In-vehicle UI standards

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Tutorial at:

4th International Conference on
Automotive User Interfaces and Interactive Vehicular Applications
(Automotive UI 2012)

Portsmouth, New Hampshire, USA, planet Earth
October 17, 2012

There are 5 basic questions to be examined.

1. What kinds of documents guiding and requiring vehicle testing and design exist?
2. What is in a typical standard?
3. How does one find them?
4. How are they created and how does research have influence their content?
5. Which standards exist that affect driver interface and driver assistance systems?

   US DOT (FMVSS, visual manual guidelines, NCAP)

   ISO

   SAE

   ITU

The terms used to refer to standards and related documents have different meanings.

Information Report
Recommendation (Design, Technical, etc.)
Recommended Practice
Guideline
Best Practice
Consensus Practice
Rule

Standard
Requirement
Specification
Code of Practice
Regulation (executive branch)
Law (legislative branch)

"Standards" differ on several dimensions.

Who creates it and their process
government, SDO, any organization who has input

National vs. International

Availability (public vs. secret)

Design, Performance, Process
bumper example, outlet example

Criteria

Authority (should vs. shall/must)

Enforcement (type approval)

Corolla & RAV4

What is in a typical standard?

Example: SAE Recommended Practice
Navigation and Route Guidance Function Accessibility While Driving (SAE J2364), 2004
(aka "15 second rule")

Obtaining standards is not easy and is costly.

document is in the SAE Handbook
(often found in an engineering library)

purchase from SAE
13 pages ($65, SAE member $52 to $58.50)

3 volumes
1800 standards
$625/$500

There is usually a 1 paragraph introduction that says why the standard is needed.

Introduction

Navigation and Route Guidance Systems have some functions that can take significantly more time to use than conventional controls and displays such as the headlights, windshield wipers, … (Kurokawa,…) …Consequently, there are concerns that interacting with navigation and route guidance systems could unduly distract drivers …

The scope describes what the standard covers and, sometimes, what it does not cover.

This … applies to both Original Equipment Manufacturer and aftermarket route-guidance and navigation system functions for passenger vehicles. It establishes … which navigation functions should be accessible to the driver while the vehicle is in motion. These methods apply only to the presentation of visual information and the use of manual control inputs ...

The … Practice does not apply to visual monitoring tasks … such as route following. Voice-activated controls or passenger operation of controls are also excluded.

You may also need copies of the normative references (referenced requirements), several of them.

Normative References for J2364

J287 Driver Hand Control Reach
J1050 Describing & Measuring the Driver's Field of View
J2396 Driver Visual Behavior Using Video Based Techniques
J2365 Calculation of the Time to Complete In-Vehicle Navigation and Route Guidance Tasks

Example:

Accessible = *within reach of the unconstrained driver as defined by SAE J287**; and** 2. the display is visible with head movement as defined by SAE J1050; **and …***

Also, numerous definitions (17 in J2364); definitions stds.

J2364 specifies 2 methods. Use 1.

Static Method - … *a sample of subjects, after practice, completes each task of interest several times using a stationary vehicle … with a functioning or simulated driver interface. … The total time .. is … from the time the subject begins the task until the task is completed.*

Interrupted Vision Method - …

Details are omitted here to save time.

Open 1.5 s, closed 1.5 s

The procedure is quite detailed.

Operational hardware in design location

Subjects (10) must be

* *Licensed drivers not familiar with, or technically knowledgeable about, the specific driver interface under investigation*
* *Capable of operating the … interface … & completing the test*
* *45 to 65 years of age*

Prior to testing, each subject shall be trained in the use of the driver interface and the task ... Following training … each subject will be given 5 practice trials for each task prior to testing.

This standard has criterion. Many do not.

Total task time
- sum of log of times < log 15
- task < 5 s is excluded

Interrupted vision
- sum of log of shutter open time < log of 20

Who develops standards and how

The U.S. (federal) government follows the Administrative Procedure Act.

All executive departments and independent agencies covered

HF related regulations/rule making examples

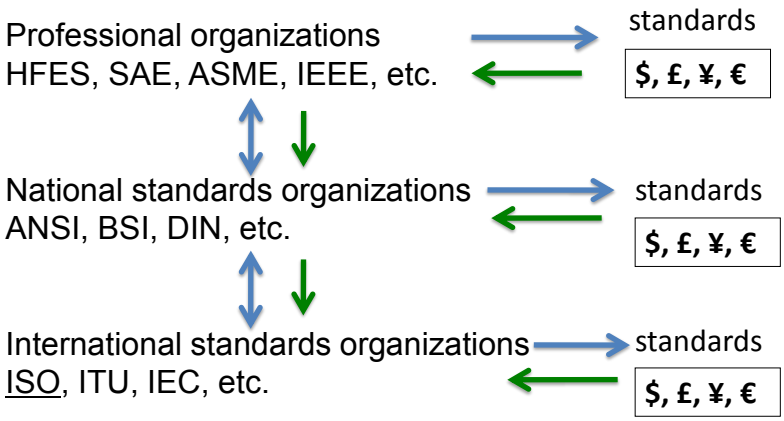
CPSC	toys, jet skis, off-road vehicles
DOL - OSHA	machine guarding, ergonomics
DOT FAA	hours of service
DOT FMCSA	control tower ops, aircraft spacing, passenger evac.
DOT NHTSA	driver distraction
FDA	medical devices, drug labels
NRC	plant design (control room, work standards, etc.)

How I think the Admin. Procedure Act works.

1. Internal agency discussion (gather data, authority (Congress can request & fund), no organizational conflict, …)
2. Notice of Proposed Rulemaking (NPRM, Federal Register)
3. Responses from anyone (companies, individuals, trade assn.)
4. Comment summary published (Federal Register)
5. Notice of public hearing (Federal Register, anyone can present, usually DC)
6. Modify rules & feedback
7. Publish of final rule (Federal Register)
8. Often legal action

years to get input & reach agreement
other governments may be different

Recognized standards development organizations have an open process, utilize recognized technical experts, avoid conflicts of interest, and work to build a consensus.



