worldskills

Standards and Assessment Guide

CNC Turning

Introduction

Welcome to the Standards and Assessment Guide (SAG), a comprehensive resource designed to support excellence in assessment practices for all skills competitions hosted at the WorldSkills Competition. A key component of the SAG is the commitment to continuous improvement through ongoing review, ensuring that these guides consistently reflect the latest industry innovations and high standards of assessment in an open and transparent manner.

Purpose

The primary purpose of this guide is to provide a structured framework for the consistent and fair assessment of each skill competition. It aims to ensure that all assessments are conducted with a high degree of accuracy, reliability, and validity, and reflect global industry standards. By adhering to these guidelines, assessors can maintain the integrity of the competition and uphold the high standards associated with WorldSkills.

Note: this guide is not a replacement for the Marking Scheme and should only be used as a reference when required during the assessment process. Competitors are not allowed to have a copy of this SAG in the workshop in either digital or paper form.

Scope

This document covers general assessment practices applicable to a diverse range of industry sectors including:

- Manufacturing and Engineering Technology
- Information and Communication Technology
- Construction and Building Technology
- Transportation and Logistics
- Social and Personal Services
- Creative Arts and Fashion

Each skill competition has its unique requirements and benchmarks, which are detailed within sections of this guide. The consistency of assessment across each skill is the overarching principle, ensuring a unified approach to evaluating Competitor performance to the highest standards.

Key Components

The guide is structured into several key components, each addressing critical aspects of the assessment process:

1. **Assessment Principles and Objectives**
    - Emphasis on fairness, transparency, and objectivity in assessments.
    - Alignment with global industry standards and best practices.
2. **Assessment Methods and Tools**
    - Description of various assessment methods in Measurement and Judgement
    - Guidance on the application of appropriate assessment tools and equipment (if applicable).
3. **Criteria and Benchmarks**
    - Examples of assessment criteria and aspects for each skill, outlining the expected competencies and performance standards.
    - Benchmarks for different levels of proficiency i.e. Judgement award range 0, 1, 2, 3 or Yes / No criteria alongside clear measurable descriptors.
4. **Expert assessment requirements**
    - Completion of the Access Programme
    - Approved Curriculum Vitae (CV)
    - Reaching 100% Expert preparedness
    - Full participation of online and in-person Mandatory Assessment Training (MAT)
    - Completion of practical assessment testing at the Competition
5. **Quality Assurance and Improvement**
    - Mechanisms for monitoring and evaluating the assessment process.
    - Strategies for continuous improvement and feedback incorporation.
    - Ongoing periodic review of the assessment process

Implementation

For effective implementation, this guide should be used for guidance purposes only and in parallel with the Technical Description for each skill. Experts are encouraged to familiarize themselves thoroughly with both the general guidelines and the particular requirements of their respective skill areas. Collaborative efforts between the Skill Management Team, Experts, and Competitors are vital for achieving the ultimate goal of global skills development.

Conclusion

The Standards and Assessment Guide embodies the commitment of the WorldSkills movement to nurturing talent and promoting the highest standards of vocational education and training worldwide. By providing clear and comprehensive guidance, we aim to empower Experts to conduct marking and assessment practices that are not only rigorous and equitable but also inspiring and transformative for all participants.

Thank you for your dedication to upholding these standards and contributing to the success of the WorldSkills Competition. Together, we can continue to champion skills excellence and celebrate the achievements of talented individuals from around the globe.

Skill 06 – CNC Turning

Measurement

Measurement is used to assess accuracy, precision, and other performance that can be measured objectively. It is used where ambiguity must be avoided.

The total marks allocated to measurement marking may vary from competition to competition depending on the Test Project.

The objective evaluation process will be carried out by different inspection teams. To avoid compatriot marking, the test projects are marked with a secret number code by the chief expert and the SCM. Now there is no reference to the competitor visible by any of the inspection teams. This also makes it impossible (or very difficult) to apply any tactical marking.

The different inspection stations in CNC Turning:

- Coordinate Measuring Machine - measure defined features on the test project, print a report.
- Bench Center - For runout inspection.
- Digital Height Gauge - For defined length- or depth measurements
- Surface roughness inspection - Checking defined surface specification on the test project.
- Handheld inspection tools - Expert teams are assigned to check with Go- No-Go gauges, Micrometres, Callipers etc. defined dimensions.
- Other expert teams are assigned to evaluate specific functions of the test project.

