GREAT DESIGNS IN STEEL

SAE SPECIFICATIONS SUPPORTING THE AUTO/STEEL PARTNERSHIP AND THE AUTOMOTIVE AND STEEL INDUSTRIES

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WHY STANDARDS? ASK BARD

Standards are important because they:

- Ensure the safety, quality and reliability of products and services.
- Facilitate trade and protect our health and the environment.
- Improve systems and processes for businesses, reducing waste and costs.
- Ensure consistency for consumers, protecting them from unsafe or unreliable products.
- Interoperability, making sure that different devices and platforms can work together.
- Standardization in fields like accounting, health care, or agriculture promotes best industry practices.
- Reflect the shared values, aspirations, and responsibilities of society.
- Standards are essential for a well-functioning society. They help to ensure that everyone is on the same page and that things work smoothly. Without standards, there would be chaos and confusion.

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE was founded in 1905, Henry Ford was 1st Vice President

Dues were $10/yr!

Charles Kettering was President during WW1

J403 Chemical Composition of Carbon Steels – June 1911

J404 Chemical Composition of Alloy Steels – June 1911

Important technological advances in automobile and aircraft history track side-by-side with the SAE standards

After WW2 SAE transformed from a standards centered organization to an information exchange organization

SAE International now has 25% of members outside the USA

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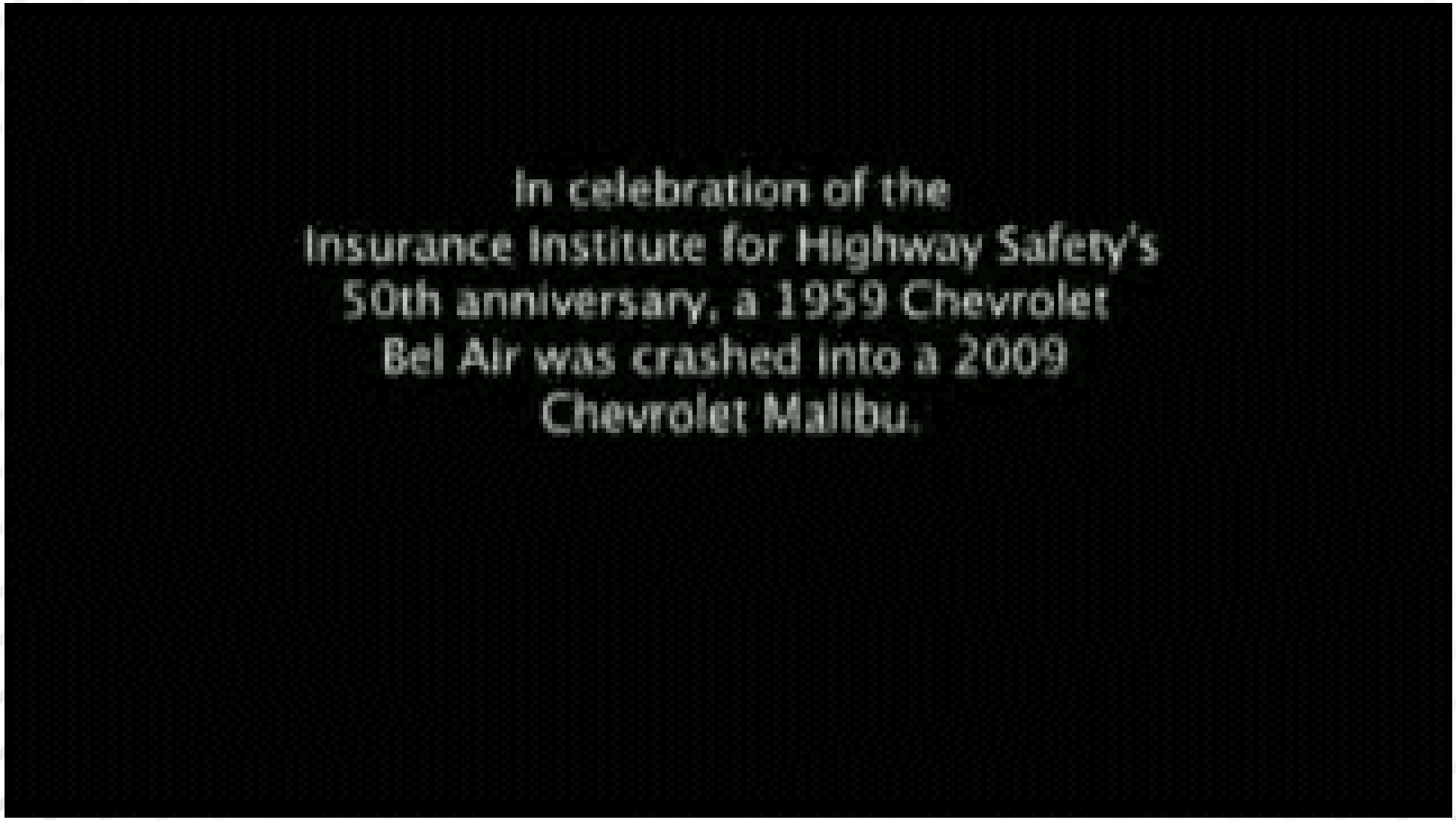
RAMIFICATION OF 50 YEARS OF STEEL



