufacturers Literature

Manufacturers assembly instructions

NUMÉRO HAUTEURS DE MARCHE NUMBER OF THE RISERS AANTAL OPTREDEN ANZAHL STUFENHÖHEN	HAUTEUR ESCALIER cm STAIR HEIGHT cm TRAPHOOGTE cm TREPPENHÖHE cm
10	210 – 235
11	231 – 258
12	252 – 282
13	273 – 305
14	294 – 329
15	315 – 352
16	336 – 376



CIVIK

PALIER UNIVERSEL

Le CIVIK est adaptable à une trémie circulaire ou quadrilatère:

modèle avec un diamètre 120: adaptable jusqu'à 133 cms de trémie

modèle avec un diamètre 140: adaptable jusqu'à 153 cms de trémie

modèle avec un diamètre 160: adaptable jusqu'à 173 cms de trémie

HAUTEUR VARIABLE

Les entretoises noires mises entre les marches, permettent les variations de la hauteur indiquées dans le tableau.

SENS DE ROTATION

Le CIVIK peut être monté indifféremment soit en sens horaire soit en sens antihoraire.

MARCHES

en acier traitées avec des resines polyestères noires (RAL 9017).

COLONNETTES

en acier traitées avec des resines polyestères noires (RAL 9017).

MAIN COURANTE

noyau flexible métallique revêté de polyuréthane intégral noir. Elle peut prendre n'importe quel type de courbure.

KIT BALUSTRADE

(garde-corps horizontal) Disponible sur demande, le kit balustrade est vendu par longueur de 120 cms.

SUR DEMANDE, LA PLASTIFICATION DES PARTIES MÉTALLIQUES PEUT ÉTRE GRIS PERLE (RAL 9006) OU BLANCHE (RAL 9010).

UNIVERSAL LANDING

CIVIK is adaptable to round or squared ceiling openings with this measure:

model with a diameter of 120 cm is adaptable until 133 cm of opening

model with a diameter of 140 cm is adaptable until 153 cm of opening

model with a diameter of 160 cm is adaptable until 173 cm of opening

ADJUSTABLE RISER

The black distancial rings put between the treads permit the height variation indicated in the table.

WINDING DIRECTION

CIVIK may be assembled indifferently in clockwise or anti-clockwise direction.

TREADS

made of stamped steel, worked through black (RAL 9017) polyester resins.

UPRIGHTS

made of steel, worked through black (RAL 9017) polyester resins.

HANDRAIL

flexibel metal core coated by black integral polyurethane: it can take any type of curvature.

KIT BALUSTRADE

A kit balustrade of 120 cm is available.

ON REQUIRY, THE PLASTIFICATION OF THE METAL PARTS MAY BE PEARL GREY (RAL 9006) OR WHITE (RAL 9010).

UNIVERSELE OVERLOOP

CIVIK kan worden geinstalleerd in ronde of vierkante openingen met de volgende afmetingen:

het model met de diameter 120 cm kan worden aangepast aan een opening met een diameter van max. 133 cm

het model met de diameter 140 cm kan worden aangepast aan een opening met een diameter van max. 153 cm

het model met de diameter 160 cm kan worden aangepast aan een opening met een diameter van max. 173 cm

REGELBARE OPTREDE

Dankzij de zwarte afstandsstukken die tussen de treden worden aangebracht, kunnen de optreden varieren zoals uit de tabel kan worden afgeleid.

DRAAIRICHTING

CIVIK kan zowel met de wijzers van de klok mee als ertegenin worden gemonteerd.

TREDEN

gemaakt van geperst staal, behandeld met zwartkleurige (RAL 9017) polyesterhars

SPIJLEN

van staal, behandeld met zwartkleurige (RAL9017) polyesterhars.

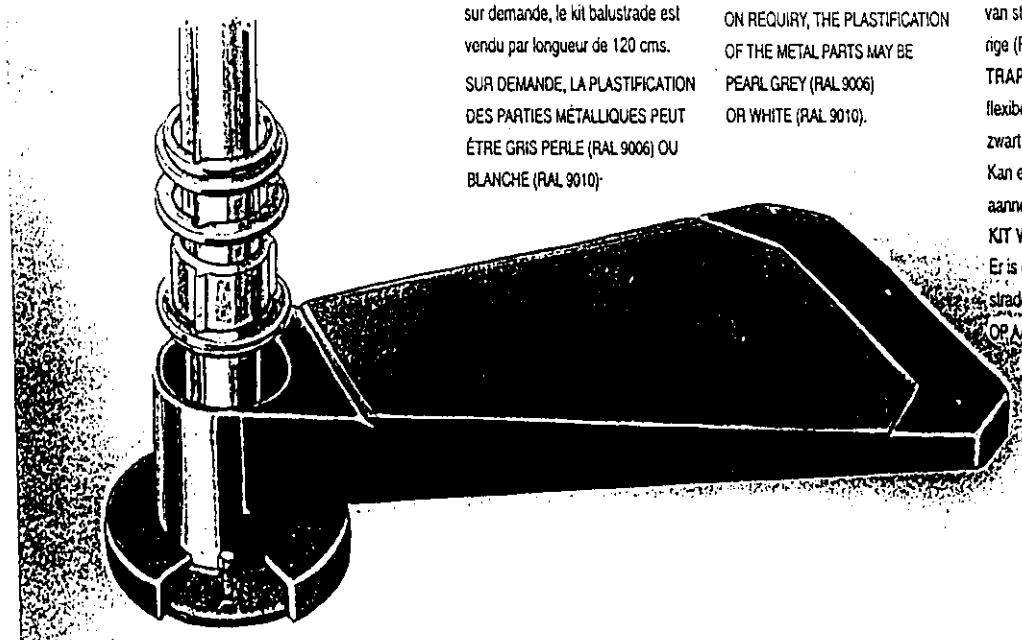
TRAPLEUNING

flexibele metalen kern, bekleed met zwart integraal polyurethaan. Kan elke willekeurige soort buiging aannemen.

KIT VOOR BALUSTRADE

Er is een kit leverbaar voor een balustrade van 120 cm.

OP AANVRAAG KUNNEN DE METALEN DELEN IN DE KLEUR PAREL GRYS (RAL 9006) OF WIT (RAL9010) WORDEN GEPLASTIFICEERD.



CIVIK

(I) ISTRUZIONI DI MONTAGGIO

(F) INSTRUCTIONS DE MONTAGE

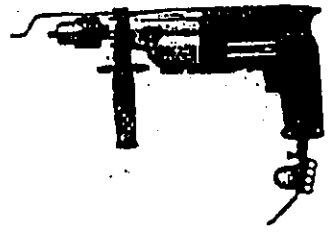
(GB) MONTAGEANLEITUNG

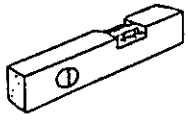
(D) ASSEMBLY INSTRUCTIONS

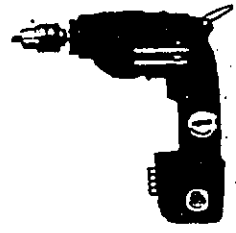
(E) INSTRUCCIONES PARA EL ENSAMBLAJE

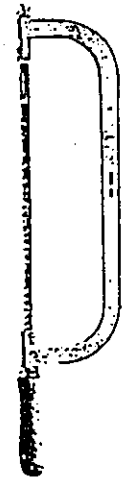
COD.4015/02

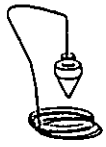
OUTILS



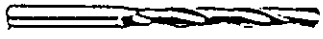




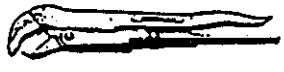


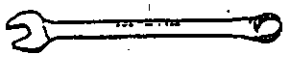


Ø 8x120 12x150 14x150



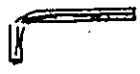
Ø 9 2.5





13 17 19 30

10 13 17



3 5 12

6

PRELIMINARY OPERATIONS

After having unpacked all the components of the stair, before starting the assembling, the following preliminary operations have to be observed:

1) Screw the dowels B02 in the bushings of the steps L02.
2) Prepare the distancial elements D14 + D03 + D02 and D04 + D03 + D02 (see "DETERMINATION OF THE DISTANCIAL ELEMENTS").
3) Assemble the articles B65-B66-B67 to the column C03 (DIS.14).
4) Assemble the articles B72 - B73 - B74 and B78 to the landing E03 WITHOUT TIGHTENING.
5) Assemble the footplate (B17 - G03 - B46).

ASSEMBLING

6) Drill with bit Ø 14 and, after having located it, fasten the plate G03 to the floor with the screws B13.
7) Screw the tube G02 in the bushing B46.
   After having assembled some steps, complete the assembling of the storey-post (articles B47 - G02 - B46 - G01).
8) Insert in the following order the plate-cover D05, the distance spacer (D14 + D03 + D02), the step L02, the distance spacer (D04 + D03 + D02), the step L02 and so on until the last step.
   We recommend positioning the steps alternatively to the right and to the left, as to keep the balance of the stair.
   Use the articles D01 inside the article D04 when the step L02 happens to be in correspondence with the bar G01.

