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AUTOMOTIVE SUMMIT 2016

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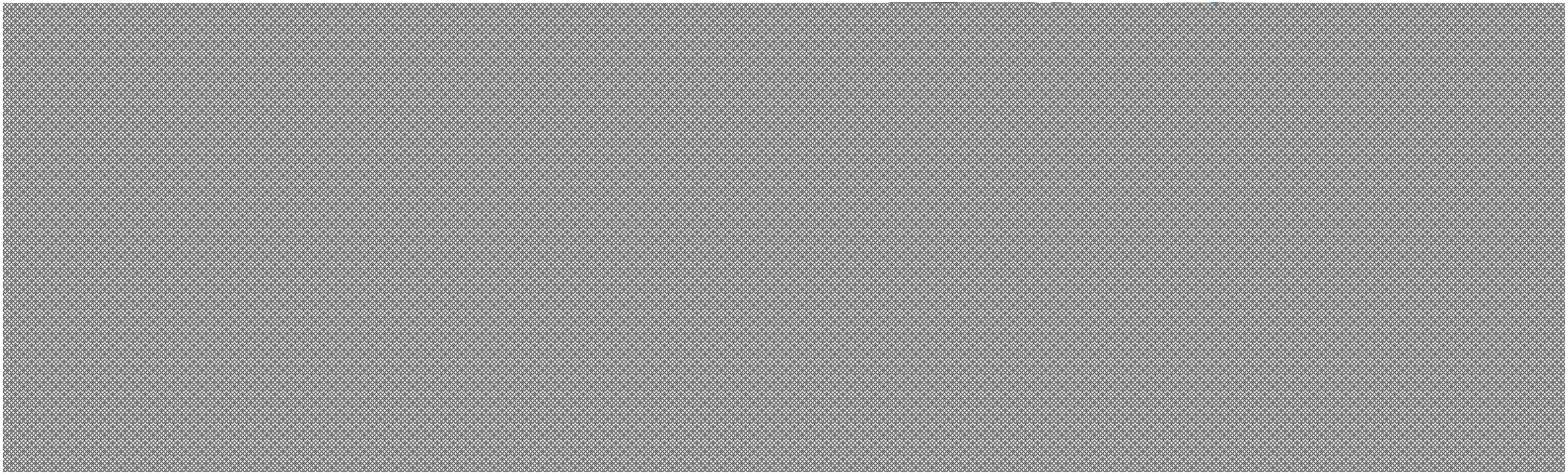

ECE R90 Regulation

FAQ & HORIBA Solution

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Speaker Introduction

Started work at Carl Schenck AG

Development Test Systems 1992

Manufacturer of Automotive Test Systems

SCHENCK Service Station Australia

SCHENCK Korea Ltd

HORIBA Instruments (Shanghai) LTD

HORIBA China Trading LTD

HORIBA (Thailand) LTD

Responsible for Mechatronics products in ASEAN Region

Agenda

ECE R90 Regulation / FAQ & HORIBA Solution

1	**History**
2	Application (ECE R90 in Detail)
3	HORIBA Solutions (HORIBA-ANT Rhein-Main Brake Test Center)
4	Summary

Overview

ECE R90 Regulation / FAQ & HORIBA Solution

History

- ECE = Economic Commission for Europe
- European Community works on regulations to make vehicles safe (since 1958)
- Regulations apply to all 28 EU member states
- ECE Regulation 90 (ECE R90), was **first introduced in Europe back in the 1990's** in an attempt to make sure that replacement brake pads and brake shoe and lining assemblies would perform safely upon installation
- **September 1999 the ECE R90** stipulates that all brake pads sold for use **must be tested** and comply to R90 standards
- As of November 2014, ECE Regulation 90 (which specifies design, construction and performance requirements for brake linings) has been **expanded to brake discs and drums**

Overview

ECE R90 Regulation / FAQ & HORIBA Solution

History

- Enforcement period: From November 2014 to November 2016
- From November 2014:
- **All heavy commercial vehicle** (HCV) brake discs and drums (including those for **buses and trailers**) manufactured and sold across Europe will have to meet the minimum standards outlined in the ECE R90 legislation
- **From November 2016** these rules will also apply to **passenger cars and light commercial vehicles** (LCV)
- In order to meet these standards, the parts must pass a series of tests and perform to levels **similar to the Original Equipment part**

