國際照明委員會(CIE)2015

參加CIE Division 2 Meeting 及TC分享
CIE閃爍及眩光發展

吳貴能 /工研院量測中心

電光計量研究室 研究員
gilbert@itri.org.tw

104年8月12日

International Commission on Illumination
Commission Internationale de l'Eclairage
Internationale Beleuchtungskommission

CIE 2015 MANCHESTER UK

INTERNATIONAL YEAR OF LIGHT 2015

內 容

- Div.2 meeting
- 眩光研究發展
- 閃爍研究發展

原有 TC Review

關閉之TC有：
TC2-65 (介視覺量測)
TC2-70 (物體之反射穿透特性量測)，TC2-70關閉，但其內容尚有產業需求，將以限縮範圍由有意願者從提新TC。

今年將完成之TC為：
TC2-29 (偵測器線性度)
TC2-59 (ILMD特性)

將更換新TC chair為：
TC2-62 (影像式近場配光量測)
TC2-68 (OLED應用在照明之光量量測)
TC2-72 (LED量測之不確定度)

新TC提案

1.寬光譜之紫外線量測標準(NIST George Eppeldauer)
2.OLED照明測試標準(比利時 Guy Vandermeersch)
3.BRDF量測(法國 Gael Obein)
4.以ILMD量測眩光方法(台灣 吳貴能)
5.LED光源動態控制之量測(大陸 Qiu-Hong Hu)
6. LED測試資料報告格式(匈牙利András Poppe)

Div.2未來活動

2015年11月23~26日德國PTB辦理CIE Tutorial and Expert Symposium on the CIE S025 LED Lamps, LED Luminaires and LED Modules Test Standard。

2016年3月3~5日澳洲墨爾本CIE 2016 Lighting Quality and Energy Efficiency Conference，7~9日為TC meeting。

2016年8月30~9月1日捷克布拉格辦理CIE Expert Symposium on Appearance。

2017年10月20~27日南韓濟州島CIE midterm meeting。

R2-53 Glare Rating Measurement by ILMD

ILMD

Simulation Software

To measure/ calculate

Luminance distribution

A lighting room

To study/ compare

L, E, L_b, UGR by these methods at various conditions

Standard Instruments

ILMD: Image Luminance Measurement Device

關閉RP2-53 ,提出成立新TC提案

JTC 7
Discomfort caused by glare from luminaires with a non-uniform source luminance

To review the literature on glare from non-uniform light sources to identify the parameters that influence the discomfort prediction (UGR) and define limits to the applicability of the UGR formula.

To propose a correction to the UGR formula that takes into account the non-uniformity of glare sources.

於前年(2013) 4月由Div.3會議中提出
於去年(2014) 10月成立之新TC。
主席是日本的Naoya Hara博士
TC Co-Chair Miyoshi Ayama及
TC Secretary Gilles Vissenberg。

JTC 7
文件制訂時程

July. 2015—1st TC meeting
(physical at Manchester CIE Session, with via WebEx)
Dec. 2015 --Relevant literature compiled
Limiting parameters identified, establish limits
to UGR, decide whether intermediate report will
be issued or not.
Mar. 2016---2nd TC meeting at the CIE Conference
July. 2016 --Intermediate report (CIE Technical Note)
completed, if any
Jan. 2017 -- First Working Draft ballot in TC
Apr. 2017 --WD delivered to CIE Central Bureau
(Later steps as per Code of Procedure)

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JTC 7
任務分配

Task		Author + Member		Timeline		
				Review	First Working Draft	Final WD
5th ch.	Fundamental correction			Mar. 2016	Jul. 2016	Dec. 2016
	Story					
	Difference between UGR and ratings					
	Non-uniform background luminance					
	Color of the light					
	Foveal vision					
	Large light source					
	Overhead glare					
	Luminance image					