FIXING OF THE LANDING

9) Assemble the landing E03 last, insert the articles B05 and B04, tighten the nut B03 in a way that still permits the rotation of the steps.
   The edges A and B of the landing must skim the floor (DRAWING 04).
10) Screw the nut B71 in the tension bar B74 thoroughly.
    Insert the stirrup B76 and then screw the other nut B71 for some threads.
11) Move the stirrup B76, which leans on the lower nut B71, until the floor.
    Drill with bit Ø 14 in correspondence with the most suitable hole of the stirrup B76.
    Insert the screw B58 and tighten hard the stirrup B76.
12) Screw the lower nut B71 until the points A - B and C (DRAWING 04) touch the floor.
13) Screw tight the upper jam nut B71 on the stirrup B76.
14) Screw tight the bolt B73.

ASSEMBLING OF THE RAILING

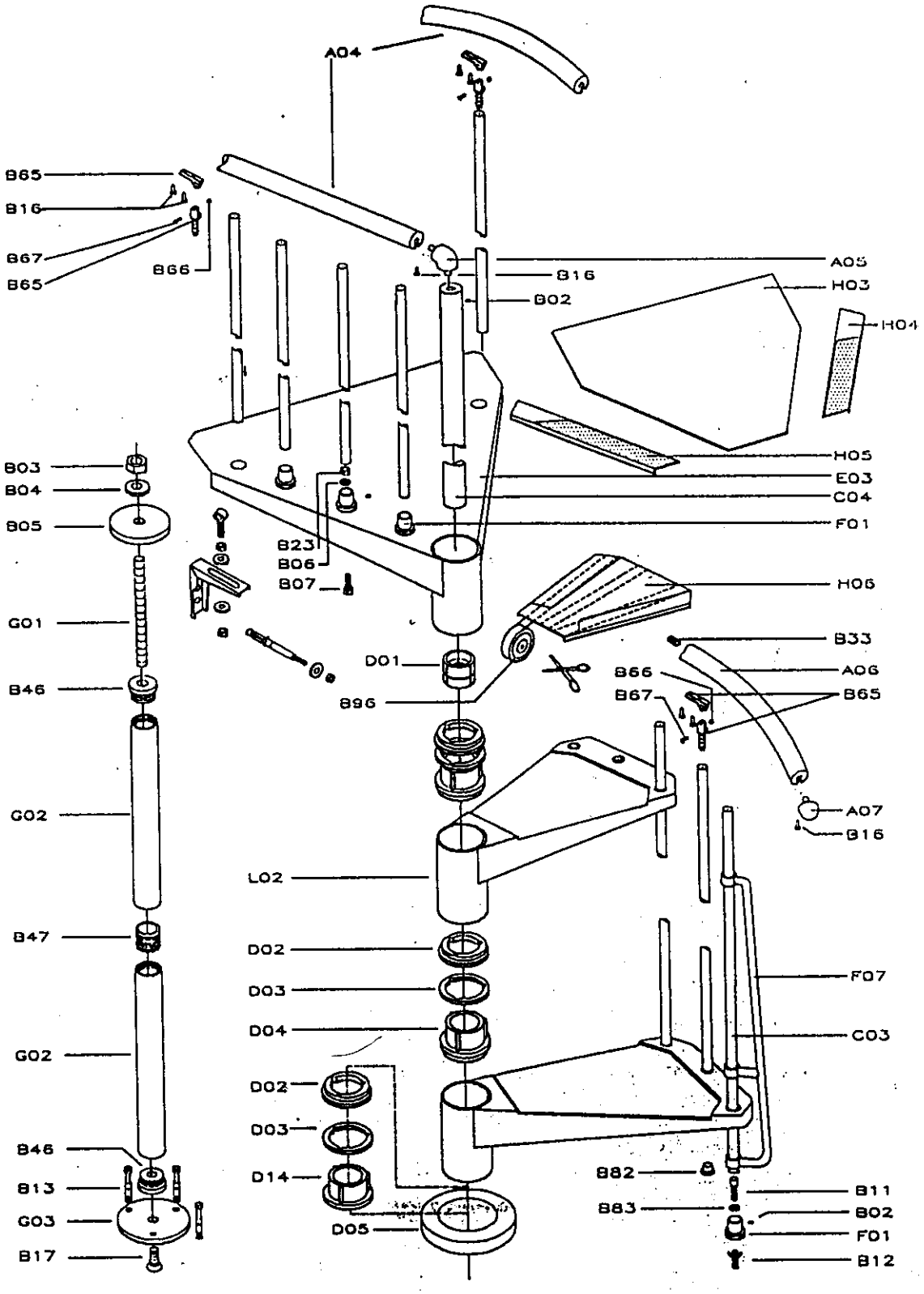
The assembling of the railing qualifies the good result of the assembling of the stair, and at the same time represents the most delicate part of the work.
The result will be satisfying if the railing posts result to be all perfectly vertical and the handrail well modelled and without humps.

15) Open the treads fan-wise as to be able to use the stair to reach the landing.
16) Beginning from the landing, insert the LONG POLES connecting all the steps one to the other.
Orient the article B65 positioning the drilled side upwards(DIS.14).
Tighten only the dowels B02 of the lower steps.
17) Check the verticality of the long poles and tighten hard and definitively the nut B03.
Screw definitively the dowels B02 of the upper steps.
18) Bed the article F01 drilling with bit Ø 8 and using the articles B12 - B83 and B11 in correspondence with the first pole.
Position the first pole inserting the reinforcing element F07.
Make the height of the first pole adequate cutting the edge of a long pole.
19) Single out the segment of the handrail characterized by the letter R (this handrail will be utilized on the landing) from the others characterized by the letter M.
20) Model the handrail (with the letter M) trying to bend it in such a way as to make it as similar as possible to the final curvature.
Start screwing the handrail at the first pole up on the landing, using the screws B16, the electrical screwer and the article B84.
Go on downwards with the fixing to the poles, giving the handrail the second curvature twisting it until it is in correspondence with the article B50.
21) Link the second segment of the handrail to the first one twisting it and glueing it with help of the article B33 and the furnished cyano-acrylic glue.
22) Insert all the other poles in the treads and fix them to the handrail, paying close attention to their verticality. In case of staircases with a diameter of 140 or more, it is advisable to assemble the shorter poles first.
23) Having reached the first step, cut the handrail with an iron saw and plug it with the cap A07, which has to be glued and screwed with a B16 screw.

ASSEMBLING OF THE BALUSTRADE ON THE LANDING

24) Drill the landing E03 with bit Ø 9, as indicated in DRAWING 11, assemble then the articles F01 using B07 - B06 and B23.
25) Drill with bit Ø 12 trying to mantain the equidistance fixed by the preceding articles F01 on the landing (see DRAWING 10) assembling the articles F01 - B07 - B06 and B23 on the landing and F01 - B87 on the floor.
26) The handrail of the balustrade has to be assembled using the articles A05 - A07 - F09 - F02, as indicated in DRAWINGS 09 and 12 which represent the various possible cases. The articles A07 and A05, in addition to being glued to the handrail, have to be attached with the screw B16 (DRAWING 13).
27) Curvature 1 of DRAWING 07 has to be made in the most gradual way.

