


# Specifications for the manufacture and examinations

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	<b>Process spec. - Fabricated Gear Parts</b> Spec. for the manufacture and examinations		<b>700.75520</b>	Revision <b>G</b>
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This specification replaces:

716. 004.01,
700. 75518, 700. 75519
700. 75500, 700. 75530
700. 75535, 700. 75550
700. 75620

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# Specifications for the manufacture and examinations

## 1. Scope of Validity

Fabricated constructions for gear parts and gear casings.

## 2. Applicable Documents

ASME IX, EN 287-1 Qualifications, EN 288-3 Welding procedure approval  
SEW 088, DIN 17103, 17243, DIN-EN 10207, 10222-1, 10219-1, EN 10025-1 to 6,  
10028-1 to 6, 10113-1/-2, 10137-1/-2 Materials

ASME II Part C, EN 440, 499, 756, 757, 758, 759, 1668 Filler Metals  
DIN 8524/3, EN ISO 6520-1, EN 25817 Weld Discontinuities

EN ISO 13920 General tolerances for fabricated constructions

EN 10204 Certifications

## 3. Monitoring

When the monitoring acc. 3.2 or 3.3 is not specified in the purchase order, par. 3.1 shall be valid.

### 3.1

The monitoring and examinations of the welds shall be performed by the supplier's quality organization.

### 3.2

The monitoring and examinations of the welds shall be performed in the presence of MAAG or Maag-representative.


### 3.3

The monitoring and examinations of the welds shall be performed by a classification organization.

## 4. Material

For butt joints with weld quality Q0 and Q1, the edge zone of the plates to be welded must be ultrasonically inspected, respecting an inner quality level equal to that of the weld quality.

In case the supplier must perform construction welds which are not intended by MAAG design, a written permission must be requested.

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## 4.1

The purchase order will mention whether the material grade indicated in the drawing is compulsory.

If no regulation is made, the selection can be made by the manufacturer, in consideration of Annex 1 of this specification.

## 4.2

The selection of filler metals shall follow the state of the art, according to the material to be welded and the welding process used.

Recommendations are given in the following Standards: EN 440, 499, 756, 757, 758, 759, 1668 and ASME II, Part C.

## 5. Quality of Welds


Table 1 of this specification contains the relevant data, examinations and acceptance criteria.

The quality levels (Q0 to Q4), joint designs and the executions of the welds are indicated in the drawings.

## 6. Manufacture

### 6.1 General Instructions to be observed

- A welding appropriate manufacturing process with minimising distortions shall be selected.
- Whenever possible, do weld in flat position.
- Weld areas shall be carefully prepared, de-rust.
- The plates for butt weld shall be aligned.
- The parts to be jointed by fillet welds shall be carefully matched.
- Welding must only be performed at ambient temperatures exceeding +5°C.
- Dry, covered electrodes at elevated temperature and store them dry and unmistakable until use, (see for example SEW 088).
- The specified preheating and interpass temperatures shall be observed.
- Maag shall be informed prior to welding of any modification for improvement of the welding construction and/or fabrication procedures.

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## 6.1.1 Machining Allowances

In consideration of the tolerances for fabricated constructions, see par. 6.2, the surfaces to be machined shall have machining allowances of at least 3 mm per side. This allowance must be considered for weld seams to be machined especially on the partition face of the casing, in order to guarantee the required weld thickness after machining.

## 6.2 Tolerances for fabricated constructions

For admissible deviations of nominal dimensions of as welded constructions, which are not tolerated in the drawings, the following standards are applicable:

- Tolerances for dimensions for lengths and angles, tolerances for form and position:  
EN ISO 13920.

The quality level to be used is indicated in the welding drawings.

## 6.3


For complex welding constructions, in consideration of the supplier's experiences, we recommend for quality assurance, the preparation of a welding procedure specification.

## 6.4

For completely closed chambers (double-wallded fabrications) the inspection of the inside weld seams and the chamber interior cleanliness shall be recorded in so far MAAG or a Maag representative does not carry out the inspection prior to the closure.

