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NOTE. **:** *The present standard is partially in accordance with ISO standard 898–1I1999.*

This Standard replaces IVECO STD. 18–0505 Part 2 ed. 4 dated 24.09.2001.

1 SUBJECT AND VALIDITY

1.1 Under the conditions of validity described in detail in IVECO STD 18–0505, the present standard establishes grades of strength, materials, mechanical properties, testing methods and marking for standard reliability screws and studs with d ≤ 39 mm major diameter, and for grub screws with d ≤ 24 mm major diameter.
Screws requiring special properties, e.g.: weldability, heat and corrosion strength, resistance to temperatures > 300 °C and < 50 °C or surface hardness higher than core hardness are excluded.

1.2 Mechanical properties specified in this Standard stand valid at ambient temperature.
To use bolts and nuts properly not at ambient temperature, within 300 °C and –50 °C limits, take into account mechanical property variation as a function of temperature, specially as concerns resistance to temperatures between –20 and –50 °C.

For minimum values of rated load $R_{p0,2}$ and of resilience at various temperatures, see **Table V**.
For inspection requirements see IVECO STD. 18–0505 Enclosure 10, the 2nd and 3rd levels of quality depending on screws' grades of strength.

Edition	Date	Description of modifications	Group
1	25.07.1985		
2	27.02.1989	Replaced references 15–2610 P. 1 by 15–2603 and 15–2610 P. 2 and 15–2604 in Table II and STANDARDS QUOTED.	
3	25.03.1999	Completely revised.	**CFO**
4	24.09.2001	Table II notes, Table III and relevant notes modified.	
5	11.05.2004	Completely revised for updating. It was 18–0505 Part 2.	
6	27.01.2006	Modified: Manager and Supervisor Dept. Added: Grade of Strength 4.6 to Tables I, II, III, V, XII and XV. IVECO STD. 18–0013 title in point 9 modified.	

2 DESIGNATION OF GRADES OF STRENGTH

Five grades of strength, identified by symbols consisting of two digits separated by a dot, are provided. The first digit represents a hundredth of ultimate tensile strength in N/mm^2, and the other one represents the ratio, multiplied tenfold, between yield strength Rs or deviation from proportion Rp0.2 and ultimate tensile strength (see **Table I**).
Screws in classes **8.8, 10.9 and 12.9** shall be hardened and tempered.

TABLE I

SCREW STRENGTH CLASS	ULTIMATE TENSILE STRENGTH (N/mm^2)	YIELDING STRENGTH RS OR PROPORTION DEVIATION RP0.2 (N/mm^2)	USE	MATERIAL CODE
4.6	400	240	Light–duty screws	00121
4.8 [1]	400	320	Light–duty screws	25105
5.8 [2]	500	400	Low–strength screws	25055
8.8	800	640	Average–strength screws	25056
10.9	1000	900	High–strength screws	25057
12.9 ★	1200	1080	Top–strength screws	25058

[1] Replaces previous class 11H when the latter is specified for headed screws.

[2] Use class **8.8** for screws with d > 16 mm major diameter.

★ Class not to be used for new designs.

3 MATERIALS

Steels to be used shall comply with chemical and structural properties specified in **Table II,** which also provides for concerned strength classes, specifications for tempering check.

TABLE II

STRENGTH CLASS	MATERIAL AND THERMAL TREATMENT	MAX. [7] THREAD DIAMETER (mm)	CHEMICAL COMPOSITION % LIMITS [4] (PRODUCT ANALYSIS)						TEMPERING TEST TEMPERATURE AND LENGTH ★★
			C	Mn min.	Σ [1] min.	Mo min.	S max.	P max.	
4.6 – 4.8 [5]	Non–alloy or alloy steel	39	≤ 0.55	–	–	–	0.06	0.05	–
5.8 [5]				0.25					
8.8 [2] [6]	Non–alloy or alloy hardened and tempered steel ★	24	0.28 (0.19) ÷ 0.50	0.45	–	–	0.04	0.04	440 ± 5°C for 30 min
		39			0.5 (0.3)				
10.9 [2]	Alloy hardened and tempered steel ★	16	0.28 (0.22) ÷ 0.50	0.45	0.5 (–)	–	0.04	0.04	425 ±5°C for 30 min
		39			0.9 (0.5)				
12.9 [3]	Alloy hardened and tempered steel ★	18	0.28 ÷ 0.50	0.45	0.9	–	0.035	0.035	410 ±5°C for 30 min
		27			1.1	0.15			
		39			1.4				

[1] Σ is the sum of alloy component percentage values, and more exactly:
Σ = Cr + Ni + Mo + V + (Mn 0.8). Addend (Mn 0.8) is to be considered only when positive.

[2] Boron steels can be used (B content = 0.0005 – 0.005%). Boron presence, together with manganese content ≥ 0.50% for class **8.8** and ≥ 0.70% for class **10.9**, enables to reduce min. carbon and Σ contents to values specified in brackets and to reduce second tempering temperature by 40 °C. For class 10.9 it is possible to reduce Mn content to ≥ 0.5 providing C content is ≥ 0.28%, and to reduce Σ to 0.25 providing Mo ≥ 0.07%.

Any change in chemical composition shall be authorised by Iveco Central Laboratory for Testing Materials.

[3] Boron steels admitted for screws class **12.9** (B content = 0.0005 + 0.005%). Boron presence, together with manganese content ≥ 0.80% enables to reduce Σ content to 0.25 providing Mo ≥ 0.07%.

Any change in chemical composition shall be authorised by Iveco Central Laboratory for Testing Materials.

[4] Lead steels are admitted to manufacture chip–forming machined screws, excluding class **12.9** screws; in this case lead content shall be: Pb ≤ 0.25% for class 10.9 and Pb ≤ 0.35% for the other classes.

