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Recommended standard for interoperability between ERC DLLs and AHU selection software

First Edition

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Document history

This Eurovent Industry Recommendation / Code of Good Practice supersedes all of its previous editions, which automatically become obsolete with the publication of this document.

Modifications

This Eurovent publication was modified as against previous editions in the following manner:

Modifications as against	Key changes
1st edition	Current document

Preface

In a nutshell

This document provides a recommended future standard for interoperability between the ERC DLL and AHU software to implement the provisions of EN 308:2022 and expected new Ecodesign requirements in air handling unit selection calculations with respect to internal leakage and moisture recovery.

It specifies the principles of data exchange at the interface between the AHU and ERC software to account for the impact of internal leakage on AHU performance. The document also comments on the implementation of ERC DLL outputs in AHU calculations.

To complement the main subject of the document, Appendix A lists other relevant and recommended DLL outputs and Appendix B provides the ventilation air terminology.

Authors

This document was published by Eurovent and was prepared in a joint effort by participants of the Product Groups 'Energy Recovery Components' (PG-ERC) and 'Air Handling Units' (PG-AHU), which represents a vast majority of all manufacturers of these products active on the EMEA market. Particularly important contribution has been provided (in alphabetical order of the last name) by Gunnar Berg, Jaroslav Chlup, Laurence Higginson, Martin Lenz, Viktor Levickij, Rikard Lindbom, Thomas Richter, Timo Schreck, Igor Sikonczyk, Søren Søholm and Fredrik Wolff.

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Important remarks

Eurovent does not grant any certification based on this document. All certification-related issues are managed by the association's independent subunit Eurovent Certita Certification in Paris. For more information, visit www.eurovent-certification.com.

Contents

List of abbreviations and symbols

AHU	Air Handling Unit
ASL	Above sea level
DLL	Dynamic-Link Library (integral sub-programme integrated with the AHU selection software to calculate the ERC performance based on the AHU selection input data; developed and provided by the component supplier)
EATR	Exhaust Air Transfer Ratio expressed in % (ratio between the exhaust air amount in supply air and supply air mass flow)
ECC	Eurovent Certita Certification
EHA	Exhaust Air (airflow leaving the extract air treatment system and discharged to the atmosphere). Alternatively, the term *Exhaust air outlet* is used (see Appendix B)
ERC	Energy Recovery Component
ETA	Extract Air (airflow leaving the treated room and entering the air treatment system). Alternatively, the term *Exhaust air inlet* is used (see Appendix B)
OACF	Outdoor Air Correction Factor (ration between ODA and SUP mass flows)
ODA	Outdoor Air (airflow entering the system from outdoors before heat recovery) Alternatively, the term *Supply air inlet* is used (see Appendix B)
PHE	Plate Heat Exchanger
RHE	Rotary Heat Exchanger
SUP	Supply Air (airflow entering the treated room after heat recovery) Alternatively, the term *Supply air outlet* is used (see Appendix B).

Referred standards and documents

[1] EN 308:2022 – Heat exchangers – Test procedures for establishing performance of air to air and flue gases heat recovery devices

[2] EN 13053:2019 - Ventilation for buildings - Air handling units - Rating and performance for units, components and sections

[3] EN 16798-3:2017 - Energy performance of buildings - Ventilation for buildings - Part 3: For non-residential buildings – Performance requirements for ventilation and room-conditioning[4] TCR EPC 08 – 05-2020 'Technical certification rules of the Eurovent Certified Performance Mark – Air to Air plate and tube heat exchangers'

[5] TCR EPC 10 – 05-2020 'Technical certification rules of the Eurovent Certified Performance Mark – Air to Air regenerative heat exchangers'

[6] Eurovent 6/15 - 2021: Air Leakages in Air Handling Units

[7] PP – 2020-12-18 - Eurovent Proposal for a simplified method for calculating the corrected power consumption of the fans and SFPint based on the OACF and EATR

1 Introduction

This document outlines the Eurovent recommended future Code of Good Practice regarding the interoperability and standard for data exchange between the Dynamic-Link Library (DLL) of the energy recovery component and the AHU selection software for the correct and consistent determination of the AHU performance. The Code of Good Practice aims to implement in a methodical way the provisions of EN 308:2022 and expected new Ecodesign requirements in air handling unit selection calculations.