SAE AND THE AUTO/STEEL PARTNERSHIP

- A/SP Committee on Uniformity of Automotive Sheet Steel Properties was active in the late 1980 thru 90's
- AISI published 2 data books - UNIFORMITY OF AUTOMOTIVE SHEET STEEL PROPERTIES Vol 1 and 2
- The Uniformity Committee met in the mornings on a regular basis and was well represented by the Detroit 3 (aka Big 3) along with all the integrated steel producers who supplied them with sheet steel. Many of the members were also part of the SAE Committee – Division 32, who were responsible for sheet steel specifications. In the best interests of all we agreed to meet in the afternoon, after lunch, following the A/SP meetings.
- After all the excellent work by the A/SP Uniformity committee was published it was decided by the members that we had a lot of good data (property windows) to generate material specifications for the auto Industry.
- Other committee work at A/SP was also taken into account and the first SAE specification was published of A/SP sponsored work.
- Standardized Dent Resistance Test Procedure J2575_200406

SAE STEEL SPECIFICATION TIMELINE

High Strength, Low Alloy Steel(Cancelled Dec 1992) J410_199212

50 Ksi yield strength example - 950 XF Original Issue date of 1962

Steel, High Strength, Hot Rolled Sheet and Strip, Cold Rolled Sheet, and Coated Sheet1(STABILIZED Mar 2017) J1392_201703

340 Mpa yield strength example - 340XLF Original Issue date of 1982

Categorization and Properties of Low-Carbon Automotive Sheet Steels J2329_201504

Boron Treated Low Carbon example - HR3 Original Issue date of 1997

Categorization and Properties of Dent Resistant, High Strength, and Ultra High Strength Automotive Sheet Steel(STABILIZED Mar 2017) J2340_201703

Recovery Annealed High Strength Example - 830R Original Issue date of 1999

Categorization and Properties of Advanced High Strength Automotive Sheet Steels J2745_201504

High hole Expansion Example HHE 440T/310Y Original Issue date of 2007

SAE J2947 – SHEETS STEELS TO GEN 2.5

Categorization and Properties of Steel Sheet for Automotive Cold Forming Applications J2947_202204

- This specification is developed to define the commonly used steel sheet grades within the automotive industry. Most of these grades have evolved from the grades listed in SAE J2329, J2340, and J2745 through a combination of current practice and global customer demand.
- SAE J2329, J2340, and J2745 were developed over a 15 year period where many grade variations and property windows were being developed. J2947 intent is to have one sheet steel specification that encompasses current technical state of the art and to provide a vehicle for a standard to control requirements on an international platform.
- **There are no Generation 3 steels in the current version due to the proprietary nature of processes and equipment in use by industry**