## 6.5 Piping

- Welded-in oil piping shall, if possible, be manufactured in one piece.
- Seamless tubes are recommended for tubes to be bent. When longitudinally welded tubes are used, the weld seam must be placed in the neutral bend line, so that the weld seam is not injured during deformation. Spiral welded tubes are prohibited to bend.
- After stress relieving the interiors of the tubes shall be cleaned and free of scale, weld spatter and dirt.
- If the interior cleaning cannot be satisfactorily carried out, stainless steel pipes can be welded with the consent of MAAG.

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## 7. Stress Relief Heat Treatment

### 7.1 General

- Execution preferably in an electric heated furnace with air circulation and proved temperature uniformity.
- The component shall be carefully and equally supported to preclude permanent distortion due to its own weight.
- Into completely closed chambers a 5 mm bore shall be drilled for pressure compensation.
- These bores shall be closed by welding after stress relieving.
  
- If subsequent repair welding causes considerable residual stresses, the stress relief heat treatment must be repeated.  
After repair welding of more than 25% of the weld seam thickness on fully penetrated welds, the stress relief heat treatment must be repeated. For any weld repair a local pre-heating is to be performed.

### 7.2 Execution


Start	: Furnace temperature max. 300°C
Heating rate	: max. 100°C/h
Soaking temp.	: 580 - 620°C (provided the steels used do not require other temperatures to avoid any reduction in tensile strength.
Soaking time <sup>°)</sup>	: min. 1 h, max. 9 h, (note that for thermo-mechanically treated steel grades the max. soaking time is to be 150 minutes, (see e.g. SEW 055)
Cooling rate	: max. 45°C/h to 300°C, below: in still air possible

<sup>°)</sup>: Time-temperature-sequence for constant temperature<sup>\*</sup>), (Definition see e.g. EN 17022)

<sup>\*</sup>) Temperature: temperature of the largest, massive material section

## 8. Leak Testing

Is to be performed according to special spec., mentioned in the purchase order. If no regulation is made, the oil piping shall be pressurised with water to at least 5 bars of at least 2h.

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## 9. Surface Treatment

- Slag, weld spatter and arc strikes shall be removed. After stress relief the entire surface shall be cleaned by abrasive blasting.
- Coatings and corrosion protection measurements shall be performed in accordance with specifications mentioned in the purchase order.

## 10. Piece Identification and Stamping

Each fabricated component is to be hard-stamped on a surface which, after welding will not be machined, with the following information: (min. 10 mm high):

- Maag purchase order number
- Drawing number
- Manufacturer's works order number

The positions mentioned in the components-list of the purchase order, for which material test certificates have to be supplied (see Par. 11.2), shall be stamped with an identification number or with the corresponding melt number.

## 11. Certification

Each document shall contain the following general data:

- Record number
- MAAG purchase order number
- Drawing numbers
- Manufacturer's works order

### 11.1 Manufacturer's Test Certificate

In any case a manufacturer's test certificate according to Annex 2 of this specification shall be supplied.


### 11.2 Material Certificate (Par. 4)

- For the positions indicated in the draw. or mentioned in the components-list of the purchase order, material test certificates according to EN 10204-3.1B, containing the melt analysis and the mechanical test results from at least the tensile test shall be supplied.

### 11.3 Dimensional Records

#### 11.3.1

For only fabricated components: records of main dimensions and connecting-up dimensions.

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### 11.3.2

For fabricated and completely finished machined components: dimensions with tolerances equal or smaller than 0,1 mm, in so far MAAG does not carry out itself an inspection.