[5] Super cutting steels can be used; in this case sulphur and phosphorus contents shall be: S ≤ 0.34% and P ≤ 0.11%.

[6] Super cutting steels can be used; in this case sulphur content shall be: S ≤ 0.13%.

[7] Bar section size for screws obtained by chip–forming machining from hardened and tempered semi–finished product. This manufacturing method is admitted just for classes **8.8** and **10.9**.

★ Steel hardenability shall be sufficient to obtain in the threaded part, a core structure having approx. all–hardening 90% martensite (before tempering).

★★The difference between the average values of the three readings obtained by Vickers hardness tests, performed on screw before and after the second tempering (the latter one being performed under the required conditions), shall not exceed 20 Vickers' points.

4 MECHANICAL AND DECARBURIZATION PROPERTIES

4.1 Mechanical properties

See **Table III**.

TABLE III

PROPERTY		STRENGTH CLASS					
		4.6	**4.8**	**5.8**	**8.8**	**10.9**	**12.9**
Ultimate tensile strength R (N/mm^2) [1]		400	420 – 700	520 – 700	800 – 1040	1040 – 1200	1220 – 1400
Yielding strength Rs min. (N/mm^2) [2]		240	340	420	–	–	–
Unit yelding load from proportionality Rp 0.2 min. (N/mm^2)		–	–	–	640 (660)	940	1100
Ultimate elongation A min. (%)		22	14	10	12	9	8
KU impact strength min. (J)		–	–	–	30	20	15
Vickers hardness HV,F $\geq$ 98 N		120 – 220	130 – 220	160 – 220	250 – 320	320 – 370	370 – 420
Rockwell hardness [3]	HRB	67 – 95	71– 95	82 – 95	–	–	–
	HRC	–	–	–	22 – 32	32 – 38	38 – 43
Surface hardness HV 0,3 max.		–	–	–	HV0.3 value obtained on core + 30		
Unit test load Rcp (N/mm^2)		225	310	380	580 (600)	830	970
Rcp / Rs or Rp 0.2 ratio min.		0.94	0.91	0.91	0.91	0.88	0.88

[1] Max. ultimate tensile strength values are given as an indication.

[2] In case Rs yielding point can not be found, deviation from proportionality Rp 0.2 can be checked.

[3] In case of dispute, Vickers hardness is decisive.

4.2 **Decarburization**

See **Table IV**.

TABLE IV

PROPERTY	STRENGTH CLASS		
	8.8	**10.9**	**12.9**
Min. non–decarburized area height in thread, E [1]	2/3 h3	3/4 h3	
Max. total decarburization depth in thread, G (mm)	0.015		
Max. global decarburization depth in thread root [1]	1/10 h3	1/13 h3	
Global decarburization on on chip–forming machined surfaces	Absent		
[1] h3 = thread depth in max. material conditions.			

4.3 **Surface coating and/or treatment specifications**

Class 10.9 and 12.9 screws when pickled or electroplated, shall be then submitted to proper dehydrogenation treatment; dehydrogenation cycle shall be equal to that specified on the relevant process Standard.

5 MECHANICAL PROPERTIES AT HIGH TEMPERATURE

Table V gives, by way of example, yielding strength Rs or proportionality deviation Rp0.2 values as a function of temperature.
These values, which show mechanical property reduction at high temperatures, shall not be taken as reference for qualification or testing.

TABLE V

STRENGTH CLASS	Yield strength Rs min. or proportionality deviation Rp 0.2 min. (N/mm^2) at the following temperatures:				
	+ 20 °C	+ 100 °C	+ 200 °C	+ 250 °C	+ 300 °C
4.6	To be defined				
4.8	340	310	270	250	230
5.8	420	380	335	310	285
8.8	640	590	540	510	480
10.9	940	875	790	745	705
12.9	1100	1020	925	875	825

6 TEST PROGRAMMES

Table **VI** establishes decisive mechanical properties as concerns screw evaluation in two test programmes.

TABLE VI

PROPERTY	TEST METHOD [1]		TEST PROGRAMME			
			A		**B**	
			STRENGTH CLASS			
			5.8	**8.8 10.9 12.9**	**5.8**	**8.8 10.9 12.9**
Ultimate tensile strength	Tensile strength test on specimen	point 7.1	●	●		
	Tensile strength test on screw	point 7.2			■	■
Yielding strength	Tensile strength test on specimen	point 7.3	●	●		
Resistance to test load	Load test	point 7.4			●	●
Elongation	Tensile strength test on specimen	point 7.5	●	●		
Vickers hardness		I.S. 15–0102	■	■	■	■
Rockwell hardness		I.S. 15–0108	○	○	○	○
Ultimate tensile strength with oblique support	Tensile strength test on oblique support	point 7.4			●	●
Impact strength	Impact strength test	point 7.5		●		●
Head toughness	Head toughness test	point 7.6	○	■	○	○
Decarburization	Micro or micro–hardness test	point 7.7		●		●
Surface defects	Non–destructive test	point 7.7.3	○	●	○	●
Tensile strength	Tensile strength test	point 7.8				●
Direction of grain	Microscopic test	point 7.9.1		●		●

[1] In general, tensile strength test is performed on entire screw; specimen is used to found properties that cannot be obtained with sufficient approximation on entire screw, and in case of dispute on test performed on entire screw and in case of doubts.

6.1 Programme *A*

This programme stands valid for screws with shank section smaller than resistant section, or for specimens obtained from screws having shank sections smaller than resistant section.

