SECTION 4

SPECIFICATION & INSPECTION OF RAW MATERIALS

Part 4.1 Common requirements

- The inspection of raw materials before being implemented as well as the required inspection documents depend on :
  - Used steel grades
  - Working stresses
  - Risks taken in case of failure
- The hereafter stated tables identify inspections and documents requested by the GRADES I,II,III for steel plates, forged and cast steel parts, and other alloys.
- The inspection requirements are defined in the specifications following these tables.
- The correspondences of admissible grades between En/ BIS/ ASTM/AISI/DIN standards are a listed.
- The requested GRADE for each component of one equipment shall be specified case by case.
- For lack of precise indications, the specifications of GRADE III are applicable
- The operation modalities for the various inspection types are defined within the section 15.
- All inspection and test results shall be recorded. Records include cartography of defects out of tolerances.
- No repair to defects is authorized without mutual agreement.

PART 4.2 STEEL PLATES

4.2.1 Required inspections, tests and documents

GRADE	CHEMICAL ANALYSIS					
		UTS	YP	E%	Z%	
I	X	X	X	X	X	ULTRASONIC
II	X	X	X	X	X	
III	X	X	X	X	X	

4.2.2 Ultrasonic inspection:

- Longitudinal waves 4 MHz
- Calibration through characteristic curves of reference echo on flat bottom hole Ø 8mm.
- Inspection of each plate periphery over a minimum width of 50mm or (1.5 x thickness).
- Inspection of the whole surface of each plate through a grid 100 x 100mm, minimum width of 50mm or (1.5 x thickness).
- Admissible isolated defects :
  - at the periphery, the surface of echoes over the characteristic curve shall be ≤ 100mm^2 and / or their length ≤ 20 mm.
- Group of defects :
  - at the periphery : no more than 2 acceptable isolated defects per 1000mm length
  - in full plate : no more than 2 acceptable isolated defects per (100 x 100) mm square or 10 per (1000 x 1000) mm square.

PART 4.3 STEEL FORGED PARTS

4.3.1 Required inspections, tests and documents

GRADE	Chemical Analysis	Grain Size	Forging Ratio (1)	Non Destructive Testing (10)						
					UTS	YP	E%	Magnetic Particles	Ultra Sonic	
I	X	X	X	S(4)	X	X	X	(7)	(8)	3.1B
II	X		X	S(4)	X	X	X	(7)		3.1B
III	X		X	N(5)				(9)		2.2

4.3.2 Visual and dimensional inspection :

The forged parts are inspected after machining except special requirement. They must not show any defect visible to the naked eye such as cracks.

The machining must be continuous without remaining rough areas.

4.3.3 Mangetic particles inspection / dye penetration test :

The magnetic particles inspection is carried out according to two perpendicular directions. The developer may be coloured or fluorescent.

The dye penetration test is performed by penetration of a coloured product during 10 minutes. The developer is spread after the surface has been perfectly cleaned. The results must be read within 5 and 10 minutes after drying of the developer.

The inspection covers 100% of the surfaces unless otherwise specified.

The sizes of admissible defect are as follows.

DEFECTS	**GRADE I**	**GRADE II**
Isolated	≤ 4mm	≤ 6mm
Group	≤2 4mm	≤36mm
Quantity of defects 2mm into a 105 x 148 mm area	≤7mm	≤ 10

4.3.4 Ultrasonic inspections:
Longitudinal waves 4 MHz, calibration with AVG curves.
Extent : Cylindrical bars : 3 generatrix at 60°
Other pieces : girding with 100mm meshing.
Isolated admissible defects : equivalent Ø ≤ 8mm.
Admissible grouped defects (distance less than 2.5 X dimension of the biggest defect) : equivalent Ø ≤ 5mm.

Part 4.4 Steel Cast Sections

4.4.1 Inspections, tests and requested documents

GRADE	Chem. Analysis	Roughness	Non Destructive Testing (9)				
				UTS	YP	UT	
I	X	(7)	S(1)	X	X	(6)	3.1 B
II	X	(7)	S(1)	X	X		3.1 B
III	X	(7)	N(2)	X	X		2.2

4.4.2 Roughness And dimensions :

The parts will be trimmed and shot blasted SA 2 1/2 . The machined parts shall comply with the indications on the drawings. The remaining rough parts subject to non-destructive test shall be as good as the following picture 1 (after grinding) or 2 (as cast), whereas the parts without non-destructive inspection shall be as good as the following picture 3 (after grinding) or 4 (as cast) .

