



# BRODER METALS GROUP BMG-AT41®

Steel for power plant high temperature bolt applications

BMG-AT41® bar is ideal for high room and elevated temperature fasteners, has good creep, notch and relaxation resistance up to 570°C, and is comparable to low alloy steel turbine casting materials in terms of its thermal expansion coefficients.

These properties make the material ideal for use for turbine and process plant fasteners and for boiler support rods and is increasingly being considered for all power generation plant. Traditionally it has been used in coal fired power stations, although we have also seen demand from biomass projects and nuclear applications around the world.

## Production

The material is produced via the ingot cast route (ingot cast material tends to produce a finer grain structure than continuous cast (concast) material and was specified in initial proving trials).

The material is heat treated in accordance with BSEN 10269:1999; 20CrMoVTiB4-10 with appropriate sub-critical annealing, hardening and tempering cycles according to the diameter of the material. Every bar is subject to spectroscopy analysis, and every bar is Circograph and Ultrasonically tested to DIN EN 10308 03/12 CLASS 4.

Independent microstructural examination from one longitudinal section across the full cross-sectional width of the bar product is carried out and reported as standard for each cast of material (see testing section later).

Grain size testing to ASTM E112 with acceptance limits of size 5 or finer is also reported as standard for each cast.

The following additional information is supplied as standard on all Mill and Broder Metals Group's own EN 10204 3.1 certificates (either/both supplied at the request of the customer):

- Values of Sb (Antimony) and R – normally the Sb value is not reported unless specifically requested, but without which the value of R cannot be independently checked.
- The results of the independent microstructural examination on each cast.

It is Broder Metals Group's intention to maintain a full range of sizes and offer our trademark service level of same/next day despatch as with as every other material in our product range.

The material meets or exceeds the following industry standard specifications:

- ∅ CEBG Standard 02596 - GDCD Standard 2 Issue 2 04/81 (T41)
- ∅ BS 1506 1990 681-820
- ∅ BS 1506 681-820
- ∅ BS 4882 Section 1 1990 B16A
- ∅ Siemens AG TLV 9185 01 08/02
- ∅ BSEN 10269 1999 Material Number 1.7729
- ∅ **Also equivalent to Durehete 1055™**

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The material is suitable for use in fastener specifications requiring steels and nickel alloys for fasteners with specified elevated and/or low temperature properties.

BMG-AT41® has been used directly, or approved for use by:

- Drax Power
- Siemens UK and Germany
- Doosan Babcock / Doosan Heavy Industry
- EDF (for use in Coal and Nuclear applications)
- GE (USA and UK)
- Weir Group (Allen Steam Turbines)
- Alstom (South Africa).

## Testing & Reporting Regime

100% of bars are hardness tested, and the hardest & softest bars are selected for full mechanical testing and must meet the testing property requirements (see below) in the longitudinal direction.

100% of bars are spectroscopy analysed and results compared against the relevant standard.

100% of bars are Circograph tested and Ultrasonically tested to DIN EN 10308.03/02 Class 4.

All material is delivered fully identified and batch traceable, along with mill or Broder Metals Group EN 10204 3.1 certification at customer's request. All certification shows manufacturing process number, chemical analysis, mechanical properties results from tests from the hardest and softest bars, both Charpy & IZOD impact test results, non-destructive testing results, heat treatment times and temperature, mill and independently tested grain size and microstructural examination details.

Additional testing can be carried out to satisfy critical requirements at independent test houses as required.