We evaluate 4 objective aspects, described below. Possible features and tolerances are described in the document "Project Design Criteria for Skill 06“."

Aspect	WSOS section as per TD		Descriptor
Surface finish	All sections are applied in combination to achieve the correct result. 1,2,3,4,5,6,7	Ra values are given on the drawing of the test project. We measure the specified Ra value and apply a modified 16% rule.	Is the specified Ra value of the test project achieved?
Main dimensions	All sections are applied in combination to achieve the correct result. 1,2,3,4,5,6,7	Features and dimensions which are difficult and/or time-consuming to make. If a "symbolized" function is implied, check if the function given.	Is the required dimension of the feature within the given tolerance? If a "symbolized" function is implied, is the function given?
Secondary dimensions	All sections are applied in combination to achieve the correct result. 1,2,3,4,5,6,7	These are features and dimensions that are not so difficult or time-consuming to make. If a "symbolized" function is implied, check if the function given.	Is the required dimension of the feature within the given tolerance? If a "symbolized" function is implied, is the function given?
Sustainability: Use of material	Section 1,3,6	Each competitor may ask for one extra material per module, but marks are then deducted. The allocated marks may vary from module to module. On the module "Mass Production" we do not have the "Use of material" aspect	Does the Competitor require more material than given?

Judgement

Judgement is used to assess the quality of performance about which there may be small differences of view when applying the external benchmarks.

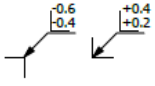
The Resources column in the table below may include all kinds/formats of resources such as a link to a YouTube video, a website link, an illustration, a photo, a reference to a book, and so on.

Generic rules:

The assessment group comprises three Experts plus one Expert who acts as the supervisor.

The difference of the three Experts' scores may not exceed 1. If this is the situation the Experts must re-score until there is a maximum difference of 1. As long as the three Experts judge within 1, the result can be entered into the CIS.

The total marks allocated to judgement marking may vary from competition to competition depending on the Test Project.

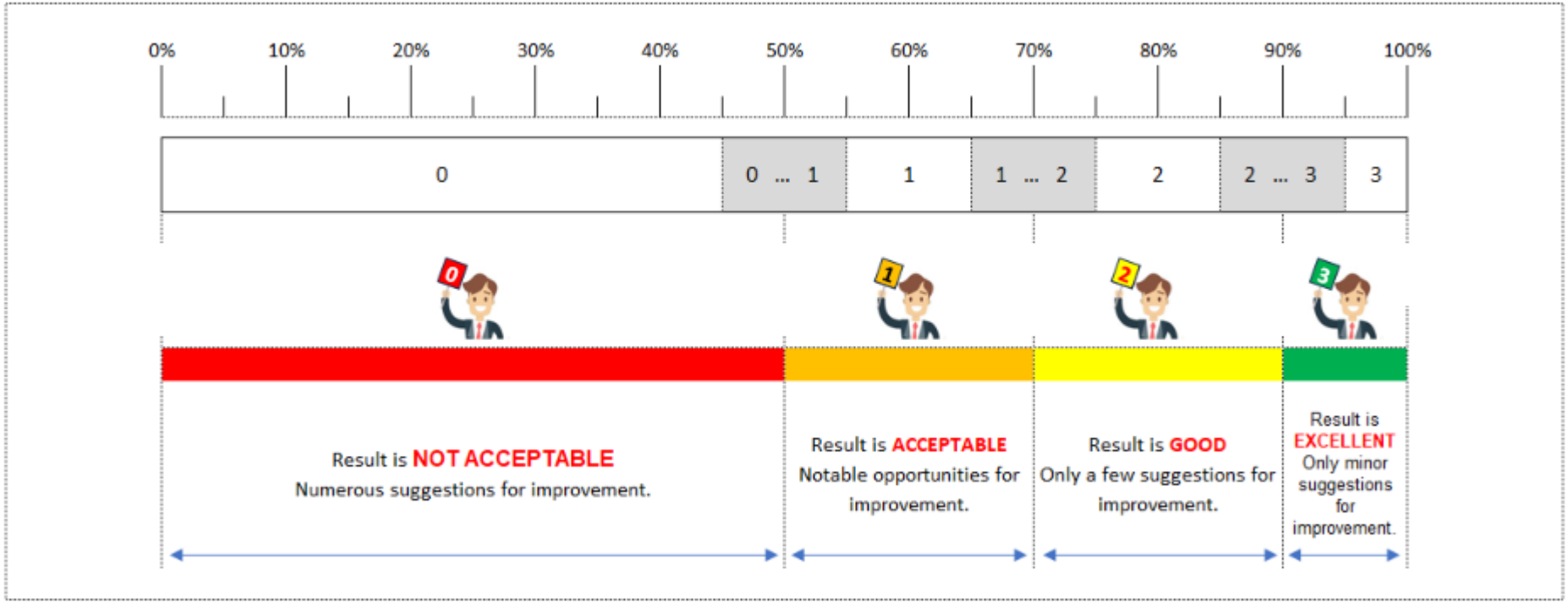
WSOS section as per TD	Score	Descriptor
Visual Conformity of part to drawing Judge percentage of conform features and Intensity of any damage like clamp marks, crash-marks, scratches, chatter etc. Do not overlook the specified corner break.  Has it been completed satisfactorily? Check also for unwanted features (Example: an extra groove? An unwanted hole?)	3	Result is EXCELLENT All features visually present and correctly executed. No unwanted features or deviations. Only minor suggestions for improvement.
	2	Result is GOOD Only minor deviations. Only a few suggestions for improvement.
	1	Result is ACCEPTABLE A small number of features are incorrect, missing and/or unwanted. Notable opportunities for improvement.
	0	Result is NOT ACCEPTABLE Unacceptable amount of incorrect-, missing-, or unwanted features. Numerous suggestions for improvement.