The tolerances on dimensions and over thickness are given in section 17.

DEFECTS		**GRADE I**	**GRADE II**
rounded	Max individual dimension	≤ 6mm	≤ 10mm
rounded ≤ 2mm	Cumulated on 105x 148 area	≤ 60mm^2	≤ 100mm^2
linear	Max individual length	≤ 6mm	≤ 10mm
linear ≤ 2mm	Cumulated on 105 x 148 area	≤ 12mm	≤ 20mm

4.4.4 Ultrasonic Inspection:
-Longitudinal waves 2 MHz

-Calibration through AVG curves
- Inspection at 100% of the surfaces unless otherwise specified.
- Admissible defects :
. No defect of equivalent Ø8mm with a length >50 mm and surface area > 1000mm ^{2}
. No defect of equivalent Ø >8mm
. No attenuation of the back echo higher than 75%.

Part 4.5 Other material

4.5.1 Cast Iron :

Unless otherwise specified, cast iron is subjected to the following requirements.

- grade : certificate as per DIN 50049, model 2.2
- hardness measurement on parts
- non destructive tests : the extend and criteria are those defined for the steel cast parts.

4.5.2 non ferrous alloys :

Unless otherwise specified, they are subjected to the following requirements.

- grade : certificate as per DIN50049, model 2.2
- Non-destructive tests : visual possibly confirmed by dye penetration test. Whether the parts are forged or cast, the criteria are those defined for the steel parts.

SECTION 5

WELDMENTS

Part 5.1 General requirements

- The quality of weldments is divided into three GRADES. The grade must be specified case by case. Unless otherwise specified, the grade III is applicable.
- For each grade, the impositions are modulated in relation with the steel group.
- The steels are ranked in 3 groups:
- **Group A** : Unalloyed or low alloy steel with an “equivalent carbon “ EC ≤ 0.40.
- **Group B** : Unalloyed or low alloy steel with an “equivalent carbon “ EC ≤ 0.40.
- **Group C** : Stainless Steels
- The Equivalent Carbon EC is calculated as follow :
  C% + (Mn/6) +[{Cr+Mo+V}/5 + [{Ni+Cu]/15]
  The requirements in relation with steel groups and grades are summarized in a table below.
  The criteria for defect acceptance are set in paragraph 5.8 to 5.13.

REQUIREMENTS	STEEL GROUP	GRADES		SEE PART N
		I	II AND III	
Material certificate	A B C	3.1B 3.1B 3.1B	2.2 3.1B 3.1B	SEE Section 4
Filler metal certificate	A B C	3.1B 3.1B 3.1B	2.2 3.1B 3.1B	
Welding procedure specification (W P S)	A B C	WPS 1 WPS 1 WPS 1	WPS2 WPS 1 WPS 2	5.2
Welding procedure Qualification (W P Q)	A B C	WPQ 2 WPQ 1 WPQ 1	No WPQ 2 WPQ 2	5.3
Welders and operators Qualification (W Q)	A B C	WQ 1 WQ 1 WQ 1	WQ 2 WQ 1 WQ 1	5.4
Heat treatment certificate or record	A B C	C2 C1 C1	C2 C 2 C 2	5.7
Visual inspection	A B C	100% 100% 100%	100% 100% 100%	5.8
D P T	A B C	100%		5.9
U T or X Ray	A	20%	No	

	B C	100% 20%	20% No	5.10 and 5.11

Part 5.2 Welding Procedure Specification

The following table indicates the data to be defined Section 16 given suggested forms for WPS, for each procedure type (WPS 1 complete ; WPS 2 simplified)

DATA TO BE DEFINED IN WPS	WPS 1	WPS 2
FOR THE COMPLETE STRUCTURE:		
sketch showing identification marks of welds	Yes	No
heat treatment procedure	Yes	No
FOR EACH WELD		
grade and thickness of base metal	Yes	Yes
sketch of the welded joint	Yes	Yes
identification of beads	Yes	No
beveling means	Yes	No
surface condition (as weld, ground)	Yes	No
pre and post heating	Yes	Yes
back gouging	Yes	Yes
welding process	Yes	Yes
filler metal, designation, size	Yes	Yes
flux or gas	Yes	Yes
welding position	Yes	Yes
welding parameters (Amp, Volt, speed)	Yes	No
reference of welders qualification	Yes	Yes
reference of welding procedure qualification	Yes	Yes
non destructive tests	Yes	Yes

Part 5.3 Welding Procedure Qualification

WPQ 1 : Valid qualification in accordance with AWS or ASME section IX. A specific qualification is required if no other valid procedure can be proposed.