## Heat Treatment

	Sub Critical Anneal	Harden	Temper
-	600-700° C	970-990° C	680-720°C
All sizes	Air Cool	-	Air Cool
<35mm dia	-	Oil	-
35-50mm dia	-	Oil or Water	-
>50mm dia	-	Water	-

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Complies with requirements of BSEN 10269:1999: 20CrMoVTiB4-10

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## Chemistry Analysis (% by mass)

Element	Min	Max
Fe	Bal	-
C	0.17	0.23
Si	-	0.40
Mn	0.35	0.75
P	-	0.02
S	-	0.02
Al	0.015	0.08
B	0.001	0.01
Cr	0.90	1.20
Mo	0.90	1.10
Ni	-	0.20
V	0.60	0.80
Ti	0.07	0.15
As	-	0.02
Sn	-	0.02
Cu	-	0.20
Sb	-	Reported
R*	-	0.10

\*R=P+2.43As+3.57Sn+8.16Sb+0.13Cu

## Mechanical Properties (Room Temperature)

Dia	0.2% PS	UTS	Elongation	Red of Area	Energy Impact	
	n/mm <sup>2</sup>	n/mm <sup>2</sup>	% on 5d	%	Charpy	IZOD
			min	min	J ave	J min
<= 100 mm	660	820-970	15	50	40	27
>100 mm	660	820-970	15	50	27	27

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Other properties in accordance with BS EN 10269:1999.

UTS allowable maximum is 1000 n/mm<sup>2</sup>

Charpy impact is average of 3 specimens

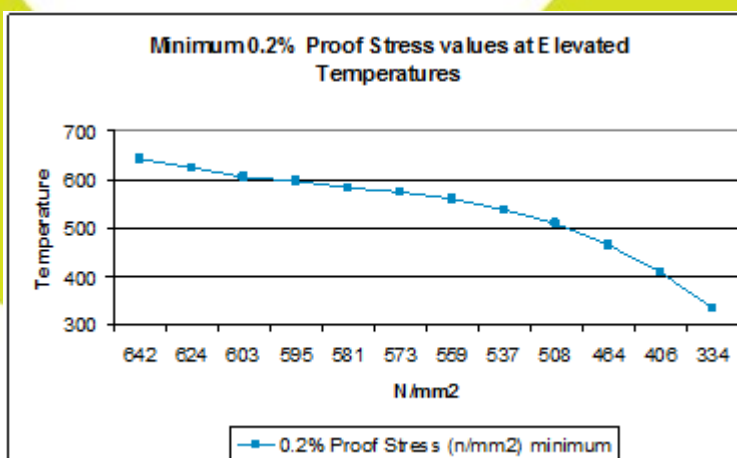
IZOD impact is minimum value required

Test piece position - generally in accordance with BSEN 10269:1999

Unless otherwise stated, all data is in accordance with BS EN 10269:1999: 20CrMoVTiB4-10, Material number 1.7729

## Mechanical Properties (Elevated Temperature)

Diameter <= 160mm	
Temperature Degrees C	0.2% Proof Stress (n/mm <sup>2</sup> ) minimum
50	642
100	624
150	603
200	595
250	581
300	573
350	559
400	537
450	508
500	464
600	406



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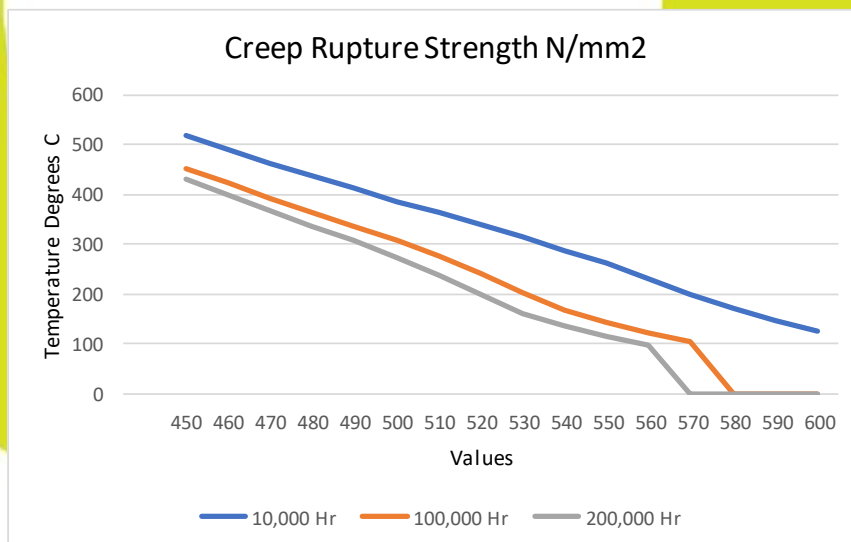
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## Creep Rupture Strength