In particular, recommended principles for interoperability between the ERC DLL and AHU software primarily in determining the impact of OACF and EATR on AHU performance and the list of required inputs and outputs are addressed.

The document does not impose any recommendations on the current-day requirements but projects a possible path to reach the goal in the future, which is the appropriate handling of OACF/EATR and AHU calculations. Its objective is to set a direction in which future modifications in tests and software development should follow.

The current obstacles to implementing the proposed approach are also pointed out and discussed.

Finally, the paper attends to systematise variables used in communication between the ERC and AHU software and to explain their proper use.

2 Reference technical basis for determining ERC performance

Technical parameters of the heat exchanger calculated by its DLL should be determined with reference to:

EN 308:2022
EN 308 - Heat exchangers - Test procedures for establishing performance of air-to-air heat recovery components

For plate heat exchangers (PHE):
TCR EPC 08 – 05-2020 'Technical certification rules of the Eurovent Certified Performance Mark – Air to Air plate and tube heat exchangers' OR its future updated version implementing the provision of EN 308:2022

For rotary heat exchangers (RHE):
TCR EPC 10 – 05-2020 'Technical certification rules of the Eurovent Certified Performance Mark – Air to Air regenerative heat exchangers' OR its future updated version implementing the provision of EN308:2022

3 Interoperability between ERC DLL and AHU Software regarding the impact of OACF and EATR in case of rotary heat exchangers

3.1 For complete rotary heat exchangers

Complete rotary exchanger means an exchanger assembled by the ERC supplier and comprising sealing system, drive and purge sector, if applicable.

3.1.1 Recommended approach

- OACF and EATR values should be determined by the RHE DLL for the actual working conditions, including $\Delta P_{22\text{-}11}$, applied sealing system and configuration of the purge sector.
- Impact of leakages (OACF, EATR) should be accounted for in the actual volume airflow rates returned by the DLL as follows:

$q_{SUPcorr} = q_{SUP} \cdot (1+EATR)$

$q_{ETAcorr} = q_{ETA} + q_{SUP} \cdot EATR$

$q_{ODAcorr} = q_{SUPcorr} \cdot OACF$

$q_{EHAcorr} = q_{ETAcorr} + q_{SUPcorr} \cdot (OACF-1)$

3.1.2 Current barriers to implement the recommended approach

- Not all ERC suppliers have measured the dynamic characteristics of their products simultaneously considering the actual values of various parameters.
- The definition of dynamic characteristic measurements needs to be clearly specified by the Eurovent Certita Certification Programme Committee for plate and rotary heat exchangers (PC-AAHE and PC-AARE).
- Tests under TCR EPC 10 – 05-2020 do not sufficiently reflect actual conditions, for example
  - Measurement only at face velocity of 2 m/s
  - OACF measured only at 0, 250, 500 and 750 Pa
  - OACF and EATR measured only at 250 Pa
- New EN 308:2022 gives adequate testing conditions to determine the characteristics of internal leakages. The testing can also be extended to other airflows if the ERC supplier so wishes.

3.2 For incomplete rotary exchangers

Incomplete rotary exchanger means an exchanger assembled from components by the AHU manufacturer.

Determination of OACF and EATR values for actual working conditions is up to the AHU manufacturer. The document does not discuss such this case.

3.3 Correction of AHU performance

3.3.1 Recommended approach

The AHU manufacturer is responsible for the correction of AHU performance, including airflow rates, pressure losses and fan powers, resulting from OACF and EATR values (determined as per 3.1.1) in line with Eurovent 6/15 [6].

3.3.2 Current barriers to implement the recommended approach

Not all AHU selection programs are ready or suitable to implement the Eurovent guidelines, as well as many of the ERC DLLs are not able to provide adequate data for correct calculation of the internal leakages. Concerned manufacturers should update their selection programmes as soon as possible.

4 Mandatory and optional variables for ERC DLLs and AHU software

4.1 Requirements for AHU software

4.1.1 Mandatory input variables

Mandatory variables to be provided by the AHU software as inputs to the ERC DLL include.

