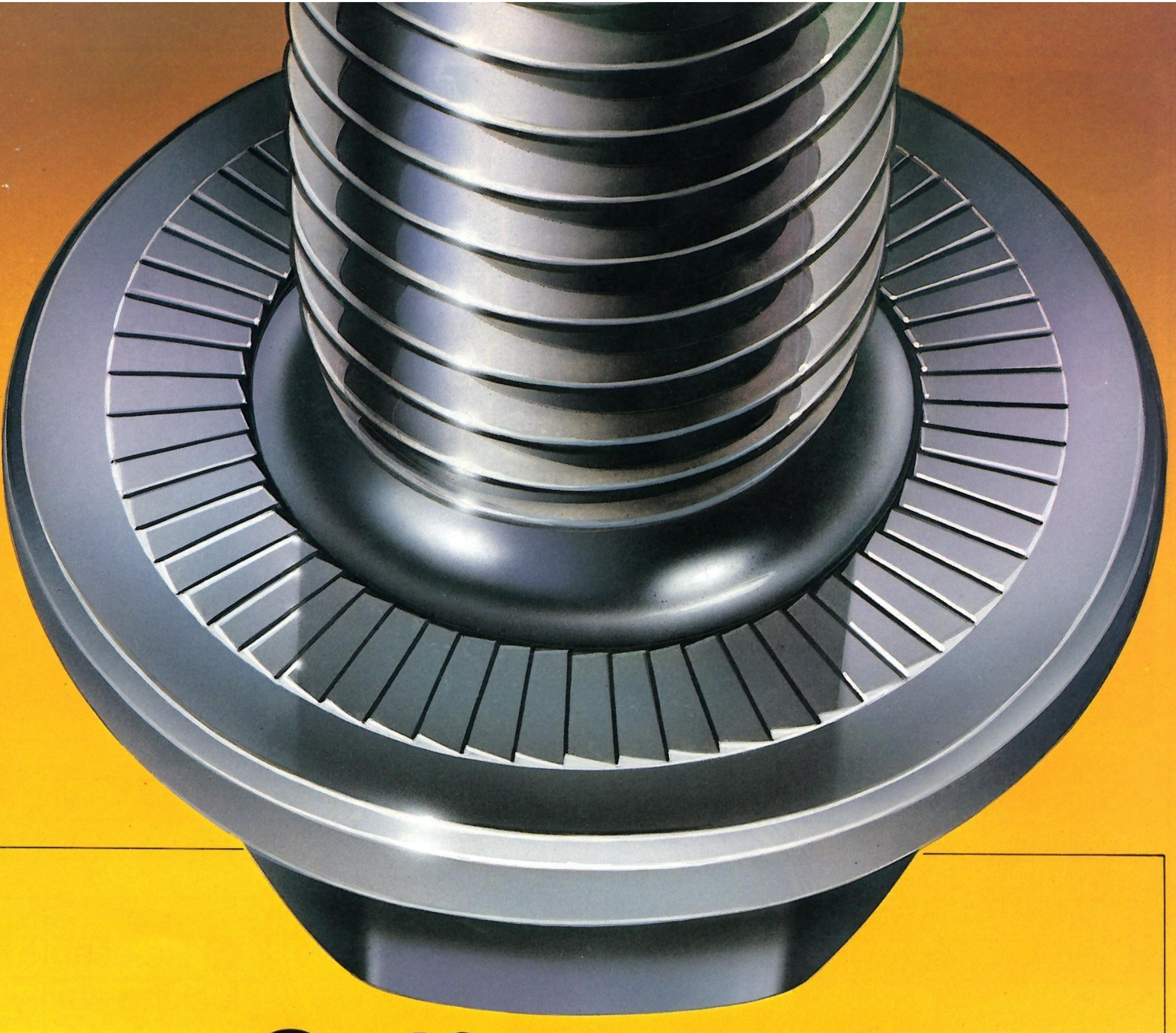


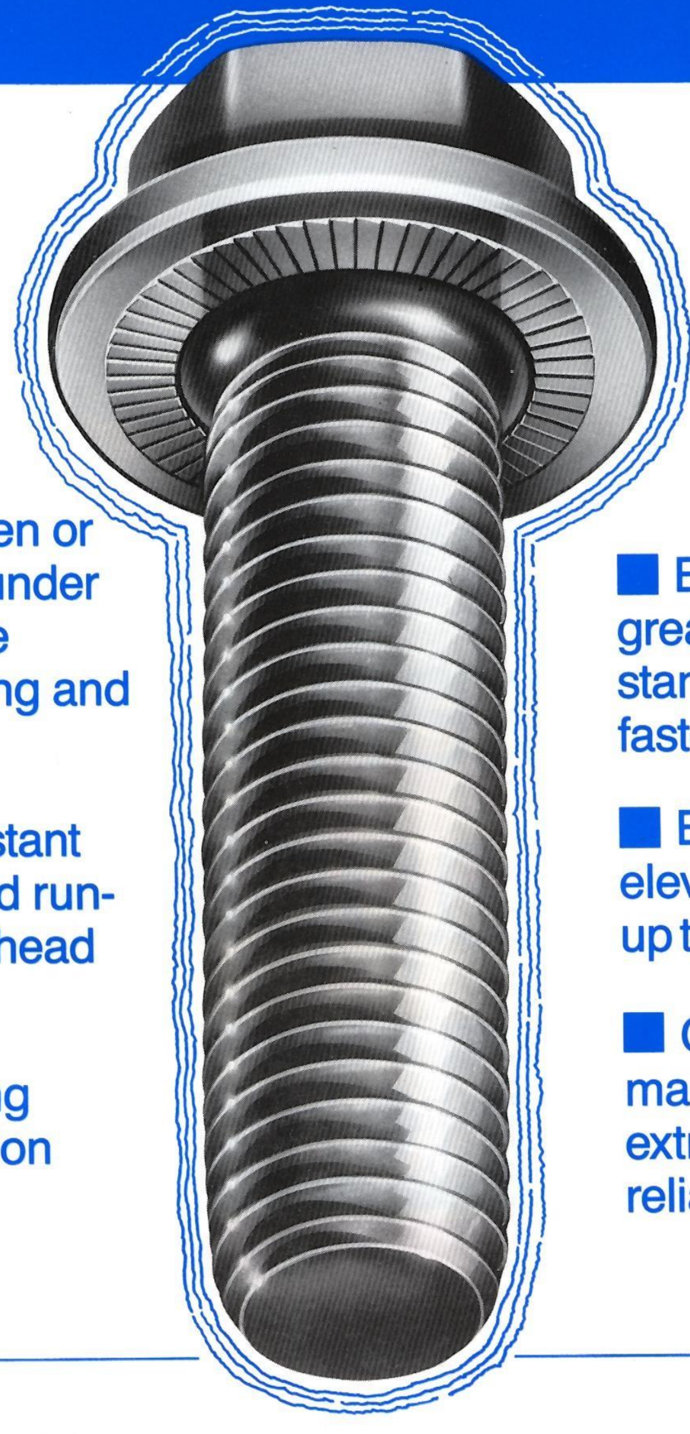
# Self-locking Fasteners for tough applications

Unbrako®

Durlok®

# The DURLOK self-locking system is the solution to one of the most persistent problems in the field of fastener technology

## ...VIBRATION.



- Will not loosen or unscrew even under the most severe transverse jarring and vibration.