TABLE 5 – COLD REDUCED STEEL GRADES

Material Type	Grade Designation	Available Strength Levels – MPa – values are minimum yield strength unless otherwise indicated
Mild Steels	Low Carbon	CR grades 1 through 5
Bake Hardenable	BH	180, 210, 240, 270, 300
High Strength Interstitial Free	IF	160, 180, 210, 240
Solid Solution Strengthened / High Strength Low Alloy	LA	210, 240, 270, 300, 340, 380, 420, 460, 500, 550
Dual Phase(1)	DP	490, 590, 690, 780, 980(3 versions)
Transformation Induced Plasticity (TRIP)(1)	TR	690, 780
Complex Phase(1)	CP	780, 980, 1180
Martensitic(1)	MS	900, 1100, 1300, 1500, 1700

1. 1. For this grade classification, the strength grade is referenced by minimum tensile strength instead of minimum yield strength.

TABLE 6 – HOT ROLL STEEL GRADES

Material Type	Grade Designation	Available Strength Level(s) – MPa - values are minimum yield strength unless otherwise indicated
Mild Steels	Low Carbon	0, 1, 2, 3
Solid Solution Strengthened / High Strength Low Alloy	LA	270, 300, 340, 380, 420, 500, 550, 700
Dual Phase(1)	DP	580
Ferrite Bainite(1)	FB	450, 580, 780
Complex Phase(1)	CP	760, 980

1. 1.For this grade classification, the strength grade is referenced by minimum tensile strength instead of minimum yield strength.

J2947 DEVELOPMENT

J2947 was informally and then formally developed over a period of years beginning in 2013 until 2020.

The SAE Sheet Metal Team (automotive and steel producers) and the extended European team (VDA core team + other European auto producers, VdEh) held regular monthly meeting to discuss material grades and properties for an all encompassing global specification on automotive sheet steels.

A number of critical lab tests were done both in Europe and North America to define test methods and measurement accuracy.

- Bake Hardening measurement criteria, upper/lower yield
- R-value determination ranges

VDA 239-100 is the European equivalent specification of J2947 and was published in May 2016.

A joint publishing method was desired but due to issues between SAE and VDA a joint agreement could not be accomplished, therefore J2947 was developed.

As J2947 was developed and approved later than VDA239-100 there are minor differences, grades were added and removed that are North America specific.

FUTURE OF J2947

J2947 was officially published in May 2022, it will be up for a required 5 year revision review and reapproval in 2027.

Some discussions on revisions have occurred at the committee meetings:

- Do we add Generation 3 grades (proprietary data issues)
- Accurately define hole expansion requirements
- Define global and local formability
- Measurement of global and local formability
- EAF specific grades
- Impact of “Green” steel manufacturing methods
- VDA relationship and their future revisions

J3215 HYDROGEN EMBRITTLEMENT TEST

Hydrogen Embrittlement Testing of Ultra High Strength Steels and Stampings by Acid Immersion J3215_202303

Published March 2023

This specification was written as a result of work from the A/SP Steel Testing and Harmonization Team project and publication