6.2 **Programme *B***

This programme stands valid for screws having shank section higher than or equal to resistant section or for entirely threaded screws.
In any case, screws checked according to programme ***B*** shall pass programme ***A*** tests, provided the latter can be performed.
These two programmes are equivalent.
Test marked with ● is decisive to evaluate screw mechanical properties. Should purchaser require reduced approval tests, tests marked with ● can be replaced by tests identified by ■.
In case of doubt, tests identified by ● are decisive, providing they can be performed, e.g. short screws or screws with excessive major diameter.
In this case test identified by ■ is decisive.
Tests identified by ○ can be performed only after special agreements, these tests can furthermore be used instead of ● tests.
See point 7 for the number of tests to perform.

7 TEST METHOD

7.1 Tensile strength test on specimen

Test is performed by proportional specimen in **Figure 1** (see IVECO STD. 15–0113), determining the following values:

– ultimate tensile strength R;

– yielding strength Rs;

– percentage elongation $A = 100. \frac{L_u - L_o}{L_o}$

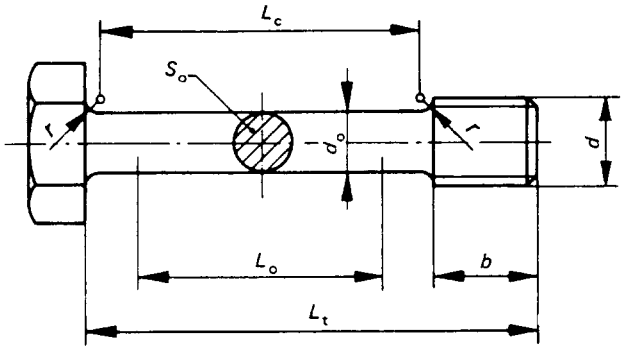


FIGURE 1

d major diameter;

d_o specimen diameter (tol. j_s 12);

b thread length ($\geq$ d);

L_o initial length between references (= 5 d_o);

L_c specimen shank cylindrical section length ($\geq L_o \div d_o$);

Lt total specimen length (= L_c + 2r + b);

L_u length after breakage;

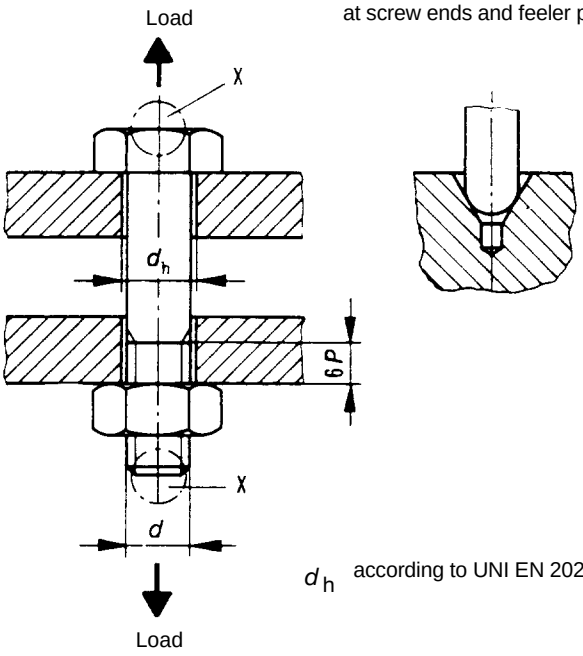
S_o initial gauged part section area;

r radius (> 4 mm).

For hardened and tempered screws with thread diameter > 16 mm, shank diameter section reduction higher than 25 % (≈ 44 % section) is not admitted for specimen preparation.

7.2 Tensile strength test on screw

This test shall be performed according to **Figure 2** on a test bed with self–centering clamps. Threaded element can be replaced with a nut having strength and tolerance class suitable for coupling.



Detail X
Ball–cone contact between centres at screw ends and feeler pin.

d_h according to UNI EN 20273 (1992), average series

FIGURE 2

For studs, a nut or a proper element tightened at finest thread root shall be used as head. Should stud threads have the same pitch, the element replacing the head shall be tightened on thread root side. Through holes D shall correspond to fine series
Threaded element in **Figure 2** shall have thread tolerance: 5H and hardness: HRC ≥ 50.
To find ultimate strength, resistant section S_r, given by the following ratio, is valid

$$S_r = \frac{\Pi}{4}\left(\frac{d_2 + d_3}{2}\right)^2$$

where: d_2 pitch diameter,
d_3 minor diameter.

Ultimate strength value, specified in **Tables VII** and **VIII** for strength class being examined, shall be applied to screw.
In case of dispute, without performing tensile strength on specimen, check min. ultimate strength with actual size d_2 and d_3, instead of S_r rated section values given in **Tables VII** and **VIII** since there can be section variations 10 % less than S_r resistant section.
During the test, a free and unladen thread length between 0.5 – 1 d shall be provided.
Headed screws shall not break in the area between head and shank.

TABLE VII

Min. ultimate strength values F_m in N for coarse pitch ISO metric thread screws

NOMINAL THREAD DIAMETER (mm)	PITCH (mm)	RESISTANT SECTION S_r (mm^2)	STRENGTH CLASS			
			5.8	**8.8**	**10.9**	**12.9**
1.6	0.35	1.27	660	1020	1320	1550
2	0.40	2.07	1075	1650	2150	2530
2.5	0.45	3.39	1765	2710	3525	4140
3	0.5	5.03	2620	4000	5230	6140
4	0.7	8.78	4570	7000	9130	10710
5	0.8	14.2	7380	11350	14800	17330
6	1	20.1	10400	16100	20900	24520
8	1.25	36.6	19000	29300	38100	44600
10	1.5	58.0	30200	46400	60300	70800
12	1.75	84.3	43800	67450	87700	103000
14	2	115	59800	92000	120000	140000
16	2	157	81600	125600	163000	192000
18	2.5	192	99800	159400	200000	234000
20	2.5	245	127000	203000	255000	299000
22	2.5	303	158000	251150	315000	370000
24	3	353	184000	293000	367000	431000
27	3	459	239000	381000	477000	560000
30	3.5	561	292000	466000	583000	684000
33	3.5	694	361000	576000	722000	847000
36	4	817	425000	678000	850000	997000
39	4	976	508000	810000	1015000	1200000