12


A04
B65
B16
B67
B65
B66
A05
B16
B02
H03
H04
H05
E03
C04
F01
B03
B04
B05
G01
B46
G02
B47
G02
B46
B13
G03
B17
B23
B06
B07
H06
B33
D01
B96
B66
B67
A06
B65
A07
B16
L02
D02
D03
D04
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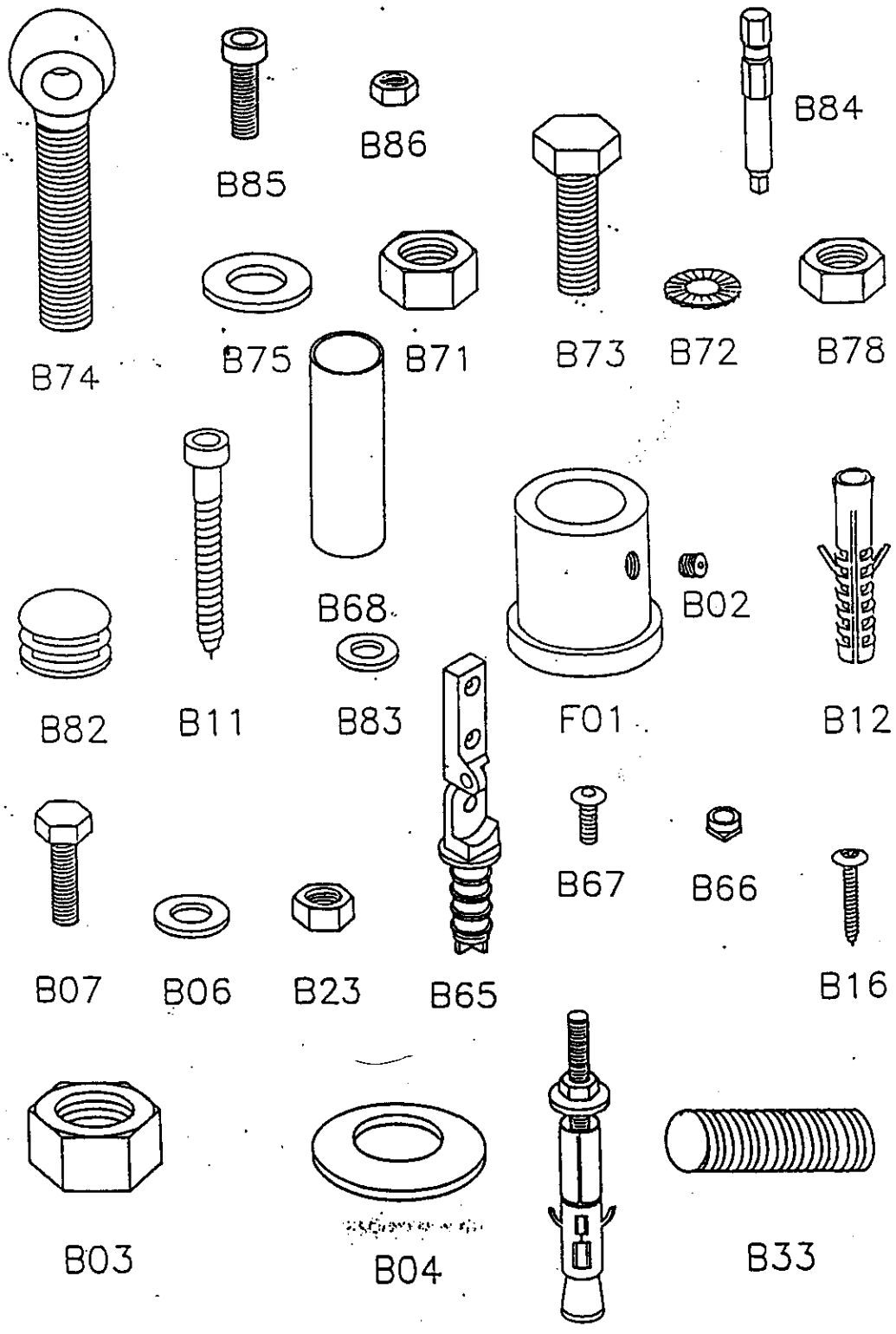
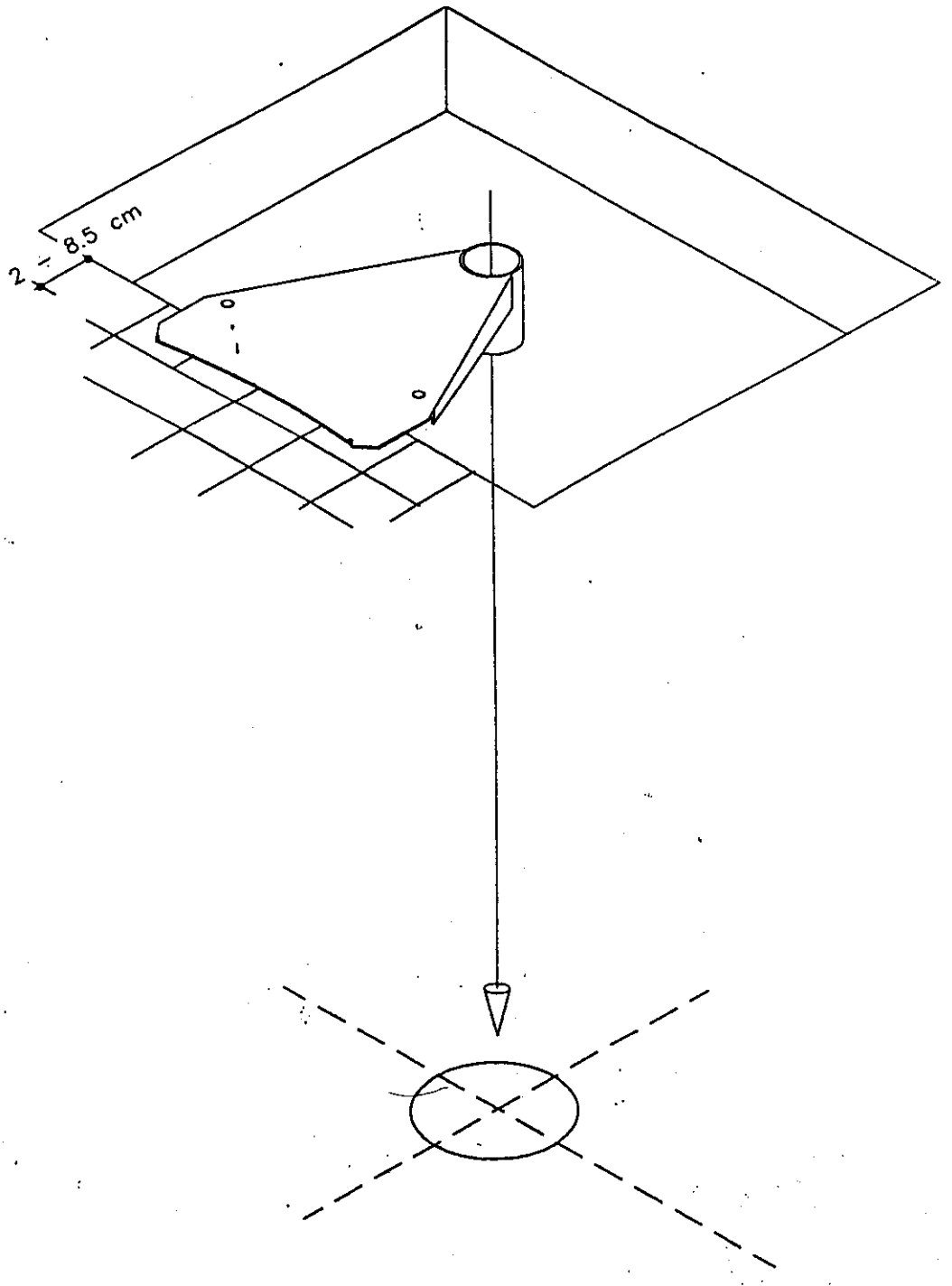
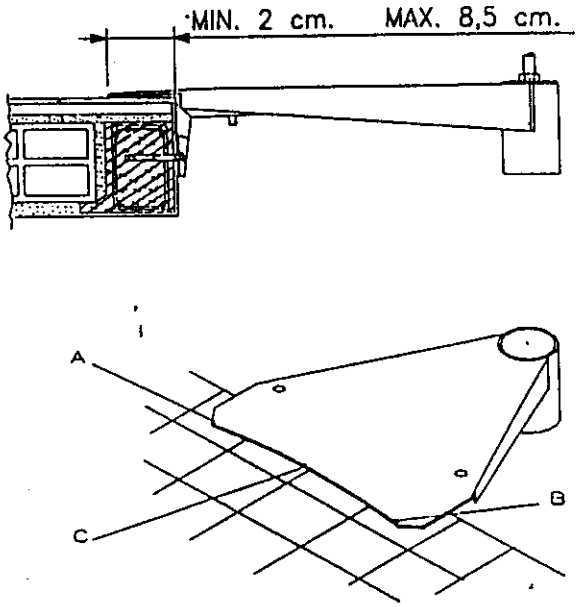
D03
D14
D05
F07
C03
B82
B83
B11
B02
F01
B12


