



Direct Tension Indicator (DTI) Manufacturing Standard Specification

Standard North American DTIs are made to ASTM F959/959M (metric), which define the chemical, mechanical (read compression load vs. residual DTI gap), and dimensional requirements per ASME B18.2.6. Complete DTI dimensions and mechanical properties are available from ASTM and ASME. The following is a summary of ASTM F959/F959M.

Product Analysis Chemical Composition Requirements, %

Element	Type 1 Series	Type 3 Series¹
Carbon	.27-.58	---
Manganese	.47-.93	---
Phosphorus, Max	.048	.045
Sulfur, Max	.053	.055
Silicon	---	.13-.37
Chromium	---	.42-.68
Nickel	---	.22-.48
Copper	---	.22-.48

Mechanical Requirements

DTIs are made to compress in proportion to the applied load or bolt tension. A sample of the lot must demonstrate a compression load range at a residual gap of .015" within the following values (the minimum is based on 70% of the minimum ultimate tensile strength of the applicable bolt grade, and the maximum is 20% higher than that). Note the F959/959M stipulates that the compression load test gap of .015" be the same whether the DTI is plain finish or coated. Note that the laboratory certification compression load tests for DTIs DO NOT involve bolts, but rather the tests are performed with the DTIs compressed between hardened mandrels.

Acceptable Range of Compression Loads (kips) Per ASTM F959/959M Table 2, inch series

Diameter, mm	A325	A490
1/2	12-14	15-18
5/8	19-23	24-29
3/4	28-34	35-42
7/8	39-47	49-59
1	51-61	64-77
1 – 1/8	64-77	80-96
1 – 1/4	81-98	102-122
1 – 3/8	97-117	121-145
1 – 1/2	118-143	148-178

¹ Type 3 DTIs are permitted to be manufactured from the type 3 steels listed in ASTM F3125



Acceptable Range of Compression Loads (kn) Per ASTM F959/959M Table 2, metric series

Diameter, mm	A325M	A490M
M16	91-109	114-131
M20	142-170	179-206
M22	176-211	221-254
M24	205-246	257-296
M27	267-320	334-384
M30	326-391	408-469
M36	475-570	595-684

Coatings

F959/959M only allows for mechanical galvanizing (to ASTM B695 class 55) and the thermal diffusion process (to ASTM A1059 class 25). Other coatings are allowed with the approval of both the manufacturer and the purchaser. Coating of DTIs by anyone other than the manufacturer is prohibited because ASTM compression testing must be done after coating.

Heat Treatment

Through-hardening to a maximum hardness of HRC37.

Certifications

ASTM F959/959M requires that compression test certifications be issued which show the results of 29 pieces selected at random from the manufactured lot and compression tested according to Table 2. The compression load of all 29 pieces must be within the range stipulated above. Applied Bolting makes all product material test reports available by download.

DTI Markings

All DTIs are stamped with an individual unique lot mark, which can be related to the lot number. Through the lot number, all DTI lots are traceable to date of manufacture and compression load properties.

Dimensions

DTI shall conform ASME B18.2.6 or ASME B18.2.6M. The number of protrusions may be altered if performance requirements are met. The minimum outside diameter of the DTIs may match the minimum outside diameter of a corresponding ASTM F436/F436M washer.