- *Either* Air volume flows on the building side and the corresponding air density
  - exhaust air inlet, q_{v11}
  - supply air outlet, q_{v22}
  - corresponding density, ρ (by default 1.2 kg/m³ at 20°C and 101 325 Pa)
- *Or* Air mass flows on the building side
  - exhaust air inlet, q_{m11}
  - supply air outlet, q_{m22}
  - corresponding density, ρ (by default 1.2 kg/m³ at 20°C and 101 325 Pa)
- Temperature on inlet sides
  - exhaust air inlet temperature, t_{11}
  - supply air inlet temperature, t_{21}
- Relative humidity on inlet sides
  - exhaust air inlet humidity, φ_{11}
  - supply air inlet humidity, φ_{21}
- Pressure difference at ΔP_{22-11} at actual operating conditions.
- Purge sector configuration (or no purge) and sealing system type, according to specifications in the ERC DLL manual and product handbook.

4.1.2 Optional input variables

- Actual air density, if the AHU 'air flow rate - pressure performance characteristic' is computed at a density other than 1.2 kg/m³ due to a specific altitude above sea level and at 20°C.

4.2 Requirements for DLLs of plate heat exchangers (PHE)

4.2.1 Mandatory DLL outputs and items on PHE selection software printouts

Table 1 below gives the essential outputs of PHEs in the context of the scope of this recommendation. Requirements for items not listed in Table 1 shall apply in accordance with TCR EPC 08 - 05-2020 clause II.1.2.

Symbol	Item	Remarks
$\eta_{t\text{-}dry\text{-}1:1}$ (dry and balanced)	Temperature efficiency under dry condition and at balanced mass flows **Comment on implementation in AHU software** Value corresponding to thermal efficiency as per Regulation (EU) 1253/2014	- At temperature difference of 20K (t_{21} = +5°C and t_{11} = 25°C) - In relation to supply air mass flow - Gross efficiency acc. EN 308:2022
$\eta_{t\text{-}dry}$ (dry)	Temperature efficiency under dry condition **Comment on implementation in AHU software**	- For dry operation of PHE without humidity transfer AND

	Value used to determine the thermal performance according to EN 13053 under actual temperatures and mass flow ratio	- For actual conditions of PHE with humidity transfer efficiency calculated on the supply side - Net efficiency acc. EN 308:2022
$\eta_{t\text{-}wet}$ (wet)	Temperature efficiency under wet condition	- For wet operation under actual conditions of plates without humidity transfer (latent heat recovery). - efficiency calculated on the supply side. - Net efficiency acc. EN 308:2022
η_{x_nrvu}	Humidity efficiency at balanced mass flows under summer conditions	- Only for PHEs with moisture recovery under summer conditions Draft reviewed VU Regulation (1253/2014) introduces the efficiency of total recovered energy defined as $\eta_{e\_nrvu} = \eta_{t\_nrvu} + 0.08 \cdot \eta_{x\_nrvu}$ Where η_{x_nrvu} is measured for the following summer air conditions: t_{21} = 35°C / 24°C (dry / wet bulb temp.) t_{11} = 25°C / 18°C (dry / wet bulb temp.)
Δp_1	Pressure drop on exhaust air side at standard density (1.2 kg/m³) and dry conditions **Comment on implementation in AHU software** This value is used to compute the AHU air flow rate/pressure performance characteristic at standard conditions according to EN 13053	- Δp_1 shall be given with consideration of the actual $\Delta P_{22\text{-}11}$ impact due to the deformation of plates. ***Current barrier*** *at present, a basis for deformation test is often only 200 Pa but new EN 308:2022 is expecting to test the PHE to its max allowed pressure difference* - Alternatively, Δp_1 can be given at $\Delta P_{22\text{-}11} = 0$, and a Δp_1 deviation due to the actual $\Delta P_{22\text{-}11}$ is reported separately
Δp_2	Pressure drop on supply air side at standard density (1.2 kg/m³) and dry conditions **Comment on implementation in AHU software** This value is used to compute the AHU air flow rate/pressure performance characteristic at standard conditions according to EN 13053	- Δp_2 shall be given with consideration of the actual $\Delta P_{22\text{-}11}$ impact due to the deformation of plates. - Alternatively, Δp_2 can be given at $\Delta P_{22\text{-}11} = 0$, and a Δp_2 deviation due to the actual $\Delta P_{22\text{-}11}$ is reported separately
q_{v11}	Exhaust air inlet volume flow at standard conditions	At 1.2 kg/m³

q_{v12}	Exhaust air outlet volume flow at standard conditions	
q_{v21}	Supply air inlet volume flow at std. conditions	
q_{v22}	Supply air outlet volume flow at std. conditions	
Δp_{max}	Limit pressure difference $\Delta P_{22\text{-}11}$ between exhaust and supply air sides	No permanent deformation of plates