B74
B85
B86
B84
B75
B71
B73
B72
B78
B68
B82
B11
B83
F01
B02
B12
B07
B06
B23
B65
B67
B66
B16
B03
B04
B33

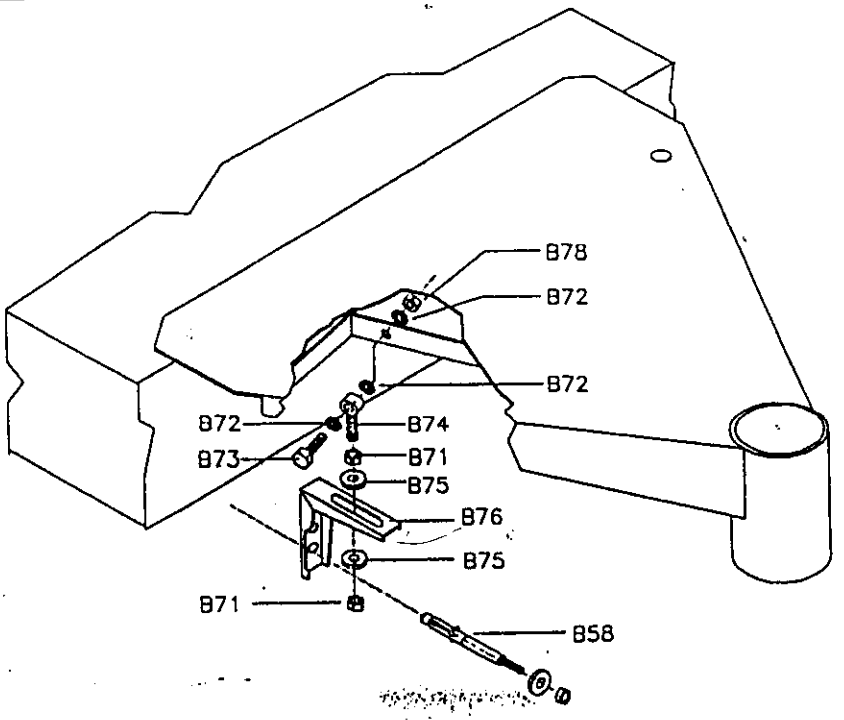
74



15

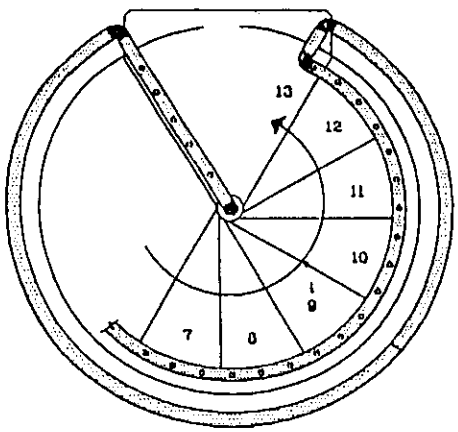


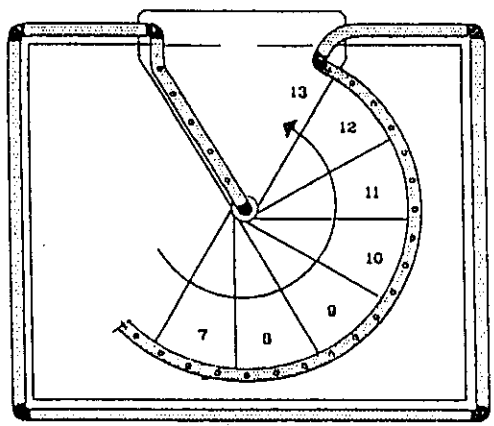
DIS.04



DIS.05

16


13
12
11
10
9
7
8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12
11
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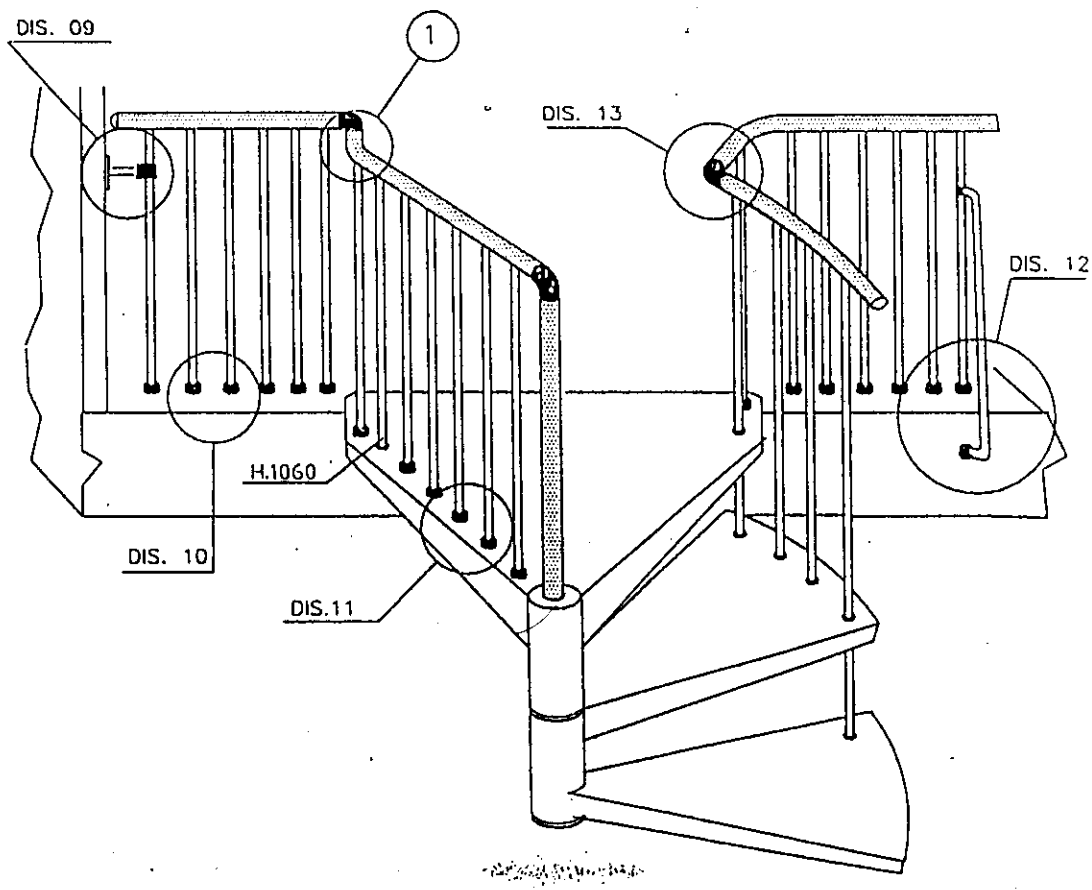
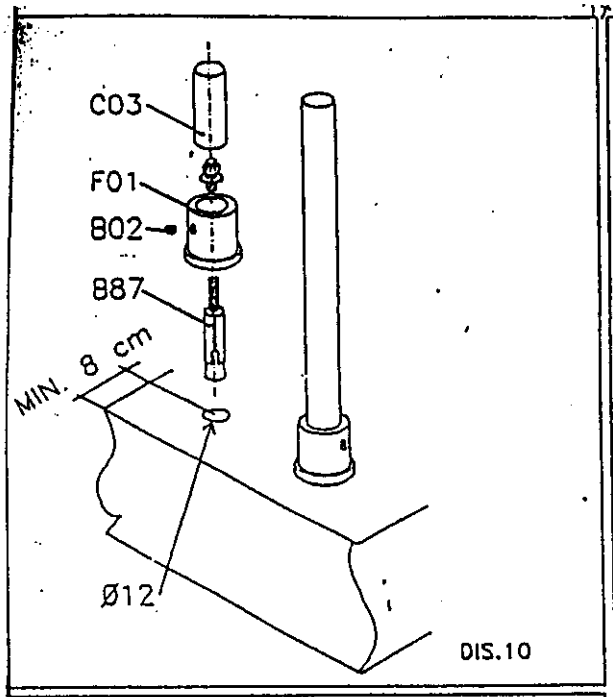
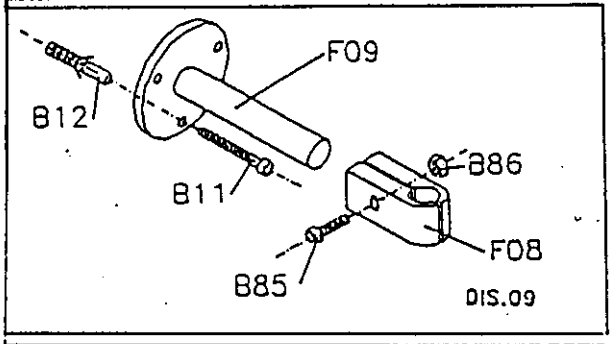
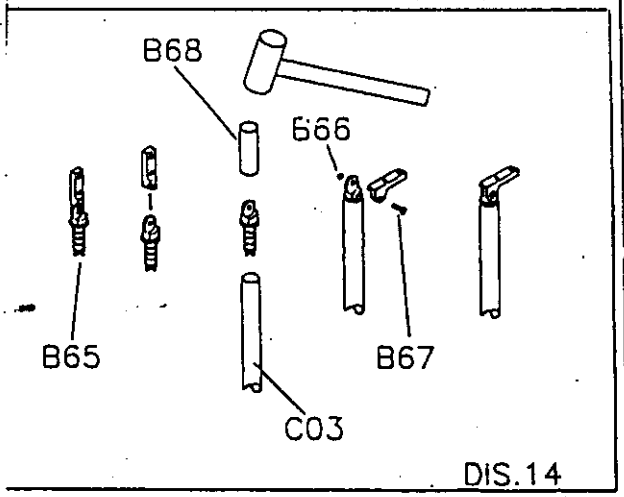

