

German Road and Transport Research Association



Working Group Traffic Management

# Guidelines for Traffic Signals

R 1

RiLSA

Traffic Lights for Road Traffic

Edition 2015  
Translation 2021

## Contents

	Page
<b>1 Fundamentals .....</b>	<b>9</b>
<b>1.1 General .....</b>	<b>9</b>
<b>1.2 Criteria for the use of traffic signals and the effects that can be achieved .....</b>	<b>9</b>
1.2.1 Road safety .....	9
1.2.2 Traffic flow quality .....	10
1.2.3 Fuel consumption and emissions .....	10
1.2.4 Balancing of conflicting aims .....	10
<b>1.3 Principles of the Road Traffic Regulations and responsibilities of the organisations involved .....</b>	<b>10</b>
<b>1.4 Traffic signals and signal sequences .....</b>	<b>10</b>
 <b>2 Signal program design .....</b>	 <b>12</b>
<b>2.1 Definitions .....</b>	<b>12</b>
<b>2.2 Documents and preliminary investigations .....</b>	<b>12</b>
<b>2.3 Signal program structure .....</b>	<b>13</b>
2.3.1 Signal staging .....	13
2.3.1.1 General considerations .....	13
2.3.1.2 Left-turning vehicles .....	13
2.3.1.3 Right-turning vehicles .....	14
2.3.1.4 Trams and buses .....	15
2.3.1.5 Pedestrian traffic .....	15
2.3.1.6 Cycle traffic .....	18
2.3.2 Number of stages .....	19
2.3.3 Stage sequence .....	20
2.3.4 Interstage periods .....	20
<b>2.4 Transition periods .....</b>	<b>20</b>
<b>2.5 Intergreen periods .....</b>	<b>21</b>
2.5.1 Calculation of clearance and approach distances .....	21
2.5.2 Pass-through times and clearance times .....	22
2.5.3 Approach times .....	25
2.5.4 Checking of intergreen periods .....	26
<b>2.6 Cycle time .....</b>	<b>26</b>
<b>2.7 Green periods and red periods .....</b>	<b>27</b>
2.7.1 Calculation of green periods .....	27
2.7.2 Return to the same stage .....	27
2.7.3 Maximum and minimum red periods .....	27
2.7.4 Minimum green periods .....	27
2.7.5 Head start in the conflict area .....	28
2.7.6 Delayed start to the green period .....	28
<b>2.8 Signal timing plan .....</b>	<b>28</b>

	Page
<b>3 Interrelationships between traffic signal control and the design of road facilities .....</b>	<b>29</b>
<b>3.1 Fundamentals .....</b>	<b>29</b>
<b>3.2 Lanes .....</b>	<b>29</b>
3.2.1 Straight-ahead lanes .....	29
3.2.2 Left-turn lanes .....	30
3.2.3 Right-turn lanes and right-turn slip lanes .....	30
3.2.4 Partial public transport lanes on approaches to intersections .....	30
3.2.5 U-turn lanes .....	31
<b>3.3 Management of cycle traffic .....</b>	<b>31</b>
<b>3.4 Central reservations and traffic islands .....</b>	<b>32</b>
<b>3.5 Crossing facilities over track beds .....</b>	<b>32</b>
<b>3.6 Crossings .....</b>	<b>32</b>
<b>3.7 Public transport stops .....</b>	<b>33</b>
<b>3.8 Road equipment .....</b>	<b>33</b>
3.8.1 Stop lines .....	33
3.8.2 Lane lines .....	34
3.8.3 Signage .....	35
<b>4 Control methods .....</b>	<b>36</b>
<b>4.1 Overview of control methods .....</b>	<b>36</b>
<b>4.2 Control parameters .....</b>	<b>37</b>
4.2.1 Overview of the parameters .....	37
4.2.2 Capture and processing of the parameters .....	37
4.2.2.1 Vehicle-actuated signal program selection .....	37
4.2.2.2 Request for a green period .....	37
4.2.2.3 Use of intervals between vehicles .....	38
4.2.2.4 Use of the occupancy rate .....	39
4.2.2.5 Use of congestion and congestion length .....	39
4.2.3 Notes on using the control methods .....	40
4.3.1 Signal program selection .....	40
4.3.1.1 Framework conditions .....	40
4.3.1.2 Time-dependent selection of signal programs .....	40
4.3.1.3 Vehicle-actuated selection of signal programs .....	40
4.3.2 Formation of framework signal programs .....	41
4.3.3 Fixed-time signal programs .....	41
4.3.4 Signal program adjustment .....	41
4.3.4.1 Green period adjustment .....	41
4.3.4.2 Stage switching .....	41
4.3.4.3 Stage requesting .....	41
4.3.4.4 Time offset adjustment .....	41
4.3.5 Signal program formation .....	41
4.4 Coordination .....	41
4.4.1 Objectives .....	41
4.4.2 Fundamentals .....	42
4.4.3 Coordination at intersections .....	42
4.4.4 Coordination on sections of road .....	42
4.4.4.1 Structural prerequisites .....	42
4.4.4.2 Traffic control conditions .....	43
4.4.4.3 Inclusion of public transport vehicles .....	44
4.4.4.4 Inclusion of cyclists .....	44
4.4.5 Coordination in transport networks .....	44