Table 1. Mandatory DLL outputs for PHE

4.2.2 Optional DLL outputs and items on PHE selection software printouts

Used if the 'air flow rate - pressure performance characteristic' of the AHU is computed at 20°C and a density other than 1.2 kg/m³ due to a given altitude above sea level.

Symbol	Item	Remarks
ρ_{act}	Actual air density	Related to a specific altitude above sea level (ASL)
Δp_{1_act}	Pressure drop on exhaust air side at the actual air density (other than 1.2 kg/m³) **Comment on implementation in AHU software** This value is used to compute the AHU air flow rate/pressure performance characteristic at the actual density due to a specific altitude ASL	- Δp_{1_act} shall be given with consideration of the actual $\Delta P_{22\text{-}11}$ impact due to the deformation of plates. - Alternatively, Δp_{1_act} can be given at $\Delta P_{22\text{-}11} = 0$, and a Δp_{1_act} deviation due to the actual $\Delta P_{22\text{-}11}$ is reported separately
Δp_{2_act}	Pressure drops on supply air side at the actual air density (different than 1.2 kg/m³) **Comment on implementation in AHU software** This value is used to compute the AHU air flow rate/pressure performance characteristic at the actual density due to a specific altitude ASL	- Δp_{2_act} shall be given with consideration of the actual $\Delta P_{22\text{-}11}$ impact due to the deformation of plates. - Alternatively, Δp_{2_act} can be given at $\Delta P_{22\text{-}11} = 0$, and a Δp_{2_act} deviation due to the actual $\Delta P_{22\text{-}11}$ is reported separately
q_{v11_act}	Exhaust air inlet volume flow at actual density	Actual air volume flows corresponding to air density other than 1.2 kg/m³
q_{v12_act}	Exhaust air outlet volume flow at actual density	
q_{v21_act}	Supply air inlet volume flow at actual density	
q_{v22_act}	Supply air outlet volume flow at actual density	

Table 2. Optional DLL outputs for PHE exchangers

4.3 Requirements for DLLs of complete rotary heat exchangers (RHE)

4.3.1 Mandatory DLL outputs and items on RHE selection software printouts

Table 3 below gives the essential outputs of RHEs in the context of the scope of this recommendation. Requirements for items not listed in Table 3 shall be applied in accordance with TCR EPC 10 - 05-2020 clause II.1.2.

Symbol	Item	Remarks
$\eta_{t\ -1:1}$ (dry and balanced)	Temperature efficiency under dry condition and at balanced mass flows **Comment on implementation in AHU software** Value corresponding to thermal efficiency (η_{t_nrvu}) as per Regulation (EU) 1253/2014	- At temperature difference of 20K (t_{21} = +5°C and t_{11} = 25°C) - In relation to supply air mass flow - Net efficiency acc. EN 308:2022
η_t	Temperature efficiency **Comment on implementation in AHU software** Value used to determine the thermal performance according to EN 13053 under actual temperatures and mass flow ratio	- Efficiency calculated on supply side - Net efficiency acc. EN 308:2022
η_{x_nrvu}	Humidity efficiency at balanced mass flows under summer conditions	- Only for RHEs with moisture recovery under summer conditions Draft reviewed VU Regulation (1253/2014) introduces the efficiency of total recovered energy defined as $\eta_{e\_nrvu} = \eta_{t\_nrvu} + 0.08 \cdot \eta_{x\_nrvu}$ Where η_{x_nrvu} is measured for the following summer air conditions: t_{21} = 35°C / 24°C (dry / wet bulb temp.) t_{11} = 25°C / 18°C (dry / wet bulb temp.)
Δp_1	Pressure drop on exhaust air side at standard conditions (1.2 kg/m³) **Comment on implementation in AHU software** This value is used to compute the AHU air flow rate/pressure performance characteristic at standard conditions according to EN 13053	- Δp_1 shall be given with consideration of the OACF and EATR impact at the actual $\Delta P_{22\text{-}11}$ - Alternatively, Δp_1 can be given at $\Delta P_{22\text{-}11}$ = 0, and a Δp_1 deviation due to the actual $\Delta P_{22\text{-}11}$ is reported separately
Δp_2	Pressure drop on supply air side at standard conditions (1.2 kg/m³)	- Δp_2 shall be given with consideration of the OACF and EATR impact at the actual $\Delta P_{22\text{-}11}$.