WPQ 2: A weld test representing the welds to be carried out shall be performed according to the WPS instructions. Inspections and tests performed on the welded sample only apply to visual and ultrasonic inspection.

Part 5.4 Welders qualification

WQ1 : Valid qualification in accordance with AWS or ASME section IX.

WQ2 : Qualification according to the same codes as WQ1. However the validity date may have expired in less than one year. As an alternative, the welders having been working on identical welds, for less than one year will be accepted.

Part 5.5 Tack welding and filler metal drying

-Tack welding must be done in accordance with the welding procedure specifications, mainly concerning pre heating, welding energy…

-Coated electrodes and flux, must be dried before using in order to avoid hydrogen in the weld.

Part 5.8 Visual inspection

It always related to 100% of the welds.

If there is a doubt on the welding quality or on the respect of the WPS either a dye penetration test, an ultrasonic inspection or a X ray test may be required.

Part 5.9 Dye penetrant test

The acceptance criteria are those of the following table.

DEFECTS		GRADE I	GRADE II	GRADE III
Cracks		Not admissible	Not admissible	Not admissible
Isolated pores (separate 3 th or 150 mm)		≤ 1mm	≤ 2mm	≤ 2mm
Group/lines of pores (cumulated Ø on 3 th or 150mm)		≤ 4mm	≤ 6mm	≤10mm
Lack of fusion		Not admissible	Not admissible	Not admissible
Lack of penetration (where full penetration required)		Not admissible	Not admissible	Not admissible
Undercuts	depth Individual length Cumul on 300mm	≤ 0.5mm ≤ 20mm ≤ 40mm	≤ 0.8mm ≤ 40mm ≤ 80mm	≤ 0.8mm Continuous Admissible
Reinforcement		≤ th/ 10 ≤ 3mm	≤ 1.5 th/10≤ 5mm	≤ 2th/10≤ 7mm
Misalignment	Welded 2 sides Welded 1 side	≤ th/ 10 ≤ 4mm ≤ th/20 ≤ 3mm	≤ 1.5 th/10≤ 6mm ≤ 1.5 th/20≤ 4mm	≤ 2th/10≤ 10mm ≤ 2th/20≤ 5mm
Incomplete welding		Not admissible	Not admissible	Not admissible
Root reinforcement		≤ 3mm	≤ 5mm	≤ 5mm
Fillet welds	reinforcement Asymmetry size	≤ 3mm 0.7 ≤ V/ H≤ 1 ≥ theoretical specified size	≤ 5mm 0.5 ≤ V/H≤ 1 ≥ theoretical specified size	≤ 5mm 0.5 ≤ V/H≤ 1 ≥ theoretical specified size

The welds dimensions must be in accordance with the drawings. All welds are continuous except if the drawings specify clearly discontinuous welds. When the surface of welds is included into the over thickness provided for machining, the depth of welds specified on the drawings are the finish depth required after machining. The depth of the bevel before machining must take into account the finish depth, the over thickness and the possible deformations of the welded structure.

Part 5.10 Ultrasonic inspection

Basically reserved for assemblies of level I. See part 5.8 for additional application field.

No “flat defects” like cracks or lack of fusion will be accepted. The tolerances on the rounded defects are specified beside.

Part 5.11 X –Ray Test

Can be used as an alternative to the ultrasonic inspection, the admissible defects are specified on the following page.

DEFECTS	CRITERIA	DEFECTS	CRITERIA
Cracks	Not admissible	Isolated inclusions	Length ≤ 20mm or th/2
Isolated pores	Ø≤th / 3≤ 5mm	Group of inclusion	Cumul of Ø on 500mm ≤2th ≤ 30mm
Group of pores	Cumul of Ø on 500mm ≤2th ≤ 30mm	Lack of fusion	Not admissible

Part 5.12 Oxygen Gas cutting

Whatever the retained level may be and unless otherwise stipulated in the drawings, the quality of the oxygen cut edges shall be at least as good as those hereafter defined.

The cuts showing defects out of tolerances shall be ground. If welding repairs are required, they must be performed in accordance with the welding procedure in force.

S- Non linearity along length. D- Non-linearity through thickness. P- Depth of undercut. L=Width of undercut

PLATE THICKNESS in mm					
DEFECTS	5→20	21→40	41→60	61→80	81→100
S	0.5	0.75	1	1.25	1.5
D	1	1.5	2	2.5	3
P(*)	1.5	2	2.5	2.5	3
L(*)	5	7.5	10	12.5	15

(*) → No more than 1 defect per meter.