The International Standards Organization (ISO) is the largest standards development organization. (iso.org)

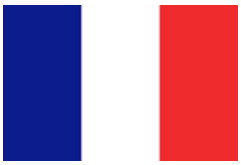
264 Technical Committees

Examples:

JTC1 - Information technology
TC8 - Ships and marine technology
TC17 – Steel
TC20 – Aircraft & space vehicles
TC22 – Road vehicles
TC34 – Food products
TC45 – Rubber and rubber products
TC61 – Plastics
TC159 - Ergonomics

Every technical committee has a secretariat (country/org that manages it), a convener (technical leader = chair) and many subcommittees.

ISO TC22 Road Vehicles (AFNOR)



19 subcommittees, 7 working groups,
~20 liaisons (TC204 – ITS)

Examples

SC1 – ignition equipment
SC2 – braking systems and equipment
SC3 – electrical and electronic equipment
SC9 – vehicle dynamics and road handling ability
SC11 – safety glazing materials
SC12 – passive safety crash protection systems
SC13 – Ergonomics applicable to road vehicles
SC17 - visibility

ISO Technical Committee 22/Subcommittee 13 (ISO TC22/SC13) Working Groups

WG 3 – Localization of controls and tell-tales
WG 5 – Symbols
WG 7 – Hand reach & R & H point determination
WG 8 – TICS on-board – MMI (telematics)

Working groups & subcommittee meetings ~ 1 week, twice / yr
Location varies (Paris, London, Munich, Stockholm, Turin, …)

Convener = John Shutko

SAE has secretariat, reports to ANSI (American National Standards Institute)

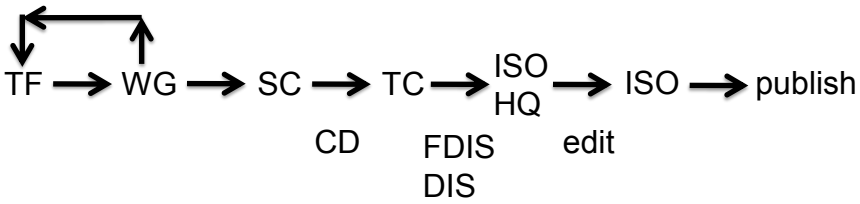
Members & membership fees

Standards of Interest to the Automotive User Interface Community (ISO TC 22/SC 13/WG 8)

Document	Abbreviated Title
Std 15005: 2002	Dialogue management principles and compliance
Std 15006:2011	Auditory information specifications and compliance
Std 15007 (2 parts)	Visual behavior measurement
Std 15008:2009	Legibility
Tech. Rep. 16352: 2005	Warnings literature review
Std 16673:2007	Occlusion method to assess distraction
Trial Std 16951:2004	Message priority
Std 17287:2003	Suitability of interfaces while driving
Std 26022:2010	Lane change test to assess distraction

The ISO Process (Road vehicle ergonomics) TF>WG>SC>TC

national delegation requests a standard on some topic
NWI (New Work Item) discussed at several WG meetings
If >1/2 SC/TC P approve & 5 commit then NP (New Project)
NWI (New Work Item), TF (task force), 3 yr clock starts
TF meets every 6 months & drafts standard (report up)



Who are the delegates (#, expertise, employers, long-term)
What happens in meetings (language, UN, technical/politics),
Who votes & comments on what
See: http://www.iso.org/iso/home/standards_development.htm

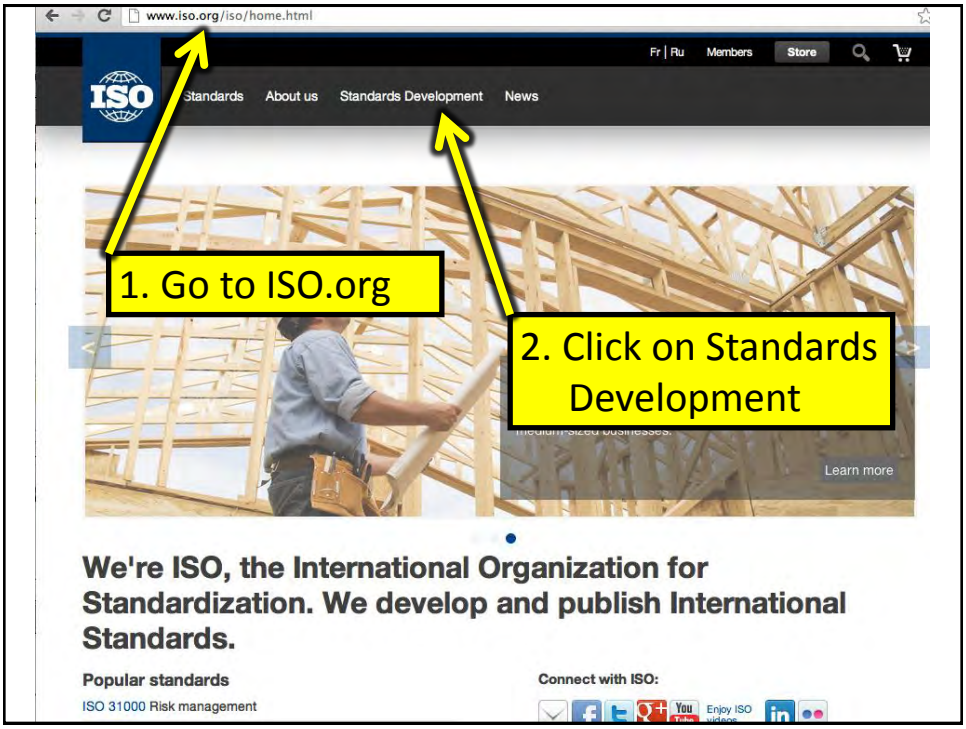
How does research influence the content of standards? Availability & amount matter (0, 4-5, >10 publications).

