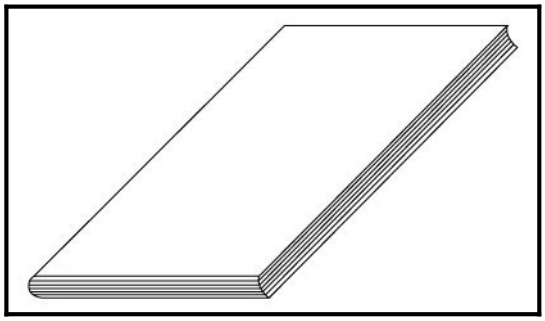


BEML - TATRA 815

26RR36 22 255 6x6.1R/50T, 51T

Workshop manual

Part A – GENERAL INFORMATION

Publication numer: 03-0254-ENG/00

TATRA, a.s. **1-st Edition 28-2-2007**

A GENERAL INFORMATION

A.1 Contact data

Fig. A.1 Contact data

A.2 Principal Information about the Manual

This Workshop Manual is determined for managers and trained service specialists. The Workshop Manual contains main specifications about the vehicle BEML - TATRA **T 815 - 26RR36 22 255 6x6.1R/50T** and **T 815 - 26RR36 22 255 6x6.1R/51T**, design and function of individual assemblies and systems, technological procedures for removal, assembly and repairs of assemblies and sub-assemblies. Should you not observe these procedures and not keep the adjustment values mentioned in this Manual, the vehicle function may be impaired resulting in damage to vehicle or injury to persons. The manufacturer is not responsible for these consequences.In order to perform repairs successfully, you need to have all needful general and special tools and workshop equipment at disposal and operative.
Only the prescribed and genuine BEML - TATRA spare parts can be used for repairs. In case that a replacement of the part is required, it must be replaced with the identical part or an equivalent in accordance with the Spare Parts Catalogue designation.
Some procedures mentioned in this Manual require a use of BEML - TATRA special tools. Should other tools be applied, the manufacturer is not liable for any possible damage.
The Manual contains a lot of „Notes“ and „Cautions“, which must be observed strictly to avoid a damage to material or injury to persons.

CAUTION:
The technical data, specifications and illustrations mentioned in this Manual respond to the vehicle design at the time of „Workshop Manual“ elaboration. The manufacturer has the right to carry out changes in it without any prior announcement. Reproducing, making multiple copies and transmitting of this document are not permitted without the prior permission of BEML.

A.3 Survey of the Related Sales and Technical Documentation

The following technical documents except for the Workshop Manual were issued for the vehicle BEML - TATRA **T815 - 26RR36 22 255 6x6.1R**:

Driver´s Manual	01 – 0254 – ENG/00
Service Booklet	02 – 0254 – ENG/00
Spare Parts Catalogue	04 – 0254 – MLT/00
Special Tools Catalogue	05 – 0254 – ENG/00
Special Test Equipment	05 – 0259 – ENG/00

A.4 How to use the Manual

A.4.1 Text Distribution and Numbering

The Workshop Manual is divided into sections, which are further divided into chapters and subchapters.

Sections – are marked with a word “Section“ and are arranged in the ascending order using Arabic numerals and are divided into chapters.

Chapters – are arranged in the ascending order using Arabic numerals within the framework of the respective “Section“. They are marked with a section number, point and chapter number. If need be, they are divided into subchapters.

Subchapters – are arranged in the ascending order using Arabic numerals within the framework of the respective „Chapter“. They are marked with a section number, point, chapter number, point and subchapter number.

Example: 3.5.4

3 – section number (Section 3)

3.*5* – chapter number (5th chapter of Section 3)

3.5.*4* – subchapter number (4th subchapter, 5th chapter, Section 3)

A.4.2 Pages Numbering

Pages are numbered continuously in each “Section“ of the Manual. The page designation consists of two numbers separated by 'of'. The first number means a page in section; the second one means number of pages in section. The page designation is situated on the page bottom to the right.

Example: 1 - 7 is the seventh page of Section 1.

A.4.3 Figures Numbering

Figures are numbered continuously in each “Section“ of Manual. The figure designation consists of the text „Fig.“ and two numbers separated by a point. The first number means a section; the second one means a figure number. The figure designation is located below the figure.

Example: Fig.6.2 is the second figure in Section 6

A.4.4 Tables Numbering

Tables are numbered continuously in each “Section” of Manual. The table designation consists of the text „Tab.“ and two numbers separated by a dash. The first number means a section; the second one means a table number. The designation is situated above the table.

Example: Tab.4.5 is the fifth table in Section 4.

A.4.5 Subchapter Paragraphs Designation

The subchapter paragraphs are marked with small letters in the alphabetical order and round bracket. Should a reference to a certain paragraph in the text be needful, it will be marked with a number of section, chapter, subchapter and paragraph alphabetical order letter completed with a round bracket.

Example: 2.5.3 a) is a paragraph a) of the Subchapter 3 in the Chapter 5 in Section 2.

Note:
In case that the chapter is not divided into subchapters, the designation is similar.

A.4.6 Procedure Steps Numbering

Individual steps are numbered with Arabic numerals in the ascending order within the framework of the respective procedure, which is marked as a section paragraph. Should a reference in the text be needful, the procedure step will be marked with the section number, chapter number, paragraph designation, dash and a procedure step order number.

Example: 7.5.2 a)

1. is the first step of the procedure mentioned in paragraph a) of Subchapter 2 in Chapter 5 of Section 7.

A.4.7 Numerical Expression of Units in the Metric System and in the British and American System of Units

a) Metric System of Units
To mark the units in the metric system (m, mm, kg, kW, Nm, etc.), a comma „**,**“ to separate decimal places and a gap to separate thousands is used.

Example: 2 854,35

b) British and American System of Units
To mark units in the British and American System of Units (inch, ft, lb, etc.), a point „**.**“ to separate decimal places and a comma „**,**“ to separate thousands is used.

Example: 2,854.35

A.5 BEML - TATRA Vehicle Identification

a) Type Plate
It is located on the left hand side under the front tilting bonnet. There are the type number, vehicle identification number (VIN) and main data concerning weights and permissible axle loads stamped on it.

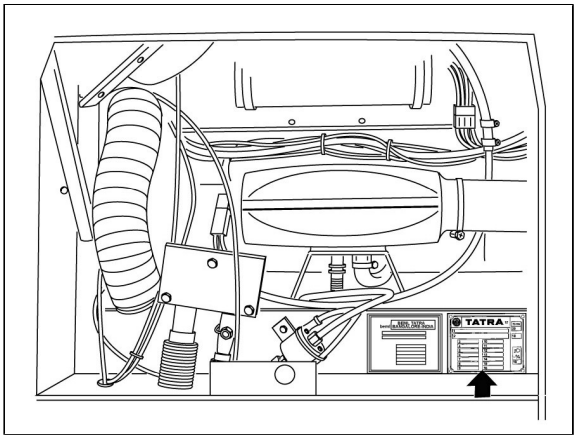


Fig. A.2 Location of the type plate

b) Data on the Type Plate

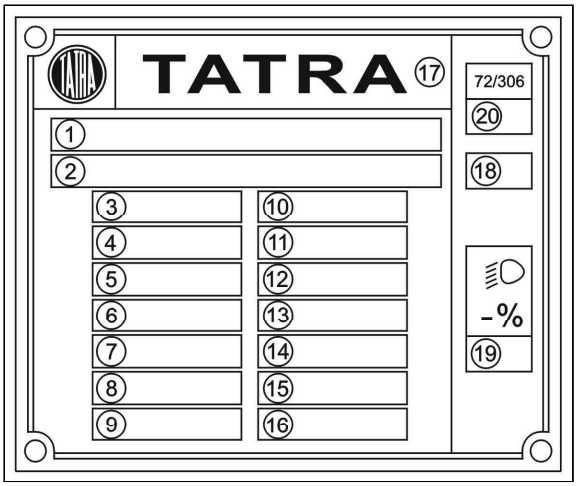


Fig. A.3 Data on the Type Plate

1 – Certificate number of the type approval in a respective country
2 – Vehicle identification number
3 – Permissible gross vehicle weight (not stamped)
4 – Gross vehicle combination weight (not stamped)
5 – First axle load (not stamped)
6 – Second axle load (not stamped)
7 – Third axle load (not stamped)
8 – Fourth axle load (not stamped)
9 – Additional data (not stamped)
10 – Gross vehicle weight
11 – Gross vehicle combination weigh
12 – Front axle load
13 – Second axle load
14 – Third axle load
15 – Fourth axle load (not stamped)
16 – Additional data (not stamped)
17 – Manufacturer's emblem
18 – Vehicle numerical code with changes in design on customer's demand
19 – Dimmed (low beam) lights adjustment value
20 – Corrected smoke emission coefficient (not stamped)

CAUTION:
Data as per points 3 through 9 above specify weights and axle loads according to regulations in force in particular states. Data as per points 10 through 16 specify maximum permissible weights and maximum axle loads. The value 18 gives a part of the description code mentioned behind the oblique stroke.

The BEML factory name plate (See Fig. **A.5**) is located on the left-hand side under tilting bonnet (See Fig. **A.4**).

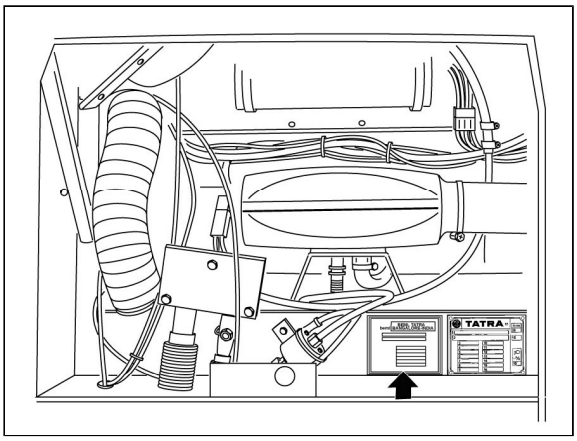


Fig. A.4 BEML factory name plate location

The factory name plate contains the following data pertaining to the vehicle.

1. Vehicle serial number & year of production
2. Model code and serial number of under carriage & engine
3. Total weight of vehicle
4. Total weight of set
5. Load on first axle
6. Load on second axle
7. Load on third axle
8. Load on fourth axle – *(not stamped)*

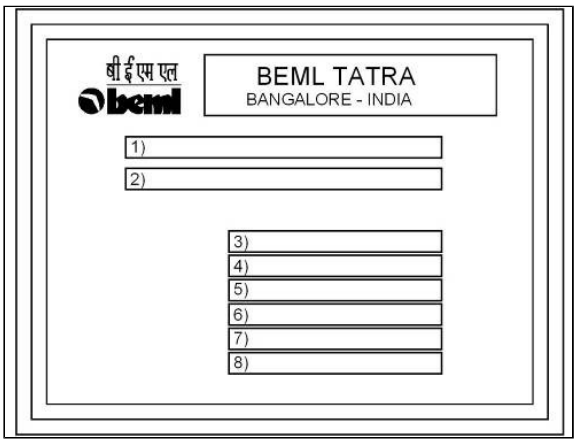


Fig. A.5 BEML factory name plane

c) Vehicle Identification Number (VIN)

1. World code of the manufacturer (TNT – TATRA, a. s.) - 3 letters
2. Vehicle description section – vehicle type and version - 6 letteres
3. Year of production: 2-2002, 3-2003, 4-2004, 5-2005 etc. - 1 letter
4. Manufacturing plant (K – TATRA, a.s., Kopřivnice) -1 letter
5. Product´s serial number - 6 letters

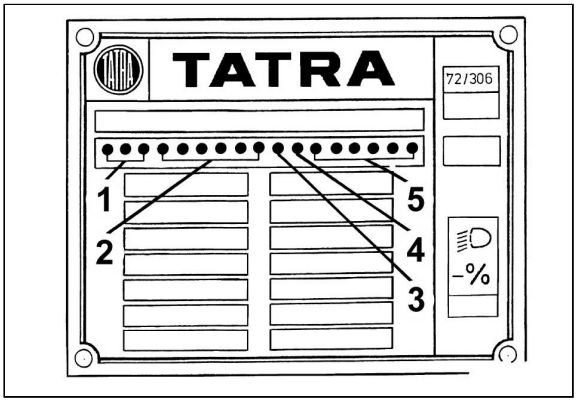


Fig. A.6 Vehicle Identification Number - VIN

d) Chassis Identification Number
It is stamped on the RH side of the front back-bone tube (behind the front axles) and is identical to that on the type plate.

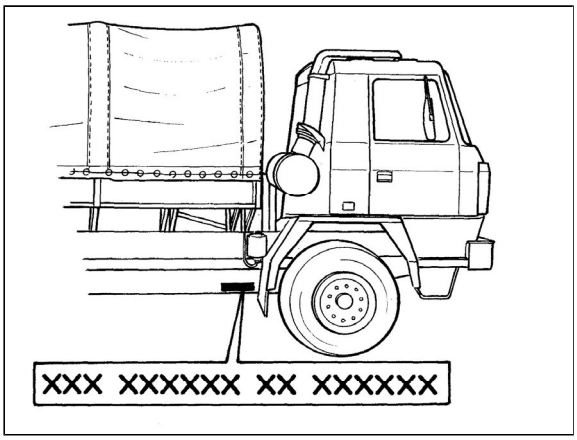


Fig. A.7 Vehicle identification number on the chassis

e) Engine Serial number
It is stamped at the front on the RH side of the crankcase and is visible after tilting the driver's cab.

xxx-xxx-xx – engine type

xxx – engine version

-xxxxxx- – engine serial number

CAUTION:
The other important assemblies (transmission, transfer case, axles, steering, body) have serial numbers of their own which are important especially when the claim is lodged.

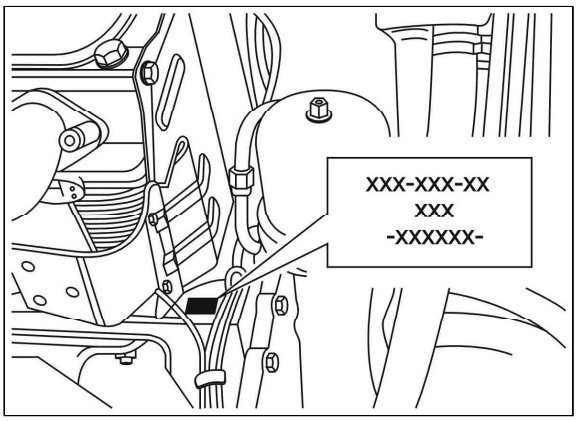


Fig. A.8 Engine Serial Number

A.6 Conversion Tables

A.6.1 Conversion Factors

Physical values mentioned in the British and American system of units can be converted into the metric system by multiplying them by conversion factors according to next tables.

