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PROJECT TECHNICAL MEMORANDUM

JOB TITLE : Swan Street Gym, Manchester

REF : HT: 31526/PTM1 Rev 1

DATE : 27 June 2024

FROM : Kyle Donald

ISSUED TO : Ridgeback

RE: SWAN HOUSE, GYM FITOUT ACOUSTIC ASSESSMENT

1.0 Introduction

Hann Tucker Associates (Hann Tucker) has been appointed to undertake acoustic testing in relation to a proposed ground floor gymnasium space within Swan House, Manchester. We understand the proposed gymnasium will be operated by FM at Swan House and operate 24 hours a day. Manchester City Council have requested an acoustic assessment is carried out with a view to establishing suitable acoustic control measures.

Hann Tucker carried out tests of airborne sound insulation and weight drop noise transfer to the first-floor residential dwellings (located directly above the proposed gymnasium space) on Tuesday 21 May 2024.

This Project Technical Memorandum presents our findings and recommendations for the proposed gymnasium fit out.

2.0 Acoustic Terminology

For an explanation of the acoustic terminology used in this report please refer to Appendix A enclosed.

3.0 Proposed Criteria

Manchester City Council does not have any specific guidance in relation to the operation of gyms. However, the ‘ProPG: Gym Acoustics Guidance (GAG)’ was published in March 2023 and presents a standardised methodology for assessing buildings and environments for the location of Gymnasiums, fitness and exercise spaces.

Section 2.3 of this guidance document presents internal sound level target criteria for gym activity in residential and other areas based on a 'G-Curve' framework. The guideline criteria for various receptor types are as follows:

Receptor Type	Airborne Sound (e.g, music) $L_{eq,T}$ (31.5Hz to 8KHz)	Heavy Impact Sound $L_{max,F}$ (31.5Hz to 8KHz)
Residential Areas	G15 – G25 (day) G10 – G20 (night)	G20 – G25 (day) G15 – G20 (night)

Notes:

1. *The Working Group generally found in their experience that levels below the upper values tended to avoid significantly adverse impacts (SOAEL) occurring and higher levels than these should generally be avoided, but this is highly dependent on context. The background and ambient noise levels at any given site can fluctuate (e.g., a building in an urban setting adjacent to busy infrastructure versus a building shielded from external adverse noise intrusions and/or quieter location). This variation will also cause a subjective variance in relation to the perceived noise impact, both during the design phase and the completed development and the SQA should be cognisant of which target criteria would be most appropriate to their Gym scheme.*

2. *In rooms with low background noise levels (below ~20 dB $L_{A90,5minutes}$), the criteria should be carefully considered and fully justified. It has been noted that the subjective impression of low frequency noise could still cause issues of disturbance, despite meeting the above target ranges. Therefore, it is recommended that resulting heavy impact noise levels at frequencies 80Hz and below, do not exceed a level of 20dB above the existing background noise dB $L_{A90,5minutes}$ within commercial and retail adjacencies (without source/Gym related activities). Where good sound insulation and closed windows results in very low background sound levels this can result in the loss of masking sound making intruding low frequency sound from Gyms more prominent and so potentially more likely to cause disturbance.*

3. *For heavy impact noise at least 1/3 octave bands analysis is desirable over the audible range from 31.5Hz, although measuring down to 20Hz is desirable to cover the audible range and may assist in identifying outlying peaks of energy.*

4. *For music noise, particular care should be given to controlling noise in the low frequency region, in the range 31.5Hz to 200Hz and $L_{max,F}$, L1, L10 may also be used as parameters as a substitution for $L_{eq,T}$.*

Based on the ProPG: Gym Acoustics Guidance (GAG) guideline criteria, the following target criteria for the residential areas located directly above the proposed gymnasium have been derived.