Part 5.13 Geometrical tolerances' of welds

Unless otherwise specified, admissible tolerances are those of the following table.

CHECKED DIMENSION in mm as per ISO 13920 class A									
	30 ↓ 120	121 ↓ 400	401 ↓ 1000	1001 ↓ 2000	2001 ↓ 4000	4001 ↓ 8000	8001 ↓ 12000	12001 ↓ 16000	16001 ↓ 20000
Dimension	± 1	± 1	±2	±3	±4	±5	±6	±7	±8
Angle		± 20'		±15'			±10'		
Geometry	± 0.5	± 1	±1.5	±2	±3	±4	±5	±6	±7

MACHINING

Part 6.1 Roughness

The roughness stated on drawings are Ra values, expressed in thousandth of a millimeter (microns). Unless otherwise indicated on the drawings, the roughness stated below are required:

- Supporting surfaces on civil work — Ra ≤ 12.5µ
- Bolted assembly surface un-tightened: — Ra ≤ 6.3µ
- Sliding surfaces — Ra ≤ 1.6µ
- Rolling surfaces — Ra ≤ 3.2µ
- Surface to be shrunk fit
  - Ø ≤ 180 — Ra ≤ 0.8µ
  - Ø ≤ 180 — Ra ≤ 1.6µ
  - Joining radius between machined surfaces — Ra ≤ 1.6µ
  - Bearing supporting surface — Ra ≤ 0.8µ

Part 6.2 Tolerances on linear dimensions

- The tolerances stated on the drawings are those of the ISO standard.

For information, a table giving the usual tolerances is stated in section 17.

- Unless otherwise specified on the drawings, the required tolerances are ISO 2768-1 class m.

The tolerance of the centre distance of holes for bolts, where there is a lack of specification on the drawings, is understated as follow : (With M=nominal Ø of the bolt & D = hole Ø)

- Tolerance for threaded holes : (D-M) / 4
- Tolerance for clearance holes : (D-M)/2

Part 6.3 Geometrical tolerances

- The tolerances stated in the drawings are those of the ISO standard
- Unless otherwise indicated on the drawings the tolerances, specified by the following table, according to ISO 2768-2 class H are required.

Dimensional tolerances as per ISO 2768-1 class m							
0.5 <d=3	3 <d=6	6 <d=30	30 <d=120	120 <d=400	400 <d=1000	1000 <d=2000	2000 <d=4000
±0.1	±0.1	±0.2	±0.3	±0.5	±0.8	±1.2	±2

Angles tolerances as per ISO 2768-1 class m				
=10	10<d=50	50<d=120	120<d=400	400<d
±1°	±0° 30’	±0° 20’	±0° 10’	±0°5’

Geometrical tolerances as per ISO 2768-2 class H Straightness and flatness					
=10	10<d=30	30<d=100	100<d=300	300<d=1000	1000<d=3000
0.02	0.06	0.1	0.2	0.3	0.4

Squareness				**Symmetry**	**Run out and concentricity**	**Circularity Cylindricity**	**Parallelism**
=100	100<d=300	300<d=1000	1000<d=3000	All dimensions	All dimensions	=tolerance on dia. And =run out	=dimensional or flatness tolerance
0.2	0.3	0.4	0.5	0.5	0.1		

Tolerances on threaded parts: Unless otherwise indicated on the drawings the tolerances are 6H, 6g.

SECTION 7

SHOP ASSEMBLY & TEST

Part 7.1 Main rules to carry out shop assembly

- As a rule, equipment are entirely assembled in the workshop, including the components supplied by others (cylinders, gear boxes…).

In some cases, a trial erection with other equipment may be required to check the erection conditions, the interfaces, etc. and to perform the function tests.

- Mechanical assemblies shall be carried out in compliance with the drawings, specifications and the practiced workmanlike manner of this speciality.
- All parts shall be checked prior to assembly. They need to be perfectly cleaned. All contact edges shall be trimmed.
- On the sliding surfaces and the bearing or bearing blocks, the greasing and lubrication holes need checking and cleaning.
- Bolted assemblies shall comply with the drawings regarding the class of screws, the torque load, any washer and nut retention, loctite securing. *See torque loads in section 17*
- Shrunk parts need to be perfectly cleaned before fitting. Shrinking is performed either by cooling the male part in a liquid nitrogen bath, or by heating the female part. Heating shall be as uniform as possible, which makes the use of an oil bath or a regulated furnace necessary. Gas burners are forbidden. The tempering temperature used for the case-hardening parts must be observed to carry out the hot shrinkage.(Preferred temperature < 180^{o} C).
- During assembly works, the parts in sliding contact are greased, the bearings as well as shafts and borings before bearing assembly are grease-stuffed. The recommended grease is one of the following :
  SHELL ALVANIA EP2, TOTAL MULTS EP2 or equivalent.