Tab. A.1 Conversion Factors Values

Multiply	**by**	**to get equivalent number of:**
Inch (in.)	25.4	Millimeters (mm)
Foot (ft)	0.3048	Meters (m)
Yard (yd)	0.9144	Meters (m)
Mile (mile)	1.609	Kilometers (km)
Multiply Area	**by**	**to get equivalent number of:**
$Inch^2(in.^2)$	6.452	$Millimeters^2(mm^2)$
$Inch^2(in.^2)$	6.45	$Centimeters^2(cm^2)$
$Foot^2(ft^2)$	0.0929	$Meters^2(m^2)$
$Yard^2(yd^2)$	0.8361	$Meters^2(m^2)$
$Inch^3(in.^3)$	16387	$Millimeters^3(mm^3)$
$Inch^3(in.^3)$	16.387	$Centimeters^3(cm^3)$
$Inch^3(in.^3)$	0.0164	Liters (L)
Quart (qt)	0.9464	Liters (L)
Imperial gallon	4.546	Liters (L)
US Gallon (gal)	3.785	Liters (L)
$Yard^3(yd^3)$	0.7646	$Meters^3(m^3)$
Multiply Mass	**by**	**to get equivalent number of:**
Ounce (oz)	28.35	Grams (g)
Pound (lb)	0.4536	Kilograms (kg)
Multiply Force	**by**	**to get equivalent number of:**
Kilogram (kg)	9.807	Newtons(N)
Ounce (oz)	0.2780	Newtons(N)
Pound (lb)	4.448	Newtons(N)
Multiply Temperature	**by**	**to get equivalent number of:**
Degree Fahrenheit (°F)	(°F –32)÷ 1.8	Degree Celsius (°C)
Multiply Acceleration	**by**	**to get equivalent number of:**
$Foot/second^2(ft/sec^2)$	0.3048	$Meter/second^2(m/s^2)$
$Inch/\ second^2(ft/sec^2)$	0.0254	$Meter/second^2(m/s^2)$

Multiply Torque	**by**	**to get equivalent number of:**
Pound-inch (lb in.)	0.11298	Newton-meters (N m)
Pound-foot (lb ft)	1.3358	Newton-meters (N·m)
Multiply Power	**by**	**to get equivalent number of:**
Horsepower (hp)	0.746	Kilowatts (kW)
Multiply Pressure or Stress	**by**	**to get equivalent number of:**
Inches of water (in.H2 O)	0.2491	Kilopascals (kPa)
Pounds/square in.(lb/in^2)	6.895	Kilopascals (kPa)
Multiply Energy or Work	**by**	**to get equivalent number of:**
Foot-pound (ft lb)	1.3558	Joules (J)
kilowatt-hour (kW hr)	3,600,000.or 3.6x106	Joules (J ='one' W/s)
Multiply Light	**by**	**to get equivalent number of:**
Foot candle (fc)	1.0764	Lumens/meter^2(lm/m^2)
Multiply Fuel Performance	**by**	**to get equivalent number of:**
Miles/Imp.gal (mile/I.gal)	0.354	Kilometers/liter (km/l)
Imp.Gallons/mile (I.gal/mile)	2.825	Liter/kilometer (L/km)
Miles/US gal (mile/gal)	0.425	Kilometers/liter (km/L)
US Gallons/mile (gal/mile)	2.352	Liter/kilometer (L/km)
Multiply Velocity	**by**	**to get equivalent number of:**
Miles/hour (mile/hr)	1.6093	Kilometers/hours (km/hr)

A.6.2 Units of Length

Tab. A.2 Conversion Table for Units of Length

	in	**ft**	**yd**	**mile**	**sm**	**m**	**m**	**km**	**km**
	to m	to m	to m	to km	to km	to ft	to yd	to mile	to sm
1.0	0.0254	0.305	0.914	1.609	1.852	3.281	1.094	0.621	0.540
1.1	0.0279	0.335	1.006	1.770	2.037	3.609	1.203	0.684	0.594
1.2	0.0305	0.366	1.097	1.931	2.222	3.937	1.312	0.746	0.648
1.3	0.0330	0.396	1.189	2.092	2.408	4.265	1.422	0.808	0.702
1.4	0.0356	0.427	1.280	2.253	2.593	4.593	1.531	0.870	0.756
1.5	0.0381	0.457	1.372	2.413	2.778	4.921	1.640	0.932	0.810
1.6	0.0406	0.488	1.463	2.574	2.963	5.249	1.750	0.994	0.864
1.7	0.0432	0.518	1.554	2.735	3.148	5.577	1.859	1.06	0.918
1.8	0.0457	0.549	1.646	2.896	3.334	5.905	1.968	1.12	0.972
1.9	0.0483	0.579	1.737	3.057	3.519	6.234	2.078	1.18	1.03
2.0	0.0508	0.610	1.829	3.218	3.704	6.562	2.187	1.24	1.08
2.1	0.0533	0.640	1.920	3.379	3.889	6.890	2.297	1.30	1.13
2.2	0.0559	0.671	2.012	3.540	4.074	7.218	2.406	1.37	1.19
2.3	0.0584	0.701	2.103	3.701	4.260	7.546	2.515	1.43	1.24
2.4	0.0610	0.732	2.195	3.862	4.445	7.874	2.625	1.49	1.30
2.5	0.0635	0.762	2.286	4.022	4.630	8.202	2.734	1.55	1.35
2.6	0.0660	0.792	2.377	4.183	4.816	8.530	2.843	1.62	1.40
2.7	0.0686	0.823	2.469	4.344	5.000	8.858	2.953	1.68	1.46
2.8	0.0711	0.853	2.560	4.505	5.186	9.186	3.062	1.74	1.51
2.9	0.0737	0.884	2.652	4.666	5.371	9.514	3.171	1.80	1.57
3.0	0.0762	0.914	2.743	4.827	5.556	9.842	3.281	1.86	1.62
3.2	0.0813	0.975	2.926	5.149	5.926	10.50	3.500	1.99	1.73
3.4	0.0864	1.036	3.109	5.471	6.297	11.15	3.718	2.11	1.84
3.6	0.0914	1.097	3.292	5.792	6.667	11.81	3.937	2.24	1.94
3.8	0.0965	1.158	3.475	6.114	7.038	12.47	4.156	2.36	2.05
4.0	0.1016	1.219	3.658	6.436	7.408	13.12	4.374	2.49	2.16
4.2	0.1067	1.280	3.840	6.758	7.778	13.78	4.593	2.61	2.27
4.4	0.1118	1.341	4.023	7.080	8.149	14.44	4.812	2.73	2.38
4.6	0.1168	1.402	4.206	7.401	8.519	15.09	5.031	2.86	2.48
4.8	0.1219	1.463	4.389	7.723	8.890	15.75	5.249	2.98	2.59
5.0	0.1270	1.524	4.572	8.045	9.260	16.40	5.468	3.11	2.70
5.2	0.1321	1.585	4.755	8.367	9.630	17.06	5.687	3.23	2.81
5.4	0.1372	1.646	4.938	8.689	10.00	17.72	5.905	3.36	2.92
5.6	0.1422	1.707	5.121	9.010	10.37	18.37	6.124	3.48	3.02

	in	ft	yd	mile	sm	m	m	km	km
	to m	to m	to m	to km	to km	to ft	to yd	to mile	to sm
5.8	0.1473	1.768	5.304	9.332	10.74	19.03	6.343	3.60	3.13
6.0	0.1524	1.829	5.486	9.654	11.11	19.69	6.562	3.73	3.24
6.2	0.1575	1.890	5.669	9.976	11.48	20.34	6.780	3.85	3.35
6.4	0.1626	1.951	5.852	10.30	11.85	21.00	6.999	3.98	3.46
6.6	0.1676	2.012	6.035	10.62	12.22	21.65	7.218	4.10	3.56
6.8	0.1727	2.073	6.218	10.94	12.59	22.31	7.437	4.23	3.67
7.0	0.1778	2.134	6.401	11.27	12.96	22.97	7.655	4.35	3.78
7.5	0.1905	2.286	6.858	12.07	13.89	24.61	8.202	4.66	4.05
8.0	0.2032	2.438	7.315	12.87	14.82	26.25	8.749	4.97	4.32
8.5	0.2159	2.591	7.772	13.68	15.74	27.89	9.296	5.28	4.59
9.0	0.2286	2.743	8.230	14.48	16.67	29.53	9.842	5.59	4.86
9.5	0.2413	2.896	8.687	15.29	17.59	31.17	10.39	5.90	5.13

Examples : 1 ft = 0.305 m; 7.5 yd = 6.858 m

Tab. A.3 Conversion Table Inch - Millimeter

based on 1 inch = 25.4 mm

inch				0	1	2	3
			-	-	25.40	50.80	76.20
		1/64	0.015625	0.397	25.80	51.20	76.60
	1/32		0.03125	0.794	26.19	51.59	76.99
		3/64	0.046875	1.191	26.59	51.99	77.39
1/16			0.0625	1.588	26.99	52.39	77.79
		5/64	0.078125	1.984	27.38	52.78	78.18
	3/32		0.09375	2.381	27.78	53.18	78.58
		7/64	0.109375	2.778	28.18	53.58	78.98
1/8			0.125	3.175	28.58	53.98	79.38
		9/64	0.140625	3.572	28.97	54.37	79.77
	5/32		0.15625	3.969	29.37	54.77	80.17
		11/64	0.171875	4.366	29.77	55.17	80.57
3/16			0.1875	4.763	30.16	55.56	80.96
		13/64	0.203125	5.159	30.56	55.96	81.36
	7/32		0.21875	5.556	30.96	56.36	81.76
		15/64	0.234375	5.953	31.35	56.75	82.15
1/4			0.25	6.350	31.75	57.15	82.55
		17/64	0.265625	6.747	32.15	57.55	82.95
	9/32		0.28125	7.144	32.54	57.94	83.34
		19/64	0.296875	7.541	32.94	58.34	83.74
5/16			0.3125	7.938	33.34	58.74	84.14
		21/64	0.328125	8.334	33.73	59.13	84.53
	11/32		0.34375	8.731	34.13	59.53	84.93
		23/64	0.359375	9.128	34.53	59.93	85.33
3/8			0.375	9.525	34.93	60.33	85.73
		25/64	0.390625	9.922	35.32	60.72	86.12
	13/32		0.40625	10.319	35.72	61.12	86.52
		27/64	0.421875	10.716	36.12	61.52	86.92

inch				0	1	2	3
7/16			0.4375	11.113	36.51	61.91	87.31
		29/64	0.453125	11.509	36.91	62.31	87.71
	15/32		0.46875	11.906	37.31	62.71	88.11
		31/64	0.484375	12.303	37.70	63.10	88.50
1/2			0.5	12.700	38.10	63.50	88.90
		33/64	0.515625	13.097	38.50	63.90	89.30
	17/32		0.53125	13.494	38.89	64.29	89.69
		35/64	0.546875	13.891	39.29	64.69	90.09
9/16			0.5625	14.288	39.69	65.09	90.49
		37/64	0.578125	14.684	40.08	65.48	90.88
	19/32		0.59375	15.081	40.48	65.88	91.28
		39/64	0.609375	15.478	40.88	66.28	91.68
5/8			0.625	15.875	41.28	66.68	92.08
		41/64	0.640625	16.272	41.67	67.07	92.47
	21/32		0.71875	18.256	43.66	69.06	94.46
		43/64	0.671875	17.066	42.47	67.87	93.27
11/16			0.6875	17.463	42.86	68.26	93.66
		45/64	0.703125	17.859	43.26	68.66	94.06
	23/32		0.71875	18.256	43.66	69.06	94.46
		47/64	0.734375	18.653	44.05	69.45	94.85
3/4			0.75	19.050	44.45	69.85	95.25
		49/64	0.765625	19.447	44.85	70.25	95.65
	25/32		0.78125	19.844	45.24	70.64	96.04
		51/64	0.796875	20.241	45.64	71.04	96.44
13/16			0.8125	20.638	46.04	71.44	96.84
		53/64	0.828125	21.034	46.43	71.83	97.23
	27/32		0.84375	21.431	46.83	72.23	97.63
		55/64	0.859375	21.828	47.23	72.63	98.03
7/8			0.875	22.225	47.63	73.03	98.43
		57/64	0.890625	22.622	48.02	73.42	98.82
	29/32		0.90625	23.019	48.42	73.82	99.22
		59/64	0.921875	23.416	48.82	74.22	99.62
15/16			0.9375	23.813	49.21	74.61	100.01
		61/64	0.953125	24.209	49.61	75.01	100.41
	31/32		0.96875	24.606	50.01	75.41	100.81
		63/64	0.984375	25.003	50.40	75.80	101.20

Values of 1 inch and more are rounded off to one hundredth of a millimeter.

A.6.3 Units of Area

Tab. A.4 Conversion Table for Units of Area

	in²	**ft²**	**yd²**	**acre**	**mile²**	**cm²**	**m²**	**m²**	**km²**
	to cm²	to m²	to m²	to a	to km²	to in²	to ft²	to yd²	to mile²
1.0	6.45	0.0929	0.836	40.5	2.59	0.155	10.8	1.20	0.386
1.1	7.10	0.102	0.920	44.5	2.85	0.171	11.8	1.32	0.425
1.2	7.74	0.111	1.00	48.6	3.11	0.186	12.9	1.44	0.463
1.3	8.39	0.121	1.09	52.6	3.37	0.202	14.0	1.55	0.502
1.4	9.03	0.130	1.17	56.7	3.63	0.217	15.1	1.67	0.541
1.5	9.68	0.139	1.25	60.7	3.89	0.233	16.1	1.79	0.579
1.6	10.3	0.149	1.34	64.7	4.14	0.248	17.2	1.91	0.618
1.7	11.0	0.158	1.42	68.8	4.40	0.264	18.3	2.03	0.656
1.8	11.6	0.167	1.50	72.8	4.66	0.279	19.4	2.15	0.695
1.9	12.3	0.177	1.59	76.9	4.92	0.295	20.5	2.27	0.734
2.0	12.9	0.186	1.67	80.9	5.18	0.310	21.5	2.39	0.772
2.1	13.5	0.195	1.76	85.0	5.44	0.326	22.6	2.51	0.811
2.2	14.2	0.204	1.84	89.0	5.70	0.341	23.7	2.63	0.849
2.3	14.8	0.214	1.92	93.1	5.96	0.357	24.8	2.75	0.888
2.4	15.5	0.223	2.01	97.1	6.22	0.372	25.8	2.87	0.927
2.5	16.1	0.232	2.09	101	6.47	0.388	26.9	2.99	0.965
2.6	16.8	0.242	2.17	105	6.73	0.403	28.0	3.11	1.00
2.7	17.4	0.251	2.26	109	6.99	0.419	29.1	3.23	1.04
2.8	18.1	0.260	2.34	113	7.25	0.434	30.1	3.35	1.08
2.9	18.7	0.269	2.42	117	7.51	0.450	31.2	3.47	1.12
3.0	19.4	0.279	2.51	121	7.77	0.465	32.3	3.59	1.16
3.2	20.6	0.297	2.68	129	8.29	0.496	34.4	3.83	1.24
3.4	21.9	0.316	2.84	138	8.81	0.527	36.6	4.07	1.31
3.6	23.2	0.334	3.01	146	9.32	0.558	38.8	4.31	1.39
3.8	24.5	0.353	3.18	154	9.84	0.589	40.9	4.54	1.47
4.0	25.8	0.372	3.34	162	10.4	0.620	43.1	4.78	1.54
4.2	27.1	0.390	3.51	170	10.9	0.651	45.2	5.02	1.62
4.4	28.4	0.409	3.68	178	11.4	0.682	47.4	5.26	1.70
4.6	29.7	0.427	3.85	186	11.9	0.713	49.5	5.50	1.78
4.8	31.0	0.446	4.01	194	12.4	0.744	51.7	5.74	1.85
5.0	32.3	0.465	4.18	202	12.9	0.775	53.8	5.98	1.93
5.2	33.5	0.483	4.35	210	13.5	0.806	56.0	6.22	2.01
5.4	34.8	0.502	4.51	219	14.0	0.837	58.1	6.46	2.08

	in²	**ft²**	**yd²**	**acre**	**mile²**	**cm²**	**m²**	**m²**	**km²**
	to cm²	to m²	to m²	to a	to km²	to in²	to ft²	to yd²	to mile²
5.6	36.1	0.520	4.68	227	14.5	0.868	60.3	6.70	2.16
5.8	37.4	0.539	4.85	235	15.0	0.899	62.4	6.94	2.24
6.0	38.7	0.557	5.02	243	15.5	0.930	64.6	7.18	2.32
6.2	40.0	0.576	5.18	251	16.1	0.961	66.7	7.42	2.39
6.4	41.3	0.595	5.35	259	16.6	0.992	68.9	7.65	2.47
6.6	42.6	0.613	5.52	267	17.1	1.02	71.0	7.89	2.55
6.8	43.9	0.632	5.69	275	17.6	1.05	73.2	8.13	2.63
7.0	45.2	0.650	5.85	283	18.1	1.085	75.3	8.37	2.70
7.5	48.4	0.697	6.27	304	19.4	1.163	80.7	8.97	2.90
8.0	51.6	0.743	6.69	324	20.7	1.240	86.1	9.57	3.09
8.5	54.8	0.790	7.11	344	22.0	1.318	91.5	10.2	3.28
9.0	58.1	0.836	7.52	364	23.3	1.395	96.9	10.8	3.47
9.5	61.3	0.883	7.94	384	24.6	1.473	102.3	11.4	3.67

The above table also applies to decimal multiples and submultiples.
Examples : 1 in^2 = 6.45 cm^2; 5.8 yd^2= 4.85 m^2; 58 yd^2= 48.5 m^2