- Fatigue resistant design in thread run-out and under-head fillet.
- Free-spinning during installation and removal.
- Re-usable with locking ability maintained.
- Embedding is no greater than with standard types of fasteners.
- Effectiveness at elevated temperatures up to 300°C is ensured.
- Closely controlled manufacturing for extra safety and reliability.

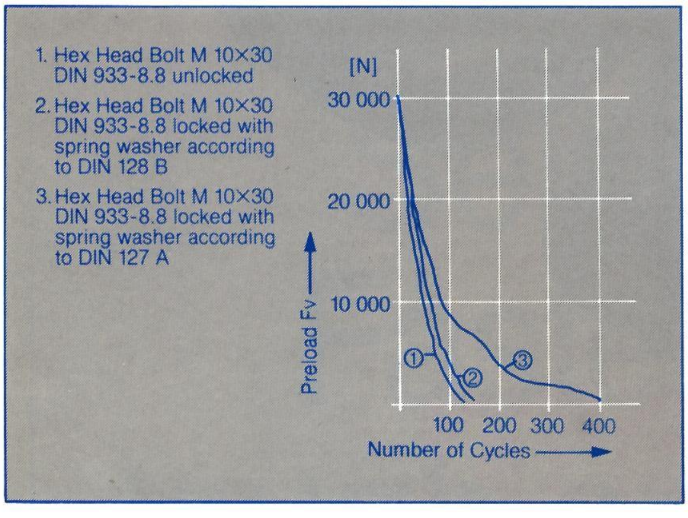
# How can the self-locking ability be evaluated?