DIS. 09
1
DIS. 13
DIS. 12
H.1060
DIS. 10
DIS.11



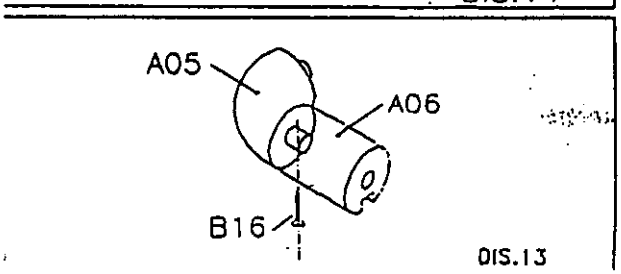
DIS.10



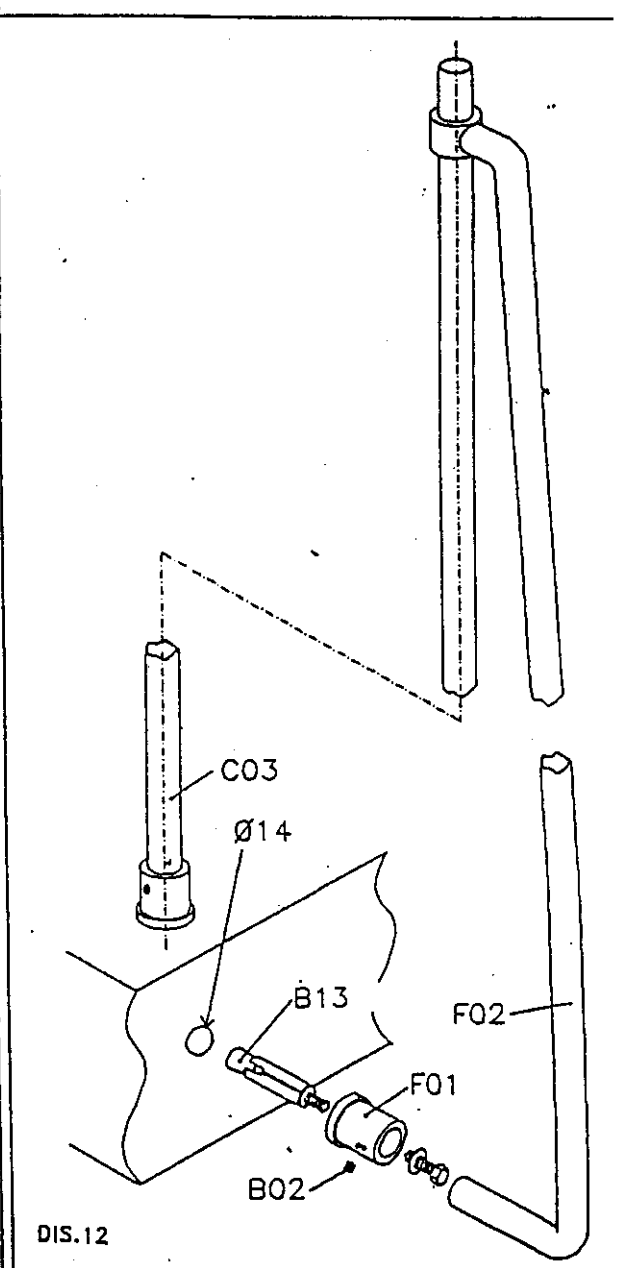
DIS.09



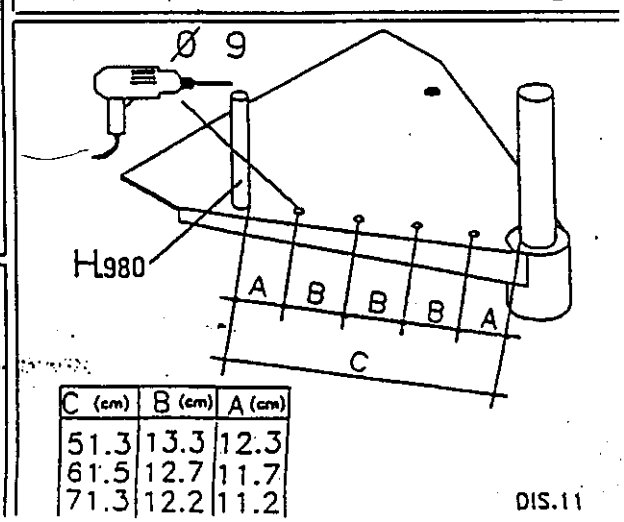
DIS.14



DIS.13



DIS.12



C (cm)	B (cm)	A (cm)
51.3	13.3	12.3
61.5	12.7	11.7
71.3	12.2	11.2

DIS.11

18

(I) DETERMINAZIONE DEGLI ELEMENTI DISTANZIATORI

La TABELLA 1 fornisce la quantità totale di dischi distanziatori D03 in funzione del numero di alzato della scala e della sua altezza misurata da pavimento a pavimento.

ESEMPIO PRATICO : per una altezza da pavimento a pavimento di cm. 299 con una scala composta da 13 alzate: aggiungere 1 a 299 cm = 300 cm. In corrispondenza di 300, nella fila 13, si legge 52.

Ciò vuol dire che devono essere distribuiti 52 dischi D03 fra tutte le alzate per raggiungere l'altezza di 299 cm. E precisamente: 4 dischi D03 fra D04 e D02 - 2 dischi D03 fra D14 e D02.

(E) ESPECIFICACION DE LOS ELEMENTOS DISTANCIADORES

La tabla n°1 proporciona la cantidad total de discos distanciadores (D03) en función del número de contrahuellas de la escalera y de la altura de la misma medida desde el suelo al techo.

EJEMPLO PRACTICO: Para una altura desde el suelo al techo de 299 cm. con una escalera compuesta por 13 contrahuellas: sumar 1 cm. a 299 cm. = 300 cm. correspondiente a 300, en la fila 13 se lee 52. Esto significa que se deben distribuir 52 discos D03 entre todos la contrahuellas para poder conseguir una altura de 299 cm. y portanto: 4 discos D03 entre D04 y D02; duo discos D03 entre D14 y D02.

(GB) DETERMINATION OF THE DISTANCIAL ELEMENTS

Table 1 supplies the total quantity of the distancial elements D03 in relation to the number of the staircase risers and to it's height mesured from floor to floor.

PRATICAL EXAMPLE: for a height from floor to floor of cm. 299 with a staircase composed of 13 risers: add 1 to 299 cm = 300 cm. In corrispondence of 300, in the line 13, you can read 52.

The meaning is that you have to distribute 52 disk D03 between all the risers to achieve the height of 299 cm. And precisely: 44 disk D03 between D04 and D02 - 2 disks D03 between D14 and D02.

(F) DETERMINATION DES PIECES-ENTRETOISES

Le tableau 1 fournit la quantité totale des disques entretoises D03 en fonction du nombre de hauteurs de l'escalier et de sa hauteur mesurée du sol au plancher.

EXAMPLE PRATIQUE: pour une hauteur du sol au plancher de cm. 299 avec un escalier composé par 13 hauteurs: ajouter 1 à 299 cm.= 300 cm. . En correspondance de 300 , dans la file 13, on lit 52.

Ça veut dire qu'on doit distribuer 52 disques D03 entre toutes les hauteurs pour atteindre l'hauteur de 299 cm. Et précisément: 4 disques D03 entre D04 et D02 - 2 disques D03 entre D14 et D02.

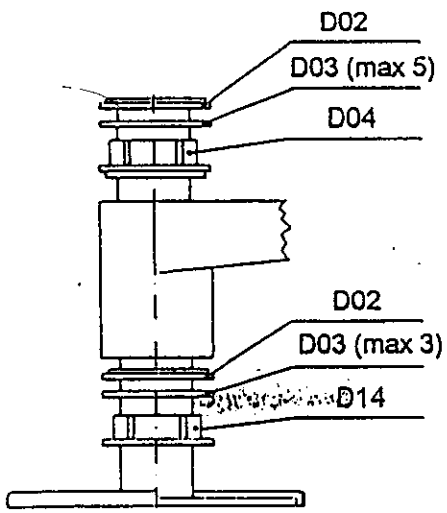
(D) BESTIMMUNG DER DISTANZELEMENTE

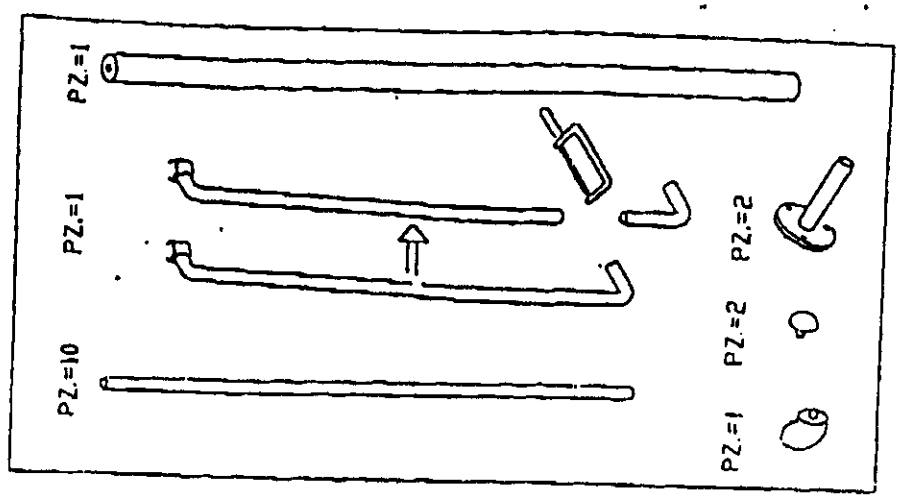
Die Tabelle 1 liefert die totale Anzahl der Distanzringe D03 in Bezug auf die Stufenhöheanzahl und die Treppenhöhe, die von Boden zu Boden gemessen wird.