A.6.4 Units of Volume and Flow

Tab. A.5 Conversion Table for Units of Volume and Flow

	in^3	**ft^3**	**yd^3**	**pt (UK)**	**liqpt (US)**	**gal (UK)**	**gal (US)**	**barrel**	**ft^3/mincfm**
	to cm^3	to l	to m^3	to l	to l	to l	to l	to l	to m^3/h
1.0	16.4	28.3	0.765	0.568	0.473	4.55	3.79	159	1.70
1.1	18.0	31.1	0.841	0.625	0.520	5.00	4.16	175	1.87
1.2	19.7	34.0	0.917	0.682	0.568	5.46	4.54	191	2.04
1.3	21.3	36.8	0.994	0.739	0.615	5.91	4.92	207	2.21
1.4	22.9	39.6	1.07	0.796	0.662	6.36	5.30	223	2.38
1.5	24.6	42.5	1.15	0.852	0.710	6.82	5.68	238	2.55
1.6	26.2	45.3	1.22	0.909	0.757	7.27	6.06	254	2.72
1.7	27.9	48.1	1.30	0.966	0.804	7.73	6.44	270	2.89
1.8	29.5	51.0	1.38	1.02	0.852	8.18	6.81	286	3.06
1.9	31.1	53.8	1.45	1.08	0.899	8.64	7.19	302	3.23
2.0	32.8	56.6	1.53	1.14	0.946	9.09	7.57	318	3.40
2.1	34.4	59.5	1.61	1.19	0.994	9.5	7.95	334	3.57
2.2	36.1	62.3	1.68	1.25	1.04	10.0	8.33	350	3.74
2.3	37.7	65.1	1.76	1.31	1.09	10.5	8.71	366	3.91
2.4	39.3	68.0	1.83	1.36	1.14	10.9	9.08	382	4.08
2.5	41.0	70.8	1.91	1.42	1.18	11.4	9.46	397	4.25
2.6	42.6	73.6	1.99	1.48	1.23	11.8	9.84	413	4.42
2.7	44.2	76.5	2.06	1.53	1.28	12.3	10.2	429	4.59
2.8	45.9	79.3	2.14	1.59	1.32	12.7	10.6	445	4.76
2.9	47.5	82.1	2.22	1.65	1.37	13.2	11.0	461	4.93
3.0	49.2	85.0	2.29	1.70	1.42	13.6	11.4	477	5.10
3.2	52.4	90.6	2.45	1.82	1.51	14.5	12.1	509	5.44
3.4	55.7	96.3	2.60	1.93	1.61	15.5	12.9	541	5.78
3.6	59.0	102	2.75	2.04	1.70	16.4	13.6	572	6.12
3.8	62.3	108	2.91	2.16	1.80	17.3	14.4	604	6.46
4.0	65.5	113	3.06	2.27	1.89	18.2	15.1	636	6.80
4.2	68.8	119	3.21	2.39	1.99	19.1	15.9	668	7.14
4.4	72.1	125	3.36	2.50	2.08	20.0	16.7	700	7.48
4.6	75.4	130	3.52	2.61	2.18	20.9	17.4	731	7.82
4.8	78.7	136	3.67	2.73	2.27	21.8	18.2	763	8.16
5.0	81.9	142	3.82	2.84	2.37	22.7	18.9	795	8.50
5.2	85.2	147	3.98	2.95	2.46	23.6	19.7	827	8.83
5.4	88.5	153	4.13	3.07	2.56	24.5	20.4	859	9.17

	in^3	**ft^3**	**yd^3**	**pt (UK)**	**liqpt (US)**	**gal (UK)**	**gal (US)**	**barrel**	**ft^3/mincfm**
	to cm^3	to l	to m^3	to l	to l	to l	to l	to l	to m^3/h
5.6	91.8	159	4.28	3.18	2.65	25.5	21.2	890	9.51
5.8	95.0	164	4.43	3.29	2.74	26.4	22.0	922	9.85
6.0	98.3	170	4.59	3.41	2.84	27.3	22.7	954	10.2
6.2	102	176	4.74	3.52	2.93	28.2	23.5	986	10.5
6.4	105	181	4.89	3.64	3.03	29.1	24.2	1018	10.9
6.6	108	187	5.05	3.75	3.12	30.0	25.0	1049	11.2
6.8	111	193	5.20	3.86	3.22	30.9	25.7	1081	11.6
7.0	115	198	5.35	3.98	3.31	31.8	26.5	1113	11.9
7.5	123	212	5.73	4.26	3.55	34.1	28.4	1192	12.7
8.0	131	227	6.12	4.54	3.79	36.4	30.3	1272	13.6
8.5	139	241	6.50	4.83	4.02	38.6	32.2	1351	14.4
9.0	147	255	6.88	5.11	4.26	40.9	34.1	1431	15.3
9.5	156	269	7.26	5.40	4.50	43.2	36.0	1510	16.1

The above table also applies to decimal multiples and submultiples.
Examples : 1 in^3= 16.4 cm^3; 3 gal (UK) = 13.6 l; 30 gal = 136 l

A.6.5 Units of Weight

Tab. A.6 Conversion Table for Units of Weight

	grain	dram	oz	lb	cwt (UK)	cwt (US)	ton (UK)	ton (US)
	to g	to g	to g	to kg	to kg	to kg	to ton	to ton
1.0	0.0648	1.77	28.3	0.454	50.8	45.4	1.02	0.907
1.1	0.0713	1.95	31.2	0.499	55.9	49.9	1.12	0.998
1.2	0.0778	2.13	34.0	0.544	61.0	54.4	1.22	1.09
1.3	0.0842	2.30	36.9	0.590	66.0	59.0	1.32	1.18
1.4	0.0907	2.48	39.7	0.635	71.1	63.5	1.42	1.27
1.5	0.0972	2.66	42.5	0.680	76.2	68.0	1.52	1.36
1.6	0.104	2.83	45.4	0.726	81.3	72.6	1.63	1.45
1.7	0.110	3.01	48.2	0.771	86.4	77.1	1.73	1.54
1.8	0.117	3.19	51.0	0.816	91.4	81.6	1.83	1.63
1.9	0.123	3.37	53.9	0.862	96.5	86.2	1.93	1.72
2.0	0.130	3.54	56.7	0.907	102	90.7	2.03	1.81
2.1	0.136	3.72	59.5	0.953	107	95.3	2.13	1.91
2.2	0.143	3.90	62.4	0.998	112	99.8	2.24	2.00
2.3	0.149	4.08	65.2	1.04	117	104	2.34	2.09
2.4	0.156	4.25	68.0	1.09	122	109	2.44	2.18
2.5	0.162	4.43	70.9	1.13	127	113	2.54	2.27
2.6	0.168	4.61	73.7	1.18	132	118	2.64	2.36
2.7	0.175	4.78	76.5	1.22	137	122	2.74	2.45
2.8	0.181	4.96	79.4	1.27	142	127	2.84	2.54
2.9	0.188	5.14	82.2	1.32	147	132	2.95	2.63
3.0	0.194	5.32	85.0	1.36	152	136	3.05	2.72
3.2	0.207	5.67	90.7	1.45	163	145	3.25	2.90
3.4	0.220	6.02	96.4	1.54	173	154	3.45	3.08
3.6	0.233	6.38	102	1.63	183	163	3.66	3.27
3.8	0.246	6.73	108	1.72	193	172	3.86	3.45
4.0	0.259	7.09	113	1.81	203	181	4.06	3.63
4.2	0.272	7.44	119	1.91	213	191	4.27	3.81
4.4	0.285	7.80	125	2.00	224	200	4.47	3.99
4.6	0.298	8.15	130	2.09	234	209	4.67	4.17
4.8	0.311	8.50	136	2.18	244	218	4.88	4.35
5.0	0.324	8.86	142	2.27	254	227	5.08	4.54
5.2	0.337	9.21	147	2.36	264	236	5.28	4.72
5.4	0.350	9.57	153	2.45	274	245	5.49	4.90
5.6	0.363	9.92	159	2.54	284	254	5.69	5.08

	grain	dram	oz	lb	cwt (UK)	cwt (US)	ton (UK)	ton (US)
	to g	to g	to g	to kg	to kg	to kg	to ton	to ton
5.8	0.376	10.3	164	2.63	295	263	5.89	5.26
6.0	0.389	10.6	170	2.72	305	272	6.10	5.44
6.5	0.421	11.5	184	2.95	330	295	6.60	5.90
7.0	0.454	12.4	198	3.18	356	318	7.11	6.35
7.5	0.486	13.3	213	3.40	381	340	7.62	6.80
8.0	0.518	14.2	227	3.63	406	363	8.13	7.26
8.5	0.551	15.1	241	3.86	432	386	8.64	7.71
9.0	0.583	15.9	255	4.08	457	408	9.14	8.16
9.5	0.616	16.8	269	4.31	483	431	9.65	8.62

The above table also applies to decimal multiples and submultiples.
Examples : 1 lb = 0.454 kg; 5 ton (UK) = 5.08 t; 42 oz = 1,190 g

A.6.6 Units of Weight in relation to Length and Density

Tab. A.7 Conversion Table for Units of Weight / Length and Density

	Conversion of						Conversion of		
	lb/ft	lb/yd	lb/ft^3	lb/gal(UK)	lb/gal (UK		+°Bé	-°Bé	°API
	to kg/m	to kg/m	to kg/m^3	to kg/l	to kg/l		to kg/l	to kg/l	to kg/l
1.0	1.49	0.496	16.0	0.0998	0.120	0	1.000	1.000	1.076
1.1	1.64	0.546	17.6	0.110	0.132	2	1.014	0.986	1.060
1.2	1.79	0.595	19.2	0.120	0.144	4	1.029	0.973	1.044
1.3	1.94	0.645	20.8	0.130	0.156	6	1.043	0.960	1.029
1.4	2.08	0.694	22.4	0.140	0.168	8	1.059	0.947	1.014
1.5	2.23	0.744	24.0	0.150	0.180	10	1.074	0.935	1.000
1.6	2.38	0.794	25.6	0.160	0.192	12	1.091	0.923	0.986
1.7	2.53	0.843	27.2	0.170	0.204	14	1.107	0.912	0.973
1.8	2.68	0.893	28.8	0.180	0.216	16	1.125	0.900	0.959
1.9	2.83	0.943	30.4	0.190	0.228	18	1.143	0.889	0.946
2.0	2.98	0.992	32.0	0.200	0.240	20	1.161	0.878	0.934
2.1	3.13	1.04	33.6	0.210	0.252	22	1.180	0.868	0.922
2.2	3.27	1.09	35.2	0.219	0.264	24	1.200	0.857	0.910
2.3	3.42	1.14	36.8	0.229	0.276	26	1.220	0.847	0.898
2.4	3.57	1.19	38.4	0.239	0.288	28	1.241	0.837	0.887
2.5	3.72	1.24	40.0	0.249	0.300	30	1.262	0.828	0.876
2.6	3.87	1.29	41.6	0.259	0.312	32	1.285	0.818	0.865
2.7	4.02	1.34	43.2	0.269	0.324	34	1.308	0.809	0.855
2.8	4.17	1.39	44.9	0.279	0.335	36	1.332	0.800	0.845
2.9	4.32	1.44	46.5	0.289	0.347	38	1.357	0.792	0.835
3.0	4.46	1.49	48.1	0.299	0.359	40	1.384	0.783	0.825
3.2	4.76	1.59	51.3	0.319	0.383	45	1.453	0.762	0.802
3.4	5.06	1.69	54.5	0.339	0.407	50	1.530	0.743	0.780
3.6	5.36	1.79	57.7	0.359	0.431	55	1.616	0.724	0.759
3.8	5.66	1.88	60.9	0.379	0.455	60	1.712	0.706	0.739
4.0	5.95	1.98	64.1	0.399	0.479	65	1.820	0.689	0.720

	Conversion of						Conversion of		
	lb/ft	lb/yd	lb/ft^3	lb/gal(UK)	lb/gal (UK)		+°Bé	-°Bé	°API
	to kg/m	to kg/m	to kg/m^3	to kg/l	to kg/l		to kg/l	to kg/l	to kg/l
4.2	6.25	2.08	67.3	0.419	0.503	70	1.942	0.673	0.702
4.4	6.55	2.18	70.5	0.439	0.527	°Bé(degrees Baumé) is a measure of the density of liquids which are heavier (+°Bé) or lighter (-°Bé) than water (at 15°C). The unit°Bé is no longer to be used. r = 144.3/(144.3 ±*n*) r Density is expressed in kg/l, and hydrometer degrees *n* in°Bé°API /American Petroleum Institute) is used in theUSAto indicate the density of fuels and oils. r = 141.5/(131.5 +*n*) r Density is expressed in kg/l, hydrometer degrees *n* in°API			
4.6	6.85	2.28	73.7	0.459	0.551				
4.8	7.14	2.38	76.9	0.479	0.575				
5.0	7.44	2.48	80.1	0.499	0.599				
5.2	7.74	2.58	83.3	0.519	0.623				
5.4	8.04	2.68	86.5	0.539	0.647				
5.6	8.33	2.78	89.7	0.559	0.671				
5.8	8.63	2.88	92.9	0.579	0.695				
6.0	8.93	2.98	96.1	0.599	0.719				
6.5	9.67	3.22	104	0.649	0.779				
7.0	10.4	3.47	112	0.698	0.839				
7.5	11.2	3.72	120	0.748	0.899				
8.0	11.9	3.97	128	0.798	0.959				
8.5	12.7	4.22	136	0.848	1.02				
9.0	13.4	4.46	144	0.898	1.08				

The above table also applies to decimal multiples and submultiples.
Examples : 7lb/ballon (US) = 0.839 kg/l; -30 °Bé = 0.828kg/l

A.6.7 Units of Force, Pressure and Stress

Tab. A.8 Conversion Table for Units of Force, Pressure and Stress

	[1)]kp/mm^2	at	atm	Torr	lbf	lbf/in^2	tonf/in^2	lbf/ft^2
	to N/mm^2	to bar	to bar	to hPa	to N	to bar	to N/mm^2	to Pa
1.0	9.807	0.9807	1.013	1.333	4.448	0.0689	15.44	47.88
1.1	10.79	1.079	1.115	1.467	4.893	0.0758	16.99	52.67
1.2	11.77	1.177	1.216	1.600	5.338	0.0827	18.53	57.46
1.3	12.75	1.275	1.317	1.733	5.783	0.0896	20.08	62.24
1.4	13.73	1.324	1.419	1.867	6.228	0.0965	21.62	67.03
1.5	14.71	1.471	1.520	2.000	6.672	0.103	23.17	71.82
1.6	15.69	1.569	1.621	2.133	7.117	0.110	24.71	76.61
1.7	16.67	1.667	1.723	2.266	7.562	0.117	26.26	81.40
1.8	17.65	1.765	1.824	2.400	8.007	0.124	27.80	86.18
1.9	18.63	1.863	1.925	2.533	8.452	0.131	29.34	90.97
2.0	19.61	1.961	2.026	2.666	8.896	0.138	30.89	95.76
2.1	20.59	2.059	2.128	2.800	9.341	0.145	32.43	100.50
2.2	21.57	2.157	2.229	2.933	9.786	0.152	33.98	105.3
2.3	22.56	2.256	2.330	3.066	10.23	0.158	35.52	110.1
2.4	23.54	2.354	2.432	3.200	10.68	0.165	37.07	114.9
2.5	24.52	2.452	2.533	3.333	11.12	0.172	38.61	119.7
2.6	25.50	2.550	2.634	3.466	11.57	0.179	40.16	124.5
2.7	26.48	2.648	2.736	3.600	12.01	0.186	41.70	129.3
2.8	27.46	2.746	2.837	3.733	12.46	0.193	43.24	134.1
2.9	28.44	2.844	2.938	3.866	12.90	0.200	44.79	138.9
3.0	29.42	2.942	3.040	4.000	13.34	0.207	46.33	143.6
3.2	31.38	3.138	3.242	4.266	14.23	0.220	49.42	153.2
3.4	33.34	3.334	3.445	4.533	15.12	0.234	52.51	162.8
3.6	35.30	3.530	3.648	4.800	16.01	0.248	55.60	172.4
3.8	37.27	3.727	3.850	5.066	16.90	0.262	58.69	181.9
4.0	39.23	3.923	4.053	5.333	17.79	0.276	61.78	191.6
4.2	41.19	4.119	4.256	5.600	18.68	0.289	64.87	201.1
4.4	43.15	4.315	4.458	5.866	19.57	0.303	67.95	210.7
4.6	45.11	4.511	4.661	6.133	20.46	0.317	71.04	220.2
4.8	47.07	4.707	4.864	6.399	21.35	0.331	74.13	229.8
5.0	49.03	4.903	5.066	6.666	22.24	0.345	77.22	239.4
5.2	50.99	5.099	5.269	6.933	23.13	0.358	80.31	249.0
5.4	52.96	5.296	5.472	7.199	24.02	0.372	83.40	258.6