Receptor Type	Period	Criteria	
		Airborne Sound (e.g., music) $L_{eq,T}$ (31.5Hz to 8KHz)	Heavy Impact Sound $L_{max,F}$ (31.5Hz to 8KHz)
Residential Areas	Daytime (07:00 – 23:00)	G25	G25
	Night-time (07:00 – 23:00)	G20	G20

4.0 Weight Drop Test Methodology

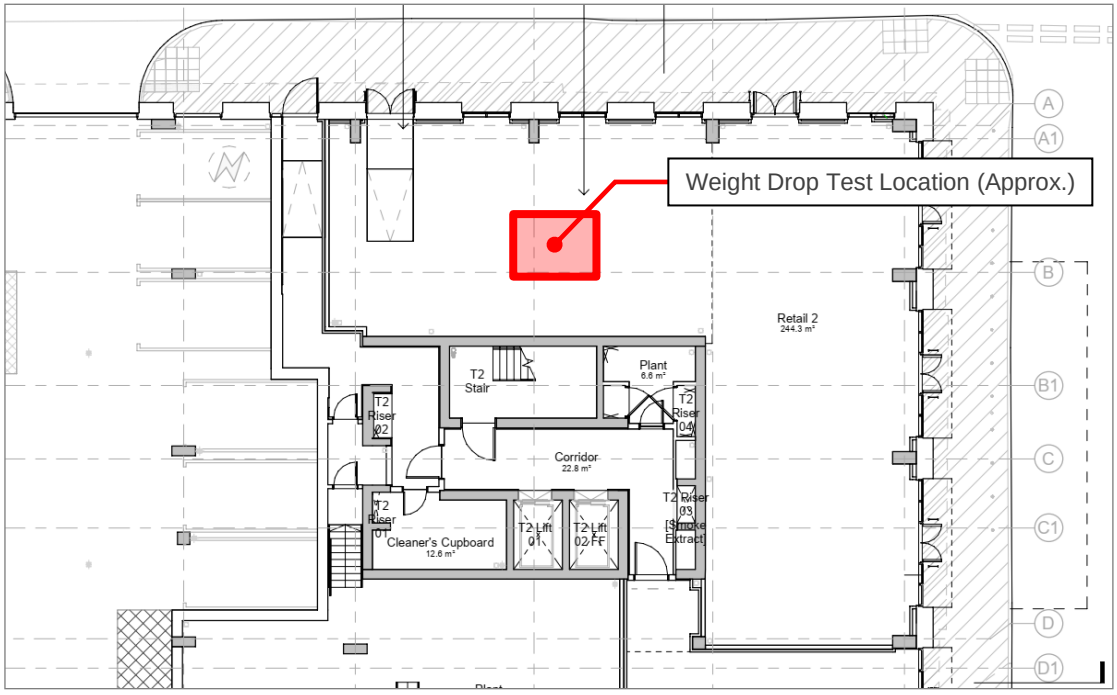
The weight drop testing involved dropping a range of weights on gym floor samples. 6 kg, 12 kg and 24 kg kettlebells were used to be representative of the intended gymnasium activities. The 6 kg kettlebell had a plastic casing, and the 12 kg and 24 kg kettlebells were cast iron (no casing or coating).

3No. weight drops were released from knee height per weight category. The worst-case representative result (of the 3No. drops) has been considered in our analyses. When a spring and pad floor sample was used the engineer was stood directly on the sample. For all other weight drop tests the engineer was stood with their feet either side of the sample (directly on the floor slab).

Time synchronised sound level meters were set up in the following locations to log sound levels during the weight drop tests.

- In Retail Unit 2 (Source Room) (proposed gymnasium space)
- In the residential apartment located directly above at first floor (Receive Room)

The drop area within Retail Unit 2 is indicated on the plan overleaf.



Weight Drop Test Area (Drawing Provided by SimpsonHaugh)

The instrumentation used for the measurements is presented in the table below.

Location	Description	Manufacturer	Type	Serial Number	Calibration
Source Room	Type 1 Data Logging Sound Level Meter	Larson Davis	LxT	4086	Calibration on 26/05/2023
Receive Room	Type 1 Data Logging Sound Level Meter	Larson Davis	LxT	5111	Calibration on 30/05/2023

Each sound level meter was calibrated prior to and on completion of the measurements. No significant changes were found to have occurred (no more than 0.1 dB).

5.0 Sound Insulation Test Methodology

Retail Unit 2 was currently a shell with exposed slabs and unlined blockwork walls. We understand that the curtain wall spans across the slab edge in a similar way to the detail between apartments.