Part 7.2 Shop test procedure

- Every equipment will be subjected to a function test. The manufacturer shall make available the following installation to case the test performance.
- Air compressor P=6 bar
- Hydraulic power pack filter class 30/10 ISO 4406 or level 7 NAS 1638. Pressure set from 0 to 250 bar, tank capacity and flow-rate adapted to the actuators.
- Variable speed drives with a variable speed from 0 to 1500 rpm, with an appropriate power.
- Test procedure

Prior to any function test, it should be verified that :

-the electrical, hydraulic connections etc are correct.

-the sliding parts, the bearings, gear boxes etc are greased or lubricated.

- the operating backlashes are adjusted.

Tests shall be performed one function after the other, at low speed and pressure by one operator and one supervisor who will check the movements.

Only afterwards, can the tests be performed at rated speed and pressure, first function after function then in sequence when specified.

All test parameters (speed, looseness and operating pressure, power requirement…) as well as observations made during the tests shall be stated in the test report, noises, vibrations, overheating, interference, condition of hoses during the movements.

After test completion, the moving parts are checked for possible deterioration, especially tooth of gear boxes and cutting tools (knives of shears, notching presses, scrap choppers…)

Every deviation should be processed according to the procedure in section 12.

- Test severity grades

GRADE I	Timed test or load test
GRADE II	Separate test of each movement at its rated speed with motor and fluids
GRADE III	Separate test of each movement, manually or mechanically, such as hoists, pulleys…..

