

Stevin report: 25.6.90.09

RESULTS OF THE TEST PROCEDURE OF THE BOLTED
CONNECTIONS OF THE NISSAN HEADQUARTERS
AMSTERDAM

April 1990

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Archives
Steel Structures

department : M&C

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SUMMARY

The HCG Steel Construction has requested us to advise about the way of tightening non friction bolts.

As described in chapter 2 we proposed to use a torque of 25% of the torque at which the bolt will yield.

After erection a number of bolts has been tested at random whether they met the requirements. At that time some bolts did not meet the requirements.

Therefore it was decided that all bolts which were reachable should be checked for the torque moment. During testing bolts which did not meet the requirements were improved accordingly.

If it was impossible to place the torque wrenche on the bolt nut (because of the dimension of the torque wrenche), the bolt was correctly tightened without a torque wrenche using the expertise of the tester.

The number of checked bolts are given in the test protocols.

All checked and approved bolts have been marked with paint.

1. INTRODUCTION

This report gives the results of the testing regarding the sufficient tightening of the bolted connections in the steel structure of NISSAN EUROPE HEADQUARTERS AMSTERDAM.

As for non friction grip bolts no requirements for tightening are given in the codes, we have proposed and agreed upon a method as described in chapter 2.

The results of the checked bolts are given in the test protocols.

2. TEST PROCEDURE

In accordance with Art. 5.4.2 of VVSG 1983 (NEN Standard 2009) the tightening of non friction bolts should be such "that the various bolt parts are tightened by hand with the appropriate spanners".

A method of calculating the torque at which bolts will yield is specified in "Staalbouwkundig Genootschap" Publication 411 (May 1981, page 5) under the heading "Tightening of bolts".

A safe assumption in the case of hand tightening of the bolts is that after erection, the bolt nuts should not display movement with respect to the bolt, when a testing torque of 25% of the torque at which the bolt will yield, is applied.

The formula for calculating the torques, given in the above publication is:

$$M_a = k \times d \times F_{v1}$$

where M_a = torque in Nm
 k = coefficient, which by testing is determined to be 0,13
 d = bolt diameter
 F_{v1} = bolt force

Using this formula, the torques are determined and given in Table 1.

It is possible to check whether bolts have been properly tightened by using a torque handwrench set to the value given in column 6 of Table 1.

Table 1 - Torques for non friction grip bolts.

bolt diam.	yield stress bolt	cross section	bolt yield strength	torque for yielding	test torque for hand tightened bolts
(mm)	(N/mm ²)	(mm ²)	(kN)	(Nm)	(Nm)
16	640	157	100	209	51
20	640	245	157	408	102
24	640	352	225	702	176
27	640	459	294	1031	258
30	640	561	359	1800	450
36	640	817	523	2664	666

3. RESULTS

The number and location of all tested bolts are given in the test protocols attached in the appendix page 1 - 19.

4. CONCLUSION

After checking, all bolts which have been tested met the desired torque moment as determined in chapter 2.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 5-4-'90

Tester : W. Groenewegen

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	88	4	5
20	102	346	12	3,5
24	176	42	3	7
30	450	--	--	--
36	666	84	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 5-4-'90

Tester : W. Groenewegen

Location of tested bolts:

Level $\frac{1}{2}$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	180	10	5,5
20	102	216	6	3
24	176	88	3	3,5
30	450	--	--	--
36	666	20	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 5-4-'90

Tester : W. Groenewegen

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	32	2	0,7
20	102	274	9	3
24	176	136	4	3
30	450	192	8	4
36	666	192	1	0,5

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 10-4-'90

Tester : B. Stuivenberg

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	15	0	0
20	102	175	4	2
24	176	16	1	6
30	450	--	--	--
36	666	80	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 9-4-'90

Tester : H. Munter

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	23	2	8
20	102	243	8	3
24	176	56	2	4
30	450	--	--	--
36	666	112	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 10-4-'90

Tester : B. Stuivenberg

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	20	0	0
20	102	181	5	2,7
24	176	16	1	6
30	450	80	3	4
36	666	80	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 9-4-'90

Tester : H. Munter

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	30	2	6,5
20	102	253	8	3
24	176	56	2	3,5
30	450	112	5	4,5
36	666	112	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 10-4-'90

Tester : B. Stuivenberg

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	20	2	10
20	102	175	4	2,5
24	176	16	1	6,5
30	450	--	--	--
36	666	80	1	1,2

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 9-4-'90

Tester : H. Munter

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	30	2	7
20	102	245	10	4
24	176	56	3	5,5
30	450	--	--	--
36	666	112	2	2

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 10-4-'90

Tester : B. Stuivenberg

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	20	1	5
20	102	175	6	3,5
24	176	16	0	0
30	450	80	5	6
36	666	80	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 9-4-'90

Tester : H. Munter

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	30	0	0
20	102	245	9	4
24	176	56	1	2
30	450	112	4	3,5
36	666	112	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 17-4-'90

Tester : B. Stuivenberg / H. Munter

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	20	0	0
20	102	175	8	4,5
24	176	16	1	6
30	450	--	--	--
36	666	80	1	1,5

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 9-4-'90

Tester : H. Munter

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	30	2	7
20	102	245	10	4
24	176	56	1	2
30	450	--	--	--
36	666	112	2	2

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 17-4-'90

Tester : B. Stuivenberg / H. Munter

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	20	0	0
20	102	175	7	4
24	176	16	1	6
30	450	80	5	6
36	666	80	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L
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Date of test : 10-4-'90

Tester : B. Stuivenberg

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	30	2	7
20	102	245	7	3
24	176	56	2	3,5
30	450	112	3	3
36	666	112	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 17-4-'90

Tester : B. Stuivenberg / H. Munter

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	20	1	5
20	102	175	5	3
24	176	16	0	0
30	450	--	--	--
36	666	80	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

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Date of test : 10-4-'90

Tester : B. Stuivenberg

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	30	1	3,5
20	102	245	7	3
24	176	56	3	5,5
30	450	--	--	--
36	666	112	1	0,8

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L

=====

Date of test : 17-4-'90

Tester : B. Stuivenberg / H. Munter

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	33	1	3
20	102	117	3	2,5
24	176	--	--	--
30	450	--	--	--
36	666	80	0	0

* All failed bolts have been corrected.

NISSAN HEADQUARTERS AMSTERDAM

T E S T P R O T O C O L
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Date of test : 10-4-'90

Tester : B.Stuivenberg

Location of tested bolts:

Level ½ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Grid 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Bolt diam.	setting torque spanner (Nm)	no. tested	no. failed	percentage * failed bolts
16	51	47	3	6,5
20	102	83	0	0
24	176	--	--	--
30	450	--	--	--
36	666	112	0	0

* All failed bolts have been corrected.