### 11.4 Welding and Examination Records. (Par. 5)

- Q0-weld seams: welder qualif./WPS/ PQR/ VE/ MT/ PT<sup>\*)</sup>/ UT/RT<sup>\*)</sup>
- Q1-weld seams: welder qualif./WPS/ PQR/ VE/ MT/ PT<sup>\*)</sup>/ UT/RT<sup>\*)</sup>
- Q2-weld seams: welder qualif./WPS/ PQR/ VE/ MT/ PT<sup>\*)</sup>/ UT/RT<sup>\*)</sup>
- Q3-weld seams: welder qualif./WPS/ PQR/ VE/ MT/ PT<sup>\*)</sup>
- Q4-weld seams: confirmation of qualif. practical experience /VE

<sup>\*)</sup> if applicable

### 11.5

Confirmation of examination of chamber interiors (Par. 6.4)

### 11.6 Records of Stress Relief Heat Treatment (Par. 7)

When the certification acc. 11.6.2 is not specified in the purchase order, par. 11.6.1 shall be valid.

#### 11.6.1

Record containing: heating rate/ soaking temperature/ soaking time/ cooling rate/ temperature at removal from furnace.

#### 11.6.2


The recorded furnace time-temperature diagram of the performed heat treatment.

### 11.7

Leak test certificate (Par. 8), (if performed)

Explication of abbreviations used:


- MT : Magnetic Particle Examination
- PQR : Procedure Qualification Report
- PT : Liquid Penetrant Examination
- RT : Radiographic Examination
- VE : Visual Examination
- UT : Ultrasonic Examination
- WPAR : Welding Procedure Approval Record
- WPS : Welding Procedure Specification

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## 12. Delivery Condition

Unless otherwise specified in the order, the components must be checked for irregularities such as sharp edges, weld spatters and so on. If any irregularities have been found on components, they must be removed according to the description shown in Annex 3 before delivery.

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## Specifications for the manufacture and examinations

Quality Level	Q0	Q1	Q2	Q3	Q4
<b>I Qualification of the Welder</b>					
Requirements	Training and qualification accord. to an acknowledge institution e.g. EN, ASME or equivalent.				Qualified practical experiences
<b>II Edge Preparation and Execution of the Weld</b>					
Welding on both sides	necessary	necessary	recommended, constructionally aspire to, determined by design		no
grinding the root area (root run) and crack check necessary	necessary	necessary	necessary however without crack detection	no	no
If accessible from one side only: special measure for welding the root	not allowed, welding on both sides	not allowed, welding on both sides determined by draw.	necessary as per drawing	no	no
Weld surface	welding with sufficient allowance, machined acc. to draw. roughness < N9	welding with sufficient allowance, machined acc. to draw. roughness < N9	completely clean ground, no notches nor edges and overlaps	clean deburred, sharp edges and undercuts ground off	cleaned, otherwise as welded
<b>III Examinations and Inspections</b>					
Procedure Qualification Report	necessary	necessary	necessary	necessary	no
Welding Procedure Specification	necessary	necessary	necessary	recommended	no
Visual Exam.	100%	100%	100%	100%	100%
Magnet. Particle Examination 1)	100%	100%	100%	100%	no
Liquid Penetrant Examination	100%	100%	100%	no	no
Ultrasonic Examination 2)	100%	100%	100%	no	no
Radiographic Examination	acc. to special agreement			no	no

1) inapplicable for not ferromagnetic. Materials

2) With UT Porosity is very difficult to recognise and to evaluate.