TABLE VIII

Min. ultimate strength values F_m in N for fine pitch ISO metric thread screws

NOMINAL THREAD DIAMETER (mm)	PITCH (mm)	RESISTANT SECTION S_r (mm^2)	STRENGTH CLASS			
			5.8	**8.8**	**10.9**	**12.9**
8	1	39.2	20400	31350	40800	47800
10	1.25	61.2	31800	49000	63600	74660
12	1.25	92.1	47900	73700	95800	112360
14	1.5	125	65000	100000	130000	152000
16	1.5	167	86800	134000	174000	206000
18	1.5	216	112000	179300	225000	264000
20	1.5	272	141000	226000	283000	332000
22	1.5	333	173000	276400	346000	406000
24	2	384	200000	319000	399000	469000
27	2	496	258000	412000	516000	605000
30	2	621	323000	515000	646000	758000
33	2	761	396000	632000	791000	928000
36	3	865	450000	718000	900000	1055000
39	3	1030	536000	855000	1071000	1260000

7.3 **Load test on screw**

This test consists in stressing the screw according to methods shown in **Figure 2** and specified below, with unit test load provided for the class being tested for 10 s, without obtaining significant permanent elongation.
According to **Tables IX** and **X** test load shall be applied to screw axially, by a tensile strength testing machine with self–centering clamps, or by a device of the type shown in **Figure 3**, composed as follows:

– ring hole (1) where oil pressure is transformed into load on screw;

– pressure gauge (2) with 10 N indexing to read load;

– two dial gauges (3) to read elongation.

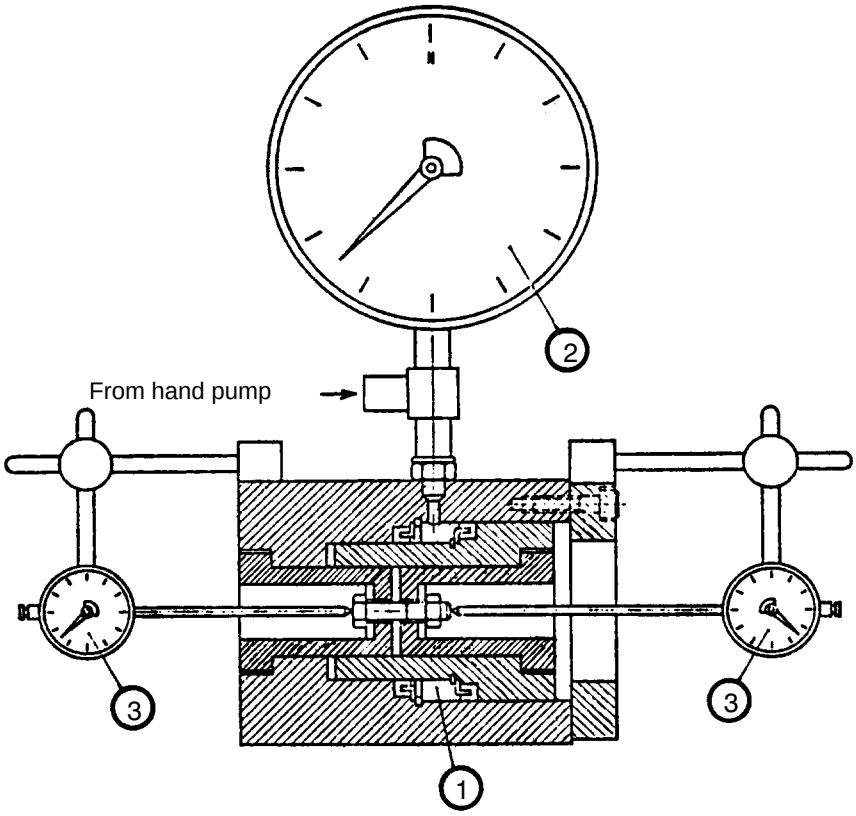


FIGURE 3

Free thread length, non–engaged, shall be between 0.5 d and d.
Through holes D shall correspond to fine series.
60° centres shall be provided at screw ends (see **Figure 4**).
Before and after test load application, screw length shall be checked by a ball feeler reading device.

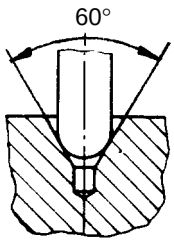


FIGURE 4

Device error hall be less than or equal to 5 μm. Other length reading methods are admitted providing not exceeding the above error.
For studs, a nut or a proper element tightened at finest thread root shall be used as head.
Should stud threads have the same pitch, the element replacing the head shall be tightened on thread root side. Unit test load for stud screws is that corresponding to less resistant section thread diameter.

In case of dispute, before passing to programme ***A***, check min. ultimate strength with actual size d_2 and d_3, instead of S_r rated section values given in **Tables IX** and **X** since there can be section variations 10 % less than S_r resistant section.