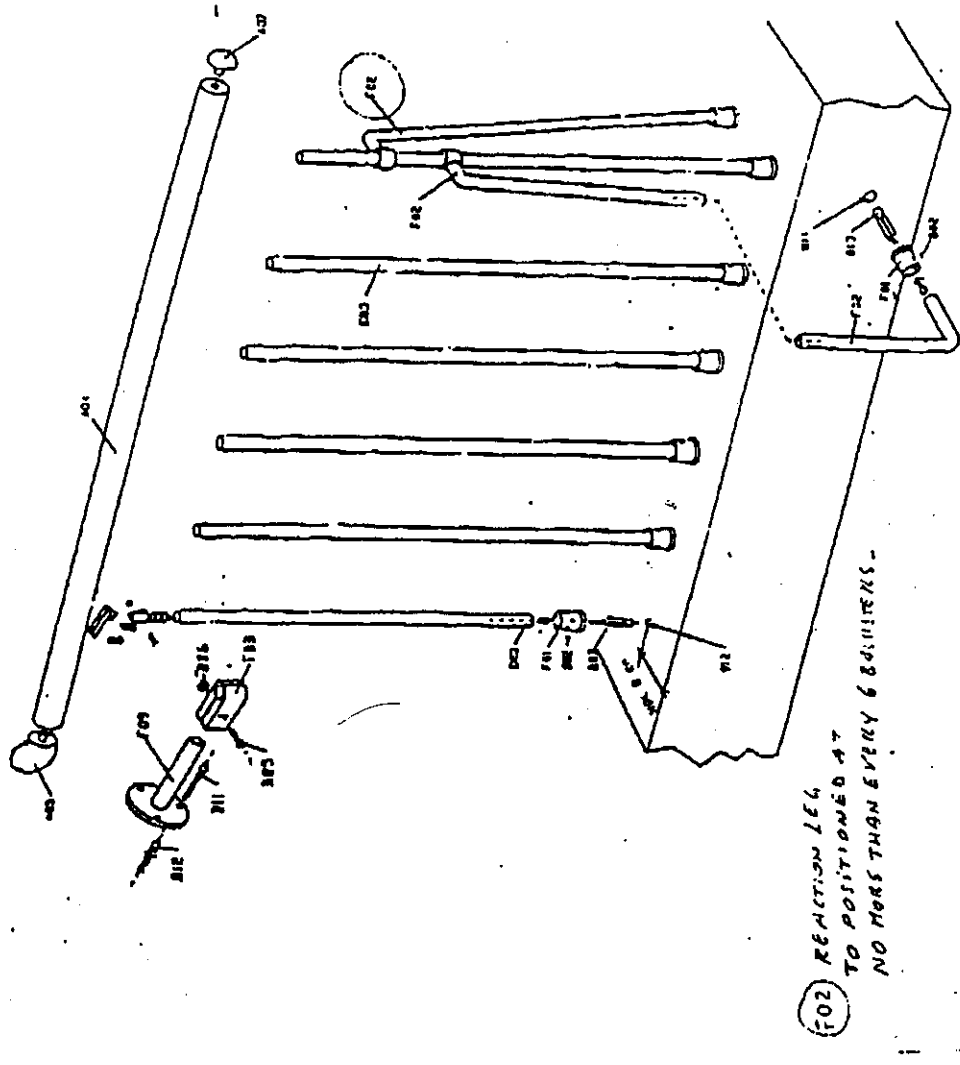
PRAKTISCHES BEISPIEL: für eine Höhe von Boden zu Boden von 299 cm und 13 Stufenhöhen: 1 zu 299 cm dazurechnen = 300 cm. Unter 300, in Reihe 13, liest man 52.

Das heisst, dass man 52 Distanzringe D03 auf 13 Stufenhöhen verteilen muss, um eine Treppenhöhe von 299 cm zu erreichen.

Das heisst: 4 Ringe D03 zwischen D04 und D02, 2 Ringe D03 zwischen D14 und D02.

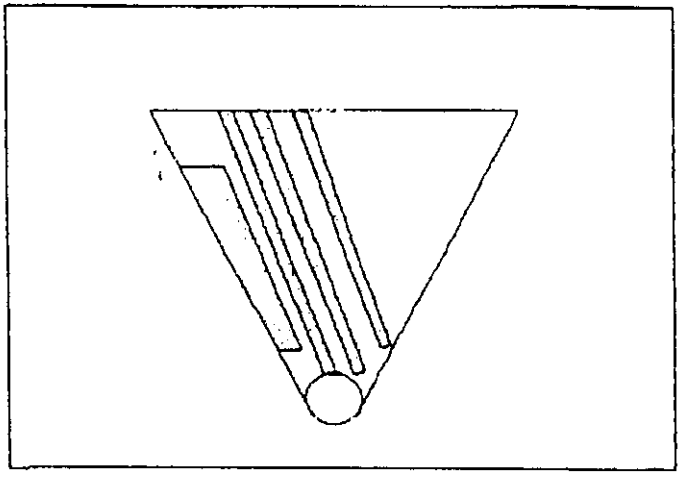






(102) REMOVE LEG, TO POSITIONED AT NO MORE THAN EVERY 6 RATCHETS.

Application of Anti slip Tape to Stair Landing



1. Apply nosing anti slip mat to approaching side of Landing
2. Apply strips of anti slip tape starting 25mm from end of mat
3. Apply subsequent strips parallel to the previous one at intervals equivalent to the width of the tape i.e. at 25mm (see drawing)

APPENDIX 2

Independent slip resistance test reports

SGS United Kingdom Ltd.
Consumer Products Division

Gaw House
Alperton Lane
Wembley
Middlesex
HA0 1WU
Telephone: 0181 998 2171
Fax: 0181 997 9723

SLIP TESTING TO BS5395
REPORT No. DC51549/GLB/98

Prepared for: Building Investigation and Testing Services Ltd
Trowers Way
Redhill
Surrey
RH1 2LH

For the attention of: Mr. I. Collins

Date: 21 July 1998

SGS

We have been requested to carry out slip resistance tests on sample steps from spiral staircases by your order No. 566 dated 15 July 1998.

Samples of two staircase steps and a landing cover were received on 9 July 1998. One sample of spiral stairway step comprised of laminated wood with a clear slightly textured coating finish. The other sample comprised of black plastic covers which would be placed over the step and landing section of a metal spiral staircase, the step cover had strips of rough textured plastic nosings on both edges.

Tests were made to BS5395 using a TRRL pendulum slip tester and a rubber test foot of specified hardness of IRHD 55 ± 5.

Test were made on both dry and wet surfaces and the machine reading converted to coefficient of friction (COF) and compared to those requirements in BS5395 Part 1.

Results

Sample	Coefficient of Friction for:	
	Dry	Wet
Wood step tested across the step	>1.00	0.24
Black plastic step cover Centre step Nosing strip	 >1.00 >1.00	 0.33 0.39
Black plastic landing cover	0.94	0.30

Notes

1. We have been told that the COF should be 0.4 minimum.
2. The wood step COF when wet was 0.24 i.e. below minimum requirement.
3. The plastic cover for the metal staircase had a COF for the nosing marginally below 0.4 and in low use conditions would probably be suitable especially as the nosing was slightly raised. In this test the full test area could not be used due to the dimensions of the nosing.
4. The texture on the plastic landing cover was finer than that on the nosing for the step and was below requirement for these structures. It is suggested that samples of the black plastic nosing material is prepared so that at full area test may be made in two directions.