Delayed Cracking of Advanced High-Strength Steel Solutions

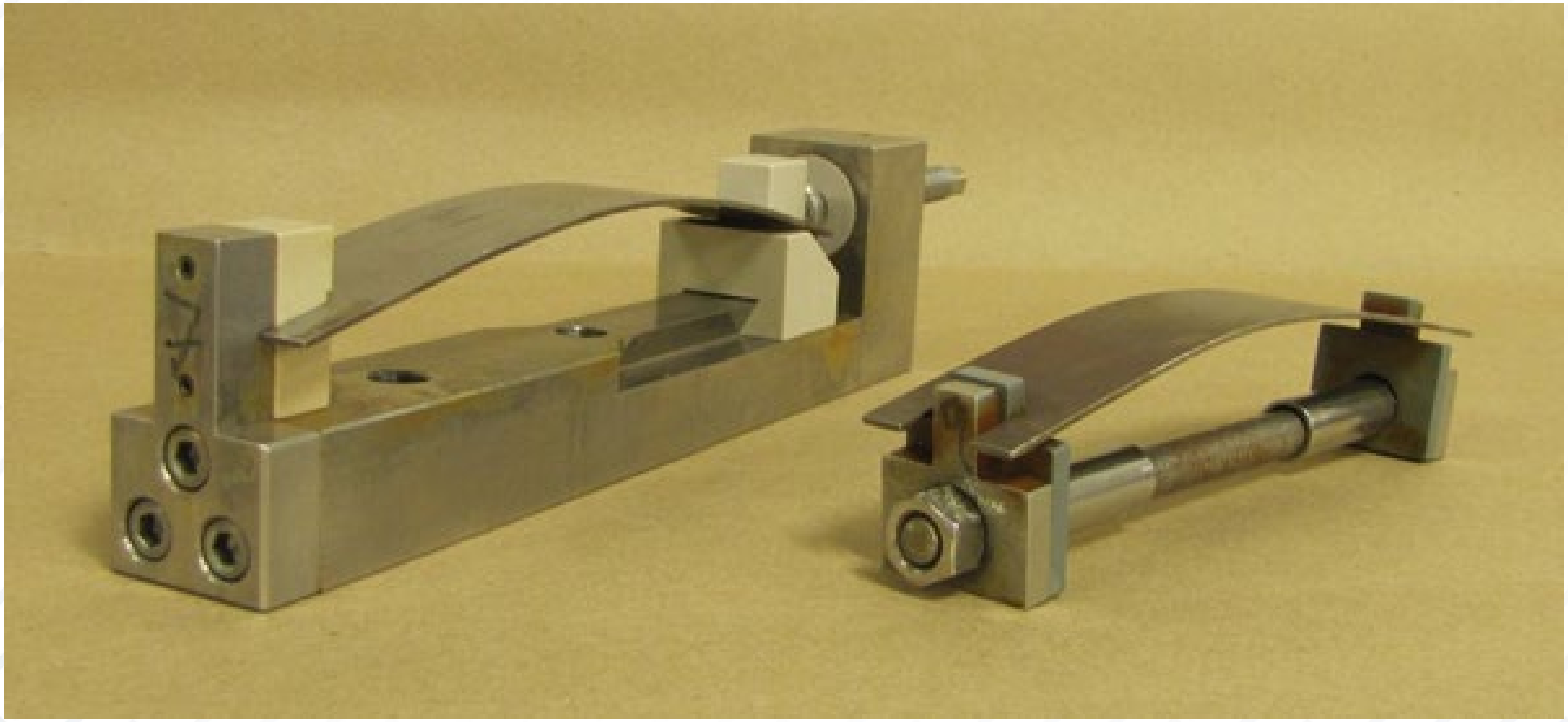
Work on this specification began in 2021 and was not delayed by COVID -19 work impacts.

The scope of the standard describes a test method for evaluating the susceptibility of uncoated cold rolled and hot rolled Ultra High Strength Steels (UHSS) to hydrogen embrittlement

The specification is intended for evaluating dual phase, multi-phase and martensitic grade steels for their susceptibility