TABLE IX

Test load values in N for coarse pitch ISO metric thread

NOMINAL THREAD DIAMETER (mm)	PITCH (mm)	RESISTANT SECTION S_r (mm^2)	STRENGTH CLASS			
			5.8	**8.8**	**10.9**	**12.9**
1.6	0.35	1.27	485	740	1055	1230
2	0.40	2.07	785	1200	1720	2010
2.5	0.45	3.39	1290	1965	2815	3290
3	0.5	5.03	1910	2920	4180	4880
4	0.7	8.78	3340	5100	7290	8520
5	0.8	14.2	5400	8230	11800	13800
6	1	20.1	7640	11660	16700	19500
8	1.25	36.6	13900	21200	30400	35500
10	1.5	58.0	22000	33700	48100	56300
12	1.75	84.3	32000	48950	70000	81800
14	2	115	43700	66700	95500	111600
16	2	157	59700	91000	130300	152300
18	2.5	192	73000	115200	159400	186200
20	2.5	245	93100	147000	203400	237700
22	2.5	303	115000	182000	251500	294000
24	3	353	134000	212000	293000	342400
27	3	459	174000	275400	381000	445000
30	3.5	561	213000	337000	465700	544000
33	3.5	694	264000	416400	576000	673000
36	4	817	310000	490000	678000	792500
39	4	976	371000	585600	810000	947000

TABLE X

Test load values in N for fine pitch ISO metric thread

NOMINAL THREAD DIAMETER (mm)	PITCH (mm)	RESISTANT SECTION S_r (mm^2)	STRENGTH CLASS			
			5.8	**8.8**	**10.9**	**12.9**
8	1	39.2	14900	22700	32500	38000
10	1.25	61.2	23300	35500	50800	59400
12	1.25	92.1	35000	53400	76400	89300
14	1.5	125	47500	72500	103800	121300
16	1.5	167	63500	96900	138600	162000
18	1.5	216	82100	129600	179300	209500
20	1.5	272	103000	163000	226000	264000
22	1.5	333	126000	200000	276400	323000
24	2	384	146000	230000	319000	372500
27	2	496	188000	298000	412000	481000
30	2	621	236000	373000	515000	602400
33	2	761	289000	457000	632000	738000
36	3	865	329000	519000	718000	839000
39	3	1030	391000	618000	855000	999000

7.4 **Tensile strength test with oblique support**

Screw is fitted in tensile strength testing device shown in **Figure 5**.
Tensile strength test with oblique support shall be performed according to methods shown in **Figure 5** and in **Table XI**, where oblique support angle is specified.
Screw shall be stressed with axial load until breaking. Unless otherwise specified on drawing, breaking shall never take place in the area between head and shank. Tensile strength test with oblique support on studs shall be performed with device shown in **Figure 6**, with methods described below and according to **Table XI**.
Should stud screw have a coarse pitch and a fine pitch, device in **Figure 6** shall be applied on coarse pitch part, leaving free a thread section equal to d. On the fine pitch part a nut shall be applied, tightened down to thread bottom.
Should stud screw threads have the same pitch, device in **Figure 6** shall be applied on root side.
Threaded element shall always be tightened by hand, although root thread is increased.

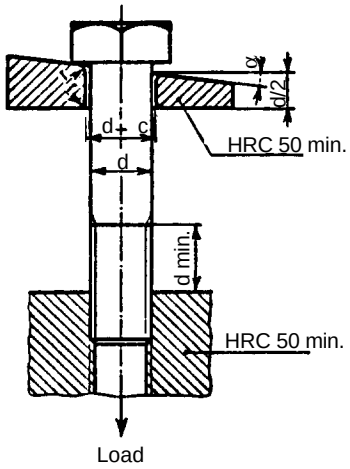


FIGURE 5

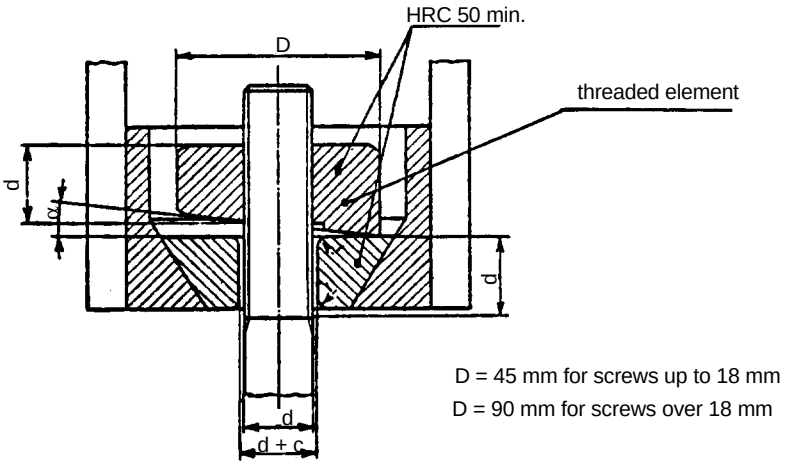


FIGURE 6

TABLE XI

Dimensions for tensile strength test device with oblique support

NOMINAL THREAD DIAMETER ***d*** (mm)		***c*** (mm)	***r*** (mm)	ANGLE α ± 30' (▲)			
				FOR SCREWS WITH ≥ 2 ***d*** NOMINAL LENGTH FOR ELONGATION STRENGTH CLASSES		FOR SCREWS WITH < 2 ***d*** NOMINAL LENGTH OR WITH ENTIRELY THREADED SHANK FOR ELONGATION STRENGTH CLASSES	
over	up to			≥ 10 %	< 10 %	≥ 10 %	< 10 %
—	6	0.7	0.5	10°	6°	6°	4°
6	12	0.8	0.8				
12	20	1.3	1.6				
20	39	1.6	3.2	6°	4°	4°	4°

(▲) For special shape screw (e.g.: rod screws) angle α shall be specified on drawing.