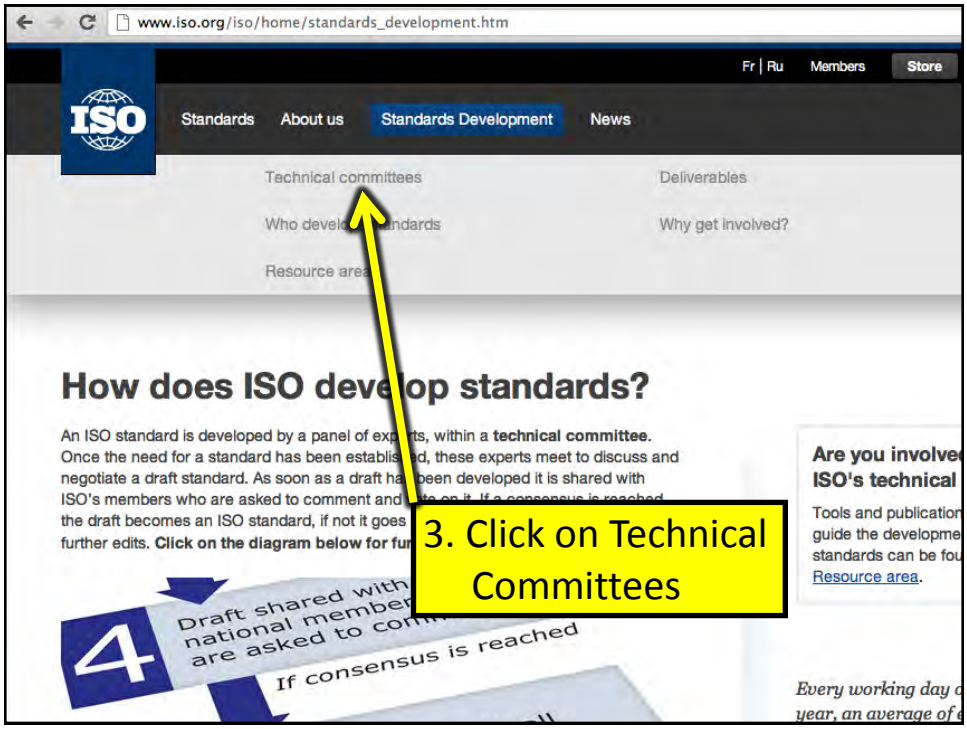
Initial consideration by authors in working group
- do they know about the research prior starting standard
  - send key people copies
  - send the committee copies -> assigned a document #
- can they find it when search the internet
  - include the standard name and # in keywords in research
  - include the standard in the article/report reference list

Review process
- does a reviewer or committee member say to include an article or report as a reference

How to find human factors/ ergonomic standards

1. Use the ppt from this presentation!
2. Look at standards development organization (ISO, ITU, SAE, etc.) web sites
3. Use Google only as a last resort.
   unlikely to be found by Google
   you may not know the terms to use




www.iso.org/iso/home/standards_development.htm
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Members
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Standards
About us
Standards Development
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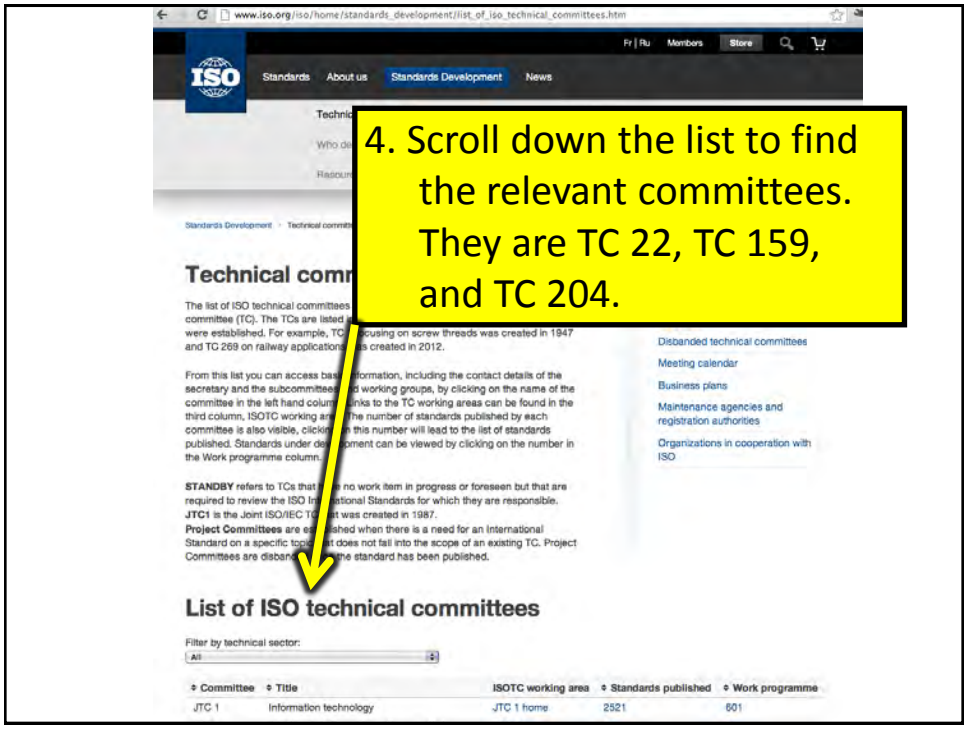
Technical committees
Deliverables
Why get involved?
How does ISO develop standards?
An ISO standard is developed by a panel of experts, within a technical committee.
Once the need for a standard has been established, these experts meet to discuss and
negotiate a draft standard. As soon as a draft has been developed it is shared with
ISO's members who are asked to comment and vote on it. If a consensus is reached
the draft becomes an ISO standard, if not it goes
further edits. Click on the diagram below for fu
4
Draft shared with
national member
are asked to com
If consensus is reached
3. Click on Technical Committees
Are you involve
ISO's technical
Tools and publication
guide the developme
standards can be fou
Resource area.
Every working day
year, an average of