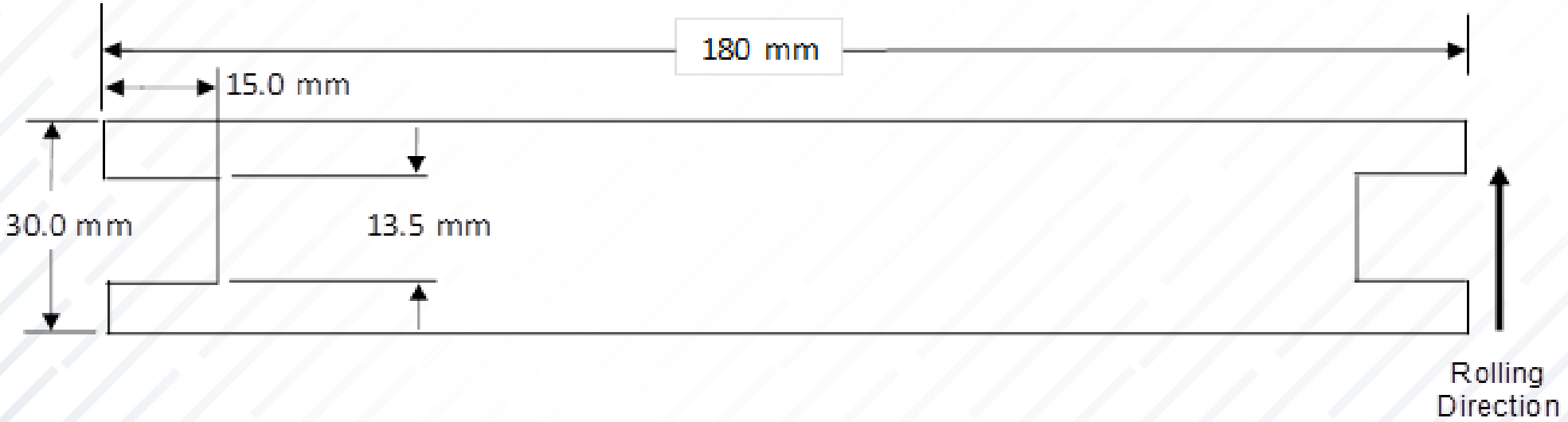
Two sample types to accommodate thick or very high strength grades

J3215 SAMPLE A FIXTURE CONFIGURATION



SAMPLE A DIMENSIONS

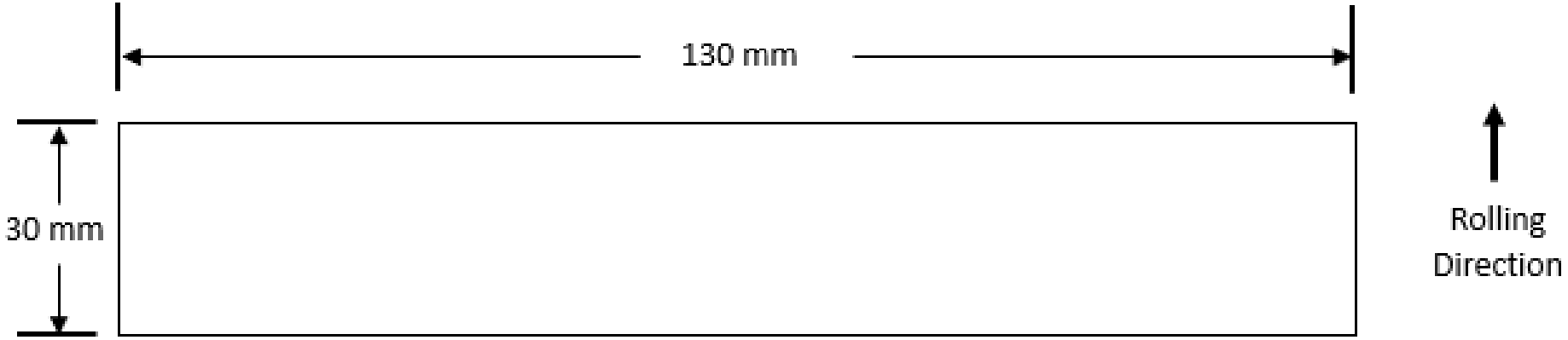
Samples are prepared by either shearing coupons to the required dimensions and testing in the as-sheared condition or milling to final dimensions. The condition of the tested edge shall be specified and included in the test report. Punch dies for shearing samples shall have a 15% die clearance with a tolerance of ±1%.