Tolerance on hole d – c shall be H8; on threaded element it shall be 5H.
Minimum tensile strength values provided for the corresponding strength class, referred to resistant section S_r (see **Tables VII** and **VIII**) shall be obtained before breaking.
For entirely threaded screws, conditions specified in this test are obtained when breaking starts in the threaded part and then enters in the transition length.
This test shall not be performed on countersunk head screws.

Should hardness replace a tensile strength test (see point 4.1), it shall be performed on a cross section set at a distance from end ≥ d and at 0.25 from external surface.
Rockwell hardness test shall be performed with scales B and C.
For any other information not provided in this Standard, see IVECO STD. 15–0102 for Vickers hardness and IVECO STD. 15–0108 for Rockwell hardness. In case of doubt, Vickers hardness is decisive.

7.5 **Impact strength test**

This test shall be performed in compliance with Charpy, with U or key hole specimen at ambient temperature. Specimen shall be obtained as much as possible next to screw surface, in axial direction. Impact strength test shall be only performed on screw with > 12 mm diameter. See IVECO STD. 15–0130 for test methods.

7.6 **Head toughness test**

This test shall be performed according to methods shown in **Figure 7** and **Table XII**.

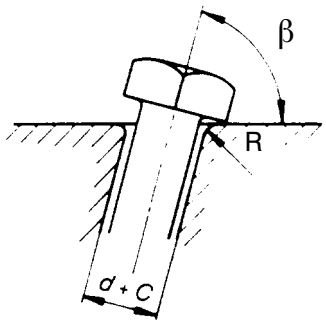


FIGURE 7

TABLE XII

STRENGTH CLASS	**4.6**	**4.8**	**5.8**	**8.8**	**10.9**	**12.9**
Angle β	60°	80°				

Screw head shall be bent by 90° – β by hammer without breaking or cracks in the area between shank and head. See **Table XI** for c and r dimensions.
This test shall not be applied to countersunk head screws. Test on entirely threaded screws is positive when breaking or cracks appear on first thread, providing head is not completely removed.

7.7 **Decarburization check**

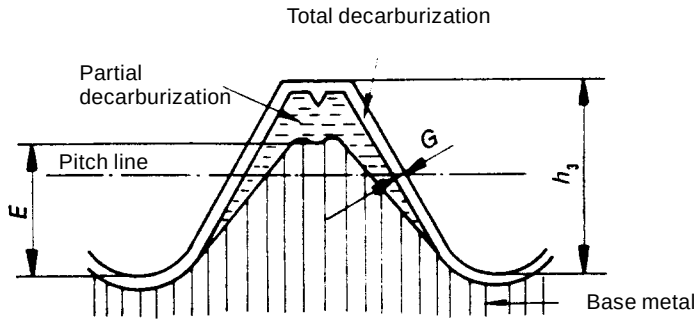
Two decarburization reading methods are provided:

– microscopic method, to be used as current method;

– microhardness method, to be mainly used in case of dispute.

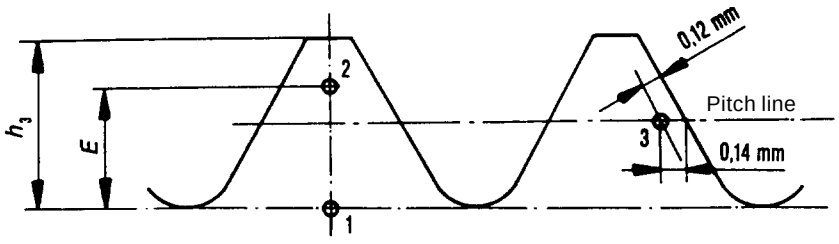
7.7.1 **Microscopic method**

Decarburization shall be checked on a longitudinal screw surface on the threaded part, as shown in **Figure 8**.
Surface shall be at a distance from screw axis equal to 1/10 thread diameter.
Sample to examine shall be prepared according to proper metallographic practice and etched with 4% nital.
Decarburization shall be read by micrometric eyepiece, or by direct reading on ground pane of micrographic room.
Magnification shall be 100 X.
Non–decarburized area depth (E) shall be at least 2/3 h_3 – 3/4 h_3, (h_3 = thread height in maximum material conditions), according to strength classes and specifications contained in relevant Standards, which specify total admitted decarburization depth read in correspondance with pitch diameter (0 to 0.015 mm) (G) (see **Figures 8** and **9**).
Total or partial decarburization depth at thread root can be 1/10 h_3 – 1/13 h_3 always according to specifications contained in relevant Standards (see **Table XIII**).



h_3 thread depth in maximum material conditions

FIGURE 8



$HV_2 \geq HV_1 - 30$
$HV_3 \geq HV_1 + 30$

FIGURE 9

Min. specified non–decarburization area depth (E) and max. total or partial decarburization depth in thread root have been summed up as a function of pitch in **Table XII**.

TABLE XIII

Admitted decarburization values

PITCH (mm)	h_3 (mm)	E VALUES (mm)		MAX. TOTAL OR PARTIAL DECARBURIZATION DEPTH IN THREAD ROOT (mm)	
		2/3 h_3	3/4 h_3	1/10 h_3	1/13 h_3
		SCREW STRENGTH CLASSES			
		8.8 22H	10.9 – 12.9 33H	8.8 22H	10.9 – 12.9 33H
0.35	0.215	0.143	0.161	0.021	0.016
0.4	0.245	0.164	0.184	0.024	0.019
0.45	0.276	0.184	0.207	0.027	0.021
0.5	0.307	0.204	0.230	0.031	0.023
0.6	0.368	0.245	0.276	0.037	0.028
0.7	0.429	0.286	0.322	0.043	0.033
0.75	0.460	0.306	0.345	0.046	0.035
0.8	0.491	0.327	0.368	0.049	0.038
1	0.613	0.409	0.460	0.061	0.047
1.25	0.767	0.511	0.575	0.077	0.059
1.5	0.920	0.613	0.690	0.092	0.071
1.75	1.073	0.716	0.805	0.107	0.082
2	1.227	0.818	0.920	0.123	0.094
2.5	1.534	1.022	1.150	0.153	0.118
3	1.840	1.227	1.380	0.184	0.141
3.5	2.147	1.431	1.610	0.215	0.165
4	2.454	1.636	1.840	0.245	0.189
4.5	2.760	1.840	2.070	0.276	0.212
5	3.067	2.044	2.300	0.307	0.236
5.5	3.373	2.249	2.530	0.337	0.259
6	3.680	2.453	2.760	0.368	0.283