The sound insulation tests were undertaken in general accordance with BS EN ISO-140 by generating a broad band, random diffuse sound field within the source room. A spatial average of the resulting 1/3 octave band noise levels was obtained within the source room from measurements undertaken over a period of a least 30 seconds. The measurement procedure was repeated in the receive room.

The receive levels were corrected for background noise and subtracted from the source levels to determine the level differences over the frequency range 100-3150Hz. The level differences for each source position are arithmetically averaged at each frequency band to give the level difference, D.

The 1/3 octave band results are then compared with a standard curve using the method described in BS EN ISO 717-1: 1997 to determine the single figure descriptor of airborne sound insulation, the Weighted Standardised Level Difference, or D.

The instrumentation used for the measurements is presented in the table below.

Equipment	Model	Serial Number	Calibration Date
Precision Sound Analyser Meter	Brüel & Kjær Type 2250	3007292	Calibration on 25/01/2024

The equipment was calibrated prior to and on completion of the survey. No significant deviations occurred.

6.0 Test Results

6.1 Airborne Sound Insulation Test

The results of the airborne sound insulation test from the Retail Unit 2 to the residential unit located directly above are tabulated below.

Description	Level Difference (D dB) at Octave Centre Frequency (Hz)							D_w ($+C_{tr}$) (dB)
	63	125	250	500	1k	2k	4k	
Retail Unit 2 to the residential unit	38	34	39	46	46	51	57	**47 (43)**

The above results will be used to assess the impact of airborne noise transfer between the Gym and the apartments above.

6.2 Weight Drop Tests

The measured sound pressure levels within the apartment during the weight drop tests are tabulated below, presented in terms of L_{AFmax} and G-value.

Test Ref.	Gym Floor Sample Arrangement (Directly on the floor slab)	Dropped Weight (kg)	Measured Sound Level in Receive Room	
			L_{AFmax} (dB)	G-Value (dB $L_{max,F}$)
D1	10mm Sportec Tile	6	51	53
D2		12	63	63
D3		24	68	70
D4	10mm Sportec Tile on 25mm Sylomer SR28	6	33	29
D5		12	71	44
D6		24	45	52
D7	40mm Sportec Style Tile on 2No. Acousticork U71	6	34	33
D8		12	35	34
D9		24	37	38
D10	Pliteq Fit70	6	39	40
D11		12	40	42
D12		24	41	43
D13	Pliteq Fit70 on 2No. Geniemat	6	36	36
D14		12	32	33
D15		24	32	27
D16	Getzner G-fit impact tile - 1 layer	6	29	27
D17		12	31	30
D18		24	41	41
D19	Getzner G-fit impact tile - 2 layers	6	29	27
D20		12	31	27
D21		24	31	27
D22	Getzner G-fit impact tile - 3 layers	6	27	27
D23		12	30	27
D24		24	28	27
D25	StraviGym Spring system with Roll W25 and a 30 tile	12	35	35
D26		24	37	37
D27	StraviGym Spring system with Roll W25 and a 70 tile	12	31	30
D28		24	33	32
D29	Pad-M50 with Roll W25 and a 70 tile	12	34	35
D30		24	33	33
D31	Pad-M50 with roll W25 and a 30 tile	12	31	29
D32		24	40	39
D33	20mm Sportec Tile	12	55	56
D34		24	62	63

The background noise climate in the receive room (first floor residential apartment) was measured to be approximately NR 26 L_{eq} in absence of any weight drops.

A table presenting the measured sound pressure levels in the source room (Retail Unit 2) has been enclosed in Appendix B.

6.3 Results Discussion and Conclusions

Based on the results of the weight drop testing, dropping weights on on-acoustic flooring such as the 10mm and 20mm Sportec tiles will likely result in the amount of noise transfer being significantly above the recommended criteria. In the case of the 20mm tile with measured levels are around 40 dB above the criteria which is unlikely to be acceptable.

However, some of the samples performed well and analysis of the test results indicates that the following flooring sample arrangements typically corresponded to the lowest weight drop sound transfer to the first-floor residential property directly above.