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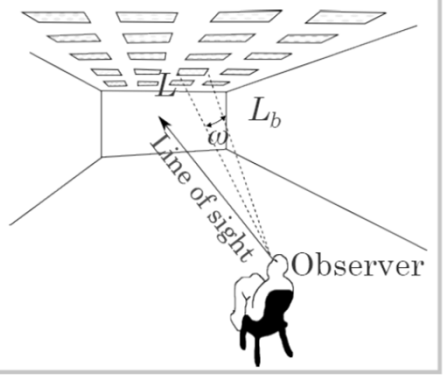
$$UGR = 8\log\left(\frac{0.25}{L_b}\sum\frac{L^2\omega}{p^2}\right)$$

(CIE 117, 1995)

UGR formula is the method of discomfort glare in **peripheral vision**

L is the luminaire luminance
ω is the solid angle of the luminaires
p is Guth position index of the luminaires
L_b is the background luminance



UGR value correspond to each category

UGR	Categories
31	intolerable
28	just intolerable
25	uncomfortable
22	just uncomfortable
19	unacceptable
16	just unacceptable
13	perceptible
10	just perceptible
7	imperceptible

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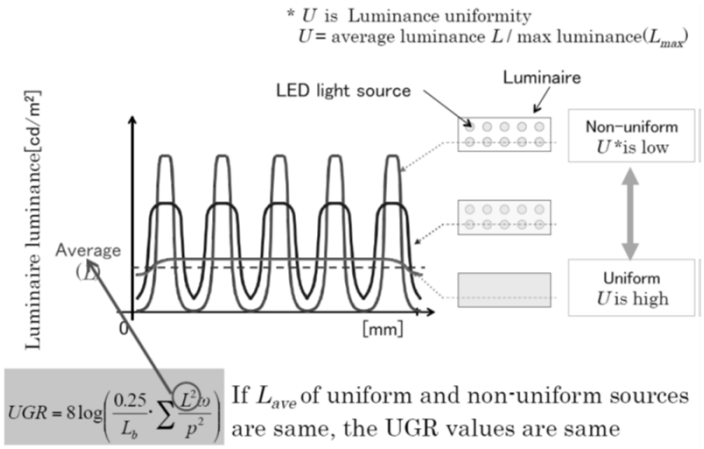

If L_{ave} of uniform and non-uniform sources are same, the UGR values are same

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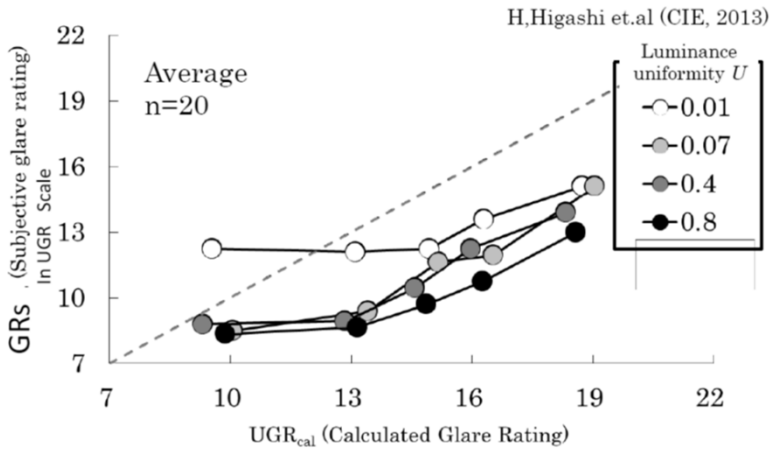

It is difficult to predict discomfort glare of uniform and non-uniform sources with UGR.