	Page
<b>4.5 Planning of the control system .....</b>	44
4.5.1 Rule-based implementation of the control methods .....	44
4.5.2 Standardised rule-based implementation of the control methods ..	45
4.5.3 Model-based implementation of the control methods .....	46
4.5.4 Switchover methods .....	46
4.5.4.1 Overview .....	46
4.5.4.2 Switchover at a specified time .....	47
4.5.4.3 Switchover on the basis of shortening/lengthening .....	47
4.5.4.4 Switchover without a specified switchover time .....	47
4.5.5 Testing the control system .....	48
<b>Special forms of signalisation .....</b>	49
<b>5.1 Partially signalised intersections .....</b>	49
5.1.1 Overview .....	49
5.1.2 Suitable application situations .....	49
5.1.3 Situations for partially signalised intersections .....	49
5.1.3.1 Creation of intervals for vehicles that have to wait .....	49
5.1.3.2 Expediting and prioritisation of public transport vehicles	50
5.1.3.3 Signal protection of crossings .....	50
<b>5.2 Signalisation where a road narrows .....</b>	51
5.2.1 Criteria for use .....	51
5.2.2 Calculation of signal periods .....	51
5.2.3 Fixed-time control .....	52
5.2.4 Vehicle-actuated control .....	53
5.2.5 Startup programs .....	53
5.2.6 Peculiarities in terms of traffic management .....	53
5.2.7 Information on the equipment .....	53
5.2.8 Markings and signage .....	53
<b>5.3 Lane control signalisation .....</b>	53
5.3.1 Overview .....	53
5.3.1.1 Dynamic lane allocation with opposing traffic (reversible lanes) .....	53
5.3.1.2 Dynamic lane allocation without opposing traffic .....	54
5.3.2 Preliminary investigations .....	54
5.3.3 Traffic control requirements .....	54
5.3.3.1 General requirements .....	54
5.3.3.2 Requirements to be met by stretches of road .....	54
5.3.3.3 Requirements to be met by intersections .....	55
5.3.3.4 Inclusion of public transport vehicles .....	56
5.3.3.5 Accompanying measures on stretches of road .....	56
5.3.4 Switching of operating statuses .....	56
5.3.5 Operation .....	56
5.3.6 Operating plan .....	56
<b>5.4 Control of inflow to sections of road with weaving or merging traffic</b>	<b>57</b>
5.4.1 Overview .....	57
5.4.2 System description .....	57
5.4.3 Legal aspects .....	59

	Page
<b>6 Technical design .....</b>	<b>60</b>
<b>6.1 Controller .....</b>	<b>60</b>
<b>6.2 Signal lamps .....</b>	<b>60</b>
6.2.1 Lighting technology regulations .....	60
6.2.2 Recognisability of the signals .....	60
6.2.3 Phantom effects .....	60
6.2.4 Size of the signal lamps .....	61
6.2.5 Operating voltage .....	61
6.2.6 Signal heads for general vehicular traffic .....	61
6.2.7 Signal heads for pedestrians .....	62
6.2.8 Audible and tactile signal indicators .....	62
6.2.9 Signal heads for cyclists .....	62
6.2.10 Signal heads for public transport vehicles .....	63
6.2.11 Supplementary signals .....	63
6.2.12 Lane control signals .....	64
6.2.13 Speed signals .....	64
6.2.14 Uniform design of the symbols in the signal lamps .....	65
6.2.15 Hoods on signal heads .....	65
6.2.15 High-contrast backboards for signal heads .....	65
<b>6.3 Detection equipment .....</b>	<b>65</b>
<b>6.4 Number and positioning of signal heads .....</b>	<b>65</b>
6.4.1 Signals at intersections .....	65
6.4.2 Lane control signalisation .....	67
<b>6.5 Design .....</b>	<b>69</b>
<b>7 Technical acceptance and operation .....</b>	<b>70</b>
<b>7.1 Preliminary remarks .....</b>	<b>70</b>
<b>7.2 Acceptance .....</b>	<b>70</b>
<b>7.3 Operation .....</b>	<b>70</b>
7.3.1 Operating statuses .....	70
7.3.2 Switching traffic signals on .....	70
7.3.3 Switching traffic signals off .....	71
7.3.4 Signal safety .....	71
7.3.4.1 Overview .....	71
7.3.4.2 Failure of a red signal .....	72
7.3.4.3 Signal period violation .....	73
7.3.4.4 Invalid signal status .....	73
7.3.5 Operations monitoring .....	73
<b>7.4 Alternative measures in the event of service interruptions .....</b>	<b>74</b>
7.4.1 Traffic control by the police .....	74
7.4.2 Traffic control through road signs and traffic-organising measures .....	74
7.4.3 Alternative form of signal control .....	74

	Page
<b>8 Quality management .....</b>	<b>75</b>
<b>8.1 Definitions .....</b>	<b>75</b>
<b>8.2 Objectives of quality management .....</b>	<b>75</b>
<b>8.3 Prerequisites .....</b>	<b>75</b>
<b>8.4 Quality management in traffic control planning .....</b>	<b>76</b>
<b>8.5 Quality management at implementation .....</b>	<b>76</b>
<b>8.6 Quality management in operation .....</b>	<b>76</b>
8.6.1 Transport network-related overview .....	77
8.6.2 Quality analysis at intersections .....	78
8.6.3 Quality improvement measures .....	80
<b>9 Standards and technical regulations .....</b>	<b>81</b>

Production and sales:

**FGSV Verlag GmbH**

50999 Cologne · Wesselinger Straße 17

Phone: +49 (0)22 36/38 46 30; fax: +49 (0)22 36/38 46 40

Web: [www.fgsv-verlag.de](http://www.fgsv-verlag.de)



R 1