Gym Floor Sample Arrangement (Directly on the floor slab)	Dropped Weight (kg)	Measured Sound Level in Receive Room	
		L_{AFmax} (dB)	G-Value (dB $L_{max,F}$)
Pliteq Fit70 on 2No. Geniemat	12	32	33
	24	32	27
Getzner G-fit Impact tile - 2 layers	12	31	27
	24	31	27
Getzner G-fit Impact tile - 3 layers	12	30	27
	24	28	27
StraviGym Spring system with Roll W25 and a 70 tile	12	31	30
	24	33	32

The best performing floors the Pliteq and Getzner systems are layered build-ups whereas the StraviGym system is a spring isolated floating floor which would likely be more expensive. However, even the best performing floor samples did not achieve either the day or night-time proposed criteria.

Notwithstanding, it should be noted that measurement results are likely to be limited by the background noise climate that was measured as approximately NR26 L_{eq} (approximately

equivalent to G26) in the receive room. Isolated noise levels from individual weight drops could therefore be less than presented in the table above, however, it should be noted that all but a select few weight drops were subjectively audible within the apartment above.

Furthermore, the measured sound levels from weight drops in the receive room are considered to be a combination of airborne sound transfer and structure borne sound transfer.

As the unit is currently a shell there is an opportunity to enhance the airborne sound insulation by installing mass barrier ceilings and suitable linings. As such, we have undertaken further analysis using the measured airborne sound insulation performance data (as presented in Section 6.1) and the time synchronised noise levels in both the proposed gym and the apartment above to establish predictions for the contribution from airborne sound transfer and structure borne sound transfer. With this information it would be possible to estimate how much of the measured noise is due to both structure borne and airborne noise.

The table below presents the estimated contribution from airborne sound transfer and structure borne sound transfer for the 'G-fit tile - 3 layers' test results which is considered the best option acoustically.

Gym Floor Sample Arrangement (Directly on the floor slab)	Dropped Weight (kg)	Calculated Contribution from Airborne Sound Transfer		Calculated Contribution from Structureborne Sound Transfer	
		L_{AFmax} (dB)	G-Value (dB $L_{max,F}$)	L_{AFmax} (dB)	G-Value (dB $L_{max,F}$)
Getzner G-fit Impact tile - 3 layers	24	24	24	27	27

The data in the table above indicates that structure borne sound transfer is likely the primary contributor to noise levels in the receiver room. However, there is likely an element of airborne noise transfer between these spaces that will need to be controlled.

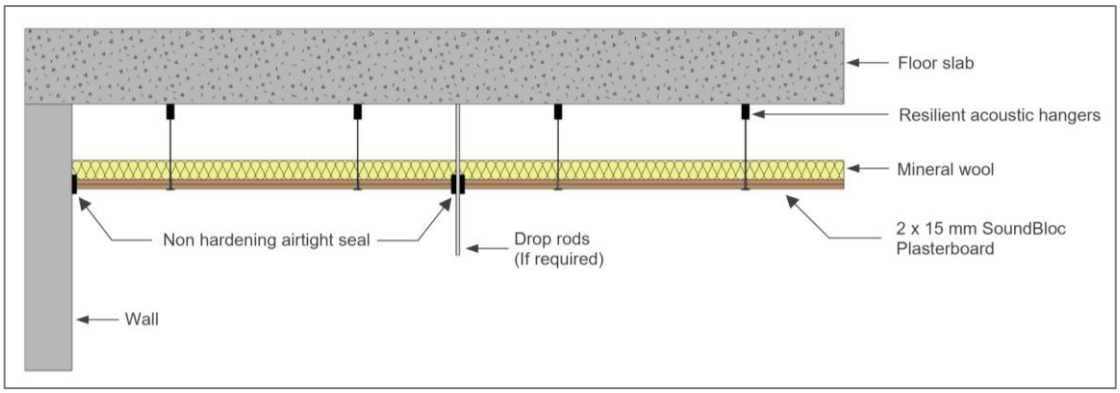
6.4 Recommendations

Based on the results of the testing, we advise that:

- A mass barrier ceiling and suitable blockwork linings would be required to the proposed gym space.
- The provision of an acoustic floor would be required to control weight drops within the gym area.