SECTION 10

INSPECTION OF SPECIAL COMPONENTS & SPECIAL PROCESSES

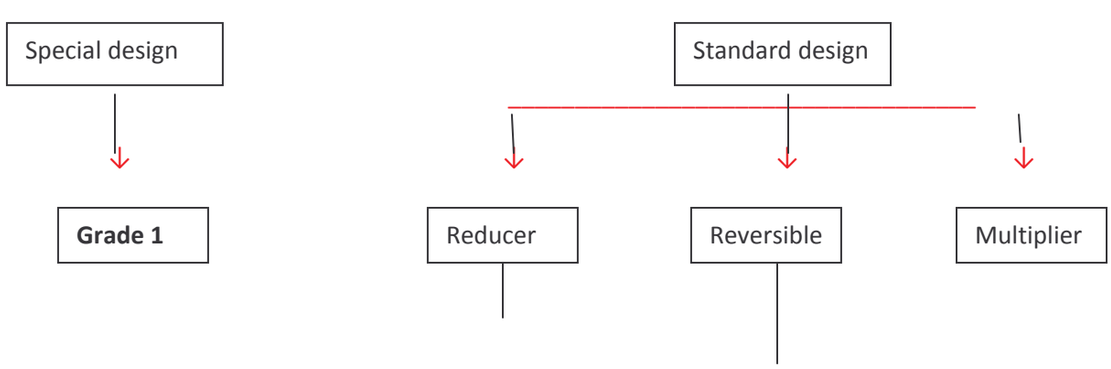
Part 10.1 Gears and gear reducers

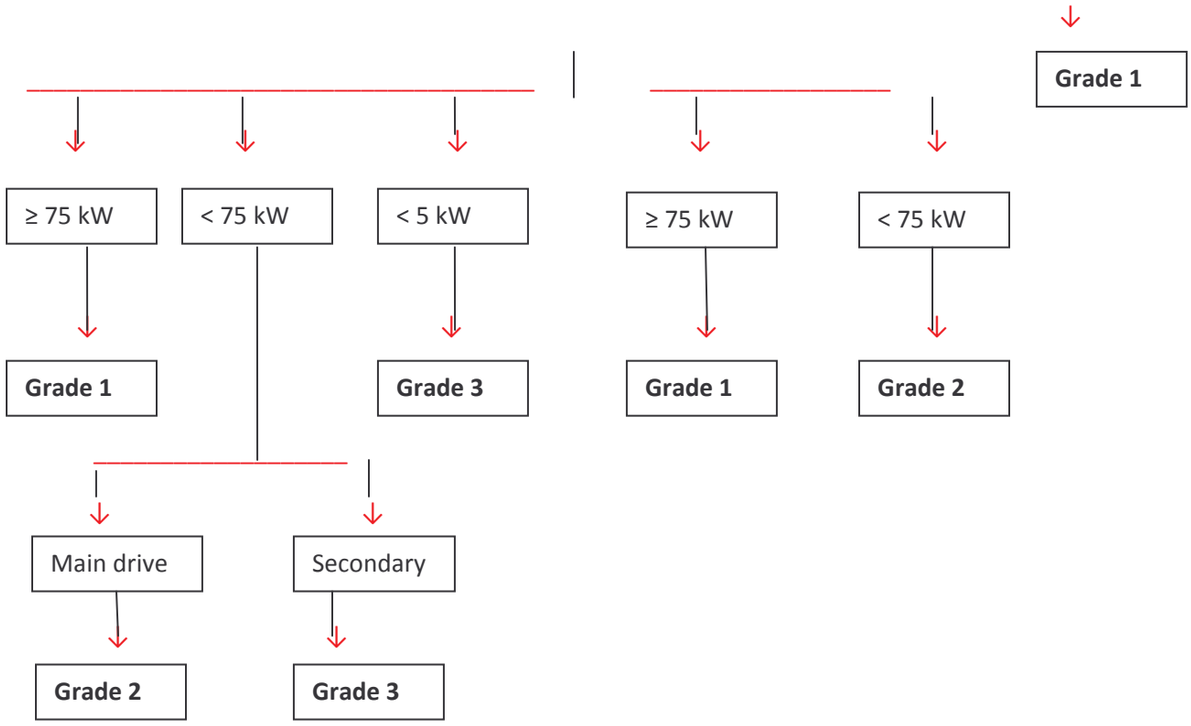
Reducers and gear are divided into 3 grades according to their design, power, function and working conditions.

The following table given the conditions justifying the 3 grades

Conditions → Grades ↓	Design	Power	Function	Working conditions		
				Reducer	Reversible	Multiplier
GRADE 1	Special	≥ 75 kW	Main drive	X	X	X
GRADE 2	Standard	< 75 kW	Main drive	X	X	
GRADE 3	Standard	< 5 kW	Secondary drive	X		

10.1.1 Determination of the applicable grade





10.1.2 Requirements

Part	Requirements		Grade 1	Grade 2	Grade 3
Casing	Material checking and certificates		See "detailed requirements " € 1		
	Welding and stress relieving treatment				
	Leakage Test		C	C	C
	Fitting surfaces and holes checking		C	C	C
	Levelling surfaces available		Yes	Yes	
	Centrelines distances checking		R	R	
	Centrelines parallelism		R	R	
Shafts	Material checking and certificates		See "detailed requirements " € 2		
	Dimensional checking		R	C	
Wheels and pinions	Material checking and certificates		See "detailed requirements " € 3		
	Hardness profile on a sample (case hardening)		R	C	
	Magnetic particles inspection (case hardening)		R	C	
	Teeth profile, helix angle and circular pitch records		R	R	
Assembly and tests	Without cover	Levelling	RW	R	
		Back lash	RW	R	
		Teeth contact	RW	R	
	No Load test	Tightening	CW	CW	C
		Temperature recording	RW	RW	R
		Noise	RW	RW	R
		Vibrations	RW	RW	
Other checking	Couplings assembly as per drawings		C	C	
	Painting as per specification		C	C	C
	Checking of lubrication as per drawings		C W	CW	

C→ Certificate of conformity required	R→ Inspection and test reports required	W→ Witness point
The certificate of conformity Gives the guaranty of conformity with drawings and specifications. No values are required	The inspection and test report gives the target values/ tolerances and the achieved values	To be performed with the buyer representatives.

10.1.3 Detailed requirements

Casings

- Materials checking and certificates as per section 4.2
  Thick plates for bearings → grade I
  Other plates → grade II
- Welding and stress relieving as per section 5, grade II
- Leakage test to be performed in order to avoid any leakage during final inspection.
- Surfaces and holes provided for fixing on support or concrete must be checked according to the drawings.
- Levelling surfaces must be available at least at each side of the casing

These surfaces will be used during shop test and then at site erection in order to ensure the good leveling of the reducer.

Leveling is checked with bubble or electronic level, accuracy 0,02 mm/m

The leveling difference between the two side shall be ≤ 0,05 mm/m

- Centre lines parallelism : Must be checked by measuring of the centerlines distances at motor and opposite sides

Measurements must be carried out by using a three axis measuring centre or by using a boring machine equipped with a digital [x;y;z] display.