WSOS section as per TD	Score	Descriptor
Product is properly deburred, free of chips and cleaned well Evaluate the severity of burrs and check whether chips have been properly cleaned from the product. Judge intensity of burrs and if chips are cleaned well off the product.	3	Result is EXCELLENT Product is free of burrs and chips, and is smooth and safe to handle. No secondary operations needed. Only minor suggestions for improvement.
	2	Result is GOOD Minor burrs or chips to be cleaned off, requiring very little secondary work. Only a few suggestions for improvement.
	1	Result is ACCEPTABLE. Product is uncomfortable to handle. Additional follow-up work is required. Notable opportunities for improvement.
	0	Result is NOT ACCEPTABLE Product is neither safe nor comfortable to handle. Significant secondary work is required. Numerous suggestions for improvement.

Guide for Judgement marking

To assess the criterion "Visual conformity of part to drawing", you must give a score from 0-3, based on the **percentage of work done correctly**.
To assess the criterion "Product is free of burrs and chips", you must give a score from 0-3, based on **the intensity and number of burrs and chips.**

Use this scale to judge the percentage of correctly accomplished work and then choose your flashcard.



There will always be a **“grey zone”** where one expert may judge slightly higher or lower than another. Is it 40 %? 45 %? 65 %? … this depends on the complexity and intensity of the features: the programming time, the setup required, the number of tools, and the procedures involved. In such cases, personal judgment is necessary. However, we expect experts to apply a **consistent standard**, so that results from different judges remain very close, within the same scale or grey zone described above.

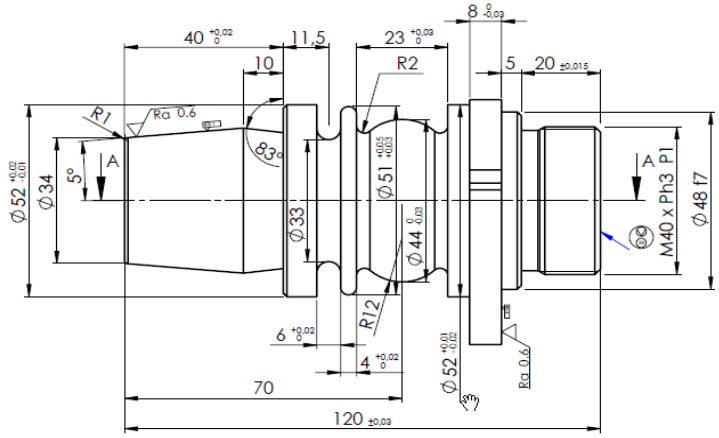
0 - 50 % is NOT ACCEPTABLE. But there is a grey zone where one expert may think the work is done to a little less than 50 % and another expert may think it is a little more than 50 %. This is PERSONAL judgement and shall be accepted … one expert may give ZERO points, while another may give ONE point.
This shall be an acceptable deviation between the judges. Experts must come to an agreement where the deviation is not more than ONE point. The difference of opinion is what I am trying to display with the "grey zone" in the image above (scale).