7.7.2 **Microhardness method (for ≥ 1mm pitches)**

Sample is prepared as described in point 7.7.1. Nital etching can be omitted.
HV0.3 hardness in tree positions (1, 2 and 3) is found as shown in **Figure 9** where 1 and 2 are on thread axis angle and 3 shall be found at pitch diameter level at 0.012 mm from thread surface or near it in the point where positions 1 and 2 have been found.
Decarburization decrease lower than 30 HV0.3 points found between 1 and 2 is not admitted; i.e.: Vickers hardness read on position 2 shall be equal to or higher than that read on position 1 increased by 30 Vickers points.
Hardness on screws rolled after hardening and tempering shall not be found on thread since, due to work hardening, values exceeding 30 Vickers points (allowed as recarburization limits) can be found.
Hardness shall be read on a shank section not rolled and not machined after hardening and tempering. Bear in mind that a previous decarburization may be hiden by cold work hardening.

7.7.3 **Surface defect examination**

To find surface defects, magnetic powder or penetrant fluid methods are used.
In case of doubt, decide the type and depth of surface defects and perform a section normal to thread and read defects by a micrometric eyepiece.

7.8 **Tensile strength** (for 10.9 and 12.9 screws)

Stress 8 screws up to loads shown in **Table XIV**, and tighten them with a nut of equivalent class, on stiff steel rings treated with HRC 41 – 45 hardness and flat, parallel and ground surfaces. Use wrenches with ± 5% accuracy; tightening torque shall be established each time tightening a screw on dynamometer.
Screw thread and supporting surfaces shall be greased with graphite oil.
Tightened screws shall be put in thermostat at –20 ± 1 °C for 24 h; no breakage shall be found at the end of the test.

TABLE XIV – Tensile strength test loads

Thread diameter (mm)	**Pitch** (mm)	**Screw resistant section** S_r (mm^2)	**LOAD** (N) [1]	
			10.9	**12.9**
7	1	28.9	18200	21800
8	1.25	36.6	23100	27700
8	1	39.2	24700	29600
9	1.25	48.1	30300	36400
9	1	51	32100	38600
10	1.5	58	36500	43800
10	1.25	61.2	38600	46300
10	1	64.5	40600	48800

[1] Should non–threaded shank diameter be smaller than resistant section diameter, loads shall be reduced according to section variation.

(continues ☞)

(☞ continued)

Thread diameter (mm)	**Pitch** (mm)	**Screw resistant section S_r** (mm^2)	**LOAD** (N) [1]	
			10.9	**12.9**
12	1.75	84.3	53100	63700
12	1.5	88.1	55500	66600
12	1.25	92.1	58000	69600
14	2	115	72400	86900
14	1.5	125	78800	94500
16	2	157	98900	119000
16	1.5	167	105000	126000
18	2.5	192	121000	145000
18	1.5	216	136000	163000
20	2.5	245	154000	185000
20	1.5	272	171000	206000
22	2.5	303	191000	229000
22	1.5	333	210000	252000
24	3	353	222000	267000
24	2	384	242000	290000
27	3	459	289000	347000
27	2	496	312000	375000
30	3.5	561	353000	424000
30	2	621	391000	469000
33	3.5	694	437000	525000
33	2	761	479000	575000
36	4	817	515000	618000
36	3	865	545000	654000
39	4	976	615000	738000
39	3	1030	649000	779000

[1] Should non–threaded shank diameter be smaller than resistant section diameter, loads shall be reduced according to section variation.

7.9 **Direction of grain** (for screws)

For headed screws the direction of grain, especially in the joining area between the head and the shank, shall be regular and without double folds and interruptions.
A regular direction means that the direction itself is continuous and concave compared to the part's axis (as an example see **Figure 10**.
Partial interruption of external grains is admitted in case of machining of the underhead surface.
For threadings the direction of grain corresponding to threads shall be continuous and shall follow the general outline of the thread itself, with maximum density at the thread–base (see **Figure 11**).

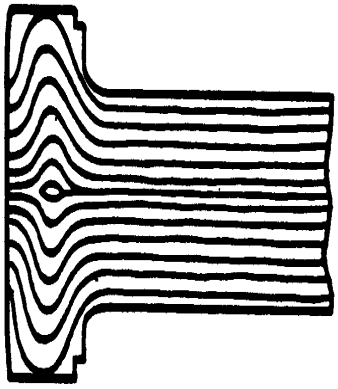


FIGURE 10

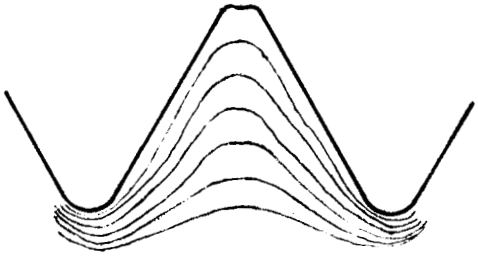


FIGURE 11

7.9.1 **Microscopic test**

This test shall be carried out along a longitudinal plane passing through the axis, as described in IVECO STD. 15–0210.