www.iso.org/iso/home/standards_development/list_of_iso_technical_committees.htm
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Members
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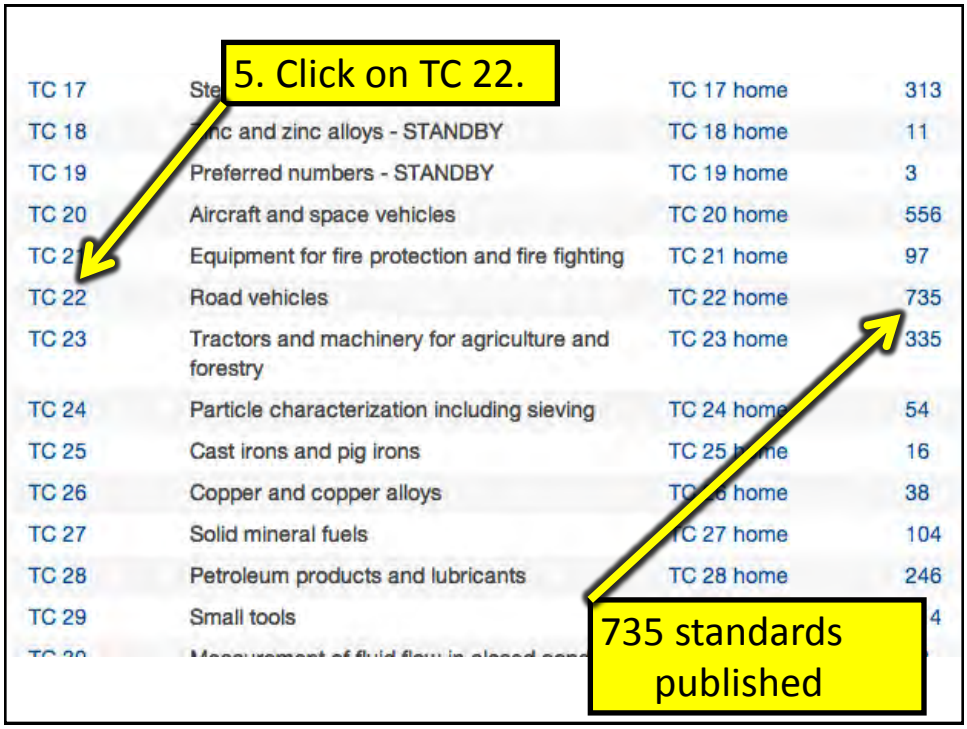
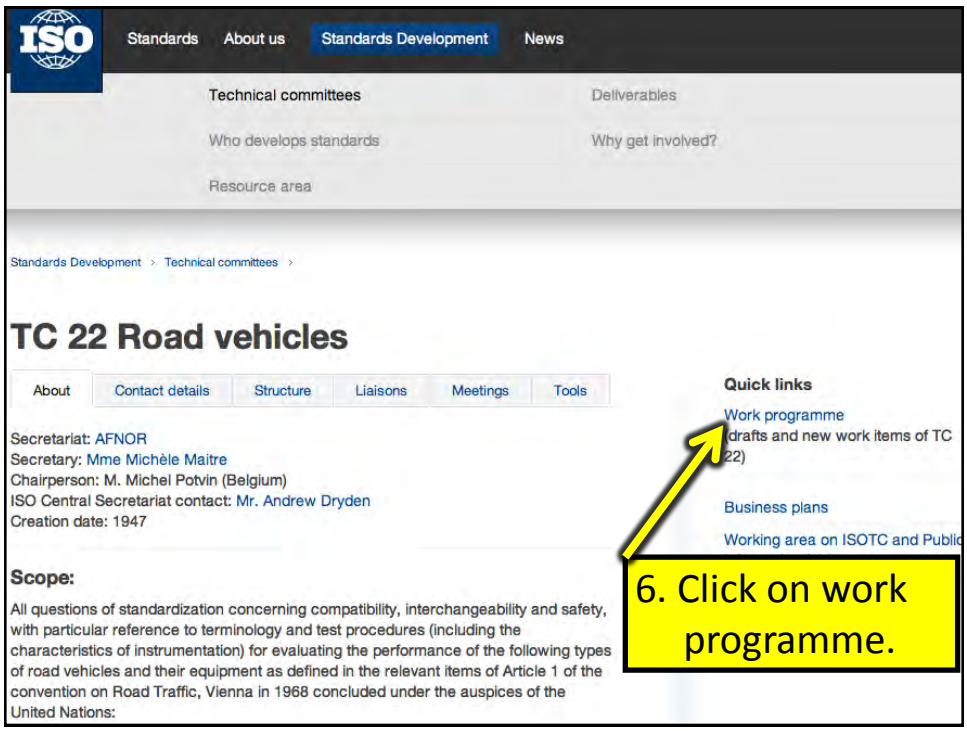
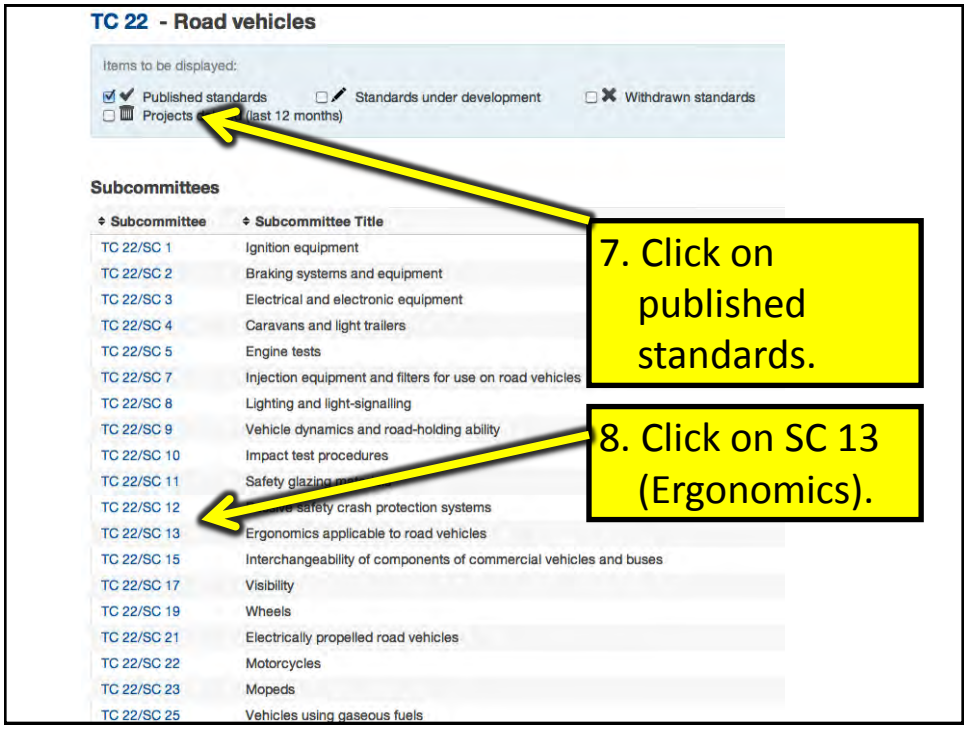
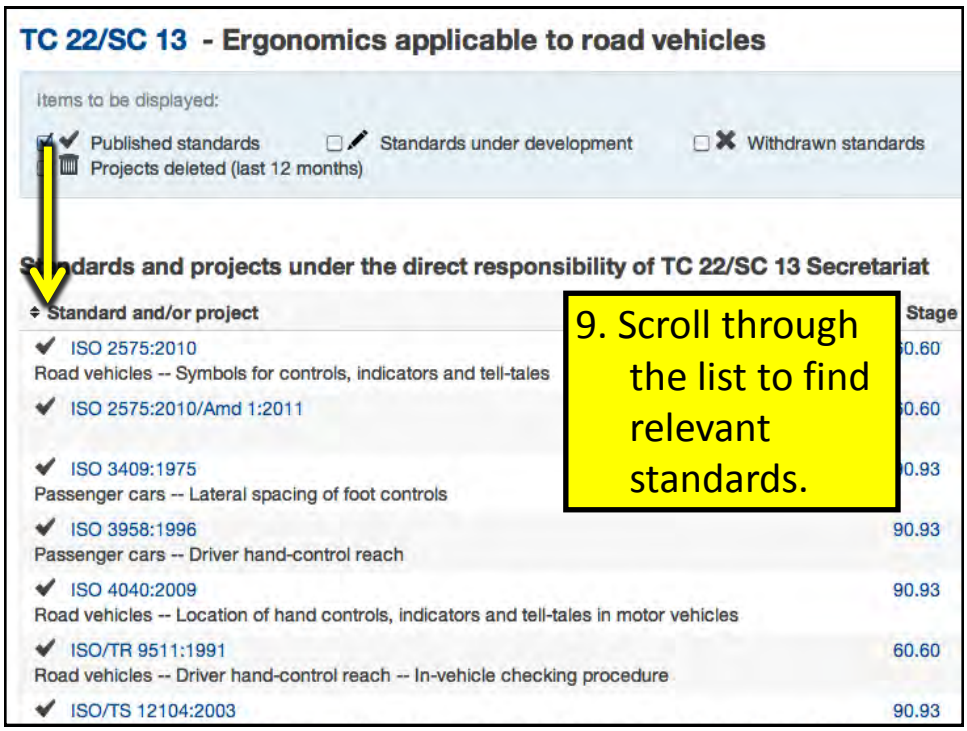
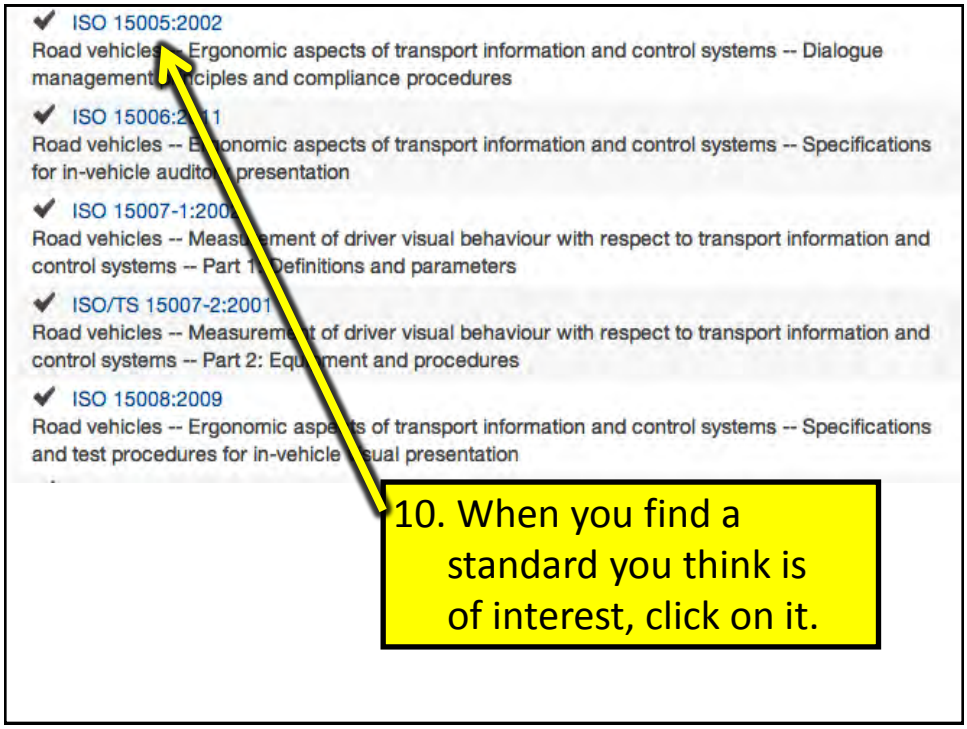
4. Scroll down the list to find the relevant committees. They are TC 22, TC 159, and TC 204.
Technical comm
Disbanded technical committees
Meeting calendar
Business plans
Maintenance agencies and registration authorities
Organizations in cooperation with ISO
List of ISO technical committees
Filter by technical sector:
All
Committee
Title
ISOTC working area
Standards published
Work programme
JTC 1
Information technology
JTC 1 home
2521
601