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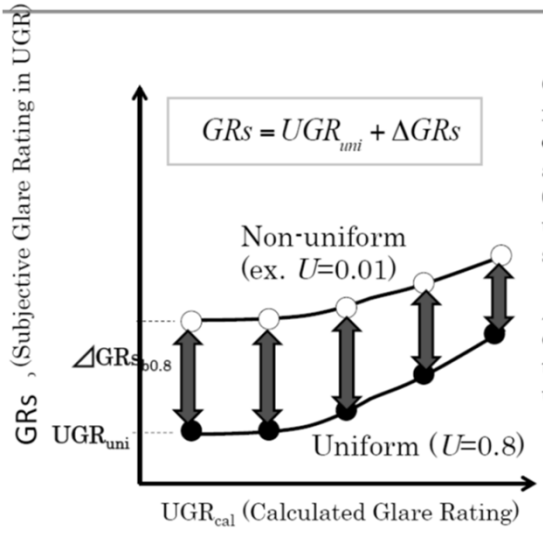

GRs of subjective glare rating are drawn in the calculated UGR using average luminance for 0.01 and 0.8 in luminance uniformity of the light source.

$\Delta GRs_{b0.8}$ means the difference of GRs between the uniform and the non-uniform.

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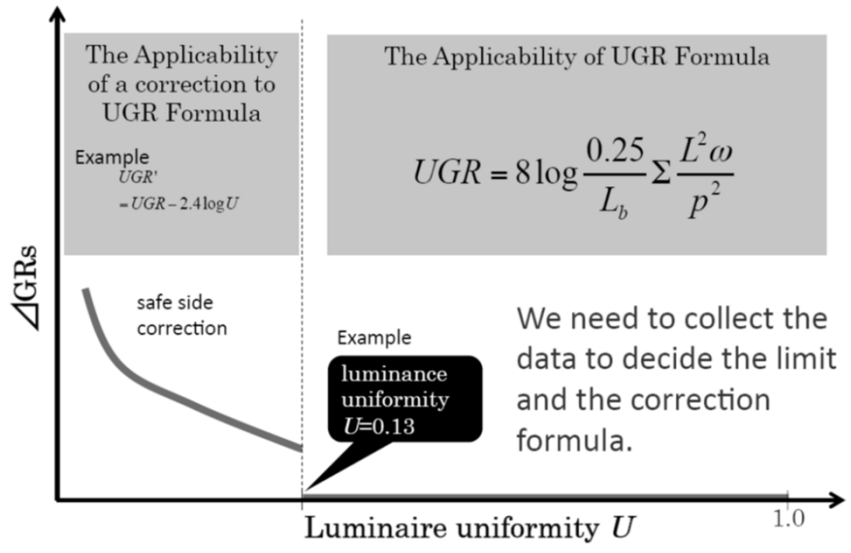

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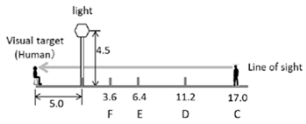
—OP19: Discomfort glare of LED street lights with different correlated color temperatures

此論文由日本Ayama教授(Utsunomiya University) 團隊發表，主要探討不同色溫下的LED街燈造成不適眩光的影響。原先的假設是認為高色溫可能的眩光會較嚴重，但經過實驗發現，不同的色溫不會影響眩光的感受，結果亦證實垂直照度作為評量眩光的程度有較高的關聯度。當用LED路燈取代傳統路燈時，可能些許的色溫差異並不會造成用路人的困擾，主要會造成眩光困擾，還是以進入到人眼的光強度為主要因素。

(a) test environment



(b) Schematic diagram of the test light, visual target, observing positions

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R2-52 Flicker measurement and flicker index study on solid state lighting

- The flicker disturbing human vision may depend on frequency, modulation, luminance level, spectrum and so on. To control the flicker of SSL in an acceptable range, the study of flicker index and its measurement is desirable.