	Comment on implementation in AHU software This value is used to compute the AHU air flow rate/pressure performance characteristic at standard conditions according to EN 13053	- Alternatively, Δp_2 can be given at $\Delta P_{22\text{-}11} = 0$, and a Δp_2 deviation due to the actual $\Delta P_{22\text{-}11}$ is reported separately
q_{v11}	Exhaust air inlet volume flow at standard conditions	At 1.2 kg/m³
q_{v12}	Exhaust air outlet volume flow at standard conditions	
q_{v21}	Supply air inlet volume flow at std. conditions	
q_{v22}	Supply air outlet volume flow at std. conditions	
OACF	Outdoor Air Correction Factor	At standard conditions (1.2 kg/m³), actual $\Delta P_{22\text{-}11}$ and purge sector configuration specified by the customer. If $\Delta P_{22\text{-}11}$ is not specified during the selection, OACF and EATR are provided at $\Delta P_{22\text{-}11} = 250$ Pa ***Current barrier*** *at present, a default $\Delta P_{22\text{-}11}$ test value is 250 Pa*
EATR	Extract Air Transfer Ratio	
q_{v11_corr}	Actual exhaust air inlet volume flow at 1.2 kg/m³	$q_{v11\_corr} = q_{v11} + q_{v22} \cdot EATR$
q_{v22_corr}	Actual supply air outlet volume flow at 1.2 kg/m³	$q_{v22\_corr} = q_{v22} \cdot (1 + EATR)$
q_{v21_corr}	Actual supply air inlet volume flow at 1.2 kg/m³	$q_{v21\_corr} = q_{v22\_corr} \cdot OACF$
q_{v12_corr}	Actual exhaust air outlet volume flow at 1.2 kg/m³	$q_{v12\_corr} = q_{v11\_corr} + q_{v22\_corr} \cdot (OACF-1)$
	Comment on implementation in AHU software Values q_{v11_corr}, q_{v22_corr}, q_{v12_corr} and q_{v21_corr} are used for correcting AHU performance due to leakages (OACF, EATR) in line with Eurovent 6/15	
	Manufacturer's code or designation of the sealing system	applied to determine OACF and EATR
	Configuration of the purge sector	applied to determine OACF and EATR and specified during selection by the customer

Table 3. Mandatory DLL outputs for RHE exchangers

4.3.2 Optional DLL outputs and items on RHE selection software printouts

Used if the 'air flow rate - pressure performance characteristic' of the AHU is computed at 20°C and a density other than 1.2 kg/m³ due to a given altitude above sea level.

Symbol	Item	Remarks
ρ_{act}	Actual air density	Related to a given altitude above sea level (ASL)
Δp_{1_act}	Pressure drop on exhaust air side at the actual air density (other than 1.2 kg/m³) **Comment on implementation in AHU software** This value is used to compute the AHU air flow rate/pressure performance characteristic at the actual density due to a specific altitude ASL	- Δp_{1_act} shall be given with consideration of the actual ΔP_{22-11} impact. - Alternatively, Δp_{1_act} can be given at ΔP_{22-11} = 0, and a Δp_{1_act} deviation due to the actual ΔP_{22-11} is reported separately
Δp_{2_act}	Pressure drop on supply air side at the actual air density (other than 1.2 kg/m³) Comment on implementation in AHU software This value is used to compute the AHU air flow rate/pressure performance characteristic at the actual density due to altitude ASL	- Δp_{2_act} shall be given with consideration of the actual ΔP_{22-11} impact. - Alternatively, Δp_{2_act} can be given at ΔP_{22-11} = 0, and a Δp_{2_act} deviation due to the actual ΔP_{22-11} is reported separately
q_{v11_act}	Exhaust air inlet volume flow at actual density	Actual air volume flows corresponding to air density different than 1.2 kg/m³
q_{v12_act}	Exhaust air outlet volume flow at actual density	
q_{v21_act}	Supply air inlet volume flow at actual density	
q_{v22_act}	Supply air outlet volume flow at actual density	

