Performance Evaluation and Monitoring of Fasteners

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ABSTRACT

Aim of this industrial-based project that is created in relation with Unilever Company is to decide on the most suitable washer for company's fastener loosening problems.

The machines of the Unilever Company are providing vibrations to the products to make them more fluid, however due to the amount of vibration, the fasteners which are connected to the machines are loosening at the end of processes. So the manufacturing processes are stopped by engineers to fix the loosening and the situation causes delays. That's why, the company wants to avoid that kind of delays and obtain maximum efficiency. Special washer type called Nord Lock is requested to be measured if it is suitable for the company's needs. Moreover for further problems concerning fasteners, a fastener reference guide which will include specified solutions and information is prepared.

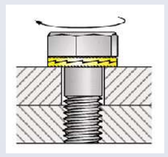
OBJECTIVES

- First objective is to measure the loosening degrees of the three different sized fasteners which are taken from Unilever Company. Those are M10x35 8.8 class, M5x10 A2-70 and M6x40 A2-70 sized bolts.
- To measure the loosening amount and the last degree that the fastener holds the force upon the bolt, clamp force tests are needed. Test needs to show the comparison among regular washer, splitknock and Nord-Lock which will allow us to decide upon the fastener.

FASTENERS AND WASHERS

Anti-Loosening Approaches before Fastener Selection

. Some anti-loosening approaches are as follows: Changing the screw diameter, Changing the engagement length, Varying the thread pitch, Reducing the external diameter of the boss, Utilizing a conical spring washer (fastener).



Tightening Methods

• Using a torque wrench with a specified torque limit

• Turning through a specified angle after full engagement

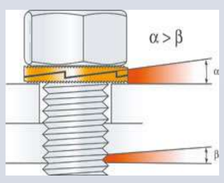
• Hydraulic tensioning – use a hydraulic cylinder to stretch a bolt for imparting an initial tension

Measuring Length & Diameter;

Fastener length is usually measured from where the material is assumed to be to the end of the fastener. Thus, countersunk fasteners are measured overall and non-counter- sunk fasteners are measured from under the head.

Nord-Lock

Tension makes the bolt self-locking. The key is the difference in angles. Since the cam angle "α" is larger than the thread pitch "β", the pair of washers expand more than the corresponding pitch of the thread. Nord-Lock washers positively lock the fastener in a joint which is subjected to extreme vibration or dynamic loads.



Split-Lock

Optimum Torque Selection

Torque Values for A2 or A4 Metric Stainless Steel Fasteners

Bolt Dia (mm)	Torque (N-m)		Torque (in-lbs. through M10; M12 & over ft-lbs.)	
	Dry	Lubricated	Dry	Lubricated
3	1.0	0.9	8.9 in-lbs.	8.0 in-lbs.
4	2.6	2.3	23.0	20.7
5	5.1	4.6	45.1	40.6
6	8.7	7.8	77.0	69.3
8	21.2	19.1	188	169
10	42	38	372	335
12	73	66	54 ft-lbs.	48 ft-lbs.
14	118	106	87	78
16	180	162	133	119
18	258	232	190	171
20	370	333	273	246
22	485	437	358	322
24	603	543	445	400

Figüre 1.1

Recommended Maximum Bolt Loads and Torque Values (Metric CoarseThreads)

	3.6		5.6		6.9		8.8		10.9		12.9		A/F
mm	Newtons	N.m	Newtons	N.m	Newtons	N.m	Newtons	N.m	Newtons	N.m	Newtons	N.m	mm
2	284	0.12	378	0.16	731	0.31	863	0.37	1216	0.52	1461	0.63	4
3	726	0.44	966	0.59	1863	1.13	2206	1.34	3109	1.88	3727	2.26	5.5
4	1255	1.00	1677	1.34	3226	2.60	3825	3.04	5374	4.31	6453	5.15	7
5	2059	1.96	2736	2.65	5286	5.10	6257	6.03	8806	8.48	10591	10.20	8
6	2903	3.43	3864	4.51	7453	8.73	8836	10.30	12405	14.71	14906	17.65	10
8	5315	8.24	7090	10.79	13680	21.57	16230	25.50	22751	35.30	27360	42.17	13
10	8473	16.7	11278	21.57	21771	42.17	25791	50.01	36284	70.61	43541	85.32	17
12	12356	28.4	16475	38.25	31773	73.55	37657	87.28	52956	122.60	63547	147.10	19
16	23340	69.6	31087	93.16	60016	178.50	71196	210.80	100027	299.10	120131	357.90	24
20	36481	135	48641	180	93849	384.1	111305	411.9	156415	578.6	187796	696.3	30
24	52563	230	70019	308.9	135331	598.2	160338	711.0	225552	1000	270662	1196	36
30	84043	466	112286	622.7	215745	1206	255952	1422	359902	2010	432471	2403	46
36	123073	814	164261	1089	316753	2099	374612	2481	527595	3491	432526	4197	55
42	169164	1304	225552	1746	435413	3364	515827	3991	725688	5609	870826	6727	65

Figure 1.2

Figure1.1 is indicating optimized torque amounts for A2-A4 classed screws. It means that there are two different torque amounts for M5x10 which is 5.1 N.m and for M6x40 which is 8.7 N.m as marked above. Figure 1.2 is showing optimized torque amount for M10x35 with 8.8 class screw and its tightening amount is 50.01 N.m.