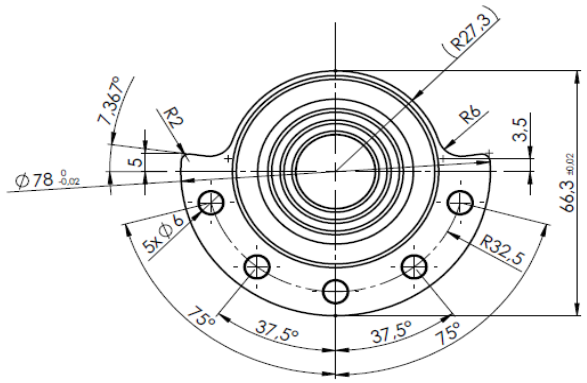
It is important to understand that the evaluation must be based on the drawing, considering the percentage of work completed. The level of effort required for different features must also be considered. In other words, the features of the test project need to be weighted appropriately. For example, a 1 mm chamfer should not carry the same weight as an M48 x 2.5 thread.

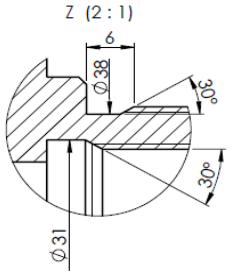
Important note

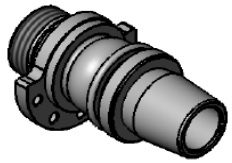
On the next pages we have outlined a process which breaks the assessment procedure into areas. It is important to note that this is an example only and there may be a different number of components on a different module for assessment. Key information is that the weighting of the judgement is dependent upon the difficulty level of the task and time management.

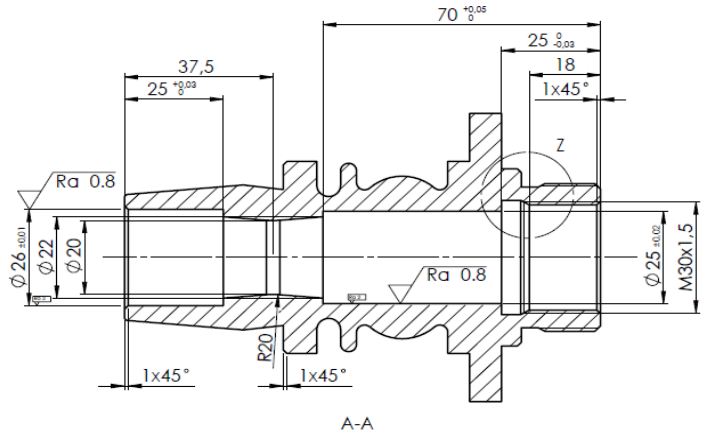
INTERNAL and EXTERNAL turning work and also LIFE-TOOLING work (milling and drilling).