The most commonly used method for measuring locking ability has been by the indirect method of measuring and comparing the tightening and untightening torques. However, there is a growing realisation that such a test in no way simulates the self-loosening mechanics of a fastener subjected to vibration. The only way this can be achieved is to apply a vibratory force to the bolted joint and determine whether the fastener rotates loose. This has been attempted but without achieving any real measure of the self-locking ability of the fastener.

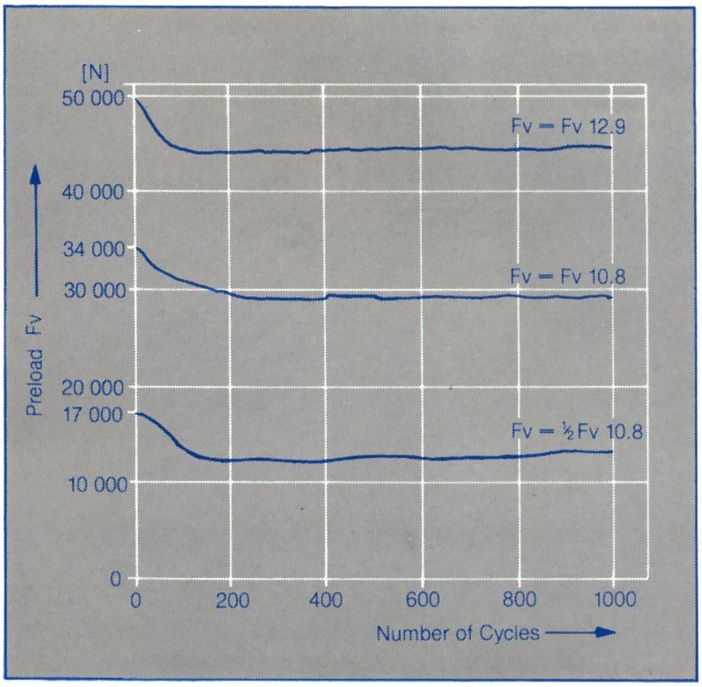
There are numerous possibilities of recording test data. However, the clearest presentation of self-locking ability is shown by recording loss of preload versus number of cycles.

A typical recording for both unlocked bolts and bolts supposedly locked with spring washers shows that the initial bolt preload is completely lost after very few test cycles; conclusive evidence that the bolt has undergone total self-loosening.

These results clearly show that spring washers do not possess any genuine self-locking ability.

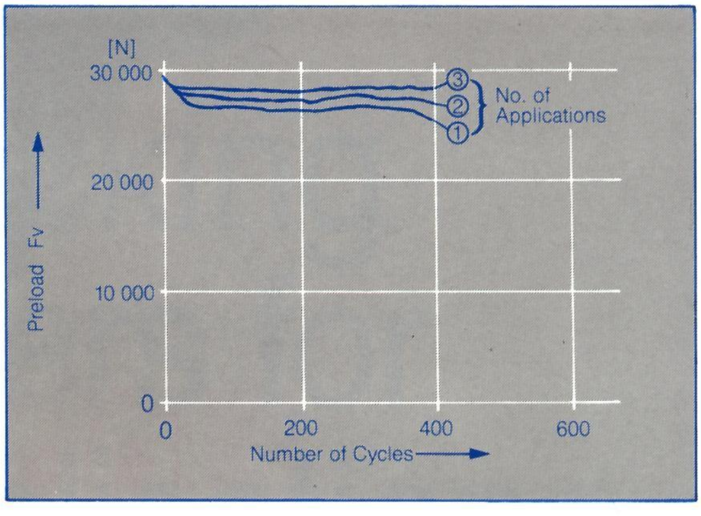



DURLOK bolts, however do not rotate loose when tested in the same way, even under the heaviest amplitudes. Even when only half of the recommended preload was used, Durlok bolts still did not loosen. This is illustrated by the figure below, which is an original recording of a vibration test on M 10 DURLOK bolts. This shows that there is minimal loss of preload even when the fastener is re-used.




# Other advantages of DURLOK

DURLOK bolts and nuts are suitable for re-use because the serrations cause relatively little damage to the clamped material. This means that the locking ability can be maintained as shown by the original vibration test recording below.




This recording shows that the minimal loss of preload due to embedding even decreases due to cold-working of the surface of the clamped material during retightening of the fastener.