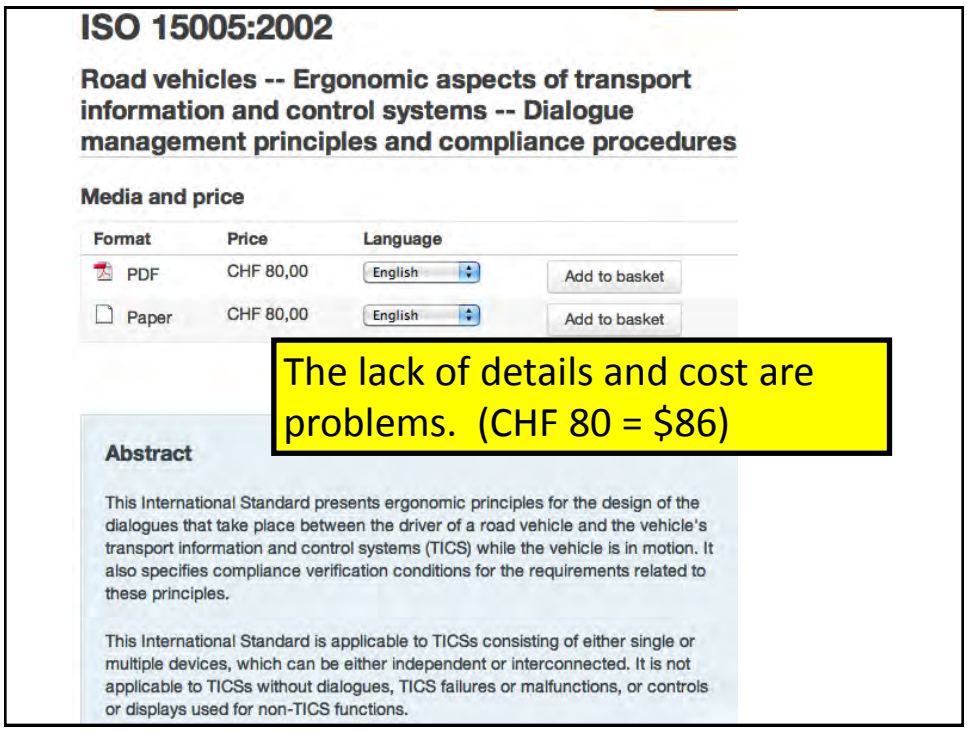

5. Click on TC 22.
TC 17 Ste TC 17 home 313
TC 18 nc and zinc alloys - STANDBY TC 18 home 11
TC 19 Preferred numbers - STANDBY TC 19 home 3
TC 20 Aircraft and space vehicles TC 20 home 556
TC 21 Equipment for fire protection and fire fighting TC 21 home 97
TC 22 Road vehicles TC 22 home 735
TC 23 Tractors and machinery for agriculture and forestry TC 23 home 335
TC 24 Particle characterization including sieving TC 24 home 54
TC 25 Cast irons and pig irons TC 25 home 16
TC 26 Copper and copper alloys TC 26 home 38
TC 27 Solid mineral fuels TC 27 home 104
TC 28 Petroleum products and lubricants TC 28 home 246
TC 29 Small tools 4
735 standards published


ISO
Standards
About us
Standards Development
News
Technical committees
Deliverables
Who develops standards
Why get involved?
Resource area
Standards Development › Technical committees ›
TC 22 Road vehicles
About
Contact details
Structure
Liaisons
Meetings
Tools
Secretariat: AFNOR
Secretary: Mme Michèle Maitre
Chairperson: M. Michel Potvin (Belgium)
ISO Central Secretariat contact: Mr. Andrew Dryden
Creation date: 1947
Scope:
All questions of standardization concerning compatibility, interchangeability and safety, with particular reference to terminology and test procedures (including the characteristics of instrumentation) for evaluating the performance of the following types of road vehicles and their equipment as defined in the relevant items of Article 1 of the convention on Road Traffic, Vienna in 1968 concluded under the auspices of the United Nations:
Quick links
Work programme
(drafts and new work items of TC 22)
Business plans
Working area on ISOTC and Public
6. Click on work programme.


TC 22 - Road vehicles
Items to be displayed:
Published standards
Standards under development
Withdrawn standards
Projects deleted (last 12 months)
Subcommittees
Subcommittee
Subcommittee Title
TC 22/SC 1 Ignition equipment
TC 22/SC 2 Braking systems and equipment
TC 22/SC 3 Electrical and electronic equipment
TC 22/SC 4 Caravans and light trailers
TC 22/SC 5 Engine tests
TC 22/SC 7 Injection equipment and filters for use on road vehicles
TC 22/SC 8 Lighting and light-signalling
TC 22/SC 9 Vehicle dynamics and road-holding ability
TC 22/SC 10 Impact test procedures
TC 22/SC 11
TC 22/SC 12
TC 22/SC 13 Ergonomics applicable to road vehicles
TC 22/SC 15 Interchangeability of components of commercial vehicles and buses
TC 22/SC 17 Visibility
TC 22/SC 19 Wheels
TC 22/SC 21 Electrically propelled road vehicles
TC 22/SC 22 Motorcycles
TC 22/SC 23 Mopeds
TC 22/SC 25 Vehicles using gaseous fuels
7. Click on published standards.
8. Click on SC 13 (Ergonomics).


TC 22/SC 13 - Ergonomics applicable to road vehicles
Items to be displayed:
Published standards
Standards under development
Withdrawn standards
Projects deleted (last 12 months)
Standards and projects under the direct responsibility of TC 22/SC 13 Secretariat
Standard and/or project
Stage
ISO 2575:2010
Road vehicles -- Symbols for controls, indicators and tell-tales
ISO 2575:2010/Amd 1:2011
ISO 3409:1975
Passenger cars -- Lateral spacing of foot controls
ISO 3958:1996
Passenger cars -- Driver hand-control reach
90.93
ISO 4040:2009
Road vehicles -- Location of hand controls, indicators and tell-tales in motor vehicles
90.93
ISO/TR 9511:1991
Road vehicles -- Driver hand-control reach -- In-vehicle checking procedure
60.60
ISO/TS 12104:2003
90.93
9. Scroll through the list to find relevant standards.


ISO 15005:2002
Road vehicles -- Ergonomic aspects of transport information and control systems -- Dialogue management principles and compliance procedures
ISO 15006:2011
Road vehicles -- Ergonomic aspects of transport information and control systems -- Specifications for in-vehicle auditory presentation
ISO 15007-1:2002
Road vehicles -- Measurement of driver visual behaviour with respect to transport information and control systems -- Part 1: Definitions and parameters
ISO/TS 15007-2:2001
Road vehicles -- Measurement of driver visual behaviour with respect to transport information and control systems -- Part 2: Equipment and procedures
ISO 15008:2009
Road vehicles -- Ergonomic aspects of transport information and control systems -- Specifications and test procedures for in-vehicle visual presentation
10. When you find a standard you think is of interest, click on it.