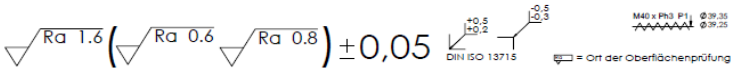






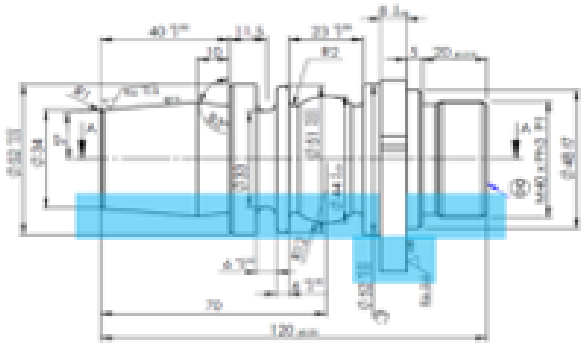


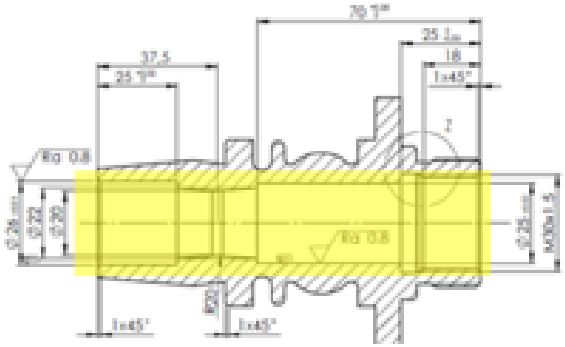
A-A



Let's assume we have a test project of competitor XX, and we now want to assess **CONFORMITY to drawing.**
Assess the percentage of conform features and the intensity of damage (clamp marks, crash-marks, chatter …), check also for unwanted features.

It is easy to see that the majority of the work is on the OUTSIDE of the part. It includes turning, grooving, threading, milling and drilling with life tooling. The inside includes drilling, boring and threading.
For this example I call the OUTSIDE the BLUE ZONE … and I call the INSIDE the YELLOW ZONE.





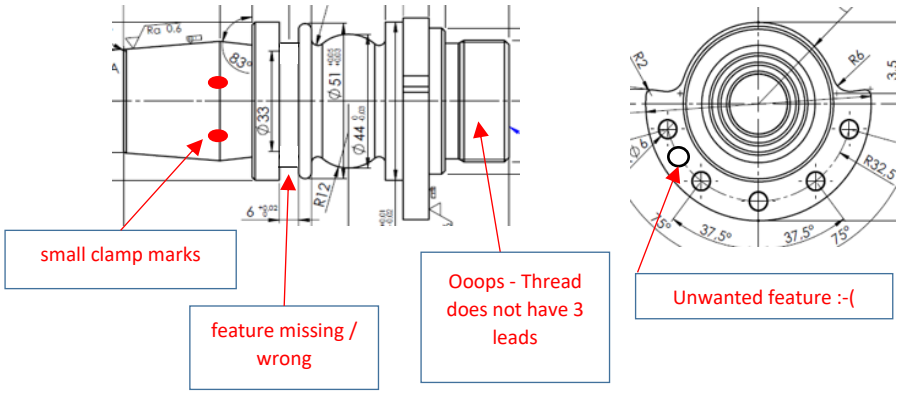
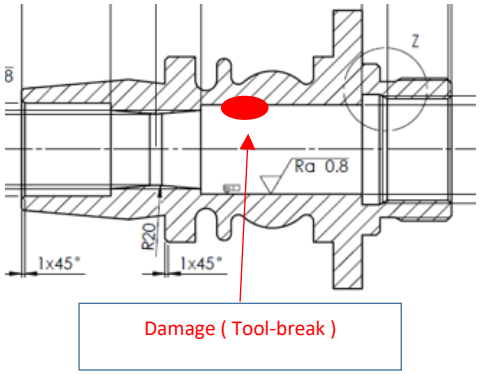
When evaluating, we must consider:

- estimated time to make the features in the zone
- difficulty level to make the features in the zone
- number of tools needed for the features in the zone

Missing features, wrong features, unwanted features, chatter marks and damages will lead to a deduction.

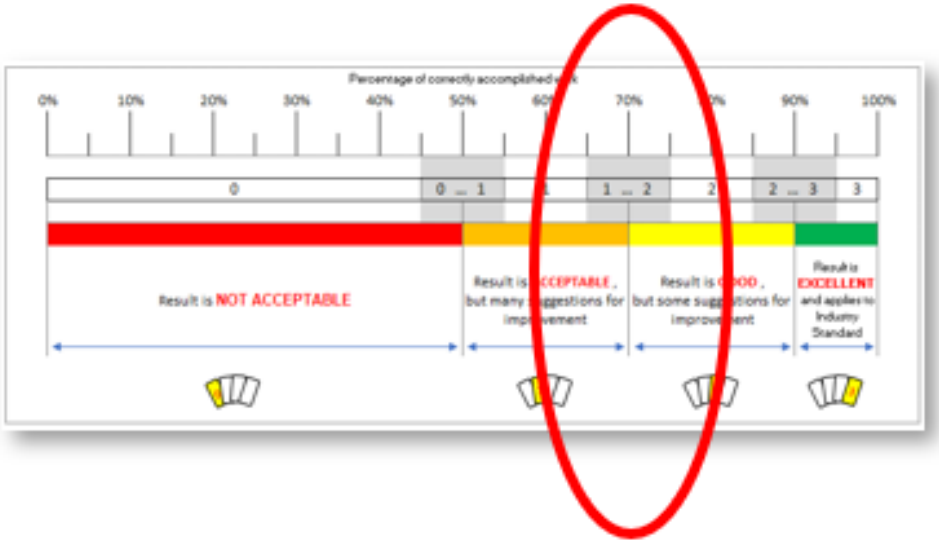
Most of us use the deduction method, which means we begin with a perfect score (100%) and then subtract points for any errors we identify.
This process involves personal judgment, so results may vary slightly between evaluators. However, among technical experts, these differences are usually very small. Usually the variation is minimal, as we train our students to consistently meet high standards … regardless in which country.