	[1)]kp/mm^2	at	atm	Torr	lbf	lbf/in^2	tonf/in^2	lbf/ft^2
	to N/mm^2	to bar	to bar	to hPa	to N	to bar	to N/mm^2	to Pa
5.6	54.92	5.492	5.674	7.466	24.91	0.386	86.49	268.1
5.8	56.88	5.688	5.877	7.733	25.80	0.400	89.57	277.7
6.0	58.84	5.884	6.079	7.999	26.69	0.413	92.67	287.3
6.5	63.74	6.374	6.586	8.666	28.91	0.448	100.4	311.2
7.0	68.65	6.865	7.093	9.333	31.14	0.482	108.1	335.2
7.5	73.55	7.355	7.599	9.999	33.36	0.517	115.8	359.1
8.0	78.45	7.845	8.106	10.67	35.59	0.551	123.6	383.0
8.5	83.36	8.336	8.613	11.33	37.81	0.586	131.3	407.0
9.0	88.26	8.826	9.119	12.00	40.03	0.620	139.0	430.9
9.5	93.16	9.316	9.626	12.67	42.26	0.655	146.7	454.9

The above table also applies to decimal multiples and submultiples.
Example : 260 lb/in^2 = 17.9 bar

[1)] also valid for conversion from kp to N

A.6.8 Conversion Table for Units of Energy and Power

Tab. A.9 Conversion Table for Units of Energy and Power

	kp.m	**PS.h**	**kW.h**	**kcal**	**kJ**	**ft.lbf**	**in.lbf**	**hp.h**	**Btu**
	kp.m/s	*PS*	*kW*	*kcal/s*	*kW*	*ft.lbf/s*	*in.lbf/s*	*hp*	*Btu/s*
	to J	to kW.h	to PS.h	to kJ	to kcal	to J	to J	to kW.h	to kJ
	to W	*to kW*	*to PS*	*to kW*	*to kcal/s*	*to W*	*to W*	*to kW*	*to kW*
1.0	9.807	0.7355	1.360	4.187	0.2388	1.356	0.1130	0.7457	1.055
1.1	10.79	0.8090	1.496	4.605	0.2627	1.491	0.1243	0.8203	1.161
1.2	11.77	0.8826	1.632	5.024	0.2866	1.627	0.1356	0.8948	1.266
1.3	12.75	0.9561	1.767	5.443	0.3105	1.763	0.1469	0.9694	1.372
1.4	13.73	1.030	1.903	5.862	0.3344	1.898	0.1582	1.044	1.477
1.5	14.71	1.103	2.039	6.280	0.3583	2.034	0.1695	1.119	1.583
1.6	15.69	1.177	2.175	6.699	0.3822	2.169	0.1808	1.193	1.688
1.7	16.67	1.250	2.311	7.118	0.4060	2.305	0.1921	1.268	1.794
1.8	17.65	1.324	2.447	7.536	0.4299	2.440	0.2034	1.342	1.899
1.9	18.63	1.397	2.583	7.955	0.4538	2.576	0.2147	1.417	2.005
2.0	19.61	1.471	2.719	8.374	0.4777	2.712	0.2260	1.491	2.110
2.1	20.59	1.545	2.855	8.792	0.5016	2.847	0.2324	1.566	2.216
2.2	21.57	1.618	2.991	9.211	0.5255	2.983	0.2486	1.641	2.321
2.3	22.56	1.692	3.127	9.630	0.5493	3.118	0.2599	1.715	2.427
2.4	23.54	1.765	3.263	10.05	0.5732	3.254	0.2712	1.790	2.532
2.5	24.52	1.839	3.399	10.47	0.5971	3.390	0.2825	1.864	2.638
2.6	25.50	1.912	3.535	10.89	0.6210	3.525	0.2938	1.939	2.743
2.7	26.48	1.986	3.671	11.30	0.6449	3.661	0.3051	2.013	2.849
2.8	27.46	2.059	3.807	11.72	0.6688	3.796	0.3164	2.088	2.954
2.9	28.44	2.133	3.943	12.14	0.6927	3.932	0.3277	2.163	3.060
3.0	29.42	2.206	4.079	12.56	0.7165	4.067	0.3390	2.237	3.165
3.2	31.38	2.354	4.351	13.40	0.7643	4.339	0.3616	2.386	3.376
3.4	33.34	2.501	4.623	14.24	0.8121	4.610	0.3841	2.535	3.587
3.6	35.30	2.648	4.895	15.07	0.8598	4.881	0.4067	2.685	3.798
3.8	37.27	2.795	5.167	15.91	0.9076	5.152	0.4293	2.834	4.009
4.0	39.23	2.942	5.438	16.75	0.9554	5.423	0.4519	2.983	4.220
4.2	41.19	3.089	5.710	17.58	1.003	5.694	0.4745	3.132	4.431
4.4	43.15	3.236	5.982	18.42	1.051	5.966	0.4971	3.281	4.642
4.6	45.11	3.383	6.254	19.26	1.099	6.237	0.5197	3.430	4.853
4.8	47.07	3.530	6.526	20.10	1.146	6.508	0.5423	3.579	5.064
5.0	49.03	3.677	6.798	20.93	1.194	6.779	0.5649	3.728	5.275
5.5	53.94	4.045	7.478	23.03	1.314	7.457	0.6214	4.101	5.803

	kp.m	**PS.h**	**kW.h**	**kcal**	**kJ**	**ft.lbf**	**in.lbf**	**hp.h**	**Btu**
	kp.m/s	*PS*	*kW*	*kcal/s*	*kW*	*ft.lbf/s*	*in.lbf/s*	*hp*	*Btu/s*
	to J	to kW.h	to PS.h	to kJ	to kcal	to J	to J	to kW.h	to kJ
	to W	*to kW*	*to PS*	*to kW*	*to kcal/s*	*to W*	*to W*	*to kW*	*to kW*
6.0	58.84	4.413	8.158	25.12	1.433	8.135	0.6779	4.474	6.330
6.5	63.74	4.781	8.838	27.21	1.552	8.813	0.7344	4.847	6.858
7.0	68.65	5.148	9.517	29.31	1.672	9.491	0.7909	5.220	7.385
7.5	73.55	5.516	10.20	31.40	1.791	10.17	0.8474	5.593	7.913
8.0	78.46	5.884	10.88	33.49	1.911	10.85	0.9039	5.966	8.440
8.5	83.36	6.252	11.56	35.59	2.030	11.52	0.9604	6.338	8.968
9.0	88.26	6.619	12.24	37.68	2.150	12.20	1.017	6.711	9.496
9.5	93.16	6.987	12.92	39.77	2.269	12.88	1.073	7.084	10.02

The above table also applies to decimal multiples and submultiples.
Example : 3.8 PS* = 2.795 kW; 38 PS* = 27.95 kW

* PS ´Pferdestarke = metric horsepower

A.6.9 Units of Temperature

Tab. A.10 Conversion Table for Units of Temperature

Temperature units	**Temperature difference**
^oC = degree Celsius, K = Kelvin,	1 K = 1^oC = 1,8^oF = 1,8^oR
^oF = degree Fahrenheit,	
^oR = degree Rankine,	**Zero points:**
Temperature conversion	$0\,°C \mathrel{\hat{=}} 32\,°F \qquad 0\,°F \mathrel{\hat{=}} -17{,}78\,°C$
$T_K = (273{,}15° C + t_C) \cdot \frac{K}{°C} = \frac{5}{9} T_R$	Absolute zero: $0K \mathrel{\hat{=}} -273.15\,°C \mathrel{\hat{=}} 0\,°R \mathrel{\hat{=}} -459.67°F$
$T_R = (459{,}67° F + t_F) \cdot \frac{°R}{°F} = 1{,}8\ T_K$	**International practical Temperature scale:** Boiling point of oxygen : - 182.97 ^{o} C, Triple point of water 0.01 ^{o} C [1)] , boiling point of water 100 ^{o} C, boiling point of sulfur (sulfur point) : 444.6 ^{o} C, setting point of silver (silver point) : 960.8 ^{o} C, setting point of gold 1063 ^{o} C.
$t_c = \frac{5}{9}(t_F - 32°F) \cdot \frac{°C}{°F} = (T_K - 273{,}15K) \cdot \frac{°C}{K}$	
$t_F = (1{,}8 t_C + 32°C) \cdot \frac{°F}{°C} = (T_R - 459{,}67°R) \cdot \frac{°F}{°R}$	
t_C, t_F, T_K and T_R denote the numeral values of a temperature in ^oC, ^oF, K and ^oR.	[1)] That temperature of pure water at which ice, water and water vapor occur together in equilibrium (at 1013.25 hPa).

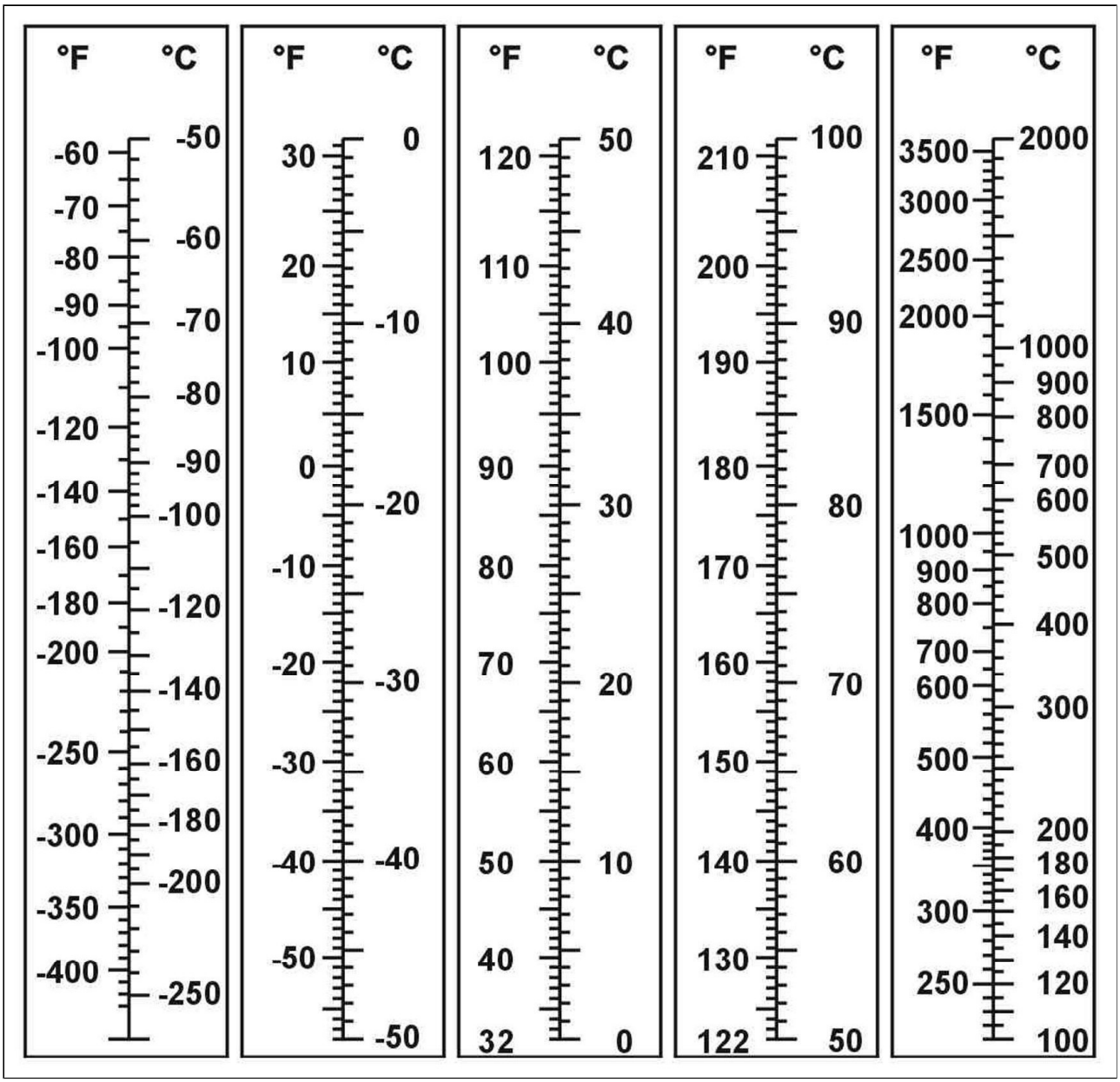


Fig. A.9 Conversion of Temperature Units

A.6.10 Units of Viscosity

Tab. A.11 Conversion Table for Units of Viscosity

Legal units of kinematic viskosity **n** 1 m^2/s=1 Pa.s/(kg/m^3)=$10^4 cm^2/s$=$10^6 mm^2/s$ **British and American units :** 1 ft^2/s = 0.092903 m^2/s RI seconds = efflux time from Redwood-I viscometer (UK) SU seconds = efflux time from Saybolt-Universal viscometer (US) **Do not use :** St (Skokes) = cm^2/s, cST = mm^2/s	**Conventional units** E (Engler degree) = relative efflux time from Engler apparatus DIN 51 560 For **n**> 60 mm^2/s is 1 mm^2/s = 0.132 E At values below 3 E, Engler degrees do not give a true indication of the variation of viscosity; for example, a fluid with 2 E does not have twice the kinematic viskosity of a fluid with 1 E, but rather 12 times that value. A-seconds = efflux time from flow cup (DIN 53 211).