ISO 15005:2002
Road vehicles -- Ergonomic aspects of transport information and control systems -- Dialogue management principles and compliance procedures
Media and price
Format
Price
Language
PDF
CHF 80,00
English
Add to basket
Paper
CHF 80,00
English
Add to basket
The lack of details and cost are problems. (CHF 80 = $86)
Abstract
This International Standard presents ergonomic principles for the design of the dialogues that take place between the driver of a road vehicle and the vehicle's transport information and control systems (TICS) while the vehicle is in motion. It also specifies compliance verification conditions for the requirements related to these principles.
This International Standard is applicable to TICSs consisting of either single or multiple devices, which can be either independent or interconnected. It is not applicable to TICSs without dialogues, TICS failures or malfunctions, or controls or displays used for non-TICS functions.

So, usually you need some guidance from a standards expert about what is in each standard, and a friendly librarian who will buy the standards.

ISO driver assistance & warning documents (TC 204, Intelligent Transportation Systems)

Document	Abbreviated Title
Std 15622:2010	Adaptive cruise control (ACC) performance requirements and tests
Std 15623:2002	Forward vehicle collision (FCW) warning performance requirements and tests
Std 17361:2007	Lane departure warning (LDW) systems performance requirements and tests
Draft Std 17387:2008	Lane change decision aid systems (LCDAS) performance requirements and tests
Std 22178:2009	Low speed following (LSF) systems performance requirements and tests
Std 22179:2009	Full speed range adaptive cruise control (FSRA) systems performance requirements and tests
Draft Std 22839	Forward vehicle collision systems—Operation and performance, requirements
Std 22840:2010	Extended-range backing aid systems (ERBA)
CD 26684	Cooperative intersection signal information and violation warning systems (CISIVWS)

**US Department of Transportation (US DOT),
National Highway Traffic Safety Administration (NHTSA),
Federal Motor Vehicle Safety Standards (FMVSS)
Most relevant examples for automotive UI**

http://www.nhtsa.gov/cars/rules/import/fmvss/index.html

101	**Controls and displays**
111	Rear view mirrors
125	Motorcycle controls and displays

Others concern windshield wiping, brake hoses, tires and rims, roof crush, side impact protection, child restraints, etc. (~54 total)

Finding the NHTSA Visual-Manual Guidelines

("voluntary" NHTSA Distraction Guidelines)

Search regulations.gov for docket NHTSA-2010-0053
Gives document, comments, notices, of hearings, etc.
(125 documents)

Document = NHTSA-2010-0053-0009
www.regulations.gov/#!documentDetail;D=NHTSA-2010-0053-0009

Outline of NHTSA Visual-Manual Guidelines

Executive summary

Background and why

NHTSA research on measurement methods

Current distraction guidelines

Justification for sections in NHTSA guidelines

- Examples: Vehicle types, devices, tasks, lock outs, steering wheel controls, downward viewing angle, tests to consider, eye glance criteria, subject selection, occlusion protocol, errors

The guidelines

Methods Preferred by NHTSA

Method Name	Acceptance Criteria
EGDS = Eye Glance Driving Simulator	85% of glances < 2.0 s Mean glance < 2.0 s Total glance time < 12.0 s
OCC = Occlusion	Total shutter open time < 9 s

Other Methods Mentioned by NHTSA

Step	# task steps<6
DS-BM=Driving Simulator with Benchmark	SD gap, 3 lane departures<=benchmark
DS-FC=Driving Simulator w/Fixed Acceptance Criteria	Performance measures<=acceptance values
DFD-BM=Dynamic Following in Driving Simulator with Benchmark	EGDS glance criteria + performance<benchmarks (perform. incl SDLP, car following delay, % targets detected, visual response time
DFD-FC=Dynamic Following in Driving Simulator with Fixed Criteria	Same as DFD-BM with fixed acceptance criteria

NHTSA Requirements for Subjects

Women	Men	Age Range
3	3	18-24
3	3	25-39
3	3	40-54
3	3	>55
12	12	

"The lower limit, 18 years of age, is due to concerns about testing with minors."

"organizations may set an upper age limit (such as 65 years old) … if they can easily find … participants and they have health concerns about testing with elderly test participants."

NHTSA Occlusion Test Protocol

Device in realistic location (fitted in buck or mockup)

Subjects are trained

Test per ISO 16673 (shutter open for 1.5 s, closed for 1.5 s)

- Start: Experiment triggers start when subject is ready
- End: when subject says done
- Min of 1 practice and 1 test trial / subject
- Computer records # open intervals

21/24 subjects must complete task
in <= 6 open intervals (= 9.0 s open time)

NHTSA Eye Glance-Driving Simulator Protocol

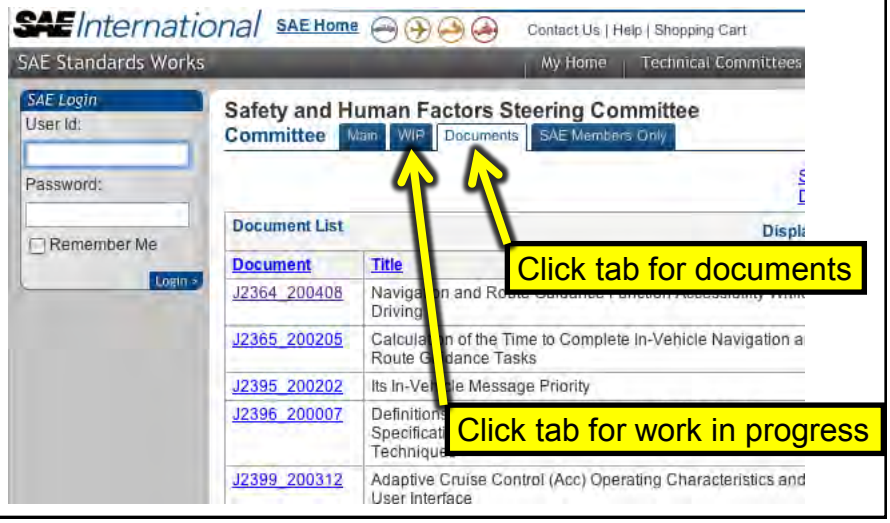
Simulator	Screen min 6.8 ft w x 4.5 ft h at >=15.4 ft (25 deg FOV, seems small) Record at >=30 Hz, Lag <=0.1 s inputs (steering wheel, brake pedal, throttle), vehicle (orientation and position, lane position, speed, lateral and longitudinal acceleration), gap Max 0.1 sec lag
Scenario	Undivided 4 lane road, flat, posted at 55 Lead vehicle at 50 mi/hr Drive >= 2 times, 1 with device, 1 without >=1 practice + 1 test trial
Criteria	<=15% of device glances <=2.0 s 21/24 mean glance time <=2.0 s 21/24 total glance time <= 12.0 s