The DURLOK fastener system is effective on a wide variety of engineering materials including steel — both heat-treated and non heat-treated, cast irons including nodular types, non-ferrous metals and sheet materials.

# Metric Sizes — Metric Units

| Size | Stress area $A_S$ mm² | Property class | Proof load (N) | Load at yield point $\alpha$ 0.2 × $A_S$ (N) | Load at minimum UTS (N) | Induced preload $F_{max}$ for $\mu$ thread =0.125 (N) | Tightening torques $T_{max}$ (Nm) for $\mu$ head of 0.125 | 0.16 | 0.20 |
|---|---|---|---|---|---|---|---|---|---|
| M6 | 20.1 | 12.9 | 19500 | 22100 | 24500 | 15950 | 18.2 | 21.0 | 24.0 |
| M8 | 36.6 | 12.9 | 35500 | 40300 | 44600 | 29300 | 44.0 | 50.0 | 58.0 |
| M10 | 58.0 | 12.9 | 56300 | 63800 | 70800 | 46600 | 84.0 | 96.0 | 109.0 |
| M12 | 84.3 | 12.9 | 81800 | 92700 | 102800 | 68000 | 148.0 | 169.0 | 194.0 |
| M14 | 115.0 | 12.9 | 111500 | 126500 | 140000 | 93000 | 233.0 | 266.0 | 304.0 |
| M16 | 157.0 | 12.9 | 152000 | 172500 | 191500 | 129000 | 362.0 | 413.0 | 472.0 |
| M20 | 245.0 | 12.9 | 238000 | 270000 | 299000 | 201000 | 698.0 | 797.0 | 913.0 |

Metric sizes: All dimensions in millimetres.

The presence of oil or other lubricants, organic or inorganic coatings should not adversely affect the locking ability.

DURLOK fasteners can be used at elevated temperatures up to 300°C and, in addition, can be manufactured in special materials to perform at even higher temperatures.

The value of the friction coefficient in the bearing area, $\mu_H$, has a different value to that of the friction coefficient in the threads, $\mu_T$, due to the serrations. As for all bolts, the friction coefficient under the head is a function of the material, surface finish and lubrication condition of the contacting materials. To account for this, the tightening torques are listed for various values of $\mu_H$.

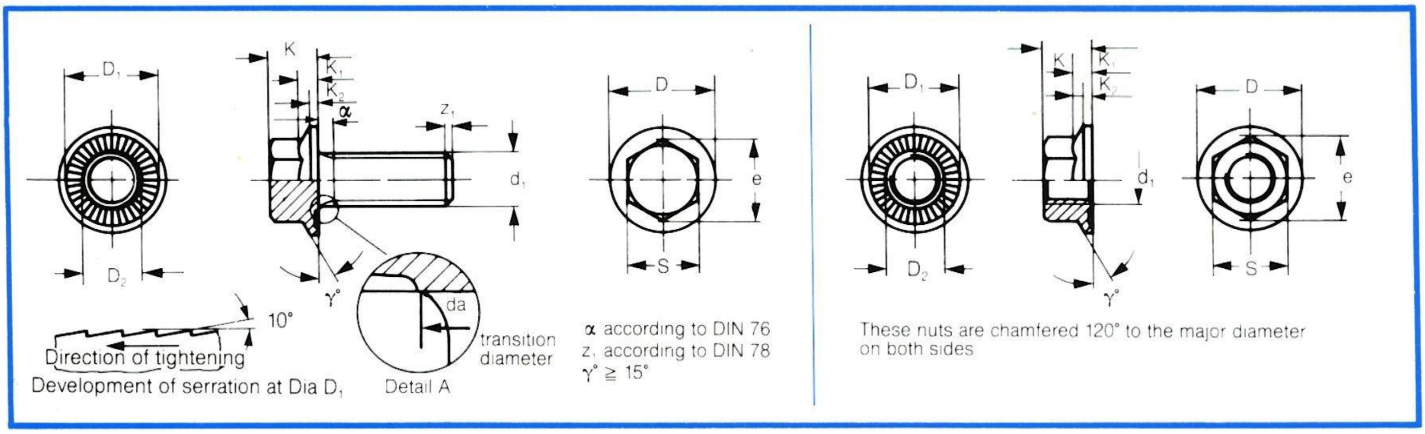
For guidance, the following chart is designed to indicate the appropriate value of friction coefficient to be applied for various engineering materials and finishes. The values of $\mu_H$ are based on the results of comprehensive tests.