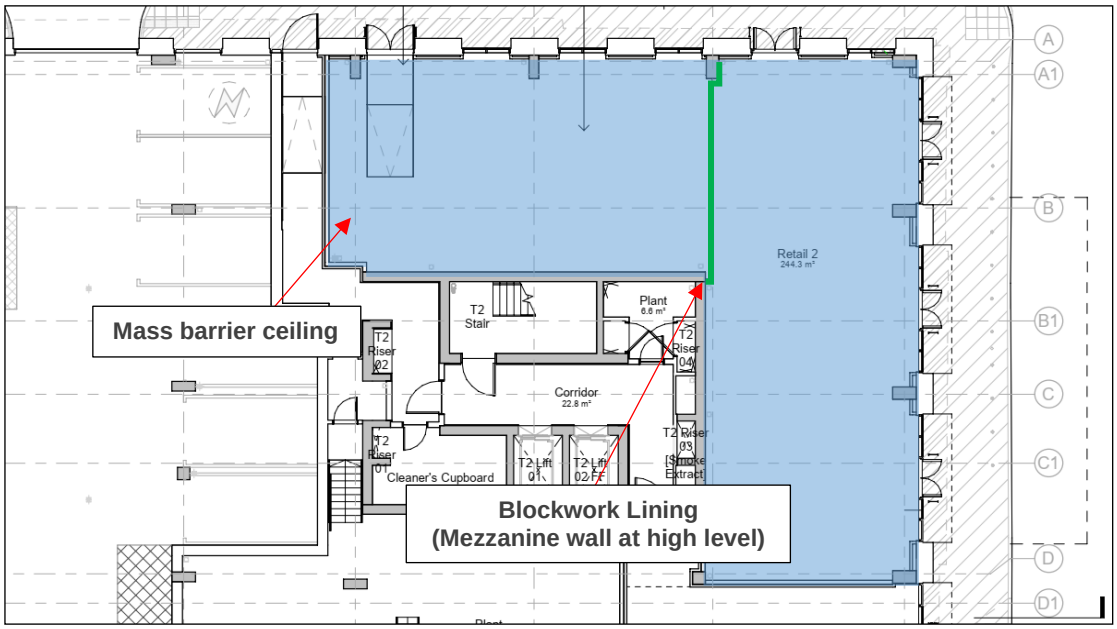
Considering the mass barrier ceiling and blockwork linings first, we advise that mass barrier ceiling comprising of 2x15mm SoundBloc on rubber/neoprene acoustic hangers with at least 50mm mineral wool is provided to the proposed Gym with a total depth of 150mm.

The below sketch illustrates a typical mass barrier ceiling and all services should be located below this mass barrier with the exception of SVPs which can be contained within the ceiling cavity with vertical elements wrapped in 25mm mineral wool and enclosed with 2x15mm SoundBloc.



Sketch Showing Typical Mass Barrier Ceiling Detail

The blockwork lining should consist of 2x15mm SoundBloc acoustically isolated from the blockwork using a suitable product (eg Pliteq Genie Clip or the Getzner Wall Lining Bracket). For clarity, the location of the mass barrier and blockwork lining are shown below:



Location of Mass Barrier Ceiling (Blue) and Blockwork Wall Lining (Green)

Linings to other core wall within the Gym space should not be required provided that these walls will not be used for impactful activities (eg subject to impacts from medicine balls). In the event that any core wall area shall be used for such activities, a lining should be in installed. This lining should meet the specification described above but also capable of withstanding the expected impacts.

With regards to the floor, based on our testing, the Getzner G-fit impact tiles (3 layer arrangement) achieved the lowest levels of sound transfer during our weight drop testing, whereby G-values of G 27 were measured within the first-floor residential apartment. As such, **we advise that this or an equivalent floor is used where any weights could be dropped** which we understand could be the entire floorplate.

It should be noted that the Pliteq and Stravitec systems performed similarly so enquiring about these systems could be considered. The contact details for the best performing systems are provided below:

- **Getzner: Ben van Breda**
  - Email: Ben.VanBreda@getzner.com
  - Mobile +4473 4066 0846
  - Website: www.getzner.com
- **Pliteq: Tim Patzke**
  - Email: tpatzke@pliteq.com
  - Mobile +44 7834154738
  - Website: www.pliteq.co.uk
- **Stravitec: Andrew Beverley**
  - Email: a.beverley@cdm-stravitec.com
  - Mobile: +44 7842 430691
  - Website: www.cdm-stravitec.com

While the above perform the best acoustically, the floors can often be soft underfoot. This should be discussed with the supplier to ensure the floor selected meets both the acoustic and use requirements.