US DOT New Car Assessment (NCAP) Program

Document	Abbreviated Title
US DOT FCW NCAP	Forward crash warning system test
US DOT LDW NCAP	Lane departure warning system confirmation test
US DOT ESC NCAP	Electronic stability control confirmation test

SAE Standards and Recommended Practices from the SAE Safety and Human Factors Committee

In Google, type “SAE safety and human factors standards”



SAE Standards and Recommended Practices from the SAE Safety and Human Factors Committee

Document	Shortened Name
J2364_200408	Navigation Function Accessibility While Driving
J2365_200205	Calculation of the Time to Complete In-Vehicle Navigation Tasks
J2395_200202	In-Vehicle Message Priority
J2396_200007	Definitions and Measures Related Driver Visual Behavior Using Video Techniques
J2399_200312	Adaptive Cruise Control (Acc) Operating Characteristics and User Interface
J2400_200308	Forward Collision Warning Systems: Operating Characteristics and User Interface
J2678_200408	Navigation Function Accessibility While Driving Rationale
J2802_201001	Blind Spot Monitoring System (BSMS): Operating Characteristics and User Interface
J2808_200708	Road/Lane Departure Warning Systems: Human Interface
J2830_200807	Process for Comprehension Testing of In-Vehicle Icons
J2831_201204	Design and Engineering for In-Vehicle Alphanumeric Messages
J2889/1_201205	Measurement of Minimum Noise Emitted by Road Vehicles

Only committee members have free access to documents. As an example, J2364 is $66.

TC159 (Ergonomics) develops standards that provide background for Automotive UI work. (Selected groups)

SC 1 - General ergonomics principles
- WG 1 Principles of ergonomics & ergonomic design
- WG 2 Ergonomic principles related to mental work

SC 3 - Anthropometry and biomechanics

SC 4 - Ergonomics of human-system interaction
- WG 1 Fundamentals of controls and signalling methods
- WG 2 Visual display requirements
- WG 3 Controls, workplace and environmental requirements
- WG 5 Software ergonomics of HCI
- WG 6 Human-centred design for interactive systems
- WG 9 Tactile and haptic interaction
- WG 11 Ease of operation of everyday products

SC 5 – Ergonomics of the physical environment

ISO TC159 (Ergonomics) has produced many standards that are of general and specific interest to human factors/ ergonomics professionals.

TC 159/SC 1 - General ergonomics principles

ISO 6385:2004	Ergonomic principles in the design of work systems
ISO 10075	**Ergonomic principles related to mental workload (definitions, principles, requirements)**
ISO/FDIS 26800	Ergonomics -- General approach, principles and concepts

TC 159/SC 4 - Ergonomics of human-system interaction

ISO 1503:2008	Spatial orient. & direx. of movement
ISO 9355	Design of displays & control actuators
ISO 11064 (7 pts)	Design of control centers
ISO 14915-1:2002	Multimedia user interfaces
ISO/TR 16982:2010	**Usability methods**
ISO/TS 18152	**Spec. of human-system assessment**
ISO/TR 18529:2000	Human-centered life cycle process
ISO 20282-1:2006	Everyday product context of use & user characteristics
ISO/TS 20282-2:2006	**Test method for walk up & use products**
ISO/NP TS 20282-3	**Test method for consumer products**
ISO 20281-4:2007	Consumer product installation tests
ISO 24503:2011	Tactile dots and bars on consumer products

ISO 9241 – Ergonomic requirements for office work with visual display terminals (VDTs) is a very important topic for the design computer hardware and software.

Examples:

- 4: keyboards
- 5: workstation layout
- 14: menus
- 15: commands
- 17: form filling
- 143: forms
- 151: web interfaces
- 300-: visual displays
- 400-: input devices

TC 159/SC 5 - Ergonomics of the physical environment

ISO 7243:1989	WBGT
ISO 7731	**Auditory danger signals**
ISO 9921	**Speech communication assessment**
ISO 11428:1996	**Visual danger signal general requirements & tests**
ISO 11428:1996	**Auditory & visual danger signals**
ISO/TS 14505	Thermal environments in vehicles
ISO/NP 16077	Indoor air quality subj. assessment
ISO 24500:2010	**Accessible design – sounds**
ISO 24501:2010	**Accessible design – luminance contrast**
ISO/DIS 28803	Application of intl. physical standards to people with special requirements

International Telecommunications Union (ITU) Focus Group on Distraction (FG-Distraction)

http://www.itu.int/en/ITU-T/focusgroups/distraction/Pages/default.aspx
Contact: Spennock@qnx.com

Reports to be produced
- factors to consider when developing UI
- driver and passenger in-vehicle tasks
- optimal information flow and message formats
- techniques to reduce distraction related crashes

Requirements input
- design guidance for mobile devices including phones
- methods to assess workload
- performance requirements for automotive servics
- coordination among components to reduce cognitive demand
- visual-manual guidelines

International Telecommunications Union P Series Terminals and subjective & objective assessment methods Examples

#	Title
P.800	Methods for subjective determination of transmission quality
P.805	Subjective evaluation of conversational quality
P.851	Subjective quality evaluation of telephone services based on spoken dialogue systems
P.862	Perceptual evaluation of speech quality (PESQ): An objective method for end-to-end speech quality assessment of narrow-band telephone networks and speech codecs
P.863	Perceptual objective listening quality assessment

For additional information contact me or go to my team's web site.

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