In case of using a boring machine, it is recommended to proceed by moving the table instead of the tool holder.

Shafts

- Materials checking and certificates as per section 4.3
  Diameter ≥ 80mm → grade I
  Other shafts → grade II
- Dimensional checking → All diameters for bearing, gears and couplings fitting ; key ways. Visual inspection of the radii between different diameters.

Wheels and pinions

- Materials checking and certificates as per section 4.3
  Wheel thickness and pinion shafts diameters ≥80mm →grade I
  Other thickness and diameter → grade II
- Hardness profile must be checked on a sample for the case hardened gears. The depth of hardening (taking into account the material to be removed by grinding) is the distance from the surface where the hardness drops to 550 HV
- Magnetic particles inspection (or dye penetration test) must be done after grinding on case hardened gears.
- Records of teeth profile, helix angle and circular pitch are required for gears in class 6 and 7 as per ISO accuracy standard.

Assembly and tests

- Leveling → See above € “casing”
- Back lash → To be performed with micrometers for each meshing
- Teeth contact → By using blue paint for each meshing. **The contact pattern must be ≥ 70%**
- Temperature recording → By using digital contact pyrometer. All bearings blocks must be checked from room temperature to stabilized temperature. Stabilization is get when the temperatures does not change any more for half an hour.

- Noise → By using sound level meter, scale “A”, speed “slow”. Measurements must be done at 1 meter of the 4 sides. For long sides, 1 measure each 1 meter.
  Apart from the sound level, all abnormal noises must be analyzed (cyclic chocks or puring….)
- Vibrations → All bearings blocks must be checked in three direction: Axial, vertical, horizontal.

Part 10.2 Hydraulic units

Inspection and tests to be carried out on the hydraulic units to the specifications are defined by the check – lists appendix 18.

The following diagram shows the applicable inspection check-lists for each kind of hydraulic units.

	Refer to Check – List No.						
	G1	E2	E3	E4	E5	E6	E7
Hydraulic tanks (Fully equipped)	X	X		(X)			(X)
Conditioning units	X		X				(X)
Power units	X	(X)		X		X	(X)
Accumulators units	X				X		(X)
Manifolds (Fully equipped)	X					X	(X)
Interconnecting piping	X						X

Part 10.3 Hydraulic and air cylinders

Air and Hydraulic cylinders must be manufactured according to the specifications and the approved drawings.

The present standard gives blank forms to record inspections and tests results.

These forms must be completed for each cylinder with the results of applicable inspections and tests carried out by the supplier.

For each cylinder are also required.

- Material certificates
- Chrome/ nickel plating thickness checking certificate
- Welding documentation according to section 5
- Parts of hydraulics cylinders submitted to pressure → Grade I
  Parts of hydraulics cylinders not submitted to pressure → Grade II
  Parts of air cylinders → Grade II

For each Part are also required.

- Material certificates
- Welding documentation according section 5 grade II for tanks, grade III for supports and structures. For pipes, see the concerned grade of section 8.

Part 10.4 Special manufacturing process

See table in section 18 which concern the special processes used for surface treatments, surface coating…. And specify what must be checked.

The measured values for depth or thickness and for hardness must be in accordance with the drawings specification.

NDT must guaranty the absence of cracks due to the treatment itself or to the subsequent operations (grinding cracks for example)

Plating (Electrolytic, flame, plasma, HVOF) must be in accordance with the drawing specification (roughness : Ra, Rt, Rmax, Pics/cm if required) and must be continuous, free of all kind of appearance defects.

DEVIATIONS

Part 12.1 Classification

-LEVEL 0 to be processed by the manufacturer alone.

All deviations matching the following conditions correspond to this level.

- They represent non conformities in relation to the drawings and specifications.
- The return to the strict conformity is possible
  Either through rejection and replacement in accordance with the time schedule
  Or by repairing using only fabrication techniques already used within the normal fabrication cycle, according to the same operation modalities.

-LEVEL 1 to be processed with previous buyer's agreement.

The deviations which do not match the criteria of above stated level 0 correspond to this level.

They represent non conformities for which one the return to the strict conformity is impossible or repairing modalities needing manufacturing techniques, that deviate from the normal fabrication cycle….