For a score to be valid in our competition, experts must assess on a scale from 0 to 3 points, with a maximum difference of one point allowed.

External Turning… the BLUE Zone	**Internal Turning… the YELLOW Zone**
	
Hmm … Well done, at first, it looks good. But there are some small clamp marks from the 3-Jaw chuck Also … The round groove is not finished (incomplete or missing feature) Oooops … Almost did not see this … The thread does not have 3 leads …. Incorrect (or incomplete) feature. On the LIFE-TOOLING work there is a hole to many – There are 6 holes instead of 5 …. **This is an unwanted feature.** Surface: No (or only minor) chatter marks Corner break: well accomplished	Wow… All features nicely completed. Well done. But look, in the deep bore there is a damage. Looks like the tool broke there. Even though the competitor fixed and deburred this very well, and dimension and/or function is given, the damage is still visible. Surface: No (or only minor) chatter marks Corner break: well accomplished.

The work that has been accomplished by the competitor is very good. He/she delivered under competition pressure an "optically" almost finished project. However, the product is not fully conformed with the drawing. We found an unwanted feature, incorrect or missing features, small clamp marks and a small damage. How would you judge the conformity?
It is not fair to give 0 (less than 50% accomplished?) - it is not fair to give 3 (90 - 100 % accomplished?)

Some experts would give ONE point; some others would give TWO points. This is well acceptable. We may have a difference of opinion. We may have a difference of one point between judges – but the award of judgement must be consistent throughout the test projects.



A scenario could look like this …

Aspect: Product is properly deburred, free of chips and cleaned well

We all understand that deburring and cleaning is an important process in machining. The customer does not want to unpack "dirty" or "not-deburred" products.

We need to consider TWO aspects:

- the quality of the deburring
- the quality of the cleaning

1st aspect, the quality of the deburring

It is not simply a matter of whether "burrs are present-or not; what matters is the **number** and the **severity** of the burrs. Burrs can range from large, noticeable, to very small "baby burrs." In some cases, a burr may even be created unintentionally during finishing - for example, when a corner is chamfered with a file or an air -grinder

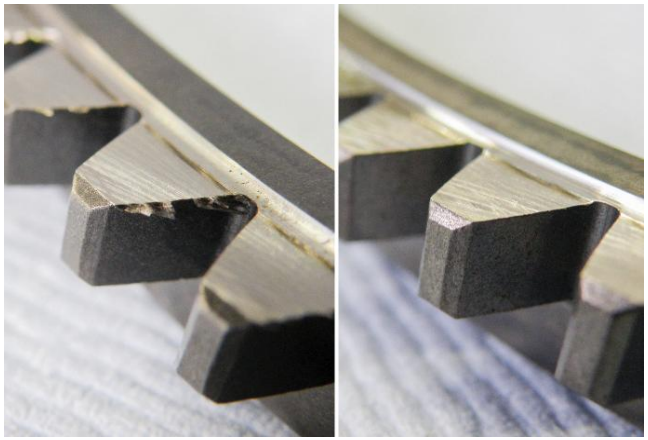
Just like in your common work practice, use the sensitivity of your fingertips to detect any burrs. In your judgment, assess both, the quantity and the severity of the burrs you identify.