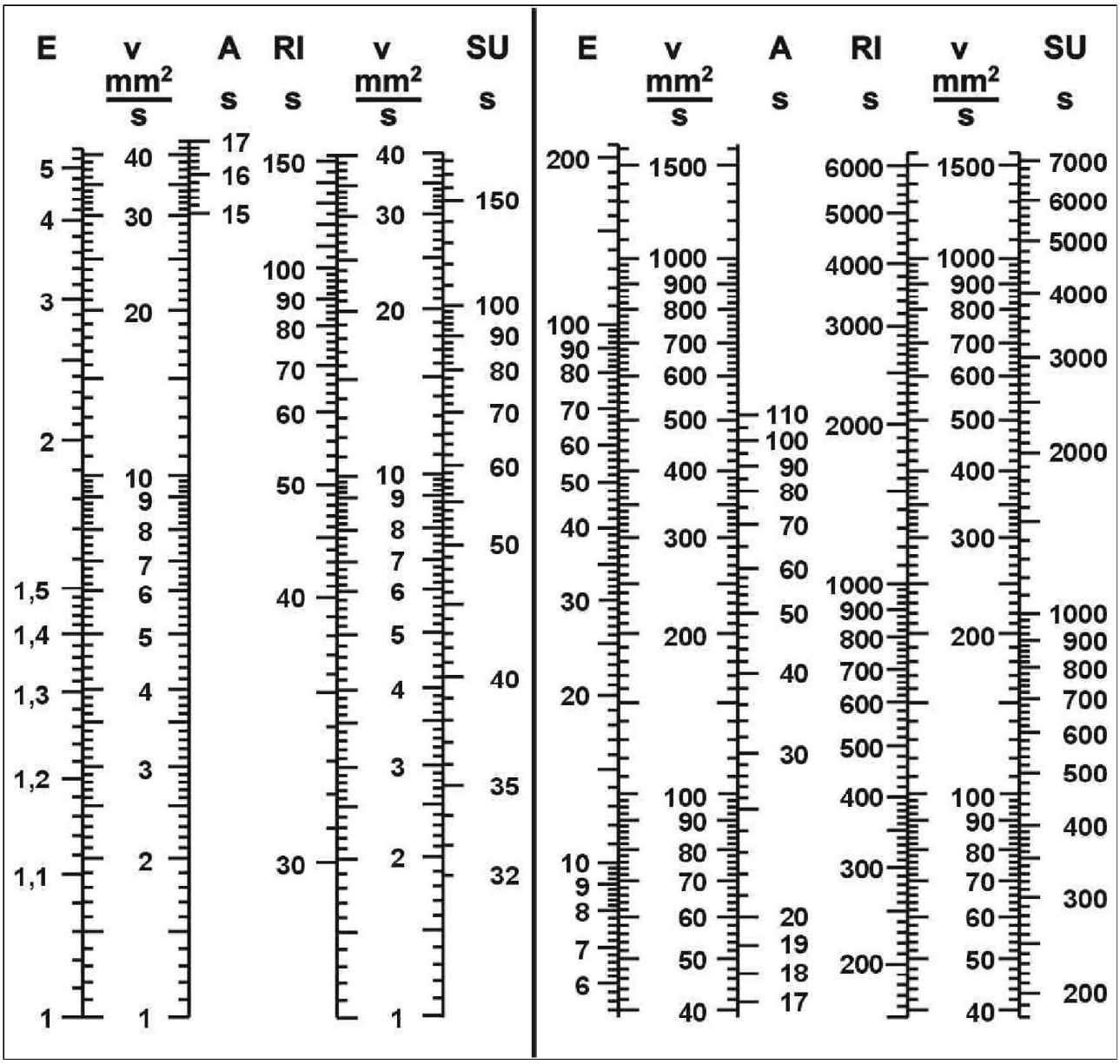


Fig. A.10 Conversion of Viscosity Units

A.6.11 Units of Velocity

Tab. A.12 Conversion Table for Units of Velocity

1 km/h = 0.27778 m/s	1 m/s = 3.6 km/h
1 mile/h = 1.60934 km/h	1 km/h = 0.62137 mile/h
1 kn (knot) = 1.852 km/h	1 km/h = 0.53996 kn
$x\,km/h \mathrel{\hat{=}} \frac{60}{x}\,min/km \mathrel{\hat{=}} \frac{3600}{x}\,s/km$	1 m/min = 3.28084 ft/min
$x\,s/km \mathrel{\hat{=}} \frac{3600}{x}\,km/h$	$x\,mile/h \mathrel{\hat{=}} \frac{37,2824}{x}\,min/km \mathrel{\hat{=}} \frac{2236,9}{x}\,s/km$

	km/h	**m/s**	**km/h**	**mile/h**	**kn**	**ft/min**	**km/h**	**mile/h**	**km/h**
	to m/s	to km/h	to mile/h	to km/h	to km/h	to m/min	to time/km	to time/km	to time/100 km
10	2.78	36	6.21	16.1	18.52	3.05	6 min	3 min 44 s	10 h
20	5.56	72	12.4	32.2	37.04	6.10	3 min	1 min 52 s	5 h
30	8.33	108	18.6	48.3	55.56	9.14	2 min	1 min 15 s	3 h 20 min
40	11.1	144	24.9	64.4	75.08	12.2	1 min 30s	55.9 s	2 h 30 min
50	13.9	180	31.1	80.5	92.60	15.2	1 min 12s	44.7 s	2 h
60	16.7	216	37.3	96.6	111	18.3	1 min	37.3 s	1 h 40 min
70	19.4	252	43.5	113	130	21.3	51.4 s	32.0 s	1 h 26 min
80	22.2	288	49.7	129	148	24.4	45 s	28.0 s	1 h 15 min
90	25.0	324	55.9	145	167	27.4	40 s	24.9 s	1 h 6.7 min
100	27.8	360	62.1	161	185	30.5	36 s	22.4 s	1 h
110	30.6	396	68.4	177	-	33.5	32.7 s	20.3 s	54 min 33 s
120	33.3	432	74.6	193	-	36.6	30 s	18.6 s	50 min
130	36.1	468	80.8	209	-	39.6	27.7 s	17.2 s	46 min 9 s
140	38.9	504	87.0	225	-	42.7	25.7 s	16.0 s	42 min 51 s
150	41.7	540	93.2	241	-	45.7	24 s	14.9 s	40 min
160	44.4	576	99.4	257	-	48.8	22.5 s	14.0 s	37 min 30 s
170	47.2	612	106	274	-	51.8	21.2 s	13.2 s	35 min 18 s
180	50.0	648	112	290	-	54.9	20.0 s	12.4 s	33 min 20 s
190	52.8	684	118	306	-	57.9	18.9 s	11.8 s	31 min 35 s
200	55.6	720	124	322	-	61.0	18 s	11.2 s	30 min
250	69.4	900	155	402	-	76.2	14.4 s	8.9 s	24 min
300	83.3	1,080	186	483	-	91.4	12 s	7.5 s	20 min
400	111	1,440	248	644	-	122	9 s	5.6 s	15 min
500	139	1,800	311	805	-	152	7.2 s	4.5 s	12 min
600	167	2,160	324	966	-	183	6 s	3.7 s	10 min
800	222	2,880	497	1,287	-	244	4.5 s	2.8 s	7 min 30 s

	km/h	m/s	km/h	mile/h	kn	ft/min	km/h	mile/h	km/h
	to m/s	to km/h	to mile/h	to km/h	to km/h	to m/min	to time/km	to time/km	to time/100 km
1,000	278	3,600	621	1,609	-	305	3.6 s	2.2 s	6 min
1,200	333	-	746	-	-	366	3 s	-	5 min
1,400	389	-	870	-	-	427	2.6 s	-	4 min 17 s

The **Mach number** ***Ma*** indicates the ratio of the speed of a body to the speed of sound.
***Ma*=** 1.3 therefore denotes 1.3 times the speed of sound.

A.6.12 Units of Fuel Consumption

Tab. A.13 Conversion Table for Units of Fuel Consumption

1 g/PS = 1.3596 g/kW.h	1 g/kW.h = 0.7355 g/PS.h
1 lb/hp.h = 608.277 g/kW.h	1 g/kW.h = 0.001644 lb/hp.h
1 liq pt/hp.h = 634.545 cm^3/kW.h	1 cm^3/kW.h = 0.001576 liq pt/hp.h
1 pt (UK)/hp.h = 762.049 cm^3/kW.h	1 cm^3/kW.h = 0.001312 pt (UK)/hp.h
$x\,mile/gal(US) \triangleq \frac{235,21}{x}\,l/100\,km$	$x\,l/100\,km \triangleq \frac{235,21}{x}\,mile/gal(US)$
$x\,mile/gal(UK) \triangleq \frac{282,48}{x}\,l/100\,km$	$x\,l/100\,km \triangleq \frac{282,48}{x}\,mile/gal(UK)$

	Conversion from			**Conversion from**				**Conversion from**	
	g/PS.h	**g/kW.h**		**lb/hp.h**	**ligpt/hp.h**	**pt (UK)/hp.h**		**mile/gal (US)**	**mile/gal (UK)**
	to g/kW.h	to g/PS.h		to g/kW.h	to cm^3/kW.h	to cm^3/kW.h		to l/100km	to l/100km
100	136.0	73.55	0.10	60.83	63.45	76.2	10	23.5	28.2
120	163.2	88.26	0.15	91.24	95.18	114.3	11	21.4	25.7
140	190.3	103.0				0	12	19.6	23.5
160	217.5	117.7	0.20	121.7	126.9	152.4	13	18.1	21.7
180	244.7	132.4	0.25	152.1	158.6	190.5	14	16.8	20.2
200	271.9	147.1	0.30	182.5	190.4	228.6	15	15.7	18.8
220	299.1	161.8	0.32	194.6	203.1	243.84	16	14.7	17.7
240	326.3	176.5	0.34	206.8	215.7	259.08	17	13.8	16.6
260	353.5	191.2	0.36	219.0	228.4	274.32	18	13.1	15.7
280	380.7	205.9	0.38	231.1	241.1	289.56	19	12.4	14.9
300	407.9	220.6	0.40	243.3	253.8	304.8	20	11.8	14.1
320	435.1	235.4	0.42	255.5	266.5	320.04	22	10.7	12.8
340	462.3	250.1	0.44	267.6	279.2	335.28	24	9.80	11.8
360	489.5	264.8	0.46	279.8	291.9	350.52	26	9.05	10.9
380	516.6	279.5	0.48	292.0	304.6	365.76	28	8.40	10.1
400	543.8	294.2	0.50	304.1	317.3	381	30	7.84	9.42
420	571.0	308.9	0.52	316.3	330.0	396.24	32	7.35	8.83
440	598.2	323.6	0.54	328.5	342.7	411.48	34	6.92	8.31
460	625.4	338.3	0.56	340.6	355.3	426.72	36	6.53	7.85
480	652.6	353.0	0.58	352.8	368.0	441.96	38	6.19	7.43
500	679.8	367.7	0.60	365.0	380.7	457.2	40	5.88	7.06
520	707.0	382.5	0.62	377.1	393.4	472.44	42	5.60	6.73

	Conversion from			Conversion from				Conversion from	
	g/PS.h	g/kW.h		lb/hp.h	ligpt/hp.h	pt (UK)/hp.h		mile/gal (US)	mile/gal (UK)
	to g/kW.h	to g/PS.h		to g/kW.h	to cm^3/kW.h	to cm^3/kW.h		to l/100km	to l/100km
540	734.2	397.2	0.64	389.3	406.1	487.68	44	5.35	5.35
560	761.4	411.9	0.66	401.5	418.8	502.92	46	5.11	6.14
580	788.6	426.6	0.68	413.6	431.5	518.16	48	4.90	5.88
600	816.8	441.3	0.70	425.8	444.2	533.4	50	4.70	5.65
700	951.7	514.8	0.80	486.6	507.6	609.6	60	3.92	4.71
750	1,020	551.6	0.85	517.0	539.4	647.7	70	3.36	4.04
800	1,088	588.4	0.90	547.4	571.1	685.8	80	2.94	3.53
900	1,224	661.9	0.95	577.9	602.8	723.9	90	2.61	3.14

Example : Example : Example :
240g/PS.h="'326.3'" g/kW.h 0.68liqpt/hp.h="'431.5'" cm^3/kW.h 18 mile/gal (US)="'13.1'" l/100 km

* PS ´Pferdestarke = metric horsepower

A.7 Torque specifications for the Series of Screws and Manifolds

A.7.1 Torque Specifications for the Series of Screws

The prescribed torque specifications for the series of screws and nuts depend on their sizes. For the non-metric screws and nuts the torque specifications are given in (See Tab. **A.14**), for the metric ones in (See Tab. **A.15**).

Tab. A.14 Torque Specifications for Non-metric Screws and Nuts

Nut and Bolt Size,inch	Tightening torque,N·m	Tightening torque,lb ft
#10 – 24	5 – 7	4 – 5
1/4 in.– 20	9 – 12	7 – 9
1/4 in.– 28	11 –14	8 – 10
5/16 in.– 18	18 – 23	13 – 17
5/16in.– 24	20 – 26	15 – 19
3/8 in.– 16	41 – 47	30 – 35
3/8 in.– 24	47 – 53	35 – 39
7/16 in.– 14	62 – 68	46 – 50
7/16 in.– 20	77 – 83	57 – 61
1/2 in.– 13	96 –102	71 – 75
1/2 in.– 20	112 –126	83 – 93
9/16 in.– 12	122 –136	90 – 100
9/16 in.– 18	145 –159	107 –117
5/8 in.–11	186 – 199	137 – 147
5/8 in.–18	228 – 241	168 – 178
3/4 in.–10	325 – 339	240 – 250
3/4 in.–16	393 – 407	290 – 300
7/8 in.–9	556 – 569	410 – 420
7/8 in.–14	644 – 657	475 – 485
1 in.–8	789 – 799	580 – 590
1 in.–14	928 – 942	685 – 695

Tab. A.15 Torque Specifications for Metric Screws and Nuts

Nut and Bolt Size, mm	Tightening torque, N m	Tightening torque,lb ft
M6 x 1.0	13 – 16	10 – 12
M8 x 1.25	30 – 38	22 – 28
M10 x 1.5	58 – 73	43 – 54
M12 x 1.75	101 – 126	75 – 93
M14 x 2.0	160 – 200	118 – 148
M16 x 2.0	245 – 306	181 – 226
M20 x 2.5	478 – 598	353 – 441

A.7.2 Torque Specifications for Manifold Unions

Tab. A.16 Torque Specifications for Manifold Unions

Pipe Plug Size, NPTF	Tightening torque, N.m	Tightening torque, lb.ft
1/8 in.	14 – 18	10 – 13
1/4 in.	19 – 24	14 – 18
3/8 in.	24 – 31	18 – 23
1/2 in	31 – 39	23 – 29
3/4 in	45 – 56	33 – 41
1 in.	102 – 127	75 – 94
1 – 1/4 in	129 –161	95 –119
1 – 1/2 in	149 –187	110 –138

Note:
These torque specifications are valid only for fasteners not assigned as a specific torque,a general torque value chart is presented here as a guide.

A.8 Special Tools

The special tools and fixtures, which are necessary for disassembly and assembly works are mentioned in the “Catalogue of Special Tools ”, Order No 05 - 0254 - ENG/00. Instructions for ordering the special tools and fixtures are given in this catalogue.
A list of special tools and fixtures for individual vehicle components is mentioned in respective sections of this Workshop Manual.

A.9 Definition of Mandatory Replacement Parts

The mandatory replacement parts are those parts that – as recommended by the manufacturer of the repaired equipment – should be replaced unconditionally on certain conditions that may occur either during operation or during repair.

- **Mandatory Replacement Parts for the Reason of the Expiration of Certain Period of Time**

This group involves the parts that are prescribed to be replaced by the manufacturer of the equipment after the expiration of a certain period of time not regarding the mileage, engine hours, jobs performed, etc. There are e. g. various rubber parts, gaskets, hoses, etc.
The necessity of replacement results from the material aging, weather conditions or expiration of the applied period.
A failure to replace these parts may influence a safety or a function of the equipment in operation and/or may impair the life environment.

- **Mandatory Replacement Parts for the Reason of the Single Use**

Some equipment components are determined for the single use, they are damaged completely during the equipment removal or dismantling and must be replaced with new ones.
There are, for example, paper gaskets, some fasteners, clamps, clips, etc.
The reuse of these parts is not allowed.

- **Mandatory Replacement Parts for the Reason of Engine Hours or Mileage Performed**

This group of mandatory replacement parts is the largest one, it includes e. g. filter elements of lubrication and hydraulic oils, protective collars, parts that are subject to a mechanical wear or that loose their function in relation to a period of operation.
Neglecting the prescribed replacement of these parts may result in an impairment of function of the equipment in operation, safety endangering of the operated equipment or it may have a negative influence upon the life environment.

- **Mandatory Replacement Parts for the Reason of Prevention**

Some components of the repaired equipment should be replaced during dismantling of the unit or the component group preventatively without regard to mileage, engine hours or periods of operation time.
This group of mandatory replacement parts includes e. g. bearings, bearing bushes, sealing rings, lock rings, gaskets, some fasteners, etc. By replacement of these parts the coming malfunctions can be prevented.

Note:
The respective specifications of the necessary mandatory replacement parts are mentioned at all repair procedures of individual groups of the vehicles.

A.10 Safety Precautions

A.10.1 General Safety Precautions

To prevent damage to the vehicle, to avoid operator´s and other person´s safety endangering, all safety precautions, warnings, cautions and safety instructions mentioned in the „Operation and Maintenance Manual“ and in this “Workshop Manual” must be observed.

Follow all precautions and warnings mentioned on vehicle labels.

Polyamide Tubes
The warning plate is placed on the co-driver’s seat pedestal. It warns of drilling and welding procedures performed near to plastic tubes.

Wheel Nuts Tightening
It is necessary to retighten all wheel nuts after covering of about 50 km on new vehicles and after every wheel removal.

Electric System
During replacement or installation of some electric or electronic components, make sure first that the components have been designed for the respective type of the electric system of the nominal voltage of 24 V.

Accessories and Spare Parts
It is inevitable to use the accessories approved by the BEML Company and BEML - TATRA genuine spare parts only.

Engine
Do not allow the engine running in the enclosed space without sufficient ventilation.

