

# ISO 21955:2021 (E)

## Acoustics — Experimental method for transposition of dynamic forces generated by an active component from a test bench to a receiving structure

---

### Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms and definitions
4	Principle of the method of transposition of the dynamic force
4.1	General matters
4.2	General formulae
4.3	Geometrical considerations
5	Operating mode
5.1	General
5.2	Synopsis of procedure
5.3	Tasks and preliminary operations
5.4	Transfer matrices determination
5.4.1	General
5.4.2	Final receiving structure transfer matrix determination $Y_{RS}$
5.4.3	Test bench transfer matrix determination, $Y_{TB}$
5.4.4	Connecting device spring-like matrix properties determination, $S_I$
5.4.5	Active Component transfer matrix determination, $Y_{AC}$
5.5	Measured dynamic forces transmitted to the test bench
5.6	Predicted dynamic forces transmitted to the final structure
5.6.1	General
5.6.2	Strong decoupling
5.6.3	Very similar bench and receiving structure
5.6.4	Case of a rigid receiving structure
5.6.4.1	General
5.6.4.2	Rigid test bench (marble)
5.6.4.3	Non-rigid test bench
5.6.5	Case of a non-rigid receiving structure
5.6.5.1	General
5.6.5.2	Rigid test bench (marble)
5.6.5.3	Non-rigid test bench
5.6.5.4	Evaluation of the quality of the predicted forces
6	Requirements for data in test report
6.1	Specification of the integrator to the supplier
6.2	Data sent by the supplier to the integrator
Annex A	(informative) Theoretical developments
A.1	Introduction
A.2	Components formulae
A.3	Total system formulae
A.4	Transposition to dynamic forces
Annex B	(informative) Frequency response functions measurement
B.1	General
B.2	Measurement of transfer functions $a(f)$

- B.2.1 Implementation and fixtures
- B.2.1.1 General
- B.2.1.2 Assembly 1 - One single 3D accelerometer by attachment point.
- B.2.1.3 Assembly 2 - Using multiple 3D anchor accelerometers by attachment point
- B.2.2 Recommendations

#### Annex C (informative) Dynamic forces measurement

- C.1 General
- C.2 Direct method by force sensor
- C.2.1 Test set-up and fixture
- C.2.2 Preliminary measurements of force/force transfers
- C.2.2.1 General
- C.2.2.2 Recommendations
- C.2.2.3 Equipment used
- C.3 Indirect method: calculation from accelerometer measurements
- C.3.1 Principle
- C.3.2 Implementation and fixtures
- C.3.2.1 Assembly 1
- C.3.2.2 Assembly 2
- C.3.2.3 Assembly 3
- C.3.3 Recommendations
- C.4 Method of dynamic stiffness
- C.4.1 Principle
- C.4.2 Implementation and fixtures
- C.4.3 Recommendations

#### Annex D (informative) Data processing

- D.1 General
- D.2 Direct measurement (see C.1)
- D.3 Indirect method (see C.2)
- D.4 Transfer matrices for dynamic force prediction

#### Annex E (informative) Study of a wiper system

- E.1 General description of the case study
- E.2 Transfer matrices measurement
- E.3 Direct measurement of the dynamic forces on test bench
- E.4 Validation of estimated dynamic forces on bench
- E.5 Estimated dynamic forces on vehicle
- E.5.1 Prediction results
- E.5.2 Validation of estimated dynamic force on bench

#### Annex F (informative) Equivalent force torsor and block-sensor method

- F.1 Description of the method
- F.1.1 General
- F.1.2 Theoretical principles
- F.1.3 Smart receiver for identification – the “block-sensor”
- F.1.4 Selection of measurement parameters
- F.1.5 Equivalent coupling point and transfer matrix
- F.1.5.1 Acceleration at the coupling equivalent coupling point  $\gamma_C$ , matrix  $H_v$
- F.1.5.2 Force at the coupling equivalent coupling point  $F_{ecp}$
- F.2 Measurement procedure
- F.2.1 General
- F.2.2 Step 1: Suspend the receiver
- F.2.3 Step 2: Sensor localization optimization and installation
- F.2.4 Step 3: measurement of the receiver acceleration
- F.2.5 Step 4: coupling of the source to the receiver
- F.2.6 Step 5-6-7: Measurement of the assembly mobility
- F.2.7 Step 8: Calculation of the active component mobility
- F.2.8 Step 9: Measurement of the operational accelerations
- F.2.9 Step10: Calculation of blocked forces
- F.3 Autovalidation