8 MARKING

Marking consists of the symbol of grade of strength and of the trademark, with the exception of studs which have an alternative countersign (see point 8.2.3).

8.1 **Symbols of grades of strength**

The marking of the symbol of grades of strength is shown in **Table XV**.

TABLE XV

STRENGTH CLASS	**4.6**	**4.8**	**5.8**	**8.8**	**10.9**	**12.9**
SYMBOL ◌	4.6	4.8	5.8	8.8	10.9	12.9
◌ The point between the numbers indicating the grade can be omitted						

8.2 **Identification**

8.2.1 **Hexagon–head or six–lobe screws**

Hexagon–head or six–lobe screws (including screws with flanges) shall be marked with manufacturer's trademark and strength class shown in **Table XV**.
Marking is compulsory for every strength class and is preferably made (printing or embossing) on the head top or printed on the head side (see **Figure 12**). Flanged screws shall be marked on flanges if marking on the head top cannot be made.

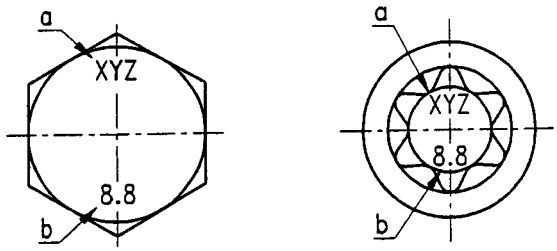


FIGURE 12 – Examples of marking for hexagon–head or six–lobe screws

Key

a Manufacturer's trademark
b Strength class

8.2.2 **Socket head screws with hexagon or six–lobe slot**

Socket head screws with hexagon or six–lobe slot must be marked with manufacturer's trademark and symbol of grades of strength of **Table XV**.
Marking is compulsory for grades of strength 8.8 and higher, preferably made (printing or embossing) on the head top or printed on cylindrical head surface deeply (see **Figure 13**).

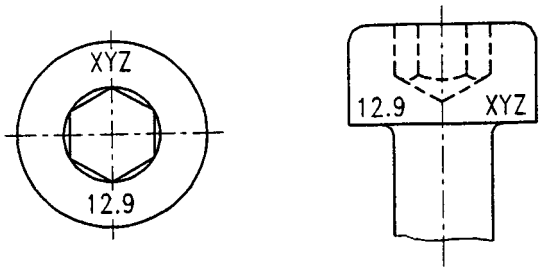


FIGURE 13 – Examples of marking for cylinder–head socket head screws with hexagon or six–lobe slot

The clockwise marking system according to IVECO STD. 18–0505 Enclosure 3 corresponding to nuts can be used as alternative system for cylindrical socket head screws with small diameters.

8.2.3 **Studs**

Studs must be marked with the symbol of grades of strength of **Table XV**.
Marking is compulsory for grades of strength **8.8** and above, preferably deeply on the end of the threaded part (see **Figure 14**);

FIGURE 14 – Stud marking

For studs having a root side with fixed connection, marking must be carried out on the end of the shank side (screwing side of nut). Symbols in **Table XVI** can be used as an alternative to the identifying symbols of grades of strength in **Table XV**.

TABLE XVI – Alternative identifying symbols for studs

STRENGTH CLASS	**5.8**	**8.8**	**10.9**	**12.9**
ALTERNATIVE IDENTIFYING SYMBOL				

8.2.4 **Other screw types**

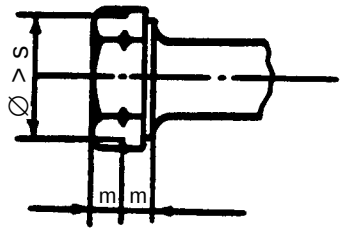
The same system of marking described in points 8.2.1 and 8.2.2 must also be used for other types of screws as explicitly directed by each product standard or drawing information.

8.3 **Marking for left–head thread screws**

Left–hand thread screws must be marked with the symbol of **Figure 15** on the head–top or at the end of the threaded shank.

FIGURE 15 – Marking for left–hand thread

For left–hand thread hexagon–head screws, scoring the corners of faces of the hexagon head as shown in **Figure 16** can be used as an alternative system.



s = width across flats

FIGURE 16 – Alternative marking for left–hand thread

8.3.1 Choice of symbol

Manufacturer chooses the symbols in accordance with points 8.1 to 8.3.

8.4 Trade–mark

Trade–mark (producer's marking) is compulsory for all screws that must bear the mark of a grade of strength symbol.

9 ENGINEERING RELEASE

General requirements given in IVECO STD. 18–0010 "Quality of supplies" are valid.
Unless otherwise specified or agreed upon, Supplier shall submit for engineering release 20 samples of the required product, on which the properties required by this Specification will be systematically checked.
The above mentioned samples must always be accompanied by a "Product Identification Sheet" (see IVECO STD. 18–0015) and by the "Product Quality Certification" (see IVECO STD. 18–0013) filled in by the Supplier with reference to the properties of this Specification and any other specifications on drawing.

10 QUALITY OF SUPPLY

The product supplied must comply with the present Specification, with drawing and with the sample on which engineering release has been given.
Supply shall be performed according to IVECO STD. 18–0010 "Quality of supplies" using the forms specified in IVECO STD. 18–0013, 18–0015.

STANDARDS QUOTED

IVECO STD.: 15–0102, 15–0108, 15–0113, 15–0130, 15–0210, 18–0010, 18–0013, 18–0015, 18–0505, 18–0505 Enclosure 2, 18–0505 Enclosure 3, 18–0505 Enclosure 10.

UNI EN: 20273 (1992).

ISO: 898–1/1988.