Maintenance and Repairs
During preventive maintenance or repairs performed under the vehicle lifted by the lifting device, secure the vehicle with supports and pay an extreme care at work. Keep a safe distance from the rotating and heat vehicle parts.

Operation Fluids
Diesel fuel, various oils and lubricants, brake fluid, electrolyte and anti-freeze, which are applied in the vehicle, can be harmful to your health in direct contact. Avoid their swallowing and inhaling or direct contact with your skin.

Accumulator Batteries
Charge the batteries in a room perfectly ventilated only. Do not use the open flame during charging. A quick battery charging can be used only exceptionally. Cables have to be detached from accumulator batteries during this kind of charging. **It is not allowed to disconnect the accumulator cables while the engine is running. Place the battery in a warm room before charging the frozen battery electrolyte. Remove all vent plugs before charging.**

Mobile Phones and Transmitters
Mobile phones and transmitters cannot be used in the vehicle without a separate antenna installed. Otherwise, the magnetic field will increase considerably inside the cab what may impair a function of electronic components in the vehicle.

A.10.2 Safety and Health Protection at Work

1. Workshop workers must be acquainted with and must observe the principal safety regulations.
2. The workplace must be kept completely clean and in order.
3. The space around the working place and passages must be free enough to allow a safe work and a free move of workers. Around the repaired truck there must be a space enough for tables to lay apart the removed parts and to perform removal and installation works in a safe way.
4. Should bigger assemblies be removed, they must be secured against fall. While lifting loads, take care of its correct gripping. Do not overload the lifting device.
5. Do not stand below the transported loads and in their vicinity.
6. Heads of all lifting jacks (hydraulic or screw-type ones) must be designed so that the load cannot slide down.
7. Causing damage to a safety device and other accessories is not permissible.
8. The worker must notify his chief of technical faults endangering the safety at work, which he has found.
9. The worker must not go away from the vehicle while its engine is running.
10. Tools (wrenches, hammers, chisels, files) must be of a correct shape and must have fixed handles. Nut wrenches must correspond to screw (nut) head dimensions and must have no clearance.
11. Vices must be attached to the workbench plate properly.
12. Hand electric tools must be earthed. They can be handled with rubber gloves, rubber shoes and/or when standing on the insulation support plate (should the manual electric tools have the double insulation, these working aids are not necessary).
13. During repairs only tools securing the safety at work can be used. Tools must be in a faultless condition and must comply with the purpose for which they have been designed.
14. When using pneumatic tools and when chipping the material, the worker must wear protective goggles. Pneumatic tools are allowed to be connected/disconnected when the feed line is closed only.
15. All workshop workers must use protective aids and their working clothes must not prevent them from a free walk.
16. The vehicle must be cleaned properly before repair.
17. Fuels and lubrication oils are drained from the vehicle (if required by the technological procedure) into suitable containers, which are deposited outside the workplace in a safe distance. The used oils are recycled or liquidated ecologically after draining from vehicle.
18. The batteries cut-off switch must be always turned off during vehicle repairs or accumulator leads must be detached. Take a special care to repairs of electric devices to prevent a fire of the vehicle.
19. The vehicle must be secured with the parking brake against spontaneous move during repair. During repairs, which do not allow the securing of vehicle with the parking brake against the spontaneous move, front and rear wheels must be secured with chocks both in front and in rear.
20. The engine can be left running only when it is inevitable for the repair. In such a case the exhaust gases must be led away through hoses outside the workplace into the open air.
21. Should the repair have to be done with wheels removed, the vehicle must be supported under the carrying parts of the undercarriage with support stands in a safe manner.
22. To work on the vehicle undercarriage bottom, the assembly pit or rolling bed must be used.

23. During overall removal of individual assemblies, disassembly, transport and installation of these assemblies, suitable lifting devices must be used. Surface of trucks used for the transport of assemblies and components must be adapted so that these assemblies and components are secured against motion and fall.
24. While inflating the flat tires the worker must be protected with a protective shield so that he would not be endangered if the lock ring of the wheel releases. It is necessary to use suitable tools for the tires removal and installation. Assembly levers must not have sharp edges.
25. The cloth or skin stained with sulfuric acid or electrolyte must be neutralized with 10% solution of cooking soda or spread with powder soda immediately. If your eyes were hit with the above-mentioned chemicals, rinse the eyes out with the borated water and call and see a doctor immediately.
26. Keep the personal hygiene regulations strictly.
27. Use trucks fitted with partition walls to transport accumulators to prevent them from falling and impacts.
28. Remove plugs from accumulators when charging them to allow escaping of gases created in cells.

A.10.3 Fire Prevention Rule

1. Workshop workers must be acquainted with and follow the fire prevention rules. They must inform their chief about any breaking of the fire prevention. They must be familiar with handling the fire fighting devices situated at the workplace.
2. The easy-flammable liquids must be stored in metal containers in amount not exceeding the one-day need. It is not permissible to use metal objects to open these containers. On termination of the work containers containing the easy-flammable liquids must be stored into a storehouse.
3. Greased rags are put into a metal lockable vessel and on termination of work the vessel contents must be transported into a place determined.
4. The leavings collected during the work must be transported to the place specified for it on termination of work.
5. It is not allowed to heat the vehicle engine with the open flame.

A.11 General Principles for Replacements and Repairs of Assemblies and Subassemblies

1. The damaged assemblies and subassemblies are dismounted from the vehicle during repair only when the defects cannot be repaired unless after their removal.
2. Should one assembly or subassembly is replaced, carefully check the other installed assemblies for technical condition. Only those removed parts can be reinstalled whose wear did not exceed the safe operation limit mentioned in the Workshop Manual and whose putting out of operation would not be economic.
3. Only the faultless and prescribed commercial and special tools and undamaged fixtures can be used for repairs. Pay an extreme attention to a technical condition of the lifting and binding devices before starting with the repair. If damaged, you cannot use them any more. If you use the crane, check the load weight and choose suitable lifting means. Only a worker who has been assigned and who has been acquainted with safety precautions can handle the crane.
4. Carefully check the attachment of suspensions and cables while replacing the assemblies. The assembly is put into a pallet or on a workshop truck after removal from vehicle. The assembly is not allowed to stay hanging on the suspension.
5. The removed connecting material should be put temporarily (before used for the reinstallation) in their places. Screws and nuts whose threads and edges have been damaged must be replaced.
6. Assemblies, which become open after removal or dismantling must be covered with protecting barrier and bound up. Terminals of detached pipes of the lubrication and fuel systems, pipes of hydraulic and pneumatic control system must be closed with plugs and blind flanges. During reinstallation, plugs and blind flanges must be removed. Terminals of electric cables must be protected against damage and dirt.
7. After installing the assembly into vehicle, you should check:

   - Amount and quality of prescribed lubricants (if needed, change it for the kind specified);
   - Completeness and correctness of tightening and locking the connecting parts (screws, nuts, etc.).

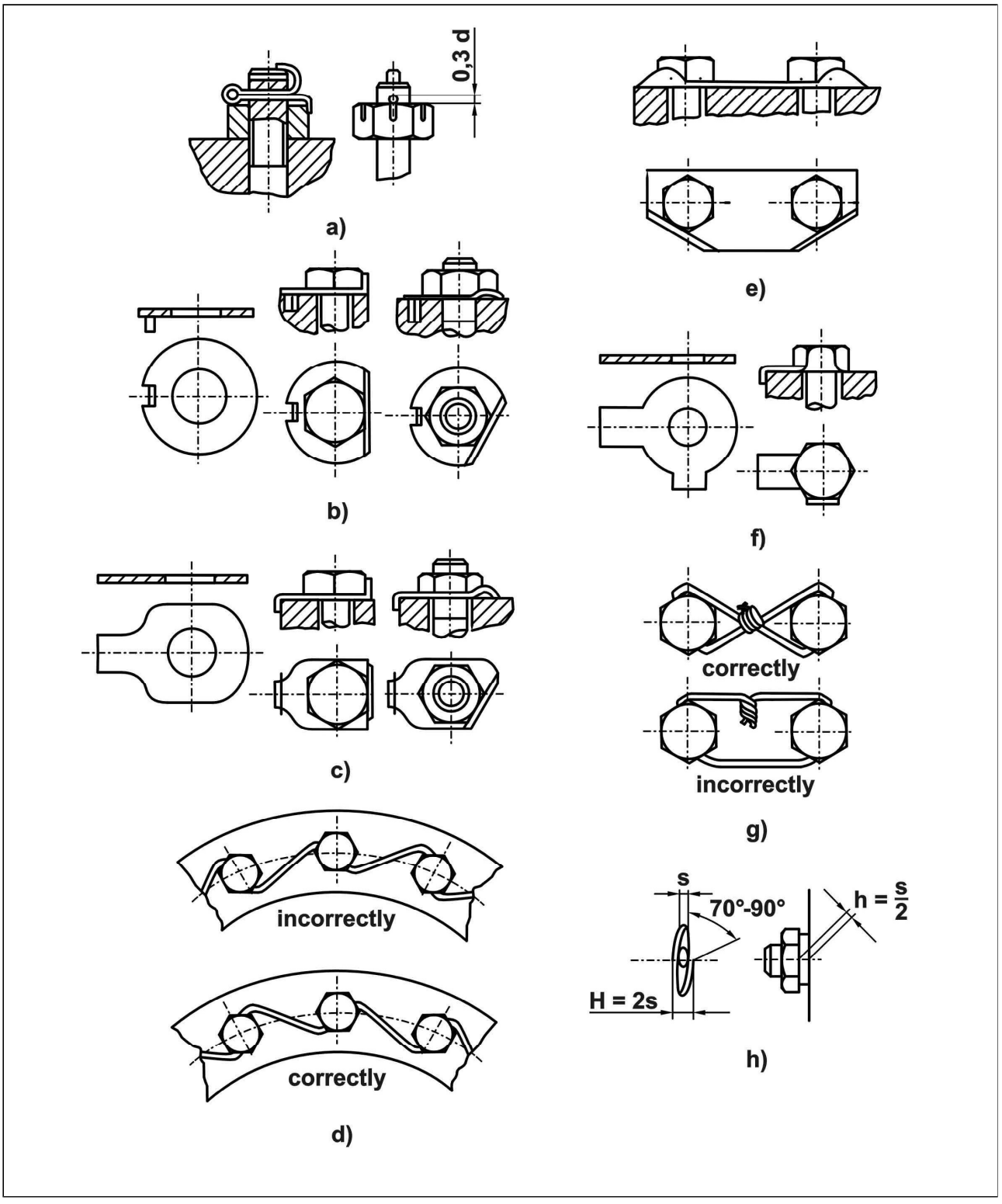
8. The installed parts must not show any signs of corrosion. Surfaces coated with paint or corroded must be cleaned and painted again. All uneven places on contact surfaces and parts edges must be smoothed.
9. Should reamer, file, scraper, emery cloth, grinder, grinding paste or some other means of material withdrawal are used for the installation of some component, all chips and filings must be removed carefully by washing in petrol or kerosene or by blowing out with the compressed air.
10. Screws, nuts, pipe couplings and other parts of screw joints must tightened properly and uniformly. Special requirements for screw and nut connections are mentioned in individual chapters.
11. It is not allowed to release and tighten nuts and screws using chisel or hammer. Should corroded nuts or screws need to be loosened, apply spray for corroded joints (if not available, apply a wick of waste wool wetted in kerosene or other suitable fluid on the corroded joint two hours before disassembly to release it.
12. Surfaces smeared with sealant must be degreased properly. Sealant is applied on the clean surface with brush in a thin layer. Nuts are tightened after the sealant dries out a little. It is not recommended to check the connection tightness so that you tighten it strongly if the sealant is completely congealed. Immerse new rubber rings (shaft seals, „O“ rings, etc.) into the pure engine or transmission oil for half an hour before assembly at least. Fill the shaft seals interiors with the prescribed plastic lubricant in accordance with the repairing technological procedure.
13. Gaskets removed from vehicle cannot be reused. Without regard to their technical condition, they must be replaced with new ones.

14. The assembly is dismantled into subassemblies and components to such an extent only to be able to detect and remedy the fault for which the removal was carried out.
15. All parts determined for the faults detection and assembly must be washed and dried using the waste wool or compressed air.
16. If you remove and dismantle assemblies, which require to be centered (balanced) are removed and dismantled, it is necessary to mark the part, which should be removed, and the part connected with marks (notches) and to reinstall them following these marks. The pressed in or heat mounted parts need to be driven out by the press using suitable mandrels or to pull them with use of removers (pullers). Contact areas of parts, which are pressed in together or shrunk on, must be always oiled before assembly properly.
17. Antifriction bearings are installed and removed using tools which secure fitting on or driving out the bearing across a race, which is either forced off or forced on. The interchange of races is not permissible. Use the prescribed plastic lubricant for assembly of bearing needles and rollers.
18. If prescribed by technical conditions, nuts and screws are locked with wire, lock washers or split pins – refer to (See Fig. **A.11**).
    It is not permissible to loose the tightened nut so that to achieve the axial alignment of its slot with hole for the split pin in screw. If not achieved by further nut tightening, the nut must be replaced. When the lock washer is used, one its nose is bent round nut edges (screw head) and the other round the material margin - point **c** , **f** (See Fig. **A.11**) or into a respective groove - point **b** (See Fig. **A.11**). Should the lock sheet be used - point **c** (See Fig. **A.11**), the sheet ends are bent round nut edges (screw heads). The bent part of lock washer (sheet) must abut to the nut edge (screw head) and no cracks are allowed to occur in the place of bending. To lock the screw with wire, two methods can be applied:

    - locking all screws situated on the part circumference using one wire - point **d** (See Fig. **A.11**).
    - locking screws per couples, one wire is used to lock two adjacent screws- point **g** (See Fig. **A.11**).

    In all cases the wire must be pulled through the hole so that its part coming out from the screw hole and not allowing its release would be inserted under angle of about 90°. Figure - point **d** , **g** (See Fig. **A.11**) show the correct and wrong wire pulling-through. The wire applied for locking must be soft, undamaged and its ends must be twisted in the length of 5 to 7 mm and then cut away.
    Spring washers dimensions are standardized. Distance of new spring washer ends in a released condition must equal to its double thickness - point **h** (See Fig. **A.11**). A nut locked with a spring washer is tightened properly when a gap between spring washers ends (in a compressed condition) equals to one half of its thickness, however, 2 mm as a maximum. It is not allowed to use two spring washers at the same time.

19. Splitpins, lock wire, lock and sealing rings removed from the vehicle cannot be reused newly. Without regard to their technical condition, they must be replaced with new ones.
20. The quality of the repair performed is checked by the vehicle stationary tests and by the driving test to the extent specified by technical conditions for vehicle tests and tests of assemblies after repair. If the testing equipment is not available at the service station, the repaired units and assemblies are installed into the repaired vehicle without prior testing outside the vehicle and their function is tested within the framework of the vehicle stationary and driving tests.
21. Instructions for lubrication of parts during installation and assembly are mentioned in technical conditions for installation and assembly and in the vehicle lubrication order (see the Operation and Maintenance Manual).
22. All parts determined for repair or replacement must be protected against corrosion



Legend: ***a*** *– locking with use of split pin;* ***b, c, e, f*** *– locking with use of lock washer or lock sheet;* ***d, g*** *– locking with use of lock wire;* ***h*** *– locking with use of spring washer.*

Fig. A.11 Methods of screws and nuts locking

A.12 Vehicle and Components Washing and Cleaning

The vehicle and components washing and cleaning are not matters of a good appearance only. The cleanness of the vehicle and components surface is a factor reducing the surface corrosion and limiting the action of atmospheric influences on the exposed parts. At the same time it reduces the unfavorable action of impurities particles on the service life and wear of components, function of individual assemblies, their reliability, etc. The components cleanness is also an important condition for the quality of the component repair.

The vehicle washing and cleaning is an initial operation of each technological procedure of the vehicle maintenance. It includes:

- Rough removal of dust and dirt from the body interior,
- Rough cleaning of the body and vehicle bottom using stream of water,
- The vehicle glasses cleaning,
- Cleaning and preservation of the vehicle bottom,
- Cleaning and preservation of the vehicle engine space,
- Proper cleaning and preservation of the vehicle interior,
- Cleaning and preservation of the vehicle body.