Table 1

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Quality Level	Q0	Q1	Q2	Q3	Q4
<b>IV Defect Criteria</b>					
Surface defects (PT/MT/VE)	Linear indications: Length larger than 3 x width rounded indications: length smaller than 3 x width				
internal defects (Ultrasonic)	Defect indications by ERS, evaluation acc. to DGS-diagram (ERS = Equivalent-Reflector-Size), DGS = Distance-Gain -(equiv. reflector) Size				
<b>V Acceptability of Defects</b>					
<b>MT/PT/VE: unacceptable are:</b>					
Q0	Q1	Q2	Q3 <sup>1)</sup>	Q4	
any indications	cracks and linear indications; rounded single indications $\geq$ 2 mm, 4 or more rounded indications in a chain, 10 or more rounded indications on a weld seam length of 250 mm	cracks and linear indications; rounded single indications $\geq$ 3 mm, 6 or more rounded indications in a chain, 10 or more rounded indications on a weld seam length of 200 mm	cracks and linear indications; rounded single indications $\geq$ 5 mm, 8 or more rounded indications in a chain, 10 or more rounded indications on a weld seam length of 150 mm	visually noticeable longitudinal and transverse cracks and lack of fusion	
	other weld discontinuities acc. to EN 25817, table 1, group B	other weld discontinuities acc. to EN 25817, table 1, group C	other weld discontinuities acc. to EN 25817, table 1, group D		
<b>UT</b>					
Q0		Q1	Q2		
Recording <Limit:> 0,7 mm ERS		Recording <Limit:> 1,5 mm ERS	Recording <Limit:> 3 mm ERS		
unacceptable are:					
Single indications > 1,5 mm ERS, independent of registration length, accumulation of smaller indications and registration; accumulated defect length: $> s$ of a weld length of 5 x s.		Single indications > 3 mm ERS, however max. 20% of s; single ind. with elongation > 2, single length > 30 mm; accumulated defect length: $> s$ of a weld length of 10 x s. transverse defects: with elongation not allowed.	Single indications > 6 mm ERS, however max. 30% of s, single ind. with elongation > 3,5, single length > 40 mm; accumulated defect length: $> s$ of a weld length of 15 x s. transverse defects: with elongation: accumulated defect length > 50% of s.		
Radiographic Examination: acc. to special agreement					

s= Weld seam thickness, res. plate thickness

Table 1 (continuation)

<sup>1)</sup> These criteria are also valid for machined weld seams on the partition face of the casing.

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## Annex 1

Selection of Plates and Tubes for ordinary Gear Components, Gear Casings and Planet Carriers

For not classified, fabricated gear components and if the following mechanical properties of the steel plates are sufficient:

$R_m = 340-550 \text{ N/mm}^2$  and  $R_{p0,2} = \text{min } 215 \text{ N/mm}^2$  (up to 140 mm thickness)

the undermentioned steel qualities can alternatively be used if one of them is mentioned in the drawing.:

EN 10025: S 235JR/RG2/J0, S275 JR/J0, E275, S355... , (former Standard DIN 17100: St 37-2, RSt 37-2, St 37-3, St 44-2, St 44-3, St 50-2 St 52-3)

EN 10113/ EN10028 (former Standard DIN 17102: StE 255 to StE 355)

EN 10219, (former Standard DIN 17120: St 37-4)

EN 10028/1/2, (former Standard DIN 17155: HI and HII)

For to be welded components however the content of the elements listed below are restricted as follows:

C max. 0,23%, P max. 0,040%, S max. 0,040%

EN 10025: Hot-Rolled Products of non-alloy Structural Steels

EN 10028: Flat products from steel for pressure purposes

EN 10113: Hot rolled products made from weldable, fine grain structural steel

DIN 17178: Welded circular fine grain steel tubes subject to special requirements

DIN 17179: Seamless circular fine grain steel tubes subject to special requirements

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## Annex 3

<b>SHARP EDGE</b>	Edges should be treated to a rounded radius of minimum 2mm, or subjected to three pass grinding or equivalent.	
<b>WELD SPATTER</b>	<p>1. Remove spatter observed before blasting by grinder, chipping hammer etc.</p> <p>2. For spatter observed after blasting:</p> <p>a) Remove with chipping hammer / scraper etc.</p> <p>b) Where spatter is sharp, use disc sander or grinder until obtuse</p> <p>c) Obtuse spatter – no treatment required</p>	
<b>PLATE LAMINATION</b>	Any lamination to be removed by grinder or disc sander	
<b>UNDERCUT</b>	Where undercut is to a depth exceeding 1mm and a width smaller than the depth, repair by welding or grinding may be necessary	
<b>MANUAL WELD</b>	For welding bead with surface irregularity or with excessive sharp edges, remove by disc sander or grinder	
<b>GAS CUT SURFACE</b>	For surfaces of excessive irregularity, remove by disc sander or grinder	