Human impact

- Headaches
- Neurological problems: photosensitive epilepsy
- Autistic sensitivity
- Performance reduction

Safety

- Distraction
- Possible hazard from stroboscopic effect: apparent stopping or slowing of motion of machinery

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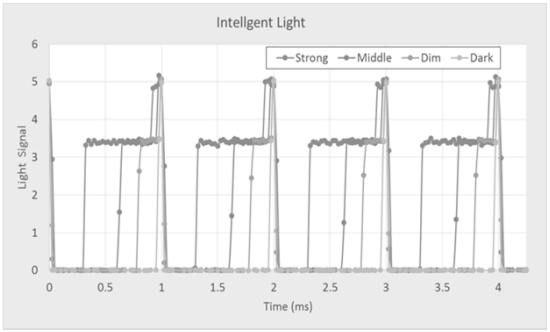
Flicker measurement for Smart Light Bulb



Light output level	Strong	Middle	Dim	Dark
Frequency (Hz)	1015	1015	1015	1015
Percent Flicker (%)	100	100	100	100
Flicker Index	0.290	0.561	0.730	0.923

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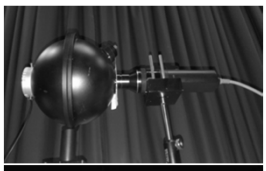
Flickermeter 1 test results

Flicker light source setting		Flickermeter results	
Frequency setting (Hz)	FMA setting (%)	FMA (%)	JEITA
10	18.2	17.2	-22.75
15	18.2	16.5	-22.89
20	18.2	21.1	-23.01
30	18.2	21.0	-25.86
40	18.2	21.0	-28.81
50	18.2	20.7	-34.94
60	18.2	18.1	-62.76



$$\mathrm{FMA} = 100\% \frac{V_{\max} - V_{\min}}{V_{\max}}.$$

Measure the maximum of the waveform $V_{\max}$.
Measure the minimum of the waveform $V_{\min}$.
Determine the percent flicker modulation amplitude (FMA) as follows.

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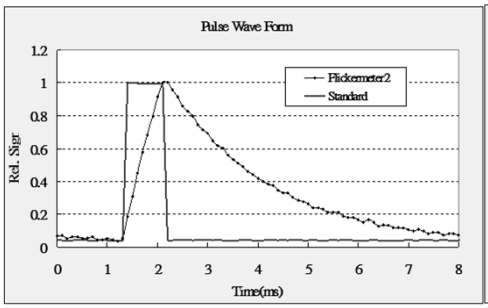
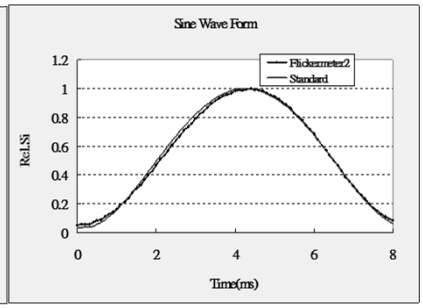
Flickermeter2 testing results





Pulse Wave	Standard flicker light output	Flickermeter 2
Frequency (Hz)	120	120
Percent Flicker(%)	93.6	92.8
Flicker Index	0.600	0.401

Sine Wave	Standard flicker light output	Flickermeter 2
Frequency (Hz)	120	119
Percent Flicker(%)	93.4	89.9
Flicker Index	0.272	0.268

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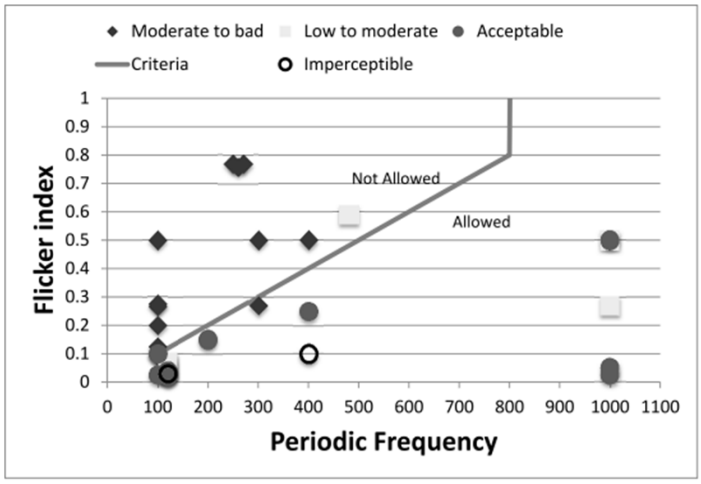

美國NPPL閃爍判定提案

Poplawski, M.E., Miller, N.M., Flicker in solid-state lighting: measurement technique and proposed reporting and application criteria. CIE Paper OP26, 188-202. Paris, FR: CIE, 2013.