Prepared by.....
G. L. Birch
Principal Consultant

SGS United Kingdom Ltd.
Consumer Products Division

Gaw House
Alperton Lane
Wembley
Middlesex
HA0 1WU
Telephone: 0181 998 2171
Fax: 0181 997 9723

SLIP TEST TO BS5395
Report No. 51549.2/GLB/98

Prepared for:	Building Investigations and Testing Services Ltd Trowers Way Redhill Surrey RH1 2LH
For the attention of:	Mr. I. Collins
Date:	02 September 1998

SGS

Our report No. DC51549 dated 21 July 1998 showed slip resistance tests on samples of spiral staircases to be satisfactory when tested dry but marginally below specification when tested in a wet condition.

We have been requested to test the same samples which have modified surfaces as per your order No. 581 dated 18 August 1998 and your fax dated 19 August 1998.

The sample received in August 1998 comprised of those samples as tested in our first report but which had anti slip tape 25 mm wide bonded to the test surface at 25 mm intervals.

Tests were made to BS5395 using a TRRL pendulum tester in the wet condition only.

The test was carried out in two directions, parallel with the tape and at right angles to it. In the parallel direction the test was made with the test foot covering two strips and one strip of abrasive tape respectively.

At right angles to the tape the two test areas included three strips and two strips respectively.

Results

Sample	Coefficient of Friction
Wood step	
Parallel direction	
A. two strips	>1.00
B. one strip	>1.00
at right angles	
A. three strips	0.82
B. two strips	0.67
Metal Step	
Parallel direction	
A. two strips	>1.00
B. one strips	1.00
at right angles	
A. three strips	0.92
B. two strips	0.82

Reported by .....

G L BIRCH
Principal Consultant

APPENDIX 3

Detailed BS 6180 test results

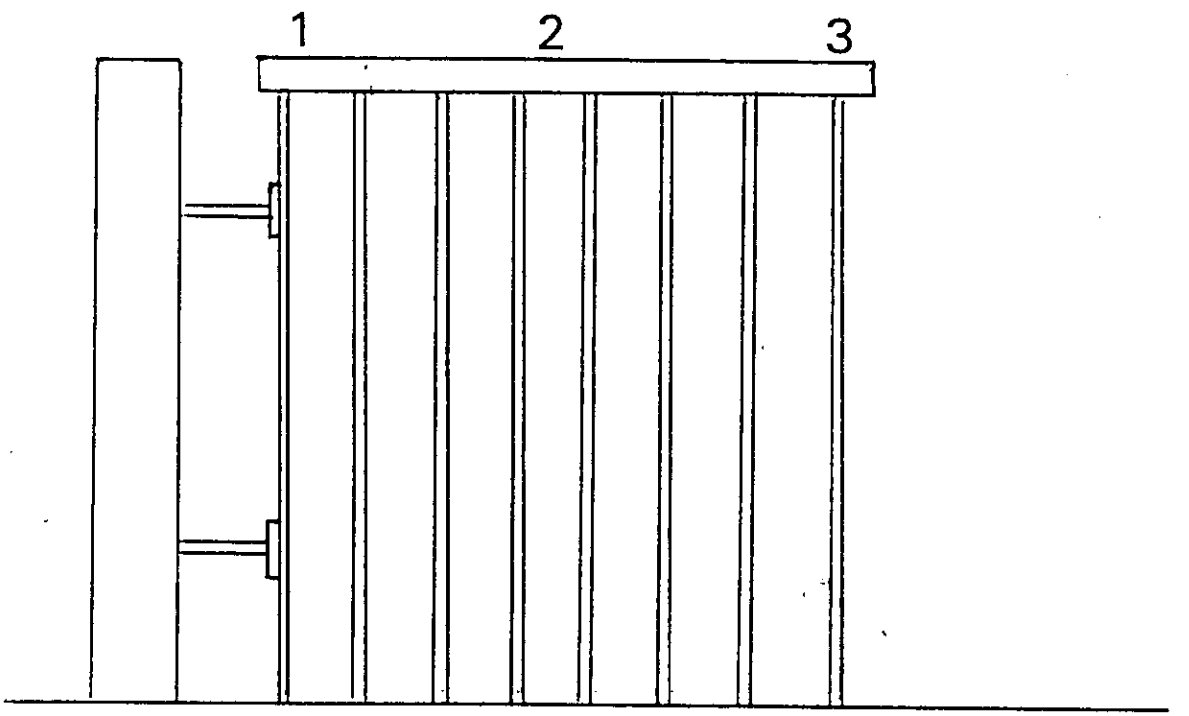


Figure 2. Location of dial gauges

6.3.4 Infill panels and balusters

Stair baluster

Load kN	Actual deflection
0.125	2.70
0.125 (after 5 mins)	2.58
0	0.17
0 (after 5 mins)	0.00

Note
Some relaxation of the handrail occurred under load due to the compressible nature of the material used.

Baluster kit

Load kN	Actual deflection
0.125	4.51
0.125 (after 5 mins)	4.51
0	0.25
0 (after 5 mins)	0.18

6.5 Deflection

Baluster kit handrail

Load kN (0.36kN/m length = 1.17m x 0.36 = 0.42)	Actual deflection		
	1	2	3
0.42	9.18	12.01	10.20
0.42 (after 5 mins)	9.50	12.23	10.15
0	2.06	2.37	1.44
0 (after 5 mins)	1.38	1.67	0.86

Note
See figure 2 for dial gauge locations.

Stair handrail

Load kN (0.36kN/m length. Tested over 1m length)	Actual deflection		
	1	2	3
0.36	13.39	24.06	16.69
0.36 (after 5 mins)	12.74	23.06	16.06
0	0.25	0.87	0.90
0 (after 5 mins)	0.09	0.63	0.75

Note
Some relaxation of the handrail occurred under load due to the compressible nature of the material used.

Landing rigid handrail

Load kN (0.36kN/m length = 0.83m x 0.36 = 0.30)	Actual deflection		
	1	2	3
0.30	17.33	20.80	8.37
0.30 (after 5 mins)	17.40	20.49	8.34
0	1.75	1.79	0.87
0 (after 5 mins)	1.58	1.36	0.62

Note
See figure 3 for dial gauge locations.

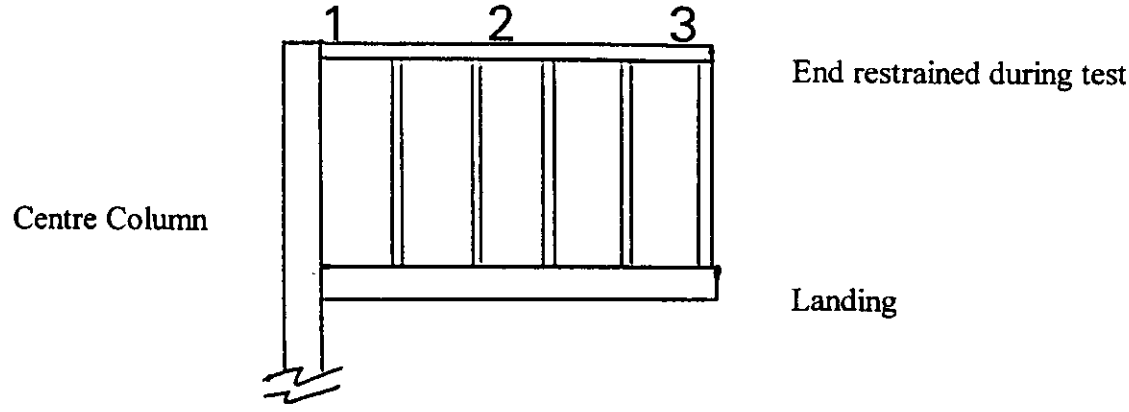


Figure 3. Location of dial gauges

APPENDIX 4

Independent fire assessors report

Roger Perryman Limited
Fire and Chemical Engineering Consultancy

REPORT No. RPL 1050.1
Date 24th July 1998

ASSESSMENT OF SPIRAL STAIRS TO BS 5395 AND ASSOCIATED REGULATIONS FOR FIRE REQUIREMENTS

Report prepared for

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ASSESSMENT OF SPIRAL STAIRS TO BS 5395 AND ASSOCIATED REGULATIONS FOR FIRE REQUIREMENTS

1 Introduction

1.1.1 It is required to determine the fire requirements for a spiral staircase, known as 'Civik' fabricated from predominantly steel. The staircase is intended for the domestic market.

1.1.2 For the purpose of this investigation two main documents apply to the staircase with respect to the fire requirements.

a) British Standard 5395: Part 2: 1984

b) The Building Regulations 1991 and 1992 & 1998 Editions

2 Assessment

2.1 British Standard 5395: Part 2: 1984

2.1.1 This Standard clearly state that, for 'Category A - Small Private Stairs'. This category of stair may be used as a fire escape for a small number of people who are familiar with the stair. To comply with the Standard, the stair must have specific dimensions for Rise, Going, Clear Width, etc.

2.1.2 Therefore, for the stairs to be in accordance with the Standard for Category A, the clear width must not be less than 600mm.