Overview

ECE R90 Regulation / FAQ & HORIBA Solution

History

- **Full implementation** of the expanded rule **is set for November 1st, 2016** for passenger cars and light commercial vehicles.
- “These regulations will make it much harder for sub-standard and counterfeit products to reach the market and seriously compromise driver safety.“
  (Richard Adgey, product group manager for braking products and services at TRW Automotive)
- This new timeline applies to **all friction materials, disc & drums** intended for sale and entry into service (passenger cars, light trucks, buses, tractors, trailers and semitrailers)
- Ultimately, **all replacement brake parts** for vehicles type-approved in the 58 countries that recognize the rules of the World Forum for Harmonization of Vehicle Regulations will be required to perform in a manner **similar to the originals**

UN Code	Country	Effective date
1	Germany	28 January 1965
2	France	20 June 1959
5	Sweden	20 June 1959
42	European Union	24 March 1998
43	Japan	24 November 1998
51	South Korea	31 December 2004
52	Malaysia	4 April 2006
53	Thailand	1 May 2006

Overview

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What we learned…?!

The latest regulation adds brake discs and drums to the mix

They must be tested and measured in the following three ways:

- braking performance
- thermal fatigue
- and braking load strength

For a part to be certified it must meet the requirements for all three metrics

Without that certification, these brake components will be **unable to be sold to the European market**

Overview

ECE R90 Regulation / FAQ & HORIBA Solution

Why to obtain type approval on products?

Brake pads with different qualities vary widely

The different technical **release criteria of each country** often do not harmonize with those from other countries

Although identical looking, **the brake pads distinguish** among themselves

Central characteristics

- performance
- fading resistance
- temperature resistance
- response and noise

Overview

ECE R90 Regulation / FAQ & HORIBA Solution

Why to obtain type approval on products?

Therefore, it was time for a **Europe-wide mandatory standard**, which was finally created with the ECE R90

The test includes **cold and hot brake friction analysis**

If a part has been approved to R90, it can be safely assumed that the **product is equal to or better than** the original equipment product

The intent of the regulation is to ensure that a service brake part performs within a **prescribed tolerance of the Original Equipment (OE) part** it is intended to replace

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Application

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By formulation, **by part number** or by vehicle?

Different from FMVSS procedures (test by vehicle), **the ECE R90 is by part number**

If there are multiple vehicle applications, the test is conducted **on the worst-case vehicle** application based on

- Vehicle weight
- Maximum speed
- And foundation brake
- For disc and drums, their mass also is taken into account to select the worst-case vehicle

Application

ECE R90 Regulation / FAQ & HORIBA Solution

Retest and certify again?

- **The approval authority** will conduct an audit or document **review within one-to-two years** for the initial type approval date
- **Additional testing** is required **if there are changes** to the product design or formulation of the parts
  - which affects its performance
  - After significant changes to the business structure or quality system
  - Whenever there are major changes to the ECE R90
  - Some additional tests can be mandated by the related approval authority

Application

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ECE category	Number of occupants		Vehicle weight/tonne					
	1 - 8	9 or more	=> 0.75	0.75-3.5	3.5-5	5 - 10	10 - 12	12=>
M_1	■							
M_2		■	■	■	■			
M_3		■				■	■	■
N_1			■	■				
N_2					■	■	■	
N_3								■
O_1			■					
O_2				■				
O_3					■	■		
O_4							■	■

M=passenger cars > 1 tonne; N=cargo or goods transport > 1 tonne,
O=trailers and semitrailers

Application

ECE R90 Regulation / FAQ & HORIBA Solution

ECE category	Friction materials (pads and lining)	Discs		Drums
	2014	**2014**	**2016**	**2016**
M_1	✓		✓	✓
M_2	✓	✓		✓
M_3	✓	✓		✓
N_1	✓		✓	✓
N_2	✓	✓		✓
N_3	✓	✓		✓
O_1	✓		✓	✓
O_2	✓		✓	✓
O_3	✓	✓		✓
O_4	✓	✓		✓

All friction materials, discs and drums have specific deadlines extending until November 1st 2016

Application

ECE R90 Regulation / FAQ & HORIBA Solution

How to obtain type approval on products?