The assemblies/components washing is done always after their removal from vehicle/assembly and has an influence upon the subsequent assessment of their technical condition (defects occurrence).

A large assortment of chemical agents is used to clean and wash the components. They include:

- **Alkaline Solutions**– to clean and to degrease components by immersion, splashing or coating; their use is advantageous because they do not endanger the workers´ safety and health when working principles are observed, their disadvantage is that they must be applied at high temperatures, they are not suitable to remove thick layers of dirt, they are not suitable to clean the dissected surface, to clean products having a lot of holes and cavities, porous materials and to clean components made of non-ferrous metals;
- **Organic Solvents**–suitable to remove animal, vegetable and mineral fats and oils; they may be used at high temperatures especially for dissected products; they are harmful to health, they dissolve rubber and some kinds of paints;
- **Inflammable Solvents** – kerosene, diesel fuel, petrol; suitable for cleaning with use of paint brush, wire brush or rag; disadvantage – high consumption, they cannot be flushed with the dissolved dirt using water; they have unfavorable biological influence upon the human being (a need of intensive ventilation and/or vapors exhaustion, skin surface protection);
- **Emulsified Degreasing, Detergents**– surface-active neutral agents, the surface is degreased either by immersing into the emulsified bath or by splashing.

Three principal methods of the components cleaning are applied:

- Using the cleaning agents – applied manually, by splashing or in bath; after degreasing and cleaning the components must be rinsed with hot water; technical spirit is used to clean the finest components (electrical accessories), the fuel system components are washed with use of diesel fuel or other suitable liquid;
- Components burning – removal of paint or protective coat;
- Sand-blasting – removal of old paint, removal of grease and rust from the surface.

Removal of non-burnable rests (decarbonization):

- Mechanically – using a scraper (tool of the softer material than the component to be cleaned);
- Chemically – a bath of the certain composition must be used for each material of the component to prevent the part from corrosion; after taking the part out of the bath, it must be rinsed with warm water or rinsed in kerosene; use the wire brush or paint brush to finish the cleaning and dry out the part with hot air;
- Electrochemically in the electrolyte heated to 100° C, the current intensity depends on the kind of the component and amount of settled rests dependent; after removal from bath the component is washed using a stream of cold water.

Equipment and aids used to clean the components:

- Metal sheet tray and brush to clean the minor components of the fuel and electric system;
- Baths of various types with the possibility of the cleaning solvent heating to the temperature of 80 °C to 130 °C; components are put in baskets or on various hinges;
- Through-passage washing machine with one or more chambers – components go through the machine on the never-ending conveyer belt while being washed by stream of cleaning solvent under pressure;
- Supersonic washing machine with trichlorate-ethylene filling to clean the minor dissected components;
- Steam generators or washing devices using the pressure water (cold/hot water) to wash large-size dismounted components but also the whole vehicles.

A.13 Component's Inspection and Selection

The purpose of parts inspection is to determine which parts can be used and which must be replaced. Although the assemblies overhaul specifications given through the text will help in determining, which parts should be replaced, considerable judgement must be exercised by the inspector. The guiding factors in determining the usability of worn parts that are otherwise in good condition is the clearance between the mating parts and the rate of wear on each of the parts. If it is determined that the rate of wear will maintain the clearance within the specified maximum allowable until the next overhaul period, the reinstallation of used parts may be justified. Rate of wear of a part is determined by dividing the amount the parts has worn by the hours it has operated.

Many service replacement parts are available in various undersize or oversize as well as standard sizes. Also, service kits for reconditioning certain parts and service sets that include all of the parts necessary to complete a particular repair job are available.

A complete discussion of the proper methods of precision measuring and inspection are outside the scope of this manual. However, every shop should be equipped with standard gauges, such as dial bore gauges, dial indicators, and inside and outside micrometers.

In addition to measuring the used parts after cleaning, the parts should be carefully inspected for cracks, scoring, chipping and other detrimental conditions.

Parts removed from an individual assembly should be kept together so they will be available for inspection and assembly. Those items having machined faces, which might easily damaged by steel or concrete, should be stored on suitable wooden racks or blocks, or a part dolly.

> **Note:**
> Minor surface defects not affecting fit or function are acceptable. Surface defects affecting serviceability must be reworked or rejected if not corrected.

General instructions.

Determine that the component does not conform to the established standard. Reject non-conforming component and record number and type of deficiencies found. Record acceptance on process record and maintain appropriate quality control.

Investigate the cause(s) of critical and major defects, and when such defects are noted, ensure the entire lot is screened and corrective action is taken.

All used components and refinished parts shall be examined 100 percent to determine serviceability in accordance with the limits, fits, and tolerances.

Procedures for inspection will be the same for many parts and components. General procedures are detailed in following paragraphs. Exercise extreme care in all phases of inspection. Repair or replace al unserviceable components.

All gear teeth, machine surfaces, shims, and bearing caps shall be inspected for embedded metal chips or metal shavings. repair or replace all unserviceable components.

Particularly check areas around studs, pipe plugs, threaded inserts and sharp corners.

Castings.

Inspect all ferrous and non-ferrous castings for cracks. Particularly check areas around studs, pipe plugs

threaded inserts, and sharp corners.
Inspect machined surfaces for nicks, burrs, and raised metal. Mark damaged areas for repair or replacement.
Inspect all pipe plugs, pipe plug openings, capscrews, and capscrews openings for damaged and stripped threads. Repair threads with correct sized tap or threaded inserts.
Check all gasket-mating surfaces, flanges on housings, and supports for warpage with a straightedge or surface plate. Inspect mating flanges for discoloration, which may indicate leakage. replace if warped.
Check all castings for conformance to applicable repair standards.

Bearings.

Check all bearings. Inspect bearings for burrs and galled or pitted surfaces. damaged bearings must be replaced.

Bushings and Bushing – Type Bearings.

Check all bushing a bushing – type bearings for secure fit, evidence of heating wear, burrs, nicks and out-of-round conditions.
Check for dirt in lubrication holes or grooves. Holes and grooves must be clean and free from damage.

Machined Parts.

Check machined parts for cracks, distortion, and damage.
Check all surfaces for nicks, burrs, and raised metal.

S**tuds, Bolts, and Capscrews.**

Replace if bent, loose, stretched, or if threads are damaged.

Gears.

Inspect all gears for cracks and missing teeth.
Inspect gear teeth for wear, sharp fins, burrs, and galled or pitted surfaces.
Inspect splines for wear, burrs, and galled or pitted surfaces.
Check keyway slots for wear and / or damage.

Note:
When gear teeth limits are not established, good judgement is required to determine if gear replacement is necessary.

Oil Seals.

Oil seals are mandatory replacement items.

Casting Plugs.

Inspect for damaged threads that may allow fluid leakage. Replace plugs if threads are damaged or fluid leakage is present.

Springs.

Inspect for damaged, distorted and collapsed coils.

Snaprings, Retaining Rings and Washers.

Many of these parts are mandatory replacement items. Inspect all others for obvious damage.

A.14 Rules for Working on Vehicle Electrical Equipment

The vehicle electrical equipment differs from the other vehicle machine components and therefore the below-mentioned principles must be observed during service and repair operations:

1. For the reason of endangering the health and causing a possible damage to electronic devices which may be sometimes very expensive, removal, repair, replacement and installation of these devices may be performed by **the skilled and professionally trained person only**, mostly with use of suitable measuring apparatus, instruments and other aids which this person can handle in a correct and safe manner.
2. Prior to remove the faulty electric devices, make sure first whether they are really faulty; use special technological procedures or special instruments and devices to check it. To carry out a correct diagnosis, first perform the specified measurements.
3. The defective electric component should be replaced only when a correct spare part is at disposal. The cables wiring should be marked although it may seem to be simple. Especially when semi-conductors are used, it is important to keep the correct wiring and polarity.
4. Should the faulty conductor be replaced with a new one, keep a proper conductor cross-section (area of the conductive core without insulation) or use a conductor of the higher cross section. The damaged insulation may cause short-circuit of the insulated conductor to earth resulting in a vehicle fire.
5. Conductors are mostly fitted with connectors or cable lugs. It is necessary to attach connectors perfectly, mostly by pressing, using a solder without any contact resistances. Carefully degrease conductor terminals and clean them from oxides before soldering. When replacing cable harnesses, release a certain number of cable harness clips and reuse them again.
6. During removal and installation of electric instruments turn always the batteries cut-off switch to the off-position (horizontally), i.e. the negative battery pole is not connected to the vehicle mains. Hereby the feed circuit is interrupted and even a haphazard short-circuit of the insulated conductor to ground cannot cause a short.
7. Bases of all connectors and plugs are designed so that they cannot be confused or connected wrong. In spite of that, verify the right connection according to the overall wiring schema of the vehicle.
8. During replacement of vehicle electric components, use only the certified spare parts for the respective vehicle type or approved universal spare parts, which may be used without any interventions and adaptations in the vehicle electric network. When non-homologated components are used, check especially the current consumption and the temperature rise. The consumer input should not exceed the specified value and the temperature rise on the consumer surface must not exceed the value of 80 ^{o}C in any case, even during long-term operation.
9. When handling accumulators, keep the strict regulations for work with caustic agents and explosive mixture. Take an extreme care and wear protective aids (goggles, protective shield, rubber gloves, apron, etc.) at work.
10. Do not smoke, eat and drink during works on accumulators.
11. Do not use any metal or organic objects to check the electrolyte level (metal wire, wooden rod). Do not use the open flame in the vicinity of open accumulators because of explosion danger of explosive gases (mixture of hydrogen and oxygen).
12. Accumulators are charged according to technological procedures valid for charging stations or charging sources applied at the charging station. It is important that no intensive gassing (water decomposition to hydrogen and oxygen) occurs during the accumulator charging to prevent an irreversible damage to accumulator cells electrodes.
13. Take an extreme care to hands washing using water with neutralizing agent (soda, soap) after handling accumulators. The discarded accumulators are dangerous waste for the environment and special regulations for their liquidation must be observed.

14. All current circuits (except for the electric starter motor supply) are protected with current fuses (fusible links). One fuse protects several circuits usually. The fuse ampere value depends on the total current flowing through connected consumers in the circuit. A blown fuse must be replaced with a fuse of the same ampere value and type.
15. Should the fuse be blown out after its replacement again, the cause of the over-current must be found. A faulty electric consumer can be found by turning-on of individual consumers connected to the pertaining fuse in successive steps until it is blown out again. The faulty consumer must be replaced or short-circuit on the feed line to consumer must be cleared.
16. In some cases it is necessary to reduce the current flowing through the fuse which is blown out repeatedly, e.g. during short-circuit on the current feed cable to turn indicators when an over-current can cause a damage to relay of turn indicators interrupter. The current can be reduced by connection of the test light (fitted with bulb 24 V, 21 W) into plugs of the fuse box instead of the fuse removed.
17. Another possibilities for the use of the test light during finding of open circuits and short-circuits in electric circuits are mentioned in the below-mentioned tables:

    - when finding a short,
    - when finding an open circuit.

18. The repeated blowout of the current fuse indicates a short to earth of the electric consumer or line in the protected circuit of this fuse. Should the short cannot be revealed by visual inspection, use the test light. Connect the test light to terminals of the turned-off fuse and carry out a step-by-step check according to illustration in (See Tab. **A.17**).
19. The breaking of any consumer feed cable is evident when the consumer does not work and the fuse remains undamaged. Try to find the place of the break by checking individual connections, attachments and conductors. Carry out a step-by-step check using the test light in accordance with a certain fault symptom and illustration mentioned in (See Tab. **A.18**).

Note:
Tables show examples of the principal procedure of the fault finding according to a fault symptom. The graphic schema of the procedure is illustrated in a very simplified circuit (See Fig. **A.12**) of the consumer (**Rz**) fitted with switch (**S**), current fuse (**Po**), source (**AKB**), batteries cut-off switch (**OA**) and ground (**K**). Before starting with any check with use of the test light, connect the bulb to the current source to check whether it is in a good condition (the bulb must light).

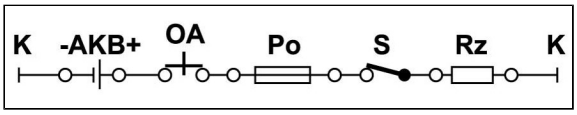
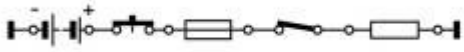
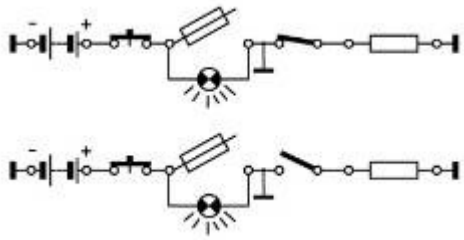
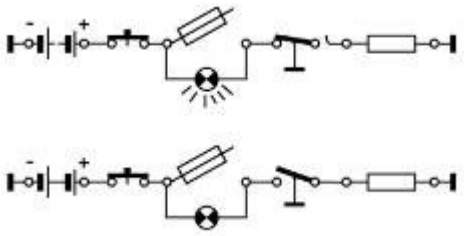
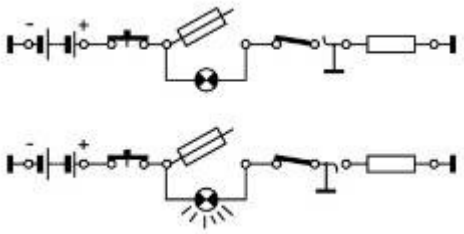
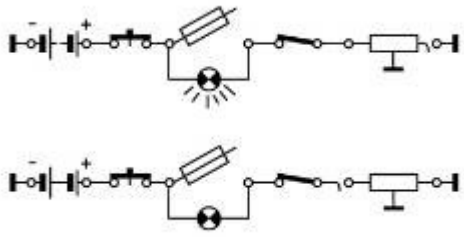
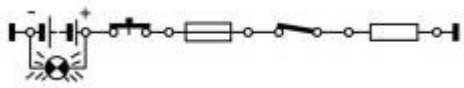
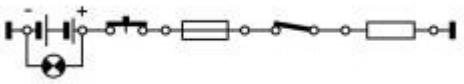
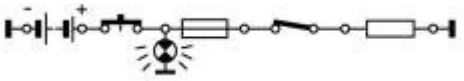
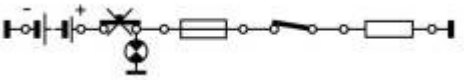
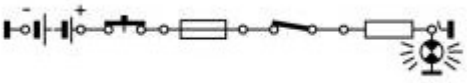
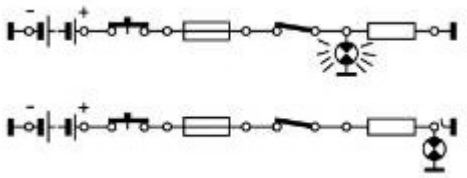
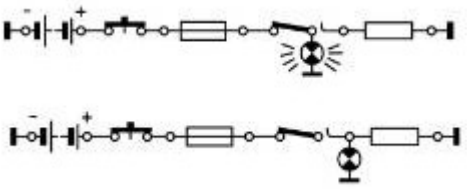
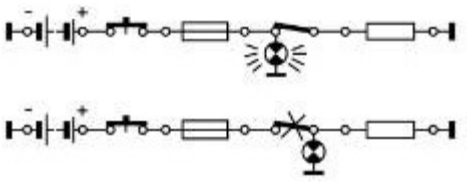


Fig. A.12 Consumer electric circuit

Tab. A.17 Finding a short

Fault symptom	Procedure wiring diagram	Note
Consumer electric circuit has no fault.		The electric consumer works properly after turning the switch on.
Short-circuit of the conductor between circuit breaker and ground.		The bulb lights both with the electric consumer switch turned on and off.
Short-circuit in the switch.		The bulb lights with the consumer switch turned on only, it does not light with the switch turned off.
Short-circuit in the conductor between switch and consumer.		The consumer switch is turned on, the feed lead to consumer is turned off on the switch – the bulb does not light. The bulb lights when the consumer feed lead is connected to switch.
Short-circuit of consumer to ground.		The consumer switch is turned on. The bulb lights even when the consumer ground is turned off. The bulb does not light when the electric consumer input terminal is turned off.