MECHANICAL SETUP AND TESTS

Figure 2: Mechanical Setup

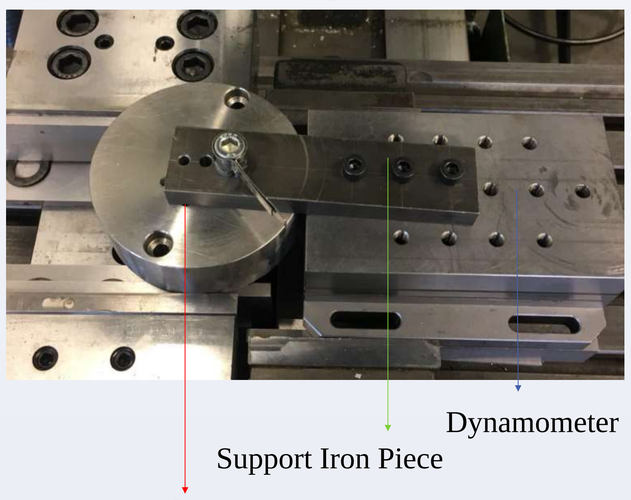
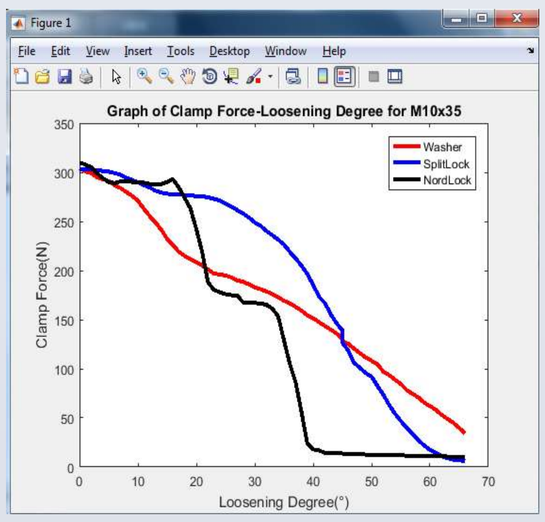


Figure 3: Measurement Paper by Degree

Figure 2 shows the mechanical setup of dynamometer with a fixture connected to it. The connection is provided by a support iron piece which has six holes on it. Three holes at the support piece are used to make a connection between the dynamometer and remaining holes are used one by one to make a connection with the fixture.

Figure 3 shows an example of experimental bolt with a connected measurement paper. Bolt is connected with two indicator, which are clinched to eachother, are used to observe changing degrees from the paper during the process of loosening.

RESULTS AND DISCUSSION



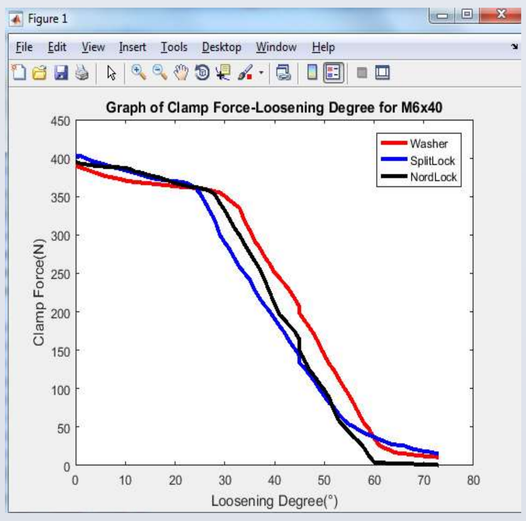


Figure 4: Graph of M10x35

Matlab graph of the M10x35 is indicating the loosing degree and clamp force relation. According to the graph Nord-lock has not enough capacity to compete with other washer types.

Graph of M6x40

Nord-Lock has almost same behavior with other washer types as shown in the figure. According to figüre, bolt has revening point at the degree of 30. Washer had the best performance.

CONCLUSION

Aim of the Project is to decide on which washer to suggest and during the project we have observed the vibrations data to understand the pattern of the force fasteners are under and tried to come up with vibration tests but since the flow was unstable and the life test of a fastener constructed of many variables, the degree of fastening according to clamp force is chosen to be the determined variable. As a conclusion around 20 and 30 degrees loosening causes massive problems and we can suggest the company to measure the loosening and plan their tightening operations according to it.

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