J3215 SAMPLE B CONFIGURATION

SAMPLE B DIMENSIONS

The specimen for this configuration will typically be a rectangle, 130 mm x 30 mm as shown in Figure 3. The test fixture shown in Figure 4 below is beneficial in loading samples of thick and/or of sufficiently high strength materials that are difficult to be loaded in the normal fixture. This fixture is described in ASTM G39



STRAIN STATE OF SAMPLES

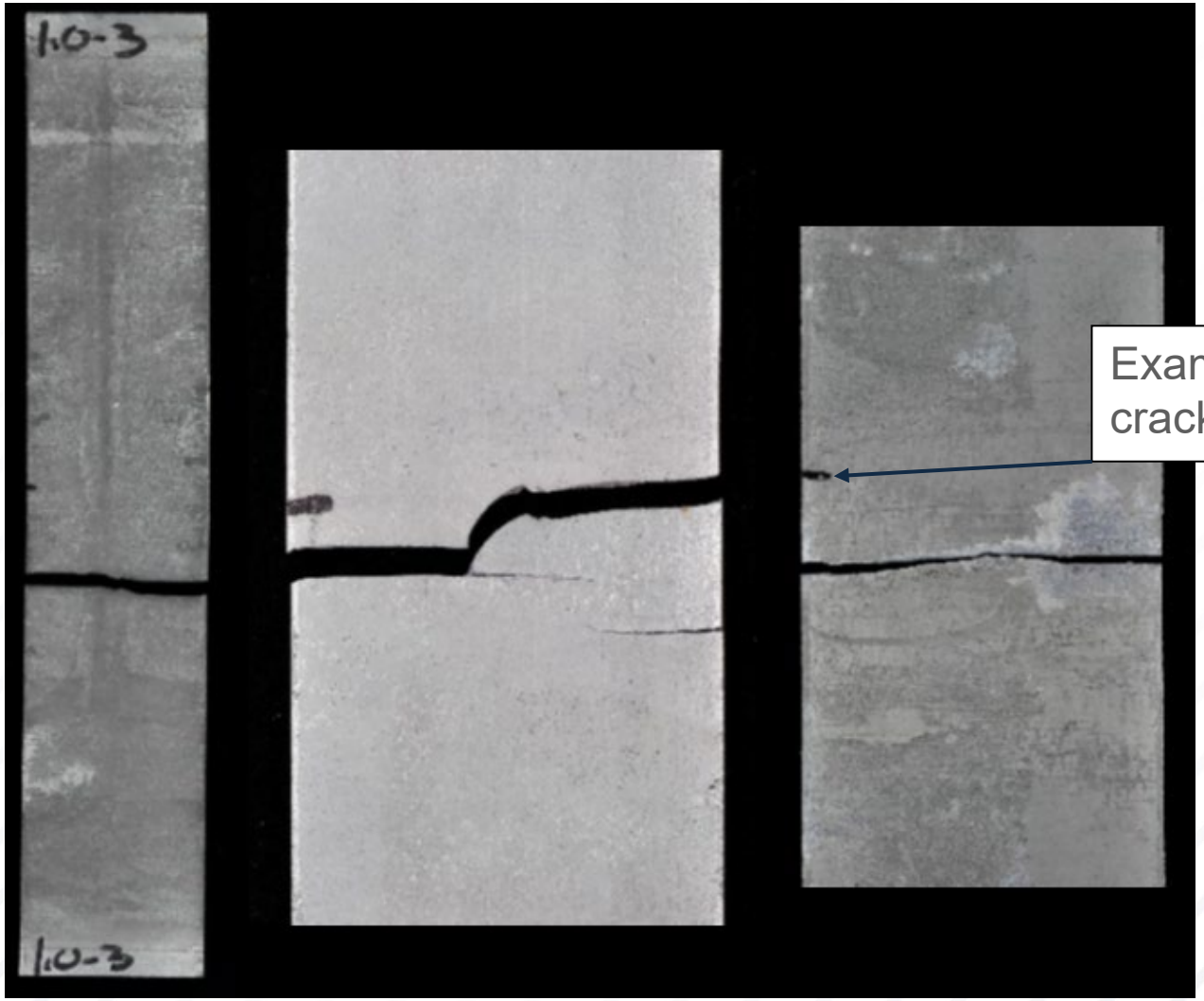
Sample Number	Number of Samples	Stress State (Percent of Yield Strength)
1	3	60%
2	3	70%
3	3	80%
4	3	90%
5	3	100%