Examples of good and bad deburring

The left part is excellent - But looking at the part on the right side … this seems to be bad; Let's look at this part now

It is important to consider the **entire** part, not only a section of the part.
It looks like the lower section is well deburred, but the upper section is not deburred very well.
Maybe the competitor ran out of time and could not finish?

Looking at this image, some may consider the deburring is well done around 70 - 90 % …. However - the severity of the burrs in the upper section seems very heavy. These are very intense burrs.
Even though, approximately 70% of the part is deburred, the remaining burrs are very severe, which could lead to judge more towards 1 point.
(deburring attempt is visible, but poorly or not fully executed)



This **example** shows on the left a part with small burrs, on the right is a part which is perfectly deburred.

What if all teeth of this gear are so poorly deburred as on the left, but the turning section is deburred very well? How would you judge it?

What if only 3 or 4 teeth of the gear are not deburred, but the rest of the entire part is perfect. How would you judge it?

It is important to identify the severity and the number of burrs of the **ENTIRE** product.

Do not assign a score of 0 points simply because you discovered a single burr. Instead, consider both - the number of burrs present, and their size/severity before making your judgment.

Aspect: Product is free of chips?

I think looking at these pictures tells us all we need to know

Excellent

Not acceptable

Please consider this: Some competitors put a thin film of oil on the product, which forces the inspection team to clean. This oil is a positive attempt of the competitor to protect the product from rust, and even if this does not give extra marks, it shall not be punished. This protection with a thin oil film is not bad cleaning!

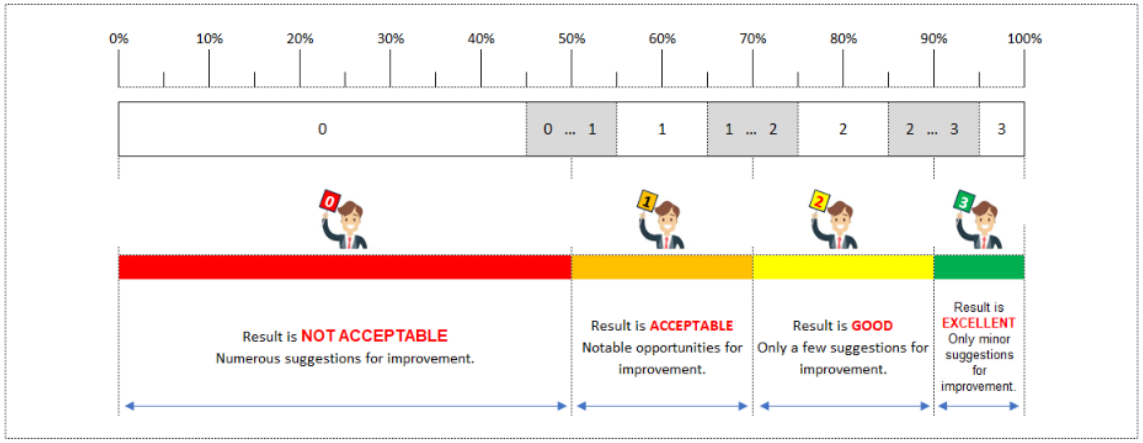
Aspect: Product is properly deburred, free of chips and cleaned well

We have to consider 2 things when judging this aspect. A scenario could look like this:

- **Deburring:** Part is well deburred. Only some small burrs found. Well done. EXCELLENT (3) for deburring
- **Cleaning:** Part is NOT entirely free of chips, acceptable, but badly cleaned. ACCEPABLE (1) for cleaning

Considering **both aspects together** some experts would give (1) … some others maybe give (2)

Keep this scale in mind when you judge. Judgement is not a question of **YES** … or **NO** …



Judgment is a question of: How much? How many? How severe? How well? How bad? How good? How deep? How high?

(a cook would say … how good does it taste? how salty does it taste? how cold or hot is it?)

Conclusion

Our challenge is to fairly judge these aspects:

a) To what extend is the project finished and conform with the drawing?

- consider how time-consuming and how difficult the features are
- consider the amount and the intensity of any damage (scratches, clamp-marks, crash marks etc.)
- consider if any features are missing or if you see "extra" features

b) To what extend is the product correctly deburred and cleaned?

- how is the quality of deburring and cleaning
- make sure you judge the amount, but also the severity of any burrs and chips

Severe Burrs

Small

Perfect Cleaning

Bad Cleaning