These measures should serve to reduce sound transfer from gymnasium activities in the ground floor space to the first-floor residential apartment. However, achievement of the night-time criteria (G20) may not be achievable (or measurable due to background noise level limitations), but the levels of sound transfer should be below the prevailing background noise of G26 in the residential apartments which should reduce the likelihood of complaints.

6.5 Operational Considerations

The installation of mass barrier ceilings and acoustic flooring would go some way to controlling noise transfer between the proposed gym and the apartments above. However, heavy weight drops, for example deadlifts or heavy dumbbells, or gym miss-use would likely result in more noise transfer than has been measured in our testing.

It is strongly advised that the space is actively managed and occupants are advised to place weights down rather than drop them. Strict policies should be put in place with regards to miss-use of the gym with access being restricted to those who abide by the rules.

If music is to be played within the gym this should be at a moderate level and the final operational noise limit should be established though post completion testing.

Yours sincerely,



Kyle Donald

for HANN TUCKER ASSOCIATES

Appendix A

Acoustic Terminology

dB - Decibel - Used as a measurement of sound pressure level. It is the logarithmic ratio of the noise being assessed to a standard reference level.

dB(A) - The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level.

Because of being a logarithmic scale noise levels in dB(A) do not have a linear relationship to each other. For similar noises, a change in noise level of 10dB(A) represents a doubling or halving of subjective loudness. A change of 3dB(A) is just perceptible.

L_{Aeq} - The concept of L_{Aeq} (equivalent continuous sound level) has up to recently been primarily used in assessing noise in industry but seems now to be finding use in defining many other types of noise, such as aircraft noise, environmental noise and construction noise.

L_{Aeq} is defined as the (A-weighted) notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (30 minutes).

L_{max} - L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.

NR - **Noise Rating (Curves)**

A method of assessing the frequency dependent sound pressure levels within a space. Gives a single figure result based upon a weighting curve roughly in line with the equal loudness curves.

G-Value - **G-Curve Rating**

G-Curves are based on interpretations of NR Curves. They provide single reference ratings which when one-third octave measurement data are plotted against the curves the value which is not broken by the data represents the G-Curve rating

Appendix B

Source Room Measurement Results

Test Ref.	Gym Floor Sample Arrangement (Directly on the floor slab)	Dropped Weight (kg)	Measured Sound Level in Source Room	
			L_{AFmax} (dB)	G-Value (dB $L_{max,F}$)
D1	10mm Sportec Tile	6	80	79
D2		12	85	86
D3		24	90	92
D4	10mm Sportec Tile on 25mm Sylomer SR28	6	70	70
D5		12	71	75
D6		24	76	82
D7	40mm Sportec Style Tile on 2No. Acousticork U71	6	71	72
D8		12	75	76
D9		24	76	77
D10	Pliteq Fit70	6	79	86
D11		12	82	88
D12		24	84	90
D13	Pliteq Fit70 on 2No. Geniemat	6	78	76
D14		12	72	75
D15		24	70	71
D16	Getzner G-fit impact tile - 1 layer	6	71	68
D17		12	71	70
D18		24	66	76
D19	Getzner G-fit impact tile - 2 layers	6	70	70
D20		12	75	75
D21		24	73	73
D22	Getzner G-fit impact tile - 3 layers	6	62	61
D23		12	66	66
D24		24	65	64
D25	StraviGym Spring system with Roll W25 and a 30 tile	12	78	77
D26		24	82	82
D27	StraviGym Spring system with Roll W25 and a 70 tile	12	73	72
D28		24	78	77
D29	Pad-M50 with Roll W25 and a 70 tile	12	75	78
D30		24	74	78
D31	Pad-M50 with roll W25 and a 30 tile	12	75	74
D32		24	84	83
D33	20mm Sportec Tile	12	78	84
D34		24	84	91