| Coated Surface / Bare Bolt Surface | Method of Producing Bearing Surface: Fine Turning Grinding (Coated) | Fine Turning Grinding (Bare Bolt) | Turning, Boring, Milling (Coated) | Turning, Boring, Milling (Bare Bolt) | Rough Turning Rough Milling (Coated) | Rough Turning Rough Milling (Bare Bolt) |
|---|---|---|---|---|---|---|
| STEEL Hardness 250-350 HV | 0.125 | 0.16 | 0.125 | 0.16 | 0.125 | 0.125 |
| STEEL Hardness 150-250 HV | 0.16 | 0.20 | 0.16 | 0.16 | 0.16 | 0.16 |
| Grey Cast Iron Nodular Cast Iron | — | 0.20 | — | 0.16 | — | 0.125 |

Coatings are: Thermal oxide, phosphate, zinc plating, cadmium plating.

Notes:
For malleable cast iron bearing material, tightening torques should be obtained for grey cast iron and then increased by 10%.

# Dimensions




Metric Sizes: All dimensions in millimetres.

| d | M6 | M8 | M10 | M12 | M14 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| D(h 15) | 14 | 18 | 21 | 25 | 28 | 32 | 39 |
| D1 min | 11.8 | 15.2 | 17.2 | 20.6 | 22.8 | 25.7 | 31.2 |
| D2* | 6.6 (7.4) | 9.0 (9.5) | 11 (12.5) | 14 (15) | 16 (17) | 18 (19) | 22.0 (22.3) |
| e min* | 11.10 | 14.49 | 16.64 | 19.01 (21.1) | 21.23 (24.5) | 24.62 (26.8) | 30.14 (34.0) |
| K (js 15) | 5.2 | 7.2 | 9.0 | 11.0 | 12.5 | 16.0 (14.5) | 18.0 (18.0) |
| K1 max | 2.27 | 2.70 | 3.24 | 4.00 | 4.50 | 6.38 (3.9) | 6.49 (4.0) |
| K2 | 1.1 | 1.3 | 1.6 | 1.9 | 2.2 | 3.8 (2.4) | 3.1 (2.4) |
| da max | 6.20 | 8.50 | 10.40 | 13.30 | 15.20 | 17.20 | 21.00 |
| S* | 10 | 13 | 15 | 17 (19) | 19 (22) | 22 (24) | 27 (30) |

* Dimensions in brackets are for nuts.

Strength grades: 12.9 for bolts and class 12 for nuts.

Material: Special alloy steel according to DIN 267
Sheet 3 for 12.9 bolts and special steels for class 12 nuts.

Thread: According to DIN 13 medium fit (6 g) for the bolts and 6 H for the nuts.

# Technical Data

The induced assembly preload, $F_{max}$, and the corresponding tightening torques, $T_{max}$, are based on a 90% utilisation of the minimum yield strength by combined tension and torsional stresses. For cases where the yield strength must never be exceeded during tightening, the tightening torque must be reduced by a value equivalent to the scatter. Comprehensive investigation has shown that the scatter, due to variations in friction coefficient and torque scatter when tightening by torque wrench, must be accounted for by using a reduced torque T which is 90% of the tabulated value $T_{max}$. $T = 0.9 \times T_{max}$.

Accordingly, the induced preload $F_{max}$ will be reduced to the new preload F $F = 0.9 \times F_{max}$.

It should be noted that preload and tightening torque are a function of the joint stiffness. The tabulated values are valid for a joint stiffness which occurs under snug conditions with a clamping length of 2.5—4d. In addition, the values are based on an average friction coefficient for the threads of $\mu = 0.125$.

This data also applies to DURLOK nuts when used with 12.9 strength grade DURLOK bolts.

Where other design criteria exist, consult the supplier for technical advice.

# Mechanical properties of DURLOK fasteners

DURLOK bolts:

| Mechanical Property | DURLOK 12.9 |
|---|---|
| Tensile Strength, Rm ($N/mm^2$) min | 1220 |
| 0.2% Proof Stress ($N/mm^2$) min | 1100 |
| Stress under Proof Load Sp ($N/mm^2$) | 970 |
| % Elongation 5D min | 9 |
| Core Hardness HV. max | 420 |

DURLOK nuts:
DURLOK nuts are manufactured to meet the mechanical properties of ISO class 12 and are suitable for use with DURLOK bolts