Table 4. Optional DLL outputs for RHE exchangers

APPENDIX A - other recommended DLL outputs

In addition to the outputs given in Tables 1 to 4, which are directly related to the subject matter of this recommendation, the following outputs are recommended to be implemented in the ERC DLLs.

Additional recommended DLL outputs for PHE

Symbol	Item	Remarks
$\Delta p_{1\ wet}$	Pressure drop on extract air side at standard density (1.2 kg/m^3) and wet extract air conditions **Comment on implementation in AHU software** Value used to compute the specific fan power of the entire building (P_{SFPd}) acc. EN 16798-3	The average value of Δp_1 and $\Delta p_{1\ wet}$ is required by EN 16798-3
$\Delta p_{2\ wet}$	Pressure drop on supply air side at standard density (1.2 kg/m^3) and wet extract air conditions **Comment on implementation in AHU software** Value used to compute the specific fan power of an entire building (P_{SFPd}) acc. EN 16798-3	The average value of Δp_2 and $\Delta p_{2\ wet}$ is required by EN 16798-3
t_{freez}	Freezing protection temperature	Supply air inlet temperature at which the freezing risk occurs under actual operating conditions.

Table 5. Additional recommended DLL outputs for PHE

Additional recommended DLL outputs for RHE

Symbol	Item	Remarks
n	Rotor speed	
P_{el}	Rotor nominal electrical power input	

Table 6. Additional recommended DLL outputs for RHE

APPENDIX B – Ventilation air terminology

Table 7 collates the ventilation air terminology used in the ERC-related EN 308 standard and in ventilation / AHU-related EN 13053, EN 13141-7 and EN 16798-3 standards.

EN 308		EN 13053, EN 13141-7, EN 16798-3		
Sub.	Term	Term	Abbreviation	Colour
11	Exhaust air inlet	Extract air	ETA	Yellow
12	Exhaust air outlet	Exhaust air	EHA	Brown
21	Supply air inlet	Outdoor air	ODA	Green
22	Supply air outlet	Supply air	SUP	Blue

Table 7. Ventilation air terminology

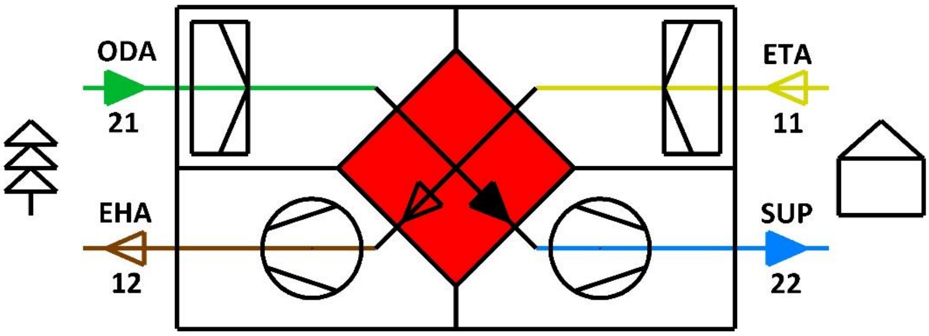

Figure 1. Marking of air flows in the ventilation unit / system

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Eurovent is Europe's Industry Association for Indoor Climate (HVAC), Process Cooling, and Food Cold Chain Technologies. Its members from throughout Europe represent more than 1.000 organisations, the majority small and medium-sized manufacturers. Based on objective and verifiable data, these account for a combined annual turnover of more than 30bn EUR, employing around 150.000 people within the association's geographic area. This makes Eurovent one of the largest cross-regional industry committees of its kind. The organisation's activities are based on highly valued democratic decision-making principles, ensuring a level playing field for the entire industry independent from organisation sizes or membership fees.

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