- Submit samples of your friction materials, discs or drums to an **ISO 17025-accredited technical service** (with ECE R90 on its scope)
- It needs to be approved by a **recognized certification service** from a country **within the European Community**
- The product is compared to a set of minimum requirements or to the original product (OE)
  - **approved for the worst-case vehicle application**

Application

ECE R90 Regulation / FAQ & HORIBA Solution

Aftermarket vs. OE products

- The replacement **(aftermarket) product is compared to the OE product**
  - Friction coefficient
  - Brake factor
  - Stopping distance
  - or mean fully developed deceleration (mfdd) are compared
- Equivalent or **interchangeable brake discs and drums are compared to the OE** for the integrity test regarding the cycle failure

Application

ECE R90 Regulation / FAQ & HORIBA Solution

Which test – **for brake pads** and for **brake discs?**

- Test procedure and requirements depends upon the vehicle category and the component
  - **Friction material** are tested for performance compared to the OE
  - Friction behaviour compared to its own specification
  - Ambient and elevated temperature compressibility
  - Bonding shear strength for disc brakes
  - Hardness for drum lining
  - Verification of non-Asbestos
  - **Discs and drums** are tested for geometry, material composition, balancing and wear markings
  - Integrity testing for thermal fatigue and high load
  - Service & parking brake compared to the OE of the ECE

Application

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Vehicle **Categories**

- While **vehicle tests** need to be done for Categories M_1, M_2 and N_1
  - expensive, time consuming and subject to road conditions and weather variability
- **Brake dynamometer** testing in the laboratory is
  - faster and less costly to screen or verify for e.g. friction material characteristics
  - more efficient
  - allow destructive integrity tests (for e.g. thermal fatigue & high load)
- Furthermore, because of the capability to control test conditions precisely, a **brake dynamometer** serves as **an excellent tool for the research and development** of friction materials.

Application

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ECE R90 Test Procedure **for Brake Pads**

- For the tests the **vehicle brake** for which the replacement linings are designed **is installed in an inertia dynamometer** instrumented for continuous recording of
  - Rotative speed
  - Brake torque
  - Brake line pressure
  - Number of rotations after brake application
  - Braking time
  - Brake rotor temperature

Application

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ECE R90 **for Brake Pads** - Properties

- Same friction coefficient as original parts of the vehicle manufacturer
  - deviations are allowed to +/- 15%
- Mechanical strength, compressive and **shear strength**
- Testing for **pressure sensitivity**
- Testing for **speed sensitivity**
- Testing for **compressibility**
- Guaranteed **asbestos free**
- The **packaging** of the coverings must be **glued or sealed** to make previous opening clearly recognizable

Application

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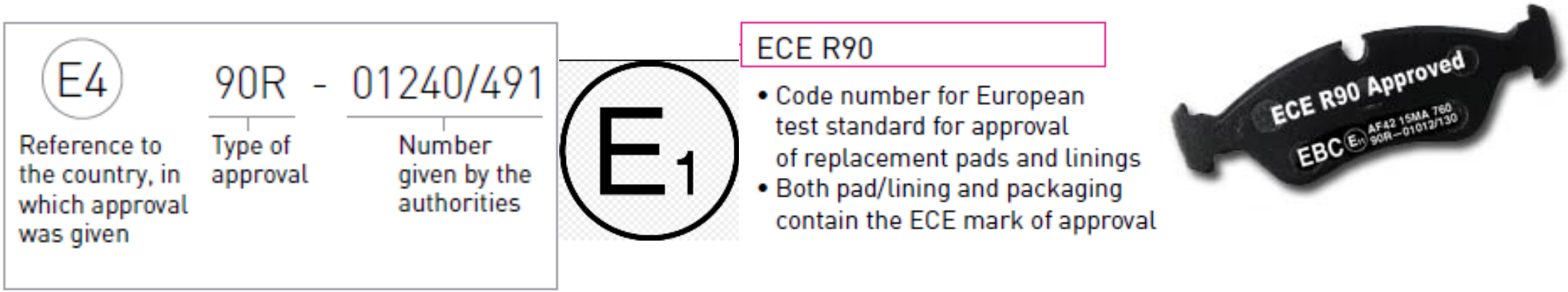
ECE R90 **for Brake Pads** – After the Test Procedure

- A check number (starting with the letter E) **must exist to the identify the spare parts** permanently
- So, the brake **pads are marked with an R90 code number** and a country code in a circle such as E1 for Germany or E53 for The Kingdom of Thailand which signifies where the testing has been done.