Temperature (Degrees C)	Creep Rupture Strength n/mm2		
	10,000 Hr	100,000 Hr	200,000 Hr
450	520	453	430
460	491	423	399
470	463	394	369
480	437	365	338
490	412	337	307
500	384	307	274
510	364	276	237
520	340	241	198
530	315	204	162
540	288	169	135
550	261	142	114
560	231	121	96
570	200	103	-
580	170	-	-
590	146	-	-
600	127	-	-



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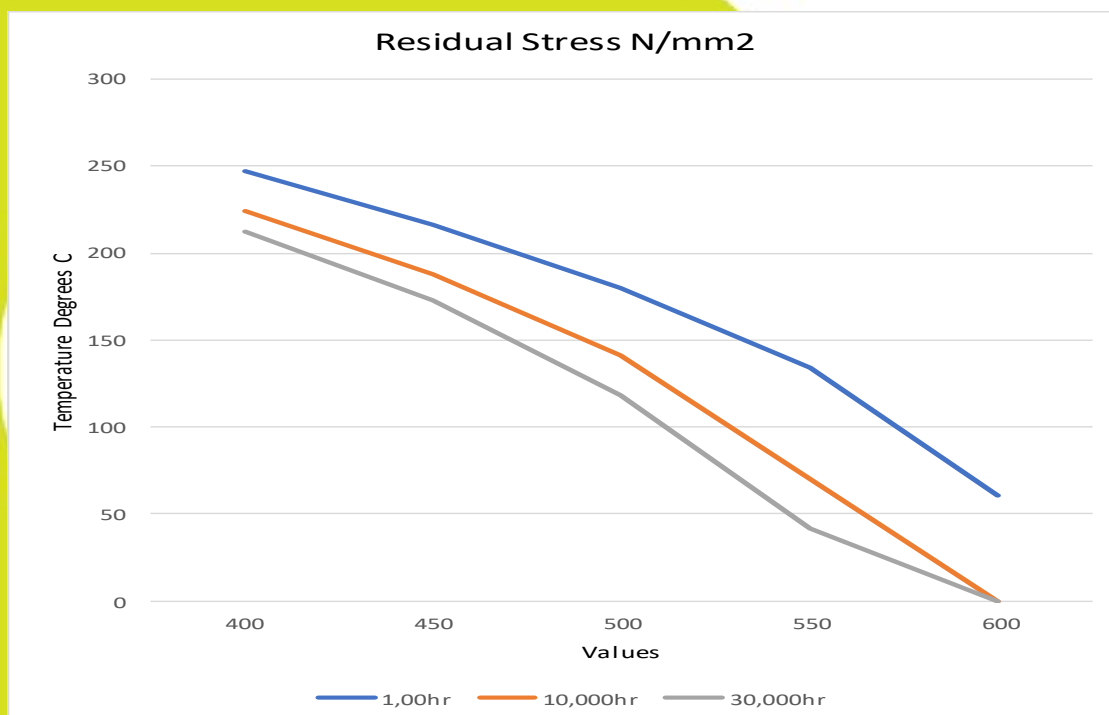
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## Mean Stress Relaxation Properties

Temperature	Residual Stress n/mm2		
	1.00hr	10.000hr	30.000hr
400	247	224	212
450	216	188	173
500	180	141	118
550	134	70	42
600	61	-	-



Additional testing can be carried out to satisfy critical requirements as required at independent test houses.

This alloy is just one of a range of bolting materials stocked by Broder Metals Group Ltd – please see our website for the full range stocked: [www.broder-metals-group.com](http://www.broder-metals-group.com)

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