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Published Lamps Specification V1.0 contains (only) flicker reporting requirement

12.3. Flicker:

Lamp Type	ENERGY STAR Requirements	Methods of Measurement and/or Reference Documents	Supplemental Testing Guidance
All Lamps Marketed As Dimmable	Lamp average light output periodic frequency, highest percent flicker, and highest flicker index shall be reported.	**Measurement:** ENERGY STAR Recommended Practice - Light Source Flicker	**Sample Size:** 1 lamp per dimmer and 4 lamps per dimmer See Section 8 of the Recommended Practice - Light Source Flicker, for reporting information.

https://www.energystar.gov/products/specs/sites/products/files/ENERGY_STAR_Lamps_V1_0_Final_specification.pdf

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TC 1-83 Visual Aspects of Time-Modulated Lighting Systems

Div.1討論閃爍量化指數的TC。

主席是飛利浦的研究員Dragan Sekulovski

1. To investigate and report on current research on the perception of visual artefacts of temporally modulated lighting systems, including flicker, the stroboscopic effect and the phantom array effect.
2. Design methodology and gather data on the visibility of temporal artefacts.
3. Build a model for the visibility of temporal artefacts and their dependence on environmental, demographical and lighting parameters.

TC 1-83 時程

Literature overview (done)
Agree on definitions (done)
Agree on best practices on methodologies (done)
Agree on the methods to extend to complex stimuli (done)
Frequency domain
Time domain
Reconcile data and identify where more data is needed (partially done, need more data, another overview in mid 2016)
Write up a technical note with the definitions, methods to extend to complex stimuli, and example sensitivity curves. Add methodologies to gather sensitivity data for simple stimuli. (First draft before Manchester meeting, publish early 2016)
· *Agree on sensitivity curves for simple stimuli (before end of 2016)*
· *Based on the technical note, extend to a technical report of the TC (before end of 2016)*

TC 1-83 內容

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1 Introduction
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5 Recommendations and future work
5.1 Recommended models
5.2 Recommended methodologies for sensitivity data gathering
References

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TC 1-83 參數分類及評估方指標

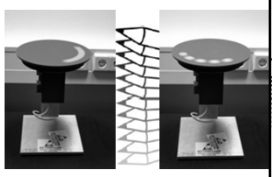
Flicker

- The perception of temporal changes in the intensity (luminance flicker) or color (chromatic flicker) of the light

⟹ IEC TR61547-1的P_{st}指數做為量化評估指數

Stroboscopic effect

- The perception that objects illuminated by fluctuated
- light move discretely rather than continuously



⟹ 此TC發展的SVM指數量化評估

Ghost effect (phantom array)

- The perception of a spatially extended series of light spots when making a saccade across a light spot that fluctuates over time