Application

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ECE R90 for **Brake Discs – Test List**

- Geometric check
- Material Check
- Balancing provisions check
- Wear condition marking
- Integrity test – thermal fatigue
- Integrity test – high load
- Service brake vehicle performance test

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HORIBA Solutions

ECE R90 Regulation / FAQ & HORIBA Solution

Ready to go test procedures

- The **HORIBA STARS Brake Application Suites** consist of **'ready-to-go' test procedures** according to the relevant brake test specifications
- The **suites include any STARS Brake resource** which is required **to run the test immediately** e.g. test schedules, data loggers, display pages, limit sets and much more
- The measuring data will be **stored in STARS Brake** data format, as **numerical DIAdem® sheets (Full Sheet)** and as a standard test report or complete National Instruments DIAdem® based data evaluation

STARS

Note: Distribution of the Application Suites and data evaluations scripts based on specific automotive industry standards requires the permission from the owner of the relevant regulation.
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HORIBA Solutions

ECE R90 Regulation / FAQ & HORIBA Solution

Ready to go test procedures

- The HORIBA Brake Application Suites include **a full range of public standards** for brake testing for hydraulic and pneumatic actuated disc and drum brakes
- They contain **performance tests as well as NVH procedures** of passenger car brakes and light to heavy duty truck brakes
- Additionally, **HORIBA provides more than 50 application suites of well-known, global OEMs**

STARS

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HORIBA Solutions

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Ready to go test procedures

AK Master	**Performance**	**Wear and Friction Behavior**
AK Noise	**NVH**	**Noise and Vibration Behavior**
SAE J2521	**NVH**	**Disc and Drum Brake Dynamometer Squeal Noise Matrix**
SAE J2522	**Performance**	**Dynamometer Global Brake Effectiveness**
Jaso C406	**Performance**	**Passenger Car - Braking Device - Dynamometer Test Procedures**
Jaso C419	**Durability**	**Passenger Cars - Service Brake - Structural Integrity**
Jaso C436	**Performance**	**Parking Brake Device Dynamometer Test Procedures**
ECE R90	**Performance**	**Braking Performance (Aftermarket-Requirement)**

STARS

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HORIBA Solutions

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New Rhein Main Brake Test Center – Contract Testing

- Horiba established **Partnership with Huehoco ANT**
- Will start in summer 2016 with 4 Brake Dynamometer Systems
- Official House Opening planed for September 15th 2016
- Final Stage 2020 = 8 Dyno Systems in Operation (4 Horiba & 4 ANT)

HORIBA Solutions

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NEW

Performance	Universal	NVH
▪ **Most compact** dynamometer ▪ For **performance tests** ▪ **Small** testing **chamber** ▪ Double winged door with **ergonomic access to the test brake**	▪ **Very flexible** dynamometer ▪ For **performance** tests **and for fundamental NVH** tests ▪ **Suspension strut assemblies** and complete **axle structures** can be utilized ▪ **Environmental simulation** system	▪ **Largest dynamometer** ▪ **Full-size NVH** dynamometer ▪ Realistic and **fully automatic NVH** tests ▪ Able to meet special customer requirements also for **sophisticated NVH investigations** ▪ Able to meet **GM-TIP** requirements