Tab. A.18 Finding an open circuit

Fault symptom	Procedure wiring diagram	Note
Circuit and signal lamp are not faulty.		Use it to check the bulb of the test light for a proper function.
The circuit is OK, signal lamp is faulty.		The test light bulb does not light.
Batteries cut-off switch is OK.		The bulb goes on after turning on the cut-off switch; if the switch is turned on, the consumer works.
Faulty batteries cut-off switch.		The bulb does not light after turning on the cut-off switch and the consumer does not work.
The consumer is not defective but it does not work.		Faulty ground circuit of the electric consumer. The consumer works when connected to a spare ground.
The electric circuit has been interrupted in the consumer.		The bulb lights on the input to consumer, but it does not light on the consumer output (with ground off).
The electric circuit between consumer and switch has been broken.		The bulb lights on the circuit breaker output, but it does not light on the consumer input.
Faulty consumer switch.		The bulb lights on the switch input, but it does not light on the output.

A.15 Principles for Electric Arc Welding on Vehicle

1. Because of the protection of semi-conductor components of the engine electronic cooling control, ABS and charging unit during electric arc welding, it is necessary to connect the ground lead as near as possible to the welding point.
2. When welding on more places of the chassis, disconnect the batteries terminal with the cable from the positive battery terminal and connect the detached cable to the vehicle ground. Simultaneously insulate the positive battery terminal to avoid a possible short-circuit.
3. When reconnecting, first disconnect the ground connection and then connect the positive battery terminal.

A.16 Using the External Source when Starting the Vehicle

If the engine cannot be started by means of its own accumulators, it is necessary to connect the external D.C. source 24 V to accumulators. The external source can be for example accumulators of some other vehicle (24 V) or two fully charged accumulators 12 V, 180 Ahrs (connected in series) and/or a suitable mains source (e.g. APS). During the start, proceed as follows:

1. Before connecting the external source, it is always necessary to switch off the circuit breakers both of the vehicle to be started and that of the auxiliary vehicle (source).
2. Connect plugs of jumper cables into the ZAB socket located under the cabin mask to the right (See Fig. **A.13**). First connect positive terminals of sockets on both vehicles and then negative terminals (ground bodies).
3. Switch on the circuit breaker of the auxiliary vehicle (source).
4. Close prior to start the engine, remember to turn on also the circuit breaker of the started vehicle (to protect the accumulators from mutual discharging). Start should be done ordinarily.

Immediately after firing the engine, switch off the circuit breaker of the auxiliary vehicle (external source) and disconnect the jumper cables in the reverse sequence (first from negative terminals and then from positive terminals of sockets). When handling the jumper cables, pay an extreme attention not to cause short-circuits between plugs.

Notification:
If the auxiliary source is a vehicle fitted with an alternator (e.g. vehicle TATRA 148, TATRA 815) and if its engine is running during the start, it is necessary to stop the engine before switching the circuit breaker off. If not inevitably necessary, it is not recommendable to let the engine run during the start.

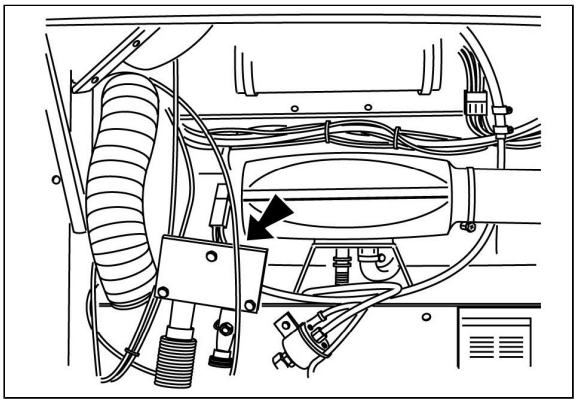


Fig. A.13 Socket for connection of external source

A.17 Instructions how to ensure the ecology

The operation fluids and materials in all forms are very dangerous to the life environment.

Except for some special cases stipulated by the law, e. g. the disposal of waste water, precious metals, radioactive waste, etc., the waste disposal is regulated by the Law No 185/2001 Col. of Laws, of the waste disposal in the Czech Republic and the change of some further laws as amended.

Outside the territory of the Czech Republic everybody has an obligation to treat the waste and dispose of it in a manner stipulated by the legal regulation and other legal provisions on the environmental protection valid in the respective locality.

The wastes are – in the sense of the mentioned law – all personal chattels (movable assets), which belong to a person who disposes of it or intends to dispose of it and/or is obliged to dispose of it while this chattel is included in some group of wastes mentioned in the Annex to this Law. The wastes mentioned in the “List of Dangerous Wastes” contained in the legal operating regulation and any other waste showing one or more dangerous properties mentioned in the Annex to this Law is considered to be a dangerous waste. We speak about the waste disposal any time when a person hands over a chattel contained in some of the waste groups for the utilization or disposal in the sense of the mentioned Law and/or when the person hands it over to another person entitled to collect or to purchase the waste in accordance with the same Law without regard to a fact if this transfer is free or against payment. It comes to the waste disposal also in the case when the person itself disposes of the chattel, which belongs to some of the waste groups stipulated by the Law.

Everyone is obliged during its activities or within the scope of its activities to precede a creation of wastes, to reduce its amount and dangerous properties; the wastes whose creation cannot be preceded must be utilized and/or disposed of in a manner which does not endanger the human health and the life environment and which is in accordance with the above-mentioned Law and special legal regulations.

Everyone is obliged during its activities or within the scope of its activity within the mentioned law to prefer the waste recycling to the waste disposal. The material utilization is preferred to other kind of the waste utilization. The fulfillment of this obligation is not required if there are no technical or economical presumptions for its fulfillment within the current time and in the given locality and the waste economy plans are met. When considering the suitability of the waste disposal methods, always that method is preferred, which secures a better health protection and which is more considerate to the environment.

Everyone is obliged to treat the waste and to dispose of it in a manner stipulated by the above-mentioned Law and other legal regulations of the environmental protection.

Vehicle Wrecks

Under the vehicle wreck all complete or incomplete motor vehicle, which has been determined for the road motor traffic to transport persons, animals or things and which became a waste as mentioned in the Law above, is understood. Everybody who disposes of this wreck is obliged to hand it over only to persons who are providers of such facilities needed to utilize, dispose of or collect and/or purchase the vehicle wrecks.

Tires

The tire is every mechanical component made of the rubber, chemical materials, fabrics and steel or other materials, which ensure the vehicle traction after assembly on vehicle wheels and contains a gas, which bears the load. Everybody who disposes of the tire, is obliged to hand it over only to persons who are providers of the facility designed for the tires utilization, disposal, collection or purchase.

Used Oils

The used oil is any mineral or synthetic lubrication or industrial oil, which became unsuitable to be used for the purpose for which it has been intended originally, especially the combustion-ignition engine oil, transmission oil, hydraulic oil and also mineral or synthetic lubrication oils. Everybody who disposes of the used oil, is obliged to hand it over only to persons who are providers of the facility designed for the used oils utilization, disposal, collection or purchase.

Accumulators

The accumulator is a source of the electric energy generated by the direct change of the chemical energy. Everybody who disposes of the accumulator, is obliged to hand it over only to persons who are providers of the facility designed for accumulators utilization, disposal, collection or purchase.

Filter Device

The filter device is such a device, which usually contains a replaceable part (filter element) determined for removal of firm particles out of liquids and gases. Everybody who disposes of the filter device or the filter element, is obliged to hand them over only to persons who are providers of the facility designed for the utilization, disposal, collection or purchase of filter devices or filter elements.

Used Operation Fluids

The used operation fluid means any liquid of the natural or synthetic origin and/or combination thereof, which became unsuitable for its purpose, for which it has been determined originally. There are mainly brake fluids, coolants, anti-freeze, fluids with anticorrosive agents and/or some others. Everybody who disposes of the used operation fluids, is obliged to hand them over only to persons who are providers of the facility designed for the utilization, disposal, collection or purchase of the used operation fluids.

Diesel Fuel

The diesel fuel is a distillate gained by the petroleum or organogenous shale refining and is determined to drive the combustion-ignition engines. Everybody who disposes of the diesel fuel, is obliged to hand it over only to persons who are providers of the facility designed to the utilization, disposal, collection or purchase of diesel fuel.

Used Greases

The used grease is any mineral or synthetic lubrication, sealing and/or preservative grease, which became unsuitable for the purpose, for which it has been intended. Everybody who disposes of the grease, is obliged to hand it over only to persons who are providers of the facility designed to the utilization, disposal, collection or purchase of greases.

Cleaning Fabrics (polluted with oil, etc.)

The cleaning fabric is any natural or synthetic textile and/or combination thereof, which became unsuitable for the use, for which it has been intended originally. Everybody who disposes of the cleaning fabric, is obliged to hand it over only to persons who are providers of the facility designed for the utilization, disposal, collection or purchase of cleaning fabrics.

Before further treatment, the wastes can be collected for a short-term period on the spot of their creation into collecting facilities. The collecting facilities of dangerous wastes may be especially special vessels, containers, packages, pits and tanks, which meet the technical requirements prescribed for the collecting facilities of the dangerous wastes stipulated by the Law N^{o} 383/2001 Col. of Laws, of the waste disposal as

amended. The collecting facilities for wastes must comply with the following technical requirements:

1. Differentiation of collecting facilities for the waste from those not used for the waste disposal or used for other kinds of wastes,
2. Waste protection against weather conditions provided that collecting facilities are determined for the use outside the protected areas and not determined for the inert wastes only,
3. Resistance against chemical influences of the waste, for which they have been designed,
4. In case that the collecting facilities serve as transport packages too, they must meet special legal regulations prescribed for the transport of dangerous things and goods.

When selecting a suitable collecting place or choosing a location of the collecting facility, you must take into consideration the safety protection during its attendance, fire safety, its availability and possibility of being handled with the mechanization and transport means. The identification sheet of the waste collected must be located next to the collecting facilities or collecting centre of the dangerous waste or on them directly. The collecting facilities must carry a catalogue number and name of the dangerous waste collected and name and surname of the person being responsible for the attendance and maintenance of the collecting facility.

The waste can be taken over to the ownership of those natural persons or corporate bodies only, which are entitled to do business and are providers of the facility for the utilization, disposal, collection or purchase of the specified kind of the waste, and/or a person, who is a provider of this facility and/or a locality. Everybody is obliged to find whether a person who takes over the wastes, is entitled to take it over. In case that the person has no certification to do it, the waste cannot be handed over to this person.

The waste originators are obliged to keep records of the waste and methods of their disposal. The records are kept at each establishment and each kind of the waste separately.

This information contains the principal information about the waste treatment during the motor vehicles operation only. The manufacturer does not assume any responsibility and gives no guarantee that the keeping of above-mentioned regulations is enough and represents a complete fulfillment of all obligations connected with the waste disposal and environmental and health protection.

A.18 List of Abbreviations

Abbreviation	Meaning
Ω	Unit of electric resistance
A	Unit of electric current
ABS	Anti-Lock Brake System
Ah	Unit of electric capacity
bar	Unit of pressure
cm^2	Unit of area
cm^3	Unit of volume
ČSN	CzechStateStandard
fc (Foot candle)	Unit of luminous intensity
ft. (Food)	Unit of length (0,3048 m)
ft/sec (Foot/second)	Unit of velocity
ft^2($Foot^2$) (sq. ft.)	Square foot (0,0929 m^2)
ft^3($Foot^3$) (cu. ft.)	Cubic foot (0,02832 m^3)
ft-lb (Foot-pound)	Unit of work
$g.cm^{-3}$	Unit of density
gal (US Gallon)	USgallon (3,7854 liter)
HI	Highest temperature
hp (Horsepower)	Unit of performance
IA	Bolts marking
IB	Bolts marking
IIA	Bolts marking
IIB	Bolts marking
in (Inch)	Unit for measuring length (25,4 cm)
in. H^2O (Inches of water)	Unit of pressure
in/sec^2($Inch/second^2$)	Unit of acceleration
in^2($Inch^2$) (sq. in)	Square inch (6,4516 cm^2)
in^3($Inch^3$) (cu. in)	Cubic inch (16,387 cm^3)
ISO	International Organization for Standardization
K	Unit of thermodynamic temperature
kg	Unit of weight
km	Unit of length
$km.h^{-1}$	Unit of velocity
kN	Unit of force (power)
kPa	Unit of pressure
ks	Piece

Abbreviation	Meaning
kW	Unit of performance
kW.hr (Kilowatt-hour)	Unit of work
lb (Pound)	Unit of weight
lb ft (Pound-foot)	Unit of moment
lb in (Pound-inch)	Unit of moment
lb/in^2(Pounds/square in.)	Unit of pressure
Lb/yd	Unit of pressure
LED	Electroluminescent diode
LO	Lowest temperature
m	Unit of length
Mh	Working hour of the engine
Mile	Unit for measuring length (1,609 km)
min^{-1}	Unit of revolutions
mm	Unit of length
mm Hg	Unit of pressure
MPa	Unit of pressure
N	Unit of force
Nm	Unit of moment
^{o}C	Centigrade (Celsius) degree of temperature
^{o}F	Fahrenheit degree of temperature
^{o}R	Rankin (Réamour) degree of temperature
oz (Ounce)	Unit of weight
PA	Polyacrylate
qt (Quart) L gallon	UKunit of volume (0,9464 liter)
RES	Reset
SET	Insert
Sm (naut. mile)	UKmeasure of distance used at sea (1,852 km)
STANAG	Standardization Agreement (NATO standards for general classification)
UK	United Kingdom(ofGreat BritainandNorthern Ireland)
UKgallon (Imperial gallon)	UKunit of volume (4,546 liter)
US	United States(ofAmerica)
V	Unit of electric voltage
W	Unit of performance
yd (Yard)	3 feet (0,9144 m)
yd^2(Yard^2)(sq. yd.)	Square yard (0,836 m^2)
yd^3(Yard^3)(cu. yd.)	Qubic yard (0,7646 m^3)
ZF	Trade mark (brand)

A.19 List of Applied Symbols

Symbol	Meaning
A	Air inlet
	Non-standard electrical device
	Output for control systems
A,B	Headlights centers transferred on measuring wall
AEK 102	System rinsing set
AKB	Source, accumulator (battery)
B	Sensor, pick-up, loudspeaker, thermos switch
	Output to safety valve
	Output from tire inflator
Ba	Socket
C	Capacitor
	Output for 1-st circuit of service brakes
C,D	Centers of fog lamps
CPL	Control Part List
D	Output for 2-nd circuit of service brakes
DC	Direct current
E	Output for trailer brakes
	Light and heat source
ECOKLIMA ECK 2000	Coolant filler
F	Fusible cut-out
	Output for emergency and parking brake
G	Output to C.T.I.S.
	Power (electric power) source
H	Length
	Panel lamp, tally lights
	Height of headlights centers
h	Ground clearance of light/dark boundary
K	Electromagnetic relay
	Ground
L	Left
	Distance of headlights centers from vehicle longitudinal axis
M	Electric motor
OA	Batteries cut-off switch
OFF	Switched-off
ON	Switched-on
P	Standard electric instrument
	Base

Symbol	Meaning
PE	Polyethylene
Pk	Base
Po	Current fuse
PTO	Power-take off drive
Q	Batteries cut-off switch
R	Radius
	Resistor
	To the right, radius
Rz	Consumers
S	Toe-in
	Switch, break contact, change-over switch, push-button, controller
U	Voltage transformer
V	Rectifier, diode
	Open air output
	Relief valve output
	Emergency and parking brake output
W	Non-electric equipment, car antenna
X	Mean value, given distance
	Socket, connector
x	Meeting beam gradient
Y	Electromagnetic valve, electropneumatic valve

The symbols shown in the next table are used besides the pictures in working procedures.

Tab. A.19 Symbols used in working procedures

	Removing		Danger of injury
	Installing		Danger of material damage
	Disassembly		Laying under, clamping
	Assembly		Oil
	Notice		Lubricating fat
	Check, adjustment		Location acc. to marks
	Special tools		Balance
	Position or sequence at assembly		Filling replenishment
	Visual check		Filling discharging
	Replacement with a new spare part acc. to condition		Loosening, releasing
	Compulsory replaceable spare part		Tightening, securing
	Deadjusting, adjusting		Draught
	Use of sealing medium (mastic, adhesive)		Cutting