J3215 SAMPLES PRIOR TO ACID IMMERSION

TEST DATA STANDARD FORMAT

Stress Level (% of Yield Strength)	Initial Thickness (mm)			Final Thickness (mm)			Initial Weight (g)			Final Weight (g)			Time to Crack (h) or N.C. (for No Crack)		
Sample Number >>	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
60%															
70%															
80%															
90%															
100%															

SAMPLES AFTER 0.1 N HYDROCHLORIC (HCL) ACID IMMERSION



Example of acceptable edge crack less than 2 mm in length

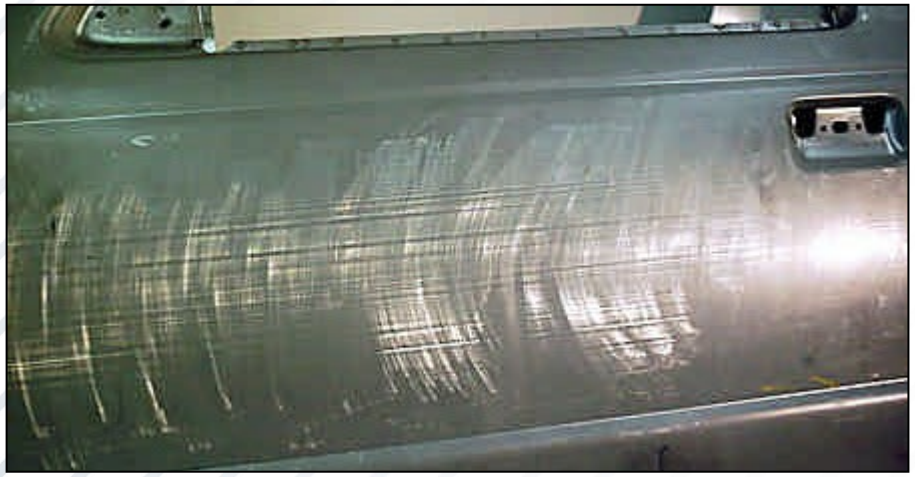
J810 COMMON IMPERFECTIONS

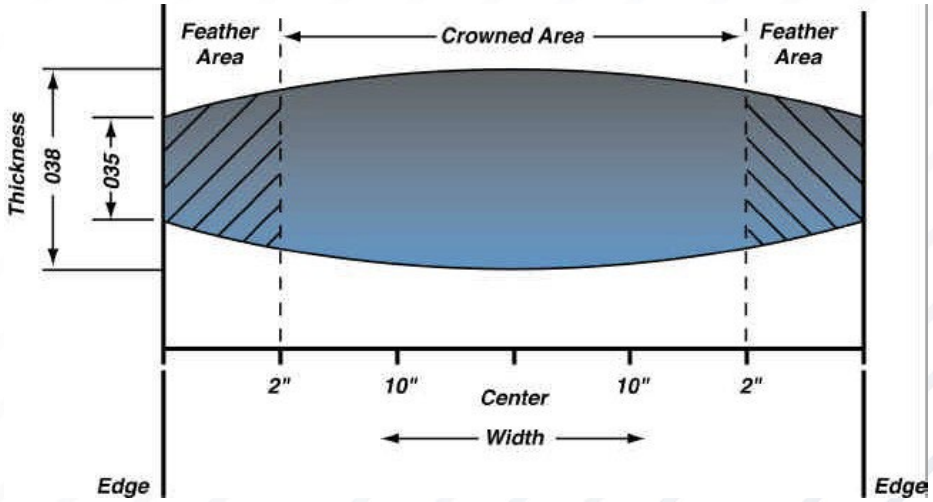
CLASSIFICATION OF COMMON IMPERFECTIONS IN SHEET STEEL J810_199603

Original Issue date of 1980 “Photographs are courtesy of the American Iron and Steel Institute, Kaiser Aluminum, LTV Steel, National Steel, The Budd Company.”

Newly revised edition has been in the works for many years, surprising how it is so difficult to get steel ~~defect~~ imperfection pictures!

Currently in ballot with many updates and computer friendly formatting.





FOR MORE INFORMATION

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