GIANT Evo

HORIBA Solutions

ECE R90 Regulation / FAQ & HORIBA Solution

Inertia Simulation Ranges of the **CORE Module**

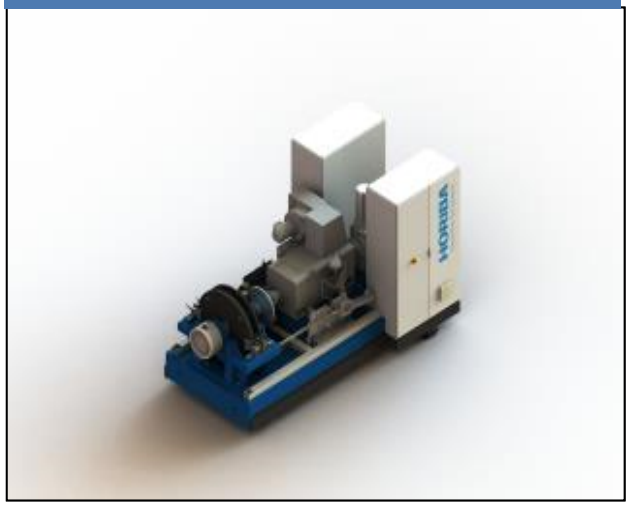
Mech. Inertia Combination

- **20kgm² basic inertia consisting of the following inertias**
  - One flywheel
  - Main drive shaft
  - Electric drive
  - Test flange
  - Adapted rotating parts
- **Two engageable flywheels:**
  - 25kgm²
  - 55kgm²

Electrical Inertia Simulation

- **Power: 220kW (254kW in overload)**
- **Max. torque from 50…840rpm**
- **Max. torque: 2.500Nm**
- **Max. torque in overload: 2.850Nm**
- **Max. speed: 2.200rpm**
  (2.200 rpm is equal to ca. 250km/h)

J_{sim} = 5 … 200kgm² max. stop braking torque: 5.500Nm



HORIBA Solutions

ECE R90 Regulation / FAQ & HORIBA Solution

Horiba Giant & Giant-EVO is accepted by global customers in 2015/2016

- **Germany:** **Huehoco / Fritz Winter / GM-Opel / Bertrandt (Daimler)**
- **China:** **TRW / FAW-VW / ASIMCO / Baofeng-Huehoco**
- **Korea:** **Hyundai Mobis / Seohan**
- **India:** **Maruti Suzuki**
- **Slovakia:** **Continental Teves**

GIANT + GIANT Evo

GIANT *Evo* Market Segment

Market Segement for GIANT *Evo*

Minis




Compacts




Large Executives




SUVs



	Minis	Compacts	Large Executives	SUV / Offroad
Europe	Peugeot 107	VW Golf 7	BMW 7er	Subaru Forester
	Volkswagen Up!	VW Golf 6 Variant	Mercedes S-Klasse	Mitsubishi Outlander
		Peugeot 308	VW Phaeton	
		Opel Astra	Opel Insignia	
Thailand	Toyota Yaris	MAZDA 3	BMW 7er	Toyota Hilux
	Toyota Vios	Honda Civic	Mercedes S-Klasse	Isuzu D-Max
	Honda City	Toyota Altis		Toyota Fortuner
	Honda Jazz	FORD Focus		Misubishi Triton
	Mitsubishi Attrage	MG 6		FORD Ranger
Japan	Honda N-One	Mitsubishi Lancer	Mitsubishi Galant	Subaru Tribeca
	Mazda Carol	Nissan Sentra	Nissan Maxima	
	Subaru Pleo	Subaru Impreza	Subaru Outback	
		Subaru Legacy	Honda Accord	

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ECE R90

- This test involves taking **each homologated vehicle** used on the public roads within Europe
- Comparing of the **front and rear brake performance** with the **original parts to those of aftermarket offerings**
- The regulation allows testing to be carried out **either on an inertia dynamometer or as track based** real world tests using a vehicle
- If a part has been **approved to R90,** it can be safely assumed that the product is **equal to or better than original** equipment product
- **Factory Approval is part** of the R90 process which **involves engineers** inspecting and accrediting the factory manufacturing the product **before approval is given**
- This can be done on **HORIBA inertia brake dynamometers**

Thank you

Cảm ơn

감사합니다

ありがとうございました

Dziękuję

धन्यवाद

Grazie

Merci

谢谢

நன்றி

ขอบคุณครับ

Gracias

Obrigado

Σας ευχαριστούμε

Děkuji

Teşekkürler

شكرا

Tack ska ni ha

Danke

Большое спасибо

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