SECTION 13

QUALITY CONTROL FILE

Part 13.1 Presentation and contest

All documents requested in the Data Sheet for the relevant equipment shall be included in the QC file. The presentation is as follows :

- Documents issued in English
- Format A4 (210 x 297)
- One file for each equipment
- Each document shall be identified by the Item No., the drawing No., and the designation of the relevant part.
- One index summarizes all supplied documents for the relevant equipment
- Unless otherwise stipulated, the manual is transmitted to the buyer in two copies. The manufacturer must keep the original for at least 15 years.

Part 13.2 Availability

Each document can be individually consulted by the buyer immediately after achievement of the relevant operation.

Availability delays of some basic documents may hold the fabrication process.

The final manual should be made available for final acceptance. No sending authorization of shipment will be granted without this manual.

TIME SCHEDULE AND PROGRESS REPORT

Part 14.1 Time Schedule

For each equipment preparation of a time schedule shall be made according to the model in Section 16.

A provisory time schedule is enclosed with the offer and must be confirmed within 15 days following the order placement.

Part 14.2 Progress Report

According to the following schedule a monthly with the progress reports, shall be prepared according to the form stated in Section 16.

Part 14.3 Inspection Request

15 days prior each inspections scheduled in the Data Sheet, the an inspection request as per form stated in Section 16 shall be sent.

SECTION 15 INSPECTION AND TEST IMPLEMENTATION

Part 15.1 Visual inspection

As a rule they are performed with the naked eye. However the buyer's inspector may decide to use means of moderate magnification to confirm or clarify his observations.

Part 15.2 Dye penetration test

The penetration product may be applied either by means of aerosol or paint brush. The cleaning shall be provided with pure clear water (no solvent). The developer shall only be applied by aerosol. The penetration product shall be capable of reacting at least 10 minutes before being cleaned. The faces on which the penetration product can trickle down need to be regularly "backfed" (2 to 3 times during application) . The surfaces shall be perfectly dried after washing and developer application. The developer shall be dried either naturally or by pressed air blowing. The defects are inspected within 10 mn after drying.

Part 15.3 Magnetic particles test

The magnetic particles test is performed by means of usual method (current passage between 2 electrodes) or by field method (passage of field generated by an induction coil). If parts are to be inspected after final machining, only the field method will be authorized. For the hardenable steels to be inspected using the usual method, the electrode impacts on the surfaces shall be ground and then inspected by the dye penetration test. The magnetizing time is at least 5 seconds per position. The inspection is always carried out according to 2 orthogonal directions.

A magnetic powder suspended in a carrying liquid (no dry powder) is used. The powder can be black or fluorescent. In such a case the inspection shall be carried out by means of UV in a dark room. Before inspection and at regular intervals during this inspection progress the inspection efficiency is to be checked by means of a magnetizing test specimen (Berthold crux). Unless otherwise specified, a demagnetization is not required.

Part 15.4 X- Rays

The films shall be correctly contrasted, the lines of the DIN quality indicator equal to the checked **thickness /100** for the thickness up to 50mm must be able to be distinguished.

Part 15.5 Ultrasonic inspections

- The ultrasonic tests of welding, and of forged or cast parts shall be performed by skilled operators trained in this technique, within the conditions recognized as acceptable by the buyer.
- The US apparatus shall be in good condition. (in particular the connection cables of the sensors). After a 30mn heating the oscillogram shall be neat and perfectly steady.
- The equipment is checked and calibrated by means of a block ISO -2400
- Before any inspection, check with the block :
- The amplification vertical linearity : The dispersion should be between **0.9 and 1.1.**
- The horizontal linearity of the time base : display at least 4 echoes positioned on the horizontal scale with a 1% accuracy.
- The resolution power
- The “silence field”

-CALIBRATION

- Steel sheets : On flat bottom holes diameter 8mm or AVG

- Forged and cast parts : curve AVG

- Welding : L waves on flat bottom hole 4 mm diameter; T waves see section 17.

Part 15.6 Balancing of rotating parts

Unless otherwise stipulated on the drawings, the rotating parts are included in balancing class.**G 6.3.**

The balancing is static for rotating speed between 150 to 750 rpm and dynamic over 750 rpm.

The tolerable remaining unbalance is given by the following formula :

Unbalance in mm.kg= (K x mass in Kg.) / speed in rpm

The **K** value is given by the formula **K=10*G** (balancing class).

For example, G=6,3, K=6.3* 10=63.

The mass producing this unbalance reduced to a radius is given by the following formula:

Mass in kg= Unbalance/radius in mm

Part 15.7 Hardness measurement

Unless otherwise specified, the hardness measure is carried out with an **“EQUOTIP D” type portable** device. The conversions table between “value L”, Brinell, Vickers, Rockwell is on the Section 16.