2.1.3 For 'Category B – Private stair'. This category is for a stair to the upper floor used as a main access of a dwelling. In other words to a main habitable area in regular use. The dimensional limits change and the Clear Width must not be less than 800mm.

2.1.4 Under Clause 6 of BS5395 Fire Protection and Means of Escape recommendations are made to BS 5588 Part 1. Section 2 Single Family Dwellings would be the only section under which this type of stair would be acceptable as a means of escape and for properties not exceeding 4.4 m in height without being a protected stair. The stair should not be in an inner room unless it is provided with a door or window providing a suitable means of escape.

2.1.5 The stair may be used for properties of greater than 4.5m height but it must be either protected or the room served above must itself be fire protected and with a separate means of escape.

2.2 **The Building Regulations 1992. Document B**

2.2.1 These Regulations are a revision of the 1991 Regulations to correct certain errors when the document was reprinted. There are no modifications as far as the staircase is concerned.

2.2.2 Under these regulations it is required to provide a means of escape from the upper floor to the area below in the event of fire. The regulations consider that any staircase is a means of escape unless there is the facility for escape from the upper room to the outside through a door or a window.

2.2.3 It is preferred that the staircase is installed from a hallway or other area requiring the opening of only one door to escape to the outside.

2.2.4 If the staircase has to be installed such that the lower end of it is in a room with no direct exit to the outside then it is required that that room should be protected from the rest of the property by a fire resistant doorset.

2.3 **The Building Regulations 1991. Document K**

2.3.1 These Regulations were revised in the 1998 Edition. They were simplified under the Requirement K1 Spiral and Helical stairs 1.21 to refer only BS 5395 Stairs, ladders and walkways. Part 2: 1984 Code of practice for the design of helical and spiral stairs.

2.3.2 It would be wise when intending to install a new stair to consult the Building Control Officer of the specific Local Authority.

2.3.3 It may be necessary to apply under Building Regulation for agreement to the proposed installation. The officer will advise on this matter and the suitability of a proposed stair under the regulations.

2.3.4 Building Control Officers may, and some do, on the basis of the requirements of The Building Regulations, ignore the requirements of BS 5395: Part 2: 1984 with regard to the 'Clear Width' given in Table 2, Sizes of Stairs for Category A. Small private stair. They consider that as the Building Regulation are more up to date. Therefore under these circumstances they will accept that the clear width may be less than that given by the Standard of 600mm minimum.

2.3.5 Where only a small number of people are likely to use the stair they may only require that the clear width is enough for a person to reasonably pass up and down the stair.

2.3.6 The Building Control Officer will require that the stair comply with the requirement for gaps between treads and balustrade rails to be not more than 100mm. This is a safety aspect to prevent entrapment of parts of the body especially children.

3 Other Requirements

3.1 Surface Spread of Flame

3.1.1 There does not appear to be a requirement under the Building Regulation for the stair to comply with a Class of Surface Spread of Flame, as it does not form either a wall or ceiling lining.

3.1.2 While there does not appear to be a requirement for a classification on surface spread of flame, it might be considered that the landing forms a type of ceiling. Therefore, the client might be wise to ascertain the performance of the coated steel for Surface Spread of Flame in accordance with BS 476: Part 7: 1987. It is thought unlikely that a performance of better than Class 3 would ever be required as the area of the landing is less than 4 square metres.

4 Conclusions

4.1 If the client requires the spiral stair to meet the requirements of the British Standard BS 5395: Part 2 1984 then the Clear Width must not be less than 600mm for the Category A type of application.

4.2 In our opinion the spiral stair complies with the requirements of BS 5395: Part 2 1984 Clause 6 Fire Protection and Means of Escape. However, there are conditions applicable to the height of the property an its installation in that property. It is recommended that reference be made to the potential purchaser that they check on the requirements for the installation of the stair with respect to the Standard.

4.3 However, there appears to be a strong case to support the installation of spiral stair of narrower clear width. The indications are that Building Control Officers consider that the Building Regulations are more up to date and that there is no mention of clear width limitations in these Regulations. Therefore, they are willing to accept spiral stairs with a clear width of less than 600mm for installation in domestic properties, or small offices, where there are a small number of people who would use and are likely to be familiar the stair.

4.4 It is recommended that the client submit a sample of the painted steel used for the landing for at least an indicative test for Surface Spread of Flame in accordance with BS 476: Part 7: 1987.

Report prepared by

R. Perryman

Roger Perryman. C.Eng. F I Chem E. A I Fire E. MIFS.
For and on behalf of Roger Perryman Limited

APPENDIX 5

Detailed loading results to Appendix 5

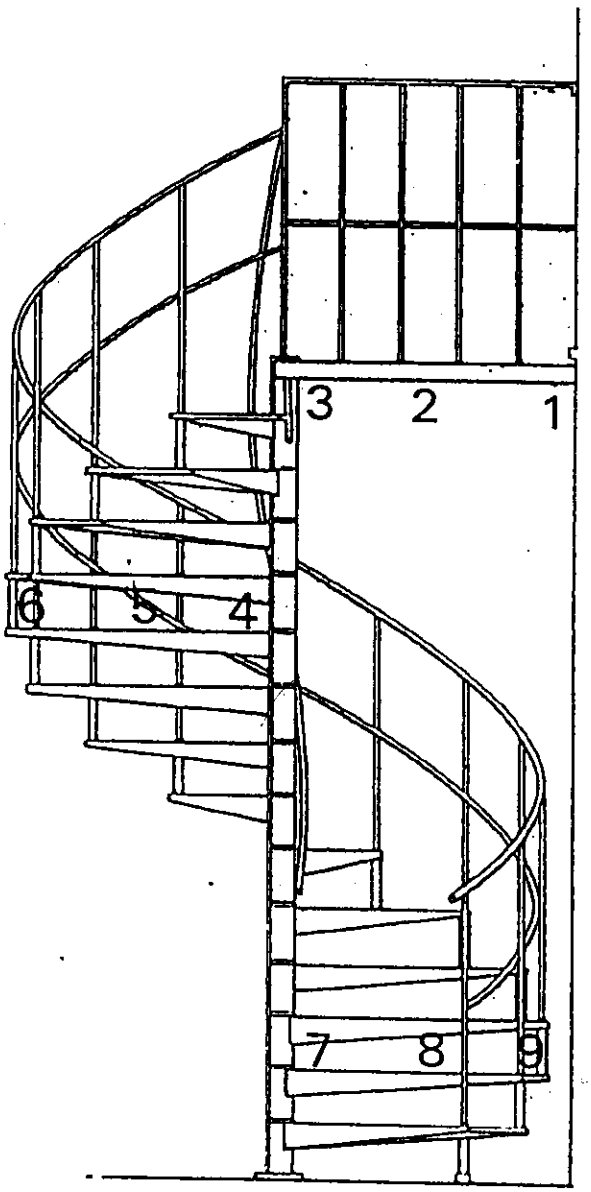

Figure 4. Dial gauge locations used.
(figure from BS 5395 for reference only)

Load	Actual deflection mm								
	Landing			Tread 7			Tread 3		
	1	2	3	4	5	6	7	8	9
Landing only	1.50	1.33	0.33	0.07	0.14	0.21	0.05	0.11	0.16
Full load	2.25	1.97	0.63	0.35	1.95	2.25	0.55	3.02	4.27
Full load(+ 5 mins)	2.28	2.00	0.64	0.35	1.98	2.31	0.57	3.08	4.37
Full load(+15 mins)	2.30	2.02	0.65	0.37	2.01	2.35	0.59	3.14	4.49
180° off	2.21	1.91	0.57	0.32	1.74	1.87	0.30	1.02	1.65
Centre only (x2)	0.38	0.25	0.10	0.00	2.01	1.68	0.09	0.29	0.44
0 load	0.15	0.11	0.04	0.00	0.23	0.50	0.05	0.07	0.25

Note

Figure 4 is a diagrammatic sketch from BS 5395 and has been included to show the general location of dial gauges 1 to 9.

Test D

Landing

Load	Actual deflection mm		
	1	2	3
Two x 0.9kN	4.68	3.05	0.73
Two x 0.9kN (after 5 mins)	4.69	3.05	0.73
0	0.18	0.10	0.04
0 (after 5 mins)	0.11	0.06	0.02

Tread 7

Load	Actual deflection mm		
	1	2	3
Two x 0.9kN	0.41	3.54	3.70
Two x 0.9kN (after 5 mins)	0.41	3.59	3.77
0	0.02	0.09	0.19
0 (after 5 mins)	0.01	0.07	0.17

Tread 3

Load	Actual deflection mm		
	1	2	3
Two x 0.9kN	0.69	4.20	4.89
Two x 0.9kN (after 5 mins)	0.69	4.27	5.00
0	0.04	0.19	0.35
0 (after 5 mins)	0.02	0.12	0.19