⟹ 尚無參數可量化。

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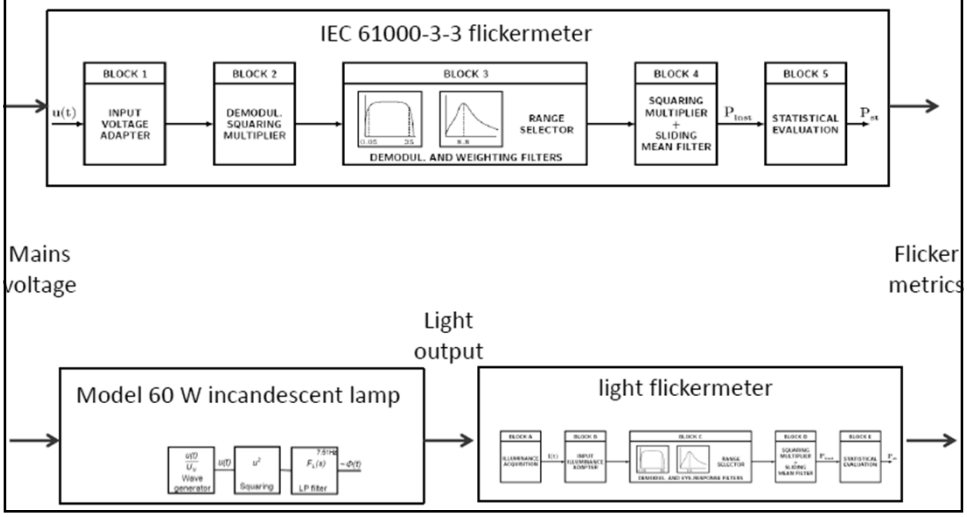
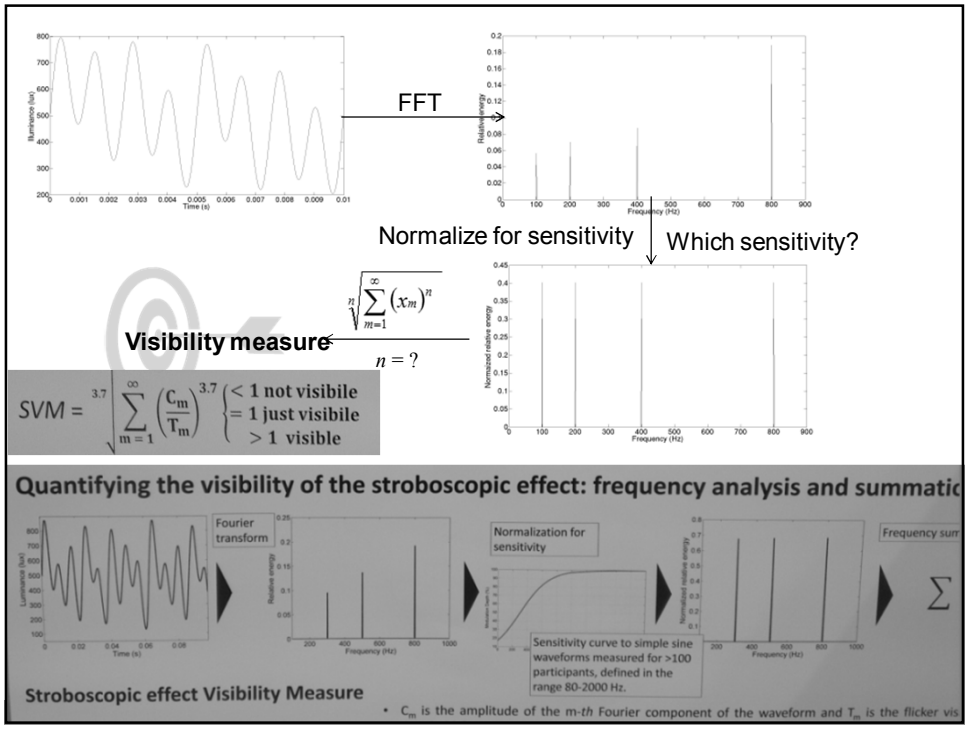
IEC TR61547的P_{st}指數

IEC voltage flickermeter & the light flickermeter





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$$SVM = \sqrt[3.7]{\sum_{m=1}^{\infty}\left(\frac{C_m}{T_m}\right)^{3.7}} \begin{cases} < 1 \text{ not visibile} \\ = 1 \text{ just visibile} \\ > 1 \text{ visible} \end{cases}$$

C_m is the amplitude of the m-th Fourier component of the waveform

T_m is the flicker visibility threshold for a sine wave at the frequency of the m-th Fourier component, expressed in terms of modulation depth

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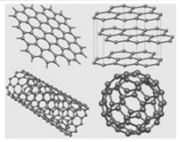
Thanks for your attention!



~謝謝~

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